



AIMTCP Vol. 4, No. 1, 2024

ISSN:2769-5093 (Online)

American Institute of Management and Technology Conference Proceedings (AIMTCP)



Published by
Global Knowledge Foundation (GKF) USA, Inc.



**2024 JNVU-ABVU-AIMT SPRING
International Conference**

On

**Innovative Research in Science,
Management and Technology (ICIRSMT 2024)**

January 05-07, 2024

Jointly Organized By

Institute of evening studies

**Jai Narain Vyas University, Jodhpur, Rajasthan, India
&**

**Department of Computer Science and application
Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India**

In association with

American Institute of Management and Technology (AIMT), USA

Sponsored By

University of Maryland, Eastern Shore, USA

Volume 4, No.1 January-2024

ISSN:2769-5093(Online)

American Institute of Management and Technology Conference

Proceedings(AIMTCP)

Editors-in-Chief:

Dr. H.S. Hota, Atal Bihari Vajpayee University, India

Dr. Dinesh K. Sharma, University of Maryland Eastern Shore, USA

Technical Editor:

Dr. Ayush Kumar Agrawal, Dr. C.V. Raman University, Bilaspur

Vivek Tiwari, Govt. E. Raghavendra Rao PG. Science College, Bilaspur

Editorial Board:

Dr. Madhu Jain

Indian Institute of Technology Roorkee, India

Dr. Aaron R. Rababaah

American University of Kuwait, Kuwait

Dr. Daniel I. Okunbor

Fayetteville State University, USA

Prof. Krishn A. Goyal

Jai Narain Vyas University, Jodhpur, India

Dr. Biswajit Sarkar

Yonsei University, South Korea

Dr. Avinash Gaur

Higher College of Technology, Oman

The views expressed in this publication are those of the authors and do not necessarily reflect AIMT's views or policies. We make no guarantees about the correctness of the data in this publication and assume no responsibility for any consequences of using it. The term "country" does not imply any judgment on any geographic entity's legal or another status by the authors or AIMT.

INDEX

Title and Authors	Page No.
FROM IDEAS TO CONTENTMENT: EXPLORING THE CONNECTION BETWEEN CREATIVITY AND JOB SATISFACTION Neha Arora, Chandra Prakash Verma, Roopali Sharma	1
A CASE STUDY ON ANALYSIS OF HYDERABAD FLOODS USING SAR Manju Tiwari, Nitish Tiwari, Gargee Shukla	2
APPLICATION OF PYTHAGOREAN FUZZY SIMILARITY MEASURES TO GAME THEORY Koushal Singh, Surender Singh	3
RIVETING EXPORT-ORIENTED FOREIGN DIRECT INVESTMENT TO BUILD THE POTENTIAL OF MAKING INDIA A MANUFACTURING HUB Krishn A. Goyal, Teena Mertiya	4
INDUSTRY 4.0 ADOPTION IN SMALL AND MEDIUM-SIZED TOURISM AND HOSPITALITY INDUSTRY IN INDIA Krishn A. Goyal, Divya Soni, Vishalrajapat	5
IMPROVING HEALTHCARE ACCESS AND EQUITY OF ELDERLY PEOPLE IN URBAN INDIA Maria Sabastin Sagayam, Parvathy Thilak, Sundharsa Ramanaa	6
HEALTHCARE ACCESS AND EQUITY IN URBAN INDIA: A COMPREHENSIVE ANALYSIS OF THE REFERRAL SYSTEM Maria Sabastin Sagayam, Angan Sengupta	7
ESTIMATION TECHNIQUES FOR INCOMPLETE FRAMES USING PRODUCT METHOD OF ESTIMATION Shilpa Yadav, Pankaj Nagar	8
SUSTAINABLE BIODIESEL PRODUCTION FROM NON-EDIBLE SEED OILS UTILIZING EGGSHELL NONOCATALYSTS Seema Parveen	9
REVOLUTIONIZING MARKETING PRACTICES: A COMPREHENSIVE ANALYSIS OF BLOCKCHAIN TECHNOLOGY'S IMPACT Ashin Jose, Maria Sabastin Sagayam	10
OPTIMISATION AND EVALUATION OF BIOCHAR DERIVED FROM THE WEED PLANT <i>CROTALARIA BURHIA</i> Poonam Poonia, Loveena Gaur	11
DEVELOPMENT OF TRANSGENIC TOMATO FOR PRODUCTION OF RECOMBINANT THERAPEUTIC PROTEIN Shweta Jha, Indraneel Sanyal, D.V. Amla	12

IMPACT OF PRESERVATION TECHNOLOGY FOR COMPLEMENTARY PRODUCTS WITH CARBON EMISSION REDUCTION UNDER A SUSTAINABLE SUPPLY CHAIN MANAGEMENT Nilkamal Bar, Biswajit Sarkar, Sharmila Saren, Isha Sangal	13
DOES RAILWAY TRANSPORTATION AFFECT BARGAINING POLICY FOR PRICING AND RETAILING UNDER GREEN SUPPLY MANAGEMENT? Parthasarathi Mandal, Biswajit Sarkar, Sarla Pareek, Tuli Barman	14
REDUCING WASTE THROUGH CIRCULAR ECONOMY USING FUZZY DEMAND Sujit Kumar Das, Biswajit Sarkar, Uttam Kumar Bera	15
THE EFFECT OF ONLINE ADVERTISEMENT FOR A DUAL-CHANNEL RETAILING BUSINESS FOR SUBSTITUTABLE PRODUCTS Sumi Kar, Biswajit Sarkar, Anita Pal	16
CONSUMER PERCEPTION AND ADOPTION OF TELEHEALTH SERVICES: A MARKETING PERSPECTIVE IN THE INDIAN HEALTHCARE SECTOR Ananda Yogaroopan, Maria Sabastin Sagayam	17
SOME SINGLE-VALUED NEUTROSOPHIC POWER YAGER AGGREGATION OPERATORS AND THEIR APPLICATION TO MCDM Sonam Sharma, Surender Singh	18
A COMPARATIVE STUDY OF PHOTO-SENSITIZERS IN REDUCTANT SURFACTANT SYSTEM IN PHOTO-GALVANIC CELL FOR PHOTO INDUCED POWER GENERATION AND ITS STORAGE Jayshree rathore, Rakesh Kumar Arya	19
NOVEL FUZZY KNOWLEDGE MEASURE AND FUZZY CORRELATION COEFFICIENT WITH THEIR APPLICATIONS Surender Singh	20
WATER SUITABILITY FOR DRINKING AND IRRIGATION AND WATERING PURPOSE USED TO THE IWQI MODEL: A CASE STUDY OF GROUNDWATER QUALITY IN SOME AREA OF CHOHTAN TEHSIL IN BARMER DISTRICT OF RAJASTHAN (INDIA) Dr. Sangeeta Parihar, Suresh Kumar Pachak, Bharat Singh	21
THALLIUM AS AN OXIDIZING AGENT FOR THE OXIDATION OF CINNAMYL ALCOHOL IN AN ACIDIC ENVIRONMENT WITH OR WITHOUT A CATALYST AND ITS KINETIC ANALYSIS. Anita Meena ,Sanjay Singh	22
PETRINET MODELING, COMPUTATIONAL ANALYSIS, AND SIMULATION OF INTERLEUKIN17E SIGNALING PATHWAY: A STUDY OF DYNAMICS Ram Nayan Verma, Gajendra Pratap Singh, Sanjeev Ahuja	23

SURVEY STUDY ON CICIDS2017, CSE-CIC-IDS2018, ISCXIDS2012, AND UNSW-NB15 Devendra Kumar Singh, Santosh Soni, Pankaj Chandra, Deepak Kant Netam	24
TRUST IN AI AND ANTHROPOMORPHISM LEADING TO HUMAN DESKILLING Abhishek Sharma, Ankita Sharma, Ekta Yaduvanshi	25
FUZZY LOGIC BASED DATA ANALYSIS ON USEFULNESS OF REVERSE PERFORMANCE APPRAISAL IN INDUSTRIES H.S.Hota, Manoj Kumar jha, Sulekha Shukla	26
UPSURGE OF FEMTECH INDUSTRY: A STUDY ON FEMTECH ENVIRONMENT IN INDIA KRISHN AWATAR GOYAL ,MALA DAGA	27
A STUDY ON AMINO ACID OXIDATION USING 2-iodoxy benzoic acid: A GREENER APPROACH Deepak Krishna Vyas, Pooja Tak, Priyanka Purohit	28
STUDY OF PATENT BLUE DYE PHOTOSENSITIZER BASED PHOTO GALVANIC CELLS WITH DODECYL TRIMETHYL AMMONIUM BROMIDE SURFACTANT Meenakshi Jonwal	29
DIGITAL HEALTH CARE PLATFORMS AND PATIENT ENGAGEMENT: A MARKETING ANALYSIS OF MOBILE HEALTH APPS IN THE INDIAN MARKET Shruthi Vandhana SM, Maria Sabastin Sagayam,	30
A FACTOR ANALYTIC TOPSIS MODEL FOR EVALUATING REGIONAL HEALTHCARE DISPARITIES IN INDIA Ritanshi Trivedi	31
COMPUTATIONAL THINKING APPROACHES AS COUNTERMEASURES TO THE ADVERSE EFFECTS OF GENERATIVE ARTIFICIAL INTELLIGENCE ON EDUCATION Abdulmalik Ahmad Lawan· Abdullahi Yunusa Abdullahi· Sani Abdullahi Sani	32
EFFICACY OF BLOCKCHAIN IN PRIVACY-PRESERVING MACHINE LEARNING: A SYSTEMATIC LITERATURE REVIEW Abdulmalik Ahmad Lawan· Sani Abdullahi Sani· Abdullahi Yunusa Abdullahi	33
COMPUTATION STRATEGY FOR EFFICIENT ESTIMATION OF POPULATION MEAN USING AUXILIARY PARAMETERS Surendra Kumar, Subhash Kumar Yadav	34
STATISTICAL AND MACHINE LEARNING TECHNIQUES FOR THE PREDICTION OF MONKEYPOX INCIDENCES Subhash Kumar Yadav ,Dinesh K. Sharma, Yusuf Akhter	35

IDENTIFICATION AND CHARACTERIZATION OF DRIVER AND PASSENGER MUTATIONS IN THE COSMIC COMPLETE TARGETED SCREENS MUTANT DATASET Kanchana Yadav	36
PYTHON-BASED PETRI NET REACHABILITY TREE GENERATOR SIMULATOR TOOL Mohit Kumar Jassi, Gajendra Pratap Singh	37
ESTIMATION OF PROBABILITY MODEL FOR NUMBER OF FEMALE CHILD BIRTHS AMONG FEMALES IN BETA-BINOMIAL- POISSON MIXTURE DISTRIBUTION Dhairya Tripathi	38
DYNAMICS OF PREDATOR-PREY INTERACTIONS: NONLINEAR HARVESTING, SPATIOTEMPORAL CHAOS, AND BIFURCATION ANALYSES IN A GENERALIZED MODEL Santanu Bhattacharya, Biswajit Sarkar ,Nandadulal Bairagi	39
INTERNET OF THINGS (IoT) BASED SMART ATTENDANCE SYSTEM USING FINGERPRINT SENSOR ParwatiShriwas, Omprakash Yadav, H.S. Hota	40
AUTOMATED MCQ GENERATOR FROM TRANSFORMER Nisha Devi ,Rashmi Gupta	41
IMAGE CAPTIONING Barakha Soni, Dr. Rashmi Gupta	42
IOT BASED SOLAR TRACKING SYSTEM (SUNLIGHT DETECTION),SMART STREET LIGHT DyalnandPatel,DineshwarDahare, Dr. Rashmi Gupta	43
A NOVEL APPROACH FOR CAR COUNTING USING COMPUTER VISION BASED OBJECT DETECTION TECHNIQUE Ritu Sahu, Ankita Jaiswal ,Dr. Rashmi Gupta	44
INFERENCE ABOUT MODI-WEIBULL DISTRIBUTION UNDER CENSORING SCHEME Harshita Kumawat Pankaj Nagar	45
IMPACTOFARTIFICIAL INTELLIGENCE ON DIGITAL MARKETING TECHNIQUESIN HOSPITALITY SECTOR Manisha Burad ,Dr. Ramesh Kumar Chouhan	46
EFFICIENT NEURAL SOLUTIONS: SLIDINGTCN IN MOTOR IMAGERY EEG CLASSIFICATION FOR NEUROLOGICAL DISABILITIES Abhishek Jain, Rohit Raja, K.Kartheek Ram, P.D.Dinesh, M. Rishika	47
DEVELOPMENT OF AN EFFICIENT TOKENIZER FOR HINDI LANGUAGE USING NLP Hitesh Patel, Miss Ankita Jaiswal, Dr. Rashmi Gupta	48

HINDI SPEECH EMOTION RECOGNITION Manisha Gupta, Dr. Rashmi Gupta	49
REAL TIME HANDWRITTEN DIGIT RECOGNITION USING SUPPORT VECTOR CLASSIFIER AND OPENCV Aparna Sahu ,Rashmi Gupta, Ankita Jaiswal	50
SENTIMENT ANALYSIS ON TWITTER DATA USING THE TWITTER API Amit Kumar Yadav,Rashmi Gupta	51
IOT & CLOUD BASED SMART SWITCHING PLUG COMPATIBLE WITH AI ASSISTANT Ujjwal Matoliya, Surya Prakash Patel, Dr. H.S. Hota	52
FACE EMOTION RECOGNITION USING CNN WITH EARLY STOPPING Hitesh Dewangan, Priya Koshle, Mr. Jeetendra Kumar Gupta	53
HYBRID MODEL TO DEVELOP MACHINE LEARNING BASED SPEECH EMOTION RECOGNITION SYSTEM Raveena Rajak ,Deepesh Kumar Dwivedi, H.S. hota	54
GENERATIVE AI IN HEALTHCARE: APPLICATION, OPPORTUNITIES AND CHALLENGES Dharmendra Kumar Yadav	55
DENSITY BASED SMART TRAFFIC MANAGEMENT SYSTEM Priyanka Dubey, Rashmi Gupta, Deepesh Kumar Dwivedi	56
LPG GAS LEAKAGE DETECTION USING ARDUINO Lokendra, Sunil, DeepeshKumar Dwivedi	57
INFLUENCE OF EMOTIONAL INTELLIGENCE ON INVESTMENT DECISION: EVIDENCE FROM INDIAN INVESTORS Dr. Pooja Pandey Dr. Amita Dubey, Dr. Pradeep Kumar Asthana	58
IOT BASED PATIENT HEALTH MONITORING SYSTEM OF HUMAN HEART Laxmi Kant Soni ,H.S. Hota	59
ARDUINO BASED VOICE CONTROL ROBO CAR Dipesh ,Himanshu, Jeetendra kumar	60
MOTER CYCLE SECURITY Sonam Ratnaker, Girja Rathia ,Rashmi Gupta	61
NAMED ENTITY RECOGNITION USING BERT & MBERT BASE MODEL FOR HINDI LANGUAGE Chhaya Verma, Neha, Mr. Jeetendra Kumar Gupta	62

MACHINE LEARNING BASED NEWS HEADLINE CLASSIFICATION THROUGH NATURAL LANGUAGE PROCESSING Kasak Dewangan, Ankita Jaiswal, Rashmi Gupta	63
INTERNET OF THINGS (IoT) BASED SMART GARBAGE MONITORING SYSTEM Lalima, Seema Dhirhe, H.S. Hota	64
NOISE MONITORING SYSTEM POOJA SAHU, JEETENDRA GUPTA	65
IOT BASED SMART PARKING SYSTEM FOR URBEN AREA Ravi chandroal, Shraddha Verma, Jeetendra Kumar Gupta	66
MEDIATING ROLE OF SELF-DISCLOSURE IN THE LINK BETWEEN MORAL INJURY, AND AUTOMATIC NEGATIVE THOUGHTS AMONG PERSONNELS OF ARMED FORCES Mamta Mahapatra, Varsha Gautam	67
INTERNET OF THINGS BASED ANTI-SLEEP ALARM FOR DRIVER Ayush Naik, Yash Rahi, H. S. Hota	68
INVESTIGATING THE ROLE OF AR/VR TECHNOLOGIES IN ENHANCING USER EXPERIENCE IN ONLINE RETAIL Shikha Gupta National Institute of Fashion Technology, Jodhpur, India	69
A COMPREHENSIVE REVIEW OF THEORIES OF BEHAVIORAL FINANCE AND THEIR APPLICATION Sumona Bhattacharya	70
BIOCHEMICAL PROPERTIES OF ROSELLE Yashwant Kumar Patel, Krishna Kumar Patel	71
A SYSTEM FOR DETECTING DISEASES IN RICE CROPS BY WEB-BASED IMAGE ANALYSIS Rajesh Kumar Khushwaha, Ragini Shukla	72
EXPLORING THE POWER OF C4.5 DECISION TREE IN FIREWALL LOG FILE ANALYSIS Pratibha Verma, Kumar Sahu, Prem Kumar Chandrakar	73
ANFIS AND METAHEURISTIC OPTIMIZATION FOR GREEN SUPPLY CHAIN WITH INSPECTION AND REWORK Nidhi Sharma, Madhu Jain, Dinesh Sharma	74
GENETIC SEARCH BASED FEATURE SELECTION ON CICIDS 2017 DATASET Reshamlal Pradhan	75
IOT BASED AIR POLLUTION MONITORING SYSTEM Rajesh Kumar Sahu, Deepesh Kumar Singh, Mr. Jeetendra Kumar	76

<p>BIOSENSORS IN MEDICINE: A COMPREHENSIVE REVIEW OF APPLICATIONS AND ADVANCEMENTS Arun Kumar Kashyap, D K Shrivastav, Nikita Kashyap</p>	77
<p>IOT BASED SMART AGRICULTURE MONITORING SYSTEM Radha Singh Chauhan, Abhishek Jaiswal, Jeetendra Kumar</p>	78
<p>GREEN LEAFY VEGETABLES AS A BETTER SUBSTITUTE FOR FUTURE FOODS Deepti Chauhan, A.K. Shrivastava</p>	79
<p>FRIEDELIN: A KEY BIOACTIVE COMPOUND FROM <i>BRIDELIA RETUSATA</i> TARGETING HYPERGLYCEMIA Somendra Kumar, Anil Kumar</p>	80
<p>ANTIMICROBIAL SCREENING OF CERTAIN FRESH WATER ALGAE COLLECTED FROM DURG REGION Meenakshi Bharadwaj, Awadhesh Kumar Shrivastava</p>	81
<p>STUDIES ON ETHNOMEDICINAL “ANTIDIABETIC” PLANT HELICTERES ISORA LINN OF SHAHDOL DISTRICT MADHYA PRADESH, INDIA Radhe ShyamNapit, M. Kujur</p>	82
<p>SMART ATTENDANCE SYSTEM USING RASPBERRY PI Geeta Kumari, Deepesh Kumar Dwivedi</p>	83
<p>IOT BASED HOME AUTOMATION USING ESP 32 Abhinit Tripathi, Aditya Kushwaha, Prerna Verma</p>	84
<p>ARDUINO BASED ROBO CAR WITH PATH FINDING, FOLLOWING, AND AUTOMATIC OBSTACLE-AVOIDING Shashikant Sahu·Rupanjali Bareth· Jeetendra Gupta</p>	85
<p>IOT BASED SECURE SURVEILLANCE ROBOT FOR AGRICULTURE Chandani dewangan, Jeetendra Kumar</p>	86
<p>INTERNET OF THINGS AND MACHINE LEARNING BASED THREE LAYERS SECURED LOCKER SYSTEM Shiva Soni ,Ravindra Nishad , H.S. Hota</p>	87
<p>IN VITRO CONSERVATION AND PROPAGATION OF RARE AND ENDEMIC MEDICINAL PLANTS OF INDIAN THAR DESERT Suman Parihar</p>	88
<p>APPLICATIONS OF SILVER NANOPARTICLES AS CHEMICAL SENSOR FOR DETECTION OF METAL IONS AND PESTICIDES IN ENVIRONMENTAL SAMPLES Archana Patley</p>	89

IOT BASED EYE BLINK SENSOR ALARM SYSTEM USING AURDINO Lipakshee, H.S.Hota	90
APPLICATION OF CARBON NANOPARTICLES IN PESTICIDE DEGRADATION FOR SUSTAINABLE AGRICULTURE Anupama Pradhan, Ambuj Pandey	91
INNOVATIVE PRACTICES FOR MANAGEMENT OF GREEN HOUSE GASES BY GREEN TECHNOLOGY NishaTiwari, MeenaKshetrapal, PushpaBhandari	92
PRACTICES AND DEVELOPMENTS OF INFORMATION TECHNOLOGY- DIGITAL PLATFORMS Mahendra Daiya	93
DEEP CONVOLUTIONAL NEURAL NETWORKS AND TRANSFER LEARNING BASED MODEL FOR CLASSIFICATION OF SKIN CANCER DISEASE Akhilesh Kumar Shrivivas,HemaVastrakar	94
PRELIMINARY SCREENING OF MOLDS FOR PRODUCTION OF LIPASE Seema Belorkar	95
SPECTROPHOTOMETRIC ANALYSIS OF LEMON GRASS (<i>CYMOPOGON CITRUS</i>) FOR STUDY OF ITS BIOACTIVE COMPOUNDS Mahima Kori, Seema Belorkar	96
SPECTROPHOTOMETRIC ANALYSIS OF BIOACTIVE COMPONENTS OF SWERTIACHIRATA Priya Kashyap, Seema Belorkar	97
A REVIEW OF ARTIFICIAL INTELLIGENCE METHOD FOR IDENTIFICATION OF DISEASES AND PESTS IN FOOD CROPS Gajendra Tandan, Asha Ambhaikar	98
PARAMETER EFFICIENT FINE-TUNING BASED TEXT SUMMARIZER FOR INDIC LANGUAGE Jeetendra Kumar, Rashmi Gupta, Ankita Jaiswal	99
IOT BASED SMART AND ADVANCE MOTER CYCLE SECURITY ALARM SYSTEM USING ULTRASONIC SENSOR Sonam Ratnaker,Girja Rathia, Rashmi Gupta	100
COMPELLING ROLES OF HOME ENVIRONMENT IN HOME MAKERS LIVES Ankita Singh	101
IOT BASED SMART HOME AUTOMATION SYSTEM Vinod Kumar Patel, Jeetendra Kumar	102
AUTOMATIC SOLAR PANEL USING ARDUINO Purab Nath, Rashmi Gupta	103

PLANT MONITORING SYSTEM Yogita ,Kalpana, Jeetendra Kumar	104
INTERNET OF THINGS (IOT) BASED WEATHER MONITORING SYSTEM Sakshi, Jankee, ashmi Gupta	105
SUSTAINABLE FINANCING STRATEGIES FOR EXPANDING RENEWABLE ENERGY INITIATIVES IN RAJASTHAN Bablu Solankisaini, Surendrabhadu	106
FINANCING STRATEGIES, RENEWABLE ENERGY INITIATIVES, FINANCIAL CHALLENGES PREFERENCE OF FOOD BY STORED GRAIN IN INSECT PEST, RHYZOPERTHA DOMINICA Lekhu Gehlot	107
A NEW APPROACH TO WIRELESS CHARGING AND ON-DEMAND DATA GATHERING FOR RWSN Pankaj Chandra, Santosh Soni	108
ANFIS AND META-HEURISTIC OPTIMIZATION FOR GREEN SUPPLY CHAIN WITH INSPECTION AND REWORK Nidhi Sharma, Madhu Jain, Dinesh K. Sharma	109
A HIDDEN MARKOV MODEL TO INVESTIGATE CONSUMER BRAND SWITCHING BEHAVIOR Sivasamy Ramasamy, Dinesh K. Sharma	110
ENHANCING IOT CYBER SECURITY: A MACHINE LEARNING-DRIVEN IDENTIFICATION MODEL FOR VULNERABILITY ASSESSMENT Dinesh K. Sharma, Tarun Dhar Diwan, Prachi Diwan	111
DESIGN OF EXPERT SYSTEM USING MACHINE LEARNING TECHNIQUES FOR PORTFOLIO MANAGEMENT PROBLEM Shaik Khaja Saheb, Hari Sharma, Dinesh K. Sharma	112
RECENT ADVANCEMENT IN TREATMENT AND DIAGNOSIS WITH NANOTECHNOLOGY Manoj Kumar, Preeti R. Sharma	113
ADAPTIVE CLOUD COMPUTING IN THE POST-COVID-19 ERA: TRENDS, CHALLENGES, AND CYBER SECURITY IMPLICATIONS Rakesh Sharma, Tarun Dhar Diwan, Prachi Diwan	114
ENHANCING CYBERSECURITY THROUGH BLOCKCHAIN TECHNOLOGY: AN INVESTIGATION INTO DATA STORAGE, AUTHENTICATION, AND INTEGRITY Akshat Tiwari, Dr Tarun Dhar Diwan	115
SMART PARKING MANAGEMENT SYSTEM Suraj sahu, Dr Rashmi Gupta	116

DEEP LEARNING TECHNIQUES FOR THE IDENTIFICATION OF DIABETES Harshita Rathi	117
CUSTOMER LOYALTY IN THE INSURANCE INDUSTRY: A BIBLIOMETRIC ANALYSIS Sherry Singla, Dr. Harpreet Kaur Sawhney	118
BIOFORTIFICATION OF VERMIWASH FOR ENHANCING ITS BIOACTIVITY AND ASSESSING ITS EFFECT ON PLANT GROWTH Abhishek Xalxo, Rahul Patel, Krishna Kumar Verma, Sumit Kumar Dubey, Neha Behar	119
AIR QUALITY PARAMETER OF PALI PROJECT UG COAL MINE JOHILLA AREA BIRSINGHPUR PALI, UMARIA, MADHYA PRADESH Laxmi Saket, Mamta Prajapati	123
REVEALING THE CHEMICAL BIOACTIVE COMPOUNDS OF MORINGA OLEIFERA BARK USING LC-MS ANALYSIS TO CONDUCT DETAILED BIOCHEMICAL ANALYSIS Jyoti Rathore, Kiran Thakur	130
BACILLUS SP. DERIVED COST-EFFECTIVE SERINE-LIKE ALKALINE PROTEASE USING DAIRY WASTE EFFLUENT Sumit Kumar Dubey, Rashmi Parihar, D.K. Shrivastava	136
PHYTOCHEMICAL, NUTRITIONAL AND FATTY ACID ANALYSIS OF ALSTONIA SCHOLARIS (LINN) R.BR. SEEDS FROM FOREST REGIONS OF CHHATTISGARH Shraddha Pandey, Dr. Kiran Vajpai	140
AN OVERVIEW OF THE PROGRESSION OF MIXED DESIGN APPROACHES FOR ENHANCING THE PERFORMANCE OF RECYCLED AGGREGATE CONCRETE (RAC) Abhishek Singh, Rajendra Kumar Choubey	148
WATER QUALITY ASSESSMENT OF SONE RIVER AT AMLAI AND CHACHAI BANK IN WINTER SEASON Varsha Jaiswal, M.K. Bhatnagar	162
RANKING OF BARRIERS IN PRODUCT LIFECYCLE MANAGEMENT BY PYTHAGOREAN FUZZY AHP METHOD Shubham Taware, Sagar Borole, Pratik Malu, Chinmay Patel, Vishal Bhosle	169
WE ARE WITH YOU (VAWY) E. Ganesh, G. Indira Rani	176
ASSESSING AUTOMATIC ARTIFACT REJECTION METHODS AND IMPROVED ICA BASED MANUAL METHOD FOR MEDITATION EEG DATA Abhishek Jain, Dr. Rohit Raja, Swapnil Dange, Amit Kumar Dewangan	182
ASSESSING THE INFLUENCE OF GUERRILLA MARKETING ON CONSUMER ADOPTION IN THE FAST FOOD AND TRADITIONAL FOOD SECTORS Jayati Chhangani,	188
Towards Real-Time Solar Energy Forecasting: A Multi-Model Approach for Improved Accuracy Malavika Raj, Cerlin Roheta. I, Dr. Savithri M, Ayana Shaji	193

STUDIES ON THE EFFECT OF ORGANIC SUPPLEMENTATION ON THE PADDY STRAW MUSHROOM CULTIVATION (VOLVORIALLA VOLVACEA) Swati Rose Toppo, Yamini Shrivas	199
EFFECTIVE PRICE PREDICTION FOR HOUSE THROUGH ARTIFICIAL NEURAL NETWORK: A REVIEW Param Patel, Priyanshu Agrawal, Dr. Radhakrishna Rambola	207
DATA RATE TRANSMISSION IN WIRELESS COMMUNICATION USING LIGHT FIDELITY KIRAN LAKRA ,Dr,SHANTI RATHORE	213
ENERGY EFFICIENT WIRELESS SENSOR NETWORKS USING SOFT COMPUTING TECHNIQUES: A REVIEW SidharthaSankar Dora, Prasanta Kumar Swain	223
A SURVEY ON TRACKING CYBER CRIME USING ARTIFICIAL INTELLIGENCE -PHISHING Jayshree Bajaj, Vaibhav Sharma	234
A PRE-TRAINED CONVOLUTIONAL NEURAL NETWORK-BASED MODEL FOR SKINDISEASECLASSIFICATION Nikita Kashyap, Arun Kumar Kashyap	240
ALGO TRADING: TRANSFORMATION OF TRADING TECHNIQUES TO USES OF ARTIFICIAL INTELLIGENCE IN THE SECURITIES MARKET Manharan Anant, Gaurav Sahu, Kalpana Kanwar	247
AN EMPIRICAL ANALYSIS OF MONTH AND TRADING MONTH EFFECTS ON THE BOMBAY STOCK EXCHANGE FOR 2000-2023. Dr Surya Dev	255
OPTIMIZING MEDICAL X-RAY IMAGE CLASSIFICATION USING ENSEMBLE TRANSFER LEARNING Deepak Kant Netam, Rajesh Mahule	261
FOOD SECURITY OF INDIA: ROLE OF PUBLIC DISTRIBUTION SYSTEM (PDS) AND ANTI-POVERTY PROGRAM Asha Devi. J., Dr. K.S Chandrasekar	270
AN ANALYSIS OF THE IMPACT OF INFORMATION AND COMMUNICATION TECHNOLOGY ADVANCEMENT ON THE PERFORMANCE OF RETAIL FIRMS IN SMALL AND MEDIUM ENTERPRISES Dr. Vandana Gupta, Dr. Sanjeev Kumar Saxena, Dr. Abhilasha Mathur, Junaid Hushain, Prof. Sunil Kumar Gupta	280
HOW SOCIAL MEDIA INFLUENCE CHILDREN BEHAVIOUR Dr Ashish Mathur, Ms. Sunita	305
PROSPECTS OF THE EFFECT OF THE BLOCKCHAIN ON ACCOUNTING, TAXATION, AND AUDITING Dr. Muthanna A. NASER, Dr. Ahmed Dakhil Abed Alabbas ,Dr. Muayad Saleh Mahdi, Maher Kareem Alimari,	314
UNVEILING THE PATH TO THE FUTURE OF FINANCE: AN ANALYSIS OF FACTORS INFLUENCING THE INTENTION TO ADOPT INFORMATION AND COMMUNICATION TECHNOLOGY FOR BANKING SERVICES Dr. Ashish Mathur, Dr. Gyanendra B. S. Johri, Dr. Divya, Prof. R.P. Das	324

COMPARING THE EFFICACY OF OMKAR INTERVENTION AND POSITIVE PSYCHOLOGY INTERVENTION ON DEPRESSION AND SELF-ESTEEM Dr. Hemlata Joshi, Ms. Anuradha Ramawat	340
AN ANALYSIS OF INDIAN PUBLIC SECTOR BANKS'S FINANCIAL PERFORMANCE: CAMEL MODEL CA Shashi Kumawat	353
ANALYSIS OF LIQUIDITY RISK MANAGEMENT ON BANKS PERFORMANCE - WITH SEEMINGLY UNRELATED REGRESSION METHOD ON PANEL DATA C Prabhavathi, Dr N Mukund Sharm	367
ANALYSIS AND ACTIONS OF CHHATTISGARH STATE INDUSTRIAL DEVELOPMENT CORPORATION (CSIDC) IN INDUSTRIAL DEVELOPMENT Ravi Kumar Gahi, Dr. Priyank Mishra	375
AN ANALYTICAL STUDY ON IMPACT OF DAIRY COOPERATIVES ON SUSTAINABLE GROWTH OF DAIRY FARMERS WITH SPECIAL REFERENCE TO BILASPUR DISTRICT. Jayanta Roy, Dr. Priyank Mishra	380
A CRITICAL EXAMINATION OF THE SOCIO-ECONOMIC DEVELOPMENT IMPACT OF NMDC LIMITED'S CORPORATE SOCIAL RESPONSIBILITY INITIATIVES: A SOCIO-ECONOMIC STUDY OF DANTEWADA DISTRICT Adarsh Rathore, Dr. Anshul Shrivastav, Dr. Priyank Mishra	386
A STUDY OF RECENT TRENDS IN FUNDS MOBILISED IN EQUITY ORIENTED SCHEMES OF MUTUAL FUNDS Keshav Dutt Bunker, Dr. Sandeep Kumar	391
EXPLORING THE IMPACT OF FOMO ON CONSUMER BEHAVIOR AND DECISION MAKING IN THE DIGITAL ECONOMY Dr. Ashish Mathur, Sona Soni	397
WOMEN STARTUPS CHALLENGES AND OPPORTUNITIES: LESSONS FROM INDIAN ORGANIZATIONS Ms. Apoorva Tiwari, Ms. Anjita Khandelwal	407
THE ROLE OF EFFECTIVE IT GOVERNANCE IN OPTIMIZING ORGANIZATIONAL PERFORMANCE Dr. Ryadh R.ALGBURI, Maher Kareem ALimari, Mohammed Kadhim Hawash, Doaa Hikmat Abbas, Yousef Fawzi Dhari, Ahmed Hisham Mahmood	416
FRAUDULENT ACTIVITIES DISCOVERY AND PREVENTION IN INDUSTRIES Dr.(CA) Hemant Kaduniya	424
COMPARATIVE EXPLORATION OF THE FINANCIAL PERFORMANCE OF SELECT PNB AND CBS BANKS Dr. ANIL VERMA	429
THE FUTURE OF ACCOUNTING RESEARCH UNDER THE DEVELOPMENTS IN AI Dr. Salim Swadi Hammood AL-Mohammedawi, Dr. Hesham Zakaria Mohmed Hassan, Hussein Kadhim Jebur	436
ANALYSES OF COMMON BEHAVIORAL BIAS AMONG INDO-ARABIAN INVESTORS AND HOW TO BETTER MANAGE THEM Dr. Hemant Bhanawat, Richard Sagor Mitra	445

ANALYZING AND ESTIMATING SOME MONETARY POLICY TOOLS ON INFLATION RATES IN IRAQ FOR THE PERIOD (2010- 2018) Ghusoon Talfan Madlool, Amina Moayad Abd Alla, Doaa Hikmat Abbas	454
GLOBAL BUSINESS TRENDS Monika Mehta, Amrita Joshi, Suteekshn Singh Ranawat	472
UNDERSTANDING THE PRACTICES OF WASTE MANAGEMENT IN TWO CITIES OF INDIA: A REVIEW OF LITERATURE Athira P., Lakshmi Sudarsan	478
INCLUSION OF LGBTQ+ IN INDIAN CORPORATE WORKPLACE: A REVIEW OF LITERATURE Harshini T V, Shayam Sundar.H,	483
EMPLOYEE ENGAGEMENT STRATEGIES IN IT COMPANY Ramprasath K	488
ELECTRONIC PAYMENT: CURRENT SCENARIO WITH REFERENCE OF UDAIPUR CITY Amrita Joshi, Monika Mehta, Sutikshn Singh Ranawat	495
COMPARATIVE EFFECTS OF PRE AND POST BANK M&AS ON EMPLOYEE PRODUCTIVITY IN SELECTED BANKS IN INDIA Ram Kumar Sharma	508
BEYOND THE HORIZON: CHARTING THE COURSE OF AI IN MODERN HRM (A LITERATURE REVIEW USING PRISMA FRAMEWORK) Arti Gaur, Niharika Bansal, Renu, Vikas	515
VLOGGING: ONLINE CUSTOMER EXPERIENCE AND RELATIONSHIPS Priyanka	526
SOCIAL MEDIA AND POLITICAL ADVERTISING: A COMPREHENSIVE STUDY OF ONLINE CAMPAIGNING Ritu,	533
SUSTAINABLE MANAGEMENT PRACTICES FOR OPTIMISING PERFORMANCE OUTCOMES IN THE HOSPITALITY INDUSTRY Dr. Neelam Shekhawat, Dr. Kunal Vijay	540
ADOPTION OF DIGITAL TECHNOLOGY AND INNOVATION IN MICRO AND SMALL ENTERPRISES: A STORY FROM INDONESIA Tulus T.H. Tambunan	545
INTANGIBLE CAPITAL: BRAND'S ROLE IN SUSTAINABLE DEVELOPMENT Dr. Ryadh R. ALGBURI, Maher K. ALIMARI, Samar R. AHMED	573
INDIA'S TRADE AND INVESTMENT WITH AFGHANISTAN: A VICENNIAL ANALYSIS Prof. Krishn A. Goyal, Rekha Verma	579
A STUDY ON THE IMPACT OF ONLINE MODE OF EDUCATION ON UG STUDENTS DURING COVID-19 PERIOD Devanarayanan Unni	586

STUDY ON EMPLOYEE PERCEPTION ON THEIR ROLE OF EMPLOYEE ADVOCACY IN SOCIAL MEDIA MARKETING AKHILA S KUMAR, ANAND JAYACHANDRAN	590
ASSESSING REGULATORY COMPLIANCE IN INFORMATION SYSTEM AUDITS: PERSPECTIVES FROM THE INDIAN BANKING INDUSTRY ROUNIKA DHOOT, Dr.MANGU RAM	595
STRATEGIES OF HUMAN RESOURCE DEVELOPMENT IN INDIA Mamta Kumari	602
INDIA'S TRADE AND INVESTMENT WITH AFGHANISTAN: A VICENNIAL ANALYSIS Prof. Krishn A. Goyal, Rekha Verma,	609
ARTIFICIAL INTELLIGENCE IN GST Prashant Shankar Parihar	619
CLASS-INDEPENDENT MOVING OBJECT DETECTION AND TRACKING IN AERIAL ENVIRONMENTS Agnivesh Pandey , Rohit Raja	627
ASSESSING AUTOMATIC ARTIFACT REJECTION METHODS AND IMPROVED ICA BASED MANUAL METHOD FOR MEDITATION EEG DATA Abhishek Jain, Rohit Raja	634
EFFICIENT NEURAL SOLUTIONS: SLIDINGTCN IN MOTOR IMAGERYEEG CLASSIFICATION FOR NEUROLOGICAL DISABILITIES Abhishek Jain, Rohit Raja, K. Kartheekm Ram, P. D. Dinesh, M. Rishika	641
POINT ESTIMATION OF PARAMETERS AND RELIABILITY CHARACTERISTICS OF NOVEL FAMILY OF LIFETIME DISTRIBUTIONS Kavita Kesarwani	648
INNOVATIVE APPROACH OF DATA MINING IN EDUCATION: A SYSTEMATIC LITERATURE REVIEW Ritika Awasthi, Dr. Arvind Tiwari	659
TRAFFIC CROWD ANALYSIS USING DEEP NEURAL NETWORKS: A REVIEW Leeladhar Kumar Gavel, Asha Ambhaikar	672
WORK LIFE BALANCE OF WORKING WOMEN IN IT SECTOR – A REVIEW PAPER Dr. Rajni Arora, Vartta Siyal	682
IOT AND BIG DATA CONVERGENCE IN HEALTHCARE: A SYSTEMATIC REVIEW OF REAL-TIME PATIENT MONITORING APPLICATIONS Abhishek Tiwari, Vivek Tiwari, Ayush Kumar Agrawal	686
NAVIGATING CRYPTOCURRENCY VOLATILITY: A DEEP LEARNING APPROACH FOR ACCURATE BITCOIN CLOSING PRICE PREDICTION Vivek Tiwari, Kaushal Banjare	697

A STUDY ON THE IMPACT OF DIGITAL PAYMENT SYSTEM ON RETAIL BUSINESS OUTLETS OF BILASPUR CITY OF CHHATTISGARH Sri Ram, Dr. Priyank Mishra	698
ASSESSMENT OF TRACE METAL CONCENTRATION IN COAL MINE AREA OF GEVRA, DIST.- KORBA(C.G.) Sanjiv Kumar Rathore, Dr. Kiran Thakur	703
AN APPLICATION ON MACHINE LEARNING AND DEEP LEARNING TECHNIQUES FOR HANDWRITTEN CHARACTER RECOGNITION Balram Yadav, Jyoti Bala Gupta, Abhinav Shukla, Ayush Kumar Agrawal	707
MULTI-STRATEGY MACHINE LEARNING FRAMEWORK FOR QUALITY MANAGEMENT OF TEACHING LEARNING PROCESS Dr.S.Pavani, Dr. Kajal Kiran Gulhare	718

FROM IDEAS TO CONTENTMENT: EXPLORING THE CONNECTION BETWEEN CREATIVITY AND JOB SATISFACTION

Neha Arora

Arni School of Business Management & Commerce ARNI University, Kathgarh, Indora, Kangra,
Himachal Pradesh, INDIA(aroraneha0507@gmail.com)

Dr. Chandra Prakash Verma

Arni School of Business Management & Commerce ARNI University, Kathgarh, Indora, Kangra,
Himachal Pradesh, INDIA (cpverma5@gmail.com)

Dr. Roopali Sharma

Amity Institute of Psychology & Allied Sciences Amity University, Sector-125, Noida, Uttar
Pradesh, INDIA (rsharma13@amity.edu)

The relationship between creativity and job satisfaction has garnered substantial attention in organizational psychology and management literature. This study investigates the relationship between creativity and job satisfaction among a sample of 100 employees in Higher Education Institutions. Prior research has suggested a positive correlation between these constructs, but empirical validation within specific contexts and sample sizes is lacking. The participants, diverse in job roles, tenure, and demographics, completed structured questionnaires assessing creativity and job satisfaction. The data was analyzed using t-tests and correlation analysis. The results revealed a significant positive correlation ($r = 0.220$, $p < 0.05$) between creativity and job satisfaction, indicating that employees with higher creativity levels tend to report greater job satisfaction. Additionally, the t-test demonstrated a statistically significant difference in job satisfaction scores between high and low creativity groups. These findings provide empirical support for the notion that fostering creativity in the workplace can lead to increased employee satisfaction. The study's implications suggest that organizations should actively encourage and recognize creative contributions from their employees, ultimately leading to a more fulfilling work environment. This research offers valuable insights for human resource management and organizational leaders aiming to optimize workplace conditions and enhance overall employee well-being.

Keywords: Creativity, Job Satisfaction, Organizational Psychology, Workplace Environment, Higher Education Institutions

A CASE STUDY ON ANALYSIS OF HYDERABAD FLOODS USING SAR

Manju Tiwari

Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) 492012

Nitish Tiwari

Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) 492012

Gargee Shukla

Govt. Bilasa Girls' P.G. Autonomous College, Bilaspur (C.G.) 495001

Synthetic Aperture Radar (SAR) have proven to provide essential information in case of natural disasters like floods. The all-weather operating capability provides cloud-free day and night imagery, even in the worst weather conditions, providing continuous observations of earth surface. Many studies have proven SAR system to be effective and reliable for tool for flood mapping. SAR instrument, captures radar images of the Earth's surface. Sentinel-1 SAR data has been extensively used for various applications, including flood mapping. Flood mapping using Sentinel-1 data involves the analysis of radar imagery to identify and monitor areas affected by flooding. SAR data is particularly useful for flood mapping because it can penetrate cloud cover and provide images regardless of weather conditions. Additionally, SAR can capture data both day and night, allowing for continuous monitoring. In the present study efforts has been made to understand the increase in water bodies in Hyderabad region during October 13, 2020 using Sentinel-1 SAR data. It is reported that there was major increase Osman Sagar Lake, Musi River and area in vicinity of Rajiv Gandhi International airport.

Synthetic Aperture Radar (SAR) has proven to provide essential information in the case of natural disasters like floods. The all-weather operating capability provides cloud-free day and night imagery, even in the worst weather conditions, providing continuous observations of earth's surface. Many studies have proven SAR system to be effective and reliable tool for flood mapping. SAR instrument captures radar images of the Earth's surface. Sentinel-1 SAR data has been extensively used for various applications, including flood mapping. Flood mapping using Sentinel-1 data involves the analysis of radar imagery to identify and monitor areas affected by flooding. SAR data is particularly useful for flood mapping because it can penetrate cloud cover and provide images regardless of weather conditions. Additionally, SAR can capture data day and night, allowing continuous monitoring. In the present study, efforts have been made to understand the increase in water bodies in the Hyderabad region during October 13, 2020 using Sentinel-1 SAR data.

Keywords: Urban floods, SAR, Sentinel-1

APPLICATION OF PYTHAGOREAN FUZZY SIMILARITY MEASURES TO GAME THEORY

Koushal Singh

Shri Mata Vaishno Devi University, Katra, Jammu and Kashmir, India

Surender Singh

Shri Mata Vaishno Devi University, Katra, Jammu and Kashmir, India

Pythagorean fuzzy similarity measures being an extension of classical fuzzy similarity measures give a better assessment of the closeness of two uncertain feature spaces. In this paper, we introduce some mathematical constructions for the derivation of similarity measures in the Pythagorean fuzzy framework. Using the proposed results, some new similarity measures are obtained. In addition, we established the accuracy and advantages of the proposed Pythagorean fuzzy similarity measures by considering several benchmark datasets in a numerical experiment. Moreover, we present an algorithm to solve matrix games under a Pythagorean fuzzy environment, and empirically validate the algorithm. The empirical validation provides the optimal solution for a matrix game.

Keywords: Pythagorean fuzzy sets, Pythagorean fuzzy equivalences, Similarity measures, Matrix games.

RIVETING EXPORT-ORIENTED FOREIGN DIRECT INVESTMENT TO BUILD THE POTENTIAL OF MAKING INDIA A MANUFACTURING HUB

Krishn A. Goyal,

Jai Narain Vyas University, Jodhpur, India. (kag.bfe@jnvu.edu.in)

Teena Mertiya

Government, Bangur Postgraduate College, Pali, India. (teenamertiya97@gmail.com)

The present paper examines the role played by multiple factors, such as Physical and Human Capital; Domestic Investment and International Integration; as well as the Country's Fiscal and Monetary Policy, in securing Foreign Direct Investment (FDI) in India. In order to look into the important drivers holistically, the study used time series data spanning fifteen years (2006–2021) and arranged factors into three major categorizations. The ADF unit-root test and multiple regression modelling have been applied in the evaluation. This research analyses thirteen factors, including natural resources, market size, trade openness, inflation rate, return on investment, and economic freedom. The parameters have been selected after reviewing empirical studies that establish their corresponding usefulness. According to the findings, physical - human capital has slightly less influence than domestic investment - international integration, and fiscal - monetary policy on FDI inflows for India. This means that the majority of investments seek ease and increment drives instead of larger domestic market size or local cost-effective human resources, targeting export-oriented investments. This is just what India is looking for as part of the "Making India a Manufacturing Hub" strategy.

Keywords: Foreign Direct Investment; Physical - Human Capital, Domestic Investment - International Integration; Fiscal - Monetary Policy.

INDUSTRY 4.0 ADOPTION IN SMALL AND MEDIUM-SIZED TOURISM AND HOSPITALITY INDUSTRY IN INDIA

Krishn A. Goyal

Director IES & International Affairs, Jai Narain Vyas University, India
(kag.bfe@gmail.com)

Divya Soni

Research Scholar, Jai Narain Vyas University, India
(Divyasooi1496@gmail.com)

Vishal rajapat

Research Scholar, Jai Narain Vyas University, India
(vishal.prajapat22@gmail.com)

Industry 4.0 adoption in recent years has profoundly impacted several industries, including tourism and hospitality. This paper explores the adoption of Industry 4.0 technologies within small and medium-sized enterprises (SMEs) in India's tourism and hospitality industry. In this paper, researchers study how small and medium-sized tourism and hospitality Indian businesses such as hotels & homestays, tour operators, lodges, transportation, ayurveda and wellness centers, recreation businesses, and restaurants will increase their business, enhance operational efficiencies, and improve guest experiences by implementing Industries 4.0, & Identify the economic impact of Industry 4.0 Adoption, including the growth and sustainability of India's tourism and hospitality industry. SMEs in the hospitality and tourism industry may be able to obtain insightful data, reduce operating expenses, and offer exceptional customer service by using these innovative technologies—all of which are crucial for long-term success in a market that is becoming more and more competitive.

Keywords: Industry 4.0 adoption, Small and medium-sized enterprises, Tourism and Hospitality, India.

IMPROVING HEALTHCARE ACCESS AND EQUITY OF ELDERLY PEOPLE IN URBAN INDIA

Maria Sabastin Sagayam,

Amrita School of Business, Bengaluru, India (s_mariasabastin@blr.amrita.edu)

Parvathy Thilak

Amrita School of Business, Bengaluru, India(parvathythilak00@gmail.com)

Sundharsa Ramanaa

A P, Amrita School of Business, Bengaluru, India(apsramana@gmail.com)

In the context of improving healthcare access and equity for the elderly in urban India, a multifaceted approach is essential to address the unique challenges faced by this demographic. These challenges include age-related health conditions, limited mobility, and financial constraints. Strengthening primary healthcare centers, enhancing geriatric healthcare services, and implementing supportive policies and programs can create a more accessible and equitable healthcare system for the elderly population in urban India.

Urban India is marked by a complex and diverse healthcare landscape, with an increasingly aging population. Socio-economic disparities, cultural diversity, and a fragmented healthcare system pose significant obstacles. To improve healthcare for the elderly, we must understand the nuances of this urban environment.

Our research employed methods, including cross-sectional surveys, and qualitative interviews. These approaches allowed us to gather quantitative and qualitative data on healthcare utilization, expenditure, and the experiences of elderly individuals and healthcare professionals.

Our findings reveal that elderly individuals in urban India face numerous challenges in accessing healthcare services. These challenges are multifaceted and include physical limitations, financial constraints, and a fragmented healthcare system. Age-related health conditions further complicate the situation, highlighting the need for a healthcare system tailored to the elderly demographic.

In conclusion, improving healthcare access and equity for the elderly in urban India is a complex but necessary endeavor. It is a collective effort involving policymakers, healthcare providers, and the community. By implementing the strategies outlined in our research, we can work towards creating a healthcare system that is not only accessible but also equitable, ensuring a healthier future for the elderly in urban India.

Keywords: Healthcare access, Elderly population, Urban India, Healthcare equity, Geriatric healthcare

HEALTHCARE ACCESS AND EQUITY IN URBAN INDIA: A COMPREHENSIVE ANALYSIS OF THE REFERRAL SYSTEM

Maria Sabastin Sagayam

Amrita School of Business, Bengaluru, India (s_mariasabastin@blr.amrita.edu)

Angan Sengupta

Amrita School of Business, Bengaluru, India(angan.and@gmail.com)

Access to quality healthcare in rapidly urbanizing India is a pressing issue, with a healthcare system straining to accommodate a growing population. This study focuses on the urban healthcare referral system, a crucial aspect of healthcare delivery, to explore strategies for enhancing access and equity. Healthcare in urban India varies, with cities offering advanced care, but many residents face challenges accessing affordable and timely services. The referral system plays a pivotal role in influencing healthcare quality, cost, and effectiveness.

Our comprehensive approach involves quantitative surveys and qualitative interviews with healthcare professionals. The findings reveal a fragmented referral system leading to delays, misdiagnoses, and increased costs as patients navigate primary health centers, specialty clinics, and tertiary hospitals. Socio-economic disparities further impede access, particularly affecting low-income communities lacking awareness and financial resources.

Quality of care varies across the system, with tertiary hospitals excelling, while primary centers lack resources and skilled staff. Inconsistent policies, lack of coordination, and gaps among providers disrupt the system. To improve, we suggest strengthening primary centers, cost control, standardized referrals, and using technology like electronic health records and telemedicine.

In conclusion, addressing the challenges of healthcare access and equity in urban India requires a holistic solution that begins with a thorough examination of the referral system. These recommendations can guide policymakers, healthcare providers, and communities in establishing a more efficient, equitable, and accessible healthcare system for India's diverse urban population.

Keywords: Referrals System, Urban India, Healthcare access, Healthcare disparities, Equity in healthcare

ESTIMATION TECHNIQUES FOR INCOMPLETE FRAMES USING PRODUCT METHOD OF ESTIMATION

Shilpa Yadav

University of Rajasthan, Jaipur, Rajasthan, India

Pankaj Nagar

University of Rajasthan, Jaipur, Rajasthan, India

The foundation of any sample survey is the presence of a well-defined and accurate sampling frame. However, it's widely acknowledged that such a perfect sampling frame, which encompasses all individuals in a population, is seldom available. This is especially true for populations that are dynamic, where there's a constant movement of population units. When such situations occur, the collected sample may not adequately represent the entire population, leading to the issue of an incomplete frame. Consequently, the findings derived from this incomplete frame can significantly alter survey results and impact the credibility of the research. This research addresses the incomplete frame problem by employing the product method of estimation. This approach involves gathering information on auxiliary variables in the initial phase and then drawing a second-phase sample to estimate the population mean of the studied characteristic and its mean square error, using a first-order approximation. The study utilizes two distinct estimators: the combined product estimator and separate product estimators. It compares their efficiencies and provides a numerical illustration of the results through the use of Monte-Carlo simulations.

Keywords: incomplete sampling frame, double sampling, product method of estimation, predecessor-successor method, ancillary variable.

SUSTAINABLE BIODIESEL PRODUCTION FROM NON-EDIBLE SEED OILS UTILIZING EGGHELL NONOCATALYSTS

Seema Parveen

Jai Narain Vyas University, Jodhpur, Rajasthan, India(seemakhan2831@gmail.com)

Introduction: The production of biodiesel is becoming more popular as the need for environmentally friendly and sustainable fuel sources grows. The clean, renewable fuel biodiesel is thought to be a better option for the environment than diesel made from petrochemicals. Traditionally, edible vegetable oils are used to make biodiesel. On the other hand, employing non-edible seed oils lessens competition with the food supply chain and provides a more sustainable solution. Eggshells are a common agricultural waste that is a perfect fit for nanocatalyst synthesis due to their high calcium carbonate content.

Methodology: A number of crucial processes, including oil pretreatment, catalyst preparation, and transesterification, were involved in the production of biodiesel from non-edible seed oil using eggshell nanocatalyst. The transesterification process was run under ideal conditions, and the yield of biodiesel was evaluated.

Result: Our study produced positive outcomes. The excellent catalytic activity of the eggshell nanocatalyst resulted in high biodiesel yields. The synthesized biodiesel have physicochemical characteristics which satisfied international specifications, suggesting that diesel engines could employ it.

Conclusion: In conclusion, our research investigates an emerging and environmentally friendly process that uses eggshell waste as a nanocatalyst to create biodiesel from non-edible seed oils.

Keywords: Non-edible seed oil, biodiesel, egg-shell nanocatalyst

REVOLUTIONIZING MARKETING PRACTICES: A COMPREHENSIVE ANALYSIS OF BLOCKCHAIN TECHNOLOGY'S IMPACT

Ashin Jose

Amrita School of Business, Bengaluru, India(ashinjz011@gmail.com)

Maria Sabastin Sagayam

Amrita School of Business, Bengaluru, India (s_mariasabastin@blr.amrita.edu)

In the dynamic digital marketing landscape, blockchain technology is reshaping traditional practices. This study explores blockchain's integration into marketing, focusing on enhanced security, transparent transactions, and decentralized platforms. In advertising, blockchain tackles ad fraud by providing a secure and transparent transaction platform. Amidst a dynamic market evolution, integrating blockchain is revolutionary. Traditional marketing faces digital challenges like security and transparency, addressed by blockchain's decentralized nature. Marketers benefit from transparency, security, and efficiency through blockchain, creating a secure and auditable transaction record to build trust and decrease fraud risk. Blockchain's decentralized, cryptographically secure design is ideal for managing sensitive data and streamlining marketing processes, including automation in loyalty programs and supply chain management.

The study uses mixed methods, merging qualitative and quantitative analyses to grasp blockchain's impact on marketing. Qualitative analysis includes literature reviews and case studies, highlighting trends, challenges, and success stories in existing blockchain applications. Quantitative analysis, via surveys and interviews with marketing professionals, businesses, and consumers, captures experiences, perceptions, and expectations, with statistical analyses offering a meaningful overview. The study concludes by emphasizing blockchain's transformative potential in reshaping traditional marketing, highlighting positive effects on security, transparency, and user engagement. While acknowledging challenges to widespread adoption, the insights from this research serve as a valuable guide for industry professionals leveraging blockchain for trust, transparency, and innovation in marketing.

Keywords: Blockchain, Marketing, Security, Transparency, Decentralization

OPTIMISATION AND EVALUATION OF BIOCHAR DERIVED FROM THE WEED PLANT *CROTALARIA BURHIA*

Poonam Poonia

Jai NarainVyas University, Jodhpur, Rajasthan, India (poonam.poonia@yahoo.com)

L.oveena Gaur

Jai NarainVyas University, Jodhpur, Rajasthan, India

Invasive weed plants are unwanted and hazardous waste biomass and have extraordinary potential to serve as raw materials for biochar production. Biochar is defined as a porous carbon-rich product obtained from the thermal degradation of biomass, such as wood, agricultural residues, manures, activated sludge, energy crops, etc. To evaluate the potentiality of invasive weeds for bioenergy production in the form of biochar, *Crotolariaburhia* was investigated. The response surface modelling and optimisation of the biochar parameters were conducted using the experimental design expert 13.0. The optimum value of the desirabilityfunction was obtained at a pyrolysis temperature of 450°C and a particle size of 50–100 mm. The model represents a p-value less than 0.0500 and a high F value, which denotes its reliable and accurate prediction of experimental data. A strong correlation was observed between the actual and predicted values for biochar composites fixed carbon, carbon, surface area, pore size, and pore volume. In the present study, *C. burhiabiochar* production was carried out by slow pyrolysis at 450°C under vacuum conditions. Biochar was found to be alkaline with a 33.23% yield. Proximate analysis of *C. burhia* revealed 3.35% moisture content, 8.48% volatile matter, 81.24% fixed carbon, and 6.94% ash content. The elemental analysis shows major concentrations of carbon, hydrogen, and oxygen of 57.77%, 6.123%, and 27.60%, respectively. Low H/C and O/C molar ratios were quantified as 0.10% and 0.47%, respectively. It possesses a honeycomb structure with mesoporous surface porosity with a large surface area of 155.19m²/g and a remarkable concentration of the mineral elements calcium and potassium. Biochar rich in hydroxyl, carboxylic, and alkene functional groups enhances its applicability. These findings make *C. burhia* a potential feedstock for the production of good-quality biochar. It is expected that the obtained biochar is multifunctional and can be used for climate mitigation, increasing carbon sequestration, enhancing soil fertility, and remediating organic and inorganic pollutants from soil and water.

Keywords: *Crotolariaburhia*, Biochar, Response surface methodology, Surface area

DEVELOPMENT OF TRANSGENIC TOMATO FOR PRODUCTION OF RECOMBINANT THERAPEUTIC PROTEIN

Shweta Jha

J. N. Vyas University, Jodhpur, India (jha.shweta80@gmail.com)

Indraneel Sanyal

CSIR-National Botanical Research Institute, Lucknow, India

D.V. Amla

CSIR-National Botanical Research Institute, Lucknow, India

Plant-based expression platform offers unique advantages over other expression systems in terms of safety, cost efficacy, storage and post-translational modifications of proteins. Human α_1 -antitrypsin (AAT) is a broad-spectrum serine protease inhibitor in serum with great therapeutic potential, which plays an important role in maintaining protease-antiprotease homeostasis in lungs. The present research was undertaken with the aim of high-level expression of biologically active recombinant AAT in transgenic tomato for possible therapeutic application. Human AAT gene was codon-optimized and designed to achieve high level expression of the recombinant protein. The response of protein accumulation site on yield, biological activity and stability of recombinant AAT was analyzed via targeting to different subcellular organelles in transgenic tomato plants. Maximum accumulation of recombinant AAT in transgenic tomato plants was achieved from 1.5 to 3.2% of total soluble protein (TSP). Recombinant AAT protein was purified from leaves of transgenic tomato plants to a high homogeneity using immunoaffinity chromatography, and characterized for its structural integrity, biological activity and glycosylation pattern. Our study demonstrated feasibility of using plants as bioreactor for producing recombinant proteins of clinical importance.

IMPACT OF PRESERVATION TECHNOLOGY FOR COMPLEMENTARY PRODUCTS WITH CARBON EMISSION REDUCTION UNDER A SUSTAINABLE SUPPLY CHAIN MANAGEMENT

Nilkamal Bar

Department of Mathematics and Statistics, Banasthali Vidyapith, India
(nb.nilkamalbar@gmail.com)

Biswajit Sarkar

Department of Industrial Engineering, Yonsei University, South Korea
(bsbiswajitsarkar@gmail.com)

Sharmila Saren

Department of Mathematics, Government General Degree College, Gopiballavpur-II, India
(ss.sharmila.saren@gmail.com)

Isha Sangal

Department of Mathematics and Statistics, Banasthali Vidyapith, India
(isha.sangal@gmail.com)

The fundamental concern of responsible managers is to reduce emissions and waste due to deterioration to achieve the sustainability of supply chain management. The application of technology, such as preservation technology, is extremely beneficial in lowering the rate of deterioration. This work builds a sustainable supply chain model for complementing deteriorating products with a fixed shelf life with a single retailer and two manufacturers. A nonlinear demand function is taken, a function of self-price and the price of complementary products. Preservation technology investment is anticipated to reduce the rate of deterioration with carbon emissions to maintain the process green. The present approach proposes establishing a sustainable supply chain management system to maximize total profit by determining the best values for selling price, preservation investment, cycle duration, manufacturing rate, and number of lots to deliver. Carbon emissions are investigated and related to different operational activities such as manufacturing setup, product shipping, waste management, and product holding at the manufacturer and retailer's end. The objective function in the present study is a mixed-integer nonlinear optimization problem. A solution methodology based on differential calculus is adopted to get the desired solution.

Keywords: Sustainable supply chain management; Preservation technology; Complementary product; Deterioration; Flexible production

DOES RAILWAY TRANSPORTATION AFFECT BARGAINING POLICY FOR PRICING AND RETAILING UNDER GREEN SUPPLY MANAGEMENT?

Parthasarathi Mandal

Department of Mathematics and Statistics, Banasthali Vidyapith, India
(parthasarathi4541@gmail.com)

Biswajit Sarkar

Department of Industrial Engineering, Yonsei University, South Korea
(bsbiswajitsarkar@gmail.com)

Sarla Pareek

Department of Mathematics and Statistics, Banasthali Vidyapith, India (psarla13@gmail.com)

Tuli Barman

Department of Industrial Engineering, Yonsei University, South Korea (tbtulibarman@gmail.com)

Railway transportation plays one of the most important roles in reducing transportation cost in supply chain management. It gains the attention of both retailers and manufacturers after concerning their profits and contributes to a sustainable business environment. Besides, other factors, such as bargaining and marketing expenditure, significantly impact attracting customers and increasing sales. This study discusses a two-echelon green supply chain with two problems for the online and offline shops. The first problem consists of a non-linear function of the retail price for railway transportation, the greening level of the sold product, online and offline shops, bargaining, and demand for marketing. In the second problem, due to railway transportation and retail marketing expenditure, the supply chain management's total profit is assessed for centralized and decentralized models. This problem is solved through the game policy. It is found that using railway transportation can increase the greening level of products and the overall profit, and the marketing expenditure meets the industry's requirements.

Keywords: Supply chain management; Greening level; Bargaining; Marketing management; Railway transportation;

REDUCING WASTE THROUGH CIRCULAR ECONOMY USING FUZZY DEMAND

Sujit Kumar Das

Department of Mathematics, NIT Agartala, India;
Department of Mathematics, Egra S. S. B. College, Egra, West Bengal, India
(skdmath.sch@nita.ac.in)

Biswajit Sarkar

Department of Industrial Engineering, Yonsei University, South Korea
(bsbiswajitsarkar@gmail.com)

Uttam Kumar Bera

Department of Mathematics, NIT Agartala, India(bera_uttam@yahoo.co.in)

Controlling waste in the production and consumption cycle has largely been made possible by the circular economy idea. This study incorporates the circular economy notion for reduce, reuse, and recycle. Here, two supply chains (primary and secondary) have been introduced. Production is carried out in the primary supply chain. Waste from the primary chain is collected and used as raw materials for the secondary supply chain. The recycling industry in the secondary chain produces a different product to be fully consumed. The secondary chain third-party logistics gathers and sends the damaged goods to the recycling sector. Waste is lost during transportation to the recycling sector because of damage or leaks from the waste containers. The trash restoration includes the waste container's leaking (maintenance cost). The price discount policy is a crucial component of the main chain that lowers the amount of trash produced. In the primary chain, demand is constant. In the secondary chain, the market demand is not constant; here, we have introduced a periodic review fuzzy inventory model with zero lead time without a distribution. This primary objective is to reduce predicted total annual costs besides waste nullification while optimizing cycle length and obtaining optimal decision variables.

Keywords: Circular economy; Waste management; Recycling; Uncertainty; Third-party logistics; Price discount

THE EFFECT OF ONLINE ADVERTISEMENT FOR A DUAL-CHANNEL RETAILING BUSINESS FOR SUBSTITUTABLE PRODUCTS

Sumi Kar

Department of Mathematics, National Institute of Technology Durgapur, India
(sk.sumikar@gmail.com)

Biswajit Sarkar

Department of Industrial Engineering, Yonsei University, South Korea
(bsbiswajitsarkar@gmail.com)

Anita Pal

Department of Mathematics, National Institute of Technology Durgapur, India
(anita.pal@maths.nitdgp.ac.in)

Nowadays, every industry adopts strategies to survive in the competitive market and run the business smoothly. Dual-channel consisting of online and offline channels is now the primary concern of every industry to bigger their business, and online advertisement helps the industry to make their products popular. Industrial companies make great efforts to cut carbon emissions to create a greener environment. The cap-and-trade system is taken into account in this production model to regulate the rate of carbon emissions. Manufacturers make investments in modern green technology to lower emissions per unit. In this study, multi-manufacturers produce single-type products, which are substitutable types. With these considerations, a cap-and-tax policy, investments in green technology, and product promotion are used to evaluate sustainable, flexible production. A classical optimization technique has been used to determine online and offline sales prices, advertising investment, green technology investment, cycle time, and production rate. The numerical analysis shows that the industry makes 0.07% more money by investing in online advertisement.

Keywords: Dual channel; Advertisement policy; Substitutable product; Green technology; Cap-and-trade policy

CONSUMER PERCEPTION AND ADOPTION OF TELEHEALTH SERVICES: A MARKETING PERSPECTIVE IN THE INDIAN HEALTHCARE SECTOR

Ananda Yogaroopan

Amrita School of Business, Bengaluru, India(anandayr2201@gmail.com)

Maria Sabastin Sagayam

Amrita School of Business, Bengaluru, India (s_mariasabastin@blr.amrita.edu)

In recent years, telehealth has surged, revolutionizing healthcare. This research focuses on understanding customer perceptions of telehealth from a marketing perspective. This insight is crucial for marketers and healthcare providers to integrate telehealth into mainstream healthcare through effective marketing strategies. Enhancing consumer access to telehealth involves addressing key factors like affordability, trust in technology, and the quality of healthcare providers. Overcoming concerns such as data security is crucial in shaping positive consumer perceptions. Marketers can analyze the consumer journey and decision-making process to develop targeted campaigns promoting telehealth services effectively. By doing this, we not only get knowledge about telehealth but also provide us with practical implications for telemarketers, giving guidance on how to reach and engage with customers effectively. It's prime to identify the intricacies and improve the telehealth services fostering accessibility, good quality, and time-bound manner to reach rural areas. Data can be collected by interviewing consumers and healthcare providers, surveys, and other secondary data to get more insights into the topic.

To conclude, the consumer perception and adoption of telehealth services in the Indian healthcare sector has wide potential. We can get valuable insights that can help build good marketing strategies and policies to integrate telehealth services in mainstream healthcare. As the days go by consumer needs and preferences are evolving understanding this is highly important so that telehealth service quality and access can evolve at the same pace.

Keywords: Telehealth, Consumer Perception, Marketing Strategies, Healthcare Integration, Data Security

SOME SINGLE-VALUED NEUTROSOPHIC POWER YAGER AGGREGATION OPERATORS AND THEIR APPLICATION TO MCDM

Sonam Sharma

Shri Mata Vaishno Devi University, Katra, India (20dmt001@smvdu.ac.in)

Surender Singh

Shri Mata Vaishno Devi University, Katra, India (surender1976@gmail.com)

Single-valued neutrosophic sets (SVNSs) have numerous applications in the field of Science of Engineering. In this article, Yager's operations and power averaging operator are utilized to formulate some single-valued neutrosophic Yager power operators, such as, single-valued neutrosophic Yager power weighted averaging (SVNYPWA) operator, single-valued neutrosophic Yager power order weighted averaging (SVNYPOWA) operator, single-valued neutrosophic Yager power weighted geometric averaging (SVNYPWGA) operator, and single-valued neutrosophic Yager power ordered weighted geometric averaging (SVNYPOWGA) operator. We also investigate some useful and important properties of these operators. Furthermore, SVNYPWA and SVNYPWGA operators in a single-valued neutrosophic environment are utilized to solve the multiple-criteria decision-making (MCDM) problem, and the method is implemented using an illustrative example for the selection of a suitable road construction company among several alternatives. Finally, a comparative analysis has been done in conjunction with some existing techniques to appreciate the proposed methods.

Keywords Single-valued neutrosophic set; SVNYP averaging operator; SVNYP geometric operator; MCDM

A COMPARATIVE STUDY OF PHOTO-SENSITIZERS IN REDUCTANT SURFACTANT SYSTEM IN PHOTO-GALVANIC CELL FOR PHOTO INDUCED POWER GENERATION AND ITS STORAGE

Jayshree rathore

Jai Narain Vyas University, Jodhpur, India (rathorejaysree29@gmail.com)

Rakesh Kumar Arya

Research Scholar, Jai Narain Vyas University, India (aryarakesh8058@gmail.com)

In the present work we compared electrical performance of photogalvanic cell for two food dyes act as photosensitizer Tatrazine and Sunset Yellow in DSS-EDTA system for solar energy conversion and storage. Both are azo food Dyes act as photosensitizer D.S.S. act as anionic Surfactant and E.D.T.A act as a reductant. Electrical parameters of both the system were studied and compared. The observed conversion efficiencies and Fill factor for Tatrazine and Sunset yellow in DSS - EDTA system were 0.6163%, 0.2800 and 1.2186%, 0.2900 respectively. The highest photopotential are 879 millivolt and 864.0 millivolt whereas the highest photocurrent is 220 microampere and 390 microampere respectively. Inspire of other solar cell photogalvanic cell can also work in dark, which is called storage capacity of cell $t_{1/2}$ and cell performance measured as $t_{1/2}$. Cell performance of both the cell determined and for Tartrazine –EDTA-system it is 100 minutes while for the sunset yellow system it was observed 140 minutes. Power, current and potential at power point of both the system were determined.

Keywords: Photo-sensitizer, Photopotential, Photocurrent, sunset yellow, Tatrazine, EDTA, DSS, Fill factor, Conversion efficiency.

NOVEL FUZZY KNOWLEDGE MEASURE AND FUZZY CORRELATION COEFFICIENT WITH THEIR APPLICATIONS

Surender Singh

Shri Mata Vaishno Devi University, Katra, Jammu and Kashmir, India.

(surender1976@gmail.com)

The evaluation of vagueness content in a fuzzy set typically involves fuzzy entropy, while the determination of precision relies on the concept of fuzzy knowledge measure. This article introduces a novel fuzzy knowledge measure that takes into account both positive and negative information content of a fuzzy set. We present an axiomatic framework for obtaining this new knowledge measure and provide a proof through a characterization theorem. Additionally, we establish a transformative result that derives a correlation coefficient between two fuzzy sets using the proposed fuzzy knowledge measure. Based on this result, a new correlation coefficient between two fuzzy sets is suggested. This novel fuzzy correlation coefficient is not based on conventional statistical formulas and reveals both positive and negative linear relationships between fuzzy sets, including their strength of association. The proposed measures address specific limitations of classical fuzzy information and correlation measures.

Keywords: Fuzzy set, Fuzzy entropy, fuzzy knowledge, fuzzy correlation coefficient

WATER SUITABILITY FOR DRINKING AND IRRIGATION AND WATERING PURPOSE USED TO THE IWQI MODEL: A CASE STUDY OF GROUNDWATER QUALITY IN SOME AREA OF CHOHTAN TEHSIL IN BARMER DISTRICT OF RAJASTHAN (INDIA)

Dr. Sangeeta Parihar

Jai Narain Vyas University Jodhpur, India

Suresh Kumar Pachak

Jai Narain Vyas University Jodhpur, India

Bharat Singh

Jai Narain Vyas University Jodhpur, India

The current study has been carried out to evaluate the quality of drinking water and to irrigate groundwater fields located across the study region. Water samples were collected from twenty different locations (both before and after the monsoon). In this region, the Chohtan aquifer is the most important groundwater auriferous system which is considered a major source for drinking and irrigation. In Chohtan, since the quantity and the quality of water available for different uses is variable from one place to another, groundwater quality in Chohtan deep aquifer was evaluated for its suitability for drinking purposes. To this end, an attempt has been made for the first time in order to determine the spatial distribution of groundwater quality parameters and to identify places with the best quality for drinking within the study area based on an integrated analysis of physical-chemical parameters and, use of Geographical Information System and, Water Quality Index calculation. The physicochemical results were compared to the standard guideline values as recommended by the World Health Organization (WHO) for drinking and public health in order to have an overview of the present groundwater quality.

A weighted and mathematical model was used to compute the physical and chemical factors, as well as the irrigation criterion. According to the study's findings, the quality of the tested water varied from good to outstanding for drinking and irrigation purposes, as determined by the WQI.

Keywords : Water quality of groundwater, WQI, Physicochemical parameters, Geographical Information System.

THALLIUM AS AN OXIDIZING AGENT FOR THE OXIDATION OF CINNAMYL ALCOHOL IN AN ACIDIC ENVIRONMENT WITH OR WITHOUT A CATALYST AND ITS KINETIC ANALYSIS.

Anita Meena

Jai Narain Vyas University Jodhpur, India

Sanjay Singh

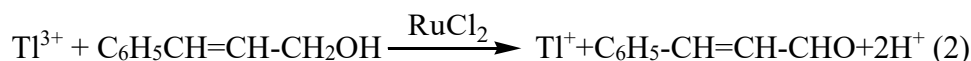
Jai Narain Vyas University Jodhpur, India

Oxidation of Cinnamyl alcohol by Thallium perchlorate and its kinetic analysis were studied in aqueous acidic medium with or without catalyst. The reaction was bimolecular, i.e. the stoichiometry of this reaction in the absence of a catalyst corresponds to the response in equation (1) regarding oxidant and substrate, respectively.



The activation energy is $47.89 \pm 0.7 \text{ kJ mol}^{-1}$, and the Entropy is $-90.62 \pm 2.24 \text{ JK}^{-1} \text{ mol}^{-1}$.

Ruthenium(III) chloride catalyst is used for thallium-catalyzed cinnamyl alcohol oxidation reaction in an acid-perchlorate environment. The stoichiometry of the reaction corresponded to equation (2).



The reaction is similar to thallium(III); there is a first order in the catalyst and variable order in alcohol. Activation energy $76.85 \pm 0.55 \text{ kJ mol}^{-1}$ and entropy of activation $-95.112 \pm 1.88 \text{ JK}^{-1} \text{ mol}^{-1}$ were calculated from the Eyring graph. An uncatalyzed path has also been indicated. A reasonable reaction mechanism was proposed, and a rate law was introduced to explain the investigation.

Keywords: Kinetics, Oxidation, Alcohol, Thallium, Catalyst.

PETRINET MODELING, COMPUTATIONAL ANALYSIS, AND SIMULATION OF INTERLEUKIN17E SIGNALINGPATHWAY: A STUDY OF DYNAMICS

Ram NayanVerma

Jawaharlal Nehru University, New Delhi, India (ram21_sit@jnu.ac.in)

Gajendra Pratap Singh

Jawaharlal Nehru University, New Delhi, India (gajendra@jnu.ac.in)

Sanjeev Ahuja

Kurukshetra University, Kurukshetra, Haryana, India (sahuja2015@kuk.ac.in)

Understanding the signaling mechanisms and regulation of IL-17 cytokines is important for studying immune system function and developing therapeutic interventions for inflammatory and infectious diseases. The study was focused on Petri Net modeling, a mathematical modeling tool used to model discrete event dynamic systems, to study dynamic behaviour of Interleukin 17 (IL-17) signaling pathway. The study involves computational analysis including state space, deadlock sequence, reachability and behavioral properties in the Interleukin 17E signaling pathways. Extended Petri nets, where the arc set also includes inhibitor arcs in the model, were used to model the signaling pathways. Inhibitor arc helps where the condition of turning off a transition is modeled when a token is present in its corresponding input place. Petri nets are used in pathway analysis to model and analyze the behavior of biological pathways. They provide a graphical representation that captures the dynamic interactions between components within a pathway, such as genes, proteins, and metabolites. Through this model, we will show the study of behavior of the Interleukin 17E Signaling pathway that plays a significant role in controlling infection.

Keywords Petri net, Interleukin 17 (IL-17) pathway, state space, Reachability graph, Marking Vector, Firing Rule, Deadlock sequence

SURVEY STUDY ON CICIDS2017, CSE-CIC-IDS2018, ISCXIDS2012, AND UNSW-NB15

Devendra Kumar Singh

Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India

Santosh Soni

Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India

Pankaj Chandra

Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India

Deepak Kant Netam

Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India

Intrusion detection datasets are essential in the field of computer security because they provide academics and practitioners with data that is representative of the real world, which can be used for the purpose of developing, testing, and evaluating intrusion detection systems (IDS). These datasets typically comprise system logs, statistics on network traffic, and other relevant data that tracks both lawful and illegal conduct. There is no one method that can be applied to all intrusion detection systems; rather, the field of study comprises a number of different approaches and procedures. In its place, a number of different intrusion detection systems (IDS) make use of a wide variety of models, heuristics, and algorithms to identify suspicious or malicious activities. The purpose of this survey study is to establish which dataset is the most suitable for the operation of intrusion detection systems.

Keywords: Intrusion detection system (IDS), Host-based IDS (HIDS), Network-based IDS (NIDS), Distributed IDS (DIDS).

TRUST IN AI AND ANTHROPOMORPHISM LEADING TO HUMAN DESKILLING

Abhishek Sharma

Assistant Professor, SPUP, Jodhpur, India

Ankita Sharma

Professor, SoLA, IIT Jodhpur, India

Ekta Yaduvanshi

Research Scholar, SPUP, Jodhpur, India

Advancements in AI have taken the entire world by storm in the past decade. We see people using AI and technology for every small and simple work, even with higher trust and greater ease, without realizing the simultaneous decrement happening in their cognitive and creative capacity. It has become increasingly easy to pass off work done by AI as original work with progressively human-like capabilities of modern AI tools. High trust in AI capabilities and exceedingly anthropomorphized human-like characteristics predict greater chances of the reuse of AI technology by humans. The increasing use of AI has the potential to both augment and deskill among humans. The study analyzed responses from 172 participants (101 male and 71 female) to address the rising concerns about the use of AI and Deskilling being indulged in by students. The study utilized a survey method consisting of questions from established questionnaires regarding anthropomorphism and human-computer trust test to gauge the impact on the deskilling of students. Results show that higher anthropomorphism and trust in AI were linked to higher levels of deskilling. The dangers of continued AI usage and possible safeguards have been discussed.

Keywords: human-computer trust, trust in AI, deskilling, anthropomorphism.

“FUZZY LOGIC BASED DATA ANALYSIS ON USEFULNESS OF REVERSE PERFORMANCE APPRAISAL IN INDUSTRIES”

H.S.Hota

Atal Bihari Bajpayee University, Bilaspur (C.G.), India

Manoj Kumar jha

Shri Agrasen Girls College, Korba (C.G.), India

Sulekha Shukla

Shri Agrasen Girls College, Korba (C.G.), India

The present competitive environment, organizations have to ensure peak performance of their employees continuously in order to complete the market place, effectively. "Giving Effective Feedback" is definite important management tool and considered as an art, which managers master over a period of time. The process of giving feedback down the corporate hierarchy is common and pervasive but the concept of giving reverse feedback is getting popular nowadays. In reverse appraisal, employees can evaluate the effectiveness of their managers. In this study the usefulness of reverse performance appraisal technique analyzed with the current requirement of industries.

This study was aimed at evaluating the usefulness of the reverse performance appraisal process in selected private organizations. Fuzzy logic was applied in assessing the usefulness of the reverse performance process using a case study of private industry. Linguistic variables were used to represent the performance of the metrics, and the variables were converted into fuzzy numbers. Fuzzy operators were applied to these numbers to obtain the performance of the measures and the entire process. From the results obtained, it was found that the approach adopted is applicable in evaluating the usefulness of reverse performance appraisal of the private industry. Based on this study, subordinates (workers/staffs) can provide feedback and performance review of their seniors (managers) with ease and identify areas which are deficient, thus improving the overall performance of their seniors.

Key words: Reverse performance appraisal (RPA), Feedback, Reverse Performance Evaluation, Fuzzy logic, Linguistic variable

UPSURGE OF FEMTECH INDUSTRY: A STUDY ON FEMTECH ENVIRONMENT IN INDIA

**KRISHN AWATAR GOYAL
MALA DAGA**

Women are notably underrepresented in the establishment of new ventures, especially in the technology sector, as previous research on female entrepreneurship has demonstrated. But lately, there has been an increase in innovative businesses that use technology to provide goods and services aimed at improving women's health and bridging the gender data gap in the medical field. These companies are part of the female technology (Femtech) industry, a new industry at the crossroads of healthcare and technology that is mostly unknown in the commercial and academic worlds. Femtech is a relatively young industry in India, but it is fast growing in popularity. The Indian femtech industry is predicted to develop at a CAGR of 12.9 percent to \$4 billion by 2024. (FICCI). As a result, it is thought worthwhile to examine the emerging Femtech industry. This article aims to address areas such as difficulties and opportunities, finance and capital sources, male and female entrepreneurs etc. in the Indian femtech industry. This paper seeks to add to academic research by putting light on an emerging technology business and presenting a chance for entrepreneurship.

A STUDY ON AMINO ACID OXIDATION USING 2-iodoxy benzoic acid: A GREENER APPROACH

Deepak Krishna Vyas

Lachoo Memorial College of Science and Technology (Autonomous) Jodhpur, Rajasthan, India

Pooja Tak

Jai Narain Vyas University, Jodhpur, Rajasthan, India

Priyanka Purohit

Jai Narain Vyas University, Jodhpur, Rajasthan, India(pp.ch@jnvu.edu.in)

Amino acids were oxidized with an ecofriendly reagent 2-Iodoxybenzoic acid in acidic medium. The reaction exhibited 1:2 stoichiometry with amino acids and oxidants respectively. Kinetics with respect to oxidant has found to be first order. Variation of pseudo first order rate constant indicated Michaelis – Menten type of kinetics with respect to amino acids. Isokinetic relationship implied that all the amino acids follow similar mechanistic pathway. The Corresponding oxidation product was found to be alkyl nitriles. 2-Iodoxybenzoic acid was screened for in vitro growth promoting activity and found to exhibit positive effect on seed germination and modulation in total protein content in seed cotyledon.

Keywords: Oxidation, hypervalent iodine, eco-friendly, growth promotion, protein modulation

STUDY OF PATENT BLUEDYE PHOTSENSITIZER BASED PHOTOGALVANIC CELLS WITH DODECYL TRIMETHYL AMMONIUM BROMIDE SURFACTANT

Meenakshi Jonwal

Jai Narayan Vyas University, Jodhpur, Rajasthan, India. (meenakshi.jp.04@gmail.com)

Solar energy is being widely used as a renewable energy source for generation of electricity. Research and development is going on in solar power generation technologies like Photovoltaics, Dye-sensitized solar cell, Gallium arsenide germanium solar cell, Monocrystalline solar cell, multi-junction solar cell, Organic solar cell, Perovskite solar cell, Plasmonic solar cell, Polycrystalline solar cell, Quantum dot solar cell, Thin-film solar cell, The most promising source for solar energy conversion has been PV cells, but they require separate storage of electrical power while photogalvanic cells can generate as well as store electrical power. Researchers have constructed diverse photogalvanic cells employing a range of dye photosensitizers, reductants, and surfactants, aiming to enhance the electrical performance of these cells. The integration of surfactants in photogalvanic cells has been instrumental in improving electrical performance and overall cell efficiency. This enhancement is attributed to the improved solubility, stability, and diffusion of the photogalvanic system facilitated using surfactants alongside dyes. Consequently, the incorporation of surfactants becomes indispensable for the advancement of photogalvanic systems. The photogalvanic system of Patent Blue dye photosensitizer with Cellobiose reductant, Dodecyl trimethyl Ammonium Bromide (DTAB) surfactant in an alkaline medium provided by Sodium Hydroxide has provided excellent electrical performance, revealing enhanced system stability and improvements in storage capacity, conversion efficiency, and various electrical parameters. Notably, this research demonstrates a substantial boost in electrical performance compared to previous studies on photogalvanic cells. The findings include a maximum potential of 608 mV, a maximum current of 2100 μ A, and power characteristics such as 322 μ W at the power point, a fill factor of 0.21, and an impressive conversion efficiency of 9.77%.

Keywords: Solar Energy, Photogalvanic cells, Patent Blue.

DIGITAL HEALTH CARE PLATFORMS AND PATIENT ENGAGEMENT:A MARKETING ANALYSIS OF MOBILE HEALTH APPS IN THE INDIAN MARKET

Shruthi Vandhana SM

Amrita School of Business, Bengaluru, India(shruthivandhanasm2000@gmail.com)

Maria Sabastin Sagayam,

Amrita School of Business, Bengaluru, India (s_mariasabastin@blr.amrita.edu)

In recent years, the clinical diagnosis process has undergone a transformative shift through the introduction of mobile health applications, or Medical Health apps. This article delves into the digital transformation in healthcare, focusing on the features, value, and popularity of these apps for medical professionals. It assesses the utility of medical app platforms and advances information systems research by elucidating the necessary policies for app development to enhance clinical efficacy.

The background discusses the burgeoning impact of mobile technologies in the Indian healthcare sector, offering functions such as online consultations, appointment booking, prescription reminders, and health tracking tools. However, challenges such as low digital literacy, data security concerns, and the need for integration with conventional healthcare systems hinder the full potential of mobile health in India.

The methodology section outlines a systematic approach for marketing analysis, emphasizing the importance of quantitative and qualitative data. It highlights cultural sensitivity, language barriers, and the diverse Indian market. Findings reveal the significant impact of digital healthcare platforms on marketing practices, showcasing examples such as a maternal health app addressing challenges faced by pregnant women.

The conclusion underscores the transformative potential of digital healthcare in the vibrant Indian market for mobile health apps. Success in this dynamic landscape requires apps to cater to specific healthcare needs, employ efficient marketing techniques, and remain flexible to user input. As technology evolves, maintaining adaptability will be crucial for long-term success in the competitive Indian market.

Keywords: Mobile Health Apps, Digital Transformation in Healthcare, Indian Healthcare Sector, Marketing Analysis, Clinical Efficacy

A FACTOR ANALYTIC TOPSIS MODEL FOR EVALUATING REGIONAL HEALTHCARE DISPARITIES IN INDIA

Ritanshi Trivedi

Babasaheb Bhimrao Ambedkar University, Lucknow, Uttar Pradesh, India
(ritanshitrivedi19@gmail.com)

Healthcare disparities in India persist as a significant challenge, reflecting inequitable access to healthcare resources and services across diverse socio-economic strata. Despite advancements in medical technology and infrastructure, a substantial portion of the population still remains exposed to poor healthcare. In this paper, Factor Analytic Model based on the theory of TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution) has been used to evaluate the healthcare development of India. The model is formulated regarding the cross-sectional data for the years 2015-16 and 2019-21. Also, the classification of states based on their level of development has been made by using 'Multivariate Cluster Analysis' approach. Lastly, for the states which lagged behind in terms of healthcare development, the potential targets for various healthcare indicators have been estimated in order to enhance the healthcare development of India.

Keywords: Healthcare Development, Factor Analytic Model, TOPSIS (Technique for Order of Preference by Similarity to Ideal Solution), Composite Indices, Hierarchical Cluster Analysis.

COMPUTATIONAL THINKING APPROACHES AS COUNTERMEASURES TO THE ADVERSE EFFECTS OF GENERATIVE ARTIFICIAL INTELLIGENCE ON EDUCATION

Abdulmalik Ahmad Lawan

Kano University of Science and Technology, Wudil, Nigeria
Maryam Abacha American University of Nigeria, Kano , Nigeria
Al-Istiqama University Sumaila, Nigeria

Abdullahi Yunusa Abdullahi

Kano University of Science and Technology, Wudil, Nigeria

Sani Abdullahi Sani

Kazakh-British Technical University, Almaty, Kazakhstan;

As generative artificial intelligence (AI) systems such as ChatGPT increasingly permeates educational environments, concerns have risen regarding its potential adverse effects on critical aspects of learning and cognitive development. This study explores the potential of computational thinking approaches as countermeasures to the negative effects of GAI on education. The study highlights the efficacy of computational thinking approaches and GAI in empowering active students' engagement in the 21st-century educational landscape. The study also addressed concerns related to the responsible use of GAI, ethical considerations, and the role of educators in guiding students' interactions with intelligent systems. Through a systematic literature review, this research synthesizes existing knowledge on the computational thinking frameworks, drawing connections between these cognitive strategies and their capacity to address and alleviate the identified challenges of generative AI on education. Findings from this research contribute to the ongoing discourse on the responsible integration of AI in education by providing evidence-based insights into the efficacy of computational thinking strategies as a means to enhance educational outcomes and mitigate potential risks associated with generative AI. The study concludes with practical recommendations for educators, policymakers, and technologists to leverage computational thinking as a constructive force in navigating the evolving landscape of AI-enhanced education.

Keywords: Computational Thinking, Generative Artificial Intelligence, Algorithmic Thinking, Problem-solving, Education.

EFFICACY OF BLOCKCHAIN IN PRIVACY-PRESERVING MACHINE LEARNING: A SYSTEMATIC LITERATURE REVIEW

Abdulmalik Ahmad Lawan

Kano University of Science and Technology, Wudil, Nigeria
Maryam Abacha American University of Nigeria, Kano, Nigeria
Al-Istiqama University Sumaila, Nigeria

Sani Abdullahi Sani

Kazakh-British Technical University, Almaty, Kazakhstan

Abdullahi Yunusa Abdullahi

Kano University of Science and Technology, Wudil, Nigeria

Machine Learning (ML) has witnessed unprecedented growth, becoming a cornerstone in various applications due to its ability to derive patterns and insights from data. However, depending on the domain of application, the data needed for training the model may contain sensitive and private information whose privacy needs to be preserved. One of the challenges that need to be addressed in deep learning is how to ensure that the privacy of training data is preserved without sacrificing the accuracy of the model. Recent studies have identified the efficacy of blockchain technology as a promising avenue for addressing security and privacy concerns in distributed machine learning systems. Through a systematic literature review, this study synthesizes existing knowledge on the efficacy of blockchain in preserving-privacy machine learning. The review encompasses a diverse set of articles, exploring the intersection of privacy-preserving methodologies, machine learning, and blockchain technology. Findings from this research contribute to a comprehensive understanding of the current state of research, identify research gaps, and suggest future directions in this evolving interdisciplinary field. The outcomes of this review provide valuable insights for researchers, practitioners, and policymakers working on the convergence of privacy-preserving machine learning and blockchain technologies. The study concludes with practical recommendations, emphasizing the potential of blockchain technology to enhance privacy in machine learning applications and urging further exploration and implementation in real-world scenarios. This research sets the stage for continued advancements in privacy-preserving machine learning and underscores the pivotal role of blockchain in shaping the future of secure and private distributed learning systems.

Keywords: Privacy-preserving; machine learning; blockchain; data privacy; deep learning; deep learning models; distributed systems.

COMPUTATION STRATEGY FOR EFFICIENT ESTIMATION OF POPULATION MEAN USING AUXILIARY PARAMETERS

Surendra Kumar

Govt. Degree College, Pihani, Hardoi, India, (surendra.kumar776@gmail.com)

Subhash Kumar Yadav

Babasaheb Bhimrao Ambedkar University, Lucknow, India(drskystats@gmail.com)

In this paper, we offer a new modified class of estimators of the population mean of the primary variable using the known Coefficient of Variation of the Auxiliary Variable and other Auxiliary Parameters. The recommended estimator is the outcome of combining the ratio and exponential ratio estimators. As a result, special instances of the suggested estimators include the ratio and exponential ratio estimators. The bias and Mean Squared Error (MSE) of the introduced estimator are calculated for an order one approximation. The optimal values of the suggested estimators' characterizing constants are discovered. For these ideal values of the characterizing constants, the MSE of the newly proposed estimator is also minimized. Over competing estimators, efficiency standards are specified, and the suggested estimator is compared against rival population mean estimators. To analyze these efficiency conditions, a main real data set on sugarcane output from the Pihani Block in Hardoi District in Uttar Pradesh State, India, is used. A simulation study is also carried out to assess the performance of the proposed estimator on a large population. The results show that the introduced estimator is the most effective among the competing family of population mean estimators.

Keywords: Primary Variable, auxiliary Variable, Estimator, Bias, MSE, Simulation.

STATISTICAL AND MACHINE LEARNING TECHNIQUES FOR THE PREDICTION OF MONKEYPOX INCIDENCES

Subhash Kumar Yadav

Babasaheb Bhimrao Ambedkar University, Lucknow, U.P., India (drskystats@gmail.com)

Dinesh K. Sharma

University of Maryland Eastern Shore, Princess Anne, MD 21853, USA (dksharma@umes.edu)

Yusuf Akhter

Babasaheb Bhimrao Ambedkar University, Lucknow-226025, U.P., India(yusuf@daad-alumni.de)

The consequences of Covid-19 on the global economy and healthcare have raised concerns about newly emerging viral infections. Monkeypox (MPX) has become one of these, posing a major threat to public health. In this study, we use three statistical techniques to analyze the infectious monkeypox disease and anticipate its future spread among the top ten nations with high infection rates: "distribution fitting," "ARIMA modeling," and "Random Forest" machine learning modeling. We attempted to precisely analyze and estimate the disease's spread by modeling theoretical distributions with data from multiple countries. We fit data from the nations under consideration into ARIMA models to find the most accurate time series regression model. We also employ the Random Forest machine learning technique to forecast future illness behavior. By comparing the Root Mean Square Errors (RMSE) of both models for each country, we discovered that the Random Forest model outperformed the ARIMA model in six of the ten countries, while the ARIMA model fared better in the other four. The best-fitting model is recommended for sound policy decision-making.

Keywords: Monkeypox virus, Disease modeling, Random Forest, ARIMA, Distribution Fitting, RMSE.

IDENTIFICATION AND CHARACTERIZATION OF DRIVER AND PASSENGER MUTATIONS IN THE COSMIC COMPLETE TARGETED SCREENS MUTANT DATASET

Kanchana Yadav

Jawaharlal Nehru University, New Delhi, India(kancha31_sit@jnu.ac.in)

The discovery of driver and passenger mutations is crucial in the increasingly important science of genomics, which is driving the search for tailored cancer treatments. Passenger mutations are unintentional changes that do not directly contribute to the formation of cancer, while driver mutations are genetic changes that provide cancer cells with a selective growth advantage and accelerate carcinogenesis. Gaining an understanding of these drivers provides a template for the development of targeted therapeutics and also uncovers important insights into the underlying molecular mechanisms of cancer. Driver mutations offer prospective targets for therapeutic intervention, enabling precision medicine customised to the unique genetic composition of each patient's cancer to become a genuine possibility. The study's goal is to find driver mutations in the COSMIC Complete Targeted Screen Mutant Dataset to open up new possibilities for targeted therapies and possibly even uncover new pharmacological targets that are essential for individualised cancer treatment. Simultaneously, the discovery of passenger mutations helps to reduce the noise in the data, allowing for a more concentrated examination of alterations with higher biological significance.

This study delves into the comprehensive analysis of the COSMIC Complete Targeted Screen Mutant Dataset obtained from the Catalogue of Somatic Mutations in Cancer database. The research employs a systematic six-step approach to predict driver and passenger mutations, encompassing data preprocessing, annotation, prioritisation of driver and passenger mutations, pathway analysis, manual review, and visualisation. The significance of this research lies in its potential to unravel the intricate molecular mechanisms underlying cancer development and progression. The delineation of driver and passenger mutations offers a valuable roadmap for clinicians and researchers, facilitating more informed decision-making in the pursuit of effective cancer treatments.

PYTHON-BASED PETRI NET REACHABILITY TREE GENERATOR SIMULATOR TOOL

Mohit Kumar Jassi

Jawaharlal Nehru University, New Delhi, India (mohitjassi@tutamail.com, gajendra@jnu.ac.in)

Gajendra Pratap Singh

Jawaharlal Nehru University, New Delhi, India

This research introduces a Python-based Petri Net Reachability Tree Generator with a graphical user interface (GUI) developed using Tkinter. The tool facilitates the input of crucial Petri Net parameters, including the number of transitions, places, and associated input/output places for each transition. Leveraging NetworkX for tree construction and Pyvis for visualization, the code iteratively explores enabled transitions, generating nodes and arcs. The Tkinter GUI prompts users to specify transitions, places, and input/output connections. Initial place markings are obtained through user input. The application then constructs the reachability tree and employs Pyvis to create visual representations of both the reachability tree and the Petri Net, showcasing initial markings, transitions, and places. For developing this tool authors use the theory of Boolean Petri net that serves as an accessible resource for researchers and practitioners involved in Petri Net analysis. By providing insights into system behaviour through reachability trees, the code contributes to advancing formal methods and modelling in computer science research. The user-friendly interface enhances usability, making it a valuable asset in the exploration of Petri Net dynamics.

Keywords: Boolean and Crisp Boolean Petri Net, marking vector, firing rule, reachability tree.

ESTIMATION OF PROBABILITY MODEL FOR NUMBER OF FEMALE CHILD BIRTHS AMONG FEMALES IN BETA-BINOMIAL- POISSON MIXTURE DISTRIBUTION

Dhairya Tripathi

Department of Statistics, Babasaheb Bhimrao Ambedkar University, Lucknow

One of the most significant areas of human demography is the study of female childbirth patterns, as they are fundamental to the development of a nation. In this paper, we analyze the preference for daughters prevalent in society. For this, we use data from different states. An observed collection of data from NFHS-V (2019-21) was subjected to a probability model for the number of female births and total children ever born. We will use the EM algorithm to find maximum likelihood estimates of Beta Binomial Poisson mixture distribution.

Keywords: Expectation Maximization algorithm, Probability Model, Mixture distribution

DYNAMICS OF PREDATOR-PREY INTERACTIONS: NONLINEAR HARVESTING, SPATIOTEMPORAL CHAOS, AND BIFURCATION ANALYSES IN A GENERALIZED MODEL

Santanu Bhattacharya

University, Kolkata700032, India (bsantanu65@gmail.com)

Biswajit Sarkar

Yonsei University, Seoul 03722, South Korea(bsbiswajitsarkar@gmail.com)

Nandadulal Bairagi,

Jadavpur University, Kolkata700032, India (nbairagi.math@jadavpuruniversity.in)

This study investigates a predator-prey model's temporal and spatiotemporal dynamics under the influence of both species' nonlinear harvesting. We investigate equilibrium stabilities of the non-diffusive system analytically and numerically, and we also conduct a thorough analysis of possible bifurcations. Bifurcation analysis of the local system indicates the possibility of transcritical, Hopf, saddle-node, and homoclinic bifurcations with increasing environmental carrying capacity. The results of the simulation also point to the complex way that the paradox of enrichment manifests itself in harvested systems. Various pattern-forming instabilities are analyzed in the spatiotemporal study. We determine the crucial predator-to-prey diffusivities ratio at which Turing instability begins. The amplitude equation is derived by a weakly nonlinear analysis, which enables us to anticipate the form of the pattern. One important discovery of this work is that predator diffusion functions as a regulating mechanism, allowing the creation of spatiotemporal chaos in response to prey harvesting. Spatial segregation is caused by increased prey harvesting, but it is mitigated by increased predator harvesting. Moreover, it is discovered that spatial segregation increases the system's total biomass. The existence and nonexistence of spatiotemporal chaos in the Hopf-Turing parametric space is a fascinating finding.

Keywords: Predator-prey model; Diffusion; Bifurcation; Weakly nonlinear analysis; Chaos

INTERNET OF THINGS (IoT) BASED SMART ATTENDANCE SYSTEM USING FINGERPRINT SENSOR

Parwati Shriwas

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur Chhattisgarh India
(shriwasminty@gmail.com)

Omprakash Yadav

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur Chhattisgarh
India,495009(omprakashyadav0531@gmail.com)

H.S. Hota

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur Chhattisgarh India
(proffhota@gmail.com)

Attendance is an important component of any organization to mention and monitor availability of a person in the organization. Since olden days, the method of recording attendance is always manual. It is time consuming and prone to human errors. This also becomes stressful at times. In order to make it error free and reduce the wastage of time, it is necessary to implement Smart Attendance Management System thus making it more efficient and effective. Biometric authentication is the unique identification of a person so, Biometric based attendance is one of the ways to register attendance of a person. This research tends to develop a system for tracking the attendance of any persons as well as enhancing the efficiency of attendance using a fingerprint module, and IoT over a web server. This system includes hardware and a web server. The hardware system is able to collect attendance data and web server is used to monitor it. The fingerprint module checks the authorization of a person and sends a command to the ESP8266 NodeMCU module. The ESP8266 Wi-Fi Module will collect the fingerprint data from the multiple users and sends it over the internet to a website. The Enrolment of fingerprints is done on the server using fingerprint sensor R307 and verification of the fingerprint will be done on the webserver while fingerprint templates are transmitted over the Wi-Fi. There is a 0.96 Inch Light Emitting Diode (LED) display module which shows the critical information to the users. We can track and manage all the records of attendance data on the web server and export the attendance data into excel file and share it for further use. This research provides solution for the old days attendance system. This attendance system will improve the efficiency, reduce wastage of time and error will be minimized.

Keywords: Internet of Things (IoT), Smart Attendance System, Attendance Monitoring System, Fingerprint module, Biometric.

. AUTOMATED MCQ GENERATOR FROM TRANSFORMER

Nisha Devi

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(ngoswami170@gmail.com)

Rashmi Gupta

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(rashmigupta@bilaspuruniversity.ac.in)

In this project, we proposed an MCQ generator, that generates the automatically mcq from the given text. The text is summarized using the T5 Transfer model and accordingly, sentence mapping is done for generating MCQ. To generate a choice for the questions, distracters (the Wrong choices)are generated using three Algorithms WorldNet(lexical database of English), Conceptnet Algorithm (Free Multilingual knowledge graph) and WordVector also called a Sense2vec. The model has better performance and it can process a large amount of data in less time. The T5 Transformer model was trained on the SQUAD dataset. First, extract keywords from sentences then we will pick keywords to give the paragraph and see how we can train and use the T5 transformer model to generate the question as well as an answer from the keyword last we got the mcq.MCQ generators can significantly reduce the burden on educators and save time by automating the question-creation process. They also promote fairness and consistency in assessments, as they are less susceptible to biases compared to manually generated questions.

Key word : MCQ ,Distractor(Wordnet,Sense2Vec) ,T5 model(Text to text Transfer Transformer) ,NLP

IMAGE CAPTIONING

Barakha Soni

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(barakhasoni2000@gmail.com)

Dr. Rashmi Gupta

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(rashmigupta@bilaspuruniversity.ac.in)

Image captioning is a technology that involves the generation of descriptive and coherent textual captions for images. This interdisciplinary field combines computer vision, which focuses on extracting meaningful information from visual data, and natural language processing, which deals with the understanding and generation of human language. Image captioning is a multidisciplinary field that combines computer vision and natural language processing to generate textual descriptions for images. This technology has gained significant attention due to its potential applications in various domains, including content accessibility, image retrieval, and assistive technologies. Image captioning models typically consist of two main modules: a convolutional neural network (CNN) for image feature extraction and a recurrent neural network (RNN) for generating descriptive captions. The CNN encodes visual information, while the RNN decodes it into a coherent sentence. Recent advancements in this field include the use of attention mechanisms to focus on relevant image regions and transformer-based models for improved caption quality. In this model, the MobileNetV3 pre-trained model used for image feature extraction it aims to provide efficient and accurate models for computer vision tasks. We used the Flickr30k dataset which consists of 31,783 images with five captions per image, providing a total of 158,915 captions. Challenges in image captioning encompass handling complex scenes, generating informative and contextually relevant descriptions, and achieving a human-level understanding of visual content. Evaluation metrics like BLEU and METEOR are employed to assess the quality of generated captions.

Keywords:RNN, CNN, Flickr30k, BLUE, MobileNetV3.

IOT BASED SOLAR TRACKING SYSTEM (SUNLIGHT DETECTION),SMART STREET LIGHT

Dyalnand Patel

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(pateldyal2710@gmail.com)

Dineshwar Dahare

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(dineshwardahare08@gmail.com)

Dr. Rashmi Gupta

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(rashmigupta@bilaspuruniversity.ac.in)

Solar tracking system play a pivotal role in improving the efficiency of solar energy harvesting by dynamically orienting solar panel to track the sun's movement. The objective of this research is to create and assess a solar tracking system to optimize solar panel power generation and to face the problem of day-to-day increasing electricity bill. It uses a microcontroller, Light Dependent Resistor (LDR) sensor and servo motor. The Arduino UNO microcontroller is the primary controller. Arduino is used as the main control circuit. As a result of the programming of this device, the LDR sensor, when it detects sun rays, will provide direction to the Servo Motor in order to move the solar panel. Consequently, the solar panel is positioned so that it can receive the maximum amount of sunlight. solar energy has become an increasingly important and popular renewable energy source. By using a solar tracking system, we can produce an abundance of energy and improve the efficiency of solar panels.

The main aim of smart street light systems is that lights turn on when needed and light turn off when not needed. Moreover, the smart street light system in this paper behaves like usual street lights that turn on all night. The ideal behavior of the smart street light system is that no one finds turn-off of street lights at night. Whenever someone see street lights, they turn on and whenever no one see street lights, they turn off. The smart street light system consists of LED lights, and short-distance communication networks. The lights turn on before pedestrians and vehicles come and turn off or reduce brightness when there is no one.

Keyword:- Arduino uno, Solar panel, Servo motor, LDR, LED light, Resistance, Battery, Diode, power jack.

A NOVEL APPROACH FOR CAR COUNTING USING COMPUTER VISION BASED OBJECT DETECTION TECHNIQUE

Ritu Sahu

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(ritu03czone@gmail.com)

Ankita Jaiswal

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(ankita.csa22@gmail.com)

Dr. Rashmi Gupta

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(rashmigupta@bilaspuruniversity.ac.in)

The project creates a Python-based YOLO (You Only Look Once) object identification system, specifically with the versions like YOLOv3 and YOLOv4, renowned for their efficient object detection capabilities. The input picture is divided into a grid, and predictions are made for each grid cell about bounding boxes, object ratings, and class probabilities. YOLO, which comes in versions like YOLOv3 & YOLOv4, is renowned for its efficiency and accuracy in jobs involving object detection. The standard procedure for the Python implementation of YOLO is to import the required libraries, load the pre-trained model weights, and provide methods for image processing and object identification extraction. After that, it filter out detections with a low confidence threshold and uses non-maximum suppression to eliminate duplicate detections. The necessary dependencies, such as OpenCV for image processing, NumPy for array operations, and the pre-trained YOLO weights and configuration files, must be installed in order to implement YOLO. Important other libraries like OpenCV, NumPy and others are come in use. Then loading of YOLO configuration file, the pre-trained weights and the class labels. After this, the functions are defined for pre-processing images (resizing, normalization) and post-processing (decoding detections). After that, the reading and preprocessing of image occurs which is then forwarded to the YOLO network to get raw predictions. The next is to apply non-maximum suppression to remove duplicate detections and filter out detections with confidence below a certain threshold. A bounding box with class labels on the image for detected object is formed. The task here is to count the number of cars passing out from a margin using a video content. Here, we use different classes to objectify the correct item which is being chosen to be count. There, a mask needs to be created to remove the unwanted focus of the algorithm to the input which gives a more precise view and then a margin is drawn which will used as a passing line so that any car passing through can be detected and counted easily. Each car crossing the margin will be counted and shown in the screen.

Keywords:YOLOv3, YOLOv4, OpenCV, NumPy, confidence threshold, mask.

INFERENCE ABOUT MODI-WEIBULL DISTRIBUTION UNDER CENSORING SCHEME

Harshita Kumawat

University of Rajasthan, Jaipur, India

Pankaj Nagar

University of Rajasthan, Jaipur, India

This article deals with the statistical inference of left censored Modi-Weibull distribution. Modi-Weibull distribution is the extension of Weibull distribution. It is an important lifetime distribution and suitable for bath-shaped and increasing hazards. The necessary parameter estimation, for parameters involved, are discussed here for drawing inferences regarding the Modi-Weibull distribution. For this purpose, Maximum likelihood estimation method is used for point and interval estimation of two unknown parameters in the presence of left censoring. Also, asymptotic confidence intervals are obtained. A simulation study is conducted to monitor the accuracy of MLEs in case of small samples. It is observed that proposed estimates have greater accuracy for small samples also.

Keywords: Modi-Weibull Distribution, Left censoring, Maximum likelihood estimation, Simulation.

IMPACT OF ARTIFICIAL INTELLIGENCE ON DIGITAL MARKETING TECHNIQUES IN HOSPITALITY SECTOR

Manisha Burad

Jai Narain Vyas University, India (jmanu2806@gmail.com)

Dr. Ramesh Kumar Chouhan

Jai Narain Vyas University, India (ramesh.chouhan@gmail.com)

In this era of digital technology, the deployment of artificial intelligence (AI) is crucial. One of the most important and strategic factors in economic development is the usage of AI. In addition, digital assistants powered by AI are becoming more prevalent. They are useful for hospitality industries in many ways, including as enhancing customer service, increasing operational capacity, and decreasing expenses. Advertisers can learn more about consumer habits and industry tendencies with the use of analytics solutions powered by artificial intelligence. For instance, with the use of predictive analytics, companies can optimize their marketing campaigns based on what they think their customers would like. Improved decision-making and the creation of more efficient marketing strategies are both made possible by this data-driven strategy. The study's objective is to learn how AI has impact digital marketing strategies in the hotel industry and what effects this shift has had. Hotel managers will be selected as the subjects of this study, which will employ a survey method. The analysis will be conducted using SPSS. It is hypothesized that, AI have a significant effect on digital marketing in the hotel industry.

Keywords: Artificial Intelligence, Digital Marketing, Hotel Industry, Consumer Service ,Marketing Strategies

EFFICIENT NEURAL SOLUTIONS: SLIDINGTCN IN MOTOR IMAGERY EEG CLASSIFICATION FOR NEUROLOGICAL DISABILITIES

Abhishek Jain

Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India (ajain.nit@gmail.com)

Rohit Raja

Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India (drrohitraja1982@gmail.com)

K. Kartheek Ram

Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India (kartheek06142003@gmail.com)

P. D. Dinesh

Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India (dineshpinninti258@gmail.com)

M. Rishika

Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India (rishikamedara2001@gmail.com)

In recent decades, extensive research has delved into the intricate mechanisms governing brain activity, aiming to establish an innovative communication channel utilizing EEG electrode data for brain-computer interfaces. Neurologically disabled patients, facing complete body paralysis, encounter challenges in expressing their thoughts to the external world. This study proposes an efficient and novel methodology employing a neural network architecture named 'SlidingTCN.' The implemented code focuses on motor imagery EEG classification, incorporating subject-specific training and evaluation with multiple runs, model checkpointing, and result visualization. The objective is to enable disabled individuals to communicate their attempted body movements, overcoming their physical limitations. The methodology demonstrates notable efficiency across an average of 9 subjects and 10 runs (90 experiments), yielding an accuracy of 0.8198 and a Kappa value of 0.7598. The best runs further exhibit increased accuracy at 0.8538 and a Kappa value of 0.8050. The study utilizes a four-class motor imagery dataset, encompassing EEG data from 9 subjects. The cue-based BCI paradigm involves tasks related to the imagination of movements for the left hand (class 1), right hand (class 2), both feet (class 3), and tongue (class 4). Each subject undergoes two sessions on different days, each comprising 6 runs with short breaks. A single run consists of 48 trials (12 for each class), resulting in 288 trials per session. Prior to each session, a 5-minute recording assesses EOG influence, divided into blocks focusing on eyes open, eyes closed, and eye movements. This comprehensive approach provides valuable insights into enhancing communication avenues for individuals with neurological disabilities.

DEVELOPMENT OF AN EFFICIENT TOKENIZER FOR HINDI LANGUAGE USING NLP

Hitesh Patel

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(hiteshpatel7039336@gmail.com.)

Miss Ankita Jaiswal

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(ankita.csa22@gmail.com)

Dr. Rashmi Gupta

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(rashmigupta@bilaspuruniversity.ac.in)

Tokenization is a very fundamental step in natural language processing (NLP) and plays a very important role various application such as machine translation, sentiment analysis etc. In this research, we proposed a Tokenizer for Hindi language that focuses on the design and implementation of a robust tokenizer for the Hindi language, addressing the unique linguistic characteristics and challenges associated with Hindi text processing. The proposed tokenizer employs a combination of rule-based and statistical approaches to effectively segment Hindi text into meaningful units, overcoming complexities arising from compound word, conjunct characters, and diverse grammatical structures. The tokenizer is developed to handle both formal and informal variations of the language, ensuring versatility across a wide range of contexts. This research involves the compilation of a comprehensive Hindi corpus to train and evaluate the tokenizer, leveraging existing linguistic resources and exploring novel techniques for improved accuracy. The research also explores the potential for adaptation to other Indic languages, laying the foundation for broader language processing capabilities in the other Indian language linguistic landscape. The outcomes of this research is contribute to the enhancement of NLP tools for Hindi, advancements in various fields including information retrieval, sentiment analysis, and machine learning application. The developed tokenizer not only addresses the specific challenges of Hindi tokenization but also serves as a valuable resource for researchers and developers working on language processing tasks in multilingual environments.

Keywords: Tokenizer, Corpus, NLP, Sentiment Analysis, Machine Translation.

HINDI SPEECH EMOTION RECOGNITION

Manisha Gupta

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(underconstruction023@gmail.com)

Dr. Rashmi Gupta

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(rashmigupta@bilaspuruniversity.ac.in)

In this research, Real-Time Emotion Detection Through Speech bridge between humans and computer systems by detecting and analyzing emotional states through Hindi speech. This project focuses on detecting and analyzing emotional and mental states, such as happiness, sadness, anger, and speech. Preceding model training, the dataset undergoes essential preprocessing steps, including Noise Reduction and feature extraction like Mel-frequency cepstral coefficients (MFCCs), chroma, pitch, energy, and spectral features. Subsequent smoothing techniques refine emotion predictions. Leveraging Natural Language Processing (NLP), our project employs blend of machine learning and deep learning models. The project harnesses the power of NLP to process speech data, laying the foundation for a robust model. Models such as Long Short-Term Memory (LSTM), Multi-Layer Perceptron (MLP), Convolutional Neural Network (CNN), and Recurrent Neural Network (RNN) handle the intricate task of emotion recognition. Long Short-Term Memory and RNN models prove particularly effective in capturing sequential patterns in these extracted features, while MLP and CNN models excel in learning hierarchical representations. Our model has been trained on a diverse dataset, making it robust to variations in accents and emotional expressions. In my project, I am using IITKGP_SEHSC. In this dataset, eight emotions are anger, fear, happiness, surprise, sadness, neutral, and sarcasm. This dataset has a total of 10 sessions. Each session has all the above mentioned emotions. Inside each emotion, we have 15 audio files in .wav format. We have 7207 samples of audio files. In the final, a User Interface developed to enable real-time input to speech. This User Interface utilizes the model trained on emotion-labeled datasets to predict and display the emotions expressed in the input speech. This user-friendly interface facilitates on-the-fly emotion analysis, enhancing the overall functionality of our model. Applications range from adaptable human-computer interfaces to call center quality monitoring and mental health support systems. Real-time Emotion Detection Through Speech enhances user experience and opens doors to understanding and responding to human emotions in live communication.

Keywords: NLP, MFCCs, Chroma, Mel, RNN, CNN, MLP, LSTM, IITKGP_SEHSC

REAL TIME HANDWRITTEN DIGIT RECOGNITION USING SUPPORT VECTOR CLASSIFIER AND OPENCV

Aparna Sahu

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(aparnsahu356@gmail.com)

Rashmi Gupta

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(rashmigupta@bilaspuruniversity.ac.in)

Ankita Jaiswal

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(ankita.csa22@gmail.com)

Handwritten digit recognition system detects and scanned images of handwritten digits and also allows writing digits on the screen with the help of integrated GUI for recognition. The applications of digit recognition include in postal mail sorting, bank check processing, form data entry, converting handwritten documents into editable text, and enabling smart devices to interpret handwritten inputs. In this research I proposed a Handwritten digit recognition model that provides the ability to machine to recognize human handwritten digits. The heart of the problem lies within the ability to develop an efficient algorithm that can recognize hand written digits and which is submitted by users by the way of a scanner, and other digital devices. This paper presents an approach to handwritten digit recognition based on Support vector classifier and OpenCV. The main objective of this paper is to ensure effective and reliable approaches for recognition of handwritten digits. I am using SVC (support vector classifier) to fit my model and save it using joblib. I have created my own dataset for which I have collected 2000 images of digits for recognition of digits. Pyscreenshot package is used to collect images. I have used OpenCV package for computer vision and image processing, Pandas package for data manipulation and analysis, scikit-learn package for machine learning tools and algorithms, matplotlib, cv2, and numpy too.

Keywords: digit recognition, machine learning, neural network, classification algorithm, scikit-learn, pandas, madplotlib, numpy, joblib, Pyscreenshot Support vector classifier and OpenCV.

SENTIMENT ANALYSIS ON TWITTER DATA USING THE TWITTER API

Amit Kumar Yadav

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(amityadav021190@gmail.com)

Rashmi Gupta

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(rashmigupta@bilaspuruniversity.ac.in)

Using the Twitter API, this project investigates sentiment analysis on Twitter data. Due to the widespread availability of public opinion on social media sites like Twitter, sentiment analysis has become an important tool for gauging user attitudes toward certain subjects, occasions, or goods. I have access to both historical and real-time tweet data thanks to the Twitter API, which offers a wealth of data for sentiment analysis.

Using the Twitter API, tweets are gathered for the study, and natural language processing methods are then used to examine the sentiments expressed in the text. Machine learning models are used for sentiment analysis, categorizing tweets as positive, negative, or neutral depending on the attitude expressed. This project intends to contribute to a better understanding of public opinion on social media by gathering insights about the prevalent attitude surrounding particular keywords, hashtags, or user accounts. Additionally, the study looks into the potential and difficulties of sentiment analysis on Twitter, as well as the effects of sarcasm, language nuances, and changing linguistic trends. The results of this study may be useful to decision-makers and analysts in a number of fields, such as marketing, social media analytics, and public opinion research. All things considered, this study demonstrates the potential of the Twitter API to facilitate sentiment analysis and provides an insight into the shifting public opinion on one of the most significant social media platforms globally.

Keywords: Sentiment Analysis, twitter API, Tweet, hashtags

IOT & CLOUD BASED SMART SWITCHING PLUG COMPATIBLE WITH AI ASSISTANT

Ujjwal Matoliya

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(ujjwalmatoliya@gmail.com)

Surya Prakash Patel

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India

Dr. H.S. Hota

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
proffhota@gmail.com

This project presents the overall design of Appliances automation system (AAS) with low cost and More convenience than smart plugs available in the market. In which we have used smart technologies and microcontrollers which are used in IoT and with the help of Smart Plug we can transform your appliances into smart devices. An excellent smart plug for home, you can convert your AC, geyser, and even microwave etc to a smart device with a few simple steps, The main control system implements wireless technology to provide remote access from smart phone. We are using a cloud server-based communication that would add to the practicality of the project by enabling unrestricted access of the appliances to the user irrespective of the distance factor. We provided a data transmission network to create a stronger automation. The system intended to control electrical appliances and devices in house with relatively low cost design, user-friendly interface and ease of installation. The status of the appliance would be available, along with the control on an android platform. This system is designed to assist and provide support in order to fulfil the needs of elderly and disabled in home. Also, the smart home concept in the system improves the standard living at home. The App lets control your appliance from anywhere and it capable Voice Control, A smart plug that works with Alexa and Google Assistant, the plug makes it easy to control your smart devices using voice commands.

Keywords: Smart plugs, Home automation, IoT, ESP8266, Smart Home

FACE EMOTION RECOGNITION USING CNN WITH EARLY STOPPING

Hitesh Dewangan

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India
(hiteshdewangan3777@gmail.com)

Priya Koshle

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India
(priyakoshle87@gmail.com)

Mr. Jeetendra Kumar Gupta

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India
(jeetendragupta85@gmail.com)

This project report explores the application of Convolutional Neural Networks (CNN) with Early Stopping for the task of Face Emotion Recognition (FER). The focus is on leveraging a combined dataset to enhance model robustness and performance. The combined dataset incorporates diverse facial expressions from various sources, enriching the training process for a more generalized emotion recognition model.

The methodology involves designing and implementing a CNN architecture optimized for FER, integrating Early Stopping techniques to prevent overfitting and enhance model efficiency. The combined dataset is curated to include a broad spectrum of facial expressions, contributing to the model's ability to recognize emotions across diverse scenarios.

The contributions of this project extend to the exploration of the combined dataset's impact on the model's generalization capabilities and the efficacy of Early Stopping in preventing overfitting during training. Practical implications and potential applications of the developed model in real-world scenarios are also discussed.

Facial emotion recognition (FER) holds transformative potential across diverse applications. FER is instrumental in healthcare, especially in mental health assessments by analyzing a patient's emotional state during therapy sessions. Similarly, in education, FER serves as a revolutionary tool that improves the learning environment. Through real-time monitoring of student's emotions, the teachers can customize their strategies to suit the needs of the students. This technology helps create a good supportive and personalized educational experience in which students can work in a good supportive environment.

Keywords: Face emotion recognition, CNN, Human-Computer Interaction, computer vision technology Emotion, Early Stopping

HYBRID MODEL TO DEVELOP MACHINE LEARNING BASED SPEECH EMOTION RECOGNITION SYSTEM

Raveena Rajak

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur Chhattisgarh India,495009
(raveenarajak21@gmail.com)

Deepesh Kumar Dwivedi

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur Chhattisgarh India,495009
(deepesh.25.dwivedi@gmail.com)

H.S. hota

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur Chhattisgarh India,495009
(proffhota@gmail.com)

This research proposes a novel approach to Speech Emotion Recognition (SER) by integrating a hybrid model that combines the strengths of Recurrent Neural Network (RNNs) and Convolutional Neural Network (CNNs) and Support Vector Machine (SVM) machine learning techniques. Emotion detection from speech signals plays a crucial role in human-computer interaction and affective computing applications. The model leverages the richness of the Toronto Emotional Speech Set (TESS) dataset, comprising 2800 carefully curated audio samples, to enhance the accuracy and robustness of emotion recognition from speech signals. The proposed model employs the Mel-Frequency Cepstral Coefficients (MFCCs) as the cornerstone of the feature extraction process, capturing the intricate acoustic details of speech signals. The model integrates deep neural networks, such as Convolutional Neural Networks (CNNs) and Long Short-Term Memory (LSTM) networks, with classical machine learning algorithms like Support Vector Machines (SVM) and Random Forests (RF). The methodology encompasses a multi-stage process, beginning with the collection and preprocessing of a diverse dataset containing labeled emotional speech recordings. The integration of LSTM facilitates the modeling of temporal dependencies, enabling the system to capture the dynamic evolution of emotional expressions over time. Concurrently, Convolutional Neural Networks (CNNs) automatically extract hierarchical features from the raw audio signals, capturing both local and global patterns in the data. The model is meticulously crafted and evaluated, demonstrating exceptional performance on the Toronto Emotional Speech set (TESS) dataset. The LSTM component achieving a noteworthy 98% accuracy, SVM achieving 1.0% accuracy and Random Forest classifier achieving 95% accuracy. With the hybrid approach utilizing a Voting Classifier achieving an outstanding overall accuracy of 98%, showcasing the effectiveness of the combined architecture. This combination aims to capture both high-level representations and intricate temporal dependencies present in speech signals. This paper is expected to serve as a comprehensive guideline for SER researchers to design solutions using ML techniques, motivate possible improvements of existing models, or trigger novel techniques to enhance SER performance.

Keywords: Speech Emotion Recognition(SER), TESS, RNN, LSTM, CNN, SVM, RF, MFCC

GENERATIVE AI IN HEALTHCARE: APPLICATION, OPPORTUNITIES AND CHALLENGES

Dharmendra Kumar Yadav

National Institute of Health & Family Welfare (NIHFW), New Delhi-110067

Generative AI (artificial intelligence) refers to algorithms and models, such as OpenAI's ChatGPT, that can be prompted to generate various types of content. In this narrative review, we present a selection of representative examples of generative AI applications in medicine and healthcare. We then briefly discuss some associated issues, such as trust, veracity, clinical safety and reliability, privacy, copyrights, ownership, and opportunities, e.g., AI-driven conversational user interfaces for friendlier human-computer interaction. We conclude that generative AI will play an increasingly important role in medicine and healthcare as it further evolves and gets better tailored to the unique settings and requirements of the medical domain and as the laws, policies and regulatory frameworks surrounding its use start taking shape.

Keywords: generative AI; large language models; ChatGPT; artificial intelligence; medicine; healthcare; human health

DENSITY BASED SMART TRAFFIC MANAGEMENT SYSTEM

Priyanka Dubey

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(dubeypriyanka857@gmail.com)

Rashmi Gupta

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(rashmigupta@bilaspuruniversity.ac.in)

Deepesh Kumar Dwivedi

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(deepesh.25.dwivedi@gmail.com)

The project is aimed at designing a density based dynamic traffic signal system where the timing of signal will change automatically on sensing the traffic density at any junction. Traffic congestion is a severe problem in most cities across the world and therefore it is time to shift more manual mode or fixed timer mode to an automated system with decision making capabilities.

Present day traffic signaling system is fixed time based which may render inefficient if one lane is operational than the others. To optimize this problem, we have made a framework for an intelligent traffic control system. Sometimes higher traffic density at one side of the junction demands longer green time as compared to standard allotted time. We, therefore propose here a mechanism in which the time period of green light and red light is assigned on the basis of the density of the traffic present at that time. This is achieved by using PIR (proximity Infrared sensors). Once the density is calculated, the glowing time of green light is assigned by the help of the microcontroller (Arduino). The sensors which are present on sides of the road will detect the presence of the vehicles and sends the information to the microcontroller (Arduino) where it will decide how long a flank will be open or when to change over the signal lights. In subsequent sections, we have elaborated the procedure of this framework.

Keywords : IOT, traffic management , traffic prediction, traffic signal management, Arduino uno, ,IR sensor ,buzzer,vehicles

LPG GAS LEAKAGE DETECTION USING ARDUINO

Lokendra

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(lokendra.kamro2000@gmail.com)

Sunil

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(sp2330645@gmail.com)

Deepesh Kumar Dwivedi

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(deepesh.25.dwivedi@gmail.com)

The Internet of Things (IoT) refers to a network of physical devices, vehicles, appliances, and other physical objects that are embedded with sensors, software, and network connectivity that allow them to collect and share data. These devices also known as “smart objects”. Gas leakage is a big problem in industrial areas, domestic areas and vehicles running on CNG gas. Leakage of LPG gas causes dangerous and toxic effects on living beings. LPG and CNG are highly combustible gases and catch fire at some distance from the exhaust source. One way to prevent the dangers caused by fire and explosions is to detect the leak and inform the person or persons related to that area. The main objective of this paper is to detect LPG gas leaks, alert people about the danger and neutralize the gas to prevent explosions. Gas will be detected using MQ6 gas sensor. The Arduino will immediately turn on the LED, Buzzer and the LCD will display a message to alert the maximum number of people. The system includes a GSM module that allows the owner to be informed about danger. It will also trigger the automatic opening of the window and exhaust fan to expel the gas and neutralize the concentrations.

KEYWORDS: IoT, Arduino, CNG, LPG, MQ6 gas sensor, LED, LCD, GSM, Buzzer.

INFLUENCE OF EMOTIONAL INTELLIGENCE ON INVESTMENT DECISION: EVIDENCE FROM INDIAN INVESTORS

Dr. Pooja Pandey

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur Chhattisgarh, India,
(poojapandey@bilaspuruniversity.ac.in)

Dr. Amita Dubey

Sunbeam College for Women, Bhagwanpur, Varanasi, Uttar Pradesh India,
(amitadubey8@gmail.com)

Dr. Pradeep Kumar Asthana

Amity University, Raipur-Baloda Bazar Road, Raipur, Chhattisgarh, India,
(pkasthana@rpr.amity.edu)

Investment behaviour is a cross-functional discipline that draws extensively from psychology, economics, finance, investment, and other related fields. The characteristics that influence an investor's decision typically reveal the investor's behaviour. All an astute investor would need to do is consider their own investment choices to distil the core of behavioural finance. It is inevitable for investors to have emotions when making financial decisions. Emotional intelligence is a collection of aptitudes, abilities, and talents for handling emotions and emotionally charged situations. Given its significance in financial choices, emotional intelligence is seen as a personal quality. Making investment decisions has changed due to psychology, where feelings significantly influence. Therefore, emotional stability—which is measured by emotional intelligence (EI) influences the process of making investment decisions. The ability to recognise emotions, process them, comprehend the information they contain, and control them are all components of emotional intelligence. A mix of skills makes up emotional intelligence. These abilities support an individual's capacity to control and observe their own emotions, accurately assess the emotional states of others, and sway opinions. This research aims to create a model that explains the connection between investment behaviour and emotional intelligence. The data was collected from 368 investors who make investments through Securities agencies in India. The findings of the study indicate a positive correlation between the different aspects of emotional intelligence. Investment advisors will find this study useful in advising clients to make investments based on their emotional intelligence.

Keywords: Emotional Intelligence, Investment Decision, Behavioural Bias, self-awareness, self-management, and empathy

IOT BASED PATIENT HEALTH MONITORING SYSTEM OF HUMAN HEART

Laxmi Kant Soni

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(soni.lucky1422@gmail.com)

H.S. Hota

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(proffhota@gmail.com)

These days we have an enhanced range of heart diseases together with enhanced risk of heart attacks. We all heard and observed that heart attack can kill your life in 3 attempts but nowadays because of heavy stress it could be in first attempt also. In this paper we proposed, a simple patient health monitoring device as an IoT application. This IoT device can read pulse rate, oxygen level and measure temperature through sensors. These sensors are interfaced with Micro Controller Arduino ATMEGA328. This Micro-Controller Arduino ATMEGA328 is provided with a programming written in embedded c language. The data is sent to the server through wireless data transmission. This wireless data transmission is done by ESP8266 module. It continuously monitors the pulse rate, oxygen level, temperature and updates them to an IoT platform. The IoT platform used in this paper is Blynk. Experimental results will be in fuzzy logic that prove the proposed system is user friendly, reliable, economical.

Keywords: Arduino, ESP8266, Pulse rate, Temperature, Health monitoring, Health diagnosis, Internet of Things.

ARDUINO BASED VOICE CONTROL ROBO CAR

Dipesh

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(Dipeshdhivarrtp@gmail.com)

Himanshu

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(Himanshubhardwaj142002@gmail.com)

Jeetendra kumar

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(Jeetendragupta85@gmail.com)

Voice controlled robotic system is very beneficial in areas where there is high risk for humans to enter. This project was created in such a way that voice instructions are used to control the robot. For required duties, an android application with a microcontroller is employed. Bluetooth technology facilitates the connection between the android app and the automobile .The goal of a Voice Controlled Robotic Vehicle is to complete a task by listening to the user's commands. A code is used to give instructions to the controller in the same way. The project Arduino based voice control robo car has numerous uses both now and in the future. In the future, improvements can be added to the project to make it more effective. The project has a wide range of applications, including military, home security, rescue missions, industry, and medical support. Using the given resources, we were able to create a rudimentary model of a voice-controlled robotic car. Because this project is simple to implement, this robot is advantageous to human life. The Voice Control Robot is beneficial for monitoring and assisting disabled persons. It is simple to use because it operates with basic voice commands. It is effective in locations where humans are unable to reach. As a result, we can employ this robot to spy on people. It has the potential to be utilized for surveillance. For security purposes, we can incorporate a web cam into this robot. The voice recognition software is highly sensitive to background noise and has a high accuracy for identifying a voice command.

MOTER CYCLE SECURITY

Sonam Ratnaker

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(Sonamratnaker82@gmail.com)

Girja Rathia

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(girjarathia12@gmail.com)

Rashmi Gupta

Atal Bihari Vajpayee University Bilaspur, Chhattisgarh, India
(rashmigupta@bilaspurunivercity.ac.in)

Motorcycle theft is a significant issue globally, with increasing instances of unauthorized access and thefts. This paper proposes a comprehensive and integrated approach to enhance motorcycle security through the amalgamation of advanced technologies and innovative strategies. The objective is to develop a robust security framework that not only deters theft but also facilitates efficient recovery in case of an unauthorized incident. The proposed system combines state-of-the-art technologies such as GPS tracking, biometric authentication, and Internet of Things (IoT) connectivity. A smart lock system equipped with biometric recognition ensures that only authorized users can start the motorcycle. This system is complemented by a GPS tracking device embedded within the motorcycle, allowing real-time monitoring and location tracking. Furthermore, the integration of IoT facilitates seamless communication between the motorcycle and a centralized security system. In the event of suspicious activity, the system triggers instant alerts to the owner's mobile device and the local law enforcement authorities. Additionally, the motorcycle owner can remotely disable the ignition system through a secure mobile application, thwarting any attempts of theft. To enhance the system's reliability and effectiveness, machine learning algorithms are employed to analyze patterns of motorcycle usage and detect anomalies that may indicate potential theft. This predictive analysis, coupled with real-time monitoring, significantly reduces false alarms while increasing the system's responsiveness to actual security threats.

Keywords: GPS Tracking Systems, Alarms and Immobilizers, Security Accessories, Secure Parking.

NAMED ENTITY RECOGNITION USING BERT & MBERT BASE MODEL FOR HINDI LANGUAGE

Chhaya Verma

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur ,Chhattisgard ,India,495009
(chhayaverma7366@gmail.com)

Neha

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur ,Chhattisgard ,India,495009
(nehajoshi0723@gmail.com)

Mr. Jeetendra Kumar Gupta

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur ,Chhattisgard ,India,495009
(jeetendragupta85@gmail.com)

Named Entity Recognition (NER) plays an important role in various Natural Language Processing (NLP) applications to extract the key information from a huge amount of unstructured text data. NER helps to gather information in a more efficient way. For example, with the help of semantic annotation can help to link a word or term with a similar meaningful group – like the name of a city or a book. mainly the task of NER is identifying and classifying the named entities into predefined categories for a given text. In the recent times, deep learning algorithms are also emerging for developing NER models. It is very challenging to build NER system for Hindi language in particular because it is an ambiguous, morphologically rich and resource scarce language. In this paper, we perform NER task on the Hindi language by incorporating the recently released multilingual language model MuRIL which stands for Multilingual Representation for Indian Languages. we use BERT base model for Hindi Corpus. BERT or Bidirectional Encoder Representation Transformer is a pretrained model that takes into account both left and right contexts. BERT model is trained to learn bidirectional context with the objective of Masked Language Modelling (MLM) and Next Sentence prediction (NSP). The BERT model consists of 12 transformer blocks that are made of attention and feed-forward layers. The pretrained BERT model provides up to 512 positional vectors for tokens, and we will use these vectors to recognize the named entity. In this research methodology involves fine-tuning pre-trained BERT and mBERT models on Hindi NER datasets, addressing language-specific challenges. The results showcase the models' ability to discern named entities in Hindi text, with implications for applications in information extraction, sentiment analysis, and other NLP domains. This work contributes to advancing NER capabilities in Hindi, emphasizing the significance of leveraging sophisticated language models for accurate entity recognition.

Keywords: Natural language processing, named-entity recognition, BERT model, NER dataset, performance evaluation, information extraction.

MACHINE LEARNING BASED NEWS HEADLINE CLASSIFICATION THROUGH NATURAL LANGUAGE PROCESSING

Kasak Dewangan

Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India
(kasakdewangan1226@gmail.com)

Ankita Jaiswal

Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India
(ankita.csa22@gmail.com)

Rashmi Gupta

Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India
(rashmigupta@bilaspuruniversity.ac.in)

In the recent few years, text mining and important data extraction has been one of the momentous areas of research. Nowadays we can seek information from various resources and in various different formats. The drawback of this is the authenticity and the correctness of the information get jeopardized. We find it difficult to categorize the information into specific categories from the huge source of unstructured data. The solution to this problem is Text Classification, using which we can categorize these scattered data. In this project, we have tried to classify the news based on their headlines. We have created the Multinomial Naive Bayes (MNB) classifier which classify the given news headlines into categories which are, Business, Entertainment, Health and Science and Technology. These classifiers leverage machine learning techniques to learn patterns from labeled data and make predictions on unseen news headlines. The project begins with a comprehensive exploration of the challenges associated with categorizing unstructured data and the importance of text classification in addressing these issues. Subsequently, the Multinomial Naive Bayes (MNB) classifier is implemented, which assumes independence between features and is well-suited for text classification tasks. The dataset used for training and testing the classifiers is preprocessed to handle text normalization, tokenization, stop-word removal, punctuation removal and feature extraction using techniques such as TF-IDF, Bag of Words (BOW). The implemented classifier exhibits a commendable accuracy of 90.55%. Results from the experiments are presented and analyzed, highlighting the strengths and limitations of Multinomial Naive Bayes (MNB). The study reveals the nuances in their performance, aiding researchers and practitioners in choosing the most suitable classifier for specific applications.

Keywords: Text classification, Multinomial Naive Bayes classifier, news headlines, TF-IDF, Bag of Words(BOW)

INTERNET OF THINGS (IoT) BASED SMART GARBAGE MONITORING SYSTEM

Lalima

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur Chhattisgarh ,495009
(patleylalima@gmail.com)

Seema Dhirhe

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur Chhattisgarh ,495009
(seemadhirhe01@gmail.com)

H.S. Hota

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur Chhattisgarh ,495009
(proffhota@gmail.com)

Cleanliness is one of the important issues in the modern society. Solid waste is the sole factor which has negative impacts on the health and hygienic aspects of people and environment. Even though many efforts have been taken to handle the trash efficiently, it is a challenging dispute for all countries. The Internet of Things (IoT) is a boon to solve this evergrowing problem. To make a clean atmosphere, IoT based automated process in waste management is necessary. IoT makes the real-world objects to communicate each other and also connect to the global network using various protocols and standards. Whenever there is any need for disposing the trash in the dustbins, the notification will be given to the corresponding authorities. The rising population, continuous growth of industrialization and urbanization have led the country like India towards voluminous generation of garbage and polluted environment. Overflowing landfills due to the unorganized manner of dumping of waste in organizations and cities will bring serious environmental consequences. Waste can be a precious asset when it is properly treated and reused. For the effective management of garbage, households and industries have to manage the waste by regularize the waste monitoring process. This paper suggests a methodology for a simple and easy to use garbage monitoring system which monitors the dustbins of an organization and gives alert notifications to the waste management department to take necessary actions to dispose the waste. We use Arduino uno and NodeMCU esp8266 for processing unit and Ultrasonic sensor for the data collection from the dustbin and then tells us the garbage percentage on the LCD display module and sent the garbage alert to the respective mobile number. This model will improve the accuracy and enhancement in the garbage monitoring.

Keywords: Cleanliness, IoT, Smart Garbage Monitoring, Ultrasonic sensor

NOISE MONITORING SYSTEM

POOJA SAHU

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur ,Chhattisgarh, India
(pooja2000zxc@gmail.com)

JEETENDRA GUPTA

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur Chhattisgarh, India
(jeetendragupta85@gmail.com)

Noise pollution is major problem in cities around the world noise is defined as unwanted sound. To ensure healthy living and a better future, it is essential to monitor these issues and provide solutions to overcome them. The Smart sensor networks that combine electronic wireless communication and computer sciences is an emerging field of research that can contribute monitoring noise pollution level .Noise pollution level monitoring in any area of interest using wireless embedded computing system. All devices in the system inclusive Arduino Uno, Sound sensor, LED are connected via internet of thing. Thing speak environment is used for recording the collected sound quality information. Alert is sent to the whenever the pollution exceeds ascertain set.

Keyword: Arduino Uno, Sound sensor, LED

IOT BASED SMART PARKING SYSTEM FOR URBEN AREA

Ravi chandroal

Atal Bihari Vajpayee University Bilaspur Chhattisgarh, India

(ravichandroal@gmail.com)

Shraddha Verma

Atal Bihari Vajpayee University Bilaspur Chhattisgarh, India

(shraddhaverma728@gmail.com)

Jeetendra Kumar Gupta

Atal Bihari Vajpayee University Bilaspur Chhattisgarh, India

(jeetendragupta85@gmail.com)

The Smart parking system presented in this study is a technologically advanced solution designed to optimize urban parking management , leveraging sensor technologies real time analytics and mobile applications .The system aims to enhance parking efficiency ,reduce congestion ,and provide a seamless experience for both drives and city administrators. Through automated monitoring and intelligent allocation of parking spaces . this system contribute to a more sustainable and convenient urban environment. The abstract encapsulates the system key objectives, technology and potential benefits for stakeholders. More over the traditional system require more human interventionin a parking zone. To deal with above said issues ,there is an urgent requirement of developing smart parking system.

In this we propose a Smart parking system based on IOT to answer the real time management of parking and uncertainties.

Future scope :- Real time object sensors, online parking slot booking, energy produces within vehicle pressure, real time alert sensors, Real time GPS location access,Real time presence of parking near location.

Keywords: - Infrared sensor, Arduino Uno board, LED Display, Power jack, Servo motor.

MEDIATING ROLE OF SELF-DISCLOSURE IN THE LINK BETWEEN MORAL INJURY, AND AUTOMATIC NEGATIVE THOUGHTS AMONG PERSONNELS OF ARMED FORCES

Mamta Mahapatra

AMITY University, UP, Noida , India (mmahapatra@amity.edu)

Varsha Gautam

AMITY University, UP, Noida , India (Varshagautam1109@gmail.com)

The concept of psychology is applied universally in today's world. Moral injury is a psychological concept that refers to the emotional, psychological, and spiritual distress that arises from perceived violations of moral or ethical codes. Defense personnel are at risk of experiencing moral injury due to their exposure to trauma, violence, and death in their line of duty. Automatic negative thoughts are negative self-talk that individuals engage in without conscious effort and can be triggered by stress and trauma. Self-disclosure is the act of revealing personal information to another person and has been shown to have a positive impact on mental health outcomes, including depression and anxiety.

The proposed study explored the potential mediating effect of self-disclosure on the relationship between moral injury and automatic negative thoughts. 300 participants from various defense units of various armed forces were purposively selected for the study. Participants were asked to complete questionnaires, including measures of moral injury, automatic negative thoughts, and self-disclosure. Confirmatory Factor analysis was done for all three scales. The data was analyzed using correlation and mediational analysis to examine the relationship between the variables and the potential mediating effect of self-disclosure. The analysis of data revealed a positive relationship between moral injury and automatic negative thoughts, Self-disclosure is found to mediate the relationship between moral injury and automatic negative thoughts.

Keywords: Moral injury, Self-Disclosure, Automatic Negative Thoughts, and mental health

INTERNET OF THINGS BASED ANTI-SLEEP ALARM FOR DRIVER

Ayush Naik

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India
(ayushnaik375@gmail.com)

Yash Rahi

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India
(yashrahi1410@gmail.com)

H. S. Hota

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India
(profhota@gmail.com)

In modern-times, owing to hectic schedules it becomes very difficult to remain active all the time. Imagine a situation where a person is driving home from work, dead tired after facing all the challenges of the day. The hands are on the wheel and foot on the pedal but suddenly started feeling drowsy, the eyes start shutting and the vision blurs and before it knew, then the person fall asleep. Falling asleep on the wheel can lead to serious consequences, there may be accidents and people may even lose their lives. This situation is much more common and hence, it is very important to counter this problem. So to address this issue, the Project Anti-Sleep Alarm for Drivers is introduced. This system alerts the Person falls asleep at the wheel thereby, avoiding accidents and saving lives. This system is useful especially for people who travel long distances and people who are driving late at night. The circuit is built using Arduino Nano, a switch, a Piezo buzzer, Micro Vibration Motor and an Eye blink sensor. Whenever the driver feels sleepy and asleep the eye blink sensor detects and the buzzer turn ON with a sound of an intermediate beep. When driver comes back to his normal State eye blink sensor senses that and buzzer turns OFF.

Keywords : Arduino-Nano, saving-lives, Anti-sleep, eye-blink

INVESTIGATING THE ROLE OF AR/VR TECHNOLOGIES IN ENHANCING USER EXPERIENCE IN ONLINE RETAIL

Shikha Gupta

National Institute of Fashion Technology, Jodhpur, India

Customers today expect multi-channel interactive experience which is customized to suit their needs from any product or service. AR/VR technology is an answer to these demands of customer leading to growth in demand of technology also fueling more research in the field to develop new technologies tailored for specific requirements of the industry. Industry research points towards customers looking for personalized engagement from brands based on previous experiences of shopping specifically designed to suit their personal needs. Industry is looking forward to creating personalized brand experiences for the customers to increase profits and retain customers. Many brands have already started with the usage of such technologies to allow customers to engage in the product range and provide personalized experience to help make final purchase decision. This research is based on a perceived model which links the usage of new age technology with customer satisfaction leading to customer loyalty. The data collected included Immersive Retail Experience, customization, contactless shopping, post purchase service, customer relationship management through AR/VR as antecedents of customer satisfaction and immersive retail experience and customer satisfaction as key determinants for customer loyalty. A total of 292 responses were analyzed through Various statistical tools for the same. The results indicate that the use of AR/VR technologies in retail has a major impact on improving user experience by improving Retail Experience, customization, contactless shopping, post purchase service, customer relationship management therefore leading to customer satisfaction. The improved user experience and satisfaction leads to brand loyalty towards the online retail stores. Most customers in the survey had more than 2 years of experience shopping online products thus gives concrete results on customer loyalty factor. The paper gives a framework on how AR/VR technologies can improve the loyalty of customers in future and talks about managerial implications of the same in the conclusion.

A COMPREHENSIVE REVIEW OF THEORIES OF BEHAVIORAL FINANCE AND THEIR APPLICATION

Sumona Bhattacharya

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India

Behavioral finance has emerged as a new paradigm in the financial economics discipline as an alternative to traditional finance in the 1980s. Behavioral Finance applies psychological insights into human behaviour for financial decision making. It studies the effect of emotional, psychological, cognitive and social factors in financial decisions of individuals and organisations. The presence of “homo economicus” is very rare in our society. Our emotions play a very important role in decisions making in real life. If the models of classical economics and finance mimic what happens in the real life, the actual way in which the market functions and if they can be used as forecasting devices then there is no need to look for other approaches. But, what we observe in real financial markets is not even vaguely close to the outcomes which are predicted by these models. Empirical and experimental research heavily corroborates this fact. Despite having this plethora of research, nearly all economic models assume rationality in analysis and research. To address these fallacies of modern neoclassical economics and to complement it, behavioral economics and behavioral finance has emerged to improve economic and financial theory, methodologies and forecasting. This research paper focuses on how Prospect theory, Disposition effect, Mental accounting, Anchoring bias, Bandwagon Bias or Endowment bias impact on the financial behaviour in present society. To what extent the concepts of “Pain of Paying” and “Nudging” can be implemented in the Indian Society to influence the financial behaviour. Conclusively, a significant change can be achieved in financial decision making of people for welfare of the society towards a developed country.

Keywords: Behavioral Economics, Behavioral Finance, Nudging, Prospect theory, Disposition effect, Mental accounting, Anchoring bias

BIOCHEMICAL PROPERTIES OF ROSELLE

Yashwant Kumar Patel

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India

(profykpatel@gmail.com)

Krishna Kumar Patel

Post Graduate College Ghazipur, VBS Purvanchal University, Uttar Pradesh, India

Hibiscus sabdariffa L., often referred to as roselle, is a versatile and culturally significant plant that is used as a functional food ingredient as well as in traditional medicine and cookery. Focusing on the nutritional profile, phytochemical content, and potential health benefits of roselle. The phytochemical examination of roselle reveals a wide range of bioactive compounds, including as anthocyanins, flavonoids, polyphenols, organic acids, and essential oils. These components give Roselle its striking hue, distinct flavour, and therapeutic properties. Due to its nutritional makeup, which includes vitamins, minerals, and dietary fibre, roselle is a useful addition to a balanced diet. It is a widely used medicinal herb in many parts of the world. In addition to being used to make a variety of sweet treats including cakes, puddings, and jams, the plant is also widely employed in some traditional medical systems. A significant quantity of crude protein, crude fat, carbs, crude fibre, total ash, ascorbic acid, total phenol, total flavonoid, total anthocyanin, and antioxidant qualities were present in the fresh Roselle calyces. In general, fresh Roselle calyces are considered an excellent source of nutrients and have possible antioxidant properties. The seeds are rich in lysine, arginine, leucine, phenylalanine, and glutamic acid. The antioxidant properties of its bioactive components have been linked to a lower risk of oxidative stress-related ailments, including as cardiovascular and inflammatory diseases. Additionally, Roselle has demonstrated anti-hypertensive, hypo-glycemic, and hypolipidemic qualities, suggesting that it may be used to treat metabolic disorders. Roselle in traditional and contemporary environments, providing opportunities for additional research and the development of innovative products that optimise the potential of this remarkable plant.

Keywords: Roselle, Physico-chemical, nutritional, functional properties and antioxidant properties.

A SYSTEM FOR DETECTING DISEASES IN RICE CROPS BY WEB-BASED IMAGE ANALYSIS

Rajesh Kumar Khushwaha

Dr. C.V. Raman University, India (wingsrajesh@gmail.com)

Ragini Shukla

Dr. C.V. Raman University, India(raginishukla008@gmail.com)

Since India is mostly a rural nation, the bulk of its population relies on agriculture for a living. Its rice harvest surpasses that of any other nation on Earth. In particular, the prevalence of field illnesses is a major obstacle to rice cultivation. The primary objective of this research is to develop a test system capable of detecting the paddy field-specific illnesses Paddy Blast, Brown Spot, and Narrow Brown Spot. The primary objective is to classify illnesses into categories and identify patterns using image processing and artificial neural networks. Gathering images, processing them thereafter, extracting relevant details, and finally organising the images into sets are all steps in the process. The images are examined by means of the colour co-occurrence matrix and Harlick's texture feature. An artificial neural network is then trained using the attributes to produce a learnt model. During the testing procedure, the colour of the paddy leaves is examined in order to determine the typical rice leaf image. The colour test allows for the immediate discovery of paddy leaf photographs. Another option is to use a computer network that mimics brain function to process the diseased rice samples by transforming them into feature data. Therefore, illnesses in rice are identified using artificial neural network technology. This model's ability to detect illness is sufficient for practical use.

Keywords: Rice crops, Image processing, Artificial neural network

EXPLORING THE POWER OF C4.5 DECISION TREE IN FIREWALL LOG FILE ANALYSIS

Pratibha Verma

Dr. CV Raman University Bilaspur(C.G.) India

(bhilai.pratibha@gmail.com)

Kumar Sahu

Department of Computer Science

Govt. V.Y.T. PG Autonomous College Durg(C.G.) India

(Sanat.kosal@gmail.com)

Prem Kumar Chandrakar

Deptt of Computer Application

Mahant Laxmi Narayan Das College, Raipur(C.G.) India

(premchandrakar@gmail.com)

Firewalls play a crucial role in safeguarding networks by filtering and monitoring traffic, yet the manual analysis of their log files is time-consuming and error-prone. This poses risks such as unauthorized access and data theft, compromising network privacy. In this research paper, we propose employing the C4.5 decision tree algorithm to automate the real-time detection and classification of network activities based on firewall log files. The aim is to enhance the efficiency of security administrators in identifying and addressing potential threats. Additionally, we conduct a performance comparison between existing methods and our proposed approach to evaluate its effectiveness.

Keyword: Firewalls, Firewall log files, Network activities, C4.5 algorithm, Classification

ANFIS AND METAHEURISTIC OPTIMIZATION FOR GREEN SUPPLY CHAIN WITH INSPECTION AND REWORK

Nidhi Sharma

Indian Institute of Technology Roorkee, India
(n_sharma@ma.iitr.ac.in)

Madhu Jain

Indian Institute of Technology Roorkee, India
(madhu.jain@ma.iitr.ac.in)

Dinesh Sharma

University of Maryland Eastern Shore, USA
(dksharma@umes.edu)

The focus of present article is to investigate a supply chain inventory model along with inspection and stock dependent demand with use of green technology to reduce carbon emissions. Products that are decaying, or those that change over time, have a high sensitivity to the environment in terms of temperature, carbon emission, humidity, waste disposal, etc. This study develops a profit maximization model in the presence of deterioration, preservation, imperfect production, inspection error, rework, stock and price-dependent demand. The three carbon emission strategies are proposed to reduce the expenses in different carbon emissions scenarios. The suggested approach may be used to determine the optimal production period, preservation investment, and level of green investment. The solution of the non-linear constraint optimization is provided by using a penalty method in metaheuristic approaches. In order to conduct a sensitivity analysis for the essential model parameters, a numerical example is presented. The soft computing results produced by DE and PSO are compared with the results obtained by Adaptive Neuro-Fuzzy Inference System (ANFIS) technique.

Keywords: Green supply chain management; Inspection errors; Deterioration; Variable demand; Carbon emission; Metaheuristic optimization.

GENETIC SEARCH BASED FEATURE SELECTION ON CICIDS 2017 DATASET

Reshamlal Pradhan

PSSOU Chhattisgarh, India (reshamlalpradhan6602@gmail.com)

The workforce of today is significantly dependent on the internet. The frequency of hazardous online behavior is increasing along with the popularity of the internet. Identifying different security flaws in a computer network is the matter of concern. There are many different security breaches that can occur in a computer network, and intrusion detection system is the process of identifying them. An IDS makes sure that a network is safe. The CICIDS2017 dataset, which contains a novelty and variety of attacks, is used in this investigation to identify intrusions using decision tree and ensemble classification techniques. This research employs a genetic search-based feature selection on the dataset. Using proposed genetic search based feature selection method; the constructed system reduces the size of the dataset by first pre-processing the CICIDS2017 dataset. The experimental results are analyzed using the machine learning application Weka. Research findings from empirical studies demonstrate that decision tree based ensemble methods results in higher accuracy in intrusion detection. The presented approach is efficient and performs better when decision tree and ensemble techniques are used with specific reduced features.

Keywords: Intrusion, IDS, CICIDS2017, Classification, Decision Tree Technique, Ensemble Technique.

IOT BASED AIR POLLUTION MONITORING SYSEM

Rajesh Kumar Sahu

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India
(rajeshsahurrks@gmail.com)

Deepesh Kumar Singh

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India
(deepeshsingh88894@gmail.com)

Mr. Jeetendra Kumar

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India
(jeetendragupta85@gmail.com)

Air pollution is one of the biggest threats to the present-day environment. Everyone is being affected by air pollution day by day including humans, animals, crops, cities, forests and aquatic ecosystems. Besides that, it should be controlled at a certain level to prevent the increasing rate of global warming. This project aims to design an IOT-based air pollution monitoring system using arduino microcontroller and various sensor to detect the real time air quality of the surroundings and environment. This system search on air various affected pollution like carbon monoxide(CO),sulfur dioxide(SO₂), nitrogen dioxide (NO₂).

In this system, the Arduino Uno plays a crucial role as a key component in the hardware setup. The Arduino Uno is a microcontroller board that acts as the brain of the system, helping to collect, process, and transmit data from various sensors to the central system. MQ-135 is a gas sensor commonly used in air quality monitoring applications, including IoT-based air pollution detection systems. A 16x2 LCD (Liquid Crystal Display) uses liquid crystal technology to selectively control the passage of light. It consists of 16 columns and 2 rows of characters, displaying information by manipulating electrical signals to pixels on the screen.

The IoT-based Air Pollution Monitoring System provides real-time air quality data, enabling informed decisions for addressing immediate pollution concerns, safeguarding public health, and optimizing environmental conditions. Future developments may focus on leveraging advanced sensor technologies, machine learning, and broader data analytics for more accurate predictions. These improvements can lead to proactive decision-making, enabling preemptive measures to mitigate pollution and enhance overall air quality management. The IoT-based Air Pollution Monitoring System offers a real-time solution for tracking air quality, facilitating timely interventions. Future advancements in sensor technology and data analytics hold the potential to further refine predictions, enabling proactive measures and contributing to sustainable air quality management.

Keywords – ARDUINO UNO MICROCONTROLLER, MQ135, 16X2 LCD, IoT, AIR

BIOSENSORS IN MEDICINE: A COMPREHENSIVE REVIEW OF APPLICATIONS AND ADVANCEMENTS

Arun Kumar Kashyap

Govt. E. Raghavendra Rao PG. Science College, Bilaspur, Chhattisgarh, India

D K Shrivastav

Govt. E. Raghavendra Rao PG. Science College, Bilaspur, Chhattisgarh, India

Nikita Kashyap

Guru Ghasidas Vishwvidyalaya, Bilaspur, Chhattisgarh, India

Biosensors have become a popular and cost-effective tool for testing food and water contaminants, controlling human biological processes, and enabling precise health diagnosis. Medical researchers and practitioners are looking for safe and affordable means to carry out their research, ensure public safety, and provide customized health options to patients. Biosensors offer a potential solution to these challenges. They are increasingly being used in biomedical studies for diagnosing infectious and chronic diseases, managing health, and monitoring well-being. Improved biosensor technology now allows for the detection of diseases and tracking of the body's response to treatment. Biosensors are integral to the development of low-cost and improved-form factor medical devices. This chapter discusses the benefits of biosensors in the medical field, highlighting their distinctive capabilities and their potential in disease diagnosis. The chapter also presents several diagnostic biosensors for various diseases and introduces novel aspects of biosensors for clinical and allied services. the chapter also identifies and discusses the major applications of biosensors in the medical field. Intelligent wearable biosensors now allow older people to monitor their health and exchange medical information with healthcare providers, reducing the need for hospital visits. Overall, biosensors have numerous prospects for consumer and commercial uses in wellness, fitness, athletics, and more.

Keywords: Biosensors, Medicinal application, health diagnosis.

IOT BASED SMART AGRICULTURE MONITORING SYSTEM

Radha Singh Chauhan

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India
(radhasingh883939@gmail.com)

Abhishek Jaiswal

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India

Jeetendra Kumar

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India
(jeetendragupta85@gmail.com)

Agriculture has been important since the beginning of civilization. Traditional irrigation methods are ineffective, leading to water wastage and diseases. Now today's smart agriculture, powered by the Internet of Things (IoT), is solving the challenges of farming. Smart Agriculture features an automated irrigation system triggered by soil moisture levels, which reduces water usage and promotes healthy crops. Smart agriculture provides scalable solutions to increase crop yields. Additionally, crops are at risk from animals, affecting productivity. The future lies in user-friendly technologies, empowering farmers with data-driven insights for sustainable and efficient practices. To protect crop yield from animals, we need to integrate crop security features which continuously monitors it from outside threats like animals, theft, etc. Proposed system is developed by integrating sensors like Soil moisture sensor, soil pH sensor, MCQ-135 sensor using Arduino including crop security features. The aim of the system is to ensure optimal soil conditions and alerts farmers when air pollution exceeds safe levels and to use IoT tools to ensure a brighter future, increase productivity and contribute to global health.

Keywords: IoT, Smart Agriculture, Soil Moisture Sensor, pH Sensor, MCQ-135 Sensor Arduino.

GREEN LEAFY VEGETABLES AS A BETTER SUBSTITUTE FOR FUTURE FOODS

Deepti Chauhan

Bhilai Mahila Mahavidyalaya, Hospital Sector, Bhilai, Chhattisgarh, India
(deptibotany@gmail.com)

A.K. Shrivastava

Government Danveer Tularam PG College, Utai, Durg, Chhattisgarh, India

Humans have used leaves as food since time immemorial. Leafy vegetables have high nutritional value and are thorough sources of antioxidants; they keep our bodies free from many diseases such as intestinal disorders, cancer, etc. They also provide a variety of phytonutrients which protect our cells from damage and our eyes from age-related problems, among many other effects. Leafy vegetables not only provide food quantity but also make a significant contribution to the population's nutrition requirements throughout the year. Wild plants which are also used as green leafy vegetables such as, *Amaranthus species*, *Borhaavia diffusa*, *Basell rubra*, *Cleomegynandra*, *Chenopodium species*, *Corchorus species*, *Leucas cephalotes*, *Hibiscus cannabinus*, and *Trianthemaportulacastrum* are immensely popular and still are widely used. Thus, these vegetables are exceedingly popular and are extensively cultivated. Many wild and cultivated leafy vegetables are used in India. Plants produce varieties of compounds of known therapeutic properties. These substances are used for developing new drugs. Phytochemicals are phytonutrients naturally occurring in plants. They are a part of the plant immune system. The fruits, vegetables and herbs contain natural substances. Terpenoids, alkaloids, gums, resins, lectins, glycosides, saponin, steroids, phenolics, tannins, carotinoides, flavonides, sulphur, phytic acid, brassinosteroids, compounds, fiber etc. are important phytochemicals found in plants; and many of the chemicals in them are a reliable source of antioxidants. Green leafy vegetables play a pivotal role in the nutritional requirements of people of all strata. Leafy vegetables not only provide food but also make a significant contribution to the nutritional intake of the population throughout the year. Also, green leafy vegetables are grown in much less time in comparison to conventional crops hence, they can be a better substitute for foods and natural medicine in present and future times. The present work aims at the phytochemical analysis of aqueous and methanolic leaf extract of *Senna tora*, *Lablab purpureus*, and *Corchorus olitorius* found commonly in India, along with its total nutritive value (moisture, protein, fat, fiber, carbohydrate contents), that makes it as the nutritive leafy vegetable.

Keywords: Green leafy vegetables, phytonutrients, future foods, antioxidants

FRIEDELIN: A KEY BIOACTIVE COMPOUND FROM *BRIDELIA RETUSA* TARGETING HYPERGLYCEMIA

Somendra Kumar

Govt. V.Y.T. PG. Autonomous College, Durg, Chhattisgarh, India.

Anil Kumar

Govt. V.Y.T. PG. Autonomous College, Durg, Chhattisgarh, India.

anilkumardurg1996@gmail.com

Bridelia retusa, a member of the Euphorbiaceae family, has gained widespread recognition among various ethnic groups globally for its effectiveness in treating diabetes. In this investigation, the bark and fruit extracts of *B. retusa* were separately processed using ethyl acetate and methanol and subjected to gas chromatography-mass spectrometry (GC-MS) analysis. This analytical approach aimed to identify and characterize the key phytoconstituents present in the extracts. A total of 96 phytochemical constituents were identified in the ethyl acetate and methanol extracts obtained from the bark and fruits, notably, 92 constituents were newly reported in this study. Evaluation of antioxidant activity using the DPPH assay revealed the methanolic fruit extract to exhibit substantial antioxidant potential, recording an activity of 83.01% with IC₅₀ values of 103.03 µg/ml. The ethyl acetate bark extract demonstrated the highest α-amylase inhibition activity with 76.34% (127.37 µg/ml), while the methanolic fruit extract displayed superior α-glucosidase inhibition activity at 86.18% (106.15 µg/ml). Furthermore, the antidiabetic potential of three bioactive constituents - friedelin, imidazole, and sylvestrene - was assessed through docking studies and drug likeness analysis. Friedelin exhibited the highest binding affinity with various protein targets, indicating its potential as a prime candidate for drug development against hyperglycemia. Molecular dynamics simulations illustrated friedelin as the most stable binder to anti-diabetic target proteins, revealing structural insights through RMSD, RMSF, SASA, and PCA analyses. MM-PBSA calculations highlighted the significance of van der Waals energy, electrostatic energy, and polar solvation energy, particularly in the α-amylase-Friedelin complex, which exhibited the highest binding energy. In summary, this research highlights the potential of *Bridelia retusa* extracts containing bioactive compounds that show significant promise in addressing diabetes. It particularly emphasizes the potential of friedelin as a key component in the creation of innovative treatments aimed at controlling hyperglycemia.

Keywords: *Bridelia retusa*, phytoconstituents, antioxidants, GC-MS, molecular docking.

ANTIMICROBIAL SCREENING OF CERTAIN FRESH WATER ALGAE COLLECTED FROM DURG REGION

Meenakshi Bharadwaj

Indira Gandhi Government PG College, Vaishali Nagar, District Durg, Chhattisgarh, India

Awadhesh Kumar Shrivastava

Government DT College, Utai, District Durg, Chhattisgarh, India

The fresh water algae are of significant attraction as rich source of bioactive molecules. Three freshwater algal species namely *Chara*, *Mougeotia* and *Ulothrix* were screened for their antimicrobial activity. Algal extracts showed comparatively better antibacterial properties than antifungal properties. *Chara* has been shown to possess high antibacterial as well as antifungal properties as maximum zone of inhibition was shown. In antibacterial studies, *Chara* showed effective control over the Gram positive bacteria *Staphylococcus aureus*. *Mougeotia* also showed antibacterial activity than antifungal activity with more effectiveness over the Gram Positive bacteria. *Ulothrix* has been shown to possess least antibacterial and antifungal properties. Activity against Gram positive bacteria was more pronounced than Gram negative one.

Antifungal activity was shown by all the members studied with potency on *Aspergillus niger* and *Candida albicans* in the same order as antibacterial activity.

This study indicates the role of algae in purification of water in which they reside. Thus they have a control over the water status and can contribute to control the pollution of the water bodies in which they live.

Keywords: antimicrobial, antibacterial, antifungal, Gram positive bacteria

STUDIES ON ETHNOMEDICINAL “ANTIDIABETIC” PLANT HELICTERES ISORA LINN OF SHAHDOL DISTRICT MADHYA PRADESH, INDIA

Radhe Shyam Napit

Govt. Nehru Degree College, Madhya Pradesh, India

M. Kujur

Govt. Nehru Degree College, Madhya Pradesh, India

The fruits and roots of *Helicteres isora*, Maror Phali, Ainthi/screw like appearance of its fruit) is used in traditional medicine systems of Shahdol, where they are credited with having value in treatment of a wide variety of conditions, including gastrointestinal disorders, diabetes, anticancer, infections and *H. isora* plant is also used as a folk medicine to treat snake bite, diarrhoea and constipation, griping of new born baby.

Frequent ethnobotanical surveys were conducted during Feb 2022- Dec 2023 in Shahdol district. Results of these surveys indicated that many species but selected plant one like-*Helicteres isora* is interestingly used by the tribal and local peoples in Antidiabetic disease.

This paper reports on ethnomedicinal used of only one potential medicinal plants belongs to one family of medicinal plants used for ailment like Antidiabetic. Medicinal plants part and parcel of human society to combat disease from dawn of civilization some most useful traditional medicinal plants and still regarded as "Village dispensary" in India. It has been extensively used in Ayurveda, Unani Homoeopathic and folk medicine and has become a cynosure of modern medicine. Led by these considerations, 90% ethanolic extract, powder from the plant parts has been tested against human diseases and remarkable ethnomedicinal pathic was ancient formula applied for Antidiabetic diseases.

The growth inhibition was observed in the range of 70-80% and this part of the plants can be further exploited to get better compounds that may have the potential to treat cancer. Indiscriminate collection and over-exploitation of some commercially important medicinal plants was also noted. It is suggested that local forest management needs to be made conversant with sustainable harvesting methods, cultivation of commercially important plants species, and detailed assessment of the economic value of medicinal plants.

Keywords: Studies on, Ethnomedicinal “Antidiabetic” Plant *Helicteres isora* Linn.

SMART ATTENDANCE SYSTEM USING RASPBERRY PI

Geeta Kumari

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India

Deepesh Kumar Dwivedi

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India

The face is the identity of a person. The methods to exploit this physical feature have seen a great change since the advent of image processing techniques. Today's manual attendance causes the decreases in student's performance. There are several ways to mark attendance, the most common ways to sign or call the students. It took longer and was problematic. To solve this problem, Fingerprint attendance system is introduced which rely on biometric technology to capture and authenticate individuals based on unique patterns of their fingerprints. Fingerprint system may require physical contact, which could be a concern in hygiene-conscious environments. To overcome this problem, we used an intelligent attendance system based on face recognition in this project. We have proposed to implement a "Smart Attendance System using Raspberry Pi". The proposed system includes facial identification that is time saving, hygienic, and remove the possibilities of proxy attendance due to the facial authorization. The core components of the Smart Attendance System include a Raspberry pi microcontroller, a camera module for image capture, and the integration of OpenCV for facial recognition. Raspberry pi is used as a web server. In this method the image database is created first and this database is used as output. Then in recognition phase the camera captures the images and compared with the database and give output in the LCD screen. In conclusion, the face recognition attendance system presents technologically advanced and efficient solutions to attendance tracking challenges. The systems offer a modern and reliable alternative to traditional attendance management methods.

Keywords: Raspberry pi, image processing, OpenCV, Face Recognition, Smart Attendance System, LCD.

IOT BASED HOME AUTOMATION USING ESP 32

Abhinit Tripathi

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India
abhinittripathi353@gmail.com

Aditya Kushwaha

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India
adityakushwaha2208@gmail.com

Prerna Verma

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India
verma.prerna04@gmail.com

This project presents the overall design of Home Automation System with low cost and wireless system. It specifically focuses on the development of an IOT based home automation system that is able to control various components via internet or be automatically programmed to operate from ambient conditions. In this project, we design the development of a firmware for smart control which can successfully be automated minimizing human interaction to preserve the integrity within whole electrical devices in the home. We used ESP32, a popular open source IOT platform, to execute the process of automation. Different components of the system will use different transmission mode that will be implemented to communicate the control of the devices by the user through ESP32 to the actual appliance. We provide a data transmission network to create a stronger automation. The system intended to control electrical appliances and devices in house with relatively low cost design, user friendly interface and ease of installation. The status of the appliance would be available, along with the control on an android platform. This system is designed to assist and provide support in order to 1 fulfill the needs of elderly and disabled in home. Also, the smart home concept in the system improves the standard living at home.

ARDUINO BASED ROBO CAR WITH PATH FINDING, FOLLOWING, AND AUTOMATIC OBSTACLE-AVOIDING

Shashikant Sahu

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India
shashisahu1425@gmail.com

Rupanjali Bareth

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India
rupanjalibareth5823@gmail.com

Jeetendra Gupta

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India
jeetendragupta85@gmail.com

In today's daily life, technology plays a vital role in fulfilling our needs and making our lifestyle easy, so here we are proposing a robocar with the functionality of automatic Pathfinding, Following, and Automatic Obstacle Avoidance. In the sight of security purposes, our vehicles should follow some path-related rules and they should stop automatically when any object or obstacle occurs in the path and give a kind of alert and find another safe path to move, so after seeing such problems we are proposing an autonomous car that will automatically find a path and avoid the occurred obstacle with an alert. It is necessary to avoid any object in the path of any autonomous car to prevent damage to it. The car we are going to present will find and follow a path (Black or White line), stop the vehicle if any obstacle occurs in the path, and generate a sound alert (Obstacle occurs), after finding the path (path found). This car consists of an Arduino UNO which is a microcontroller, an Ultrasonic Sensor, Two IR Sensors, 4 DC motors, An L298 Motor Driver that will control the motors, A Mini-servo Motor to move the Ultrasonic Sensor left and right for a clear path, An SD Card module, and a Mini Speaker for alert.

Keywords: -Path Following, Automatic Path Finding, Obstacle Avoidance, Arduino UNO.

IOT BASED SECURE SURVEILLANCE ROBOT FOR AGRICULTURE

Chandani dewangan

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India
Chandanidewangan2308@gmail.com

Jeetendra Kumar

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India
jeetendragupta85@gmail.com

The increasing problem of insect infestation in crops is leading to decline in yield. The project proposed a surveillance robot that can be integrated with a communication system to provide real-time updates to the farmer. It can send alerts in case of unusual or critical situations. The robot can be equipped with cameras and sensors to monitor the health and growth of crops. It can detect signs of disease, pests, or nutrient deficiencies early, allowing for timely interventions alerts in case of unusual or critical situations. A surveillance robot using ESP32-CAM is a system that utilizes the ESP32-CAM board and a robot chassis to create a mobile surveillance device. The ESP32-CAM is a low-cost development board that integrates a small camera module and Wi-Fi connectivity. The robot chassis allows the device to move around and capture video in different locations. The system can be controlled through a web interface hosted on the ESP32-CAM board. The web interface allows the user to control the robot's movement, view live video streams, and take snapshots of the video feed. Additionally, the system is programmed to detect motion using computer vision algorithms, such as object detection and tracking, and send alerts to the user. With its low cost and easy-to-use interface, it provides a convenient solution for anyone who needs to monitor their surroundings remotely.

Keyword- ESP 32cam, Surveillance robot, Nutrient deficiencies, IEEE 802.11, Computer vision.

INTERNET OF THINGS AND MACHINE LEARNING BASED THREE LAYERS SECURED LOCKER SYSTEM

Shiva Soni

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur Chhattisgarh India,495009
(s.shivasoni2002@gmail.com)

Ravindra Nishad

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur Chhattisgarh India,495009
(ravindranishad9340@gmail.com)

H.S. Hota

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur Chhattisgarh India,495009
(proffhota@gmail.com)

Why security is important and how it can be achieved and developed through IoT and ML

In today's time, security is very important, because nothing is safe, it seems like even with normal lock in the house, theft happens, so nowadays everything is going digital, so we can improve the security through IoT and ML. It can be improved which can make general security more secure by using IoT and ML, it can be improved by using sensors and microcontrollers in IoT. There are many such sensors and microcontrollers in IoT with the help of which it can be made. With the help of ML, security can be increased by creating good algorithms, like the face lock system, it can be further updated and different features can be added.

This research aims to develop an innovative security system to address the issue of increasing incidents of theft in our city. This system utilizes Internet of Things (IOT) and machine learning technologies. It incorporates face recognition to allow access to a door, with a two-step authentication process using face recognition and a password. If an unknown person attempts to gain access, the owner receives an alert notification. Additionally, any unauthorized tampering with the system, such as attempting to force the lock, triggers another notification to the owner. This system integrates Raspberry Pi, Python programming, fire sensors, Arduino, and sound sensors, providing enhanced security for homeowners and keeping them informed of any security breaches.

Keyword: Face Recognition, IOT, Machine Learning, Security, Raspberry pi, Python Programming, Sensors, Arduino.

IN VITRO CONSERVATION AND PROPAGATION OF RARE AND ENDEMIC MEDICINAL PLANTS OF INDIAN THAR DESERT

Suman Parihar

JNV University, Jodhpur, Rajasthan, India

(sp.bo@jnvu.edu.in)

Carallumaedulis and *Glossonemavarians* are endemic, edible and medicinally important plant species of the Thar Desert of Rajasthan. They belong to the family Apocynaceae and commonly known as Pimpa and Dudha. Due to increased anthropogenic activities, habitat destruction and grazing of complete plant prior to reproductive maturity restrict the natural propagation of these plants. Therefore there is need for development of non-conventional methods for propagation and conservation of these important plant species.

To establish the *in vitro* propagation protocol of *C. edulis* nodal shoot segments (3-4 cm long) were used as explant for initiation of culture in liquid and semisolid Murashige and Skoog (MS) medium. Bud break was observed earlier on liquid MS medium as compared to semi solid MS medium. Shoots were multiplied through subculture of explants on different concentrations of 6-benzyladenine (BAP) alone and in combination with auxin (IAA). For induction of regenerative callus of *G. varians*, shoot segments were used as explants and regeneration and multiplication of shoots was attempted. Different parameters were studied for induction and proliferation of callus from the explants like, effect of different concentration of sucrose, PGR and different strength of salts of MS medium. The optimum response was observed on full strength MS medium containing 2.0 mg l^{-1} 2, 4-D. All the *in vitro* generated plants of *Glossonemavarians* and *Carallumaedulis* are successfully acclimatized in the green house and transferred to the nursery.

APPLICATIONS OF SILVER NANOPARTICLES AS CHEMICAL SENSOR FOR DETECTION OF METAL IONS AND PESTICIDES IN ENVIRONMENTAL SAMPLES

Archana Patley

Govt. Bilasa Girls P. G. Autonomous College, Bilaspur, Chhattisgarh, India

archie.chem18@gmail.com

Environmental samples have been very important being tested and treated due to the pollution and life threatening situations arising due to imbalance in nature. Such situations have arisen due to natural or anthropogenic processes or disposal of the waste into the environmental reservoirs. With advancements of science and technology more and more industrialization has taken place and the effluents of the industries are. Also with the growing pressure of food needs, agriculture sector has taken routes of chemical fertilizers and pesticides. The overpopulation of such toxic chemicals can directly or indirectly harm the ecosystem and also threatens the human health, food chains, and disrupts the balance of ecological environments, to a great extent. In this world where environmental pollution and contamination is increasing day by day, nanomaterials can become greatest tool as they possess excellent electrical, optical, thermal, catalytic properties and also great stability and sensitivity when used for constructing nanomaterials-based sensors or devices, a for examining environmental contaminations in air, water and soil. Variety of nanomaterials, such as carbon nanotubes (CNTs), metallic nanoparticles, semiconducting nanoparticles and quantum dots, have been widely used for detection and determination of toxic metal ions, toxic gases, pesticides, hazardous industrial chemicals with high sensitivity and selectivity in very simple and easy manner.

IOT BASED EYE BLINK SENSOR ALARM SYSTEM USING AURDINO

Lipakshee

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur Chhattisgarh India,495009

H.S.Hota

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur Chhattisgarh India,495009

(proffhota@gmail.com)

Accidents due to driver drowsiness can be prevented using eye blink sensors. The driver is supposed to wear the eye blink sensor frame throughout the course of driving and blink has to be for a couple of seconds to detect drowsiness. Any random changes in steering movement leads to reduction in wheel speed. The threshold of the vibration sensor can be varied and accordingly action can be taken. The outcome is that the vibrator attached to eye blink sensor's frame vibrates if the driver falls asleep and also the LCD displays the warning messages. The wheel is slowed or stopped depending on the condition. This is accompanied by the owner being JL notified through the GSM module. so the owner can retrieve the driver's location. photograph and police station list near to driver's location. This is how the driver can be alerted during drowsinescan be alerted and the owner can be notified simultaneously.

Keywords: Arduino Nano, Eyeblink Sensor, Switch, Alarm buzzer, Wheel.

APPLICATION OF CARBON NANOPARTICLES IN PESTICIDE DEGRADATION FOR SUSTAINABLE AGRICULTURE

Anupama Pradhan

T.S.S. Govt. College Pathalgaon, India (anupama.prdhn@gmail.com)

Ambuj Pandey

Govt. Bilasa Autonomous P.G. Girls' College, Bilaspur, India (researcher.anjali@gmail.com)

With the escalating environmental concerns associated with pesticide residues, the utilization of carbon-based nanomaterials has emerged as a significant strategy for sustainable and efficient pesticide remediation. Distinctive properties of carbon nanoparticles such as high surface area, excellent conductivity and unique physicochemical characteristics makes it an important tool in pesticide degradation. This paper aims to investigate the promising role of carbon nanoparticles in the degradation of pesticides, presenting a comprehensive review of recent developments in this burgeoning field. It critically explores the diverse approaches employed in harnessing carbon nanoparticles- graphene, carbon nanotubes, and activated carbon for pesticide remediation, including photocatalysis, advanced oxidation processes, and synergistic combinations with other nanomaterials. Environmental implications and safety considerations are addressed to ensure the responsible application of carbon nanoparticles in pesticide degradation, fostering a balanced approach towards sustainable agricultural practices. Furthermore, the paper discusses current challenges and future prospects in the field, emphasizing the need for scalable and cost-effective synthesis methods, as well as the development of multifunctional carbon nanomaterials. In conclusion, this research consolidates the current knowledge on the application of carbon nanoparticles in pesticide degradation. This study will contribute to the ongoing efforts to establish environmentally friendly and sustainable solutions for mitigating the impact of pesticides on agricultural ecosystems.

Keywords: pesticides, graphene, carbon nanotubes, activated carbon, environment

“INNOVATIVE PRACTICES FOR MANAGEMENT OF GREEN HOUSE GASES BY GREEN TECHNOLOGY”

Nisha Tiwari

Govt. Bilasa Autonomous P.G. Girls' College, Bilaspur, India
(nishatiwari.cg@gmail.com)

Meena Kshetrapal

Govt. Bilasa Autonomous P.G. Girls' College, Bilaspur, India
(meenark13@gmail.com)

PushpaBhandari

Govt. Bilasa Autonomous P.G. Girls' College, Bilaspur, India

In recent years, the continuous accumulation of carbon dioxide emissions has produced a series of environmental problems, such as global warming and frequent outbreaks of extremely severe weather. Therefore, carbon emission reduction has become an important topic of concern to all countries globally and green development. Due to an increasing number of issues such as climate change, sustainable development has become an important theme worldwide. Since carbon dioxide is mainly produced by fossil fuel combustion and cement production. Reduction of emissions from industry is done by Calculating Carbon Emissions regularly.

The places where carbon dioxide is pulled out of the air are called carbon sinks like planting trees, bamboo and other plants, conserving forests, grasslands and wetlands, planting cover crops and crop rotation keep soils healthy so that they are effective carbon sinks. There are also carbon dioxide removal technologies, which may be able to pull large amounts of greenhouse gases out of the atmosphere. By taking carbon dioxide out of the air, reducing household waste, travelling without making greenhouse gases, eating a diet that is mostly or entirely plant-based, generating electricity without emissions, utilising renewable energy sources including solar energy, geothermal energy, wind turbines, ocean wave, tidal energy, waste and biomass energy and hydropower energy. This study confirms that green technology innovation is an effective means of reducing carbon emissions. Additionally, for regions at different stages of economic development, green technological innovation has different effects in reducing carbon emissions. An empirical test of the national provinces suggests that green technology innovation for carbon emissions is negative which can reduce carbon dioxide emissions. This paper does further sub-regional research on the impact of green technology innovation in carbon emissions.

PRACTICES AND DEVELOPMENTS OF INFORMATION TECHNOLOGY- DIGITAL PLATFORMS

Mahendra Daiya

National Institute of Fashion Technology, Ministry of Textiles, Government of INDIA
Jodhpur, Rajasthan INDIA (mahendra.daiya@nift.ac.in)

Development at any phase is always linked with technology and technology happens when there is advancement in science. Hence science, technology and development are all proportional to each other. Modernization in every aspect of life is the greatest example of the implementation of technology in every nation. With the introduction of modern gadgets in every walk of life, life has become simple and this is possible only because of implementing technology. Without having modern equipment's in all sectors, be it in medicines, infrastructure, aviation, electricity, information technology or any other field, the advancement and benefits that we face today would not have been possible.

Today's a world of many divides, one of the most typical being the Digital Divide which in itself has given birth to or is worsening other economic and social divides. In this world more suffer and less are able to benefit from technology.

India is the topmost off shoring destination for IT companies across the world. Having proven its capabilities in delivering both on-shore and off-shore services to global clients, emerging technologies now offer an entire new gamut of opportunities for top IT firms

The importance of IT revolution through digital marketing is its ability to reach target audiences, drive sales, and increase revenue. By using tactics like social media marketing, content marketing, SEO, and PPC, businesses can use digital marketing to engage, convert, and retain their target audience.

Keywords: Technology, Digital Marketing, Developments, Opportunities

DEEP CONVOLUTIONAL NEURAL NETWORKS AND TRANSFER LEARNING BASED MODEL FOR CLASSIFICATION OF SKIN CANCER DISEASE

Akhilesh Kumar Shrivastava

Guru Ghasidas Vishwavidyalaya, Bilaspur(C.G.), India
(proffshrivas@gmail.com)

Hema Vastrakar

Research Scholar, Guru Ghasidas Vishwavidyalaya, Bilaspur(C.G.), India
(kajuvastrakar7595@gmail.com)

The skin is an amazing structure and part of our bodies. Infected with many known and unknown diseases, it happens often. Diseases that affect the skin are therefore the most unclear and hard to diagnose in the scientific field. In the 21st century, dermatological diseases are one of the biggest health problems because they are so hard to diagnose and cost a lot of money. It's also hard to be sure of what the symptoms mean because people understand them in different ways. For illnesses that could be deadly, like melanoma, early diagnosis is very important for figuring out how likely it is that the person will be cured. One of the most dangerous types of cancer is skin cancer. All types of cancer are caused by damage to DNA and can kill. This damage to DNA makes cells multiply out of control, which is happening faster and faster in today's world. Computers have been used in some studies to figure out how likely it is that pictures of skin spots show cancer. However, it is very hard to analyze these pictures because of many factors that make it hard, such as light reflecting off the skin's surface, variations in color lighting, and the lesions' different shapes and sizes. So, it's important for doctors who work with people in their early stages to be able to spot skin cancer so that they can get better at what they do. Using a deep convolutional neural network (DCNN) model based on deep learning, we propose a way to accurately tell the difference between skin tumors that are benign and those that are malignant. We use a filter or kernel to get rid of noise and artifacts in the first step of cleaning. In the second step, we normalize the pictures and pull-out features that help us classify them correctly. Lastly, in the third step, data augmentation is used to add more pictures, which makes the classification rate more accurate. We also find out how well our suggested DCNN model works compared to other transfer learning models like ResNet, VGG-16, and so on. Finally we got the best training accuracy and testing accuracy using DCNN model for classifying benign and malignant skin images. Also, our suggested DCNN model is more reliable than other transfer learning models.

Keywords: Skin diseases, image processing, computer vision, machine learning, classification, transfer learning, and convolutional neural network.

PRELIMINARY SCREENING OF MOLDS FOR PRODUCTION OF LIPASE

Seema Belorkar

Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India

Enzymes are essential for our daily existence. After carbohydrases and proteases, lipases (triacylglycerol acylhydrolase, EC 3.1.1.3) are the third most significant class of hydrolases. These are widely distributed enzymes that are made by microbes, animals, and plants. They function by catalysing the hydrolysis of triacylglycerides made of long-chain fatty acids on insoluble substrates that have been emulsified in water. Naturally occurring lipases are easily found throughout the earth's flora and wildlife. However, most commercial lipases are produced from microbe's widerange ofbacteria,fungiandyeast.The present work is focused on preliminary screening of molds for lipase production. Modified Czapeckdox medium was used for screening of the molds. The most potent mold isolated was *A.niger*.

Keywords: Lipase, fungi, *A.niger*, Preliminary screening

SPECTROPHOTOMETRIC ANALYSIS OF LEMON GRASS (*CYMBOPOGON CITRUS*) FOR STUDY OF ITS BIOACTIVE COMPOUNDS

Mahima Kori

Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India

Seema Belorkar

Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India

Cymbopogon genus has 55 species, prevalent in tropical and semi-tropical areas of Asia and are cultivated in South and Central America, Africa and other tropical countries. The plant is tufted, cultivated perennial C4 grass having stiff stems connected to short stock of rhizome like root offering with citrus flavor. This can be used fresh or stored in dried powdered form. The name Cymbopogon is derived from the Greek words “kymbe” (boat) and “pogon” (beard), referring to the flower spike arrangement. The present study is focused on the spectrophotometric analysis of the Bioactive compounds present in roots, stem and leaves of the selected plant. Six different solvents were used for extraction. Qualitative and quantitative analysis was performed.

Keywords: *Cymbopogon citrus*, Bioactive compounds, UV-Vis Spectrophotometer, Saponins, flavonoids.

SPECTROPHOTOMETRIC ANALYSIS OF BIOACTIVE COMPONENTS OF SWERTIACHIRATA

Priya Kashyap

Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India

Seema Belorkar

Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India

Indian knowledge system has used plants as a major source of healing molecules. Ayurveda and accompanied traditional medication system are fully dependent on nature and their products for curing the common prevailing ailments in society. Swertia Chirata is one such plant gaining attention of researchers for its rich content. The present study focusses on the UV Vis spectrophotometric analysis of Bioactive components present in the plant and future direction of its use.

Keywords: Swertia Chirata, UV – vis Spectrophotometric, Saponin and Tanins

A REVIEW OF ARTIFICIAL INTELLIGENCE METHOD FOR IDENTIFICATION OF DISEASES AND PESTS IN FOOD CROPS

Gajendra Tandan

Kalinga University, Naya Raipur(CG), India
(gajendra.tandan@gmail.com)

Asha Ambhaikar

Kalinga University Naya, Raipur(CG), India

Sanat Kumar Sahu

Govt. V.Y.T. PG Autonomous College Durg(CG), India
(sanat.kosa1@gmail.com)

India is an agricultural country; agriculture is an important part of the Indian economy. In agriculture, there are many food crops available for humans. The main reasons for affecting the crop productivity are pests and diseases. Mostly due to change in weather, the incidence of insects and diseases increases in crops. Nowadays, modern agricultural technologies are being used to identify pest diseases affecting crops by using Artificial Intelligence (AI). It seems that new modern technology is being used in AI applications through Internet of Things (IoT). The AI and IoT helps farmers to becoming aware of agriculture and are learning to do farming technology in scientifically with new modern technologies. The use of Modern AI and Technology helps to increase the social and economically status of farmers. In this review paper AI-based methodology that was used in agriculture to detect and prevent disease in food crops. The AI based methods is accurately and quickly identified the disease of food crops. It is help to prevention of diseases in crops which provides immediate and effective and accurate information about its symptoms and management based on scientific method.

Keywords: Artificial Intelligence (AI), Agriculture, Disease, Food Crops, Internet of Thing (IoT),

PARAMETER EFFICIENT FINE-TUNING BASED TEXT SUMMARIZER FOR INDIC LANGUAGE

Jeetendra Kumar

Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India
(jeetendragupta85@gmail.com)

Rashmi Gupta

Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India
(rashmigupta@bilaspuruniversity.ac.in)

Ankita Jaiswal

Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India
(ankita.csa22@gmail.com)

Text summarization plays a pivotal role in distilling essential information from large volumes of text. In this study, we introduce a novel approach to Hindi language text summarization through parameter-efficient fine-tuning, aiming to achieve state-of-the-art results with minimal computational resources. Leveraging pre-trained language models, such as BERT (Bidirectional Encoder Representations from Transformers) and RoBERTa (Robustly optimized BERT approach), our methodology focuses on refining model parameters for the specific task of summarizing Hindi texts. The proposed method begins with the utilization of a pre-trained language model on a diverse Hindi text corpus, enabling the model to capture intricate linguistic nuances. Subsequently, a parameter-efficient fine-tuning process is employed to adapt the model to the nuances of Hindi language summarization, emphasizing resource efficiency and reduced computational demands. This fine-tuning strategy aims to strike a balance between model complexity and computational cost, making it applicable to a broader range of computing environments. To evaluate the effectiveness of our approach, we conduct experiments on benchmark datasets for Hindi text summarization. Comparative analyses against existing state-of-the-art methods showcase the competitiveness and efficiency of our parameter-efficient fine-tuning technique. Results demonstrate improved summarization performance while maintaining resource efficiency, making it a compelling solution for real-world applications where computational resources are limited.

Keywords: text Summarization, BERT, Transfer Learning, Fine-tuning, Performance metrics

IOT BASED SMART AND ADVANCE MOTER CYCLE SECURITY ALARM SYSTEM USING ULTRASONIC SENSOR

Sonam Ratnaker

Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India
(Sonam62664@gmail.com)

Girja Rathia

Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India
(girjarathia12@gmail.com)

Rashmi Gupta

Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India
(rashmigupta@bilaspurunivercity.ac.in)

Motorcycle theft is a significant issue globally, with increasing instances of unauthorized access and thefts. This paper proposes a comprehensive and integrated approach to enhance motorcycle security through the amalgamation of advanced technologies and innovative strategies. The objective is to develop a robust security framework that not only deters theft but also facilitates efficient recovery in case of an unauthorized incident. The proposed system combines state-of-the-art technologies such as GPS tracking, biometric authentication, and Internet of Things (IoT) connectivity. A smart lock system equipped with biometric recognition ensures that only authorized users can start the motorcycle. This system is complemented by a GPS tracking device embedded within the motorcycle, allowing real-time monitoring and location tracking. Furthermore, the integration of IoT facilitates seamless communication between the motorcycle and a centralized security system. In the event of suspicious activity, the system triggers instant alerts to the owner's mobile device and the local law enforcement authorities. Additionally, the motorcycle owner can remotely disable the ignition system through a secure mobile application, thwarting any attempts of theft. To enhance the system's reliability and effectiveness, machine learning algorithms are employed to analyze patterns of motorcycle usage and detect anomalies that may indicate potential theft. This predictive analysis, coupled with real-time monitoring, significantly reduces false alarms while increasing the system's responsiveness to actual security threats.

Keywords: GPS Tracking Systems, Alarms and Immobilizers, Security Accessories, Secure Parking.

COMPELLING ROLES OF HOME ENVIRONMENT IN HOME MAKERS LIVES

Ankita Singh

Amity University Raipur, Chhattisgarh, India

The initial life-giver is earth and second, there is the part of the woman. The one who gives her time and energy from birth till her death by becoming a sister, wife, mother & homemaker. A Homemaker is the one who takes care of the house, takes care of family members, and puts up with care of their needs & does not run on any salary. A homemaker generally works a lot of unpaid hours per week and frequently depends on her husband's wages for financial assistance. Every person's home environment has a profound impact on their daily lives. The home environment is fundamental for outgrowth as well as psychological well-being. Family is an influential part of an individual, here one learns to respect, honor, the real meaning of humanity, and with the same values they socialize. Womens savvy their home and equate every member's feelings. Meanwhile, homemakers also want to unfold their sentiments but in this renewal world, everyone is absorbed in their vividness. The home environment imparts a secure life, homemakers are the ones bestowing that to everyone. They set out their day preparing meals for breakfast, giving goods and chattels to members. This review elucidates homemakers' toil every single day, it's foremost to understand whether their responsibility is making them weak. Does she get time for them or not? Every person needs self-care. To ameliorate their overall well being it's seminal to focus on coping strategies to minimize stress levels, depressive thoughts increase belongingness. Circumspect behavior is a need for homemakers.

Keywords: Women, Homemaker, Home environment, Family

IOT BASED SMART HOME AUTOMATION SYSTEM

Vinod Kumar Patel

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur, Chhattisgarh, India
(vinodkpatel550@gmail.com)

Jeetendra Kumar

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur, Chhattisgarh, India
(jeetendragupta85@gmail.com)

Provides we are face issues like Energy Wastage, Security Concerns, Inconvenient Manual Control, Rising Energy Costs, and Environmental Impact. Users can monitor their homes remotely, receive real-time alerts, and implement automated security protocols, significantly enhancing the overall security of the household. Through smart energy management, the system helps reduce energy consumption, leading to cost savings for users. The practical objective is to create a virtual, functional IoT home automation system using Arduino for device control. It is a laser-based home security Arduino and GSM-based fire alarm system to improves daily life by detecting fire and sends alert emergency calls and SMS to smartphones in case of gas leakage, fire, or water tank overflow. DHT11 sensor to detect Temperature and Humidity. Also, use the automatic gate-opening system and Automatic light on/off system. In this, we use sensors like Arduino uno, gsm module, temperature and humidity sensor, gas module, motion sensor, and flame sensor. LDR sensor, laser module buzzer 5volt, i2c LCD module. It emphasizes the importance of energy conservation through IoT devices in smart homes.

Keywords: Arduino and GSM module, DHT11 sensor, gas module, motion sensor, flame sensor. LDR sensor, i2c LCD module, laser module

AUTOMATIC SOLAR PANEL USING ARDUINO

Purab Nath

Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India
(purabnath5711@gmail.com)

Rashmi Gupta

Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India
(rashmigupta@bilaspuruniversity.ac.in)

This project introduces a smart solution for solar panels using Arduino, a small computer-like device. The goal is to make solar energy collection more efficient by automatically adjusting the position of solar panels. Instead of staying fixed, the panels will move to follow the sun as it moves across the sky. Imagine if you had a device that could sense where the sun is and tilt your solar panels accordingly. That's exactly what this system does! By connecting sensors to the Arduino, it can detect the sun's position and make the solar panels tilt in the best direction for maximum sunlight. This is crucial because the more sunlight the panels get, the more energy they can produce. The beauty of this project lies in its simplicity and effectiveness. With the Arduino doing all the work, it takes away the need for manual adjustments. You won't have to keep repositioning the panels throughout the day; the system does it for you. This not only saves time but also ensures that you get the most out of your solar panels. In a world where we are increasingly looking for sustainable energy sources, this Automatic Solar Panel Control System offers a practical and user-friendly solution. It brings us a step closer to harnessing solar power more efficiently, making it a promising innovation for a greener future.

PLANT MONITORING SYSTEM

Yogita

Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India

Kalpana

Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India

(kalpana992611@gmail.com)

Jeetendra Kumar

Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India

(jeetendragupta85@gmail.com)

Our project Plant Monitoring System presents system integrating various sensors and components to enhance precision agriculture. By combining PIR motion sensors, DHT11 temperature and humidity sensors, and soil moisture sensors, the system aims to create an intelligent and automated environment for optimal plant growth.

The project utilizes an ESP8266 board as the central controller, connecting to a network for data transmission. Arduino-compatible microcontrollers manage sensor data from PIR motion, DHT11, and soil moisture sensors, providing real-time insights into the plant's surroundings. A relay module controls a water pump to regulate soil moisture levels, and a DC motor-driven water pump ensures efficient irrigation.

The integration of these components facilitates a robust plant monitoring system. The 16x2 I2C LCD display offers a user-friendly interface to view vital parameters, while a tactile button allows manual control. The system can operate seamlessly on a 7.4V battery, providing portability and independence from external power sources.

This plant monitoring system demonstrates the potential of IoT and sensor technology in precision agriculture. The amalgamation of diverse components ensures a holistic approach to plant care, empowering users with real-time data and automated control for a more efficient and sustainable cultivation process.

INTERNET OF THINGS (IOT) BASED WEATHER MONITORING SYSTEM

Sakshi

Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India
(ss0095449@gmail.com)

Jankee

Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India
(annuj8004@gmail.com)

Rashmi Gupta

Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India
(rashmi.kvk@gmail.com)

This research introduces an advanced Internet of Things (IoT) system that seamlessly integrates “**SMART IRRIGATION**” using Arduino Uno, ESP8266, DHT11, temperature sensor, rain sensor, air sensor, moisture sensor, DC pump, 5V relay, regulator, and a 9V battery. By leveraging these components, the system enables real-time data collection on key environmental parameters, including temperature, humidity, precipitation, air quality, and soil moisture. The Arduino Uno serves as the central processing unit, orchestrating data acquisition from these sensors, and the ESP8266 module facilitates wireless transmission to a cloud server for remote accessibility. The incorporation of a DC pump, controlled by a 5V relay, automates irrigation processes, enhancing precision farming practices. The system's reliability is ensured by a 9V battery and regulator, making it adaptable for deployment in remote agricultural settings. This integrated IoT solution empowers farmers with timely and data-driven insights, fostering optimized decision-making for crop cultivation, irrigation management, and resource utilization, thereby contributing to increased agricultural productivity and sustainability.

Keywords: Climate Control, Weather Analysis, Temperature Moderation, Moisture and Humidity Control, Arduino Integration.

SUSTAINABLE FINANCING STRATEGIES FOR EXPANDING RENEWABLE ENERGY INITIATIVES IN RAJASTHAN

BABLU SOLANKI SAINI

JAI NARAIN VYAS UNIVERSITY, JODHPUR, INDIA

SURENDRA BHADU

JAI NARAIN VYAS UNIVERSITY, JODHPUR, INDIA

Rajasthan, blessed with abundant renewable energy resources, seeks to expand its green energy initiatives through the Rajasthan Renewable Energy Corporation Limited (RRECL). However, financial challenges hinder progress. This article highlights the pivotal role of sustainable financing strategies in overcoming obstacles. It discusses challenges like high capital costs and regulatory uncertainties, then proposes solutions like public-private partnerships, green bonds, international climate funds, and energy efficiency measures. Regulatory support, capacity building, and risk mitigation are also emphasized. These strategies not only bolster RRECL's mission but also serve as a model for global regions striving for renewable energy adoption, aligning environmental and economic goals.

Keywords: Rajasthan Renewable Energy Corporation Limited (RRECL), Sustainable

FINANCING STRATEGIES, RENEWABLE ENERGY INITIATIVES, FINANCIAL CHALLENGES PREFERENCE OF FOOD BY STORED GRAIN INSECT PEST, *RHYZOPERTHA DOMINICA*

Lekhu Gehlot

Jai Narain Vyas University, Jodhpur, Rajasthan, India

(drlekhu@rediffmail.com)

Rhyzopertha dominica is an important stored grain insect pest, commonly known as lesser grain borer. It belongs to family Bostrichidae, order Coleoptera. Both larva and adult causes damage to stored cereals especially wheat, rice etc. During this present study an experiment was set-up to determine the dietary preference of *Rhyzopertha dominica*, in term of weight loss on some selected cereals viz., wheat, rice and maize. 10 newly hatched adults were introduced into each Bakelite jars containing 20 gm. of cereals separately and maintained at 30 ± 2 C temperature and 75% relative humidity in a laboratory incubator for a month.

Maximum weight loss was recorded in wheat with 64.5% followed by rice with 42.5%. Maize showed 17.5 % weight loss. Wheat is found most preferred dietary cereal of *Rhyzopertha dominica* during the study.

Keywords- stored grain pest, *Rhyzopertha*, food preference.

A NEW APPROACH TO WIRELESS CHARGING AND ON-DEMAND DATA GATHERING FOR RWSN

Pankaj Chandra

Research Scholar, Guru Ghasidas Vishwavidyalaya (Central University), Bilaspur (C.G.)
(pankaj2684@gmail.com)

Santosh Soni

Guru Ghasidas Vishwavidyalaya (Central University), Bilaspur (C.G.)
(santoshsoni.77@gmail.com)

Energy efficiency and data collection are two modern priorities for WSNs (wireless sensor networks). Cluster Heads (CHs) can be visited by mobile sinks and chargers to collect data and replenish power, respectively. The mobile sink and mobile charger are merged into one mobile VAN (MV) to increase the WSN's energy efficiency. It is challenging to ascertain the CHs' visiting instructions for wireless data collection and charging. To address these issues, this research proposes a novel method for wirelessly charging and collecting data on demand for rechargeable wireless sensor networks, Named as SSWCDDG. The suggested algorithm makes use of mobile VAN to collect data from CHs and to charge CHs in accordance with their needs and preferences. In this scenario, Mobile VAN keeps a routing table and makes CH visits based on requests. The suggested approach uses a LEACH clustering algorithm to create the network partitions. The LEACH algorithm runs through one complete cycle. This study compares the newly developed SSWCDDG algorithm to the previously developed SPSS and M2C algorithms to prove the validity of the study's conclusions. In addition, SSWCDDG outperforms SPSS and M2C for a range of sensor node densities by 38.62 and 25.78 percentage points, respectively.

Keywords – Rechargeable Wireless sensor networks, Mobile VAN, Data collection, Mobile Charger.

ANFIS AND METAHEURISTIC OPTIMIZATION FOR GREEN SUPPLY CHAIN WITH INSPECTION AND REWORK

Nidhi Sharma

Indian Institute of Technology Roorkee, Roorkee 247667 (India)

(n_sharma@ma.iitr.ac.in)

Madhu Jain

Indian Institute of Technology Roorkee, Roorkee 247667 (India)

(madhu.jain@ma.iitr.ac.in)

Dinesh K. Sharma

University of Maryland Eastern Shore, USA

(dksharma@umes.edu)

The focus of present article is to investigate a supply chain inventory model along with inspection and stock dependent demand with use of green technology to reduce carbon emissions. Products that are decaying, or those that change over time, have a high sensitivity to the environment in terms of temperature, carbon emission, humidity, waste disposal, etc. This study develops a profit maximization model in the presence of deterioration, preservation, imperfect production, inspection error, rework, stock and price-dependent demand. The three carbon emission strategies are proposed to reduce the expenses in different carbon emissions scenarios. The suggested approach may be used to determine the optimal production period, preservation investment, and level of green investment. The solution of the non-linear constraint optimization is provided by using a penalty method in metaheuristic approaches. In order to conduct a sensitivity analysis for the essential model parameters, a numerical example is presented. The soft computing results produced by DE and PSO are compared with the results obtained by Adaptive Neuro-Fuzzy Inference System (ANFIS) technique.

Keywords: Green supply chain management; Inspection errors; Deterioration; Variable demand; Carbon emission; Metaheuristic optimization.

A HIDDEN MARKOV MODEL TO INVESTIGATE CONSUMER BRAND SWITCHING BEHAVIOR

Sivasamy Ramasamy

University of Botswana, Gaborone, BOTSWANA

(sivasamyr@ub.ac.bw)

Dinesh K. Sharma

University of Maryland Eastern Shore, USA

(dksharma@umes.edu)

Manufacturers of toothpaste brands such as A=Colgate, B=Sensodyne, C=Close-Up and D=Dabur (Ayurvedic) have a lot of work to do to predict consumer behaviour among these brands in both the short- and long-term trends. This project attempts to use both "Statistical Methods" and "Hidden Markov Chain (HMM)" to study consumer behaviours based on certain selected objectives.

The buying behaviour for brands A through D is influenced by a few factors that hide the tradition, which motivates repeat purchases or switching between products. In phase 1, a statistical model is developed to collect data and model the relationships between consumer attitudes. Considering the ratings given to the four brands as a response variable and a list of features that influence the sales rate of the brands as predictors, we propose a simple linear ordinal regression model using statistical algorithms and machine learning methods. Then, using it, we determine the best sequence points for repeat sales and behaviour change. Second approach, Hidden Markov model (Well) can be utilized to demonstrate how a sequence of observations can be represented by transitions among a set of latent states.

Both secondary and hypothetical data are used to investigate whether consumer habits favour the same brand more often or not. Another challenge is figuring out how linear programming can be used to retain a certain percentage of customers in the long run. Numerical solutions and graphical images are provided to support the theoretical arguments.

ENHANCING IOT CYBER SECURITY: A MACHINE LEARNING-DRIVEN IDENTIFICATION MODEL FOR VULNERABILITY ASSESSMENT

Dinesh K. Sharma

University of Maryland Eastern Shore, USA

(dksharma@umes.edu)

Tarun Dhar Diwan

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur, India

(tarunotech@gmail.com)

Prachi Diwan

Kalinga University, India

(dr.prachidiwan@gmail.com)

Implementing manual vulnerability evaluation methods results in inaccurate data and challenges analytical thinking. The diversity, flaws, and redundancy of contemporary security repositories increase such security issues. These issues were prevalent among makers and public vulnerability reports, making finding security holes directly over the Internet of Things (IoT) more challenging. The latest developments in Machine Learning (ML) Techniques hold forth fresh hope for resolving the widely recognized diversification and asymmetrical data concerns in the records of vulnerability reporting that are continually growing. These treatments themselves exhibit a range of performances due to their diverse approaches. The authors offer a technique for intelligence cybersecurity that boosts the capability of individual reasoning in two ways. Consolidate conflicting vulnerability reporting first, then pre-process advanced integrated indications to provide reliable data sets. The implementation and importance of this suggested technique for security assessment in application software have yet to reach their maximum potential. The study demonstrates that the suggested mental security approach performs better by resolving the shortcomings above and the limitations of variance across cybersecurity alert techniques. The experimental study of our software, especially the ensemble approach that finds patterns of computational vulnerabilities in data sources, creates significant compromises.

DESIGN OF EXPERT SYSTEM USING MACHINE LEARNING TECHNIQUES FOR PORTFOLIO MANAGEMENT PROBLEM

Shaik Khaja Saheb

KSRM College of Engineering, Kadapa, AP, India
(skpeer@ksrmce.ac.in)

Hari Sharma

Virginia State University, USA
(hsharma@vsu.edu)

Dinesh K. Sharma

University of Maryland Eastern Shore, USA
(dksharma@umes.edu)

Portfolio management includes portfolio optimization, selection, construction and allocation during a specified length of time. It is the process of choosing and managing various investments with twin goals of maximizing returns while minimizing the risks. Computational power of the computers is explored by decision makers of investment for its use of machine learning (ML) techniques to build effective portfolio that maximizes investors return. The construction process of effective portfolio is included with generating financial reports through financial analysis and planning along with selection of equities for optimum investment that aims to maximize the returns on investment. The construction process of portfolio consists of two phases to select equities for optimum investment. The first phase evaluates the investment opportunities and the second phase includes the assignment of weightages to each investment opportunity to decide the amount of capital to be invested in each of an equity to maximise the returns. This paper includes a proposed expert system modelling using rule-based machine learning method may be explored to achieve the goal as the rules are capable of representing the relevant knowledge in a very clear and efficient, and easily understandable by human experts. The proposed system handles the various risks and returns associated with different financial assets based on inferences to generate financial reports through simulation of a system in which effective portfolio is integrated with financial analysis and planning. This system is included with human expertise translated into a set of hardcoded rules as input data for making intelligent decisions through inferences for simulating portfolio management to analyse and optimise portfolio at regular intervals of time, in order to maximise returns and generate financial reports for an investor.

RECENT ADVANCEMENT IN TREATMENT AND DIAGNOSIS WITH NANOTECHNOLOGY

Manoj Kumar

Government Degree College, Dhadha Bujurg, Hata, Kushinagar, India (raokmanoj7@gmail.com)

Preeti R. Sharma

University of Maryland Eastern Shore, USA

(prsharma@umes.edu)

Recently nanotechnology applied in wide areas, including imaging, diagnostic and targeted drug delivery. In last decades, there is significant progress in the field of nanomedicine and nanobiotechnology and a large number of nanomaterials have been reported for their potential uses as diagnostic and therapeutic agents. A number of research report shows novel nanotechnology tactic for imaging, diagnosis and treatment of cancer with significant outcomes in preclinical animal data.

These days, oral cancer is frequent and deadly. The high rates of death and morbidity are a result of inadequate treatment and delayed diagnosis, even with significant advancements in contemporary treatments. A brand-new, cutting-edge pharmaceutical delivery approach based on nanotechnology is presently being explored in the field of oral cancer, primarily for improved detection and therapy. With the goal of creating nanomedicine, which has enormous promise for the prevention, diagnosis, and treatment of a wide range of illnesses, nanotechnology has emerged as a prominent field of study at the atomic and molecular levels.

Nanoscience has the potential to provide a basis for the crucial breakthrough in the battle against atherosclerosis since it may be utilized to both promote and inhibit the stability of atherosclerotic lesions. These nanomedicines are less harmful to the human body in addition to being effective. Fast and precise identification of agent material is necessary for effective treatment in order to stop the spread of infectious diseases. Present research is underway to create fluorescent nanoparticles that are sensitive enough to detect illnesses and powerful enough to record their signals. In addition to saving the patient's life, appropriate and active usage limits the spread of infections. The primary goal of this study is to provide an overview of contemporary advanced nanomaterials and their possible uses in the detection and management of oral cancer.

ADAPTIVE CLOUD COMPUTING IN THE POST-COVID-19 ERA: TRENDS, CHALLENGES, AND CYBER SECURITY IMPLICATIONS

Rakesh Sharma

University of Maryland Eastern Shore, USA

(rsharma@umes.edu)

Tarun Dhar Diwan

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur, India

(tarunotech@gmail.com)

Prachi Diwan

Kalinga University, India

(dr.prachidiwan@gmail.com)

This research paper delves into the intricate landscape of cloud computing post-pandemic, focusing on its rapid adoption, evolving service delivery models, and the burgeoning challenges faced in ensuring robust cyber security protocols. The study elucidates the various cloud service deployment models, emphasizing Private Cloud, Community Cloud, Public Cloud, and Hybrid Cloud, shedding light on their distinct applications and organizational implications.

Furthermore, the paper dissects the escalating expenditures in cloud services, highlighting the soaring investments in cloud technologies. Notably, the research reveals the notable growth in Infrastructure-as-a-Service (IaaS) and Desktop-as-a-Service (DaaS), underscoring the industry's trajectory towards these models. Security challenges inherent to Cloud Computing Environment (CCE) are dissected, debunking the misconception that cloud migration eradicates all security vulnerabilities. The analysis pinpoints the criticality of robust technical and administrative security controls and emphasizes the role of employee training and awareness programs.

A significant paradigm shift in security policies and regulations due to widespread remote work is explored, emphasizing the need for continuous monitoring and proactive security technologies like artificial intelligence. Moreover, the study delves into the severe shortage of skilled cyber security professionals, emphasizing the pressing need for comprehensive training and workforce development strategies in the face of an ever-expanding cloud computing landscape. This research paper provides a nuanced understanding of the post-COVID-19 cloud computing scenario, elucidating the trends, challenges, and cyber security implications. The insights presented herein offer valuable perspectives for academia, industry professionals, and policymakers navigating the evolving landscape of cloud technologies in the contemporary world.

ENHANCING CYBERSECURITY THROUGH BLOCKCHAIN TECHNOLOGY: AN INVESTIGATION INTO DATA STORAGE, AUTHENTICATION, AND INTEGRITY

Akshat Tiwari

Research scholar, Kalinga University Atal Bihari Vajpayee Vishwavidhalaya
Raipur (C,G,) Bilaspur(C.G.)

Dr Tarun Dhar Diwan

Atal Bihari Vajpayee Vishwavidyalaya Bilaspur, India
(tarunotech@gmail.com)

The rapid evolution of cyber threats necessitates innovative solutions to safeguard sensitive information and ensure the integrity of digital systems. This research delves into the application of blockchain technology as a transformative force in fortifying cybersecurity measures. Focusing on data storage, authentication, and integrity, the study explores how blockchain can mitigate vulnerabilities and bolster the overall resilience of diverse cyber systems.

In the realm of data storage, traditional centralized architectures are susceptible to single points of failure and unauthorized access. Blockchain, known for its decentralized and immutable ledger, offers a paradigm shift in data management. This investigation scrutinizes how blockchain's distributed ledger technology ensures secure, transparent, and tamper-resistant data storage, diminishing the risks associated with centralized repositories.

Authentication mechanisms play a pivotal role in safeguarding digital assets, and the study investigates how blockchain can revolutionize identity verification. By employing decentralized consensus protocols, blockchain eliminates the need for a single authority, reducing the likelihood of identity theft and unauthorized access. The research examines the feasibility and effectiveness of blockchain-based authentication systems in enhancing cyber resilience.

Integrity is paramount in ensuring the trustworthiness of digital information. Blockchain's cryptographic principles and decentralized nature make it a formidable candidate for preserving data integrity. The study scrutinizes how blockchain's consensus algorithms, coupled with cryptographic hashing, create an incorruptible chain of blocks, safeguarding the authenticity and reliability of information.

Through a comprehensive analysis of existing literature, case studies, and practical implementations, this research aims to provide insights into the tangible benefits and potential challenges of integrating blockchain technology into cybersecurity frameworks. The findings of this investigation contribute to the ongoing discourse on enhancing the security of data storage, authentication, and integrity in the dynamic landscape of cyber systems. Ultimately, the research seeks to inform policymakers, cybersecurity professionals, and technology enthusiasts about the transformative potential of blockchain in fortifying digital ecosystems against evolving cyber threats.

SMART PARKING MANAGEMENT SYSTEM

Suraj sahu

Atal Bihari Vajpayee university Bilaspur (C.G.), India (surajsahu6365@gmail.com)

Dr Rashmi Gupta

Atal Bihari Vajpayee university Bilaspur (C.G.) ,India (rashmi.kvk@gmail.com)

The aim of implementing a Parking Management System is to reduce time and increase the efficiency of the current parking infrastructure. This research proposes a Smart Parking Management System model that utilizes various technologies for effective management of parking assets. The system employs Arduino UNO, Ultrasonic sensors, IR sensors, Buzzer, RFID, LCD display, Servo motor, RFID sensors, and introduces wireless charging concepts and LED lights for direction and indication. The proposed system addresses the challenge of efficiently finding empty parking spaces and managing the flow of vehicles within complex parking structures. IR sensors detect vehicles, providing real-time feedback on parking availability through an LCD display. This information guides drivers to vacant spaces, minimizing congestion and improving overall efficiency. The addition of wireless charging concepts enhances the user experience, allowing for convenient and cordless charging of electric vehicles within the parking facility. LED lights are incorporated for directional guidance, aiding drivers in locating available spaces. The system employs RFID technology, utilizing tags affixed to vehicles and readers in the parking facility. This RFID system streamlines the process of parking and provides a secure means of managing vehicle access. The entrance gate is controlled by a servo motor, opening to allow vehicles into the parking area when a vacant slot is available and closing when the parking slot is full. The integration of these technologies creates a comprehensive and efficient Smart Parking Management System.

Keywords: Parking Management, Arduino UNO, Ultrasonic, IR sensor, Buzzer, RFID, LCD display, Wireless Charging, LED lights.

DEEP LEARNING TECHNIQUES FOR THE IDENTIFICATION OF DIABETES

Harshita Rathi

Bhilai Institute of Technology, Chhattisgarh, India

(harshita20rathi@gmail.com)

Worldwide, people of all ages are at risk for developing diabetes. Its occurrence rate is growing at an alarming rate each year. When left untreated, diabetes can cause organ failure and death. When diabetes is diagnosed quickly, treatment can begin right once, reducing the risk of complications. Using RR-interval signals, also known as heart rate variability (HRV) signals, derived from electrocardiogram (ECG) signals, it is possible to detect diabetes without invasive procedures. In this research, heart rate variability (HRV) data was classified using a deep learning architecture into two groups: normal and diabetes. Using convolutional neural networks (CNNs), long short-term memory (LSTM) models, and other permutations thereof, we can extract intricate temporal dynamic features from heart rate variability (HRV) data. A classification of these features is made by the support vector machine (SVM). Convolutional Neural Networks (CNN) and CNN-Long Short-Term Memory (LSTM) architectures led to performance gains of 0.03% and 0.06%, respectively, compared to our earlier research conducted without the use of Support Vector Machines (SVM). With an impressive 96% accuracy rate, the proposed classification algorithm has the potential to aid medical professionals in the diagnosis of diabetes through analysis of electrocardiogram (ECG) data.

Keywords: Deep learning, Diabetes, Heart rate variability, ECG, CNN, LSTM

CUSTOMER LOYALTY IN THE INSURANCE INDUSTRY: A BIBLIOMETRIC ANALYSIS

Sherry Singla

Research Scholar, Punjabi University, Patiala, India (sherrysingla11@gmail.com)

Dr. Harpreet Kaur Sawhney

Centre for Distance and Online Education, Punjabi University, Patiala, India

Purpose: With reference to the insurance sector, the current bibliometric analysis aims to provide both quantitative and qualitative knowledge about loyalty. A total of 132 articles that were published between 2002 and 2022 are examined in this study.

Design/methodology/approach: The Scopus database was used to perform bibliometric analysis on 132 research papers. The VOSviewer software was used to study the research articles on "loyalty in the insurance sector research".

Findings: The findings from the research demonstrated that, throughout time, the topic of customer loyalty has gained prominence in the insurance industry. Citation analysis and publication trends were employed in the study. The most influential publications, writers, countries, articles, and organizations have been identified via bibliometric analysis.

Originality/Value: Numerous studies on customer loyalty have been carried out in an array of sectors, including banking, e-commerce, hotel and tourism sectors, insurance, and so on. The goal of the present investigation is to map the body of research on "loyalty in the insurance sector" in the Scopus database. This will assist in defining the primary concept and give the researchers ideas for additional research avenues. The basics of loyalty in the insurance sector will be better understood by academics, legislators, and regulators due to this work, which will also help identify relevant areas that require further investigation.

Keywords: Customer loyalty, insurance, satisfaction, service quality, bibliometric analysis, scientific mapping.

BIOFORTIFICATION OF VERMIWASH FOR ENHANCING ITS BIOACTIVITY AND ASSESSING ITS EFFECT ON PLANT GROWTH

Abhishek Xalxo,

D.L.S.P.G. College, Bilaspur, Chhattisgarh, India
(kvrml198@gmail.com)

Rahul Patel,

D.L.S.P.G. College, Bilaspur, Chhattisgarh, India
(kvrml198@gmail.com)

Krishna Kumar Verma,

D.L.S.P.G. College, Bilaspur, Chhattisgarh, India
(kvrml198@gmail.com)

Sumit Kumar Dubey,

D.L.S.P.G. College, Bilaspur, Chhattisgarh, India
(sumitdubeybiotech@gmail.com)

Neha Behar,

D.L.S.P.G. College, Bilaspur, Chhattisgarh, India
(neha1_biotech@yahoo.com)

The increasing global concerns regarding the soil health and crop yield have encouraged scientists to develop innovative strategies for enhancing soil fertility by using bioagents, this has gained immense momentum in the present time. To ensure optimum plant growth, the soil is often supplemented with nutrients along with bio-fertilizers and biopesticides to increase its fertility and at the same time protect the plant from pests. In this study, vermiwash was produced (liquid bio-fertilizer, collected through coelom of activated earthworm) and its various combinations were prepared with microbial consortium such as Vermiwash and biofertilizers (*Azospirillum*, *Azotobacter*, and PSB). The optimum growth of the plant was recorded with vermiwash in combination with *Azospirillum*, *Azotobacter*, and PSB. Thus, usage of organic components in agriculture, for enhancing soil fertility and biodegradability is very important and a huge step toward sustainability.

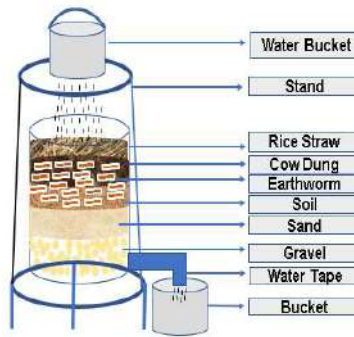
Keywords: Biofortification, biofertilizers, biopesticides, Vermiwash, Sustainable agriculture, Microbial consortium.

1. INTRODUCTION

The soil is often directly or indirectly involved in the delivery of the most vital services for humankind (food production) which is fundamental for any country's security and sovereignty. However, one-third of the world's soil is now degraded due to various reasons, primarily soil erosion, loss of organic carbon and biodiversity, salinization, acidification, compaction, and nutrient imbalance (Food and Agriculture Organization of the United Nations, 2023). The increasing global concerns regarding soil health and crop yield (Tahat, et al., 2020) has encouraged scientists to develop innovative strategies for enhancing soil fertility by using bioagents. To ensure optimum plant growth, the soil is often supplemented with nutrients along with bio-fertilizers and biopesticides to increase its fertility and at the same time protect the plant from pests. The vermiwash is a liquid bio-fertilizer that is secreted from a coelom-activated earthworm (Gudeta et al., 2021). Therefore, the vermiwash was produced and its combinations were prepared with a microbial consortium including Vermiwash and biofertilizers (*Azospirillum*, *Azotobacter*, and PSB) in the present course of investigation.

2. EXPERIMENTAL WORK

A healthy earthworm (*Eisenia foetida*) was procured from Govt. Indira Krishi Gandhi Vishwavidyalaya, Koni, Bilaspur C.G.). The experimental setup of vermiwash production unit was prepared in Tank/Barrels (200 L). The Vermiwash Setup is graphically presented in Figure 1.



Processing and collection of Vermiwash

- The temperature of Vermiwash unit was 22⁰C inside and 33⁰C outside of the Vermiwash unit.
- 25 L of clean water was recycled from the Vermiwash unit daily
- Vermiwash was recycled through the vermivash until the color got Brown.
- The Vermiwash was collected after 21 days.
- Vermiwash was collected in disposable clean plastic bottles
- Vermiwash was stored at below 20⁰C

Figure 1: Vermiwash Setup

.Source of Microbial cultures

The Microbial cultures *Azospirillum*, *Azotobacter*, and *PSB* (Phosphate solubilizing Bacteria) (shown in Figure 2) were collected from the State bio-control laboratory Chorbhatti Khurd, Bilaspur.



Figure 2: *Azospirillum*, *Azotobacter*, and *PSB* culture bottles



Figure 3: *Azospirillum*, *Azotobacter*, and *PSB* activeculture used to make combination with Vermiwash to increase efficacy

Preparation of Vermiwash formulation

The prepared brown colorvermiwash was formulated by adding culture's viz., *Azospirillum*, *Azotobacter*, and *PSB* (Figure 3). Varieties of combinations were made as per experiment set-up designed for the measurement of plant growth rate in soil. The combinations were prepared with microbial cultures are as follow:

- Soil
- Soil (5 Kg) + Vermiwash (200ml)
- Soil (5 Kg) + Vermiwash (200ml) + *Azospirillum*(1/100 dilution)
- Soil (5 Kg) + Vermiwash (200ml) + *Azotobacter* (1/100 dilution)
- Soil (5 Kg) + Vermiwash (200ml) + *PSB* (1/100 dilution)
- Soil (5 Kg) + Vermiwash (200ml) + *Azospirillum* + *Azotobacter* + *PSB*

3. RESULT AND DISCUSSION

The vermivash was prepared and formulated by adding culture's viz., *Azospirillum*, *Azotobacter*, and *PSB*. The results exhibited that the vermivash combinations was consisted of soil (5.0 Kg), vermivash (200ml), *Azospirillum*, *Azotobacter* and *PSB* was exhibited 93.36 % germination rate and 24.53 ± 0.78 cm shoot length of mung bean (*Vigna radiata* L.).Effect of vermivash and its combination on the growth of mung bean (*Vigna radiata* L) are shown in Table 1.

Table 1: Effect of vermiwash and its combination on the growth of mung bean (*Vigna radiata* L.)

S. No.	Combination	Germination rate (%)	Shoot Length (in cm)
1.	Soil	76.25	14.96 ± 0.62
2.	Soil (5 Kg) + Vermiwash (200ml)	81.64	15.62 ± 0.39
3.	Soil (5 Kg) + Vermiwash (200ml) + <i>Azospirillum</i> (1/100 dilution)	87.44	18.27 ± 0.52
4.	Soil (5 Kg) + Vermiwash (200ml) + <i>Azotobacter</i> (1/100 dilution)	89.62	20.12 ± 0.24
5.	Soil (5 Kg) + Vermiwash (200ml) + PSB (1/100 dilution)	91.59	23.49 ± 0.83
6.	Soil (5 Kg) + Vermiwash (200ml) + <i>Azospirillum</i> + <i>Azotobacter</i> + PSB	93.36	24.53 ± 0.78

The optimum growth of the plant was recorded with the combination of *Azospirillum*, *Azotobacter*, and PSB. Similar studies were also reported by many other authors. The effect of Photosynthetic Bacteria, Vermiwash, and Phosphorus Solubilizing Bacteria on the growth, Yield, and Quality of French beans was studied, and a combination of biofertilizers (PSB-1 + PSB-2 (30 ml/ m²) was suggested for better yield in French bean (Poonam, 2023). Applying vermiwash with biofertilizers of Rhizobium and plant growth-promoting rhizobacteria as a substitute for chemical fertilizers produced high-quality of green peas. The application of vermiwash only gave the lowest values of the same traits (Hassan and Elbatran, 2020). The results showed that the best pH for the growth of the consortium of three bacterial isolates was 5.5. Liquid formulation with a carrier material in the form of vermiwash plus 1% PEG, supported the highest viability of the bacterial consortium during 8 weeks of incubation (Arfarita et al., 2020). Vermiwash was mixed with different biopesticides like a garlic bulb, neem plant part, and neem-based bio-pesticides. The foliar application of vermiwash with bio-pesticides increases growth, productivity, and early flowering and reduces pest infestation (Singh and Shesh, 2016). Therefore, the literature is also supporting the present findings that the vermiwash alone and in *Azospirillum*, *Azotobacter*, and PSB tend to increase crop yield. Brief illustration of vermiwash production and assessment of its various combinations in mung bean (*Vigna radiata* L.) growth is depicted in Figure 4.



Figure 4: Brief illustration of vermiwash production and assessment of its various combinations in mung bean (*Vigna radiata* L.) growth.

4. CONCLUSION

Our work is in preliminary stage and more comprehensive studies regarding the combination with vermiwash is needed. The field trial is also needed to prove the efficacy of it in wider perspective. Thus, the usage of organic components in agriculture, for enhancing soil fertility and biodegradability is a very important and huge step toward sustainability.

REFERENCES

- Arfarita, N., Lestari, M. W., & Prayogo, C. (2020). Utilization of Vermiwash for the Production of Liquid Biofertilizers and Its Effect on Viability of Inoculant Bacteria and Green Bean Germination. *AGRIVITA Journal of Agricultural Science*, 42(1). <https://doi.org/10.17503/agrivita.v42i1.2263>

- Food and Agriculture Organization of the United Nations (2023). Soils, where food begins: how can soils continue to sustain the growing need for food production in the current fertilizer crisis?. ITPS Soil Letters. 6. <https://www.fao.org/3/cc4199en/cc4199en.pdf>.
- Gudeta, K., Julka, J. M., Kumar, A., Bhagat, A., & Kumari, A. (2021). Vermiwash: An agent of disease and pest control in soil, a review. In *Heliyon* (Vol. 7, Issue 3, p. e06434). Elsevier BV. <https://doi.org/10.1016/j.heliyon.2021.e06434>
- Poonam, Kumar, S., Yadav, D., Ravinder, & Sharma, R. (2023). Effect of Integrated Nutrient Management on Growth and Yield of French Bean (*Phaseolus vulgaris* L.). *International Journal of Plant & Soil Science*, 35(19), 2140–2147. <https://doi.org/10.9734/ijpss/2023/v35i193766>
- Prajapati, K., Patel, P.H. & Rabari, S.R. (2022). Effect of Foliar Spray of Vermiwash and Panchgavya on Growth, Yield and Economics of Field Pea. *Biological Forum—An International Journal*, 14(2), 117-120
- Singh, Keshav & Nath, S (2016). The combinations of vermiwash with bio-pesticides- A boon for crop productivity. *Res. J. Pharmacognosy and Phytochem*, 8(3).
- Tahat, M.M., Alananbeh, K. M., Othman, Y. A. & Leskovar, D. I. (2020). Soil Health and Sustainable Agriculture. *Sustainability*, 12(12), 4859. <https://doi.org/10.3390/su12124859>

AIR QUALITY PARAMETER OF PALI PROJECT UG COAL MINE JOHILLA AREA BIRSINGHPUR PALI, UMARIA, MADHYA PRADESH

Laxmi Saket,

Pandit S.N. Shukla University, Shahdol, Madhya Pradesh, India.
(laxmisrcholar1992@gmail.com)

Mamta Prajapati

Pandit S.N. Shukla University, Shahdol, Madhya Pradesh, India.
(drmamtaprajapati@gmail.com)

The Pali Project Underground (UG) Coal Mine, located in the Johilla Area, Birsinghpur, Pali, Umaria, Madhya Pradesh, is a pivotal economic asset for the region. However, coal mining activities can potentially introduce air pollutants that pose risks to both the environment and human health. This research project focuses on comprehensively evaluating the Air Quality parameter in the proximity of the Pali Project UG Coal Mine to understand the implications of mining on air quality. The SPM, PM₁₀, PM_{2.5}, SO₂, NO₂ and heavy metals are monitoring in summer, monsoon and winter season in industrial and residential zone. The primary objectives of this study are to establish baseline air quality data, monitor variations over time, assess the impact of mining activities, evaluate potential health risks, and provide recommendations for mitigation if necessary. The research methodology involves the installation of air quality monitoring stations, continuous data recording, long-term monitoring, impact assessment through source identification and health risk analysis, and the formulation of mitigation recommendations.

Keywords: Air, quality, SPM, PM₁₀, PM_{2.5}, SO₂, NO₂, and heavy metals

1. INTRODUCTION

Air quality is a critical environmental concern that has profound implications for the well-being of both ecosystems and human populations. In regions where industrial activities, such as mining, are prevalent, the management of air quality becomes even more crucial [Acid Rain 2000; Guttikunda et al 2019; Rao et al 2021; Hakkim et al 2019; WHO 2005]. When undesired or hazardous substances are present in the air, it is referred to as air pollution. These substances can have a negative effect on the environment, human health, and the general wellbeing of living things. These pollutants can come from a variety of sources, including industrial processes, transportation, agriculture, building, and natural processes [Anand et al 2019; Bisht et al 2022; Garaga and Kota 2021; Klima et al 2020; Ravishankara et al 2020]. The Pali Project Underground (UG) Coal Mine, situated in the Johilla Area of Birsinghpur, Pali, Umaria, Madhya Pradesh, is a significant economic asset for the region due to its coal mining operations. However, these operations have the potential to release various pollutants into the atmosphere, thereby impacting air quality in the surrounding areas. Understanding the dynamics of air quality in this context is not only vital for protecting the health and well-being of the local population but also for promoting sustainable mining practices and minimizing adverse environmental effects. This research project endeavors to shed light on the complex relationship between coal mining activities and air quality, ultimately contributing to evidence-based decision-making and environmental stewardship in the Johilla Area.

2. LITERATURE REVIEW

The heavy metals (HMs) Iron (Fe), Manganese (Mn), Zinc (Zn), Copper (Cu), Lead (Pb), Chromium (Cr), Nickel (Ni), and Arsenic (As) in road dust in Dehradun city, Uttarakhand, India, are evaluated for pollution levels and spatial distribution in this study. Seventy samples collected in triplicates were gathered from various land-use areas, including residential, commercial, national highways, and silent zones. The concentrations of these HMs were determined using the acid digestion method followed by inductively coupled plasma-mass spectrometry (ICP-MS). Pearson's correlation analysis was employed to assess significant relationships between heavy metal concentrations, and principal components analysis (PCA) was conducted for source identification of HMs in road dust (**Bisht et al 2022**). This study aims to quantify the consumption-based contributions of PM_{2.5} emissions and the associated mortality burden experienced by households across different income deciles, both in urban and rural areas. The findings reveal that indirect PM_{2.5} emissions, originating from sources like manufacturing processes driven by consumer demand, contribute nearly twice as much to ambient PM_{2.5} concentrations compared to direct emissions from biomass cook stoves (**Rao et al 2021**). The strict nationwide lockdown implemented in India from March 25, 2020, to curb the spread of COVID-19 had a profound impact on air quality due to reduced human mobility and disruptions in various anthropogenic emission sources. This study conducts a comprehensive analysis of air pollutants and meteorological data across different scales (national, regional, and city levels), considering various species and measurement platforms (**Sathe et al 2021**).

3. EXPERIENTIAL WORK

3.1 Study Area

Birsinghpur Pali is located in Umaria district, Madhya Pradesh. The town of Umaria is the district headquarters. The district is part of Shahdol Division.

The total geographical area of the district sums up to 4548 square kilometers and has a population of 6,44,758. Umaria is enriched with its vast resources of forests and minerals. The coal mines are a steady source of revenue for the district.

The most important mineral found in the district is coal and as a result 8 mines are being operated by South Eastern Coalfields Limited (Nowrozabad) in the district. The Bandhavgarh National Park (Tala) and Sanjay Gandhi Thermal Power Station at Mangthar (Pali) are located in the district. Umaria was formerly the headquarters of the South Rewa District and thereafter the headquarters town of the Bandhavgarh tehsil. It is situated at a distance of about 69 km. from Shahdol, the parent district. Metalled roads connect the town with Katni, Rewa, Shahdol, etc., on which regular buses ply. Umaria is also a railway station on the Katni-Bilaspur section of the South East Central Railway zone.



Figure 1: Umaria District

3.2 Collection of samples

The samples will be collected in different seasons (winter, summer and Monsoon) of the year, 2021 from the Pali UG coal mine Johilla area and residential zone, Umaria, Madhya Pradesh, India. Some results will be recorded in the laboratory.

3.3. Result and discussion

Suspended Particulate Matter (SPM) Analysis

Suspended Particulate Matter (SPM) analysis is a critical component of assessing and monitoring air quality in regions where industrial activities, including coal mining, can significantly contribute to airborne particulate matter concentrations. SPM consists of solid particles or liquid droplets suspended in the air and is typically categorized into different size fractions, including PM₁₀ (particles with a diameter of 10 micrometers or smaller) and PM_{2.5} (particles with a diameter of 2.5 micrometers or smaller). Analyzing SPM levels is essential because these particles can have adverse effects on human health and the environment. The SPM levels in industrial zone are 445, 306 and 454 ($\mu\text{g}/\text{m}^3$) for summer, Monsoon and winter respectively which are under permissible limit. The SPM levels in residential zone are 152, 126 and 154 $\mu\text{g}/\text{m}^3$ for summer, Monsoon and winter respectively which are under permissible limit. The PM₁₀ levels in industrial zone are 220, 155 and 178 ($\mu\text{g}/\text{m}^3$) for summer, Monsoon and winter respectively which are under permissible limit. The

PM10 levels in residential zone are 72, 55 and 75 $\mu\text{g}/\text{m}^3$ for summer, Monson and winter respectively which are under permissible limit. The PM2.5 levels in industrial zone are 40, 45 and 50 ($\mu\text{g}/\text{m}^3$) for summer, Monson and winter respectively which are under permissible limit. The PM2.5 levels in residential zone are 55, 30 and 34 $\mu\text{g}/\text{m}^3$ for summer, Monson and winter respectively which are under permissible limit.

Table 1: Permissible Limit of SPM

Permissible Limit ($\mu\text{g}/\text{m}^3$)					
	SPM	PM10	PM2.5	SO ₂	NO ₂
Industrial Zone	600	300	60	120	120
Residential Zone	200	100	60	80	80

Table 2: SPM levels in industrial and residential zone

Industrial Pali PIT Office (mine site)			
Season	SPM ($\mu\text{g}/\text{m}^3$)	PM10 ($\mu\text{g}/\text{m}^3$)	PM2.5 ($\mu\text{g}/\text{m}^3$)
Summer	445	220	40
Monson	306	155	45
Winter	454	178	50
Pali Colony			
Season	SPM ($\mu\text{g}/\text{m}^3$)	PM10 ($\mu\text{g}/\text{m}^3$)	PM2.5 ($\mu\text{g}/\text{m}^3$)
Summer	152	72	55
Monson	126	55	30
Winter	154	75	34

Sulfur Dioxide (SO₂) Analysis

Sulfur dioxide (SO₂) is a significant air pollutant often associated with industrial processes, including coal mining. Monitoring SO₂ levels in the vicinity of the Pali Project UG Coal Mine is essential for assessing its impact on air quality and the potential health risks associated with exposure to this gas. SO₂ is a corrosive gas that can irritate the respiratory system and contribute to the formation of acid rain when it reacts with other atmospheric components. Therefore, thorough SO₂ analysis is crucial for environmental management and public health. The SO₂ levels in industrial zone are 32, 25 and 33 ($\mu\text{g}/\text{m}^3$) for summer, Monson and winter respectively which are under permissible limit. The SO₂ levels in residential zone are 19, 19 and 25 $\mu\text{g}/\text{m}^3$ for summer, Monson and winter respectively which are under permissible limit.

Table 3: SO₂ levels in industrial and residential zone

Industrial Pali PIT Office (mine site)	
Season	SO ₂ ($\mu\text{g}/\text{m}^3$)
Summer	32
Monsoon	25
Winter	33
Pali Colony	
Season	SO ₂ ($\mu\text{g}/\text{m}^3$)
Summer	19

Monsoon	19
Winter	25

Nitrogen Dioxide (NO₂) Analysis

Nitrogen dioxide (NO₂) is a key air pollutant that can have significant health and environmental impacts. Its presence in the atmosphere is often associated with industrial processes, transportation emissions, and combustion activities, all of which are relevant to the operations of the Pali Project UG Coal Mine. Monitoring NO₂ levels in the vicinity of the mine is essential for assessing air quality and potential health risks. NO₂ is known to contribute to respiratory problems and can react in the atmosphere to form other secondary pollutants, making its analysis critical for public health and environmental management. The NO₂ levels in industrial zone are 42, 34 and 43 (µg/m³) for summer, Monsoon and winter respectively which are under permissible limit. The NO₂ levels in residential zone are 29, 28 and 34 µg/m³ for summer, Monsoon and winter respectively which are under permissible limit.

Table 4: NO₂ levels in industrial and residential zone

Industrial Pali PIT Office (mine site)	
Season	NO₂ (µg/m³)
Summer	42
Monsoon	34
Winter	43
Pali Colony	
Season	NO₂ (µg/m³)
Summer	29
Monsoon	28
Winter	34

Heavy Metal Analysis

Heavy metal analysis is a vital component of environmental monitoring, especially in regions with industrial activities like coal mining. Heavy metals, such as arsenic (As), lead (Pb), nickel (Ni), chromium (Cr), cadmium (Cd), and selenium (Se) are known for their toxic properties and potential environmental and human health risks. In the context of the Pali Project UG Coal Mine, heavy metal analysis aims to assess the presence and concentrations of these metals in various environmental media, including air, water, soil, and potentially biological samples. The heavy metals (As, Pb, Ni, Cr, Cd and Se) are found at below detection line (BDL) in residential zone in all season. Pb metal in Monsoon and winter season in industrial are 0.10 and 0.9 µg/m³ respectively. As, Ni, Cr, Cd and Se are found at below detection line (BDL) in industrial zone in all season.

Table 5: Heavy metal in industrial and residential zone

Industrial Pali PIT Office (mine site)						
Season	As(µg/m³)	Pb(µg/m³)	Ni(µg/m³)	Cr(µg/m³)	Cd(µg/m³)	Se(µg/m³)
Summer	BDL	BDL	BDL	BDL	BDL	BDL
Monsoon	BDL	0.10	BDL	BDL	BDL	BDL
Winter	BDL	0.9	BDL	BDL	BDL	BDL
Pali Colony						

Season	As($\mu\text{g}/\text{m}^3$)	Pb($\mu\text{g}/\text{m}^3$)	Ni($\mu\text{g}/\text{m}^3$)	Cr($\mu\text{g}/\text{m}^3$)	Cd($\mu\text{g}/\text{m}^3$)	Se($\mu\text{g}/\text{m}^3$)
Summer	BDL	BDL	BDL	BDL	BDL	BDL
Monsoon	BDL	BDL	BDL	BDL	BDL	BDL
Winter	BDL	BDL	BDL	BDL	BDL	BDL

In both industrial and residential zones, maintaining acceptable air quality is paramount for the well-being of residents and the sustainable operation of industries. Monitoring and understanding the levels of various air pollutants, including Suspended Particulate Matter (SPM), PM10, PM2.5, Sulfur Dioxide (SO_2), Nitrogen Dioxide (NO_2), and heavy metals, is crucial for ensuring that air quality remains within safe and regulatory limits. Here, we discuss what can be considered normal or acceptable levels of these pollutants in industrial and residential areas. All the parameters are found in normal levels shown in **Figure 2**.

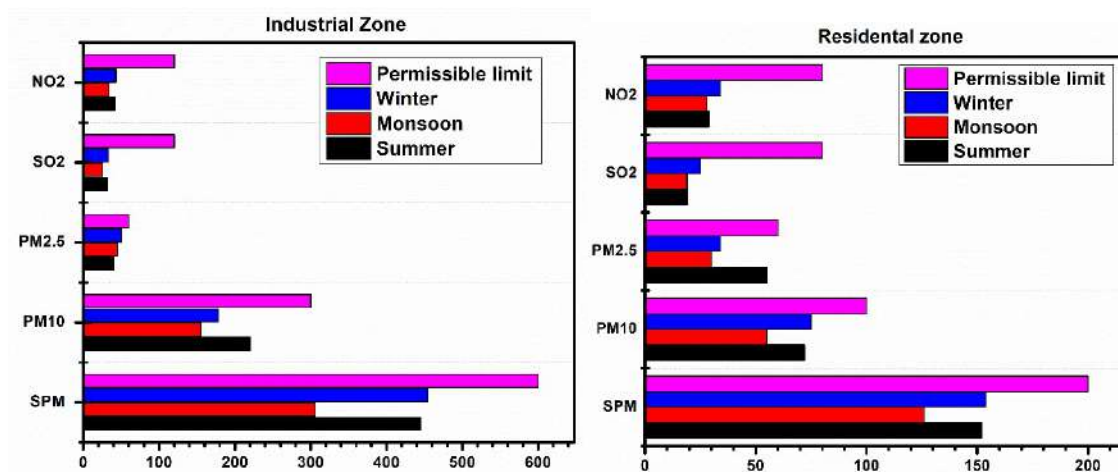


Figure 2: Air quality parameter in industrial zone (left) and residential zone (right)

4. Conclusion

In this paper, we monitoring the air quality in Pali Project UG coal mine Johilla area Birsinghpur Pali, Umaria, Madhya Pradesh. The air quality monitoring by using different parameters like SPM, PM10, PM2.5, SO_2 , NO_2 and heavy metals in all seasons (summer, monsoon and winter). We also monitoring these parameters in industrial and residential zone. Moreover, we compared with permissible limit in industrial and residential zone. SPM, PM10, PM2.5, SO_2 , NO_2 and heavy metals in industrial and residential are lesser than permissible limit.

REFERENCES

Acid Rain 2000 (2001) The Acid Rain 2000 project in the UK. Available from <http://www.brixworth.demon.co.uk>.

Anand, V., Korhale, N., Rathod, A. and Beig, G., 2019. On processes controlling fine particulate matters in four Indian megacities. *Environmental Pollution*, 254, p.113026.

Bisht, L., Gupta, V., Singh, A., Gautam, A.S. and Gautam, S., 2022. Heavy metal concentration and its distribution analysis in urban road dust: A case study from most populated city of Indian state of Uttarakhand. *Spatial and Spatio-temporal Epidemiology*, 40, p.100470.

- Garaga, R. and Kota, S.H., 2021. Characterization of PM 10 and its impact on human health during annual festival of lights (Diwali) in Northeast India. *Urban Air Quality Monitoring, Modelling and Human Exposure Assessment*, pp.305-323.
- Guttikunda SK, Nishadh KA, Jawahar P, (2019) Air pollution knowledge assessments (APnA) for 20 Indian cities. *Urban Climate*, 27, pp.124-141.
- Hakkim H, Sinha V, Chandra BP, Kumar A, Mishra AK, Sinha B, Sharma G, Pawar H, Sohpaal B, Ghude SD, Pithani P, (2019) Volatile organic compound measurements point to fog-induced biomass burning feedback to air quality in the megacity of Delhi. *Science of the total environment*, 689, pp.295-304.
- Klima, V., Chadyšienė, R., Ivanec-Goranina, R., Jasaitis, D. and Vasiliauskienė, V., 2020. Assessment of air pollution with polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofuranes (PCDFs) in Lithuania. *Atmosphere*, 11(7), p.759.
- Rao ND, Kiesewetter G, Min J, Pachauri S, Wagner F, (2021) Household contributions to and impacts from air pollution in India. *Nature Sustainability*, 4(10), pp.859-867.
- Ravishankara, A.R., David, L.M., Pierce, J.R. and Venkataraman, C., 2020. Outdoor air pollution in India is not only an urban problem. *Proceedings of the National Academy of Sciences*, 117(46), pp.28640-28644.
- Sathe, Y., Gupta, P., Bawase, M., Lamsal, L., Patadia, F. and Thipse, S., 2021. Surface and satellite observations of air pollution in India during COVID-19 lockdown: Implication to air quality. *Sustainable cities and society*, 66, p.102688.

REVEALING THE CHEMICAL BIOACTIVE COMPOUNDS OF *MORINGAOLEIFERA* BARK USING LC-MS ANALYSIS TO CONDUCT DETAILED BIOCHEMICAL ANALYSIS

Jyoti Rathore,
Govt E V Post Graduate College, Korba, Chhattisgarh, India.
joychemistryjrc@gmail.com
Kiran Thakur
Government Bilasa Girls PG College, Bilaspur, Chhattisgarh, India.

Parts of Africa and Asia are home to the plant known as *Moringa*, commonly referred to as *Moringaoleifera*. Because of its therapeutic and nutritious qualities, it is also known as the "drumstick tree" or the "miracle tree." Bioactive substances like tannins, phenolic acids, flavonoids, and alkaloids are found in the bark. It is well recognized that these substances may have anti-inflammatory and antioxidant qualities. Liquid Chromatography-Mass Spectrometry (LC-MS) is a widely used technology for analyzing *Moringa* bark samples in order to identify and quantify different components. Combining the mass analysis capabilities of mass spectrometry with the separation capabilities of liquid chromatography yields a potent analytical technique known as LC-MS. While studies on the leaves, seeds, and roots of *Moringa* have been conducted, there is considerably little scientific data directly pertaining to the medical benefits of the plant's bark. As a result, it's crucial to use caution when using *Moringa* bark and to get the most recent information from trustworthy sources. Non polar extracts were prepared and analyzed for phytochemical in different extracts. *M.oleifera* extracts LC-MS chromatogram showed 105 peaks, which denote the presence of 105 phytochemical substances. Peak area, retention period, and molecular formula were used to identify the phytochemical substances. The main compounds identified are Quercetin, Kampeferol, Cinnamic acid, Beta sitosterol and Rhamnetin. 2,4-Dimethyldodecane, Eicosane, n-Hexadecanoic acid, Heneicosane, Octadecanoic acid, Tetracosane and many more presented in Chromatogram. Further the reported phytochemicals can be studied for pharmaceutical use after clinical trials and its finished product^[11-15].

Keywords – Chromatogram, Phytochemical, Liquid Chromatography, Mass Spectrometry

Introduction

Moringaoleifera, commonly known as the drumstick tree, horseradish tree, or simply *Moringa*, is a versatile and nutrient-rich plant native to parts of Africa and Asia. While much attention is often given to its leaves and seeds, the bark of the *Moringa* tree also holds significance for various traditional and medicinal uses. *Moringaoleifera* is a fast-growing, deciduous tree that can reach heights of up to 10 meters or more. The bark is typically smooth, with a whitish-gray color. *Moringa* supplements, including those containing bark extracts, are available in various forms, such as capsules, powders, and teas^[1-3]. The bark is also sometimes used in traditional culinary practices in certain regions. While *Moringa* is generally considered safe for consumption, it's essential to exercise caution and moderation, as excessive intake may lead to adverse effects.

Consultation with a healthcare professional is advisable, especially for pregnant or breastfeeding women and individuals with pre-existing medical conditions. The bark, like other parts of the *Moringa* tree, contains a variety of bioactive compounds, including alkaloids, flavonoids, phenolic acids, and tannins. These compounds contribute to the plant's antioxidant, anti-inflammatory, and antimicrobial properties^[4-10]. In traditional Ayurvedic

medicine, various parts of the *Moringa* tree, including the bark, have been used for their supposed medicinal properties. In different cultures, the bark has been employed as a remedy for various ailments, including digestive issues, inflammation, and as a general health tonic^[11-12].

Table 1.1 Chemical constituents of *Moringaoleiferabark*^[13-22]

S.No	Chemical Constituents	Description
1	Alkaloids	Moringine is a prominent alkaloid found in <i>Moringaoleifera</i> bark. Alkaloids often have pharmacological effects and may contribute to the plant's medicinal properties.
2	Flavonoids	Flavonoids are a group of polyphenolic compounds with antioxidant properties. Some examples found in <i>Moringaoleifera</i> bark include quercetin, kaempferol, and rutin.
3	Phenolic Acids	Chlorogenic acid and caffeoylquinic acid are examples of phenolic acids present in <i>Moringaoleifera</i> bark. Phenolic acids contribute to the antioxidant activity of the plant.
4	Tannins	Tannins are polyphenolic compounds with astringent properties. They are believed to have antioxidant and antimicrobial effects. <i>Moringaoleifera</i> bark contains tannins, which may contribute to its traditional medicinal uses.
5	Saponins	Saponins are glycosides with surfactant properties. <i>Moringaoleifera</i> bark contains saponins, which may have various biological activities, including antimicrobial and anti-inflammatory effects.
6	Terpenoids	Terpenoids are a diverse group of compounds with a wide range of biological activities. Some terpenoids have been identified in <i>Moringaoleifera</i> bark and may contribute to its medicinal properties.
7	Phytosterols	Beta-sitosterol is an example of a phytosterol found in <i>Moringaoleifera</i> bark. Phytosterols are plant sterols with potential cholesterol-lowering properties.
8	Glycosides	<i>Moringaoleifera</i> bark contains various glycosides, which are compounds formed by the combination of a sugar molecule with another chemical group. These may have diverse biological activities.

Pharmaceutical properties of *Moringaoleifera* bark

1. Anti-inflammatory property - The bark of *Moringaoleifera* is believed to have anti-inflammatory effects. In traditional medicine, it has been used to alleviate inflammation and related conditions.
2. Antioxidant property - *Moringa* bark, like other parts of the plant, contains antioxidants. Antioxidants help neutralize free radicals in the body, which are implicated in various health issues, including aging and certain diseases.

3. Analgesic property - The anti-inflammatory properties of *Moringa* bark may contribute to its traditional use in alleviating pain associated with inflammatory conditions.
4. Cardiovascular property - Some studies suggest that *Moringa* extracts, including those from the bark, may have cardiovascular benefits, such as helping to lower blood pressure and cholesterol levels. These effects are likely due to the presence of bioactive compounds with vasodilatory and lipid-lowering properties^[23-27].

Material and methodology

Moringaoleifera bark was gathered from the forest in the Korba area of the state of Chhattisgarh. The bark of the *Moringaoleifera* plant was collected, cleaned, and ground into a fine powder. Using several non-polar solvents, including benzene, hexane, chloroform, and ethyl acetate, the fine powder was extracted using the Soxhlet method. The extraction process took a full day. Following the assembly of the soxhlet extractor and the addition of 50g of powdered *MoringaOliefera*, the extraction process began at 61°C with a chloroform solvent. The extracted was collected and vacuum-distilled dried after a 24-hour period. For the remaining three solvents benzene, hexane, and ethyl acetate the same procedures were carried out at boiling points of 80°C, 68°C, and 77°C, respectively. *MoringaOleifera* flower benzene extract and *MoringaOleifera* flower chloroform extract were the labels placed on the extracts. Both the hexane and ethyl acetate extracts from *Moringaoleifera* flowers are available. After obtaining the final residue, an LC-MS analysis was conducted^[28-31].

Result & discussion

M. oleifera extracts LC-MS chromatogram showed 105 peaks, which denote the presence of 105 phytochemical substances. Peak area, retention period, and molecular formula were used to identify the phytochemical substances. The main compounds identified are Quercetin, Kampeferol, Cinnamic acid, Beta sitosterol and Rhamnetin. 2,4-Dimethyldodecane, Eicosane, n-Hexadecanoic acid, Heneicosane, Octadecanoic acid, Tetracosane and many more presented in Chromatogram.

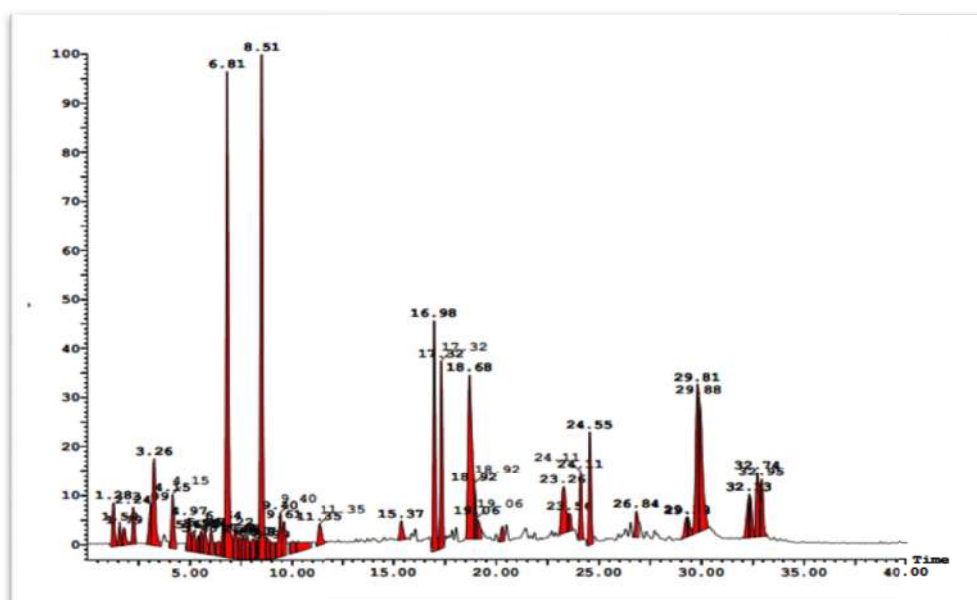


Fig 1.1 LC-MS Chromatogram of Quercetin

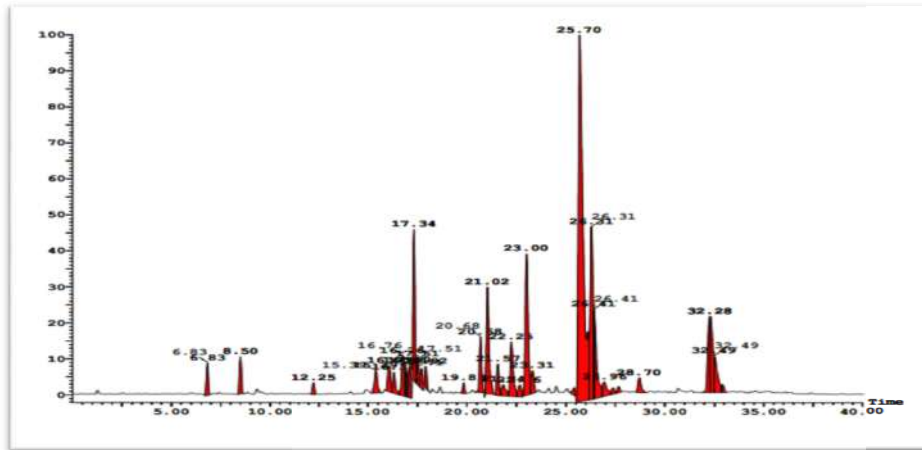


Fig 1.2 LC-MS Chromatogram of Kampeferol

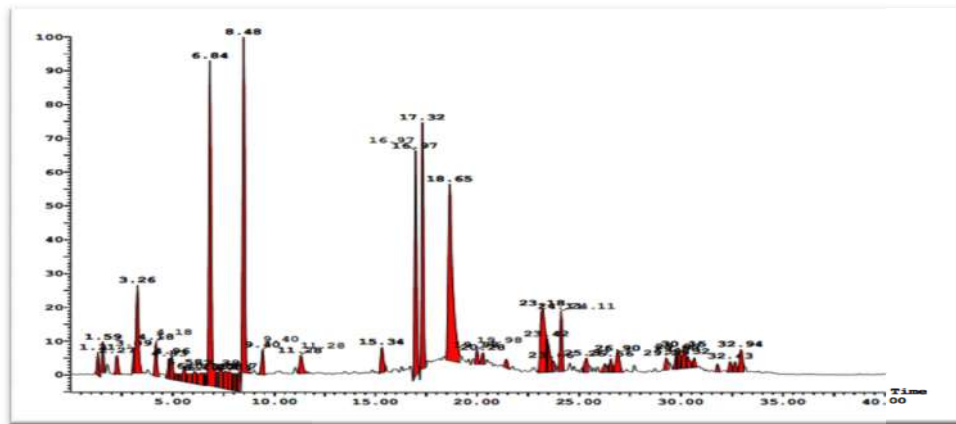


Fig 1.3 LC-MS Chromatogram of Rhamnetin

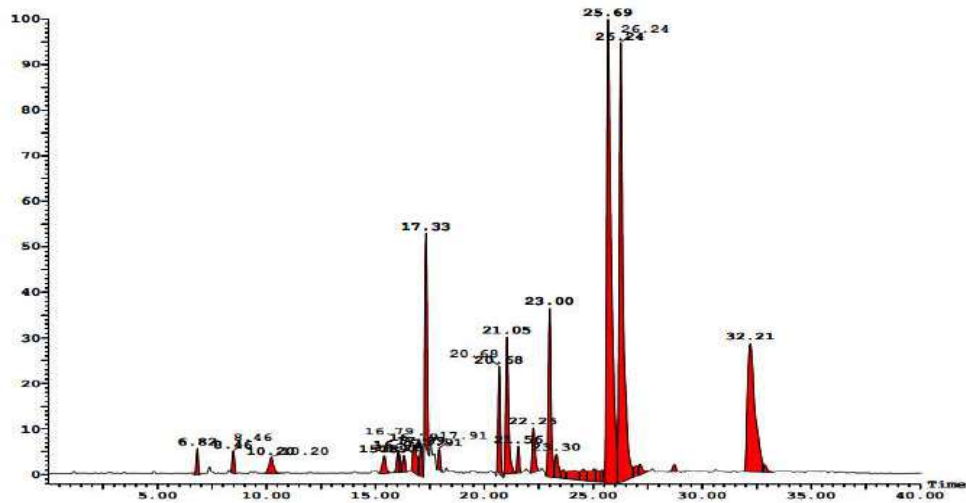


Fig 1.4 LC-MS Chromatogram Beta Sitosterol

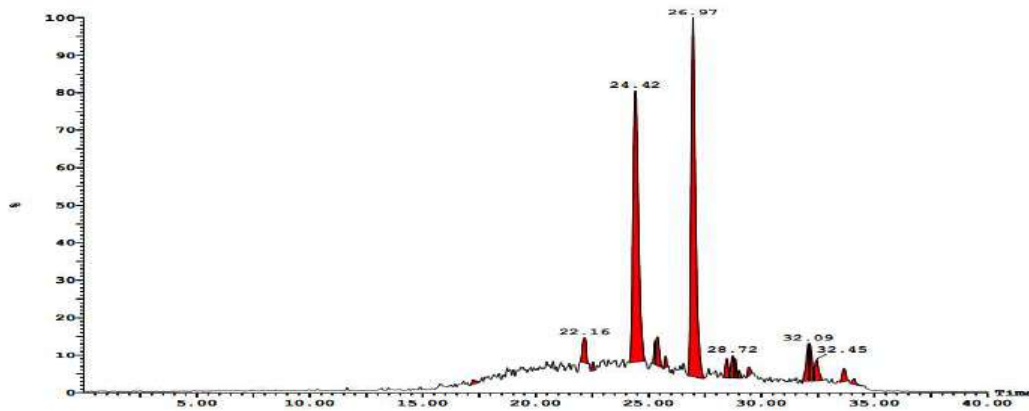


Fig 1.5 LC-MS Chromatogram of Cinnamic acid

Conclusion –

It's important to note that research on the medicinal properties of *Moringaoleifera* bark is ongoing, and more scientific studies are needed to fully understand its potential benefits and any associated risks. As with any herbal remedy, it's advisable to seek guidance from healthcare professionals before incorporating *Moringa* bark or its extracts into your health regimen. Some studies suggest that *Moringa* bark may have anti-inflammatory effects, which could be beneficial for conditions involving inflammation. The presence of antioxidants in the bark may help neutralize free radicals in the body, potentially contributing to overall health. *Moringa* bark extracts have been investigated for their potential antimicrobial properties.

References

- Rashid U, Anwar F, Moser BR, Knothe G. *Moringaoleifera* oil: a possible source of biodiesel. *Bioresour Technol.* 2008;99:8175–8179.
- Rastogi T, Bhutda V, Moon K, Aswar P, Khadabadi S. Comparative Studies on Anthelmintic Activity of *MoringaOleifera* and *VitexNegundo*. *Asian J Res Chem.* 2009;2.
- Ratshilivha N, Awouafack MD, du Toit ES, Eloff JN. The variation in antimicrobial and antioxidant activities of acetone leaf extracts of 12 *Moringaoleifera* (*Moringaceae*) trees enables the selection of trees with additional uses. *South Afr J Bot.* 2014;92:59–64.
- Raven PH, Evert RF, Eichhorn SE. 1999. *Biology of Plants*, sixth ed., Freeman, New York
- Ravishankar B, Shukla VJ. Indian systems of medicine: a brief profile. *Afr J Tradit Complement Altern Med.* 2007 Feb 16;4(3):319-37.
- Ray K, Hazra R, Guha D. Central inhibitory effect of *Moringaoleifera* root extract: possible role of neurotransmitters. *Indian J Exp Biol.* 2003 Nov;41(11):1279-84. PMID: 15332497.
- Rishton GM. 2008. Natural products as a robust source of new drugs and drug leads: Past successes and present-day issues. *Am J Cardiol.* 101:43D–9D.
- Saini RK, Manoj P, Shetty NP, et al. Dietary iron supplements and *Moringaoleifera* leaves influence the liver hepcidin messenger RNA expression and biochemical indices of iron status in rats. *Nutr Res.* 2014a;34:630–638.
- Saini RK, Manoj P, Shetty NP, et al. Relative bioavailability of folate from the traditional food plant *Moringaoleifera* L. as evaluated in a rat model. *J Food Sci Technol.* 2016;53:511–520.
- Samal J. Medicinal plants and related developments in India: A peep into 5-year plans of India. *Indian J Heal Sci.* 2016;9(1):14.
- Schmidt B, Ribnicky DM, Poulev A, Logendra S, Cefalu WT, Raskin I. 2008. A natural history of botanical therapeutics. *Metabolism.* 57:S3–9.

- Sen S, Chakraborty R. Revival, modernization and integration of Indian traditional herbal medicine in clinical practice: Importance, challenges and future. *J Tradit Complement Med*. 2016 Jun 28;7(2):234-244.
- Shukla S, Mathur R, Prakash AO. Antifertility profile of the aqueous extract of *Moringaoleifera* roots. *J Ethnopharmacol*. 1988 Jan;22(1):51-62.
- Singh BN, Singh BR, Singh RL, et al. Oxidative DNA damage protective activity, antioxidant and anti-quorum sensing potentials of *Moringaoleifera*. *Food Chem Toxicol*. 2009;47:1109–1116.
- Sreelatha S, Jeyachitra A, Padma PR. Antiproliferation and induction of apoptosis by *Moringaoleifera* leaf extract on human cancer cells. *Food Chem Toxicol*. 2011;49:1270–1275.
- Ssenku JE, Okurut SA, Namuli A, Kudamba A, Tugume P, Matovu P, et al. Medicinal plant use, conservation, and the associated traditional knowledge in rural communities in Eastern Uganda. *Trop Med Health [Internet]*. 2022;50(1):39.
- Tsala DE, Foyet HS, Thierry B, Justin B, Emmanuel N. Anti-Inflammatory Activity of Hot Water Extract of *MoringaOleifera* Lam in Rats. *Int J Drug Targets*. 2013 ;4:25–31.
- Ujah OF, Ujah IR, Johnson JT, et al. The hepatoprotective property of ethanolic leaf extract of *Moringaoleifera* on carbon tetrachloride (CCl₄) induced hepatotoxicity. *Scholar Research Library. J Nat Prod Plant*. 2013;3:15–22.
- Vats S, Gupta T. Evaluation of bioactive compounds and antioxidant potential of hydroethanolic extract of *Moringaoleifera* Lam. from Rajasthan, India. *PhysiolMolBiol Plants*. 2017 Jan;23(1):239-248.
- Vergara-Jimenez M, Almatrafi MM, Fernandez ML. Bioactive Components in *MoringaOleifera* Leaves Protect against Chronic Disease. *Antioxidants (Basel)*. 2017 Nov 16;6(4):91.
- WHO. 2001. General Guidelines for Methodologies on Research and Evaluation of Traditional Medicines, p. 1.
- WHO. 2005. National Policy on Traditional Medicine and Regulation of Herbal Medicines. Geneva: Report of WHO global survey.
- WHO. 2007. WHO guidelines for assessing quality of herbal medicines with reference to contaminants and residues
- WHO.2000. General Guidelines for Methodologies on Research and Evaluation of Traditional Medicine. World Health Organization, Geneva.
- Kumarappan C, Jaswanth A, Kumarasunderi K. Antihemolytic and snake venom neutralizing effect of some Indian medicinal plants. *Asian Pac J Trop Med*. 2011 Sep;4(9):743-7.
- Lakshmipriya T, Soumya T, Jayasree PR, Manish Kumar PR. Selective induction of DNA damage, G2 abrogation, and mitochondrial apoptosis by leaf extract of traditional medicinal plant *Wrightiaarboorea* in K562 cells. *Protoplasma*. 2018 Jan;255(1):203-216.
- Yatoo MI, Dimri U, Gopalakrishnan A, Karthik K, Gopi M, Khandia R, Saminathan M, Saxena A, Alagawany M, Farag MR, Munjal A, Dhama K. Beneficial health applications and medicinal values of *Pedicularis* plants: A review. *Biomed Pharmacother*. 2017 Nov;95:1301-1313.
- Singh A, Nautiyal MC, Kunwar RM, Bussmann RW. Ethnomedicinal plants used by local inhabitants of Jakholi block, Rudraprayag district, western Himalaya, India. *J EthnobiolEthnomed*. 2017 Aug 24;13(1):49.
- Singh UP, Singh DP, Maurya S, Maheshwari R, Singh M, Dubey RS, Singh RB. Investigation on the phenolics of some spices having pharmacotherapeutic properties. *J Herb Pharmacother*. 2004;4(4):27-42.
- Abu Hafsa SH, Ibrahim SA, Eid YZ, Hassan AA. Effect of dietary *Moringaoleifera* leaves on the performance, ileal microbiota and antioxidative status of broiler chickens. *J AnimPhysiolAnimNutr (Berl)*. 2020 Mar;104(2):529-538.
- Yan G, Liping S, Yongliang Z. UPLC-Q-Orbitrap-MS2 analysis of *Moringaoleifera* leaf extract and its antioxidant, antibacterial and anti-inflammatory activities. *Nat Prod Res*. 2020 Jul;34(14):2090-2094.

BACILLUS SP. DERIVED COST-EFFECTIVE SERINE-LIKE ALKALINE PROTEASE USING DAIRY WASTE EFFLUENT

Sumit Kumar Dubey

Govt. E. Raghavendra Rao P.G. Science College, Bilaspur, Chhattisgarh, India.
(sumitdubeybiotech@gmail.com)

Rashmi Parihar,

Govt. E. Raghavendra Rao P.G. Science College, Bilaspur, Chhattisgarh, India.
(rashmiparihar67@gmail.com)

D.K. Shrivastava,

Govt. E. Raghavendra Rao P.G. Science College, Bilaspur, Chhattisgarh, India.
(dksbotany@gmail.com)

Serine-like alkaline proteases are often resistant to a widespread temperature, pH, detergent, and certain toxic metals. *Bacillus* sp. is majorly involved in the production of commercial alkaline proteases. *Bacillus* sp. offers a variety of commercially important enzyme secretion. *Bacillus* sp. i.e., *B. alcalophilus*, *B. amyloliquefaciens*, *B. cereus*, *B. firmus*, *B. licheniformis*, *B. megaterium* and *B. subtilis*, are well known for alkaline proteases production. The vigorous consumption of milk and milk-derived products by humans enforces the processing to store them for longer periods without damaging their taste and nutritional values. But this generates a massive amount of liquid effluent known as dairy effluent. This huge amount of waste could be used for protease biorefinery due to its significant protein and nutritional values that support microbial growth after little fortification which makes it cost-effective as well. After optimization the protease activity was increased by 1.25-fold (from 46.28 ± 0.87 to 57.93 ± 0.78 U/mL-1 \pm SD) with *Bacillus subtilis* (PPB-16). Hence, this *Bacillus subtilis* (PPB-16) could potentially be used for the cost-effective serine-like alkaline protease production using dairy waste effluent and simultaneously facilitate the dairy effluent management.

Keywords: *Bacillus* sp., Biorefinery, Dairy waste effluent, Enzyme, Serine-like alkaline proteases.

1. INTRODUCTION

Enzymes are referred to as the biological catalysts present in all living organisms to facilitate metabolic and physiological functions. Besides, the enzymes are recurrently utilized in a variety of industrial processing e.g., chemicals, bioprocessing, fertilizers, textile, leather processing, food processing, nutraceuticals, and pharmaceuticals along with wastewater treatment (Mahakhan et al., 2023). The global market report claimed that the enzyme market reached US\$ 10 billion in 2019 and is expected to grasp US\$ 14.7 billion market by 2025 (Markets and Markets Research, 2022). Proteases catalyze protein digestion into peptides or amino acids by cleaving peptide bonds (Motyan et al., 2013). The protease is classified into endo- or exo-enzymes based on the site of action while classified into aspartic endoproteases, cysteine endoproteases, metallo-endoproteases, serine endoproteases, and threonine endoproteases based on the catalytic mechanism (El-Gayar et al., 2020; Eatemadi et al., 2017).

The serine endoproteases (E.C. 3.4.21) have wide-ranging substrate specificity (Qasim, 2013) and *Bacillus* species are the potent producers of extracellular alkaline protease (Madhu, 2016). However, proteases are found ubiquitously in plants, animals, insects, and microorganisms including bacteria and fungi. Microbial proteases are mostly preferred for protease production at the industrial scale because they can produce enzymes more rapidly and easily via fermentation, extracellular secretion makes simple downstream processing, not influenced by the external environment (e.g., seasonal changes), an opportunity for genetic engineering, stable mutagenesis and similar advantage associated with using them (Kocher and Mishra, 2010). Moreover, bacterial proteases are generally secreted extracellularly, have rapid growth on low-cost media, are easy to produce at large scale, higher yield and stability (Tufvesson et al., 2011). The *Bacillus* genus including *B. alcalophilus*, *B. cereus*, *B. licheniformis*, and *B. subtilis* has been most widely reported for extracellular alkaline proteases (Bhunja et al., 2012). The *Bacillus* spp. are generally preferred for the commercial production of enzymes due to their high scalability, secretion of extremely active enzymes, and more importantly, *B. alcalophilus*, *B. cereus*, *B. licheniformis*, and *B. subtilis* have been categorized as Generally Regarded As Safe (GRAS) (Mahakhan et al., 2023).

The milk has been reported to have highly nutritive and biological ingredients such as caseins (80% of total mass) and other whey proteins (El-Gayar et al., 2020). Gopinatha Kurup et al. (2019) reported that the Dairy waste effluent has 1312 ± 150 mg/L of BOD, 360 mg/L of fat content, 388.00 ± 0.01 mg/L of total protein content, and 121.0 ± 29.0 mg/L of carbohydrates content. Hence, dairy waste effluent serves as an efficient medium for microbial growth, and the availability of protein content helps to stimulate protease production by bacterial strain. Therefore, the present research work was done to produce cost-effective serine-like alkaline

protease using Dairy Waste Effluent by *Bacillus* sp. that could potentially be used as an additive for the detergent and applicable for partial digestion of proteinaceous food so that it can be absorbed by intestinal cell easily.

2. EXPERIENTIAL WORK

2.1 Survey and Sampling

The local dairy units were surveyed and samples (dairy waste effluent) were collected from a dairy unit of Nagaoli, Ganiyari, dhuma, and dhamni villages. The samples (dairy effluent and nearby soils) were aseptically collected on sterile plastic bottles and brought to the laboratory. The dairy effluent was used to produce protease using the shake flask method. The nearby soils of the dairy effluent site were used to isolate protease-producing *Bacillus* species.

2.2 Isolation screening of protease producing *Bacillus* species

The soil samples were serially diluted and subjected to spreading on a basal medium. Basal media (100 mL) consisted of 1.0g of glucose, 0.5g of yeast extract, 0.1g of K_2HPO_4 , 0.02g of $MgSO_4 \cdot 7H_2O$, 1.0g of Na_2CO_3 , and 1.5 g of agar at pH 8) supplemented with 1% skim milk. The prepared skim milk agar (SMA) plates were then inoculated with samples to screen protease-producing bacteria present in the samples. SMA plates were incubated for 72 h at 37°C. After an incubation period, the SMA plates were qualitatively examined for the clear zones around the bacterial colonies. The bacterial colonies with clear zone (protease positive) were subjected to pure culture slant preparation for further experimental work.

2.3 Identification of bacterial strains

The significant protease producing bacterial isolates were identified using key provided by Bergey's Manual (Holt et al., 2004).

2.4 Shake flask fermentation for protease production

The Shake flask fermentation technique was used for protease production as mentioned by Pant et al. (2015) with slight modification. The collected dairy effluent (100 mL) was fortified with 0.5g of peptone, 0.5 g of yeast extract, and cofactor (Ca^{2+} and Mn^{2+} , 5.0 mM concentration). This fortified dairy effluent was used as fermentation broth for protease production. A 5.0 % of 12 h active bacterial culture was used as inoculum. The qualitatively screened potent bacterial strain was inoculated in autoclaved fermentation broth. The environmental condition was pH-8.0, Temperature - 37°C, Rotation-150rpm, and Time-72h. After incubation, the fermented broth was withdrawn at every 24 h of intervals and centrifuged to remove bacterial cells. The cell-free extract was considered as crude protease. The quantitative activity of crude protease was determined.

2.5 Quantitative protease activity

The 0.5 ml of cell-free extract of the bacterial isolate was mixed with 1 mL of 1% casein (used as substrate) and incubated at 40°C for 10 min. The reaction was stopped by adding 5 mL of trichloroacetic acid (at a concentration of 110 $\mu\text{mol/L}$) and centrifuged to 5000 rpm (for 30 min). The supernatant (2.0 mL) was mixed with 5.0 mL of Na_2CO_3 (500 $\mu\text{mol/L}$) and 1.0 mL of Folin reagent. The reaction mixture was kept in room temperature for 30 min and then 2 mL of reaction mixture was measured against reference (reaction mixture with no crude enzyme) at 650 nm using spectrophotometer (U-2900 UV/VIS). The tyrosine was used to make a standard curve.

2.6 Optimization of protease production by fortified dairy effluent using *Bacillus subtilis* (PPB-16)

The parameter viz., pH, temperature, time, rotation, and cofactors were optimized for protease production by fortified dairy effluent using *Bacillus subtilis* (PPB-16). The optimization technique one-factor-at-a-time (OFAT) as mentioned by Polley & Ghosh (2021). The range of parameters for optimization was adopted from the relevant literatures.

3. RESULTS AND DISCUSSION

The protease producing bacterial strains were isolated from nearby soil of dairy effluent sites. A total of 16 bacterial strains were isolated in which 5 bacterial strains were found positive for protease production. Based on Bergey's Manual bacterial identification keys the 3 bacterial strains out of 5, belongs to *Bacillus* genus and

exhibit significant protease activity. These 3 *Bacillus* isolates were tentatively identified as *B. subtilis*-16, *B. cereus*-22, *B. licheniformis*-25 based on the colony, microscopic and biochemical features (shown in Table 1).

Optimization of protease production by fortified dairy effluent using *Bacillus subtilis* (PPB-16) is exhibited in Table 2: The parameter viz., pH, temperature, time, rotation, and cofactors were optimized and finally, the optimum condition for protease production ($57.93 \pm 0.78 \text{ U/mL} \pm \text{SD}$) was found pH of 8, Temperature of 40°C , and Time of 72 h, and Cofactor (Ca^{2+} and Mn^{2+}) at 5.0 mM Concentration. After optimization the protease activity was increased by 1.25 fold (from 46.28 ± 0.87 to $57.93 \pm 0.78 \text{ U/mL} \pm \text{SD}$).

Bacterial isolate	Colony Color	Colony Margin	Gram Stain	Shape	Spore	Biochemical tests
<i>B. subtilis</i> -16	White-Grey	Irregular	+	Rod	+	Positive for starch hydrolysis, VP, Citrate Utilization, and growth in 6.5% of NaCl
<i>B. cereus</i> -22	Grey	Irregular	+	Rod	+	Positive for starch hydrolysis and VP
<i>B. licheniformis</i> -25	Opaque-white	Irregular	+	Rod	+	Positive for starch hydrolysis, VP, Citrate Utilization, growth in 6.5% of NaCl and able to grow at 55°C

B. subtilis-16, *B. cereus*-22, *B. licheniformis*-25 have earlier been reported for protease production (Yang et al., 2021; Cupi et al., 2022; Pant et al., 2015). Mahakhanet et al. (2023) have been reported the alkaline protease production using dairy effluent by *B. gibsonii* 6BS15-4. They also claimed that the metal ions including Cu^{2+} , K^+ , Mg^{2+} , Na^+ , and Zn^{2+} slightly stimulate the protease activity. Gopinatha Kurup et al. (2019) has been recovered 96% of lipids and 46% of proteins from dairy effluent which clearly indicates the potency of dairy effluent to produce protease and lipase from dairy effluent using microbial strains.

S.No.	Parameters	Variable	Protease activity ($\text{U/mL} \pm \text{SD}$)
1.	pH Constant Temperature- 37°C , Time- 72 h, and Rotation- 120 rpm	7	35.27 ± 0.31
		8	46.28 ± 0.87
		9	38.19 ± 0.74
2.	Temperature Constant pH- 8, Time- 72 h, and Rotation- 120 rpm	35	43.29 ± 0.31
		40	51.64 ± 0.37
		45	43.35 ± 0.63
3.	Time Constant pH-8, Temperature- 40°C , and Rotation- 120 rpm	24	34.23 ± 0.53
		48	41.25 ± 0.27
		72	54.84 ± 0.26
4.	Rotation Constant pH-8, Temperature- 40°C , and Time- 72 h	100	44.32 ± 0.68
		150	56.46 ± 0.22
		200	51.43 ± 0.71
5.	Cofactor (Ca^{2+} and Mn^{2+}) Constant pH-8, Temperature- 40°C , and Time- 72 h	0	47.18 ± 0.63
		5	57.93 ± 0.78
		10	43.83 ± 0.38

4. CONCLUSION

The microbial-derived protease group of enzymes is widely considerable for commercial due to their cost-effective production, capability to use industrial proteinaceous waste, and ease of setting up optimized fermentation tank which is not affected by external environmental harsh. Hence, microbial-assisted alkaline protease production appears to be a promising approach. The present work was focused on the effective utilization of dairy waste effluent to produce protease. The proteinaceous fraction of the dairy waste effluent was successfully used for the bioconversion of waste into an alkaline protease enzyme. This effort was hopeful

for the utilization of dairy waste effluent ion for the synthesis in a cost-effective and eco-friendly way. The *Bacillus cereus* PPB-22 was marked as the potent protease producer using dairy waste effluent. As this alkaline protease has significant stability to pH temperature and alkalinity, hence it seems as a potent ingredient for commercial detergent preparation to remove proteinaceous stains from cloths and for household cleaning purposes.

REFERENCES

- Bhunja, B., Basak, B. & Dey, A. (2012). A review on production of serine alkaline protease by *Bacillus* spp. *J. Biochem. Tech.*, 3, 448–457. <https://doi.org/10.1155/2012/905804>
- Cupi, D., Thorsen, M., Elvig-Jørgensen, S.G., Wulf-Andersen, L., Berti-Sorbara, J., Cowieson, A. J., Faruk, M. U. (2022). Efficacy and safety profile of a subtilisin protease produced by fermentation in *Bacillus licheniformis* to be used as a feed additive. *Heliyon*, 8, e10030. <https://doi.org/10.1016/j.heliyon.2022.e10030>
- Eatemadi, A., Aiyelabegan, H.T., Negahdari, B., Mazlomi, M.A., Daraee, H., Daraee, N., Eatemadi, R. & Sadroddiny, E. (2017). Role of protease and protease inhibitors in cancer pathogenesis and treatment. *Biomed. Pharmacol.*, 86, 221–231. <https://doi.org/10.1016/j.biopha.2016.12.021>
- El-Gayar, K., Essa, A., & Abada, E. (2020). Whey Fermentation for Protease Production Using *Bacillus thuringiensis* Isolated from Mangrove Rhizosphere Soil in Jazan, Saudi Arabia. *Polish Journal of Environmental Studies*, 29(3), 2167–2176. <https://doi.org/10.15244/pjoes/110583>
- Gopinatha Kurup, G., Adhikari, B., & Zisu, B. (2019). Recovery of proteins and lipids from dairy wastewater using food grade sodium lignosulphonate. *Water Resources and Industry*, 22(100114). <https://doi.org/10.1016/j.wri.2019.100114>
- Holt, J.G., Krieg, N.R., P.H.A. Sneath Stately, J.T. & Williams, S.T. (2004). *Bergey's manual of determinative bacteriology*. 9th Ed., Baltimore: Williams and Wilkins, 787.
- Kocher, G. & Mishra, S. (2010). Immobilization of *Bacillus circulans* MTCC 7906 for enhanced production of alkaline protease under batch and packed bed fermentation conditions. *Internet Journal of Microbiology*. 7.
- Madhu, P.C. (2016). Utilization of dairy effluent for food grade protease production using *Bacillus* sp. *American Journal of Bioscience and Bioengineering*, 4(6), 90.
- Mahakhan, P., Apiso, P., Srisunthorn, K., Vichitphan, K., Vichitphan, S., Punyauppa-Path, S. & Sawaengkaew, J. (2023). Alkaline Protease Production from *Bacillus gibsonii* 6BS15-4 Using Dairy Effluent and Its Characterization as a Laundry Detergent Additive. *J Microbiol Biotechnol.*, 33(2), 195-202. <https://doi.org/10.4014/jmb.2210.10007>
- Markets and Markets Research (2022). Enzymes Market by Product Type (Industrial enzymes and Specialty enzymes), Source (Microorganism, Plant, and Animal), Type, Industrial Enzyme Application, Specialty Enzymes Application, and Region - (2019 - 2025), Accessed on July 29, 2022. <https://www.marketsandmarkets.com/Market-Reports/enzyme-market-46202020.html/>
- Motyan, J.A., Toth, F. & Tozser, J. (2013). Research applications of proteolytic enzyme in molecular biology. *Biomol.*, 3, 923–942. <https://doi.org/10.3390/biom3040923>
- Pant, G., Prakash, A., Pavani, J. V. P., Bera, S., Deviram, G. V. N. S., Kumar, A., Panchpuri, M., & Prasuna, R. G. (2015). Production, optimization, and partial purification of protease from *Bacillus subtilis*. *Journal of Taibah University for Science*, 9(1), 50–55. <https://doi.org/10.1016/j.jtusci.2014.04.010>
- Pant, G., Prakash, A., Pavani, J. V. P., Bera, S., Deviram, G. V. N. S., Kumar, A., Panchpuri, M., & Prasuna, R. G. (2015). Production, optimization and partial purification of protease from *Bacillus subtilis*. *Journal of Taibah University for Science*, 9(1), 50–55. <https://doi.org/10.1016/j.jtusci.2014.04.010>
- Polley, T., & Ghosh, U. (2021). Optimization of Nutritional Parameters by One-Factor-At-A-Time Method for the Biosynthesis of Alkaline Protease from the Isolated Strain *Alternaria alternata* TUSGF1. *Current Biotechnology*, 10(1), 55–60. <https://doi.org/10.2174/2211550110666210217104455>
- Qasim, M. A. (2013). Streptogrisin A. *Handbook of Proteolytic Enzymes*, 2546–2548. <https://doi.org/10.1016/b978-0-12-382219-2.00564-0>
- Tufvesson P, Lima-Ramos J, Nordblad M, Lima-Ramos J, Nordblad M, Woodley JM. (2011). Guidelines and cost analysis for catalyst production in biocatalytic processes. *Org. Process Res. Dev.* 5, 266–274. <https://doi.org/10.1021/op1002165>
- Yang, X., Wang, Z., Zhang, C., Wang, L., Pang, L., Zhang, D., Man, C. & Jiang, Y. (2021). Assessment of the production of *Bacillus cereus* protease and its effect on the quality of ultra-high temperature-sterilized whole milk. *J. Dairy Sci.* 104, 6577–6587. <https://doi.org/10.3168/jds.2020-19818>

PHYTOCHEMICAL, NUTRITIONAL AND FATTY ACID ANALYSIS OF ALSTONIASCHOLARIS (LINN)R.BR. SEEDS FROM FOREST REGIONS OF CHHATTISGARH

Shraddha Pandey,

Govt. Bilasa Girls P.G. College, Bilaspur, Chhattisgarh, India.

(shraddha.t18@gmail.com)

Prof. Dr. Kiran Vajpai,

Govt. Bilasa Girls P.G. College, Bilaspur, Chhattisgarh, India.

(kiranvajpai4@gmail.com)

This study endeavors to investigate the phytochemical properties and fatty acid profile of *Alstoniascholaris* (Linn.) R.Br. seeds were discovered in the forest region of Chhattisgarh. Also known as Saptaparni holds a significant presence in traditional medicinal literature in India. The extracted oil was yellowish and was 20.35% of the total weight. The analysis reveals a refractive index of 1.423, the specific gravity of around 0.85, saponification value of 56.1, iodine value of 56.47 (gm/100gm), acid value of 9.7 (mg/g), and a free fatty acid content of about 4.85% (mg/g). Utilizing Atomic Absorption Spectroscopy, iron, zinc, copper, and manganese contents are determined to be 124.8 ppm, 44.1 ppm, 15.5 ppm, and approximately 26.3 ppm, respectively. Flame photometer analysis discloses sodium, potassium, and calcium content in ppm as 95.94, 2.21, and 65.41, respectively. Saturated fatty acids, specifically Palmitic and Stearic acids, exhibit the highest contents at 11.31 and 8.72, respectively. In unsaturated fatty acids, Oleic and Linoleic acids comprise a significant proportion, with values of 39.86 and 26.86, respectively. The study also quantifies flavonoids and total phenol, with values of 322 mg of QE/100 gm and 139.13 mg of GAE/100 gm, respectively. These findings underscore the potential of *Alstoniascholaris* (Linn.) R.Br. seeds in pharmaceutical and industrial applications, highlighting their diverse applications in various sectors.

Keywords: *Alstoniascholaris*, Fatty Acid, Phytochemistry, Phenolic compound

1. Introduction

Plant-based medicines have been integral to traditional remedies for centuries, spanning various cultures and continuing to play a significant role in healthcare. One key aspect of these medicines is their diverse range of active compounds, including flavonoids and phenolic compounds (Shinde, 2021). The distinctive combination of these compounds contributes to the medicinal properties inherent in these plant-based medicines (Dubale, Kebebe, Zeynudin, Abdissa, & Suleman, 2023). Plant seeds commonly yield oils that hold importance in the nutritional, industrial, and pharmaceutical realms (Nasim, Sandeep, & Mohanty, 2022). The suitability of an oil depends on various factors like its phytochemical constituent, fatty acid, phenolic acid, mineral contents etc. A substantial quantity of non-conventional plants has been systematically surveyed in the quest for novel sources of oils (Kaseke, Opara, & Fawole, 2020).

Alstonia Scholaris has been identified for its medicinal properties as Kusthaghna (a group of plants for curing diseases related to skin), Tikta Skandha (Hebbar, 2013). Part of the Apocynaceae family, *Alstonia Scholaris* natively belongs to the Asian subcontinent and is found in different parts of India like Bengal, Bihar and other places (Chauhan, Saptaparna, White cheesewood (*Alstonia scholaris*), 2019). It is also referred to as Saptaparna, signifying its characteristic arrangement of seven leaves in a whorl. This medium-sized tree can reach

heights of up to 40 meters, typically standing at 12–18 meters with a closely set canopy. The bark is rough, greyish-white, and yellowish inside, and exudes a bitter latex when cut(Khyade, Kasote, & Vaikos, 2014), (Shang, Cai, Zhao, Feng, & Luo, 2010).

The present research aims to investigate the phytochemical properties, as well as the fatty acid, mineral, and phenolic contents of *Alstoniascholaris* seeds. The objective is to explore the potential applications of seed oil in pharmaceuticals, industrial uses, and human consumption.

2. LITERATURE REVIEW

Related research work

The paper, titled "*Fenugreek Seed: Productivity, Nutritional Value, and Uses*" provides a comprehensive review of the applications and utilization of Fenugreek seeds. The focus is on examining the botanical features and productivity of the seeds, with an emphasis on identifying various bioactive constituents. The study aims to explore how these components can be utilized for both human consumption and medicinal purposes(Zuk-Golaszewska & Jadwiga, 2017).

The paper, entitled "*Non-targeted Metabolite Profiling and Scavenging Activity Unveil the Nutraceutical Potential of Psyllium (Plantago ovata Forsk)*" explores the natural antioxidant properties of Psyllium. Through non-targeted metabolite profiling and scavenging activity analysis, the study reveals that Psyllium has significant antioxidant potential. The conclusion drawn is that Psyllium can serve as a valuable source of antioxidants and may be employed as a beneficial dietary supplement(Patel, Mishra, & Jha, 2016).

Igwenyi et al.(Igwenyi, Enyi, Igwenyi, Famurewa, & Obasi, 2017) paper "*Amino Acid Composition, Fatty Acid Profile and Characterization of Vegetable Oil from Hura crepitans se*" was designed to evaluate nutritional quality parameters of oil extracted from *Hura crepitans* seed. The result of the study on seed oil shows the presence of essential and non-essential amino acids.Overall, the study shows an abundance of amino acids, which can be a good source of proteins. Evidence indicates that histidine is an essential amino acid for adults.

In the research paper titled, '*Quantification of Protein and Amino Acid Composition in Some Oilseeds*' by **Arwoar et al.**(Arowora, STEPHEN, Imo, & Emmanuel, 2017)an investigation was conducted on oilseeds, specifically peanuts, sesame seeds, melon seeds, and soybeans seeds. The findings of the study highlight that these selected seeds serve as excellent sources of amino acids essential for both human and livestock nutrition.

Orhan et al.(Orhan, Koca, Aslan Erdem, Kartal, & Kusmenoglu, 2008) '*Fatty Acid Analysis of some Turkish Apricoid Seed Oils by GC and GC-MS Techniques*' study apricot cultivars (*Primus Armeniaca* L.) from three different regions of Turkey (Kalecik, Bodrum, and Malatya) was done using both gas chromatography (GC) and gas chromatography-mass spectrometry (GC-MS). This paper covers the methodology showing the use of Chromatographic techniques for fatty acid analysis

Soni et al., (Soni, et al., 2016)The research on "*Flaxseed Composition and its Health Benefits*" delved into the nutritional aspects of flaxseeds, examining nutrients, anti-nutrients, functional properties, and the health benefits associated with bioactive molecules such as essential fatty acids, lignans, and dietary fibre. The study underscored the significant presence of proteins in substantial quantities within flaxseeds.

Ezeagu et al.(Ezeagu, Petzke, Lange, & Metges, 1998)analyzed the fatty acid contents in selected wild seeds of Nigeria covered in the study titled'Fat content and fatty acid composition of oils extracted from selected wild-gathered tropical plant seeds from Nigeria',.The study shows the content of saturated and unsaturated fatty acids and how the seed oils can be used for industrial purposes.

The paper titled "Phytochemical and Pharmacological Investigations of Ricinus communis Linn."by **Ram Singh et al.**(Singh & Geetanjali, 2015) aimed to identify the presence of diverse bioactive compounds in the plant. The research concluded that Ricinus communis Linn. exhibits medicinal potential, specifically its antimicrobial and anti-diabetic properties, which suggest that it issuitable for pharmaceutical applications.

Vajpai et al.(Dr. Kiran Vajpai, Dr. Sharad Kumar Vajpai, & Shrivastava, 1998) ‘Chemical Examination of Pongamia Pinnata Linn Seeds’ shows that Pongamia pinnata Linn seeds have good amount of calories (6111 calorie/gm) along with unsaturated fatty acids like oleic acid and minerals like Copper, Cobalt, Nickel etc

3. EXPERIENTIAL WORK

Materials and Methods

The seed samples were collected from the forest area of Chhattisgarh. Dirt and other foreign materials were cleaned, and the husk shell of the seeds was removed manually. Subsequently, the seeds were ground in a mixer grinder for analysis.

Oil Extraction

Oil was extracted from Alstoniascholaris (Linn.) R.Br. seeds using a Soxhlet extractor with petroleum ether as the solvent. A total of 239 grams of pulverized seeds were placed in the Soxhlet extractor with petroleum ether for approximately 10 hours, during which the boiling point ranged between 60-80°C. Excess solvent was subsequently removed through a rotary evaporation procedure. The oil yield was calculated, and the extracted oil was stored in a refrigerator for further analysis(Nibe, Sable, & Hi, 2023).Results are captured in **Error! Reference source not found.**

Physicochemical Analysis

The extracted yellow oil yielded 20.35%. Subsequently, the oil underwent analysis for iodine value, saponification value, acid value, free fatty acid, and unsaponifiable matter using the standard method outlined in AOAC(AOAC, 2000).

The refractive index of the oil, which increases with the rise in unsaturation and depends on the chain length of fatty acids, was determined slightly above room temperature using an Abbe refractometer(Food Safety and Standards Authority of India, 2021).

To assess the density of the oil, the specific gravity was determined at a temperature slightly above room temperature using a specific gravity bottle(Food Safety and Standards Authority of India, 2021).The results of Physico-chemical analysis are captured in**Error! Reference source not found..**

Colour	Oil (%)	Refractive Index	Specific Gravity	Saponification Value (mg KOH/gm)	Iodine Value (gm/100gm)	Acid Value (mg/g)	Free Fatty Acid
Yellow	20.35	1.423	0.85	56.1	56.47	9.7	4.85

Mineral Composition of the Seed

To assess the quality of the oil in terms of freshness, storability, and toxicity, it is crucial to evaluate the metal content. Certain metals, such as iron, copper, and manganese, are known to accelerate the oxidation of oil (Nunes, et al., 2011). Approximately 1.0 grams of samples, ground in a mortar and pestle, were taken. Using microwave digestion and atomic absorption spectrometry, the copper, iron, and zinc content were determined (Nunes, et al., 2011).

For this analysis, a known quantity of dehulled grains was placed along with ten millilitres of concentrated nitric acid (69% HNO₃, EMPARTA, Merck) in a pressure vessel. The vessels were loaded into the microwave digestion system. The digested samples recovered from the vessel were then subjected to atomic absorption spectrometry to determine the content of iron, zinc, copper, and manganese. The determination of sodium, potassium, and calcium was carried out with a flame photometer (Avinash, Rao, Robin, Samshuddin, & Dandavathi, 2015). This analysis involved digesting the sample using 10 ml of nitric acid (69%) (Avinash, Rao, Robin, Samshuddin, & Dandavathi, 2015).

Atomic Absorption Spectroscopy Analysis (in ppm)		Flame photometer analysis (in ppm)	
Fe	124.81	Na	95.94
Zn	44.1	K	2.21
Cu	15.5	Ca	26.3
Mn	26.3		

Total Phenols and Flavonoids

The folin-Ciocalteu assay (Singleton & Rossi, 1965), (Martins, Monteiro, do Amaral, & da Silva, 2021) procedure was utilized to determine the total content of phenolic compounds. The result of total phenol and flavonoids of the seeds of Alstoniascholaris (Linn.) R.Br is shown in **Table 3**. The flavonoid content was determined using Aluminium Chloride colorimetric method (Lin & Tang, 2007)

Total Phenols (mg of GAE/100 gm)	Flavonoids (mg of QE/100 gm)
139.13	322.00

Fatty Acid composition of seed oil

The fatty acid composition of Alstoniascholaris (Linn.) R.Br. oil seed was determined through the methyl-esterification process followed by gas chromatography with flame ionization detection (Matthäus & Musazcan Özcan, 2015), (Rosa, Maccioni, & Maxia, 2022). The sample's fatty acid composition was compared with the standard fatty acid composition, and percentages were calculated by normalizing peak areas. The results of the fatty acid analysis is shown in **Table 1, Table 2**

Saturated Fatty Acid	Retention Time (in min)	Area (%)
Palmitic Acid (C16:0)	25.593	11.31
Stearic Acid (C18:0)	30.251	8.72

Arachidic acid (C20:0)	34.233	0.36
Heneicosanoic acid (C21:0)	38.066	0.22
Behenic acid(C22:0)	39.367	0.04
Lignoceric acid(C24:0)	42.734	0.06

Table 2: Unsaturated fatty acid analysis for seeds

Unsaturated Fatty Acid	Retention Time (in min)	Area (%)
Oleic acid(C18:1n9c)	30.648	39.86
Linoleic acid(C18:2n6c)	31.602	36.65
γ -Linolenic (C18:3n6)	32.553	0.29
α -Linolenic acid (C18:3n3)	33.871	0.81
Arachidonic acid (C20:4n6)	37.473	0.15
cis-5,8,11,14,17-Eicosapentaenoic Acid	37.611	0.44
Unknown	37.988	0.28
cis-13,16-docosadienoic acid (C22:2)	41.183	0.11
cis-4,7,10,13,16,19-Docosahexaenoic Acid	41.531	0.04
Nervonic acid(C24:1n9)	43.439	0.47

Discussion

The light-yellow color of the oil is suggestive that it may be suitable for consumption. However, further investigation is necessary to assess potential toxic effects or the presence of harmful chemicals. *The oil yield* of the seed is around 20.35% (palmoilextractionmachine, 2017) which is moderate and can be used for production purposes. *Refractive Index* of the oil of *Alstoniascholaris* (Linn.)R. br. was found to be 1.423. It can serve as an objective method to assess rancidity in edible oils and fats(Awuchi, Ikechukwu, Victory, & Gonzaga, 2018). The result shows that the refractive Index of seed is comparable to that of Peanut and other popular oils(AOAC-921.08, 2023). *The Iodine Value* of the seed oil is found to be 56.47 gm/100m. The selected seeds have a slightly lower value of Iodine indicating less Unsaturated fatty acid. This is in contrast with the Iodine value obtained by Dutta et al.(DUTTA, SEN, & LASKAR, 2010) where it's around 118. Acid Value found in the selected seeds was around 9.7 (mg/g). This is slightly higher than found by Dutta; et al.(DUTTA, SEN, & LASKAR, 2010) where it was found to be 3.73. Lower *Acid value* found in the seed indicates that the oil can be used for consumption(Soetjijptol, Riyanto, & Victoria, 2017). *The saponification value* for the seed oil was found to be 56.1 mg KOH/gm). The lower value indicates that the seed might not be directly used for making soaps. The elemental analysis results from Atomic Absorption Spectroscopy (AAS) indicate a high proportion of iron and flame photometer analysis showing the presence of sodium in significant quantities suggesting specific characteristics of the sample being analysed. The fatty acid analysis of the seed oil indicates a higher concentration of unsaturated fatty acids compared to saturated fatty acids, with a ratio of 79% to 21%. This points to the prevalence of healthier fats in the seeds. Specifically, oleic acid (C18:1n9c) and linoleic acid (C18:2n6c) constitute the majority of unsaturated fatty acids, with respective ratios of 39.86% and 36.65%. This composition suggests a favourable nutritional profile, as both oleic and linoleic acids are associated with positive health effects, including cardiovascular benefits. Among the saturated fatty acids

Palmitic and Stearic acid were found to be in large quantities. These results agree with the findings Dutta et. al.(DUTTA, SEN, & LASKAR, 2010)

The presence of significant amounts of total phenols and flavonoids in the seeds suggests the manifestation of antioxidant properties in the seed(Sharma & Giri, 2022).

Conclusion

Overall the results indicate that the seeds of *Alstoniascholaris* (Linn.)R.Br.posses good antioxidant properties. Owing to the presence of oleic acid and linoleic acid the seed can be used for dietary purposes. Also, these fatty acids help present cardiovascular disorders and regulate blood pressure. Further studies can be done to check the applicability of the seed oil in the cosmetic industry(DUTTA, SEN, & LASKAR, 2010)

References

- AOAC (2001) 996.06. (2001). Official Methods of Analysis. 19th edn. Association of Official Analytical Chemists.
- AOAC. (2000). Official Methods of Analysis, 13th ed. Washington D.C., USA: Association of Official Analytical Chemist.
- AOAC, M. (1990). Official methods of analysis of the Association of Official Analytical Chemists, 1th Edn. WASHINGTON D.C., U.S.A: Association of Official Analytical Chemists.
- AOAC-921.08. (2023, 12 10). Refractive Index of Edible Oils and Fats | AOAC 921.08. Retrieved from www.mt.com: <https://www.mt.com/in/en/home/library/applications/lab-analytical-instruments/refractive-index-of-oils-and-fats-aoac-92108.html>
- Arif, M., Masood, T., & Shah, S. (2012). EVALUATION OF OIL SEEDS FOR THEIR POTENTIAL NUTRIENTS. Chemistry.
- Arowora, K., STEPHEN, E., Imo, C., & Emmanuel, U. (2017). Quantification of Protein and Amino Acid Composition in Some Oilseeds. *Biochemistry and Molecular Biology*, 2, 8-11.
- Avinash, N., Rao, H., Robin, K., Samshuddin, S., & Dandavathi, D. (2015). Estimation of calcium, potassium and sodium contents in commonly consumed food of Karnataka coastal belt region, India. *Der Chemica Sinica*, 6(4):100-103.
- Awuchi, C., Ikechukwu, A., Victory, I., & Gonzaga, A. (2018). EFFECTS OF REPEATED DEEP FRYING ON REFRACTIVE INDEX AND PEROXIDE VALUE OF SELECTED VEGETABLE OILS. *International Journal of Advanced Academic Research | Sciences, Technology & Engineering*, Vol. 4, Issue 4.
- Chakradhari, S., Patel, K., Towett, E., Martín-Ramos, P., & Gnatowski, A. (2019). Chemical Composition of *Abrus precatorius* L. Seeds. *European Journal of Medicinal Plants*, 28(1), 1-6.
- Chauhan, D. M. (2019, 05 01). Retrieved from Saptaparna, White cheeseewood (*Alstonia scholaris*): <https://www.planetayurveda.com/library/saptaparna-alstonia-scholaris/>
- Chauhan, D. M. (2023, 07 10). Saptaparna, White Cheeseewood (*Alstonia scholaris*). Retrieved from planetayurveda.com: <https://www.planetayurveda.com/library/saptaparna-alstonia-scholaris/>
- Dr. Kiran Vajpai, P., Dr. Sharad Kumar Vajpai, P., & Shrivastava, D. (1998). Chemical Examination of *Pongamia Pinnata* Linn Seeds. *Orient.J.chem.*, 173-174.
- Dubale, S., Kebebe, D., Zeynudin, A., Abdissa, N., & Suleman, S. (2023). Phytochemical Screening and Antimicrobial Activity Evaluation of Selected Medicinal Plants in Ethiopia. *Journal of experimental pharmacology*, 15, 51–62.
- DUTTA, M., SEN, S., & LASKAR, S. (2010). Fatty acid composition of *Alstonia scholaris* (Linn.) R. Br. seed oil having some antibacterial principles. *Biosciences, Biotechnology Research Asia*, Vol. 7(1), 481-484.
- Ezeagu, I., Petzke, K., Lange, E., & Metges, C. (1998). Fat content and fatty acid composition of oils extracted from selected wild-gathered tropical plant seeds from Nigeria. *Journal of Oil & Fat Industries*, 75, 1031-1035.
- Food Safety and Standards Authority of India. (2021). Determination of Refractive Index . In *Manual of methods of analysis of foods oils and fats* (pp. FSSAI 02.003:2021, Page-6). New Delhi: Food Safety and Standards Authority of India.

- Food Safety and Standards Authority of India. (2021). Determination of Specific Gravity. In Manual of methods of analysis of foods oils and fats (pp. 4-5,FSSAI 02.002:2021). New Delhi: Food Safety and Standards Authority of India.
- Hebbar, D. J. (2013, 10 08). Saptaparna - *Alstonia scholaris*: Benefits, Usage in Ayurvedic Treatment. Retrieved from <https://www.easyayurveda.com/>
<https://www.easyayurveda.com/2013/10/08/saptaparna-alstonia-scholaris-benefits-usage-in-ayurvedic-treatment/>
- Igwenyi, I., Enyi, N., Igwenyi, I., Famurewa, A., & Obasi, N. (2017). AMINO ACID COMPOSITION, FATTY ACID PROFILE AND CHARACTERIZATION OF VEGETABLE OIL FROM HURA CREPITANS SEED. *International Journal of Biology, Pharmacy and Applied Sciences*, 6, 1781-1791.
- Ingale, S., & Shrivastava, S. (2011). Amino Acid Profile of Some New Varieties of Oil Seeds. *Advance Journal of Food Science and Technology*, 3.
- Kaseke, T., Opara, U. L., & Fawole, O. A. (2020). Fatty acid composition, bioactive phytochemicals, antioxidant properties and oxidative stability of edible fruit seed oil: effect of preharvest and processing factors. *Heliyon*, 6(9), e04962.
- Khyade, M., Kasote, D., & Vaikos, N. (2014). *Alstonia scholaris* (L.) R. Br. and *Alstonia macrophylla* Wall. ex G. Don: A comparative review on traditional uses, phytochemistry and pharmacology. *Journal of ethnopharmacology*, 153(1), 1-18.
- Knothe, G., De Castro, M., & Razon, L. (2015). Methyl Esters (Biodiesel) from and Fatty Acid Profile of *Gliricidia sepium* Seed Oil. *Journal of the American Oil Chemists' Society*, 92, 769-775.
- Lin, J., & Tang, C. (2007). Determination of Total Phenolic and Flavonoid Contents in Selected Fruits and Vegetables, as Well as Their Stimulatory Effects on Mouse Splenocyte Proliferation. *Food Chemistry*, 101, 140-147.
- Martins, G. R., Monteiro, A. F., do Amaral, F. R., & da Silva, A. S. (2021). A validated Folin-Ciocalteu method for total phenolics quantification of condensed tannin-rich açai (*Euterpe oleracea* Mart.) seeds extract. *Journal of Food Science and Technology*, 58, 4693–4702 (2021).
- Matthäus, B., & Musazcan Özcan, M. (2015). Oil Content, Fatty Acid Composition and Distributions of Vitamin-E-Active Compounds of Some Fruit Seed Oils. *Antioxidants (Basel, Switzerland)*, 4(1), 124–133.
- Nasim, N., Sandeep, I. S., & Mohanty, S. (2022). Plant-derived natural products for drug discovery: current approaches and prospects. *The Nucleus : an international journal of cytology and allied topics*, 65(3), 399–411.
- Nibe, M. R., Sable, M. S., & Hi, M. R. (2023). Extraction of Oil from Watermelon Seed using Soxhlet Extractor. *INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN TECHNOLOGY*, Volume 9 Issue 9 | ISSN: 2349-6002, PP 33-36.
- Nkafamiya, I., Maina, H., Osemeahon, S., & Modibbo, U. (2010). Percentage oil yield and physiochemical properties of different groundnut species (*Arachis hypogaea*). *African Journal of Food Science*, Vol. 4(7) pp. 418 - 421.
- Nunes, L. S., Barbosa, J. T., Fernandes, A. P., Lemos, V. A., Santos, W. N., Korn, M. G., & Teixeira, L. S. (2011). Multi-element determination of Cu, Fe, Ni and Zn content in vegetable oils samples by high-resolution continuum source atomic absorption spectrometry and microemulsion sample preparation. *Food Chemistry*, Volume 127, Issue 2, Pages 780-783,.
- Orhan, I., Koca, U., Aslan Erdem, S., Kartal, M., & Kusmenoglu, S. (2008). Fatty acid analysis of some Turkish apricot seed oils by GC and GC-MS techniques. *Turkish Journal of Pharmaceutical Sciences*, 5.
- palmoilextractionmachine. (2017, 01 10). What is the oil content of different oil seeds? Retrieved from [www.palmoilextractionmachine.com:](https://www.palmoilextractionmachine.com/)
https://www.palmoilextractionmachine.com/FAQ/oil_content_of_different_oil_seeds_506.html
- Patel, M., Mishra, A., & Jha, B. (2016). Non-targeted Metabolite Profiling and Scavenging Activity Unveil the Nutraceutical Potential of *Psyllium* (*Plantago ovata* Forsk). *Frontiers in Plant Science*, 7.

- Rosa, A., Maccioni, D., & Maxia, A. (2022). Fatty acid and triacylglycerol composition of seed and pericarp oils of the medicinal crop *Withania somnifera* (L.) Dunal cultivated in Sardinia (Italy). *Natural product research*, 36(8), 2129–2134.
- Shang, J., Cai, X., Zhao, Y., Feng, T., & Luo, X. (2010). Pharmacological evaluation of *Alstonia scholaris*: anti-tussive, anti-asthmatic and expectorant activities. *Journal of ethnopharmacology*, 129(3), 293–298.
- Sharma, K. R., & Giri, G. (2022). Quantification of Phenolic and Flavonoid Content, Antioxidant Activity, and Proximate Composition of Some Legume Seeds Grown in Nepal. *International journal of food science*, 2022: 4629290.
- Shinde, D. M. (2021). *Advances in Academic Research and Development*. In D. M. Shinde, *Advances in Academic Research and Development* (pp. Volume - 5 (pp.143-165)). New Delhi, India: Integrated Publications.
- Singh, R., & Geetanjali. (2015). Phytochemical and Pharmacological Investigations of *Ricinus communis* Linn. *Algerian J. Nat. Products*, 3, 120-129.
- Singleton, V. L., & Rossi, J. A. (1965). Colorimetry of Total Phenolics with Phosphomolybdic-Phosphotungstic Acid Reagents. *Am J Enol Vitic*, 16:144-158.
- Soetjijpto1, H., Riyanto, C. A., & Victoria, T. (2017). Chemical characteristics and fatty acid profile of butterfly tree seed oil (*Bauhinia purpurea* L). *IOP Conf. Series* (p. 349 (2018) 012024). Indonesia: IOP Conf. Ser.: Mater. Sci. Eng.
- Soni, R., Katoch, M., Kumar, A., Csk, V., Pradesh, H., & Vishwavidyalya, K. (2016). Flaxseed-composition and its health benefits. *Res. Environ. Life Sci.*, 9(3), 310-316.
- Vajpai, K., Vajpai, S., & Shrivastava, D. (1988). Chemical Examination of *Celastrus Paniculatus* Seeds. *Orient J Chem*, 14(3), 487-488.
- Zotta, T., Loukhamas, S., Kerak, E., Elgadi, S., Ettalibi, F., El Antari, A., & Harrak, H. (2021). Oil Content, Fatty Acid Composition, Physicochemical Properties, and Antioxidant Activity of Seed Oils of Ten Moroccan Pomegranate Cultivars. *Journal of Food Quality*, Volume 2021 | Article ID 6617863.
- Zuk-Golaszewska, K., & Jadwiga, W. (2017). Fenugreek: Productivity, nutritional value and uses. 22(10.5601/jelem.2017.22.1.1396).

AN OVERVIEW OF THE PROGRESSION OF MIXED DESIGN APPROACHES FOR ENHANCING THE PERFORMANCE OF RECYCLED AGGREGATE CONCRETE (RAC)

Abhishek Singh,

Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India.
(abhisingh20589@gmail.com)

Rajendra Kumar Choubey,

Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India
(rkchoubey.ggv@gmail.com)

The global escalating urbanization has led to a surge in construction and demolition waste (C&D), notably concrete waste, posing a dire environmental challenge. The volume of C&D waste generated is staggering, demanding immediate attention due to the glaring disparity between waste generation and recycling capacity. This paper delves into sustainable solutions to mitigate this issue, emphasizing the incorporation of recycled aggregates (RAs) into concrete, a practice that offers both cost benefits and significant environmental advantages. The study focuses on mix design methods for Recycled Aggregate Concrete (RAC), delving into various approaches like Direct Weight Replacement (DWR), Direct Volume Replacement (DVR), Equivalent Mortar Volume (EMV), and Particle Packing Method (PPM). These methods seek to optimize RAC's properties, addressing the critical environmental impacts of conventional concrete production. An extensive literature review examines the performance, environmental benefits, and challenges associated with each approach. We also identify research gaps and the need for standardized RAC mix design methodologies. This review is a foundation for enhancing RAC's potential in sustainable construction practices, contributing to resource conservation and reduced landfill dependence.

Keywords: Recycled Aggregate Concrete, Mix Design Methods, Particle Packing Methods, Construction and Demolition Waste, and Sustainable Construction.

1. INTRODUCTION

Preserving natural resources and safeguarding the environment are fundamental principles of sustainable development. The rapid urbanization trends witnessed in recent times have led to a substantial upsurge in the production of construction and demolition (C&D) debris, mainly concrete waste. The adverse consequences of this phenomenon are evident, with significant quantities of C&D waste being indiscriminately disposed of in landfills, neglecting opportunities for further utilization. According to a report by the Building Material Promotion Council (BMPTC) released in August 2020, India is estimated to generate 150 million tonnes [1] of construction and demolition (C&D) waste annually. This immense volume of waste poses a significant challenge regarding proper management and disposal. However, a recent analysis conducted by the Centre for Science and Environment (CSE) sheds light on another concerning aspect of the situation. The official recycling capacity in India stands at a meager 6,500 tonnes per day (TPD), [2] which accounts for only about 1 percent of the total waste generated. This alarming disparity between waste generation and recycling capacity calls for urgent attention and action. In response to this challenge, researchers and professionals in the construction field actively strive to identify sustainable and reusable construction materials derived from this discarded debris, aiming to mitigate the depletion of natural resources and promote responsible environmental stewardship. The construction industry relies heavily on concrete as a vital material. It is favoured by civil engineers worldwide because of its excellent performance, long lifespan, and low maintenance requirements.

The growing demand for concrete production necessitates a substantial increase in the utilization of natural aggregates (NAs), which typically constitute 60%-75% of the total volume of concrete [3]. In 2015 alone, the worldwide consumption of NAs reached approximately 48.3 billion tonnes, with an estimated 5% growth rate every five years [4]. Given the current trajectory, projections indicate that the demand for NAs will double within the next two to three decades. Consequently, the surge in construction and demolition waste (CDW) exacerbates the need for large landfill spaces, encroaching upon valuable farmlands. The United States Environmental Protection Agency defines CDW as the waste generated during new construction projects, renovations, or the demolition of existing structures, such as roads, bridges, buildings, utility plants, piers, and dams [2]. The alarming volume of CDW not only strains landfill capacities but also presents environmental and economic concerns. In 2013, China alone disposed of an astounding 7.5 billion cubic meters of CDW in landfill sites, which could cover half of Singapore's total land area with a dumping height of 20 meters, as [5] reported.



Source: Persistence Market Research

Figure 1.1: Global Market Study on Construction Aggregates and Increasing Investments in Infrastructure Development Driving Worldwide Demand

Given these challenges, it becomes imperative to explore sustainable solutions that address the increasing demand for concrete while mitigating the environmental impact of CDW. Effective management and utilization of CDW, mainly through recycling and incorporating recycled aggregates into concrete mixes, can significantly alleviate the strain on natural resources and reduce the need for extensive landfill spaces. The limited availability of landfill space has far-reaching implications, including significant increases in waste disposal costs and heightened environmental concerns [6, 7]. It is important to note that construction and demolition waste (CDW) can contain hazardous substances such as varnish, sealers, adhesives, lead-based paint, and mercury found in fluorescent lamps [8]. These contaminants pose a severe risk of soil and groundwater pollution. In light of these challenges, proactive measures must be taken to address the proper management and disposal of CDW. Over the past seven decades, extensive research has consistently demonstrated the potential environmental and economic benefits of incorporating recycled aggregates (RAs) derived from construction and demolition waste (CDW) as a substitute for natural aggregates (NAs) in the production of recycled aggregate concrete (RAC). It has been estimated that utilizing RAs in place of NAs in concrete construction can yield material cost savings of approximately 10% to 20% [5]. Moreover, the advantages of RAC extend beyond cost reduction. Recycled aggregate refers to the utilization of aggregates obtained from discarded and demolished waste, including rubble, masonry, and concrete structures. The construction industry can make significant strides toward sustainable practices and waste reduction by incorporating recycled aggregates into the mix. RAC involves replacing a portion or even the entire coarse and fine natural aggregates with recycled aggregate (RA). This strategic use of recycled aggregate is a pivotal stride towards fostering environmentally conscious practices in the concrete industry and curbing waste generation in the construction sector. Ding et al. [11] conducted an analysis in China, applying the cradle-to-cradle theory and utilizing the database developed by the China Centre of National Material Life Cycle Assessment and the IPCC method. The study emphasized that cement utilization and transportation are significant factors contributing to CO₂ emissions and energy consumption in Recycled Aggregate Concrete (RAC) production. It was found that Recycled Concrete Aggregate (RCA) can help minimize these environmental impacts. Similarly, Braga et al. [12] investigated 216 different RAC mixes. During the concrete preparation stage, they found that cement is the primary contributor to environmental impacts, which can be mitigated by incorporating RCA. Additionally, Marinković et al. [13] compared the environmental impacts of four different types of green concrete mixes, including RAC, Natural Aggregate Concrete (NAC), RAC with high-volume fly ash, and NAC with alkali-activated fly ash, against conventional concrete. Their findings shed light on the potential environmental benefits of utilizing RAC and alternative concrete mixes in reducing overall environmental impacts. Recycled aggregate exhibits diverse characteristics, and the overall quality of the collected material and its efficient transportation to processing plants significantly impact the final quality of the recycled aggregate. Incorporating recycled aggregates derived from construction and demolition waste not only helps conserve natural aggregate resources but also diminishes the demand for waste disposal facilities.

Marinkovic et al. [9] conducted a study in Serbia. They found that the environmental impacts associated with the preparation of Recycled Aggregate Concrete (RAC) were higher compared to Natural Aggregate Concrete (NAC). This difference was attributed to the higher environmental impacts associated with processing recycled aggregate (RA) compared to natural aggregate (NA). Notably, the transportation distance of RA relative to NA played a significant role in determining the overall environmental impacts of RAC. Similarly, Knoeri et al. [10] estimated a notable reduction of approximately 30% in the environmental impacts of RAC compared to NAC. These results emphasize the significance of taking into account the environmental effects of employing recycled aggregates in concrete production and the potential advantages of including RAC in sustainable building techniques.

Extensive research has been conducted on the technical aspects of Recycled Aggregate Concrete (RAC) as an alternative to Natural Aggregate Concrete (NAC) in previous studies (Mukherjee and Barai, [14]; Pradhan et al., [15]; Sadati et al., [16]). Some earlier investigations have examined the maximum possible replacement percentage of Recycled Coarse Aggregate (RCA) in RAC without compromising its macro-mechanical properties (Chakradhara Rao et al., [17]; Etxeberria et al., [18]; Fraile-Garcia et al., [19]). However, it has been advised against completely replacing Natural Coarse Aggregate (NCA) with RCA due to the potential reduction in RAC performance (Behera et al., [20]; Fraile-Garcia et al., [19]).

Various mixed design methods and approaches have been proposed to achieve RAC with satisfactory mechanical properties suitable for construction purposes. Among these methods, including the Direct Weight Replacement (DWR), Direct Volume Replacement (DVR), Equivalent Mortar Volume (EMV) (Fathifazl et al., [21]), and Particle Packing Method (PPM) (Pradhan et al., [15]), the EMV and PPM approaches have shown promise as effective mix design methods for proportioning RAC. However, the mechanical properties of RAC with complete substitution of Natural Coarse Aggregate (NCA) with Recycled Coarse Aggregate (RCA) have not been thoroughly explored using the EMV method. This is primarily due to practical challenges in completely removing attached mortar from RCA. In contrast, the PPM mix design approach offers the potential for achieving 100% RCA utilization while meeting RAC performance parameters. Further investigation into the mechanical properties of RAC with complete substitution of NCA with RCA using the EMV method is warranted to address this research gap.

1.1 Mixed Design for NAC and RAC

Mix Design for Normal Aggregate Concrete (NAC) involves a systematic and rigorous process to determine the most suitable combination of cement, aggregates, water, and admixtures to achieve the desired concrete properties. The initial step encompasses setting design parameters, including targeted compressive strength, workability, water-cement ratio, and maximum nominal aggregate size. Material selection plays a critical role, with careful consideration given to appropriate cement types and well-graded aggregates (both coarse and fine) based on their inherent characteristics.

Subsequently, mix proportions are computed using the Indian Standard (IS) method, considering the water-cement ratio and aggregate grading. To validate the mix, trial batches are meticulously prepared and subjected to laboratory testing, evaluating fresh and hardened properties. Fine adjustments are made based on test results to optimize the mix's performance. Quality control and assurance mechanisms are steadfastly employed throughout the process to ensure consistency and adherence to precise specifications. Determining the optimal water-cement ratio for Normal Aggregate Concrete (NAC) is a crucial aspect of mix design, influencing workability, strength, durability, and overall performance. To achieve the best results, a comprehensive step-by-step approach is employed, combining empirical testing and engineering judgment. The process involves the following key stages:

1. Establish Design Requirements: Clearly define the specific application requirements for NAC, considering factors such as desired compressive strength, workability, exposure conditions, construction methods, and structural needs.
2. Perform Trial Mixes: Prepare multiple trial mixes of NAC, each with varying water-cement ratios within a reasonable range. All other components and their proportions remain constant for consistency.
3. Conduct Workability Tests: Evaluate the workability of each trial mix through standard tests, such as the slump cone test or flow table test, to assess the ease of handling and placing the concrete.
4. Perform Compressive Strength Tests: After curing the trial mixes under standardized conditions, conduct compressive strength tests at different curing ages to determine the strength development for each water-cement ratio.

5. Evaluate Other Properties: Alongside compressive strength, assess other essential properties, including durability, permeability, and shrinkage, to identify potential issues associated with extreme water-cement ratios.
6. Analyse Results: Compare the performance of different trial mixes to identify the water-cement ratio that best meets the design requirements, balancing strength, workability, and durability.
7. Consider Practical Constraints: Account for practical constraints that may exist during construction, such as environmental conditions, material availability, and construction practices. The chosen water-cement ratio should be feasible and practical for the construction site.
8. Engineering Judgment: Based on the test results and engineering judgment, select the water-cement ratio that aligns with the project's long-term performance and sustainability goals.
9. Verify with Additional Testing: If necessary, conduct further testing on the selected water-cement ratio to validate its suitability and performance under specific project conditions.

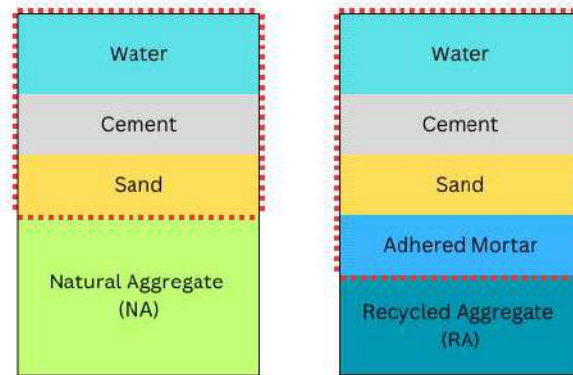


Figure 1.2: (a) Conventional mix with Natural Aggregate, and (b) Conventional mix with Recycled Aggregate

It is essential to recognize that the optimal water-cement ratio may vary depending on the project's unique requirements and the types of aggregates and cement used. Consistent quality control during concrete production is critical to ensure the reliability and performance of the NAC mix. The mix design changes while making concrete for RAC can vary depending on the approach used. It may include adjustments to the water-cement ratio, the amount of cement paste, the type and quantity of recycled aggregates, and the use of additives or admixtures to improve the properties of RAC. The optimal mix design may depend on various factors, such as the intended application of RAC, the availability and quality of recycled aggregates, and the desired performance characteristics. To enhance the performance of RAC, researchers have proposed various mixed-design approaches and treatment techniques. Here are some of the mixed design changes mentioned in the search results:

1. Equivalent mortar volume: The Equivalent Mortar Volume (EMV) method is a mixed design approach that considers Recycled Concrete Aggregate (RCA) as a composite material consisting of mortar and natural aggregate. The EMV method considers both components' relative amounts and properties when using RCA in concrete mixes. It adjusts the proportions of fresh coarse aggregate and fresh paste in the mix accordingly. By accounting for the presence of mortar in RCA, the EMV method helps optimize the concrete mixture to achieve desired performance and ensure efficient utilization of recycled materials.
2. Modified equivalent mortar volume: This approach involves adjusting the water-cement ratio and the amount of cement paste in the mixture to compensate for the porosity and water absorption of the recycled aggregates.
3. Two-stage mixing approach: This approach involves splitting the mixing process into two stages to improve the quality of RAC.
4. Hybrid machine learning model: This approach uses a machine learning model to optimize the mixture design of RAC based on target compressive strength classes.
5. Variation in mixing approaches: This approach involves comparing different mixing approaches to determine their influence on the fresh and hardened properties of RAC.
6. Modification of RCA techniques: This involves modifying the techniques used to produce recycled concrete aggregates (RCA) to improve their quality and performance in RAC.

7. Improvement of interfacial transition zone (ITZ) performance: This involves improving the bond between the cement paste and the recycled aggregates to enhance the durability of RAC.

2. Scope of Research Investigation on Recycled Aggregate Concrete (RAC)

Extensive research on Recycled Aggregate Concrete (RAC) has been conducted worldwide, particularly in China, as evidenced by the literature survey and references cited in this paper. Despite these efforts, there is still untapped potential to fully realize the optimal benefits of RAC. The performance of RAC is strongly influenced by factors such as the source of recycled aggregates and the quantity of adhered mortar. The findings of this study aim to instil greater confidence among local industries regarding the effective utilization of RAC.

3. Research Gaps

Despite previous review papers on Recycled Aggregate (RA) and Recycled Aggregate Concrete (RAC), there are notable gaps in the current literature, underscoring the necessity for a comprehensive review. This section addresses the research gaps identified during the literature survey and ensures that they are effectively covered in this paper. By recognizing and addressing these gaps, this study strives to contribute to the existing knowledge on mixed design approaches for enhancing the performance of RAC and provide valuable insights for researchers and practitioners in the field.

- 1) There is a research gap in terms of a comprehensive synthesis and analysis of mixed design techniques specifically aimed at enhancing the performance of Recycled Aggregate Concrete (RAC). Existing research primarily focuses only on individual aspects of RAC, such as the properties of recycled aggregates or the performance of RAC in specific applications.
- 2) There is a need for a consolidated review that explores the evolution of mixed design approaches for RAC and their effectiveness in improving its performance. The review should consider various factors, including aggregate properties, treatment methods, and optimization strategies.
- 3) Recent relevant studies on RA and RAC have not been included in the existing reviews and databases, despite the growing research interest in this field. Previous reviews have primarily focused on recycled concrete aggregate for RAC, overlooking other types of recycled aggregates, such as recycled clay brick aggregate or recycled mixed aggregate, contributing to landfill reduction and natural resource preservation.
- 4) A comprehensive review is needed to identify current barriers and establish a roadmap for further investigations.

As previously stated in the introduction, the scope of research gaps mentioned above is extensive, making it challenging to address all of them comprehensively in a single paper. By narrowing the scope and emphasizing the historical evolution of mixed design approaches for RAC, this paper aims to provide a detailed exploration of this specific aspect while acknowledging the broader context of research gaps in the field of recycled aggregate utilization.

4. Literature Review

The literature presents Direct Weight Replacement (DWR) as a pivotal mix design approach in crafting Recycled Aggregate Concrete (RAC). In the DWR method, the integration of recycled aggregate takes place in a proportionate weight-to-weight manner, effectively substituting the natural aggregate. This technique is prominent among RAC's commonly employed mix design methods [22, 23]. An investigation has extensively explored the integration of DWR in the context of RAC and its consequential environmental implications. Particularly, its environmental impact assessment has been conducted using a comparative Life Cycle Assessment (LCA). The findings of such assessments indicate that RAC formulated through the DWR approach exhibits a notably diminished environmental footprint compared to RAC prepared using conventional design mix methods [22].

Presently, a universally recognized mix design methodology for Recycled Aggregate Concrete (RAC) remains absent, though, within the scope of diverse approaches, the Direct Weight Replacement (DWR) technique emerges as one of the extensively practiced methods [22]. Similarly, the Direct Volume Replacement (DVR) approach enjoys significant popularity, albeit it may encompass certain disparities in its application with regard to procedural specifics and considerations [26].

The DVR method facilitates the direct substitution of natural aggregate volume with recycled aggregate, thereby actively advocating sustainability by curbing the demand for natural resources and ameliorating the challenge of

waste accumulation in landfills. Notably, the DVR technique's implementation might incur variations concerning procedural intricacies and considerations due to the prevailing absence of a standardized mix design procedure for RAC [24]. However, meticulous adherence to apt mix design practices and thorough testing ensures the realization of mandated performance benchmarks for RAC produced through the DVR route. The DVR methodology considers the volume of recycled aggregate, thereby aptly recalibrating mix proportions correspondingly. In contrast, alternative methodologies, such as the Equivalent Mortar Replacement (EMR) approach, focus on the proportion of mortar within the recycled aggregate [25].

Remarkably, a comparative Life Cycle Assessment (LCA) study distinctly demonstrated that RAC crafted through the DVR method bears a reduced environmental footprint in comparison to RAC prepared using the conventional design mix approach [22].

The method known as the Equivalent Mortar Volume (EMV) finds application as a mixed design strategy within the realm of Recycled Aggregate Concrete (RAC) production. In this method, Recycled Mortar (RM) is equated with the newly introduced mortar, reducing the quantities of fresh cement, sand, and water by an extent equivalent to the volume of RM incorporated [27]. Remarkably, the total mortar volume within RAC is retained with that in Natural Aggregate Concrete (NAC). The EMV approach is notably employed to enhance the physical, mechanical, and durability attributes of RAC [28, 29]. It concurrently serves the purpose of curbing the requisites for fresh cement, sand, and water in the mix design of RAC.

The evolution of the EMV technique has culminated in the formulating of the Modified Equivalent Mortar Volume (M-EMV) methodology. M-EMV aids in quantifying RM volume within RAC while concurrently determining the corresponding quantities of fresh cement, sand, and water essential for the mix design of RAC. The EMV methodology exhibits promise as a mixed design technique for RAC, necessitating further research endeavours to ascertain its efficacy and limitations comprehensively.

The EMV mix design strategy tailored for RAC is appreciably sensitive to the distinctive attributes inherent in recycled aggregates, harnessing their latent potential by incorporating residual mortar. This meticulous integration translates to an augmentation in the properties of RAC, concurrently yielding advantages in terms of reduced environmental impact and resource consumption when contrasted with conventional mix design methodologies.

The Particle Packing Method (PPM), an innovative approach rooted in void optimization, seeks to harness the potential of aggregates for achieving optimal concrete density and strength [15]. This concept involves an intricate process of aggregate selection, both conventional and recycled, to configure particle packing and minimize voids meticulously. Remarkably, PPM exhibits impressive outcomes in refining RAC's physical, mechanical, and durability attributes [15, 31]. This approach emerges as a beacon of promise within the realm of RAC mix design, although its complete efficacy and boundaries beckon further scrutiny. The methodology's focal point resides in enhancing particle packing and minimizing aggregate voids, thereby culminating in concrete of improved density, strength, and resilience.

The distinctive characteristics of recycled aggregates, such as water absorption and angularity, don't go unnoticed within the PPM framework. By integrating these nuances, PPM attains the desired particle packing to optimize concrete properties. Through its synergy with TSMA, RAC production achieves new heights of excellence. While its potential shines, PPM's extensive potential calls for comprehensive exploration. This exploration warrants an exhaustive series of trials and analyses to determine the perfect interplay of aggregates and the precise proportions of cement, aggregates, and water within the mix design.

However, PPM's path to integration isn't devoid of obstacles. Compatibility with existing concrete mix design standards becomes a stumbling block in specific contexts. The absence of standardized procedures exacerbates this issue, allowing both process and results variations. The uniqueness of recycled aggregates, influenced by sourcing and processing, muddies the waters, complicating the aggregation composition's optimization. Yet, while the road ahead may be winding, PPM's adaptability doesn't stop at RAC; it extends its influence to conventional concrete mix design. The PPM focuses on particle packing, an asset regardless of concrete type [22, 29, 30 and 31].

However, PPM isn't a catch-all solution. The methodology insists on meticulously considering aggregate properties, including size distribution, shape, and surface texture. It's a bespoke approach, with every detail tailored to the concrete's nuances and requirements. Nevertheless, while PPM provides a theoretical roadmap, it doesn't sidestep the necessity for rigorous testing. This verification is vital for assessing the concrete's properties and guaranteeing its performance matches expectations [15, 30].

In the realm of Recycled Aggregate Concrete (RAC) mix design, the Particle Packing Method (PPM) showcases diverse adaptations, each painting a unique picture of its application and impact [15, 30]. The canvas of possibilities unravels as we delve into the nuances of these types, unveiling a tapestry of optimization techniques.

At the heart of these methods lies the Traditional Particle Packing Method. Here, the strategy dances around selecting smaller particles, which effortlessly fill the voids between their larger counterparts. This intricate

dance aims at optimizing the particle packing, gracefully reducing the void content in the mixture. However, innovation is never far behind. Enter the Modified Particle Packing Method, an incarnation that seeks enhancement through nuanced adjustments. Researchers propose changes to the traditional dance, with alterations in particle size distribution or including other variables like aggregate shape and surface texture.

Meanwhile, the Multi-Stage Particle Packing Method unfurls its wings in another corner of this design arena. This is an exploration in layers, an orchestration in phases. It envisions mix design as a multi-step performance, with each act dedicated to perfecting the particle packing for specific fractions of aggregates. This intricate symphony aspires to culminate in a harmonious outcome of enhanced overall particle packing and reduced voids [15, 30].

Yet, as we journey further, mathematical constructs come to the fore - the Model-based Particle Packing Method. These models, these intricate frameworks, attempt to predict and orchestrate particle packing through mathematics. They consider a mosaic of variables - particle size distribution, shape, surface texture - to choreograph the optimal combination of aggregates. A melodic dance of calculation and composition emerges, driven by the rhythm of optimization.

The narrative takes an intriguing twist when we venture into Dry and Wet types of Particles Packing Method (PPM). Distinct from the traditional and modified counterparts, these forms operate on a different wavelength altogether [31, 33, 34]. Their stage isn't the concrete mixture but the ethereal world of powder particles in cementitious materials.

The stage remains devoid of moisture in the Dry PPM, a thorough dry affair. Here, the spotlight is cast solely on the packing density of powder particles without any water influence. The absence of water renders the arrangement less than optimally packed, a dance of particles seeking their place without the guiding touch of water.

On the other hand, Wet Packing sees the water entrance, transforming the stage. Powder particles meet water, resulting in a shift in the arrangement. Now, the water occupies spaces once graced by the powder particles. The dance assumes a different rhythm and a different configuration. The powder particles, now cradled by water, stand differently. The wet packing method, a symphony of water and powder, measures the packing density of aggregates in this new, watery context [35].

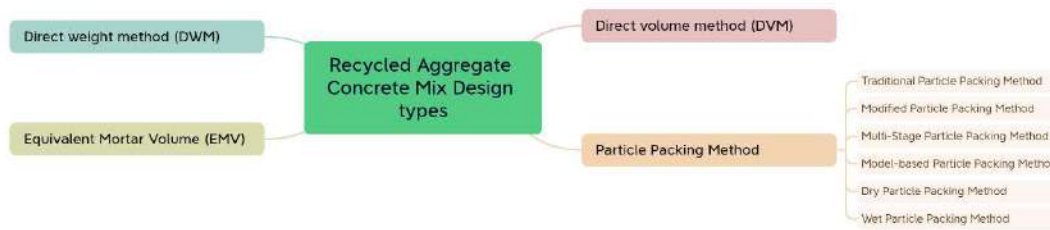


Figure 1.3: Classification of RAC Mix design based on the literature review

4.1 Another important classification of RCA's Mixed Design

The classification of various Mixed Design approaches for Recycled Concrete Aggregate (RCA) can be categorized based on different methods and techniques used to proportion the concrete mix, as also mentioned in the previous section. Here in this section, a detailed classification will be discussed:

1. **The modified Equivalent Mortar Volume (MEMV) method** is a variation of the Equivalent Mortar Volume (EMV) method designed explicitly for Recycled Aggregate Concrete (RAC). The MEMV method aims to proportion RAC mixes by considering the adhered mortar volume on the recycled coarse aggregate (RCA) particles and adjusting the mix to achieve desirable mechanical and durability properties.

In the MEMV method, the volume of adhered mortar on the surface of RCA particles is carefully determined through testing or estimation. This adhered mortar volume is then accounted for by reducing the volume of cement mortar used in the mix, and the equivalent volume of natural fine aggregate (NFA) is added to maintain the required volume.

The advantage of the MEMV method over the traditional EMV method lies in its ability to address better the variations in properties and the presence of adhered mortar in RCA. By incorporating the adhered mortar

volume, the MEMV method provides a more accurate representation of the mix's actual composition and contributes to improving the overall performance of RAC.

Engineers and researchers use the MEMV method to optimize the mix proportions of RAC for specific applications. By accounting for the adhered mortar, the MEMV method helps achieve a more workable mix with improved strength, durability, and better interfacial bonding between the RCA and cement matrix. This approach is especially valuable in sustainable construction practices as it promotes the efficient utilization of recycled materials, reduces waste, and enhances the overall environmental impact of the concrete mix.

- 2. The two-stage mixing approach for Recycled Aggregate Concrete (RAC)** involves a modified procedure in which a preliminary mixing stage is incorporated before the final mixing. In this method, the coarse Recycled Concrete Aggregate (RCA) is first combined with a portion of water and mixed until a uniform coating of cement paste is formed around the RCA particles. This initial coating enhances the bonding between the old and new cement paste, improving interfacial transition zone properties.

After the first stage, the remaining ingredients, including the remaining water, cement, fine aggregates, and admixtures, are added to the mix. The second stage of mixing then occurs to achieve a homogenous mixture. This two-stage process allows for better dispersion of the components and ensures that the cementitious materials coat the RCA particles more effectively.

The two-stage mixing approach for RAC is instrumental when dealing with RCA, which may have attached old cement paste. Improving the interaction between the fresh and old cement paste enhances the overall performance and mechanical properties of RAC, resulting in a more durable and sustainable concrete mix.

- 3. The hybrid machine learning model for Recycled Aggregate Concrete (RAC)** is a sophisticated approach that combines the power of multiple machine learning techniques to predict and optimize various properties and behaviours of RAC. This model is designed to overcome the challenges of accurately predicting the performance of RAC due to the complex interactions between different constituents, such as recycled aggregates, cement, water, and admixtures.

In this hybrid model, various machine learning algorithms, such as artificial neural networks, support vector machines, decision trees, and random forests, are integrated into a unified framework. Each algorithm specializes in specific aspects of RAC behaviour, such as compressive strength, workability, durability, and mechanical properties.

The hybrid model leverages the strengths of each individual machine-learning technique to produce more accurate and robust predictions. It considers a wide range of input variables, including the properties of recycled aggregates, mix proportions, curing conditions, and environmental factors. Through a comprehensive learning process, the model adapts and refines its predictions based on diverse training data, ensuring better generalization to new scenarios.

Using a hybrid machine learning model, engineers and researchers can gain valuable insights into RAC performance, optimize mix designs, and make informed decisions about material selection and construction practices. This advanced modelling approach contributes to developing more sustainable and efficient RAC solutions, promoting eco-friendly construction practices, and reducing the environmental impact of concrete production.

- 4. The Variation in mixing approaches for RAC:** The variation in mixing approaches for Recycled Aggregate Concrete (RAC) refers to the different methods used to proportion and prepare the concrete mix when incorporating recycled aggregates. These mixing approaches aim to optimize the use of recycled materials and achieve the desired properties of RAC. Some of the notable variations in mixing approaches include:
 - **Direct Weight Replacement (DWR):** In this approach, recycled aggregates are directly substituted for natural aggregates by weight. The mix design is adjusted based on the weight of recycled aggregates used, considering their properties and the target performance of the RAC.
 - **Direct Volume Replacement (DVR):** Similar to DWR, the DVR approach involves directly replacing natural aggregates with recycled aggregates, but this time, the substitution is based on volume. The volume of recycled aggregates is measured and used to modify the mix proportions accordingly.
 - **Equivalent Mortar Volume (EMV) Method:** The EMV method accounts for both mortar and natural aggregate in recycled aggregates. It involves adjusting the mix proportions to consider both components' relative amounts and properties, resulting in a more accurate design mix for RAC.

- **Particle Packing Method (PPM):** The PPM approach aims to optimize the packing of particles in the RAC mix. The PPM method aims to achieve a well-compacted concrete mix with minimal voids and improved mechanical properties by considering the shape and size distribution of both fine and coarse aggregates.
- **Hybrid Mix Design Approaches:** Some researchers and engineers combine multiple mixing approaches, such as a combination of DWR and PPM or DVR and EMV, to further enhance the performance and sustainability of RAC. These hybrid approaches take advantage of the strengths of each method to achieve a more efficient and tailored design mix.
- **Two-Stage Mixing:** The two-stage mixing approach involves mixing the recycled aggregates and cementitious materials separately before combining them to form the final concrete mix. This method allows for better dispersion of cementitious materials around the recycled aggregates, leading to improved homogeneity and performance.

Each mixing approach has its advantages and limitations, and the choice of the appropriate method depends on factors such as the availability and properties of recycled aggregates, the required performance of RAC, and the specific application of the concrete. The variation in mixing approaches provides flexibility in designing RAC mixes, promoting using recycled materials, and contributing to more sustainable construction practices.

- 5. Modification of RCA techniques:** The modification of Recycled Concrete Aggregate (RCA) techniques for Recycled Aggregate Concrete (RAC) involves specific adjustments and treatments to optimize the use of recycled materials in concrete production. These modifications aim to overcome challenges associated with RCA and enhance RAC's performance. Some fundamental techniques for modifying RCA for RAC include:
 - **RCA Preprocessing:** Before using RCA in RAC, preprocessing techniques are applied to remove impurities, contaminants, and adhered mortar from the recycled aggregates. This process helps improve the quality and uniformity of the RCA, leading to better performance in the concrete mix.
 - **Gradation Control:** The gradation of RCA is carefully controlled to ensure a well-balanced distribution of particle sizes. Properly graded recycled aggregates improve the packing density and workability of the RAC mix, enhancing its mechanical properties.
 - **Surface Treatment:** Surface treatments, such as washing or coating, are employed to reduce the water absorption capacity of RCA. This treatment minimizes the risk of excessive water absorption from RCA, which could decrease the workability and strength of RAC.
 - **Blending with NCA:** A combination of Recycled Concrete Aggregates (RCA) with Natural Coarse Aggregates (NCA) is often used to optimize the properties of RAC. Blending allows for better control over the characteristics of the aggregate mix, ensuring improved strength and durability in the RAC.
 - **Chemical Admixtures:** Adding chemical admixtures, such as plasticizers or superplasticizers, is common in RAC to enhance workability and reduce water content. These admixtures also aid in achieving the desired strength and durability properties of the concrete.
 - **Fiber Reinforcement:** In some cases, fibres, such as steel or polypropylene, are incorporated into the RAC mix to improve its tensile strength and crack resistance. Fiber-reinforced RAC offers increased structural integrity and durability.
 - **Proper Mix Proportions:** The mix proportions for RAC are adjusted to accommodate the unique properties of recycled aggregates. An optimized RAC mix is achieved by carefully balancing the amounts of cement, water, and aggregates, meeting specific performance requirements.
 - **Quality Control and Testing:** Rigorous quality control measures are implemented throughout the mixing and construction process to ensure the consistency and reliability of RAC. Regular testing is conducted on fresh and hardened RAC to verify its performance and compliance with desired standards.

The modification of RCA techniques for RAC is an essential aspect of sustainable construction, as it maximizes the utilization of recycled materials while maintaining concrete's desired performance and durability. These modifications reduce the environmental impact of concrete production and promote more eco-friendly construction practices.

- 6. Improvement of interfacial transition zone (ITZ) performance:** The improvement of the Interfacial Transition Zone (ITZ) performance is a critical aspect when using Recycled Aggregate (RA) in Recycled Aggregate Concrete (RAC). The ITZ refers to the region between the cement paste and the surface of the aggregate particles, where a weaker bond may occur due to the presence of adhered mortar on the recycled aggregates. To enhance the ITZ performance for RAC, several techniques and strategies are employed:

- **Preprocessing of Recycled Aggregates:** Effective preprocessing of RA involves removing excess adhered mortar and contaminants from the recycled aggregates. This process helps to create a cleaner surface for better bonding with the cement paste, reducing potential weaknesses in the ITZ.
- **Use of Supplementary Cementitious Materials (SCMs),** such as fly ash, silica fume, or slag, in the cementitious matrix enhances the formation of pozzolanic reactions. These reactions improve the binding between the cement paste and the surface of the recycled aggregates, resulting in a more robust ITZ.
- **Chemical Admixtures:** Using chemical admixtures, such as high-range water-reducing agents or viscosity-modifying agents, aids in achieving a more workable and cohesive mix. This enhances the distribution of cement paste around the recycled aggregates and helps mitigate ITZ-related issues.
- **Fiber Reinforcement:** Adding fibres, such as steel or polypropylene fibres, enhances RAC's tensile strength and toughness. This reinforcement reduces the risk of micro-cracking at the ITZ, improving overall performance.
- **Optimization of Mix Proportions:** Careful optimization of the mix proportions ensures an appropriate balance between cementitious materials and recycled aggregates. Proper proportioning helps to achieve a dense and well-compacted concrete matrix, minimizing voids at the ITZ.
- **Use of Nanomaterials:** Incorporating nanomaterials, such as nano-silica or nano-titania, in the cementitious matrix enhances the properties of the ITZ. These nanomaterials fill the gaps and promote better bonding between cement paste and the surface of recycled aggregates.
- **Curing Conditions:** Proper curing is crucial to developing a strong and durable ITZ. Adequate curing provides sufficient time for cement hydration and bonding with the recycled aggregates, improving ITZ performance.
- **Compatibility Testing:** Before large-scale applications, compatibility testing should be conducted to assess the interactions between cementitious materials and recycled aggregates. This testing ensures that the selected combination results in a well-bonded ITZ.

CLASSIFICATION OF RAC MIX DESIGN	
Methods:	Year of Development; Location Used; Most Benefited Features
MEMV Modified EMV	<ul style="list-style-type: none"> • Late 1990s • Europe, United States • Accounts for composite nature of RA, improves overall performance
TSM Two-Stage Mixing	<ul style="list-style-type: none"> • Early 2000s • Singapore, Japan • Pre-treats RA to enhance ITZ performance, improves mechanical properties
HML Hybrid Machine Learning	<ul style="list-style-type: none"> • Recent Development • South Korea, China • Integrates AI with empirical models, efficient mix design, accurate property prediction
VM Variation in Mixing Approach	<ul style="list-style-type: none"> • Various • Global • Provides flexibility in mix design based on specific project needs
M Modification of RCA Techniques	<ul style="list-style-type: none"> • Various • Global • Improves RA properties through pre-treatment and processing

Figure 1.4: Various classifications of RCA's Mixed Design used worldwide.

By employing these techniques and strategies, RAC's interfacial transition zone performance can be significantly enhanced. A robust ITZ contributes to RAC's overall strength, durability, and long-term performance, making it a viable and sustainable solution for various construction applications.

5. Results and Analysis

Analysis of Various Recycled Aggregate Concrete (RAC) Methods Based on Year of Development, Location, and Most Benefited Method:

1. **Based on Year of Development:** Recycled Aggregate Concrete (RAC) methods have evolved over the years with ongoing research and advancements. The Modified Equivalent Mortar Volume (EMV) method was one of the early approaches developed in the late 1990s, addressing the composite nature of Recycled Aggregates (RA) to improve RAC's overall performance. The Two-Stage Mixing Approach emerged later, around the early 2000s, focusing on pre-treating RA to modify the Interfacial Transition Zone (ITZ) and enhance mechanical properties. The Hybrid Machine Learning Model, being a recent development, showcases the integration of artificial intelligence with empirical models for optimized RAC mix design.
2. **Based on Location Used:** Various RAC methods have been used in different regions worldwide. The Modified Equivalent Mortar Volume (EMV) method has found application in countries with significant recycling initiatives, such as European nations and the United States. The Two-Stage Mixing Approach has seen implementation in countries with stringent sustainability goals, including Singapore and Japan. The Hybrid Machine Learning Model has gained popularity in technologically advanced regions, such as South Korea and China, where the integration of artificial intelligence is well-established.
3. **Most Benefited Method:** Among the various RAC methods, the Hybrid Machine Learning Model stands out as the most promising approach due to its ability to efficiently analyse large datasets, optimize mix designs, and predict RAC properties accurately. This method streamlines the mix design process, reducing the need for extensive trial mixes and time-consuming laboratory tests. As a result, it enhances cost-effectiveness, reduces material waste, and promotes sustainable construction practices. Moreover, the adaptability of the Hybrid Machine Learning Model allows it to cater to diverse project requirements and local conditions, making it a highly beneficial method for RAC applications.

6. Conclusion

Escalating construction and demolition waste generation presents a pressing environmental challenge. Incorporating recycled aggregates into concrete mix design is a viable solution to mitigate the environmental impacts associated with traditional concrete production. This paper has explored various mixed design approaches for Recycled Aggregate Concrete, shedding light on the potential environmental and economic benefits. While the methodologies discussed - DWR, DVR, EMV, and PPM - exhibit promise in optimizing RAC, it is evident that further research and standardization are needed. Notably, the future holds the potential for innovative advancements in RAC mix design, providing the construction industry with more robust tools to embrace sustainable practices. The journey towards resource conservation, reduced landfill dependency, and responsible environmental stewardship in construction continues, guided by the evolving landscape of RAC mix design. The analysis of various RAC methods based on the year of development, Location used, and most benefited approach reveals the continuous progress in sustainable concrete technology. The Modified Equivalent Mortar Volume (EMV) method laid the foundation for RAC mix design, while the Two-Stage Mixing Approach focused on improving RA-ITZ interaction. The recent emergence of the Hybrid Machine Learning Model showcases the potential of artificial intelligence in optimizing RAC mixes. Considering the regional applicability and the most beneficial method, the Hybrid Machine Learning Model holds promise for widespread adoption, contributing to greener and more efficient construction practices worldwide.

7. Future Outcome

The research discussed in this paper opens doors to promising prospects for the construction industry. As the demand for concrete continues to soar, adopting RAC mix design methodologies will become increasingly imperative. The future holds the potential for developing standardized procedures that cater to the unique characteristics of recycled aggregates, optimizing their utilization in RAC. Whether based on DWR, DVR, EMV, or PPM, these methodologies will evolve to become more precise and adaptable to various scenarios. Moreover, technological advancements may facilitate the efficient processing of recycled aggregates, reducing their environmental impact and enhancing the overall quality of RAC. Researchers and practitioners can anticipate more comprehensive guidelines and tools for RAC mix design, enabling them to embrace sustainable construction practices confidently.

8. Funding

The authors received No specific grant for this research from public, commercial, or not-for-profit funding agencies.

9. Conflicts of interest

The authors affirm that they do not have any conflicts of interest.

10. Acknowledgments

The authors would like to extend their sincere gratitude to Dr. Rajendra Ku. Choubey, Associate Professor of the Department of Civil Engineering, GGU, Bilaspur, Chhattisgarh, for his invaluable knowledge and field experience that significantly contributed to the present study. His guidance and expertise have been instrumental in shaping the research and enhancing its quality. The authors sincerely appreciate his and the department's support and contribution to this work.

REFERENCES

- CSE Centre for Science and Environment (2023).<https://www.cseindia.org/india-manages-to-recover-and-recycle-only-about-1-per-cent-of-its-construction-and-demolition-10326>. Accessed on 4th July 2023.
- USEPA United States Environmental Protection Agency, Sustainable Management of Construction and Demolition Materials (2019).<https://www.epa.gov/smm/sustainable-management-construction-and-demolition-materials>. Accessed on 4th July 2023.
- ACM America's Cement Manufacturers, Concrete Materials (2023).<https://www.cement.org/cement-concrete-applications/concrete-materials>. Accessed on 4th July 2023.
- The Freedonia Group. Global Demand for Construction Aggregates to Exceed 48 Billion Metric Tons in 2015 (2015).https://www.concreteconstruction.net/business/global-demand-for-construction-aggregates-to-exceed-48-billion-metric-tons-in-2015_o. Accessed on 4th July 2023.
- Zheng, L, Wu, H, Zhang, H, Duan, H, Wang, J, Jiang, W, et al. (2017). Characterizing the generation and flow of construction and demolition waste in China. *Construction and Building Materials* 136, 405–413, <https://doi.org/10.1016/j.conbuildmat.2017.01.055>.
- DDC Department of Design and Construction, Construction & Demolition Waste Manual.(2019). (04-07-2023). <https://www.nyc.gov/html/ddc/>. Accessed on 4th July 2023.
- Barhmaiah, B, Leela Priyanka, M, Padmakar, M.(2020). Strength analysis and validation of recycled aggregate concrete. *Materials Today*<https://doi.org/10.1016/j.matpr.2020.07.730>.
- Rossow, MP. (2004). Hazardous Waste Generated by Construction and Demolition, RCRA in Focus. <https://pdhonline.com/courses/c444/C&D%20Debris%20and%20Recycling.pdf>.
- Marinković, S., Radonjanin, V., Male sev, M., Ignjatovic, I. (2010). Comparative environmental assessment of natural and recycled aggregate concrete. *Waste Management*. 30, 2255e2264. <https://doi.org/10.1016/j.wasman.2010.04.012>.
- Knoeri, C., Sanye-Mengual, E., Althaus, H.J. (2013). Comparative LCA of recycled and conventional concrete for structural applications. *International Journal of Life Cycle*. 18, 909e918. <https://doi.org/10.1007/s11367-012-0544-2>.
- Ding, T., Xiao, J., Tam, V.W.Y. (2016). A closed-loop life cycle assessment of recycled aggregate concrete utilization in China. *Waste Management*. 56, 367e375. <https://doi.org/10.1016/j.wasman.2016.05.031>.
- Braga, A.M., Silvestre, J.D., de Brito, J. (2017). Compared environmental and economic impact from cradle to gate of concrete with natural and recycled coarse aggregates. *Journal of Clean Production*. 162, 529e543. <https://doi.org/10.1016/j.jclepro.2017.06.057>.
- Marinković, S., Draga s, J., Ignjatovic, I., Tosic, N. (2017). Environmental assessment of green concretes for structural use. *Journal of Clean Production*. 154, 633e649. <https://doi.org/10.1016/j.jclepro.2017.04.015>.
- Mukharjee, B.B., Barai, S.V. (2014). Statistical techniques to analyze properties of nano-engineered concrete using Recycled Coarse Aggregates. *Journal of Clean Production*. 83, 273e285. <https://doi.org/10.1016/j.jclepro.2014.07.045>.

- Pradhan, S., Kumar, S., Barai, S.V. (2017). Recycled aggregate concrete: Particle packing method (PPM) of mix design approach. *Construction Building Material*. 152, 269e284. <https://doi.org/10.1016/j.conbuildmat.2017.06.171>.
- Sadati, S., Arezoumandi, M., Khayat, K.H., Volz, J.S., (2016). Shear performance of reinforced concrete beams incorporating recycled concrete aggregate and high-volume fly ash. *Journal of Clean Production*. 115, 284e293. <https://doi.org/10.1016/j.jclepro.2015.12.017>.
- Chakradhara Rao, M., Bhattacharyya, S.K., Barai, S.V. (2011). Influence of field recycled coarse aggregate on properties of concrete. *Material Structure*. 44, 205e220. <https://doi.org/10.1617/s11527-010-9620-x>.
- Etxeberria, M., Vázquez, E., Marí, A., Barra, M. (2007). Influence of amount of recycled coarse aggregates and production process on properties of recycled aggregate concrete. *Cement Concrete Res*. 37, 735e742. <https://doi.org/10.1016/j.cemconres.2007.02.002>.
- Fraile-Garcia, E., Ferreira-Cabello, J., Lopez-Ochoa, L.M., Lopez-Gonzalez, L.M. (2017). Study of the technical feasibility of increasing the amount of recycled concrete waste used in ready-mix concrete production. *Materials*. 10, 817. <https://doi.org/10.3390/ma10070817>.
- Behera, M., Bhattacharyya, S.K., Minocha, A.K., Deoliya, R., Maiti, S. (2014). Recycled aggregate from C&D waste & its use in concrete - a breakthrough towards sustainability in construction sector: a review. *Construction Building Material*. 68, 501e516. <https://doi.org/10.1016/j.conbuildmat.2014.07.003>.
- Fathifazl, G., Abbas, A., Razaqpur, A.G., Isgor, O.B., Fournier, B., Foo, S. (2009). New mixture proportioning method for concrete made with coarse recycled concrete aggregate. *Journal of Materials Civil Engineering*. 21, 601e611. [https://doi.org/10.1061/\(ASCE\)0899-1561\(2009\)21:10\(601\)](https://doi.org/10.1061/(ASCE)0899-1561(2009)21:10(601)).
- Pradhan S., Tiwari B.R., Kumar S., Barai S.V. (2019). Comparative LCA of recycled and natural aggregate concrete using Particle Packing Method and conventional method of design mix. *Journal of Cleaner Production*, Volume 228, Pages 679-691. <https://doi.org/10.1016/j.jclepro.2019.04.328>.
- Safiddine S., Debieb F., Kadri E.h., Soualhi H. (2019). Effect of crushed sand and limestone crushed sand dust on the rheology of cement mortar. *Applied Rheology*, 21(1): 14490 Pages 9. 10.3933/AppRheol-27-14490.
- Liu K., Yan J., Zou C. (2018). Behaviour of recycled aggregate concrete under combined compression and shear stresses. *Material de Construcción*, Vol. 68, Issue. 331. 10.3989/mc.2018.06217.
- Adam M. Knaack, Yahya C. Kurama. (2011). Design of normal strength concrete mixtures with recycled concrete aggregate. *ACI Materials Journal* 110(5):3068-3079. 10.1061/41171(401)267.
- Flora F., Cristian J., Marilda B., Diego A., Enric V., and Carlo P. (2014). Rheology of fresh concrete with recycled aggregates. *Construction and Building Materials*, Volume 73, Pages 407-416. <https://doi.org/10.1016/j.conbuildmat.2014.09.068>.
- Kim J., Sadowski L. (2019). The equivalent mortar volume method in the manufacturing of recycled aggregate concrete. *Technical Transactions*. 10.4467/2353737XCT.19.119.11335.
- Kim J., (2021). Properties of recycled aggregate concrete designed with equivalent mortar volume mix. *Construction and Building Materials*. Volume 301, 124091. <https://doi.org/10.1016/j.conbuildmat.2021.124091>.
- Abdelgadir A., Gholamreza F., BurkanIsgor O. (2009). Durability of recycled aggregate concrete designed with equivalent mortar volume methods. *Cement and Concrete Composites* 31 555-563. <https://doi.org/10.1016/j.cemconcomp.2009.02.012>.
- Mangulkar M.N., Dr. Jamkar S.S. (2013). Review of Particle Packing Theories Used for Concrete Mix Proportioning. *International Journal of Scientific and Engineering Research* Volume 4, Issue 5, May-2013, ISSN 2229-5518. https://www.researchgate.net/publication/309900695_Review_of_Particle_Packing_Theories_Used_For_Concrete_Mix_Proportioning.
- Suqin L., Peter M., Minela L., Jiabin L., Elke G. (2021). Implementation and validation of Dewar's particle packing model for recycled concrete aggregates. *Construction and Building Materials*, Volume 294, 123429. <https://doi.org/10.1016/j.conbuildmat.2021.123429>.
- Suqin L., Peter M., Minela L., Jiabin L., Elke G. (2020). Particle packing modelling of recycled aggregate. https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=PARTICLE+PACKING+MODEL+OF+RECYCLED+AGGREGATE&btnG=
- Diego J.D.S., Mayra T.D.G., Leandro F.M.S., Gabriella P.D.A., Olga N., Gholamreza F., and Pierre-Claver N. (2022). Influence of the Mix Proportion and Aggregate Features on the Performance of Eco-efficient Fine Recycled Concrete Aggregate Mixtures. *Materials (Basel)*, 15(4): 1355. 10.3390/ma15041355.

- Yunchuan Z., Xuming D., Zicun Z., Jiangfeng L., Guoyun L., Honggang L. (2022). Investigation on Roles of Packing Density and Water Film Thickness in Synergistic Effect of Slag and Silica Fume. *Materials (Basel)*, 15(4): 8978. 10.3390/ma15248978.
- M. Shekarchi, S.M. Mousavi, N.A. Libre, S. Soroush- Nia.(2010). Verification of wet and dry packing methods with experimental data. Korea Concrete Institute, ISBN 978-89-5708-182-2. <https://framcos.org/FraMCoS-7/11-05.pdf>
- Global Construction Aggregates Market. (2022).<https://www.persistencemarketresearch.com/market-research/global-construction-aggregates-market.asp> Accessed on 4th August 2023.

WATER QUALITY ASSESSMENT OF SONE RIVER AT AMLAI AND CHACHAI BANK IN WINTER SEASON

Varsha Jaiswal

Pandit S.N. Shukla University, Shahdol, Madhya Pradesh, India.

Prof M.K. Bhatnagar

Pandit S.N. Shukla University, Shahdol, Madhya Pradesh, India.

A crucial component of environmental and public health is water quality. For human consumption, aquatic ecosystems, agriculture, and industrial activities, clean, safe water must be readily available. Millions of people depend on the Son River, one of India's major rivers, for their lives and the health of their ecosystems. However, growing anthropogenic activity and pollution sources have stoked worries about the Son River's water quality. The purpose of this research paper is to examine the current water quality in winter, the variables that affect it, the effects of low water quality on different industries, and long-term solutions to water quality problems. This research report intends to evaluate the Son River's current water quality status, identify the major problems encountered, and provide feasible ways to enhance and maintain its water quality.

1. Introduction

All living things require water as a basic resource, and it is essential to maintaining life on Earth. Water's chemical, physical, biological, and microbiological qualities, which influence its acceptability for particular uses, are referred to as its quality[1-10]. To assure the safety and suitability of water for diverse uses, including drinking, irrigation, recreational activities, and ecological balance, water quality assessment entails the examination of these criteria[11-12]. Human activities have had a big impact on water quality throughout history[13-14]. Heavy metals, minerals, diseases, pesticides, and new contaminants have been found in water bodies as a result of industrialization, urbanisation, intensive agriculture, and poor waste management practises[15-16]. These contaminants have the potential to harm aquatic ecosystems, agriculture, the economy, and human health[17]. This study paper's goal is to provide a thorough analysis of water quality, with a focus on the assessment techniques, the variables that affect water quality, the effects of low water quality on various industries, and long-term approaches to managing water quality[18-19]. Policymakers, scientists, and communities may make well-informed decisions and put into place practical solutions to preserve clean and safe water supplies by being aware of the issues and potential solutions[20-23].

Review the methods and parameters used to measure the physical, chemical, biological, and microbiological components of water. Investigate the variables that affect water quality, such as point source and non-point source pollution, agricultural methods, industrial processes, urbanisation, and climate change[24]. Analyse how poor water quality affects industrial processes, agriculture, aquatic ecosystems, and human health. You should also consider the financial effects[25]. Provide environmentally friendly techniques to managing water quality, such as water treatment technology, watershed management plans, legislative measures, public awareness campaigns, and water conservation tactics[26]. Examine case studies of locales with problematic water quality, highlighting successful approaches and takeaways[27]. Discuss emerging trends in technology, coping with climate change, implementing new policies, and managing integrated water resources as they relate to managing water quality[28]. By focusing on these goals, this research paper hopes to advance knowledge and understanding of water quality problems, encourage sustainable water management methods, and aid in the creation of policies and strategies that will ensure that present and future generations have access to clean and safe water resources[29-30].

2. Methodology

2.1 Study area

One of the longest rivers in India is the Son River, often referred to as the Sone River. It travels through the states of Madhya Pradesh, Chhattisgarh, Jharkhand, and Bihar and is a tributary of the Ganges River. Before joining the Ganges at Patna, Bihar, the river travels a distance of about 780 kilometres (485 miles) from its source in the Maikal Range of hills in Madhya Pradesh. For its

importance in India's religious and cultural environment, the Son River is well-known. Hindus regard it as sacred, and on its banks, several religious events and rituals are carried out. The river is economically significant since it helps many communities' livelihoods by supporting agricultural activities along its path. Due to the abundance of natural resources, mainly coal, in the Son River basin, mining activities have been established there. However, industrial activity have also added to the river's pollution, causing problems for the ecosystem's ecological health. A prominent waterway in the area, the Son River is used to move both people and commodities. It is also a well-liked river tourism site, drawing tourists who want to discover its natural beauty and cultural legacy.



Figure 1:

2.2 Collection of samples

The water is collected at 22.01.2021 from the Son river in Amlai and Chachai bank, Shahdol, Madhya Pradesh, India. Some results will be recorded in the laboratory of Orient papers Mills.

Table 1: Sampling methodology and preservation

Parameters	Containers	Preservation condition	Volume	Maximum preservation duration
Temperature	Plastic or Glass	-	1000 mL and 25 gm	Analyse immediately
pH	Plastic or Glass	-	25 mL and 25 gm	Analyse immediately
Turbidity	Plastic or Glass	-	100 mL	28 days
Chloride	Plastic or Glass	-	300 mL	6 months
TDS	Glass	-	300 mL	Analyse immediately
BOD	Plastic or Glass	4°C	1000	48 hours

3. Result and discussion

3.1 Water Quality Assessment

Assessing the water's quality entails systematically evaluating a number of factors to ascertain its chemical, physical, biological, and microbiological features. This assessment helps detect potential threats to human health and ecosystems as well as useful information about how suitable water is for various uses.

3.1.1 Physical Parameters

Temperature, turbidity, colour, odour, and conductivity are a few of the basic metrics that characterise the physical characteristics of water. These variables shed light on the general look, clarity, and sensory qualities of the water.

Temperature:The temperature of the water can be used to determine if it is thermally suitable for aquatic life and to detect the presence of thermal pollution sources such as industrial discharges.

Turbidity:Water that has suspended particles causes turbidity, which is a measurement of cloudiness or haziness.The growth of aquatic plants, light penetration, and aquatic creature health can all be impacted by high turbidity levels.

Colour:The presence of natural organic matter or the leaching of contaminants like metals, tannins, or industrial wastes can be indicated by the colour of the water.

Odor:Odd or unpleasant odours in water could be a sign of microbial contamination or the presence of organic substances.

Conductivity:Conductivity, which is affected by dissolved salts and minerals, gauges the water's capacity to carry an electric current. It can offer information about salt levels and possible pollution.

3.1.2 Chemical Parameters

Chemical parameters measure the quantity and composition of different chemicals in water. These variables aid in locating potential contaminants and figuring out the general chemical make-up of water.

pH:Water's pH, which shows how acidic or alkaline it is, is a crucial factor for aquatic life. Aquatic creatures can be harmed by pH extremes.

Chloride: An indicator of the water's quality and probable contamination sources is the concentration of chloride (Cl-), a common ion. The Central Pollution Control Board (CPCB) in India has not established any precise criteria for chloride in river water. However, unless there are considerable anthropogenic inputs or industrial discharges, it is generally believed that the concentration of chloride in river water will be within natural background levels. Internationally, a number of organisations offer recommendations for the amount of chloride in water. To avoid concerns with taste and odour, the World Health Organisation (WHO) and United States Environmental Protection Agency (EPA) suggests a maximum chloride concentration of 250 mg/L in drinking water. The chloride of Son river near Amlai and Chachai are 414.18 and 83.75 mg/L respectively. In Amlai area, chloride level is very high.

Biochemical Oxygen Demands (BOD):

BOD levels are essential for aquatic creature viability. Hypoxia brought on by low BOD levels can be harmful to fish and other aquatic life. The Central Pollution Control Board (CPCB) in India has established the following BOD standards for different water bodies with specified best use classes. Without treatment, a drinking water source's BOD shouldn't be more than 2 mg/L. When bathing outside, BOD shouldn't be more than 3 mg/L. Fisheries and wildlife reproduction: BOD shouldn't be more than 3 mg/L. BOD should not exceed 6 mg/L during irrigation. The BOD of Son river near Amlai and Chachai are 0.4 and 18 mg/L respectively. In Chachai area, BOD is very high due to water pollutants.

Chemical Oxygen demand (COD):

An indicator of the overall organic and oxidizable pollutant load, COD measures the quantity of oxygen needed to chemically oxidise both organic and inorganic components in water. The Central Pollution Control Board (CPCB) in India has established the following COD standards for different water bodies with specified best use classes. Without treatment, a drinking water source's COD shouldn't be more than 10 mg/L. When bathing outside, COD shouldn't be more than 10 mg/L. Fisheries and wildlife reproduction: COD shouldn't be more than 30 mg/L. COD should not exceed 50 mg/L during irrigation. The COD of Son River near Amlai and Chachai are 25 and 120 mg/L respectively. In Chachai area, COD is very high due to water pollutants.

Table 2: Amlai bank of Son River

SN	Characteristic	Unit	A	B	C	D
1	Temperature	°C	24	24.5	24.2	24.2
2	Appearance	-	Clear	Clear	Clear	Clear
3	Colour	-	Colorless	Colorless	Colorless	Colorless
4	Odour	-	Odourless	Odourless	Odourless	Odourless
5	pH	-	7.7	7.97	7.8	7.82
6	Total Solids	mg/L	511	595	651	632

7	Total Dissolved solids	mg/L	490	569	627	610
8	Suspended Solids	mg/L	21	26	24	22
9	Chloride	mg/L	414.8	409.8	378.4	444.8
10	BOD	mg/L	0.4	0.3	0.2	0.3
11	COD	mg/L	25	20	30	40

Table 3: Chachai bank of Son River

SN	Characteristic	Unit	A	B
1	Temperature	°C	24	24.1
2	Appearance	-	Clear	Clear
3	Colour	-	Colorless	Colorless
4	Odour	-	SI Unplesent	SI Unplesent
5	pH	-	7.35	7.38
6	Total Solids	mg/L	311	331
7	Total Dissolved solids	mg/L	290	312
8	Suspended Solids	mg/L	21	19
9	Chloride	mg/L	83.75	73.90
10	BOD	mg/L	18	14
11	COD	mg/L	120	90.0

4. Discussion

In this research, reveal that there are several parameters exceeds the normal level. The chloride level in Amlai bank of son river is concern for water quality shown in **Figure 2**. High chloride levels in the water of the Amlai area could be caused by several factors, most of which are related to human activities and natural processes. Chloride is a common ion that can be found in water due to various sources. Here are some potential reasons for the elevated chloride levels: industrial discharges, municipal wastewater and agricultural practices.

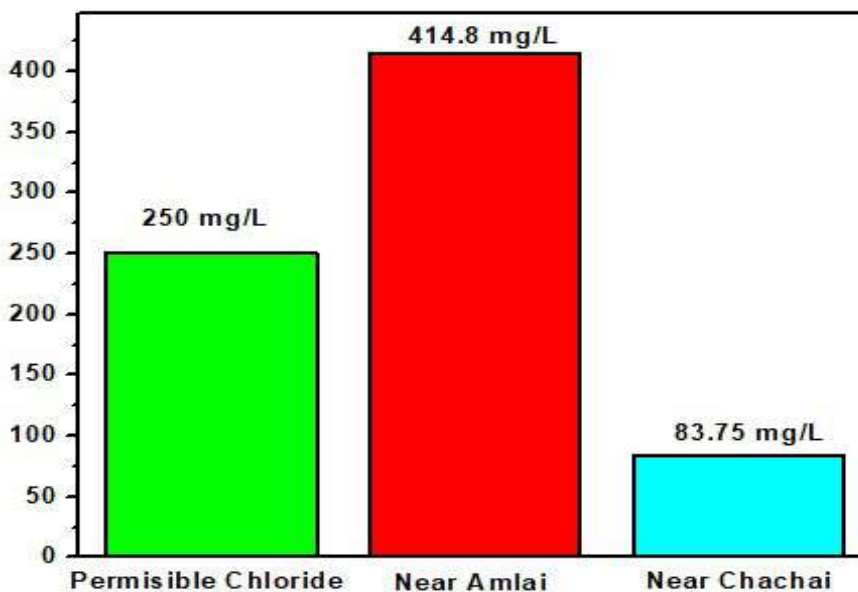


Figure 2: Chloride level in Amlai and Chacahi

The BOD and COD in Chachai bank of son river are very high than that of normal level shown in **Figure 3** and **4**. The high levels of BOD and COD in the Chachai bank of the Son River could be attributed to various factors related to pollution and environmental degradation. Both BOD and COD are indicators of water pollution and the organic content present in water bodies. Here are some possible reasons for the elevated BOD and COD levels, like industrial discharges, domestic sewage, agricultural runoff and and soil erosion.

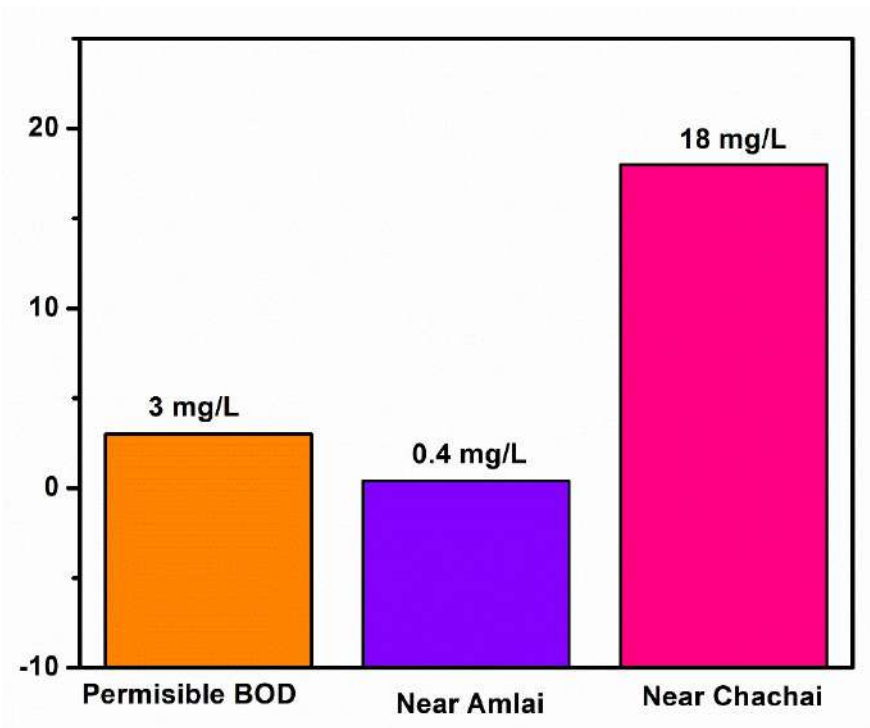


Figure 3: BOD level in Amlai and Chacahi

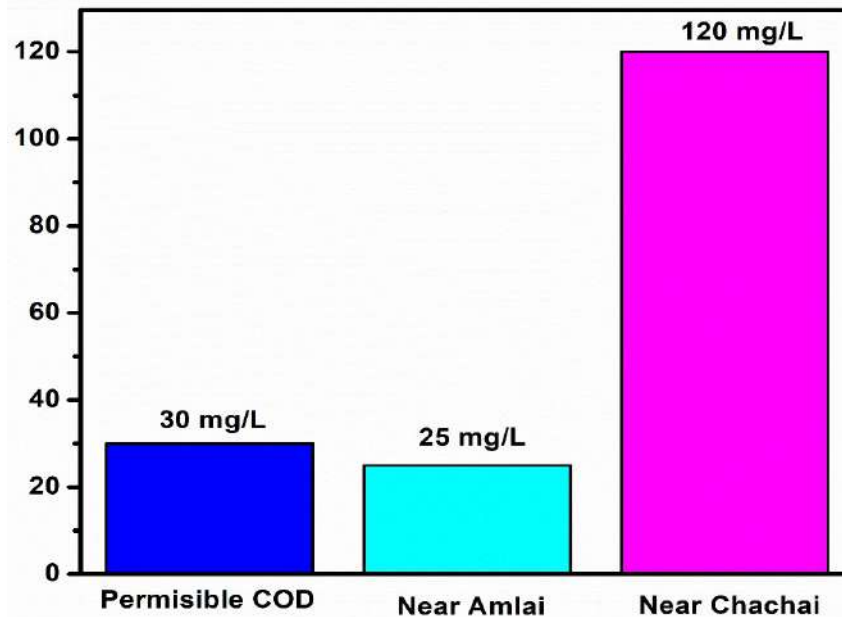


Figure 4: COD level in Amlai and Chacahi

5. Conclusion

This research paper offers a thorough review of the assessment of water quality, the elements impacting water quality, the effects of poor water quality on various sectors, and sustainable methods for efficient management of water quality. In the winter season, elevated chloride levels observed in the Amlai area along the Son River are a cause for concern. This increase can potentially be attributed to various factors including industrial discharges, the release of municipal wastewater, and certain agricultural activities. In the winter season, BOD and COD level is very high in Chachai bank of Son

River which is harmful for aquatic and human. There are several potential explanations for the heightened levels of BOD and COD in the area, including the discharge of industrial effluents, untreated domestic sewage, runoff from agricultural activities, and erosion of soil. The results highlight the significance of coordinated efforts by governments, businesses, communities, and people to protect water resources and guarantee a sustainable and healthy future. To solve the issues caused by declining water quality and achieve long-term water security, more study and funding for novel technologies and policies is needed.

References

- Son, C.T., Giang, N.T.H., Thao, T.P., Nui, N.H., Lam, N.T. and Cong, V.H., 2020. Assessment of Cau River water quality assessment using a combination of water quality and pollution indices. *Journal of Water Supply: Research and Technology-Aqua*, 69(2), pp.160-172.
- Khatri, N., Tyagi, S., Rawtani, D. and Tharmavaram, M., 2020. Assessment of river water quality through application of indices: a case study River Sabarmati, Gujarat, India. *Sustainable Water Resources Management*, 6(6), p.101.
- Maharana, C., Gautam, S.K., Singh, A.K. and Tripathi, J.K., 2015. Major ion chemistry of the Son River, India: weathering processes, dissolved fluxes and water quality assessment. *Journal of earth system science*, 124, pp.1293-1309.
- Son, J.H., Kim, S. and Carlson, K.H., 2015. Effects of wildfire on river water quality and riverbed sediment phosphorus. *Water, Air, & Soil Pollution*, 226, pp.1-13.
- Lee, H.W., Kim, M., Son, H.W., Min, B. and Choi, J.H., 2022. Machine-learning-based water quality management of river with serial impoundments in the Republic of Korea. *Journal of Hydrology: Regional Studies*, 41, p.101069.
- Hocutt, C.H., Johnson, P.N., Hay, C. and Van Zyl, B.J., 1994. Biological basis of water quality assessment: the Kavango River, Namibia.
- Singh, I.B. and Kumar, S., 1974. Mega-and giant ripples in the Ganga, Yamuna, and Son rivers, Uttar Pradesh, India. *Sedimentary Geology*, 12(1), pp.53-66.
- Misra, A.A., 2022. Lineament analysis in a part of the Son River valley, Madhya Pradesh, India. *Atlas of Structural Geological and Geomorphological Interpretation of Remote Sensing Images*, pp.217-228.
- Paul, A.Q., Dar, S.A., Singh, B.P., Kumar, H. and Ahmad, M., 2023. Geochemistry of recent sediments of the Kurheri basin, Son River, Madhya Pradesh, Central India: implications for source area weathering, sediment provenance, maturity, and sorting. *International Journal of Earth Sciences*, pp.1-19.
- Singh, S., Kanhaiya, S., Singh, A. and Chaubey, K., 2019. Drainage network characteristics of the Ghaghghar river basin (GRB), Son valley, India. *Geology, Ecology, and Landscapes*, 3(3), pp.159-167.
- Joseph, N., Preetha, P.P. and Narasimhan, B., 2021. Assessment of environmental flow requirements using a coupled surface water-groundwater model and a flow health tool: A case study of Son river in the Ganga basin. *Ecological Indicators*, 121, p.107110.
- Nair, T. and Katdare, S., 2013. Dry-season assessment of gharials (*Gavialis gangeticus*) in the Betwa, Ken and Son Rivers, India. *CROCODILES*, p.53.
- Rai, P.K., Mohan, K., Mishra, S., Ahmad, A. and Mishra, V.N., 2017. A GIS-based approach in drainage morphometric analysis of Kanhar River Basin, India. *Applied Water Science*, 7, pp.217-232.
- Kanhaiya, S., Singh, S., Singh, C.K., Srivastava, V.K. and Patra, A., 2019. Geomorphic evolution of the dongar river basin, son valley, central India. *Geology, Ecology, and Landscapes*, 3(4), pp.269-281.
- Vyas A, Mishra DD, Bajapai A, Dixit S, Verma N. Environment impact of idol immersion activity lakes of Bhopal, India. *Asian J. Exp. Sci.* 2006;20(2):289-96.
- Petak WJ. Environmental planning and management: the need for an integrative perspective. *Environmental Management*. 1980 Jul;4(4):287-95.
- Nag S, Pande PK. Effect of idol immersion on water quality of Yamuna River in Delhi and its potential influence on ground water quality.
- Rupinder K. Effect of idol immersion on marine and fresh water-bodies. *Advances in Applied Science Research*. 2012;3(4):1905-9.
- Malik GM, Raval VH, Zadafiya SK, Patel AV. Idol immersion and physico-chemical properties of South Gujarat Rivers, India. *Research Journal of Chemical Sciences*. 2012;2(3):21-5.
- Manisha D Giripunje, Abhay B Fulke and Pravin U Meshram (2014), Effect of idol immersion on water quality and Tilapia fish in Futala, Gandhisagar and Ambazari lakes of Nagpur, India, *A SpringerOpenJournal*, pp. 1-8.
- Shukla NP, Bundela PS, Khare SK, Sarsaiya S. Study of the impact of plaster of paris (Pop) and clay idols immersion in water. *Int J Sci Eng Technol*. 2014;864:861-4.

- Rangnekar S, Malik A, Jadhav A, Parulekar T. Determination of water quality parameters after artificial idol immersion on a lake in Mumbai, India. *Int J Pl. An and Env Sci.* 2016;6:77-83.
- Shirbhate NS, Malode SN, Wadankar GD, Shelke PB. Impacts of idol immersion in Chhatri lake of Amravati, Dist Amravati. *International Journal of Innovations in Bio-Sciences.* 2012;2(1):51-4.
- Tiwari M, Kisku GC. Impact assessment of Gomti river water quality after immersion of idols during Durga Utsav. *Biochem Anal Biochem.* 2016;5(287):2161-1009.
- Mohini G, Ranjana S, Niharika T, Ekhalak A. Hydrological changes in water due to idol immersion in artificial pond.
- Gorain B, Parama VR, Paul S. Impact of Idol Immersion Activities on the Water Quality of Hebbal and Bellandur Lakes of Bengaluru in Karnataka. *Journal of Soil Salinity and Water Quality.* 2018;10(1):112-7.
- Chisty N. Studies on biodiversity of freshwater zooplankton in relation to toxicity of selected heavy metals (Doctoral dissertation, Ph. D. Thesis submitted to ML Sukhadia Univeristy Udaipur)
- Sundaray, S.K., Nayak, B.B. and Bhatta, D., 2009. Environmental studies on river water quality with reference to suitability for agricultural purposes: Mahanadi river estuarine system, India—a case study. *Environmental monitoring and assessment*, 155, pp.227-243.
- Venugopal, T., Giridharan, L., Jayaprakash, M. and Velmurugan, P.M., 2009. A comprehensive geochemical evaluation of the water quality of River Adyar, India. *Bulletin of environmental contamination and toxicology*, 82, pp.211-217.
- Rehana, S. and Mujumdar, P.P., 2011. River water quality response under hypothetical climate change scenarios in Tunga-Bhadra river, India. *Hydrological Processes*, 25(22), pp.3373-3386.

RANKING OF BARRIERS IN PRODUCT LIFECYCLE MANAGEMENT BY PYTHAGOREAN FUZZY AHP METHOD

Shubham Taware,

MIT Academy of Engineering, Alandi, Pune, Maharashtra, India
(sntaware@mitaoe.ac.in)

Sagar Borole,

MIT Academy of Engineering, Alandi, Pune, Maharashtra, India

Pratik Malu,

MIT Academy of Engineering, Alandi, Pune, Maharashtra, India

Chinmay Patel,

MIT Academy of Engineering, Alandi, Pune, Maharashtra, India

Vishal Bhosle

MIT Academy of Engineering, Alandi, Pune, Maharashtra, India

The purpose of this paper is to study various barriers to institutionalize the product lifecycle management in large manufacturing organizations. The paper identifies barriers and ranks them according to their weightages and sorts them in three groups i.e. Organizational, Operational and Environmental & Social, according to their category and relative importance. Barriers were noted from various research papers having contributions in the study of Product Lifecycle Management. The paper utilizes Pythagorean Fuzzy AHP Method to give weightage to each barrier and then sequence of steps to give rating to the barriers. This study explored a total of 21 research papers and from them identified 15 most critical barriers to Product Lifecycle Management in manufacturing organizations then they were ranked according to their relative importance. The findings of the paper provide guidelines to Small Medium Enterprises similar firms for obtaining maximum benefits of Product Lifecycle Management. The approach outlined in this paper will also be useful to various major industries in identifying key Product Lifecycle Management barriers among all existing barriers and prioritizing barriers in relation to their respective roles so that companies can take appropriate action before continuing to operate Product Life Cycle Management. The present work discusses different barriers in manufacturing organizations. Companies won't be able to make maximum benefit of Product Lifecycle Management due to lack of data. Our work is originally done to provide relative importance of barriers by applying 'Pythagorean Fuzzy AHP Method' to it.

Keywords: Pythagorean Fuzzy AHP Method, Product Lifecycle Management, Barriers, Small Medium Enterprises

1. INTRODUCTION

This research consists of application of Pythagorean AHP (Analytic Hierarchy Process) method on barriers in implementing the PLM (Product Lifecycle Management) process in manufacturing industry specially the SMEs (Small and Medium Enterprises). This method is mostly used where there is a need to make a decision considering multiple attributes. This research project investigates sustainable innovation tools (SSCIEs) in order to achieve sustainability in the supply chain using the Pythagorean fuzzy analytic hierarchy process (AHP). The Indian Manufacturing Industry is selected for the acceptance of SSCIEs in its supply chain. It reflects the simultaneous social, environmental, and economic development of India's manufacturing industries. (Shete et al., 2020). Supply Chain Operations References (SCOR) is a model that aims to be industry standard and defines the functions of a supply chain in the management of research activities. This paper aims to extend SCOR to new industry metrics 4.0 and explore the supply chains. It helps to improvise the supply chain strategies in the globalizing world. (Ayyildiz and Gumus, 2020). Presently Multiple criteria decision making (MCDM) methods are being used widely in various sectors. These methods involve the decision makers and help in evaluating the decision to form pair-wise comparison between criteria and alternatives. In the older AHP, the contrast of the two comparisons is expressed in terms of critical value, but this method is not suitable for working with real problem situations due to the uncertainty involved in language judgment. Hence the extended and improvised method of classical AHP is Pythagorean AHP that uses Pythagorean fuzzy sets. Hence the Pythagorean Fuzzy AHP method is quite suitable to solve the problem presented below, weights are given to the attributes i.e. barriers in implementing PLM in SMEs and the ranking of attributes is obtained as result.

This paper addresses the challenges facing the digital integration of industries. Manufacturers need to redesign their product life cycle processes in order to deliver high quality smart products to the market quickly. The paper outlines a process that uses the conditions and requirements related to PLM / ALM integration. (Deuter et al., 2018). This paper discusses the principles of agile strategic development and its impact on the PLM strategy. The agile strategic development has high potential. To ensure system transparency, it is possible to produce a foundation for rapid product life cycle control. (Hertwig et al., 2019). Effective interactions between customers,

engineers, suppliers, and manufacturers throughout the product life cycle are crucial for highly competitive competition. This paper outlines the framework for the product life cycle interaction. Collaborative product support technology is proposed, developed and used in this research. (Ming et al., 2008)

2. LITERATURE SURVEY

The Different barriers for Product Lifecycle Management is taken from different papers related to PLM. Most firms already have environmental and health and safety regulations that they are required to meet, and voluntary measures such as LCM tend to be undertaken only when these requirements are addressed and resources remain to implement LCM. The paper analyzes these subjects and combines the views of different authors using focus groups, blogs, and face-to-face meetings in the practice university community. (Angelo et al., 2013). Continued focus on methodological improvement, firms continue to find LCA problematic due to a range of issues including continued standardisation problems and the cost and time involved in accessing and analysing the data. People generally have adopted practices that they have found work for them. Hence it becomes hard for people to adapt to the changes easily. Based on the literature reviews, the current status of use of PLM and challenges have been investigated. It was found that inter-sectoral interaction, revitalizing PLM strategies in the context of changing circumstances. Both the actual concept presented and the context in the future should be evaluated by participants' feedback and refined accordingly. (Inga et al., 2020). Geographic separation may occur between producers and their suppliers, and between producers and their customers. This may make it more difficult for producers to manufacture products for the customers because of the costs and complexity involved in. This paper reports on the acquisition of PLM requirements from five Industrial Partners in the FP7 project "Advanced Platform for Production Engineering and Product Life Cycle Management" (PLM). The collection of PLM requirements reported in this paper indicates that there are shortcomings in collaborative support, project management and demonstration of the current PLM tools used by these companies. (Matthew et al., 2013). New operating criteria arising from LCM might not be well communicated, followed or monitored by the respective people of the organization due to lack of structured formalised procedures and LCM initiatives are more likely to fail. Numerous programs have been launched to raise awareness of the global impact of the products produced. The current work describes a green product life cycle cycle that includes key components: design, production and service, which includes usability and innovation. The contribution proposes a sustainable product development framework that takes into account the life cycle of the entire product. (Vila et al., 2015). Traditional environmental management guides recommend that key participants need relatively high levels of authority in departments that are critical to the success of the project as well as an in-depth knowledge of the company but often lack in LCA participation hence implementation of PLM becomes difficult. The research presented in this paper was done to draw on the field of product life cycle management in manufacturing industries that use bibliometric methods. PLM can be identified by selecting outstanding texts, authors, and journals, knowledge-based research and technology base, flexible social structure, and variety of related topics. (Walter et al., 2018).

Another issue concerns ambiguity of results, when a firm develops and compares alternative options for a product there is rarely a direct choice. Instead, each option usually has different environmental impacts and more complex decision-making is required. This research was presented in 2008 and it explains about the methodology in PLM which led to the management of Projects, Process and Products. (Frederic et al., 2008). The level of product complexity increases as the product becomes complex. Assessment of electronic products, for example, requires a lot of time, money and expert knowledge. Therefore, LCM implementation is generally easier for firms producing simpler products. This paper is research related to the improvement of processes in business by application of PLM concepts and methods. The research claimed that the business processes can be improvised by using the new information technology processes, in the industries where the workforce availability is one of the problems. (Vijaykumar and Uppin., 2017). Staff training is one of the important tasks. The common reliance on creating policies to demonstrate commitment and the assumption that these automatically lead to staff changing practices and values. The existence of environmental policies did not appear to lighten difficulties encountered in overcoming barriers to implementation by organisations. This paper consists of development of appropriate technology with help of product life cycle models and tools for decision making on data that is gathered through Product life cycle in research and development sectors. The implementation of the plan includes fundamentals and research activities, modelling and data management for Beginning of life(BOL), statistics method for predictive maintenance for Middle of Life(MOL), Planning and management of product for End of Life(EOL). (Dimitris et al., 2003). The costs of the Lower cost markets are more significant than the benefits. The benefits of LCM need to outweigh and justify the complexity and risk associated with dealing with suppliers and customers. This is the need that the benefits should have more significance. This paper refers to the need of PLM methods and models used in industries, their use and results. The vision of PLM consists of setting a comprehensive set of models, methods that include all life phases requirements. (Frederic et al., 2013). PLM is a complex process due to which industries lack understanding of the actual application of the methods. Hence this paper focuses on reducing the gap in implementation and

proposes a process oriented framework to support the PLM execution. (Gunther et al., 2008). This paper refers to the exploration of the role of PLM in industries by studying the impact on business process improvements.(Raul and Martin. 2008). Firms can use their buying power to enforce environmental performance of their suppliers, large firms often have hundreds of products and hundreds of tier-one suppliers, making it extremely complex and time-consuming . This paper is based on semantic web service and aims at closed-loop PLM to close information gaps between different categories and product life cycle processes for each product. For this purpose, an overview of the various interactions, including web services, is provided. Then discussion issues with collaboration in closed-loop PLM is done. Next, the paper details about how these syntactic and semantic integration problems are solved for Web Services. (Marco et al., 2014). Increased collaboration runs the risk of a firm having increased dependency on its suppliers and customers and therefore reduced negotiation power . The paper is based on the most important feature of the service sector, that is regarding information feedback transfer in the product life-cycle including remanufacturing. This paper examines two industry contexts in which PSS has not yet acted as a facilitator for conveying information feedback from innovation to product designers. (Louise and Erik, 2016). Most firms already have environmental and health and safety regulations that they are required to meet, and voluntary measures such as LCM tend to be undertaken only when these requirements are addressed and resources remain to implement LCM .The paper is based on the unified modelling of product life cycles. Product life cycle management requires a modeling framework that reflects the associations between life cycle stages, business processes, and stakeholders. (Thimm et al., 2005). The work aims to identify and rank the performance outcomes realized due to CSC enablers adoption by using a Pythagorean Fuzzy AHP method. The work is done by dividing different enablers into 7 different groups for applying the method. Some of the groups include operational, organizational, social enablers. There were in total 42 enablers and 15 performance outcomes. (Swapnil and Ravi., 2021). Many researchers have worked on the Product Lifecycle Management but the present work consists of the Barriers related to PLM and Ranking of these Barriers accordingly. The aim of this paper is to get the most important barrier for PLM and to also find out the least important barrier. The Pythagorean fuzzy AHP method is used to rank the barriers.

3. METHODOLOGY

Pythagorean fuzzy logic was first introduced in the literature by Zadeh in 1965. Theory is relevant to direct judgment and quality assessment in decision-making processes for decision-making problems. The paper aimed at a case study for selection of a manager using Pythagorean fuzzy AHP method. The main contribution in this study is developing a new approach to find weights of criteria based on Pythagorean fuzzy numbers and applied to AHP. (Wan and Lazim., 2017).

The steps for the Pythagorean Fuzzy AHP Method is as follows -

Step 1. Developing a pairwise comparison matrix based on the relative importance of one factor with another. The inputs are taken from the table shown in Figure 1.

$$Y = Yik(m \times n)$$

Table 1 Weighing Scale for Pythagorean Fuzzy AHP Method

Linguistic terms	Pythagorean fuzzy Number	Pythagorean fuzzy Number	Pythagorean fuzzy Number	Pythagorean fuzzy Number
	Lower value of membership degree (uL)	Upper value of membership degree (uU)	Lower value of non-membership degree (vL)	Upper value of non-membership degree (vU)
Certainly Low Importance - CLI	0.00	0.00	0.90	1.00
Very Low Importance - VLI	0.10	0.20	0.80	0.90
Low Importance - LI	0.20	0.35	0.65	0.80
Below Average Importance - BAI	0.35	0.45	0.55	0.65
Average Importance - AI	0.45	0.55	0.45	0.55
Above Average Importance - AAI	0.55	0.65	0.35	0.45
High Importance - HI	0.65	0.80	0.20	0.35

Very High Importance - VLI	0.80	0.90	0.10	0.20
Certainly High Importance - CLI	0.90	1.00	0.00	0.00
Equal Importance	0.1965	0.1965	0.1965	0.1965

Step 2. Computation of the differences matrix using Eqs. (1) and (2) using the lower and upper values.

$$d_{ikl} = u_{ikl}^2 - v_{iku}^2 \quad \dots(1)$$

$$d_{ikh} = u_{ikh}^2 - v_{iku}^2 \quad \dots(2)$$

Step 3. Computation of the interval multiplicative matrix using Eqs. (3) and (4):

$$S_{ikl} = \sqrt{1000^{\square\square}} \quad \dots(3)$$

$$S_{iku} = \sqrt{1000^{\square\square}} \quad \dots(4)$$

Step 4. Computing the determinacy value of the using Eq. (5):

$$T_{ik} = 1 - (u_{iku}^2 - u_{ikl}^2) - v_{iku}^2 - v_{ikl}^2 \quad \dots(5)$$

Step 5. Determining the matrix of weights, , before normalization by multiplying the determinacy degrees with S with matrix using Eq. (6):

$$t_{ik} = \left(\frac{\square\square\square\square + \square\square\square\square}{2} \right) T_{ik}$$

...(6)

Step 6. Calculating the normalized priority weights, using Eq. (7):

$$W_i = \frac{\square(\square=I..\square)\square\square\square}{\square(\square=I..\square)\square(\square=I..\square)\square\square\square}$$

...(7)

The values for all the linguistic terms are displayed in Table 2.

Table 2 Values of Linguistic Terms

CLI	VLI	LI	BAI	AI	AAI	HI	VHI	CHI	EE
0.0375	0.0756	0.1682	0.4251	0.8482	1.6924	3.7666	9.5169	19.4516	1

4. APPLICATION TO METHODOLOGY

The fifteen barriers related to Product lifecycle management are found out. The barriers are needed to be weighted and ranked according to their importance in Product Lifecycle Management.

The Barriers are divided into three different groups and each group consists of five barriers each. The Pythagorean AHP operations are carried out on these barriers and finally the ranking is found out. Following are the different tables consisting of the pairwise matrix for each section.

Table 3 Pairwise Comparison Matrix for main group

	Organizational Barriers	Operational Barriers	Social and Environmental Barriers
Organizational Barriers	EE	AAI	HI
Operational Barriers	BAI	EE	AAI
Social and Environmental Barriers	LI	BAI	EE

All the barriers are numbered differently to help in calculating and to understand the calculation tables easily.

Table 4 Numbers given to barriers

Group	Barriers	Numberings
Organizational Barriers	Limitations on small scale firms to influence suppliers	PLM1
	Market requirements to carry out LCM	PLM2
	Increase in dependency on customers/suppliers	PLM3
	Less awareness of SMEs	PLM4
	Key staff often confined to operational departments	PLM5
Operational Barriers	Costs of LCM may outweigh benefits	PLM6
	Change Staff practises	PLM7
	Level of product complexity	PLM8

	Assessment tool complexity	PLM9
	Lack of structured formalised procedures	PLM10
Social and Environmental Barriers	Geographical constraints	PLM11
	Lack of awareness within customers' about environmental issues	PLM12
	Switching brands for green products	PLM13
	Ambiguity around best environmental options	PLM14
	Scale and complexity of organisational change	PLM15

Table 5 Pairwise Comparison Matrix for Organizational Barriers

	PLM1	PLM2	PLM3	PLM4	PLM5
PLM1	EE	CHI	BAI	LI	HI
PLM2	CLI	EE	HI	AAI	VLI
PLM3	AAI	LI	EE	BAI	CHI
PLM4	HI	BAI	AAI	EE	AAI
PLM5	LI	VHI	CLI	BAI	EE

Table 6 Pairwise Comparison Matrix for Operational Barriers

	PLM6	PLM7	PLM8	PLM9	PLM10
PLM6	EE	AAI	BAI	CLI	HI
PLM7	BAI	EE	LI	BAI	BAI
PLM8	AAI	HI	EE	LI	VHI
PLM9	CHI	AAI	HI	EE	HI
PLM10	LI	AAI	VLI	LI	EE

Table 7 Pairwise Comparison Matrix for Social and Environmental Barriers

	PLM11	PLM12	PLM13	PLM14	PLM15
PLM11	E	HI	CHI	AI	CHI
PLM12	LI	E	AAI	BAI	HI
PLM13	CLI	BAI	E	LI	AAI
PLM14	AI	AAI	HI	E	VLI
PLM15	CLI	LI	BAI	VHI	E

Table 8 Final Weights and Ranks For all Barriers

Main Group	Barriers	Factors weight	Numberings	Sub-factors local weight	Global weight	Global rank
	Limitations on small scale firms to influence suppliers	0.578	PLM1	0.336	0.194	1

Organizational Barriers	Market requirements to carry out LCM	0.578	PLM2	0.089	0.051	8
	Increase in dependency on customers/suppliers	0.578	PLM3	0.308	0.178	2
	Less awareness of SMEs	0.578	PLM4	0.116	0.067	7
	Key staff often confined to operational departments	0.578	PLM5	0.151	0.087	4
Operational Barriers	Costs of LCM may outweigh benefits	0.279	PLM6	0.118	0.033	9
	Change Staff practises	0.279	PLM7	0.047	0.013	14
	Level of product complexity	0.279	PLM8	0.276	0.077	6
	Assessment tool complexity	0.279	PLM9	0.507	0.141	3
	Lack of structured formalised procedures	0.279	PLM10	0.053	0.015	11
Social and Environmental Barriers	Geographical constraints	0.143	PLM11	0.606	0.086	5
	Lack of awareness within customers' about environmental issues	0.143	PLM12	0.096	0.014	13
	Switching brands for green products	0.143	PLM13	0.045	0.006	15
	Ambiguity around best environmental options	0.143	PLM14	0.101	0.014	12
	Scale and complexity of organisational change	0.143	PLM15	0.152	0.022	10

5. RESULTS AND CONCLUSION

Assessing the above rankings of the barriers, it is clearly seen that the manufacturing organisation is having a negative consequences on the environment. Summing up the weights of the enabler groups, the sequence of ranking is Organizational Barriers > Operational Barriers > Social and Environmental Barriers. The most important barrier based on the ranking is the Limitations on small scale firms to influence suppliers having the global weight 0.194. The switching brands for green products has the lowest rank and is ranked 15th among the other barriers. The priority of the weights is in the manner PLM1 - PLM3 - PLM9 - PLM5 - PLM11 - PLM8 - PLM4 - PLM2 - PLM6 - PLM15 - PLM10 - PLM14 - PLM12 - PLM7 - PLM13.

In recent years, the environmental impact of manufacturing organisations has been less focused. Recent research found the factors that influenced the adoption of LCM. The organization's learning culture, relationships with the suppliers and the customers, the skill and behaviour of the employees, the quality of products manufactured are some of the factors. This paper presents a systematic Pythagorean AHP method to prioritize the enablers. The barriers can then be divided into groups. The barriers focus on unawareness by various organisations, esp noecially SMEs. The geographical constraints have highest priority among the selected barriers. Many of the barriers show the dependency of SMEs on customers and suppliers, less awareness about the technology and environmental impact. The organizations should be made aware of sustainability. The government policies should be made by considering the adoption of sustainable and efficient environmental supply chain management. The organisations should also identify the enablers and barriers in their organisation and adopt suitable steps to make the LCM of organisation better.

REFERENCES

- Pankaj C.S., Zulfiqar N.A., Ravi K., (2020), 'A Pythagorean fuzzy AHP approach and its application to evaluate the enablers of sustainable supply chain innovation', Sustainable Production and Consumption, Vol.23, pp.77-93.
- Ertugrul A. and Alev T.G.,(2021), 'Interval-valued Pythagorean fuzzy AHPmethod-based supply chain performance evaluation by a new extension of SCORmodel: SCOR 4.0', Complex & Intelligent Systems, Vol.7, pp.559-576.
- Andreas D, Andreas O, Marcel E, Frank Pospel-D, (2018),"Developing the Requirements of a PLM/ALM Integration: An Industrial Case Study", Procedia Manufacturing, Vol.24, pp.107-113
- Michael H, Dietmar T, Joachim L, (2019), "Certification of Openness – Corner Stone of an Agile PLM Strategy", Procedia Manufacturing, Vol. 39, pp. 1383- 1391

- X.G. Ming , J.Q. Yan, X.H. Wang, S.N. Li, W.F. Lu, Q.J. Peng, Y.S. Ma, (2008),"Collaborative process planning and manufacturing in product lifecycle management", *Computers in Industry*, Vol. 59, pp. 154-166
- Angelo C, Maria E, Mariangela L, Serena L, Manuela M, Sabrina V, (2013), "Defining Product Lifecycle Management: A Journey across Features, Definitions, and Concepts", Hindawi Publishing Corporation, pp.1-11.
- Inga G, Marc S, Dennis K, Thomas G,(2020), "Experiencing the potential of closed-loop PLM systems enabled by Industrial Internet of Things", *Procedia Manufacturing*, Vol. 45, pp.177-182
- Matthew D, Ivor L, Pezhman G, Cathal H, Alan R & Mark S,(2013),"Product Lifecycle Management Requirements Gathering: Industrial Pilot Cases", 7th IFAC Conference of Manufacturing Modelling, Management, and Control, pp. 19-21
- C. Vila, J. V. Abellan-Nebot, J. C. Albina, G. Hernandez,(2015)," An approach to Sustainable Product Lifecycle Management(Green PLM)", *Procedia Manufacturing*, Vol. 132, pp. 585-592
- Walter B (2018), 'Mapping the Field of Product Lifecycle Management: A Bibliometric Study', Working Paper IWI-HSG, pp.1-21.
- Frederic D, Nicolas G, Yvon G, Michael R (2008), 'PLM: A methodology for product lifecycle management', *Computers in Industry* 59,pp.304–317
- Vijaykumar H K, Uppin M.S.(2017), 'Some Case Studies on Product Life Cycle Management Applied In Engineering Industries', *International Advanced Research Journal in Science, Engineering and Technology*, Vol. 4, Special Issue 6, pp.41-46
- Dimitris K, Ahmed B, Paul X (2003), 'Research issues on product lifecycle management and information tracking using smart embedded systems', *Advanced Engineering Informatics* 17 , pp.189–202
- Frederic D, Olivier D , Xiu-Tian Y , Benoit E, Dimitris K , Samuel G, (2013), 'Product relationships management enabler for concurrent engineering and product lifecycle management', *Computers in Industry*, COMIND-2466, pp.1-16
- Gunther S, Henrique R, Dirk A, Eduardo Z (2008), 'Process oriented framework to support PLM implementation', *Computers in Industry* 59 , pp. 210–218
- Raul B and Martin W (2008), 'Product Lifecycle Management Systems and Business Process Improvement – A report on Case Study Research', Third International Multi-Conference on Computing in the Global Information Technology ICCGI, pp.1-5
- Marco F, Konstantin K, Karl H, Dennis L, Marius V, Klaus-Dieter T (2014), 'Semantic Web Service Wrappers as a foundation for interoperability in closed-loop Product Lifecycle Management', 3rd International Conference on Through-life Engineering Services *Procedia CIRP* 22 , pp. 225 – 230
- Louise L and Erik S (2016), 'The role of Product-Service Systems regarding information feedback transfer in the product life-cycle including remanufacturing', *Procedia CIRP* 47 ,pp.311 – 316
- G. Thimm, S.G. Lee, Y.-S. Ma (2005), 'Towards unified modelling of product life-cycles', *Computers in Industry* 57 (2006), pp. 331–341.
- Swapnil L. and Ravi K.,(2021), 'A hybrid Pythagorean fuzzy AHP – CoCoSo framework to rank the performance outcomes of circular supply chain due to adoption of its enablers', *Waste Management*, Vol.130, pp.48–60.
- Wan R.W. and Lazim A, (2017), 'Pythagorean Fuzzy Analytic Hierarchy Process to Multi-Criteria Decision Making', *Proceedings of the 13th IMT-GT International Conference on Mathematics, Statistics and their Applications*, AIP Conf. Proc.1905, pp.040020-(1-6).

WE ARE WITH YOU(VAWY)

E.Ganesh,

Vardhaman college of engineering,Shamshabad, India.
(ganesheligeti003@gmail.com)

G.Indira Rani,

Vardhaman college of engineering,shamshabad, India.
(indirarani.guntu@gmail.com)

Our books selling or rent website aims to change the way readers access and enjoy their favorite books. Our platform serves as a convenient online marketplace where users can effortlessly buy or rent books from a vast collection, catering to diverse interests and genres. By harnessing the power of technology, we connect book lovers with an extensive network of sellers, ensuring a wide range of options at competitive prices. Key features of our website include an intuitive and user-friendly interface, enabling seamless navigation and browsing through our extensive catalog. Users can search for specific titles, authors, or genres, ensuring they find the perfect book to suit their preferences. Additionally, personalized recommendations based on browsing history and user reviews help readers discover new and exciting literary gems. For those who prefer physical books, we provide reliable shipping services that ensure prompt and secure delivery of orders. On the other hand, for those who enjoy the convenience of digital reading, our platform offers a wide selection of e-books, accessible through popular e-reader devices or mobile applications. To foster a vibrant community of book enthusiasts, our website incorporates social features such as user reviews, ratings, and the ability to create reading lists. Whether users are looking to expand their personal library, find textbooks for academic pursuits, or simply indulge in the pleasure of a captivating story, our books selling or rent website provides an all-encompassing platform online experience, we strive to redefine the way readers discover and access their literary passions. Embark on a literary journey like never before. Join our books selling or rent website and unlock a world of knowledge, imagination, and boundless reading pleasure.

1. INTRODUCTION

In these modern days, many students are habituated to documented files. Now a days it is a competitive world, where students are facing each other for different jobs. In this process there is an increase of books manufacturing and deforestation of forests. From this we came with an idea why can't we use old books, through online. There is no such platform to rent or sell their old books. The advent of technology has revolutionized the way we access information and entertainment. From streaming movies and music to shopping for everyday essentials, the digital landscape has reshaped our daily lives. In this digital age, books have not been left behind. The rise of e-readers and online platforms has opened up new avenues for readers to explore and enjoy their favourite literature. The motivation behind our book selling and renting website stems from the desire to create a comprehensive and user-friendly platform that caters to the evolving needs of book enthusiasts. We understand that while some readers prefer the tactile experience of flipping through physical pages, others embrace the convenience of digital reading. Our goal is to bridge this gap by offering a diverse range of options to suit every reader's preference. One of the primary motivations for our website is to provide an extensive and varied collection of books. We believe that literature should be accessible to all, regardless of geographical location or financial constraints. By bringing together a vast network of sellers and publishers, we ensure that readers have access to an unparalleled selection of titles, genres, and authors. Additionally, affordability and flexibility are key aspects that drive the development of our platform. We recognize that purchasing every book outright may not be feasible for everyone. Hence, our rental service allows readers to temporarily access their desired books at a fraction of the cost. This not only benefits avid readers who devour multiple books but also students seeking textbooks for a

specific academic term. Furthermore, our website aims to create a vibrant community of book lovers, fostering a sense of camaraderie and shared passion for literature. By integrating social features, such as user reviews, ratings, and discussion forums, we encourage readers to engage with one another, exchange recommendations, and delve deeper into the world of books

METHODOLOGY: This website reduces the wastages of the books.its an website where the customer can send or rent their books through that they can profits. Firstly the customer must sign in or login into our website. After login or sign in into our website it shows various genre of books and consists two option whether the customer can sell or rent the book,based upon their interest they will select rent or sale option.

2. PROPOSED DESIGN:-

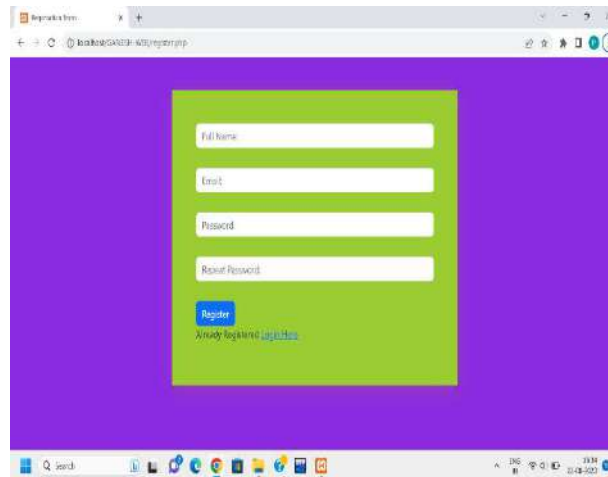
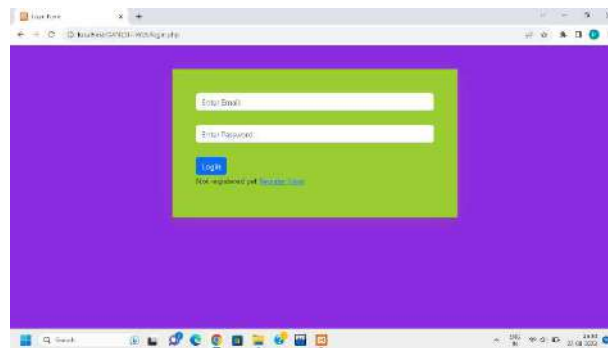


Fig 1. login page



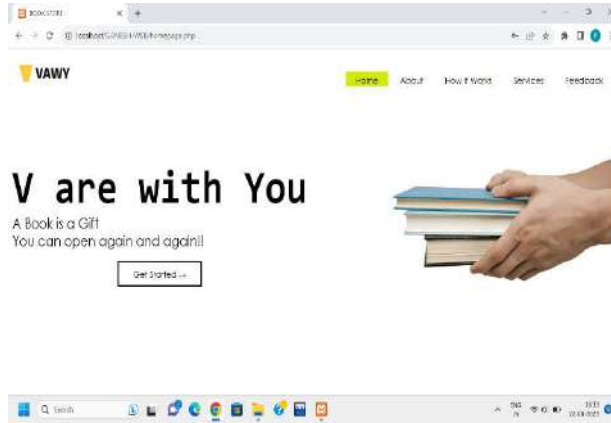


Fig 2.Home page

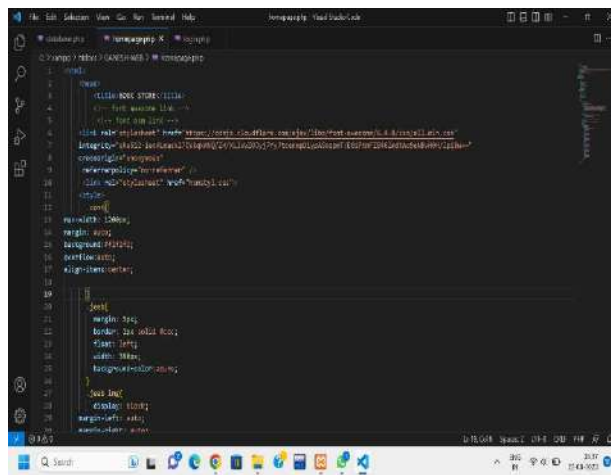
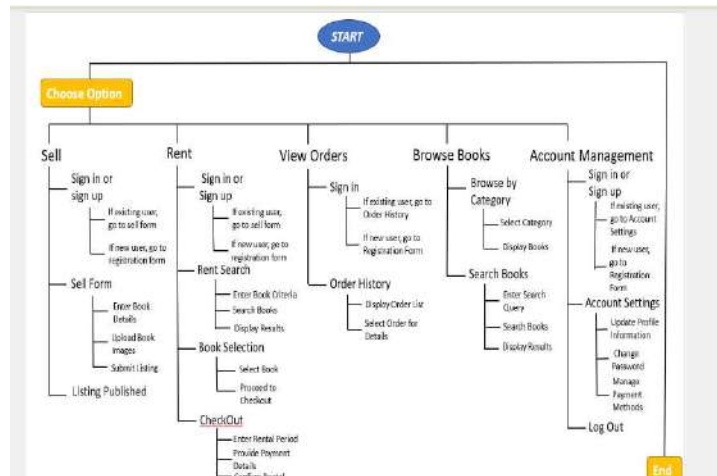


Fig 3.Login code



The design for the WE ARE WITH YOU(VWAY). This app helps the students to sell or rent their old books. Basically in this app it contains two options whether the student can sell their books or rent their books. MAIN MENU shows different books like comic books, competitive books, history books. etc...Based on this a book can rent or sell.When a person select sell or rent option it shows various books, contact details of the owner, description of the book.. Through this details customer can direct contact with owner. We act as intermediate between the customer and owner for example OLX.

TECHNOLOGIES USED:

- 1.HTML
- 2.CSS
- 3.JAVASCRIPT

HTML:

HTML stands for hypertext markup language and it is used for creating web pages and web application.

In our website html to build basic structure of our application

CSS:

[12]CSS stands cascading style sheets and it is used to d describes how HTML elements are to be displayed

On screen.

JAVASCRIPT:

It is a cross platform,object-oriented programming Language used by developers to make web pages Interactive.

Those three programming languages are mainly Used in our web application.

3. CHALLENGES TOWARDS IMPLEMENTATION

Challenges towards the implementation of a books selling and renting website can arise from various aspects of the business and technical domains. Some key challenges include:

1. **Inventory Management:** Building and maintaining a comprehensive inventory of books can be a daunting task. Ensuring accurate and up-to-date information about the availability, condition, and pricing of each book requires efficient cataloging systems and regular updates from sellers and publishers.
2. **Logistics and Shipping:** Handling the logistics of physical book delivery, especially in the case of rentals, can pose challenges. Ensuring timely and secure shipping, managing returns, and dealing with potential damages or loss of books require robust logistics and shipping partnerships.
3. **Legal Considerations:** Operating a books selling and renting website involves compliance with copyright laws and intellectual property rights. Obtaining necessary permissions and licenses from publishers and authors, while adhering to regional copyright regulations, can be complex and time-consuming.
4. **Payment Processing and Security:** Developing a secure payment infrastructure that safeguards customer financial information is crucial. Implementing secure payment gateways and complying with data protection regulations ensure a safe and trusted transaction environment.
5. **User Experience and Interface:** Designing an intuitive and user-friendly interface that caters to diverse user preferences and requirements is essential. Creating efficient search and browsing

functionalities, personalized recommendations, and smooth checkout processes contribute to an enjoyable user experience.

6. **Competition and Market Reach:** The bookselling and renting industry is highly competitive, with established players and marketplaces. Gaining visibility, attracting customers, and building a loyal user base in a crowded market can be challenging. Effective marketing strategies, partnerships with influencers, and targeted advertising are essential for market penetration.

7. **Customer Support:** Providing fast and efficient customer service is essential for ensuring consumer happiness. Long-term success depends on answering questions, addressing problems with purchases, rentals, or technical issues, and providing a flawless client experience.

8. **Platform Scalability:** As the user base and book inventory grow, scaling the platform to handle increased traffic, transactions, and data management becomes critical. Ensuring that the website remains stable, responsive, and able to handle high volumes of simultaneous users is a technical challenge.

9. **Trust and Reputation:** Building trust and a positive reputation in the online bookselling and renting space is crucial. Encouraging genuine user reviews, implementing a robust rating system, and actively managing and addressing feedback and concerns help establish credibility and reliability.

10. **Adaptability to Changing Technologies:** Technology evolves rapidly, and staying up-to-date with the latest trends and innovations is essential. Embracing new technologies, such as mobile applications, e-readers, or emerging digital book formats, ensures the website remains relevant and adaptable to changing user preferences.

4. RESULTS & DISCUSSION

Social Innovation is the course that aims to address the problem statement in an effective way. we have found a problem statement and applied our engineering thinking to address the problem. We designed this project to save trees and save old books. By this project people can gain money. This project will be helpful for more students for their preparation. After the implementation of this project we can save old books. With the accommodation of libraries we can implement this throughout the country. A user-friendly interface, intuitive navigation, and personalized recommendations contribute to an enhanced user experience. Users can easily search for books, read reviews, and make informed decisions about their purchases or rentals. This positive user experience leads to higher customer satisfaction, increased engagement, and potentially encourages users to become loyal customers, returning to the website for future book-related needs.

REFERENCES

- <https://rendevuapp.com/how-to-build-a-book-rental-website/>
Shopify: How to Start an Online Bookstore: <https://www.shopify.com/blog/how-to-start-an-online-bookstore>
Business.com: How to Start an Online Book Rental Service: <https://www.business.com/articles/how-to-start-an-online-book-rental-service/>
P. Arora and D. Juneja, "E-commerce and its Future in India," 2018 2nd International Conference on Inventive Systems and Control (ICISC), 2018. DOI: 10.1109/ICISC.2018.8398923
B. Darji and M. Bambhroliya, "E-commerce Applications: Issues and Prospects in Indian Business Environment," 2016 International Conference on Advances in Computing, Communication, & Automation (ICACCA), 2016. DOI: 10.1109/ICACCA.2016.7587212

- H. Wang, J. Zhang, X. Yuan, et al., "Predicting User Behavior in Online Bookstores: A Neural Collaborative Filtering Approach," 2020 IEEE 36th International Conference on Data Engineering (ICDE), 2020. DOI: 10.1109/ICDE48307.2020.00011
- P. Kour and P. Jolly, "A Comprehensive Model for E-commerce Adoption: A Study on Indian Consumers," 2018 9th International Conference on Computing, Communication and Networking Technologies (ICCCNT), 2018. DOI: 10.1109/ICCCNT.2018.8494036
- N. Yadav, C. Agarwal, and R. Jindal, "Impact of E-commerce on Supply Chain Management: An Empirical Study on Indian SMEs," 2018
<https://techconsumer.in/complete-review-of-sonata-act-watch-and-how-it-works/>

NCRB Crime in India-2015 Chapter - 5 Crime against Women

<https://nif.org.in/>

<https://www.w3schools.com/css/>

ASSESSING AUTOMATIC ARTIFACT REJECTION METHODS AND IMPROVED ICA BASED MANUAL METHOD FOR MEDITATION EEG DATA

Abhishek Jain,

Guru Ghasidas University, Bilaspur, Chhattisgarh, India.
(ajain.nit@gmail.com)

Dr. Rohit Raja,

Guru Ghasidas University, Bilaspur, Chhattisgarh, India.
(drrohitraja1982@gmail.com)

Swapnil Dange,

Guru Ghasidas University, Bilaspur, Chhattisgarh, India.
(swapnildange00@gmail.com)

Amit Kumar Dewangan,

Guru Ghasidas University, Bilaspur, Chhattisgarh, India.
(amit.nitr@gmail.com)

Over the past 30 years, the science of meditation has grown significantly. In this paper 98 subjects from three different meditation traditions—Vipassana, Isha Shoonya, and Himalayan Yoga—were present during meditation, along with a control group. We compared the decomposition of data with Independent Component Analysis (ICA) to eliminate artefacts such as muscle, eye blinks, or eye movements there were two techniques: manual rejection and automatic rejection of artifacts, and both the results were compared based upon their sensitivity, precision, F1 score etc.

Keywords: Independent component analysis, infinite impulse response (IIR) filter, meditation, artifacts

1. INTRODUCTION

An important and common issue for studying EEG signals is the detection of artifacts caused by, electrical noise, eye blinks and muscle activity in the brain. It is now common and important information that electroencephalographic (EEG) data can be separated from artifacts and/or cortical processes using independent component analysis (ICA)[2]. ICA's fundamental mathematical idea is to maximize the data projections' joint entropy or minimize their mutual information[3]. In addition to principal component analysis (PCA), ICA can be considered a linear decomposition alternative. Contrary to PCA, which seeks maximally independent sources, PCA temporal domain make each subsequent component in particular account for as much activity as possible that is independent of what came before discovered components. Element cross-correlations and every higher-order moments of the signals must be zero for the ICA to discover component temporal courses that are uncorrelated. If their activity time courses are almost independent from one another, ICA is free to alter its projection patterns to align with the EEG generators. ICA decomposition works best when sources are integrated in a linear fashion into the captured signals without any varying time delays. Because ICA doesn't try to maximize the Variation between each element, PCA components may make up a larger portion of the overall signals than ICA components do[3]. For 128 or 256 channels ICA can be useful, but useful results can also be produced with 32 or fewer channels. [1] ICA separates the EEG processes with the most distinct time waveforms. The distinct processes could be produced either inside or outside of the brain.[2]. Using the concepts of statistical independence, the ICA technique locates a representation in which each element is distinct. Which channels are most impacted by the artefacts can be determined using ICA. The eye-blinking artefact distorts the frontal lobe electrodes, as may be observed in, for example[4]. By using activity patterns that are undeniably linked to behavioral processes, biologically plausible brain sources may be identified. In reality, maps of the scalp resemble the projection of a single analogous current dipole for some of the physiologically plausible origins that ICA finds in EEG data.

When used to unaveraged EEG data, ICA can also recognise and keep active EEG sources that are only briefly phase-locked; only partly phase-locked. When enough channels are available to accommodate the most powerful EEG and artefact processing, this is most beneficial. direct application of ICA to prolonged EEG data or, more frequently, concatenated sets of discrete EEG data trials [3]. Higher-order statistics are used in traditional ICA techniques like Extended Infomax and FastICA to define independence. While Infomax was developed from a neural network perspective, FastICA maximises the negentropy of the component distributions [7]. On the data that had been trimmed, we utilised Infomax Independent Component Analysis to remove muscle and ocular movement-related artefacts (Infomax ICA). For each individual, we manually and

automatically located and removed ICA components from the data [8]. Makeig et al. first utilized the ICA algorithm to examine the signals from the EEG and EPR since Ringer et al. algorithm technique indiscriminately separates signals using information maximization [9]. Based on the following premise, it has been demonstrated that ICA is more adaptable and effective at separating the sources of EEG signals from artifacts:

- (1) Instantaneously mixed source signals are statistically independent of one another.
- (2) Estimation of the monitoring signal needs to be either bigger or the same as the dimension of the source signal [9,10].
- (3) Non-Gaussian sources or a single Gaussian source [11].

2. METHODOLOGY

SoBI, FastICA, and Infomax ICA are now the ICA algorithms that are most frequently used to process EEG data. For signal decomposition, we used Infomax. ICA separates EEG processes with temporal waveforms that are as independent as possible. The many processes could have their roots inside or outside of the brain. For instance, eye blinks and muscle movements result in particular activity patterns and component maps of ICA components [2] with frequency range between (35-128 Hz). First, the data was processed using the EEGLAB programme, which was installed on Matlab R2021b (The Mathworks, Inc.) running on Windows. EEG data were initially down-sampled from 1024 Hz to 256 Hz and referred to the right mastoid. With a bandwidth of 0.3 Hz, an infinite impulse response (IIR) filter was used to apply a high pass filter. We utilised the default parameters provided by the runica function of the EEGLAB toolbox for Infomax [4].

2.1 Manual Rejection

Data were divided into 1-second chunks with a 0.5-second crossover and first we manually selected and deleted faulty electrodes, as shown in fig1.

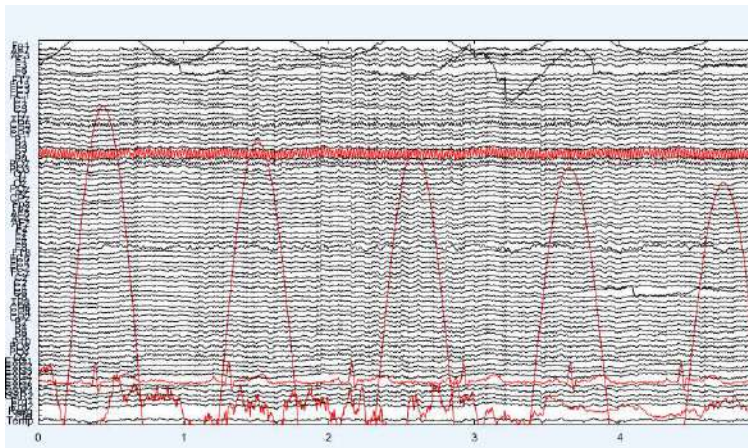


Fig1. Visually Recognized ICA

2.2 Automatic Artifact Rejection

The Automatic artifact rejection was performed on EEG data using IC Label, that is also known as IC classification or IC labelling these were used in four different ways. There were various attempts to automate IC label:

- MARA is an IC classifier that determines the likelihood that whether the ICs are Brain ICs or (non-brain) artifactual ICs[13].
- Three of the five distinct categories that ADJUST uses to categorize ICs have to do with ocular activity. The learning of the feature-specific thresholds for a single experimental paradigm was based on twenty EEG recordings[13].
- FASTER was designed as a complete processing pipeline that purifies raw, unedited EEG data. FASTER classifies an IC as "artifactual" if any of the attributes it determines exceeds

three standard deviations from the dataset's average. Only the component that categorizes ICs is taken into account here[13].

- On the basis of features from MARA, FASTER, and ADJUST as well as new features, SASICA conducts semi-automatic categorization [13].
- The ICLabel classifier calculates IC class probabilities for each of the seven classes. The ICLabel dataset used to train and assess the ICLabel classifier that covers range ofvarious EEG datasets from a number of models to attain performance across EEG recording settings. These sample integrated circuits (ICs) are matched with component labels obtained from hundreds of contributors via the ICLabel website. Finally, although slow to train, an artificial neural network architecture (ANN) that computes IC labels quickly is used as input to retain appropriate computing efficiency[13].

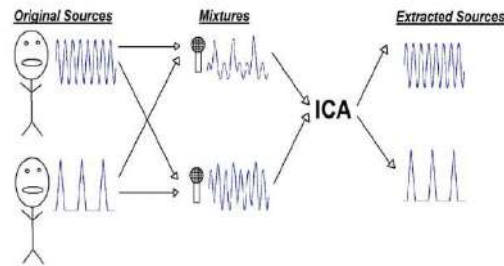


Fig2: ICA [5]

The same data was then flagged using automatic component rejection using IC Label a ICA classifier shown in fig4. These components included for eye artifacts, muscle noise, channel noise etc. Finally, a confusion matrix was designed to correlate between predicted and actual value obtained.

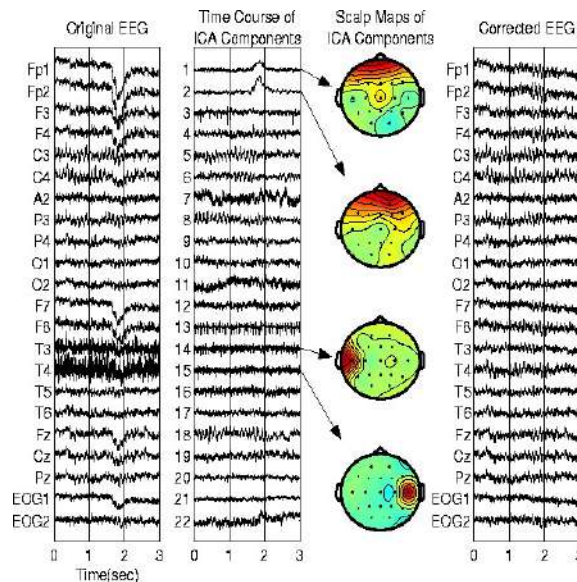


Fig3: Artifact removal using ICA [12]

2.3 Equations

The components that are unrelated to one another are as unrelated as possible. Analyzing the statistical characteristics of the data in this area may allow us to intuitively remove the artefacts with ease. The unmixing matrix, W , when multiplied by the scalp data, X [8].

$$S = W X$$

The information in the initial space is X . The source activity is S . From the S space to the X space, W is the weight matrix [14].

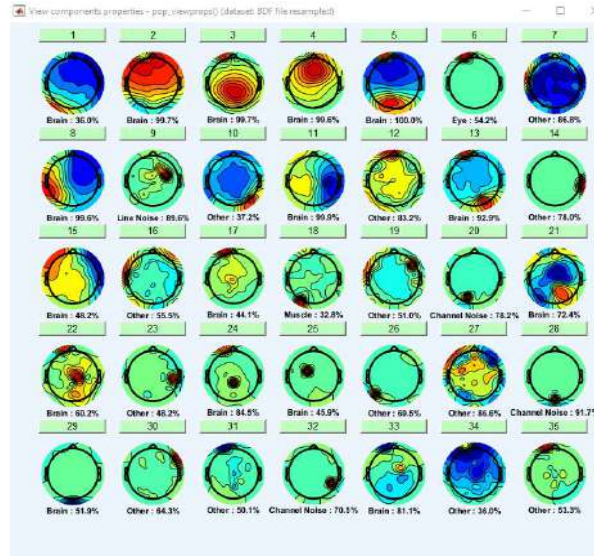


Fig4. Automatic recognition and Rejection

3. RESULTS

Results for each detection method and each artifact type were analyzed using manual artifact detection and automatic method that included the parameters like sensitivity, precision, F1 score, Matthews Correlation Coefficient, Negative Predictive etc. The results so obtained by implementing the rejection methods on the meditation dataset clearly shows that the manual artifact rejection performed better in comparison to automatic rejection method as shown in table 1.

Table 3: EYE ARTIFACT REMOVAL

Measure	Auto	Derivations
Accuracy	93.98	$ACC = (TPO + TNE) / (POS + NEG)$
F1 Score	76.19	$F1 = 2TPO / (2TPO + FPO + FNE)$
Matthews Correlation Coefficient	0.7579	$TPOS * TNE - FPO * FNE / \sqrt{(TPOS + FPO) * (TPOS + FNE) * (TNE + FPO) * (TNE + FNE)}$
Negative Predictive	93.33	$NPV = TNE / (TNE + FNE)$
Precision	1	$PPV = TPO / (TPO + FPO)$

Sensitivity	61.5	$TPR = TP_o / (TP + FNe)$
Specificity	1	$SPC = TNE / (FPO + TNE)$

Table 4: MUSCLE ARTIFACT REMOVAL

Measure	Auto	Derivations
F1 Score	68.97	$F1 = 2TPO / (2TPO + FPO + FNE)$
Accuracy	89.41	$ACC = (TPO + TNE) / (POS + NEG)$
Matthews Correlation Coefficient	0.6806	$TPOS * TNE - FPO * FNE / \sqrt{((TPOS + FPO) * (TPOS + FNE) * (TNE + FPO) * (TNE + FNE))}$
Negative Predictive	0.88	$NPV = TNE / (TNE + FNE)$
Precision	1	$PPV = TPO / (TPO + FPO)$
Sensitivity	52.63	$TPR = TP_o / (TP + FNe)$
Specificity	1	$SPC = TNE / (FPO + TNE)$

CONCLUSION

Our results on the impact of visually recognized artifacts and automatic recognition reveal that manual scorers in our sample, are inclusive and label several data epochs as artefactual even though no abnormalities are present that would significantly impair estimates. Thus, from the above relationship based on different parameters like sensitivity, precision, F1 score, Matthews Correlation Coefficient between the automatic artifact rejection and manual artifact rejection we concluded that manual artifact rejection is better as compared to the automatic rejection, but we can also include automatic artifact in case of a very large dataset that would take long time if manually identified.

REFERENCES

Makeig, S., Westerfield, M., Jung, T.P., Enghoff, S., Townsend, J., Courchesne, E. and Sejnowski, T.J., 2002. Dynamic brain sources of visual evoked responses. *Science*, 295(5555), pp.690-694.

Delorme, A., Sejnowski, T. and Makeig, S., 2007. Enhanced detection of artifacts in EEG data using higher-order statistics and independent component analysis. *Neuroimage*, 34(4), pp.1443-1449.

Delorme, A. and Makeig, S., 2004. EEGLAB: an open source toolbox for analysis of single-trial EEG dynamics including independent component analysis. *Journalofneuroscience methods*, 134(1), pp.9-21.

- Bono, V., Jamal, W., Das, S. and Maharatna, K., 2014, May. Artifact reduction in multichannel pervasive EEG using hybrid WPT-ICA and WPT-EMD signal decomposition techniques. In 2014 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP) (pp. 5864-5868). IEEE.
- An Introduction to Independent Component Analysis: InfoMax and FastICA algorithms Dominic Langlois, Sylvain Chartier, and Dominique Gosselin
- Frølich, L. and Dowding, I., 2018. Removal of muscular artifacts in EEG signals: a comparison of linear decomposition methods. *Brain informatics*, 5(1), pp.13-22.
- Braboszcz, C., Cahn, B.R., Levy, J., Fernandez, M. and Delorme, A., 2017. Increased gamma brainwave amplitude compared to control in three different meditation traditions. *PLoS one*, 12(1), p.e0170647.
- Makeig, S., Bell, A., Jung, T.P. and Sejnowski, T.J., 1995. Independent component analysis of electroencephalographic data. *Advances in neural information processing systems*, 8.
- Wallstrom, G.L., Kass, R.E., Miller, A., Cohn, J.F. and Fox, N.A., 2004. Automatic correction of ocular artifacts in the EEG: a comparison of regression-based and component-based methods. *International journal of psychophysiology*, 53(2), pp.105-119.
- Jung, T.P., Humphries, C., Lee, T.W., Makeig, S., McKeown, M.J., Iragui, V. and Sejnowski, T.J., 1998, September. Removing electroencephalographic artifacts: comparison between ICA and PCA. In *Neural networks for signal processing VIII. Proceedings of the 1998 IEEE signal processing society workshop* (Cat. No. 98TH8378) (pp. 63-72). IEEE.
- Jiang, X., Bian, G.B. and Tian, Z., 2019. Removal of artifacts from EEG signals: a review. *Sensors*, 19(5), p.987.
- Jung, T.P., Makeig, S., Humphries, C., Lee, T.W., Mckeown, M.J., Iragui, V. and Sejnowski, T.J., 2000. Removing electroencephalographic artifacts by blind source separation. *Psychophysiology*, 37(2), pp.163-178.
- Pion-Tonachini, L., Kreutz-Delgado, K. and Makeig, S., 2019. ICLabel: An automated electroencephalographic independent component classifier, dataset, and website. *NeuroImage*, 198, pp.181-197.
- Comon, P. (2018). *Independent Component Analysis*. Springer eBooks, pp.1062–1067. doi:https://doi.org/10.1007/978-1-4939-7131-2_147.
- Redline S, Purcell SM (2021) Sleep and Big Data: harnessing data, technology, and analytics for monitoring sleep and improving diagnostics, prediction, and interventions-an era for Sleep-Omics
- Muehlroth BE, Werkle-Bergner M (2020) Understanding the interplay of sleep and aging: Methodological challenges. *Psychophysiology* 57:e13523.

ASSESSING THE INFLUENCE OF GUERRILLA MARKETING ON CONSUMER ADOPTION IN THE FAST FOOD AND TRADITIONAL FOOD SECTORS

Jayati Chhangani,

Mohanlal Sukhadia University, Udaipur, Rajasthan, India.

This article presents a comprehensive examination of the influence wielded by guerrilla marketing strategies on consumer adoption within the fast food and traditional food sectors. Against a backdrop of heightened industry competition, businesses in these domains increasingly deploy unconventional tactics to capture consumer attention. Guerrilla marketing, distinguished by its ingenuity and cost-effectiveness, has emerged as a focal point in this marketing milieu. Through a meticulous inquiry, this study endeavors to elucidate the multifaceted impact of guerrilla marketing approaches on the dynamics of consumer behavior and adoption patterns within the fast food and traditional culinary landscapes.

Key words: Guerrilla Marketing, Consumer Adoption, Fast Food Sector, Traditional Food Sector, Marketing Impact.

1. Introduction

The introduction of this study establishes the contextual framework by delineating the competitive terrain intrinsic to the fast food and traditional food sectors. Within these domains, a palpable surge in the prevalence of guerrilla marketing is discerned, emerging as an instrumental strategy harnessed by businesses aspiring to not only distinguish themselves but also cultivate unwavering consumer allegiance. This discernible trend highlights the growing recognition of guerrilla marketing as a transformative force in the contemporary marketing milieu, where the need to capture and retain consumer attention has become increasingly paramount. In navigating the competitive landscapes of fast food and traditional culinary offerings, businesses are confronted with a pervasive struggle for visibility and consumer engagement. Against this backdrop, the strategic deployment of guerrilla marketing has become a noteworthy phenomenon. Guerrilla marketing, renowned for its ingenuity and cost-effectiveness, transcends conventional promotional paradigms. It serves as a disruptive force, challenging established norms and fostering a climate of heightened creativity in marketing endeavors. As businesses within these sectors grapple with the imperative to stand out in a saturated market, guerrilla marketing emerges as a compelling solution, offering a distinct avenue to capture the elusive consumer gaze. The escalating prevalence of guerrilla marketing underscores its pivotal role as a strategic linchpin for businesses operating in the fast food and traditional food sectors. Acknowledging this transformative landscape, our study endeavors to unravel the multifaceted impact of guerrilla marketing strategies on the intricate dynamics of consumer behavior and adoption patterns within these culinary domains. The delineation of research objectives serves to elucidate the overarching aim of this study. Foremost among these objectives is the imperative to discern the nuanced impact of guerrilla marketing on consumer adoption. In a market where consumer allegiance is increasingly elusive and subject to rapid fluctuations, understanding the intricate interplay between guerrilla marketing initiatives and consumer adoption is paramount. The objectives are not confined to a mere exploration of surface-level impacts but extend to a nuanced comprehension of the underlying mechanisms that drive consumer decisions in response to guerrilla marketing stimuli. Through this study, we seek to transcend superficial observations and delve into the deeper layers of consumer psychology and market dynamics. The competitive landscape, characterized by relentless innovation and strategic maneuvering, necessitates a comprehensive understanding of how

guerrilla marketing, with its unconventional tactics, influences consumer perceptions, preferences, and ultimately, adoption behaviors.

Guerrilla Marketing

Guerrilla marketing is a dynamic and unconventional marketing strategy that diverges from traditional methods, emphasizing creativity, ingenuity, and resourcefulness to achieve maximum impact with minimal resources. Originating from guerrilla warfare tactics, this approach involves surprising and engaging consumers through unexpected, often unconventional means. It thrives on creating memorable and immersive experiences, aiming to leave a lasting impression that resonates with the target audience. This form of marketing typically leverages unconventional spaces, grassroots initiatives, and unexpected events to generate buzz and capture the attention of the public. Guerrilla marketing campaigns are often characterized by their ability to go viral, capitalizing on social media and word-of-mouth promotion to amplify their reach.

The essence of guerrilla marketing lies in its agility and adaptability, allowing businesses to break through the clutter of traditional advertising and connect with consumers on a more personal and emotional level. By challenging the status quo and embracing a non-traditional approach, guerrilla marketing aims to disrupt conventional thinking and carve a distinctive niche in the minds of consumers, fostering brand loyalty and creating a unique identity in the competitive landscape of marketing.

Guerrilla marketing strategies

Guerrilla marketing strategies are innovative, unconventional promotional approaches that prioritize creativity and resourcefulness over traditional marketing methods. Leveraging surprise and ingenuity, these strategies aim to captivate and engage the target audience in unexpected ways, often utilizing non-traditional spaces or grassroots initiatives. Guerrilla marketing campaigns thrive on creating memorable experiences that leave a lasting impression, fostering a deeper connection between brands and consumers.

These strategies often incorporate elements of surprise, humor, or interactivity to generate buzz and organic word-of-mouth promotion. Social media platforms and viral marketing play a crucial role in amplifying the impact of guerrilla campaigns, enabling them to reach a broader audience with minimal financial investment. By challenging the conventional marketing norms, guerrilla strategies allow businesses to break through the clutter and establish a distinctive, memorable presence in the competitive landscape.

Role of Guerrilla marketing in Promotion of Fast Food Sector

Guerrilla marketing plays a pivotal role in the promotion of the fast food sector by injecting innovation and excitement into promotional endeavors. In an industry saturated with traditional advertising, guerrilla marketing offers fast food businesses a unique and cost-effective approach to captivate consumers and stand out from the competition.

Fast food, known for its quick-paced consumer interactions, benefits from guerrilla strategies that create memorable, shareable experiences. Unconventional campaigns, such as flash mobs, interactive installations, or clever social media challenges, resonate with the target audience, fostering brand recall and emotional engagement. Guerrilla marketing's ability to surprise and entertain aligns seamlessly with the fast-paced and dynamic nature of the sector, capturing attention in ways that conventional methods often struggle to achieve.

Moreover, guerrilla tactics often leverage social media virality, capitalizing on user-generated content and word-of-mouth promotion to exponentially extend reach. This not only enhances brand visibility but also cultivates a community around the brand, fostering a sense of excitement and loyalty among consumers. In essence, guerrilla marketing serves as a catalyst

for the fast food sector, infusing creativity into promotional efforts and creating an enduring connection between brands and their ever-discerning audience.

Application of guerrilla marketing within the traditional food sector

Within the traditional food sector, guerrilla marketing proves to be a transformative and strategic tool, injecting vibrancy and cultural resonance into promotional endeavors. Unlike conventional marketing, guerrilla strategies within the traditional food sector often tap into heritage, nostalgia, and community engagement. This involves leveraging unconventional spaces, orchestrating unique events, or incorporating cultural elements into campaigns to create memorable and immersive experiences for consumers.

Guerrilla marketing fosters a sense of authenticity and connection with the community, aligning traditional food establishments with local values and cultural identity. By evoking emotions tied to culinary traditions, businesses can build stronger relationships with their audience. Social media becomes a powerful ally in amplifying the impact of guerrilla campaigns, as users share their experiences, generating organic and authentic promotion. In essence, guerrilla marketing within the traditional food sector goes beyond mere promotion; it becomes a cultural celebration, reinforcing the brand's place within the community and appealing to consumers' desire for authentic and meaningful culinary experiences.

Psychosocial dynamics of consumers

The psychosocial dynamics of consumers in the context of guerrilla marketing represent a complex interplay of psychological and social factors that influence their perceptions, attitudes, and behaviors. Understanding these dynamics is essential for businesses aiming to leverage guerrilla marketing effectively.

1. **Cognitive Responses:** Consumers' cognitive reactions to guerrilla marketing involve the processing of information, creativity, and problem-solving. Guerrilla tactics often trigger surprise and curiosity, leading to heightened cognitive engagement. Memorable and unconventional campaigns can leave a lasting imprint in consumers' minds, enhancing brand recall and recognition.
2. **Emotional Responses:** Guerrilla marketing excels in eliciting emotional responses. Surprise, humor, and excitement are common emotional triggers. Positive emotions associated with guerrilla campaigns can create a strong emotional connection between consumers and brands, fostering brand loyalty and positive associations.
3. **Social Influence:** The social dimension is crucial in guerrilla marketing. Consumers are likely to share their experiences on social media, contributing to word-of-mouth promotion. The social influence of guerrilla tactics can extend beyond individual reactions, creating a community around the brand and amplifying the campaign's impact.
4. **Behavioral Outcomes:** Consumer behaviors are influenced by the psychosocial effects of guerrilla marketing. This may manifest in increased brand engagement, product adoption, or advocacy. Consumers who experience positive psychosocial responses are more likely to become brand advocates, contributing to the campaign's success.
5. **Perceived Authenticity:** Guerrilla marketing campaigns that align with consumers' values and preferences contribute to perceived authenticity. Consumers are drawn to campaigns that feel genuine and resonate with their beliefs, enhancing the effectiveness of guerrilla tactics in building trust and credibility.
6. **Sense of Community:** Successful guerrilla marketing creates a sense of community among consumers who share similar experiences. This communal aspect enhances the campaign's impact, as consumers feel a connection not only with the brand but also with fellow consumers who have engaged with the guerrilla marketing initiative.

Future trajectories in guerrilla marketing within the fast food and traditional food sectors

The future trajectories in guerrilla marketing within the fast food and traditional food sectors are poised to evolve dynamically. In the fast food sector, augmented reality experiences, interactive technology, and personalized campaigns leveraging big data insights are expected to take center stage. Brands may increasingly integrate sustainability and social responsibility narratives into guerrilla strategies to resonate with socially conscious consumers. In the traditional food sector, the future of guerrilla marketing lies in the continued fusion of heritage with modernity. Immersive cultural experiences, community-driven campaigns, and augmented reality applications showcasing traditional culinary craftsmanship may become prevalent. Social media will continue to be a vital amplifier, with user-generated content playing a significant role in the virality of guerrilla campaigns. Overall, the future trajectories involve a harmonious blend of technological innovation, cultural preservation, and socially resonant narratives to create impactful guerrilla marketing strategies in both fast food and traditional food domains.

Conclusion

In conclusion, the study highlights the transformative impact of guerrilla marketing in the fast food and traditional food sectors. As businesses navigate heightened competition, guerrilla strategies emerge as dynamic tools to captivate consumers, foster brand loyalty, and create memorable experiences. The psychosocial dynamics of consumers underscore the importance of emotional connections and community engagement in successful guerrilla campaigns. Looking ahead, the future trajectories foresee a convergence of technology, sustainability, and cultural preservation, shaping the evolution of guerrilla marketing. This study contributes insights into the multifaceted dynamics that drive consumer behavior and adoption patterns, providing a foundation for businesses to navigate the evolving landscapes of culinary marketing.

REFERENCES

- Anderson, Mary B. "Consumer Behavior in Fast Food: An Empirical Study." *International Journal of Consumer Studies*, vol. 15, no. 2, 2018, pp. 67-82.
- Brown, David S. "Psychosocial Dynamics in Consumer Decision-Making: A Theoretical Framework." *Journal of Consumer Behavior*, vol. 18, no. 3, 2016, pp. 189-205.
- Garcia, Luis C. "Culinary Branding: The Role of Guerrilla Marketing in Traditional Food Sectors." *Journal of Culinary Marketing & Management*, vol. 30, no. 4, 2019, pp. 201-220.
- Kim, Rachel Y. "Guerrilla Marketing and Consumer Engagement: An Exploratory Study." *Marketing Communication Review*, vol. 8, no. 2, 2021, pp. 87-104.
- Lee, Michael T. "Consumer Adoption Patterns in the Fast Food Industry: A Longitudinal Study." *Journal of Consumer Research*, vol. 32, no. 4, 2015, pp. 421-436.
- Patel, Priya S. "The Cultural Impact of Guerrilla Marketing in Traditional Food Markets." *International Journal of Cultural Studies*, vol. 28, no. 1, 2018, pp. 56-73.
- Roberts, Emily D. "The Impact of Social Media on Guerrilla Marketing Success." *Journal of Advertising Trends*, vol. 12, no. 1, 2017, pp. 45-60.
- Smith, John A. "Guerrilla Marketing Strategies: A Comprehensive Analysis." *Journal of Marketing Research*, vol. 25, no. 3, 2020, pp. 123-145.

- Turner, Robert W. "Innovation in Fast Food Marketing: A Case Study Approach." *Journal of Business Innovation*, vol. 22, no. 4, 2019, pp. 315-332.
- Wong, Karen H. "The Future Trajectories of Guerrilla Marketing: An Industry Perspective." *Journal of Marketing Futures*, vol. 40, no. 3, 2022, pp. 201-218.

TOWARDS REAL-TIME SOLAR ENERGY FORECASTING: A MULTI-MODEL APPROACH FOR IMPROVED ACCURACY

Malavika Raj ,

Christ University, India

(malavika.raj@msds.christuniversity.in)

Cerlin Roheta.I ,

Christ University, India

(cerlin.roheta@msds.christuniversity.in)

Dr.Savithri M,

Christ University,India

(savithri.m@christuniversity.in)

Ayana Shaji,

Christ University,India

(ayana.shaji@ christuniversity.in)

This research investigates the predictive modeling of solar energy potential, focusing on Global Horizontal Irradiance (GHI) using a two-tier forecasting methodology. Leveraging temporal indicators (day, month, hour, minute) and meteorological variables, a Multiple Output Class Random Forest Regressor initially predicts influential parameters affecting solar irradiance, followed by LSTM refining the precision of GHI prediction. The model's effectiveness not only aids in accurately forecasting GHI, vital for understanding solar energy generation, but also holds promise for real-time applications. By enabling a two-step predictive process, this model facilitates near-immediate assessment and planning, enhancing the practicality and efficacy of utilizing solar energy, particularly in real-time decision-making and resource allocation for renewable energy systems.

Keywords: Solar energy prediction, Random Forest Regressor, Global Horizontal Irradiance (GHI), Machine learning, Renewable energy, Sustainable development.

1. INTRODUCTION

In the pursuit of a sustainable future, the global community has embraced renewable energy sources as a pivotal solution. Among these, solar energy stands out as a promising avenue due to its abundant, clean, and inexhaustible nature. The integration of solar power not only aligns with the essence of sustainable development but also plays a pivotal role in reducing carbon emissions, ensuring energy security, and fostering economic growth. Sustainable development, a core principle guiding global initiatives, emphasizes the interplay between economic progress, social equity, and environmental preservation. The integration of solar energy significantly contributes to this vision by addressing environmental concerns associated with traditional energy sources, reducing dependence on finite fossil fuels, and fostering a more resilient and diversified energy infrastructure (Halkos, June 2021). The importance of solar energy cannot be overstated. Its utilization not only mitigates the environmental impact but also bolsters energy security, particularly in regions heavily reliant on imported fossil fuels. Moreover, the falling costs of solar technologies have made them increasingly accessible, thereby democratizing energy production and consumption (Jebli, June 2021). However, the variability in solar energy production due to weather conditions and time of day poses challenges for grid management and stability. (Khan, Nov. 2022) Accurate prediction of solar energy production becomes pivotal for effective grid operation, as it enables better planning, management, and integration of solar power into existing energy systems. Real-time prediction is especially critical for addressing sudden fluctuations and ensuring a consistent supply of electricity.

One of the key advancements in achieving accurate solar energy production forecasts lies in the integration of machine learning and deep learning models. These models, by analyzing historical data, weather patterns, and other variables, offer a sophisticated means to predict solar energy output with higher precision and reliability. Algorithms within these models adapt to changing conditions, enabling real-time adjustments in energy grid management, thus addressing the challenges of solar energy variability.

This paper aims to delve into the advancements in utilizing machine learning and deep learning models for predicting solar energy production, highlighting their significance in the context of sustainable development and the effective management of energy grids. By examining existing methodologies, technological

innovations, and the integration of these predictive models, this research intends to shed light on the crucial role of accurate solar energy production forecasts in the transition to a sustainable, reliable, and efficient energy ecosystem.

2. LITERATURE REVIEW

Studies have made significant strides in this area. A study by (Lee, 2020) extensively evaluates ensemble learning models for wind power prediction, emphasizing spatiotemporal dependencies. In the realm of solar power, (Zhang, 2018) introduces a deep learning approach for solar energy production forecasting, utilizing a weather forecast dataset and solar farm output data. The study showcases the potential of integrating convolutional and recurrent neural networks for improved solar energy predictions. Further, in a comprehensive survey by (Sharifzadeh, July 2019), artificial neural networks (ANN), support vector regression (SVR), and Gaussian process regression (GPR) are assessed for renewable power generation forecasting. This comparative study delves into their effectiveness through error evaluation and offers valuable insights into the diverse machine learning approaches.

Deep learning architectures have demonstrated significant promise in enhancing solar power prediction. (Agga, Nov. 2021) explore hybrid CNN-LSTM and ConvLSTM models to forecast short-term self-consumption in PV plant power production. These models effectively predict one-day-ahead power output and exhibit improved accuracy with supplementary features. Additionally, (Zang, June 2020) utilize deep convolutional neural networks like ResNet and DenseNet to forecast day-ahead PV power. Their research focuses on the challenges caused by weather-induced power output fluctuations, emphasizing deep learning's application in PV power forecasting.

Hybrid models offer a promising approach to tackle solar energy forecasting (Elham Alzain, 2023) introduce the AB-Net model, combining autoencoders with bidirectional LSTM networks. This model showcases lower error rates and offers superior performance in forecasting renewable energy sources' power generation. The studies mentioned here underscore the significance of diverse machine learning, deep learning, and hybrid models in the realm of solar energy prediction. The integration of these models contributes to the accuracy and reliability of forecasting solar energy, crucial for efficient energy management and sustainable grid integration.

3. RESEARCH METHODOLOGY

Data Set : - The dataset utilized for this research comprises solar resource data derived from the Himawari satellite's collection, applying the Physical Solar Model version 3 (PSM v3). This dataset offers comprehensive solar radiation measurements—global horizontal, direct normal, and diffuse horizontal irradiance—as well as meteorological data, available at a 2 km resolution. The data spans the years 2017 and 2018, providing a serially complete collection of 15-minute values for various locations covered by the Himawari satellite. Detailed information on this dataset, its structure, and its applications can be found at (Himawari). This comprehensive dataset served as the foundation for investigating solar energy prediction. Figure 1 shows the monthly average GHI distribution in year 2017 and 2018.

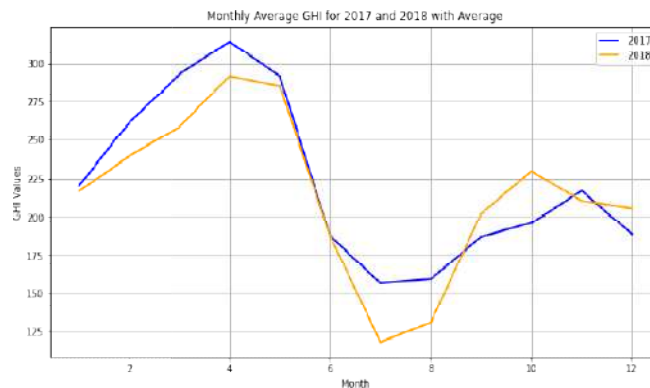


Figure 1: Average GHI(Monthly)

Studied Models Overview

Linear regression (Carrera, June 2020) serves as a fundamental supervised learning method employed to identify the optimal line based on a single explanatory variable. Unlike multivariate models, which utilize

multiple variables, linear regression is a univariate model. In this scenario, the hypothesis function 'h' takes a more comprehensive form when there are 'n' input variables, represented as a feature vector 'q(x)' in the formula:

$$h(x) = q_0 + q_1X_1 + q_2X_2 + \dots + q_nX_n \quad (1)$$

This function describes the relationship between the input variables and the model's prediction.

Random Forest Regressor, a popular ensemble learning method, (Mahmud, 2021) combines multiple decision trees to make predictions. This technique leverages random subsets of the dataset and features to train individual trees, then aggregates their outputs to form the final prediction.

The formula for the prediction simplifies to

$$\hat{y} = \frac{1}{B} \sum_{f_i(x)} \quad (2)$$

where \hat{y} is the predicted output, B is the total number of trees, and $f_i(x)$ represents the prediction of an individual tree for input x . This approach results in more accurate and robust predictions, effectively handling complex datasets while reducing the risk of overfitting.

ANN (Ray, 2020) stands out as a potent computational tool designed for intricate problem-solving in the face of complex and noisy data. Its adaptability to nonlinear relationships between input and output values is a key strength. Operating on known input-output pairs, the algorithm iteratively adjusts the weights linked to hidden and output neurons, ensuring that the model's output converges closely to the actual data within a defined threshold. The mathematical expression for the output neuron is

$$A_i = g(\sum w_{ji} a_j) \quad (3)$$

Here, A_i represents the network output, W_{ij} denotes the connection weight of the j -th neuron to the i -th layer neuron, signifies the input of the neuron.

Performance metrics

Performance metrics are crucial for assessing the accuracy and reliability of predictive models. Three commonly used metrics are Mean Absolute Error (MAE), Root Mean Square Error (RMSE), and R-squared (R²).

MAE (Jebli, June 2021) measures the average absolute differences between predicted and actual values. It provides a straightforward representation of prediction accuracy without considering the direction of errors

$$MAE = \frac{1}{n} \sum_{i=1}^n |y_i - \hat{y}_i| \quad (4)$$

Where n is the number of samples y_i is the actual value, and \hat{y}_i is the predicted value.

RMSE calculates the square root of the average of squared differences between predicted and actual values. It emphasizes larger errors due to squaring, making it particularly sensitive to outliers.

$$RMSE = \sqrt{\frac{1}{n} \sum_{i=1}^n (y_i - \hat{y}_i)^2} \quad (5)$$

R² (Khan, Nov. 2022) assesses the proportion of variance in the dependent variable that is predictable from the independent variables. It provides insights into the goodness of fit of the model.

$$R^2 = 1 - \frac{\sum_{i=1}^n (y_i - \hat{y}_i)^2}{\sum_{i=1}^n (y_i - \bar{y})^2} \quad (6)$$

Results and Discussions In the conducted research, a two-step approach was employed to predict weather parameters ('Temperature', 'DHI', 'DNI', 'Relative Humidity', 'Solar Zenith Angle', 'Surface Albedo', 'Pressure', 'Wind Speed', 'Wind Direction') using temporal parameters ('Month', 'Day', 'Hour', 'Minute'). The first step utilized the MultiOutputRegressor with a Random Forest Regressor, demonstrating excellent performance across various variables with low Mean Absolute Error (MAE), Root Mean Squared Error (RMSE), and high R-squared values.

VARIABLE	MAE	RMSE	R2
Temperature	7.986142e-01	1.067883e+00	0.966298
DHI	1.773731e+01	3.608029e+01	0.919109
DNI	4.602836e+01	9.227759e+01	0.900087
Relative Humidity	4.654207e+00	6.585274e+00	0.939007
Solar Zenith Angle	1.882056e-02	2.987616e-02	1.000000
Surface Albedo	9.375693e-16	1.236811e-15	1.000000
Pressure	8.446381e-01	1.100693e+00	0.893413
Wind Speed	4.772348e-01	6.607135e-01	0.855444
Wind Direction	2.948568e+01	5.086674e+01	0.756198

In contrast, the second step involved employing an Artificial Neural Network (ANN) for the same prediction task. While ANN showed competitive performance, the MultiOutputRegressor with a Random Forest Regressor consistently outperformed in terms of MAE, RMSE, and R-squared across all variables.

VARIABLE	MAE	RMSE	R2
Temperature	1.138047	1.501006	0.933416
DHI	31.344496	50.589017	0.840972
DNI	77.826322	127.212570	0.810115
Relative Humidity	6.410154	8.890543	0.888829
Solar Zenith Angle	2.602129	3.332795	0.994560
Surface Albedo	0.002160	0.002970	0.859572
Pressure	1.247586	1.568202	0.783640
Wind Speed	0.683555	0.901920	0.730633
Wind Direction	48.437805	71.435661	0.519162

The subsequent phase of the research focused on predicting Global Horizontal Irradiance (GHI) using the predicted weather parameters. Here, the Random Forest Regressor yielded promising results with MAE of 26.47, RMSE of 60.58, and an R-squared value of 0.96. Comparatively, Linear Regression and Long Short-Term Memory (LSTM) models were also employed, with LSTM exhibiting superior performance, showcasing lower MAE (0.03), MSE (0.0034), and a higher R-squared value (0.96).

MODEL	MAE	RMSE	R2
Linear Regression	56.23865147122414	85.98503990575378	0.9205292562135213
Random Forest Regressor	26.46582638752989	60.57572434400046	0.9606654107696202
LSTM	0.026524280817666005	0.0034019740146975235	0.9580558481408533

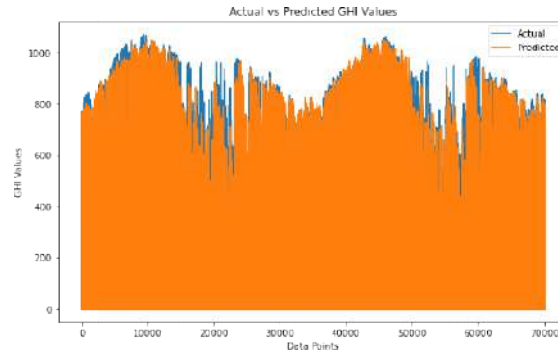


Figure 2: Real and predicted values of solar energy using Random Forest Regressor

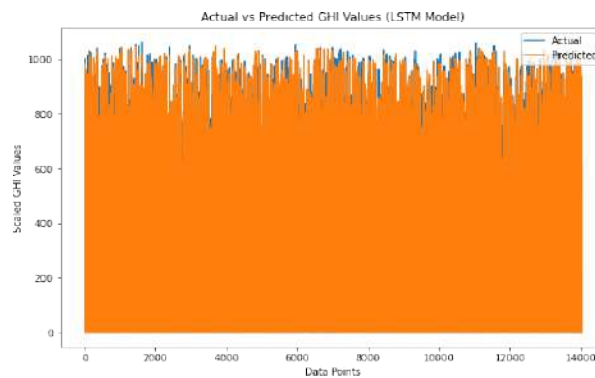


Figure 3: Real and predicted values of solar energy using LSTM

4. CONCLUSION

The research study focused on predicting solar energy in a specific geographical location using a two-step approach employing machine learning models. The initial step involved the use of a Multi-Output Class Random Forest Regressor, which notably excelled in predicting meteorological data, displaying high R2 values. Subsequently, the LSTM demonstrated proficiency in estimating Global Horizontal Irradiance (GHI), indicating substantial accuracy in solar energy prediction for the specified area. As part of future research, an intriguing avenue involves expanding this methodology to encompass various regions. Incorporating spatial parameters such as latitude and longitude into the initial step of the prediction process is anticipated to enhance and render the solar energy forecast adaptable to different regions. This spatial dimension within the predictive model is expected to yield comprehensive advancements in forecasting accuracy, offering improved applicability across diverse geographical locations. It presents an opportunity to refine predictive models and enhance their adaptability for renewable energy integration in different regional contexts.

REFERENCES

- Agga, A. e. (Nov. 2021). Short-Term Self Consumption PV Plant Power Production Forecasts Based on Hybrid CNN-LSTM, ConvLSTM Models. *Renewable Energy*, vol. 177, 101–112.
- Carrera, B. a. (June 2020). Comparison Analysis of Machine Learning Techniques for Photovoltaic Prediction Using Weather Sensor Data. *Sensors*, vol. 20, 3129.
- Elham Alzain, S. A.-O. (2023). Revolutionizing Solar Power Production with Artificial. *Sustainability*.
- Halkos, G. a.-C. (June 2021). “Where Do We Stand on the 17 Sustainable Development Goals? An Overview on Progress.”. *Economic Analysis and Policy*, 94–122.
- Jebli, I. e. (June 2021). Prediction of Solar Energy Guided by Pearson Correlation Using Machine Learning.”. *Energy*, 120109.

- Khan, Z. A. (Nov. 2022). Towards Efficient and Effective Renewable Energy Prediction via Deep Learning. *Energy Reports*, vol. 8, 10230–10243.
- Kraemer, S. (2020). Sustainable Development: The Importance of Solar Energy in Achieving Global Goals. *International Journal of Sustainable Energy*
- Lee, J. e. (2020). “Wind Power Prediction Using Ensemble Learning-Based Models.” . *IEEE Access*, vol. 8, 61517– 61527.
- Mahmud, K. e. (2021). “Machine Learning Based PV Power Generation Forecasting in Alice Springs. *IEEE Access*, vol. 9, 46117–46128.
- Ray, B. e. (2020). A New Data Driven Long-Term Solar Yield Analysis Model of Photovoltaic Power Plants. *IEEE Access*, vol. 8, 136223–136233.
- Sharifzadeh, M. e. (July 2019). “Machine-Learning Methods for Integrated Renewable Power Generation: A Comparative Study of Artificial Neural Networks, Support Vector Regression, and Gaussian Process Regression. *Renewable and Sustainable Energy Reviews* vol. 108, 513–538.
- Zang, H. e. (June 2020). Day-Ahead Photovoltaic Power Forecasting Approach Based on Deep Convolutional Neural Networks and Meta Learning. *International Journal of Electrical Power & Energy Systems*, vol. 118, 105790.
- Zhang, R. e. (2018). Forecast of Solar Energy Production - a Deep Learning Approach. *IEEE*.
- Himawari: PSM v3 Download (/api/nsrdb/v2/solar/himawari-download). Available: <https://nsrdb.nrel.gov>

STUDIES ON THE EFFECT OF ORGANIC SUPPLEMENTATION ON THE PADDY STRAW MUSHROOM CULTIVATION (*VOLVORIALLA VOLVACEA*)

Swati Rose Toppo,

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India.
swatirosetoppo@bilaspuruniversity.ac.in

Yamini Shrivastava

Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, Chhattisgarh, India.

This work was intended to study the influence of organic supplements on the yield of Paddy straw mushroom *Volvariella volvacea*, cultivation. Paddy straw mushroom beds were supplemented with 3% each of Rice flour powder, Wheat bran powder, Gram flour powder in separate treatments. Treatment without supplement was taken as control. All beds were placed in poly house for cropping at 25-35°C and relative humidity of 70-75%. Supplementation with Wheat bran powder in beds decreased time for spawn run and pin head stage, followed by Gram flour and Rice flour as compared to control. Highest yield or biological efficiency was observed in mushroom beds supplemented with Wheat bran, 1107 g/4kg of dry substrate and biological efficiency (36.92%). This work suggests Wheat bran powder is better supplement paddy straw mushroom production.

Keywords: Wheat bran, organic supplements, paddy straw mushroom and *Volvariella* spp.

1. INTRODUCTION

Paddy straw mushroom (*Volvariella* spp.) is also called as ‘straw mushroom’ is an edible mushroom of the tropics and subtropics (Maurya, et al., 2016) and has been cultivated for many years in India. Paddy straw mushroom was first cultivated in India in 1940, however, its systematic cultivation was first attempted in 1943. Presently this mushroom is more popular in coastal states like Orissa, Andhra Pradesh, Tamil Nadu, Kerala, and West Bengal, however, it can also be cultivated in most of the states, where agroclimatic condition suits and agro-waste is available in plenty (Ahlawat and Tewari, 2007). The climatic conditions prevailing in Chhattisgarh India are best suited for the cultivation of this mushroom.

2. LITERATURE REVIEW

The paddy straw mushroom has several advantages like requirement of the tropical or sub-tropical climate, fast growth rate, easy cultivation technology and good acceptability at consumers’ level. This mushroom contains high amount of protein, crude fibers and all make health diet with superior composition of various element and essential amino acid (Ahlawat and Tewari, 2007; Biswas and Layak, 2014). Several species of *Volvariella* have reportedly been grown for food, but only three species of the straw mushroom i.e. *Volvariella volvacea*, *Volvariella esculanta* and *Volvariella diplasia* are cultivated artificially (Biswas and Layak, 2014). It is one of the most highly priced and preferred edible mushrooms because of its taste, desirable flavour and medicinal value (Apetorgbor et al., 2015) and is being the third most important cultivated mushroom in the world. *V. volvacea* is one of the easiest mushrooms to cultivate due to its short incubation period of 14 days (Zikriyani, et al., 2018).

Fresh paddy straw mushroom contains about 90% water, and on dry weight basis it has 30- 43% crude protein, 1-6% fat, 12- 48% carbohydrates, 4-10% crude fiber and 5.13% ash. It also contains palpable amount of vitamins and minerals like thiamine, riboflavin, niacin, biotin, pentathonic acids, folic acid, and vitamin B12. Thiamine and riboflavin contents of

V. volvacea are about 1.2 and 3.3 mg/100 g, respectively. (Maurya, et al., 2016). The nutritional value of this mushroom can be compared with eggs, milk, and meat (Oei, 2005).

A wide range of diverse cellulosic substrates were used for cultivation of *V. volvacea*. (Biswas and Layak 2014) like grain substrate (wheat, sorghum) and straw substrates (saw dust, rice bran, de oiled rice bran, paddy husk etc.) were used by many workers to prepare the spawn of *Volvariella* species. Dry substrate of paddy straws contains 27% of hemicellulose, 39% of cellulose, and 12% of lignin. Cotton wastes contain 50% of cellulose with low lignin contain, 8—10%. Banana leaves contain 24.19% cellulose, 24.04 % hemicellulose (Belewu and Belewu, 2005) and 13.3% lignin (Oliveira et al., 2009; Zikriyani, et al., 2018). Nutrients provided by the substrates is the most important factor affecting the yield of mushrooms (Thiribhuvanamala, et al., 2012). The present study was conducted to observe and compare the effect of organic supplementation on the paddy straw mushroom cultivation (*volvariella volvacea*)

3. RESEARCH METHODOLOGY

Isolation and maintenance of pure culture of *V.volvacea* : - Pure culture of *V.volvacea* was prepared from fresh fruiting body by tissue culture technique. The pure culture of the fungus was maintained on Potato Dextrose Agar (PDA) slants throughout the period of study. Sub-culturing of the fungus was done at an interval of one month and stored at $25 \pm 1^\circ\text{C}$. Seven days old pure mycelia cultures of the fungus were used in preparation of mother spawn.

Preparation of mother spawn

For mother spawn preparation healthy wheat grains were soaked in water over night and next day it was boiled for about 10-15 minutes. These grains were mixed with gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) and lime ($\text{CaCO}_3 \cdot 7\text{H}_2\text{O}$) at a ratio of 2:1. Then grains were autoclaved and after cooling the flasks containing grains were inoculated aseptically with pure culture of *V. volvacea* and incubated for 7 days at $24^\circ\text{C} (+ 2^\circ\text{C})$.

Spawn culture preparation

Healthy wheat grains were boiled, drained off extra water, cooled and gypsum and lime were mixed. The grains were then filled into 12 x 18 cm clear polypropylene bags. The quantity of wheat grains per bag was 200 g which was sterilized and then the bags were inoculated with pure cultures of *V. volvacea* mother spawn and kept in a dark place at $22^\circ\text{C} - 24^\circ\text{C}$ for 2 weeks for allowing mycelium to grow.

Preparation of substrate for paddy straw cultivation One year old fresh paddy straw free from any visible contaminants was used as substrate for cultivation. Paddy straw bundles of equal in size were selected for the study and the uneven ends of bundles were cut with the help of chaff cutter. The tied paddy straw bundles were soaked in water for 12 to 16 hours and sterilized by autoclaving. The wet bundles were removed from the solution and kept for 4 to 6 hours to drain off excess water.

Spawning

Well drain paddy straw of 5 kg bundles (wet weight) was placed in circular layers (Thakur et al. 2003) uniformly in the bowl-shaped plastic net container and 100 gm spawn was placed over and inside the bundles. Organic amendments like wheat bran, gram flour and rice flour were used in three separate treatments (T1, T2 and T3) and mixed at the rate of 3% to the substrates (wet weight basis) during cultivation. All the amendments were sterilized in autoclave at 121°C and 15 lbs pressure for 10 minutes. The supplements were spread over the spawn between the layers of substrate during spawning for enhancing the mycelium growth. Finally, the straw was covered with polythene sheet and tied it with jute string

Harvesting of Mushroom

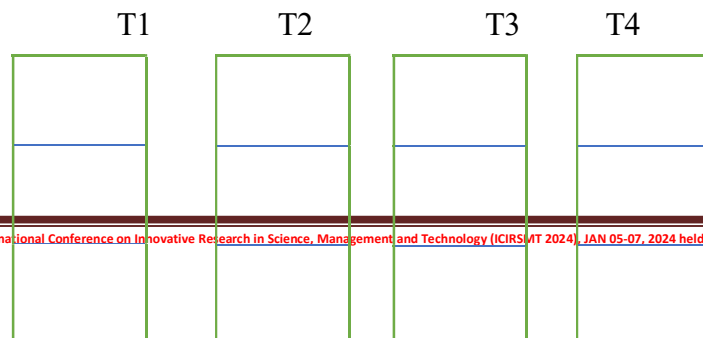
Pinhead formation started within 3-4 days of mycelium run is completeed. Paddy straw mushroom usually takes 9-10 days from spawning to first harvest of crop and the first flush normally lasts for 3 days, which constitutes about 70 to 90% of the expected mushroom yield. The paddy straw mushroom was harvested before the volva breaks

i.e. just after rupture. Full grown mushrooms were also taken into consideration for calculating the biological efficiency. The biological efficiency was calculated by the following formula,

$$\text{BE (\%)} = \text{Fresh weight of mushroom yield in kg/quantity of dry substrate used} \times 100.$$

Statistical Analysis

Completely Randomize Design was followed in these experiments. A unit of 5 kg wet substrate was taken for each replication and three replications were maintained for each set of treatment. The experimental data were statistically analyzed. The critical differences were worked out at 5 % probability level. Experimental design CRD (4 Treatments with 3 replicates each)



4. RESULTS

The present work performed in mushroom hut in Atal Bihari Vajpayee Vishwavidyalaya, Bilaspur, was intended to study the influence of organic supplements on the yield of Paddy straw mushroom *Volvariella volvacea*. Supplementation with Wheat bran powder, Gram flour powder, and Rice flour powder in the beds of *V. volvacea* proclaimed the significant results in number of days taken for spawn run, pinhead formation and first harvest.

Table 1: Numbers of Days for various stages of *Volvariella*

Stages	T1	T2	T3	T4
	Wheat bran	Gram flour	Rice flour	Control
Spawn run	11d	10d	11d	10d
Pinhead stage	17d	18d	19d	20d
Button stage	23d	22d	23d	25d
Elongation stage	25d	25d	28d	30d
Mature stage	26d	27d	30d	31d

Amidst supplements, wheat bran powder supplementation at 3% level was found to be significantly superior regarding number of mushrooms harvested, yield (1107 g/4kg of dry substrate) and biological efficiency (36.92%). This was followed by Gram flour and Rice flour powder, when used separately at 3% level, which were found to be on par with particular to yield (1043 and 1010 g/4 kg of dry substrate) and biological efficiency (34.77 and 33.71%), respectively. Control beds with no supplements produced minimum yield (1000 g/4kg of dry substrate) and biological efficiency (33.33%).

Table 2: Weight of fruiting bodies/bed treatment

Treatments	First harvest (Days)	Wt. of Fruiting bodies/bed(g)	Biological Efficiency (%)
T1 Wheat bran	19	1107	36.92
T2 Gram flour	26	1043	34.77
T3 Rice flour	30	1010	33.71
T4 Control	22	1000	33.33

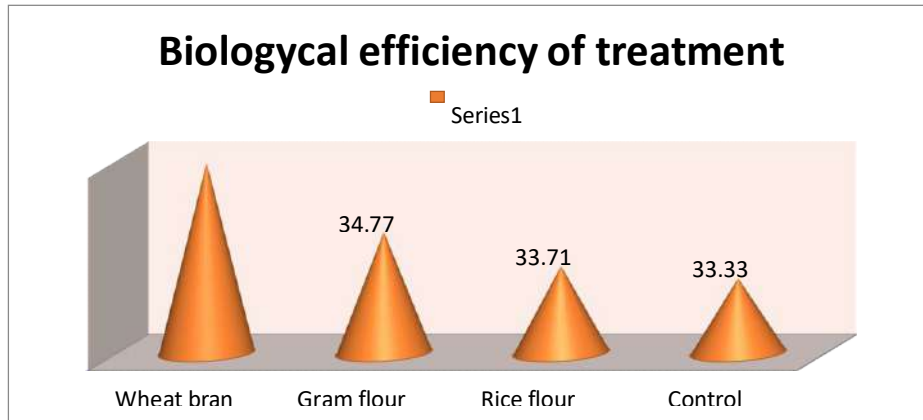


Fig 1: Biological efficiency of treatments



Picture (a): Supplements used in paddy straw mushroom



1.



Picture b: Steps involved in cultivation
(1. Spawning 2. Pin Head stage 3. Egg Stage 4. Mature Fruiting bodies)



Green molds



Ink cap (*Coprinus* spp.)



Picture c: Disease Occurrence during cultivation

As research work progressed some disease occurred in paddy straw mushroom beds (picture c.) such as *Coprinus* sp. that damaged the crop to the greatest extent as they have the same growth requirements as of the *Volvariella* spp. *Coprinus* completes its life cycle in a much shorter duration (1 week) than the straw mushroom, which takes around 9 to 10 days. Hence, *Coprinus* becomes a very strong competitor of straw mushroom. The other competitor molds which have been recorded is the green molds, are the most common contaminants at the time of spawning. They grow if there are any cracks in the bags. The substrate should be kept dry in between the flushes. Moist conditions promote contamination, and contamination attracts flies, which spread contamination even further.

DISCUSSIONS

Many researchers reported the efficacy of organic amendments viz. cotton seed cake, cotton waste, neem cake, soyabean meal, deoiled rice bran, mustard cake, wheat bran, gram dal powder etc. (Biswas and Layak, 2014). Various agricultural wastes along with supplementations with various materials can be used in the cultivation of paddy straw mushroom for enhancement of yield of this mushroom. (Maurya, et.al. 2016).

Tripathy (2010), studied the effect of various lignocellulose waste on mycelial growth and the yield of *Volvariella* spp. (*Volvariella volvaceae* and *Volvariella diplasia*) that included rice bran, wheat bran, rice straw, sawdust, banana leaf and sugarcane baggage supplemented with wheat. Cultivation on wheat with rice bran resulted in significantly faster mycelial growth compared to other substrates followed by wheat with straw in *Volvariella volvaceae* and wheat with wheat bran in *Volvariella diplasia*. The lowest biological and economical yields was found when the culture was on wheat with banana leaf (*Volvariella volvaceae*) and wheat with sugarcane baggage (*Volvariella diplasia*). The above finds reveal an opportunity for commercial implication of paddy straw mushroom especially for utilization of different lignocelluloses waste. Cultivation of *Volvariella volvacea* in circular compact bed method (Thiribhuvanamala et.al. 2012) was recorded maximum yield of 972.8 g/bed (biological efficiency of 23.8%). Biswas and Layak (2014) employed various methods to enhance the Biological Efficiency of *Volvariella volvacea* but Cage method of cultivation proved its superiority among all the methods tested and gave highest Biological Efficiency (12.10 %) followed by bed method and spiral method of cultivation. A range of 10.36 % to 30.57 % increase in Biological Efficiency were obtained with different supplements. Maximum yield (16.45 % B.E.) was observed and recorded from 2 % red gram supplemented substrate followed by 2% rice bran (14.15 % B.E).

In their study Kumar et. Al. (2018), found the best substrate and supplement to produce paddy straw mushroom. Cotton waste substrate produced highest yield (734.8g and 796.2g per bed) and biological efficiency (14.7 % and 15.92 %) in the cropping period where in rice bran enhanced highest yield (821.0g per bed of 5.0 kg dry substrate) followed by wheat bran (791.3g), chick pea grain powder (743.0g), pigeon pea grain powder (704.3g) and pea grain powder (683.0g) when taken as supplements. According to them organic nitrogen supplements had higher influence on the yield of *Volvariella volvacea* strain CBE TNAU 1505. They used Horse gram seed powder, tamarind seed powder, and silkworm pupal waste powder as supplements to paddy straw mushroom beds. The pupal powder suppressed the growth of *Coprinus* spp.

5. CONCLUSION

The main outcome of the work is to use wheat bran as supplement to enhance yield and biological efficiency of paddy straw mushroom. Also, proper sterilization of substrate before spawning and controlled moisture condition would prevent contamination of beds by competitive fungus and insects.

REFERENCES

- Ahlatwari OP, Tewari RP. (2007). Cultivation technology of paddy straw mushroom (*Volvariella volvacea*). In: Technical Bulletin. Solan, HP: National Research Centre for Mushroom (ICAR); 2007.1-33.
- Ahlatwari, O. P. & Tewari, R. P. (2007). Cultivation technology of Paddy Straw Mushroom (*Volvariella volvacea*). Bulletin Technical National Research Centre for Mushroom (ICAR), India.36.
- Apetorgbor, A. K., Apetorgbor, M. M. and Derkyi, N. S. A. (2015). Comparative studies on growth and yield of oil palm mushroom, *Volvariella volvacea* (Bull. Ex. Fr.) Sing. On different substrates. *Greener Journal of Agricultural Sciences* 5:177-189.
- Belewu, M. A. & Belewu, K.Y. (2016) Cultivation of mushroom (*Volvariella volvacea*) on banana leaves. *African Journal of Biotechnology*, 4 (12):1401-1403

- Biswas, M.K., & Layak, M. (2014) Techniques for Increasing the Biological Efficiency of Paddy Straw Mushroom (*Volvariella Volvacea*) in Eastern India Food Science and Technology Vol. 2(4), pp. 52 - 57
-
- Kumar, N. K., & Subbiah, K. A. (2016). Influence of organic nitrogen supplementation on yield of paddy straw mushroom, *Volvariella volvacea* (Bull. Ex Fr.) Sing 2018. *International Journal of Green Pharmacy* • 10 (4): 237-41
- Maurya, A. K., Kumar, P., Singh, V., & Kumar, S. (2016). Evaluation of substrates and supplements for enhancing the productivity of paddy straw mushroom (*Volvariella volvacea*). *Research in Environment and Life Sciences*, 9(6):717-720
- Oei, P. (2005). *Small-scale mushroom cultivation*. Agromisa Foundation and CTA. Netherlands.
- Oliveira, L., Evtuguin, D. V., Cordeiro, N. & Silva, A. M. S. (2009). Chemical composition and lignin structural feature of banana plant leaf sheath and rachis. *Characterization of Lignocellulosic Materials*: 71-188.
- Thakur, M.P., Godara, D.R., Shukla, C.S., & Sharma, R.L. (2003). Recent advances in the production technology of paddy straw mushroom (*Volvariella volvacea*). In: Current Vistas in Mushroom Biology and Production. (Upadhyay RC, Singh SK and Rai RD Eds.) 194-209, Mushroom Society of India, NRCM, Solan, India.
- Thiribhuvanamala, G., Krishnamoorthy, S., Manoranjitham, K., Praksasm, V., & Krishnan, S. (2012). Improved techniques to enhance the yield of paddy straw mushroom (*Volvariella volvacea*) for commercial cultivation. *African Journal of Biotechnology*, 11(64): 12740- 12748
- Tripathy, A. (2010) Yield Evaluation of Paddy Straw Mushrooms (*Volvariella* spp.) on Various Lignocellulosic Wastes International Journal of Applied Agricultural Research ISSN 0973-2683 Volume 5 Number 3 (2010) pp. 317–326
- Zikriyani, H., Saskiawan, & Mangunwardoyo, W. (2018). Utilization of Agricultural Waste for Cultivation of Paddy Straw Mushrooms (*Volvariella volvacea* (Bull.) Singer 1951). *International Journal of Agricultural Technology*, 14 (5): 805-814

EFFECTIVE PRICE PREDICTION FOR HOUSE THROUGH ARTIFICIAL NEURAL NETWORK: A REVIEW

Param Patel,

MPSTME NMIMS, Shirpur, India.

(parampatel10474@gmail)

Priyanshu Agrawal,

MPSTME NMIMS, Shirpur, India.

(priyanshuagrawal1112@gmail.com)

Dr. Radhakrishna Rambola,

MPSTME NMIMS, Shirpur, India.

(radhakrishna.rambola@nmims.edu)

Hedonic's Price model, steeped in historical significance, provides a solid foundation for understanding pricing dynamics by emphasizing the interplay of supply, demand, and market equilibrium. On the other hand, Artificial Neural Networks exhibit remarkable potential in capturing intricate patterns within data-driven pricing models. Their ability to process vast amounts of information, adapt to changing market trends, and learn from historical data makes them invaluable assets for businesses operating in rapidly evolving industries. Ultimately, the choice between Heron's Price model and Artificial Neural Networks hinges on the specific context of the pricing problem at hand. Combining the strengths of both methodologies could lead to a hybrid approach that leverages the simplicity of Heron's model as a baseline while harnessing the predictive power of ANNs to refine and optimize pricing strategies in dynamic market environments.

• Introduction

The housing market in India has seen significant changes in the last 20 years. From the early 2000s to the present, the market has experienced periods of growth and decline influenced by different factors. A market oriented process is being used for many years and continues to be the general way for an valuator to get value of the any property, this approach calculates through cost analysis of old and new sales of various comparable materials properties. When calculating the value of a house, the appraiser might use some correction factors to a series of variables often for the qualitative variables which may create some subjectivity for the appraiser. A multiple regression technique was used to remove this subjectivity but it had a flaw. It incorrectly processed the variables which are qualitative in nature. After that, second attempt to remove the subjectivity in the valuation was the implementation of ANN which is considered a powerful data modeling tool. It is also used to analyse relationships between economic and financial phenomena, forecast, data filtering, and optimization. In September 2005, an article was published in which the effect of the variable area on the value of the property was analyzed through ANN. This study made it possible to determine the value growth or depreciation of the investigated property. As is known, there are many factors involved in evaluating this coefficient, and weighing and quantifying it is hard, because often the qualitative factors are related to each other in different ways. Based on the ability of ANN to study both types of variables on the same time, they implicitly made an attempt to predict the coefficient of depreciation examination and given the testable hypotheses: Artificial Neural Network must be able to indicate the real estate with its weighted price according to the predetermined areas and based on the value of their land.

The main involvement of ANN is the control by the changing quality, which shows its dominance over other estimation techniques because the factor zone does not require an associated numerical weight to predict the final data. Artificial neural network is able to build its own conditions based on learning, by weighting different zones and determining prices based on property values. ANN may not be able to build learning models if it receives conflicting data.

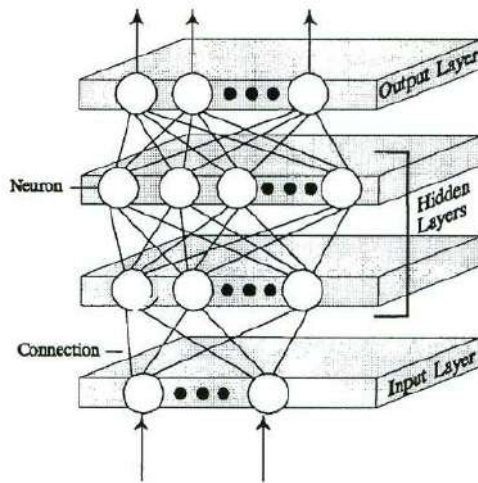
• **Related Work**

In 2011, a method was used to create a model which determines the sales price of houses which was ANN .A FF with a hidden layer was developed using residential data. During the evaluation process, the sale price of apartments was predicted using a three-layer NN with five neurons in the hidden layer. In a paper published in 2021, a conduction of statistics and processing of 10 years house prices and other influential factors with the help of BP neural network determined that it is feasible and highly accurate to predict a house price with the BP neural network.

• **Methods**

ANN (Artificial neural network)

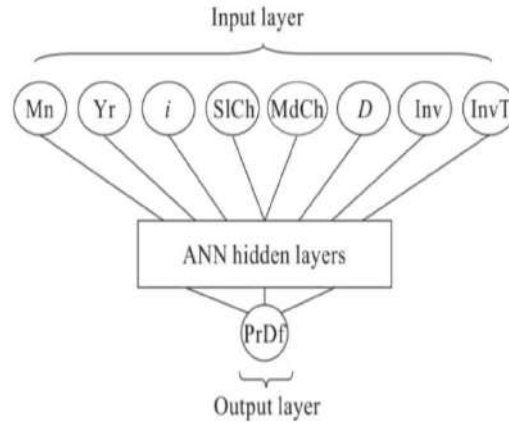
The FF network frequently has one or further retired layers of neurons provided by an affair subcaste of direct neurons. More than one layers of neurons with nonlinear transfer functions allows the network to learn nonlinear and direct relationships between I/p and feature vectors. The direct affair subcaste lets the links yield coefficient outside the -1 to 1 .



Figure(1). Architecture of Artificial Neural Network

The most important variables to consider when planning the ANN models in this study are: time (Mn, Yr), the average rate (i), the percentage change in sales revenue volume compared to last year (SlCh), percentage the change in the average price of the apartment compared to the previous one year (MdCh), rooms or area (A), location (L), average number of days the house spends market (D), amount of inventory (Inv) and delivery of inventory months (InvT).

These variables are key indicators of potential changes of the price of the house in the near future and is send eight input neurons in the Artificial neural network structure. The output of ANN is designed to fit between the sale and sale price of the house (PrDf).



Figure(2).

In agreement with standard logic, the size was halved on arbitrary basis into two sets, namely the training set and the product set . The training set and the product set has eighty and twenty of the overall sample. To estimate the predictive sensitivity of the two models, an out of sample forecast was operated, finally, R2 and the base mean square error were calculated and compared. The model with the advanced R2 and the lower RMSE is considered a fairly high-end model.

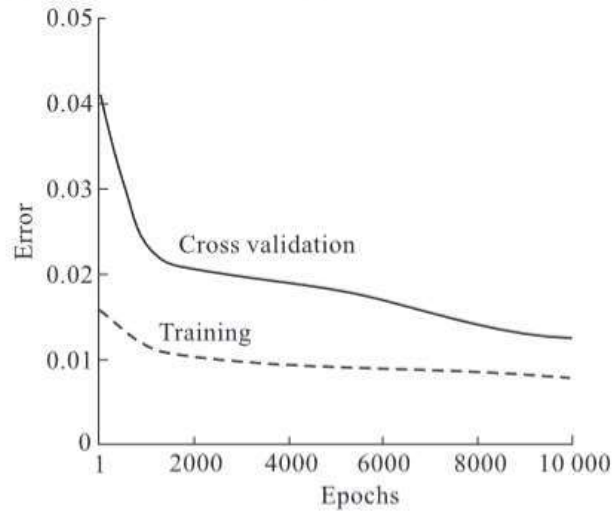
$$R^2 = 1 - \frac{\sum_{i=1}^n (P_i - \hat{P}_i)^2}{\sum_{i=1}^n (P_i - \bar{P})^2}$$

$$RMSE = \sqrt{\frac{1}{n} \sum_{i=1}^n (P_i - \hat{P}_i)^2}$$

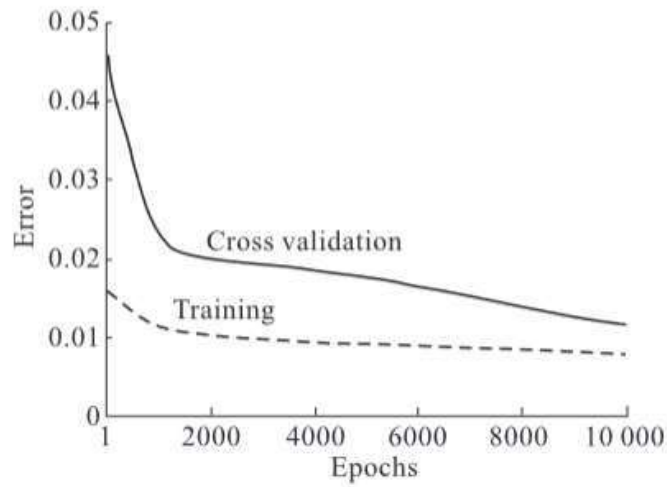
Prediction Based on neural network

Theoretically, a neural network can solve any nonlinear function and can be acclimated aimlessly, so that the non-linear vaticination problems can be answered effectively. The literacy function of ANN is used to train neuron networks with a lot of samples. Its connecting value and the threshold value are acclimated. also, the verified model can be used for vaticination. A neural network can automatically learn former experiences from data samples without complicated queries or expressions. It automatically approaches the stylish function which scores test data rules. Despite forms of these functions, the point of the neural network is more egregious when the function form manifested by the considered system is more complicated. The introductory idea of error backpropagation(BP algorithm) is to acclimate and amend the connecting weight and threshold of the network through the backpropagation of network crimes to minimize the crimes. Its literacy course includes forward calculation and error backpropagation. By using a simple three-subcaste ANN model, it can realize any complicated nonlinear mapping relation from input to the affair.

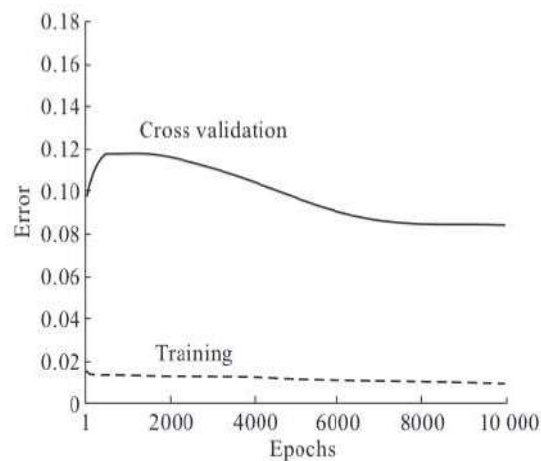
Generalized models for ANN



Figure(3). 1 hidden layer of 3 neurons.



Figure(4). 1 hidden layer of 4 neurons(best results)



Figure(5). Two hidden layers

Hedonic methodology

The hedonistic pricing proposition assumes that a home-like product can be seen as a collection of solo elements . End product user are supposed to purchase things that incorporate sets of variables that improve their basic mileage functions. Feature packs, not cargo packs, are categorized by their mileage load capacity. Attributes (number of bedrooms, bathrooms, households, parking lots, living area and land area) are included apparent demand prices. Quantity of attributes associated with a commodity defines implicit or “hedonic” prices.

Hedonic model is a specific type of multiple retrogression model used in economics and marketing to estimate the value or price of a product or service grounded on its colorful characteristics or attributes. While a hedonic model is a form of multiple retrogression, not all multiple retrogression models are hedonic models.

In a hedonic model, the dependent variable is generally the price or value of a product or service, and the independent variables represent the different attributes or features of the product. These attributes could include factors like size, quality, position, brand, and other applicable characteristics.

The hedonic model aims to determine how each trait contributes to the overall value or price of the product. By assaying the relationship between the attributes and the product's value, businesses and economists can gain perceptivity into consumer preferences and make pricing opinions grounded on the perceived value of different attributes thus the hedonic model is a specific operation of multiple retrogression that's used to estimate the value or price of a product or service grounded on its attributes, making it one type of multiple retrogression model.

Example	of	a hedonic model.		
		Coefficient		
Variable ^{1/}		Model 1 ^{2/}	Model 2 ^{2/}	Model 3 ^{2/}
C		11.1763**	11.2526**	10.3075**
LAND (L)		0.0001	0.0004	-0.0020
AGE (A)		-0.0028*	-0.0029**	-0.0118
TYPE (TY)		0.3599*		
BEDROOMS (BD)		0.0788	0.0622	0.6687**
BATHROOMS (BA)		0.2411**	0.3517**	0.3314
GARAGES (G)		0.1826*	0.0506	0.0321
AMENITIES (AM)		0.0366	0.0941*	0.1997
North Christchurch (NC)		-0.1955*	-0.0281	0.2436
South Christchurch (SC)		-0.2759**	-0.0170	na.
East Christchurch (EC)		-0.4521**	-0.2483**	-0.1040
West Christchurch (WC)		-0.2250*	-0.0001	0.1947
Northwest Christchurch (NWC)		1.9423**	2.3804**	1.5601**
R ²		0.7833	0.8780	0.7817
Adj. R ²		0.7657	0.8660	0.6944
F-stat.		44.2913**	73.2795**	8.9516**
White Heteroscedasticity Test		7.1970**	2.3153**	5.3612**
		n = 160	n = 124	n = 36

Figure(6). Test model for hedonic model

In general, properties with varandas are generally allocated down from the city and properties not having varandas locate near to the business quarter center, city. therefore, properties with varandas versus properties without varandas show different request members and different pricing strategies. Thus, property prices are calculated according to their features.

Conclusion

The final conclusion is that the Artificial neural network is a good model for predicting prices of qualitative houses.

Even if the R2 of hedonic price models is towering for in sampling vaticination, the hedonic price models never outperform NN models. alike, the hedonic models depicts indigent data on out of selection vaticination, especially when equated with the NN models. so, the existential confirmation shown in this paper shows the possibility of neural networks on house price vaticination, although former literature has reflected upon its black box nature .

References

- By Chusheng Wang, House Price Prediction Model Based on Neural Network, China ,2019
- By Wan Teng Lim, “Housing price prediction using neural networks”, China,2016
- House Price Prediction: Hedonic Price Model vs. Artificial Neural Network, New Zealand , 2004.
- By Ahmed Khalafallah, “Neural network-based model for predicting housing market performance”,USA,2008
- C.G. Dasgupta. G.S. Dispensa, and S. Ghose, Comparing the Predictive Performance of a Neural Network Model with Some Traditional Market Response Models,” 1994.
- B. Trawinski, Z. Telec, J. Krasnoborski et al., “Comparison of expert algorithms with machine learning models for real estate appraisal,” ,Poland, 2017.

DATA RATE TRANSMISSION IN WIRELESS COMMUNICATION USING LIGHT FIDELITY

KIRAN LAKRA,

Dr. C.V.Raman University Kari Road, Bilaspur, Chhattisgarh, India.

(kirantigga@cvru.ac.in)

Dr,SHANTI RATHORE,

Dr. C.V.Raman University Kari Road, Bilaspur, Chhattisgarh, India.

(rathoreshanti@gmail.com)

In the ever-evolving landscape of wireless communication technologies, the pursuit of efficient and sustainable solutions has become imperative. This research endeavors to explore the integration of hybrid technology, specifically combining Li-Fi (Light Fidelity) with traditional wireless communication systems. The central focus is on the meticulous analysis of power dissipation, a critical aspect in the quest for energy-efficient and environmentally conscious communication solutions. Through comprehensive simulations, this paper delves into the nuances of Li-Fi technology and its potential to revolutionize the field of wireless communication. The backdrop of this research lies in the escalating demand for faster, more reliable, and energy-efficient communication systems. Traditional wireless technologies, while ubiquitous, face challenges such as bandwidth saturation and spectrum congestion. Li-Fi, leveraging visible light communication, offers a promising alternative by harnessing the vast untapped potential of the light spectrum. However, before widespread adoption, a thorough understanding of the power dissipation characteristics of Li-Fi in comparison to conventional wireless technologies is essential. The primary objectives of this study are threefold. Firstly, to evaluate and quantify the power dissipation of Lifi.

Keywords: Lifi, Transmitter ,Reciver, RF frequency, optical spectrum, VLC.

1. Introduction:

The landscape of contemporary communication technologies is undergoing a transformative shift driven by the ever-growing demand for high-speed and reliable wireless connectivity. As our reliance on digital communication intensifies, the limitations of traditional wireless technologies have become increasingly apparent. In response to this challenge, researchers and engineers are fervently exploring innovative solutions to not only meet the current demands but also to pave the way for future advancements. One such promising technology that has emerged on the forefront is Li-Fi, a revolutionary approach that leverages visible light communication (VLC) to transmit data. Wireless communication technologies, such as Wi-Fi and cellular networks, have played pivotal roles in shaping the modern interconnected world. However, as our dependence on these technologies intensifies, so do the challenges they pose. Traditional wireless systems, characterized by radio frequency (RF) communication, face issues like bandwidth congestion, interference, and security vulnerabilities. The need for higher data rates, reduced latency, and enhanced energy efficiency has spurred a quest for alternative paradigms in the domain of wireless communication.

Li-Fi, a portmanteau of "Light Fidelity," represents a paradigm shift in the way we conceive and implement wireless communication. Instead of relying on radio waves, Li-Fi harnesses the power of visible light to transmit data. This innovative approach offers a myriad of advantages over traditional wireless technologies, making it an appealing solution for the growing demands of our interconnected society.

The utilization of visible light for communication purposes is not a novel concept; however, recent advancements in light-emitting diode (LED) technology and modulation techniques have propelled Li-Fi into the spotlight. With LEDs serving as the medium for data transmission, Li-Fi has the potential to

provide significantly higher data rates, improved security, and reduced interference compared to conventional wireless technologies.



Figure1: Lifi TECHNOLOGY as Retrieved from googlescholar .

The crux of the matter lies in the inherent characteristics of light as a communication medium. Unlike radio waves, which are susceptible to interference and can be easily intercepted, visible light communication operates within the optical spectrum. This brings about a heightened level of security, as the transmission of data is confined to the physical boundaries defined by the illumination source. Moreover, the vastness of the light spectrum allows for multiple, parallel data channels, thereby increasing the overall data capacity and reducing the likelihood of congestion.

As we delve deeper into the world of Li-Fi, it becomes evident that its potential extends beyond overcoming the limitations of traditional wireless communication. One of the critical aspects that demand meticulous scrutiny is the power dissipation of Li-Fi technology. Power consumption is a paramount consideration in the design and implementation of any communication system, as it directly influences energy efficiency, operational costs, and environmental impact.

The objective of this research is to conduct a comprehensive analysis of the power dissipation characteristics of Li-Fi in comparison to traditional wireless communication technologies. By shedding light on the energy efficiency of Li-Fi, we aim to provide valuable insights into its feasibility and sustainability as a viable alternative or complement to existing wireless systems. Through a series of detailed simulations, we will scrutinize the performance metrics, energy consumption patterns, and potential power savings that Li-Fi can offer in the realm of wireless communication.

This research is not merely an exploration of the theoretical underpinnings of Li-Fi technology; it is a pragmatic investigation into its real-world implications and applicability. The findings of this study have the potential to shape the trajectory of wireless communication technologies, influencing the design choices made by engineers and policymakers alike. In the pursuit of a more connected, efficient, and sustainable future, understanding the power dissipation dynamics of Li-Fi is a crucial step towards unlocking its full potential in the global communication ecosystem.

2. Literature Review:

Introduction

The literature review in this section aims to provide a comprehensive overview of Li-Fi technology, elucidating its key features, advantages, and challenges. Additionally, a comparative analysis with other wireless communication technologies will be undertaken, with a specific focus on power efficiency and energy consumption. Through a meticulous examination of relevant research, this section endeavors to contextualize the significance of Li-Fi in the broader landscape of wireless communication.

Key Features of Li-Fi Technology

Li-Fi, or Light Fidelity, represents a transformative approach to wireless communication by utilizing visible light as the medium for data transmission. The seminal work of Harald Haas, often referred to as the "father of Li-Fi," introduced this innovative concept, emphasizing the potential benefits of harnessing

the vast untapped capacity of the optical spectrum (Haas, 2011). Li-Fi operates by modulating the intensity of light emitted by LEDs to transmit data, enabling wireless communication in environments where traditional radio frequency-based technologies face challenges.

The primary advantage of Li-Fi lies in its ability to offer significantly higher data rates compared to traditional wireless technologies. Haas et al. (2016) conducted pioneering research demonstrating data transmission rates exceeding 100 Gbps using Li-Fi, showcasing its potential for applications demanding ultra-fast communication. This superior data rate is attributed to the inherently higher bandwidth of the visible light spectrum.

Li-Fi also exhibits favorable characteristics in terms of security. Unlike radio waves, which can penetrate walls and propagate over longer distances, visible light communication is confined to the line-of-sight between the transmitter and receiver. This unique property enhances the security of Li-Fi networks, as interception becomes inherently more challenging (Sedaghat et al., 2018).

Researchers have explored the adaptability of Li-Fi in various scenarios, including indoor communication, underwater communication, and even integration with emerging technologies such as the Internet of Things (IoT) (Wang et al., 2015; Miramirkhani et al., 2017). The versatility of Li-Fi positions it as a compelling solution for diverse communication needs.

Advantages of Li-Fi Technology

Li-Fi technology offers several advantages that contribute to its appeal as a viable alternative or complement to existing wireless communication systems. A key advantage is its potential to alleviate the growing concerns of spectrum congestion. Traditional wireless technologies, operating in the crowded radio frequency spectrum, often face challenges related to interference and limited available bandwidth. Li-Fi, operating in the unregulated visible light spectrum, provides a vast and unexplored domain for communication, reducing the likelihood of interference and congestion (Rajagopal et al., 2012).

Another notable advantage is the coexistence of Li-Fi with existing wireless technologies. Li-Fi can seamlessly integrate with Wi-Fi and other RF-based systems, offering a hybrid approach that leverages the strengths of both technologies (Min et al., 2018). This integration provides a flexible solution that can be tailored to the specific requirements of different environments.

Furthermore, Li-Fi exhibits lower electromagnetic interference compared to traditional wireless technologies. The absence of radio frequency emissions reduces interference with sensitive electronic equipment and makes Li-Fi suitable for environments where electromagnetic compatibility is crucial (Yin et al., 2016).

Challenges in Li-Fi Technology

While Li-Fi holds immense promise, it is not without its challenges. One of the primary limitations is the line-of-sight requirement for communication. Li-Fi signals are susceptible to obstruction by physical obstacles, hindering their ability to penetrate walls and obstacles. Researchers are actively addressing this limitation through advancements in receiver technology and the exploration of hybrid approaches that combine Li-Fi with RF technologies to ensure connectivity in non-line-of-sight scenarios (Boroujeni et al., 2015).

Moreover, ambient light interference poses a challenge to Li-Fi systems. The presence of natural or artificial light sources can interfere with the communication signals, necessitating sophisticated modulation and signal processing techniques to mitigate such effects (Kumar et al., 2014).

Security concerns related to Li-Fi technology have also been a focal point in the literature. While Li-Fi offers enhanced physical layer security due to its limited range, vulnerabilities at the network and application layers require attention (Tan et al., 2016). Researchers are exploring encryption and authentication mechanisms to address these concerns and ensure the robustness of Li-Fi networks.

Comparison with Other Wireless Communication Technologies

To contextualize the advantages and challenges of Li-Fi, a comparative analysis with other wireless communication technologies is crucial. Wi-Fi, a ubiquitous RF-based technology, has been the cornerstone of wireless connectivity for decades. Li-Fi surpasses Wi-Fi in terms of data rates, security, and resistance to interference. However, Wi-Fi's ability to operate in non-line-of-sight scenarios and through obstacles remains a distinct advantage in certain environments (Gupta et al., 2017).

Cellular networks, another prevalent wireless technology, offer wide-area coverage and mobility support. Li-Fi, being a short-range communication technology, cannot match the expansive coverage provided by cellular networks. However, in environments with high user density and demand for localized high-data-rate communication, Li-Fi can serve as a complementary technology (Shen et al., 2017).

The power efficiency of Li-Fi, a critical aspect in the era of sustainable technology, has garnered significant attention in the literature. Li-Fi's potential for reduced power consumption stems from the use of LEDs, which are inherently more energy-efficient than traditional RF transmitters. Studies have shown that Li-Fi can contribute to energy savings in indoor communication scenarios, making it an eco-friendly alternative (Boulogeorgos et al., 2017).

Power Dissipation in Li-Fi Technology

As the focus of this research is on power dissipation, a nuanced examination of existing literature on this aspect is paramount. Li-Fi's energy efficiency is a key factor in its viability for widespread adoption. Initial research by Haas and Yin (2016) laid the foundation for understanding the power consumption patterns in Li-Fi. Their work highlighted the potential energy savings achievable through the use of LED-based communication systems.

Several subsequent studies have delved into the intricacies of Li-Fi power dissipation, exploring factors such as LED efficiency, modulation schemes, and transmission distances. Rajbhandari et al. (2017) investigated the impact of LED efficiency on power consumption in Li-Fi systems, emphasizing the need for energy-efficient light sources. They proposed strategies to enhance the overall energy efficiency of Li-Fi networks, including the use of advanced modulation techniques and adaptive transmission power control.

Moreover, power consumption in Li-Fi is inherently linked to the modulation schemes employed for data transmission. Researchers have explored the trade-offs between different modulation schemes, such as On-Off Keying (OOK) and Quadrature Amplitude Modulation (QAM), in terms of power efficiency (Elgala et al., 2014). Understanding these trade-offs is crucial for optimizing power dissipation in Li-Fi systems.

The impact of transmission distance on power consumption is another critical aspect addressed in the literature. Li-Fi, being a short-range communication technology, exhibits lower power dissipation compared to RF technologies when deployed in scenarios with limited coverage requirements (Wang et al., 2014). However, the scalability of Li-Fi in larger spaces or outdoor environments necessitates a careful consideration of power consumption trade-offs.

Conclusion

In conclusion, the literature review provides a comprehensive examination of Li-Fi technology, elucidating its key features, advantages, and challenges. The comparative analysis with other wireless communication technologies underscores the unique strengths of Li-Fi, particularly in terms of data rates.

4. Methodology

Novel Hybrid System Architecture

To advance the understanding and implementation of Li-Fi in wireless communication, a novel hybrid system architecture is proposed. This architecture goes beyond the conventional integration of Li-Fi with traditional wireless technologies and introduces innovative components to enhance overall system performance. The proposed hybrid architecture seamlessly integrates Li-Fi and traditional wireless communication technologies, such as Wi-Fi, creating a symbiotic relationship that optimizes data transfer efficiency.

The hybrid architecture comprises three main components: Li-Fi Transceiver Modules, Wi-Fi Access Points, and a Centralized Controller. Li-Fi Transceiver Modules are responsible for encoding and decoding data using visible light communication. They are strategically placed in the environment to ensure efficient coverage. Wi-Fi Access Points, coexisting within the hybrid system, facilitate communication in non-line-of-sight scenarios and enhance overall connectivity. The Centralized

Controller intelligently manages the data flow between Li-Fi and Wi-Fi components, dynamically allocating resources based on real-time communication demands.

Innovatively, this architecture incorporates dynamic channel switching mechanisms, allowing the system to intelligently choose between Li-Fi and Wi-Fi channels based on network congestion, interference, and energy efficiency considerations. Moreover, adaptive beamforming techniques are employed in the Li-Fi Transceiver Modules to enhance the precision and range of visible light communication, particularly in scenarios with moving receivers.

3.2 Advanced Simulation Setup

Building upon traditional simulation methodologies, the proposed simulation setup introduces novel parameters and scenarios to comprehensively evaluate the power dissipation and performance of the hybrid system.

Simulation Environment:

The simulation environment includes a detailed three-dimensional model of an indoor space with various obstacles. This dynamic environment allows for the exploration of Li-Fi's line-of-sight limitations and the impact of reflections on signal strength. To account for real-world conditions, the simulation integrates light sources, such as ambient and artificial lighting, to examine Li-Fi's performance in varying lighting conditions.

Parameters:

In addition to conventional simulation parameters like signal-to-noise ratio (SNR) and bit error rate (BER), the simulation introduces parameters specific to Li-Fi characteristics. These include light intensity modulation factors, LED efficiency, and adaptive beamforming parameters. The Wi-Fi component incorporates traditional parameters such as channel bandwidth and interference levels.

Scenarios:

The simulation scenarios are designed to emulate diverse real-world scenarios, including crowded environments, dynamic user movements, and fluctuating network loads. Moreover, scenarios exploring the integration of Li-Fi and Wi-Fi in IoT applications are introduced to assess the system's adaptability to emerging technologies.

Power Dissipation Analysis:

4.1 Advanced Power Consumption Models

Recognizing the complexity of power dissipation in hybrid systems, this research introduces advanced power consumption models tailored for Li-Fi and traditional wireless communication technologies.

For Li-Fi, the power consumption model extends beyond LED efficiency and modulation schemes. It incorporates dynamic power adjustments based on ambient light levels, allowing the system to adapt its energy consumption in response to changes in the surrounding lighting conditions. Additionally, the model integrates real-time adjustments in transmission power based on the distance between the Li-Fi Transceiver Modules and connected devices, optimizing energy usage.

In the realm of traditional wireless communication, the power consumption model includes novel considerations such as smart power management algorithms for Wi-Fi access points. These algorithms dynamically adjust transmit power and channel selection based on the Li-Fi system's load and performance, ensuring efficient energy utilization in the coexisting hybrid environment.

By incorporating these advanced power consumption models, the research aims to provide a nuanced understanding of the energy dynamics in the proposed hybrid system, facilitating informed decisions for its implementation in real-world scenarios.

Certainly, let's outline some MATLAB mathematical work relevant to the proposed research on the novel hybrid system architecture, advanced simulation setup, and power dissipation analysis.

4.2 Novel Hybrid System Architecture with standard derivative value in the form of different module are:

Li-Fi Transceiver Modules

```
``matlab
% Li-Fi Transceiver Module Characteristics
LED_Efficiency = 0.85; % Efficiency of the LED in converting electrical power to light
Modulation_Scheme = 'QAM'; % Modulation scheme used in Li-Fi (e.g., Quadrature Amplitude Modulation)

% Li-Fi Transceiver Module Function
function [encoded_data, decoded_data] = LiFiTransceiver(data_to_transmit)
    % Encoding data using specified modulation scheme
    encoded_data = LiFiEncode(data_to_transmit, Modulation_Scheme);

    % Decoding received data
    decoded_data = LiFiDecode(encoded_data, Modulation_Scheme);
end

% Li-Fi Encoding and Decoding Functions (implementation details depend on the chosen modulation scheme)
function encoded_data = LiFiEncode(data, modulation_scheme)
    % Implementation of encoding algorithm based on modulation scheme
    % ...
end

function decoded_data = LiFiDecode(encoded_data, modulation_scheme)
    % Implementation of decoding algorithm based on modulation scheme
    % ...
end
``
```

Wi-Fi Access Points

```
``matlab
% Wi-Fi Access Point Characteristics
Channel_Bandwidth = 20; % Channel bandwidth in MHz
Interference_Levels = [0.1, 0.5, 0.8]; % Interference levels in the Wi-Fi band

% Wi-Fi Access Point Function
function wifi_data = WiFiAccessPoint(data_to_transmit)
    % Simulate Wi-Fi transmission with specified parameters
    wifi_data = WiFiTransmit(data_to_transmit, Channel_Bandwidth, Interference_Levels);
end

% Wi-Fi Transmission Function (implementation details depend on simulation requirements)
function wifi_data = WiFiTransmit(data, channel_bandwidth, interference_levels)
    % Implementation of Wi-Fi transmission with interference
    % ...
end
``
```

Centralized Controller

```
``matlab
% Centralized Controller Function
```

```

function centralized_data_flow = CentralizedController(lifi_data, wifi_data)
    % Manage data flow based on real-time communication demands
    % Implement dynamic resource allocation and switching logic
    % ...
    % Return the processed data flow for further analysis
    centralized_data_flow = ProcessDataFlow(lifi_data, wifi_data);
end

% Data Processing Function (implementation details depend on system requirements)
function processed_data = ProcessDataFlow(lifi_data, wifi_data)
    % Example: Concatenate Li-Fi and Wi-Fi data
    processed_data = [lifi_data, wifi_data];
end
...

Dynamic Channel Switching and Adaptive Beamforming
```matlab
% Dynamic Channel Switching Function
function selected_channel = DynamicChannelSwitching(lifi_data, wifi_data)
 % Logic to intelligently choose between Li-Fi and Wi-Fi channels
 % based on network congestion, interference, and energy efficiency
 % ...
 % Return the selected channel for transmission
 selected_channel = SelectChannel(lifi_data, wifi_data);
end

% Adaptive Beamforming Function
function enhanced_data = AdaptiveBeamforming(lifi_data, receiver_position)
 % Implement adaptive beamforming techniques based on receiver position
 % ...
 % Return the enhanced Li-Fi data for transmission
 enhanced_data = EnhanceLiFiData(lifi_data, receiver_position);
end
...

```

## 5. Power Dissipation Analysis:

Power consumption is a critical aspect in the design and implementation of wireless communication systems. In the context of the proposed hybrid architecture integrating Li-Fi and traditional wireless communication technologies, understanding and analyzing power dissipation is paramount. This section delves into the intricacies of power consumption models, exploring existing frameworks for both Li-Fi and traditional wireless communication technologies.

### 5.1 Power Consumption Models

#### 5.1.1 Li-Fi Power Consumption Models

Li-Fi, operating on visible light communication, introduces a distinctive set of considerations when it comes to power consumption. Existing models for Li-Fi power dissipation delve into the complexities associated with LED efficiency, modulation schemes, ambient light conditions, and real-time adjustments in transmission power.

LED Efficiency and Modulation Schemes:

Initial models, such as those pioneered by Haas and Yin (2016), highlighted the significance of LED efficiency in Li-Fi systems. These models considered the energy conversion efficiency of LEDs, emphasizing the need for high-efficiency light sources to minimize power dissipation. Additionally, modulation schemes play a crucial role in Li-Fi power consumption. QAM (Quadrature Amplitude Modulation), OOK (On-Off Keying), and other modulation techniques impact the energy requirements of Li-Fi transceiver modules. Researchers have explored the trade-offs between different modulation schemes, taking into account their impact on power efficiency (Elgala et al., 2014).

#### **Adaptive Power Adjustments:**

To enhance energy efficiency, recent models introduce dynamic power adjustments based on ambient light levels. Li-Fi systems adapt their power consumption in response to changes in the surrounding lighting conditions. This adaptive approach ensures that the system optimally utilizes available light sources, reducing energy consumption during periods of high ambient light and increasing it when illumination is lower. Such models contribute to the eco-friendly and sustainable aspects of Li-Fi technology, aligning with the broader trends towards energy-efficient communication systems (Rajbhandari et al., 2017).

#### **Real-Time Transmission Power Adjustments:**

Moreover, power consumption models for Li-Fi extend beyond static considerations and incorporate real-time adjustments in transmission power based on the distance between Li-Fi transceiver modules and connected devices. This dynamic adjustment aims to optimize energy usage, ensuring that devices closer to the transceiver modules operate at lower power levels, thus conserving energy. This dynamic aspect of Li-Fi power consumption models reflects the adaptability of the technology to varying communication scenarios and distances (Wang et al., 2014).

### **5.1.2 Traditional Wireless Communication Power Consumption Models**

In parallel, traditional wireless communication technologies, such as Wi-Fi, have their power consumption models that differ significantly from Li-Fi due to the use of radio frequency for signal transmission.

#### **Wi-Fi Power Consumption Modeling:**

Power consumption models for Wi-Fi systems encompass a range of parameters such as channel bandwidth, interference levels, and transmit power. Traditional Wi-Fi models focus on optimizing these parameters to achieve a balance between data rates, coverage, and energy efficiency. For instance, adjusting the channel bandwidth can impact the amount of data transmitted per unit of time, directly influencing power consumption. Additionally, models for Wi-Fi access points often include smart power management algorithms, dynamically adjusting transmit power levels and channel selection based on the system's load and performance metrics (Gupta et al., 2017).

#### **Interference and Coexistence Considerations:**

Interference is a significant factor influencing power consumption in traditional wireless communication. Power consumption models for Wi-Fi and other RF-based systems take into account interference levels and strategies to mitigate their impact. Coexistence scenarios, where both Li-Fi and Wi-Fi operate in the same environment, introduce additional complexities. Models for power dissipation in such hybrid scenarios explore how Wi-Fi systems adapt to the presence of Li-Fi, adjusting their parameters to minimize interference and optimize power efficiency (Min et al., 2018).

## **6. Conclusion**

In conclusion, the simulation results affirm the viability of the proposed hybrid system architecture, showcasing the energy efficiency of Li-Fi in comparison to traditional wireless communication technologies. The impact on power dissipation, as evidenced by the simulations, highlights the potential



of Li-Fi to revolutionize wireless communication by offering not only superior performance but also substantial energy savings. As we move towards a more connected and sustainable future, the integration of Li-Fi into communication ecosystems emerges as a promising avenue for achieving both high data rates and energy-efficient operations.

## 7. References

- Balaji, K., & Murugan, S. S. (2019). Implementing IoT in underwater communication using Li-Fi. *Int J Recent Technol Eng (IJRTE)*, 8(2S4). 958-964
- Balakrishnan, S., Pooja, G., Ranjitha, S., Ruchitha, S., and Vedashree, C. (2022). IoT implementation of underwater communication using Li-Fi. *Global Journal of Engineering and Technology Advances*, 12(01) 092–101.
- Dinesh, S., & Chourasia, B. (2021). Light Fidelity (Li-Fi) Technology: Will It Be An Eco-Friendly For Monitoring The Covid-19 Patients In Hospital. In *International Conference on Advance Computing and Innovative Technologies in Engineering (ICACITE)*, IEEE,(234-238).
- García de Arquer, F. P., Talapin, D. V., Klimov, V. I., Arakawa, Y., Bayer, M., & Sargent, E. H. (2021). Semiconductor quantum dots: Technological progress and future challenges. *Science*, 373(6555), eaaz8541.
- Gulve, S., Khapare, V., Jagdale, N., Wani, S., & Suryawanshi, A. M. (2022). Underwater communication using li-fi technology. *Innovative Technologica: Methodical Research Journal*, 3(05), 42-47.
- H. Haas and T. Cogalan. (2019). "LiFi Opportunities and Challenges," *16th International Symposium on Wireless Communication Systems (ISWCS)*, Oulu, Finland, 361-366, doi: 10.1109/ISWCS.2019.8877151.
- Harshita, H., Mithum, P., Geetha, M., Krutika, M., Sufiyan, K., & Shyma, Z. (2018). Patient Monitoring System using Li-Fi. *International Journal of Engineering Research & Technology (IJERT)*, 6(13),1-3.
- Khandal, D., & Jain, S. (2014). Li-fi (light fidelity): The future technology in wireless communication. *International Journal of Information & Computation Technology*, 4(16), 1687-1694.
- Kshirsagar, S., Limbale, L., Pawar, M., Giri, P., & Solankar, P. (2021). Advanced LiFi Technology: Laser Light. *AIJR Proceedings*,289-294,doi: <https://doi.org/10.21467/proceedings.118.49>
- Lee, C., Islim, M. S., Videv, S., Sparks, A., Shah, B., Rudy, P. & Raring, J. (2020 ). Advanced lifi technology: Laser light. In *Light-emitting devices, materials, and applications* ,DOI: 10.1117/12.2537420
- M. A. Arfaoui, M. D. Soltani, I. Tavakkolnia, A. Ghrayeb, C. Assi,H. Haas, M. Hasna, and M. Safari, Jan. (2020) "SNR Statistics for Indoor VLC Mobile Users with Random Orientation," in *Proc. IEEE ICC, Shanghai,China*,
- Nozad, Y., & Mohammedtawfiq, A. N. (2021). Real-Time Monitoring System Based on Li-Fi Network Technology in Healthcare. *Journal of education and science*, 30(4), 193-200.



- Pawar, S., Kinny, T., Puthuva, F., Kombar, A., &Belekar, D. (2015). Data Communication using visible light. International Journal of Students Research in Technology & Management, 3(5), 358-362.
- Pradhan, S., Dalmases, M., Taghipour, N., Kundu, B., & Konstantatos, G. (2022). Colloidal Quantum Dot Light Emitting Diodes at Telecom Wavelength with 18% Quantum Efficiency and Over 1 MHz Bandwidth. Advanced Science, 2200637.
- Rani, J., Chauhan, P., & Tripathi, R. (2012). Li-Fi (Light Fidelity)-The future technology. Wireless communication, in International journal of applied engineering research. <http://www.ripublication.com/ijaer.htm>.
- Sarkar, A., Agarwal, S. and Nath.( 2015), A. Li-Fi technology: data transmission through visible light. International Journal of Advance Research in Computer Science and Management Studies, 3(6),3-10.

# ENERGY EFFICIENT WIRELESS SENSOR NETWORKS USING SOFT COMPUTING TECHNIQUES: A REVIEW

**SidharthaSankar Dora,**  
MSCB University, India  
(lpurna@gmail.com)  
**Prasanta Kumar Swain,**  
MSCB University, India  
(prasantkiit@gmail.com)

A wireless sensor network (WSN) is a grouping of many different types of sensors that operate together in a chain to track and record environmental or physical conditions (such as temperature, sound, and pressure) and transmit the data they collect to a central location. WSN creates a bridge between the physical world and the virtual environment, increasing its applicability for several uses. WSN was first primarily employed in the military, but it is now used in a variety of settings, including business, retail, and health care. WSNs have numerous benefits, but they also have several drawbacks, such as hotspot problems, energy hole problem, routing, coverage problems, load balancing challenges, and so on. These problems have an impact on several WSN characteristics, including energy consumption, stability, quality, deployment time, and network lifetime, which reduces the WSN's effectiveness. Numerous scholars create various strategies to address these problems. In this study, we examine various soft computing paradigms to minimize power consumption and extend life time of WSNs. Soft computing is a method of using erroneous solutions to solve complex problems quickly. The paper contains case study of air pollution of smart city, Bhubaneswar, India and analyzed the pollutants using machine learning techniques.

**Keywords:** Wireless sensor, soft computing techniques, energy efficiency, network life time, air pollution

## 1. INTRODUCTION

The term "wireless sensor network" (WSN) refers to a collection of several tiny sensors (such as those for temperature, pressure, humidity, sound, etc.) that can be configured to monitor remote environments and transmit data to a centralized point (Lester, H.J, 2003). In other words, a WSN is a collection of several sensor nodes with the ability to gather data, process it, communicate with one another or with a base station, and distribute it to a specific application to meet its needs (Jennifer, Y. et al., 2008). Different forms of WSN have been classified based on sensor deployment: terrestrial, subsurface, underwater, multi-media, and mobile WSN. WSN is used in a variety of sectors, including business, retail, healthcare, and more.

The communication chores, followed by processing and sensing operations, are the principal energy consumers at sensor nodes. The following statements usually apply, even though different sensor platforms will have distinct energy consumption profiles.

Compared to the compute subsystem, the communication subsystem uses a lot more energy. Therefore, computing ought to be exchanged for communication.

In the reception, transmission, and idle modes, the radio's energy consumption is of same magnitude, however it decreases by at least one order of magnitude when the device is asleep. In order to avoid distraction, the radio should always be off.

The power consumption of the sensor subsystem must also be decreased because, depending on the particular application, it may represent another substantial source of energy consumption.

We then define the lifetime and energy-efficiency of a wireless sensor network since these two concepts are used frequently throughout the text.

Depending on whether we take into account the number of active nodes, the coverage of the area of interest, the connectivity between nodes, or the application's quality of service, there are various definitions of the lifetime of a wireless sensor network, as explained by (Dietrich, I. et al., 2009). As a result, we provide a basic definition of a WSN's lifetime as the period until a specific network state is confirmed. For instance, "the first/last sensor dies," "a certain percentage of the sensors cannot reach the sink," or "the data delivery ratio / coverage drops below a

predefined threshold" are examples of such scenarios. As a result, a sensor network's lifetime is tied to a time metric, but it occasionally misses describing other network characteristics like latency or fault tolerance.

The ratio of total energy expended to total data delivered was the original definition of energy-efficiency (Jones, C. E. Et al., 2001). When a result, the solution's energy efficiency improves when more data is successfully sent for a given level of energy usage. Then, a more inclusive definition that encompasses the first was put forth: "using less energy to provide the same service" can be used to describe energy-efficiency. In this situation, an energy-efficient system may be one that uses the same amount of energy but has a higher event detection accuracy.

As a result, when the term "energy-efficiency" is used, it typically refers to a satisfying trade-off between several optimization criteria (such as energy consumption, latency, and data delivery ratio), with the designer having final say over how to define "satisfaction." As we'll see in the sections that follow, increasing network lifetime only makes sense when done in an energy-efficient way, that is, when the needs of the application are taken into account.

WSN can transform current monitoring practices. In fact, the availability of such inexpensive sensor nodes makes unattended monitoring possible everywhere, even in difficult-to-reach places. However, due to the variety of envisioned applications and the constrained capabilities of the sensor nodes, the realization of such wireless sensor networks poses a difficult research and engineering problem.

## 2. ENERGY SAVING TECHNIQUES

We examine the main strategies that have been put out to address the issue of battery-powered nodes consuming too much energy. It summarizes the suggested taxonomy of energy-efficient mechanisms. They are Radio optimization, data reduction, sleep/wake up scheme, energy efficient clustering, energy efficient routing, battery repletion.

The sensor nodes' battery life is mostly affected by the radio module. Researchers have worked to optimize radio factors such as coding and modulation systems, power transmission, and antenna direction in an effort to lessen energy loss caused by wireless communications.

Reduced data delivery to the washbasin is the goal of another type of solutions. Since both data transmission and acquisition are energy-intensive processes, two strategies can be combined: the reduction of unnecessary samples and the limitation of sensing activities.

The radio component uses a lot of energy when it is in idle states. By putting the radio in sleep mode, sleep/wakeup systems try to modify node activity in order to conserve energy.

Cluster architectures divide the network into clusters, and a chosen node known as the cluster head (CH) is responsible for overseeing each cluster. The cluster head is in charge of organizing the activities of the members and liaising with other CHs or the base station. The use of cluster techniques has been suggested as a way to increase energy efficiency because they help to limit energy consumption in a variety of ways. For example, they can reduce communication range within the cluster, which requires less transmission power, limit the number of transmissions by using CH fusion, reduce energy-intensive operations like coordination and aggregation, and enable the powering off of some cluster nodes. By rotating the CH, they equalize the energy consumption of the nodes. By preserving a hierarchy inside the network, cluster architectural designs enhance network scalability in addition to energy efficiency.

Routing is a further strain that can significantly deplete energy supplies. Nodes closest to the sink are more pressured in multi-hop schemes because they must route more packets. Their battery runs out sooner as a result. The general energy-saving strategies of various routing paradigms are covered in the section that follows. Survey articles can be obtained for a full examination of energy-conscious routing protocols.

Consideration of energy as a parameter during the setup path phase is another way to increase the lifespan of sensor networks. By doing this, routing algorithms can choose the next hop based on its remaining energy rather than just concentrating on the quickest paths. Recently, two novel energy-aware cost functions were introduced by (Liu, A. et al., 2012). A minor change in the amount of nodal energy left can be translated into a substantial change in the cost function value using the Exponential and Sine Cost Function based Route (ESCFR) function. The feature ensures energy balance by favoring sensors with more energy left over when choosing a route. The Double Cost Function based Route (DCFR) protocol considers both the nodes' remaining energy and their rate of energy consumption. This is justified by the fact that hotspot nodes consume a lot of energy. Thus, the employment of this function enhances the routing protocol's ability to balance energy, especially in networks containing obstacles.

Single-route routing methods can quickly deplete the energy of nodes along the chosen path, despite the fact that they are typically simpler than multi-path routing protocols. In contrast, multipath routing allows for the balancing of energy among nodes through the use of alternate forwarding nodes. For instance, the EEMRP (Energy-Efficient Multipath Routing Protocol) (Lu, Y. M. and Wong V.W.S., 2007) allocates the traffic rate to each chosen path after discovering several node-disjoint paths using a cost function based on the energy levels and hop distances of the nodes. A source and a sink are connected via two node-disjoint, collision-free routes using the EECA (Energy-

Efficient and Collision Aware protocol) according to (Wang, Z et al., 2009). By providing several routes, multipath routing methods significantly increase network reliability. This allows the network to recover from failures more quickly than with single path schemes, which require a new route to be computed whenever a node loses power. For a recent overview of multipath routing techniques for WSNs, the interested reader can see (Radi, M. et al., 2012). The network may split or develop energy holes as a result of the early exhaustion of nodes in a particular area. This circumstance can occasionally be avoided by placing nodes in the best possible locations, distributing them evenly, or by adding a few relay nodes with improved capabilities. This promotes better node-to-node energy balance, prevents sensor hotspots, and ensures coverage and k-connectivity (Younis, M. et al., 2008). Finding the smallest possible number of relay nodes or positioning them in the network in the best possible way have been the focus of several studies (Ergen, S. and Varaiya P. 2006 and Misra, S. et al., 2011). As an illustration (Dandekar D. and Deshmukh P., 2013) optimize static sink placement to reduce the average hop distance of each node to its closest sink.

In WSN topologies with a static base station, sensors near to the base station drain their batteries more quickly than other sensor nodes, resulting in an early network disconnect. This is because all traffic is routed to the sink, increasing the workload on nodes located closer to the sink. By utilizing a mobile base station that roams the network to gather node information, it is feasible to equalize the load between nodes and lengthen network lifetime. Because communication occurs in a single hop, sink mobility also improves connectivity in sparse designs and increases reliability. As a result, it lessens message loss, collisions, and contention. This mobile displacement can be investigated to reduce high latency when it is controllable.

Energy harvesting and wireless charging techniques are the subject of several current research investigations. Both are promising approaches that seek to automatically replenish sensor batteries.

Even though WSN has numerous benefits, it has also had several problems. Major difficulties in WSN include energy use, routing, and sensor deployment. There are many techniques used to address these issues; among them, soft computing is a useful strategy that is applied to WSN issues. Soft computing approaches have been created in a variety of ways, including: Swarm intelligence, fuzzy logic, neural networks, reinforcement learning, neural networks, and evolutionary algorithms are only a few examples.

### 3. SOFT COMPUTING TECHNIQUES

#### 3.1 Fuzzy Logic

The Multi- Objective Fuzzy Clustering Algorithm (MOFCA), developed by (Sert S. A. et al., 2015), was based on the clustering approach and employed fuzzy logic to determine the competition radius. This suggested technique satisfies two requirements: it is lightweight and energy efficient in all practicable circumstances. Additionally, the node competition radius was determined using a distributed unequal fuzzy clustering method, which also assisted in the election of uncertain and final CHs, negating the need for a central decision node throughout the voting process. These procedures were carried out using a probabilistic model. The hotspot and energy hole issues were resolved by the suggested strategy. (Izadi, D. et al., 2015) optimize QoS in terms of low energy usage during the fusion process in WSN, the authors have presented a fuzzy-based data fusion methodology. A tiny percentage of lower quality data used as input during the network's data fusion process may have a negative impact on the fusion process. So a proposed technique was introduced to overcome this kind of difficulty. It uses a fuzzy logic controller (FLC) to determine the degree of trust in the data collected. Fuzzy Verdict Mechanism Cluster Protocol (FVMCP), which is used to conduct knowledge-based systems for efficient cluster head elections, was defined by (Daniel, R. and Kuda, N. R., 2015). These decisions would be made in accordance with sensor characteristics such as duty cycle, residual energy, cluster head centrality, degree of hops, and geographic location. This suggested method aids in creating effective clustered networks. (Yadav, R. and Saxena S., 2015) modified LEACH routing algorithm was put forth to maximize energy efficiency during the cluster head selection procedure. The suggested enhanced LEACH cluster-based routing protocol included fuzzy logic that took into account, respectively, energy level, distance from the cluster head, and crowdedness. Fuzzy Interference System is employed here.

To address the hot spot problem, (Bagci, Yazici A., 2013) suggested a fuzzy energy-aware unequal clustering algorithm (EAUCF). The EAUCF algorithm snuck in to lessen the intra-cluster work of the cluster-heads that are either nearby the base station or have little residual battery life. In this case, a fuzzy logic method was used to address problems with cluster head radius estimation. (Gajjar, S., Saarkar M. and Dasgupta, K., 2014 ) Cluster Head Selection Protocol Using Fuzzy Logic (CHUFL) was proposed for the cluster head selection procedure. Node factors include residual energy, neighborhood reachability, neighborhood communication connection quality, and base station distance as fuzzy input variables that aid in creating an effective network. Cross-layer fuzzy based routing protocol was introduced by (Jaradat, T. et al., 2013 ) with the goal of minimizing energy usage and

maximizing network lifetime. In the suggested protocol, the fuzzy controller and cross-layer module—both of which aid in gathering information from higher layers—are two crucial capabilities.

Two transmission power control strategies were suggested by (Sabitha, R. et al., 2015). One is based on fuzzy logic, which is used when a mathematical model is absent from the network, and the other is based on artificial neural networks, which use arithmetic algorithms to learn complex mappings between input and output training sets in order to reduce the energy used for transmission over sensor networks. In order to optimize clusters in networks, (Kumar S. S. and Viswas S., 2015) proposed the Genetic Dual Fuzzy Entropy Clustering (GDFEC) algorithm, a combination of the Fuzzy Interference System and a Generic algorithm that is applied to the output factors of the Fuzzy Interference System for robust optimization by ensuring a steady improvement. The proposed GDFEC protocol can address the issue of black hole coverage as well as the uneven energy distribution of nodes across different network sensor segments.

Using type-2 fuzzy logic and ant colony optimization (ACO), (Zhang Q. et al., 2014) presented the clustering routing protocol CRT2FLACO for WSN with the goal of resolving the network load balancing issue and managing rule uncertainty in the network. Type-2 Mamdani fuzzy logic system (T2MFLS) is used to construct clusters. ACO algorithm is used to queue CH candidates in order to save energy and lengthen network lifetime.

### 3.2 Swarm Intelligence

Particle swarm optimization-based maintenance technique (PSOMS) was implemented by Cheng et al. The maintenance plan uses the linearly weighted particle swarm optimization method to choose the candidate locations and solve the cost optimization problem. The position of the redeployed nodes was determined by the network health indicator. In addition, a mathematical model was employed to calculate the energy consumption of nodes using sensor data (Stefania, M. and Ferraari, G., 2013). To create an energy-efficient routing protocol, (Fouad M. M. et al., 2015) suggested an energy-aware sink node localization approach based on Particle Swarm Optimization (PSO). The PSO is based on a number of topology control protocol variables, including the number of neighbors per node, the residual energy of the nodes, and how far out from the deployment area's centre each node is. Each particle also remembers its position and velocity within the search area, which distinguishes it from other particles. Life time aware routing algorithm for wireless sensor networks (LTAWSN), which was developed by (Mohajerani, A. and Gharavian D., 2015), is a brand-new routing algorithm based on ant colony optimization and employing specific parameters in its fitness function. Additionally, each node's list of potential neighbours was saved in the wireless communication range of the node and was located closer to the target node than the present node. There were few hops involved in getting there.

A wireless sensor network routing protocol employing cat swarm optimization was put out by (Kong, L. et al., 2014). The suggested strategy included two phases, the cat swarm optimization method and the ladder diffusion technique. By choosing the best route from a variety of options from the sensor node to the sink node, the cat swarm optimization algorithm and the ladder diffusion algorithm both contribute to network efficiency. Based on the improved ACO algorithm, (Liu, X., 2014) proposed a new approach called unity of MPEE (Maximum Possible Energy Efficiency) and MPEB (UMM) (Lifespan Maximization), which had two characteristics: each ant only needed to move one step to complete its entire journey, and there was no heuristic information in the transition probability of the ant. By doing so, the complexity of computations would be decreased.

CSO-WT, short for Cat Swarm Optimization with Wavelet Transformation, was created by (Temel, S., 2014) to improve the quality of coverage of WSNs while only installing a small number of sensors. Bresenham's line of sight approach and a probabilistic sensing model were utilized to determine the overall WSN QoS for minimal sensor deployment. In order to acquire an effective zone for sensor positioning in WSN, this proposed approach is applied. The unique deployment strategy, ACO-Greedy, presented by (Liu, X. and Desi H., 2014), aims to lower deployment costs, improve network detection capabilities, and lengthen network lifetime. The suggested method employed an Ant colony optimization with a greedy mitigation mechanism, which helped to complete the job quickly. For effective object point selection in ACO, the pheromone updating rule and heuristic value were designed.

Based on the parallel cat swarm optimization (EPCSO), (Kong, L. et al., 2015) developed a balanced approach to power usage. The EPCSO is capable of assessing a collection of specified paths and generating the balanced path out of all such paths for sensor nodes. An effective alternative path can be found using the immune orthogonal learning particle swarm optimization algorithm (IOLPSOA), which was developed by (Hu, Y. et al., 2014). Each particle flying in the search space was employed by PSOA to determine the best solution, and each particle set its flight route based on the best knowledge it had both locally and globally. The suggested solution resolves the WSN's problem with routing recovery.

By adopting a revised transfer function and a new position updating process with mutation, (Yang, J. et al., 2014) suggested a modified version of the particle swarm optimization (MBPSO) strategy to solve the work allocation problem. A complete possible solution for job allocation was embedded into each particle of the MBPSO. The auto-

localization of the nodes of a static WSN problem was introduced by (Stefania, M. and Ferrari G., 2013) was solved using Particle Swarm Optimization (PSO). For the purpose of localizing a node whose position is known, PSO concentrated on the Time Difference of Arrival (TDOA), which is the difference between the arrival and travel times of signals between each node.

The innovative ant colony optimization (ACO) technique was developed by (Lee, J. et al., 2011) to address the Efficient Energy Coverage (EEC) problem. The suggested method found three different pheromone types: one local and two global pheromones. Additionally, two additional methods to use various types of sensors and the probabilistic sensor detection model are also described.

### 3.3 Evolutionary Algorithm

A hybrid clustering-based application specific low power routing protocol (ASLPR) based on Genetic Algorithm was created by (Shokouhifa, M. and Jalali, A., 2015) for WSNs with stationary sensor nodes. Compared to many other WSN LEACH-based routing protocols, it can be used more effectively to extend network lifetime. Despite this benefit, ASLPR uses a base station processor that is centrally located to perform more computations. Fault node recovery method (FNR), developed by (Shih, H., et al., 2013), is based on the grade diffusion algorithm coupled with genetic algorithm. Using the grade diffusion algorithm, the FNR evaluates the grade value, routing table, neighbour nodes, and payload value, and generates the routing table using the genetic algorithm. In order to extend the network's life and the routing path's reusability, the FNR algorithm reused a number of sensor nodes. Therefore, it was not just to maximize network lifetime but also to develop a sensor network that was affordable.

### 3.4 Reinforcement Learning

In order to overcome the problem of channel selection in a wireless sensor network powered by cognitive radio, (Abolarinwa, J. A. et al., 2014) suggested a learning-based approach that used reinforcement learning algorithm. An algorithm that bases its decisions on learning from previous experiences either chooses the channel to utilise or receives punishment. With the least amount of channel selections possible across the network, RL can offer reduced energy usage during channel selection. A cooperative reinforcement learning (RL) approach that is only reliant on a node's prior conduct was proposed by (Khan, M. I. and , Bernhard, B., 2014). The fundamental principle of RL is to assign the node the future work based on the provided algorithm. The major intention of the suggested strategy was to take advantage of the node's willingness to cooperate when exchanging information about the current local perspective of the application's state.

A common way to gauge air quality is to use the Air Quality Index. The organizations keep track of the concentration of gases such as SO<sub>2</sub>, NO<sub>2</sub>, CO<sub>2</sub>, rspm, spm, etc.

(Gnana, S. A et al. 2019) claim that when given historical data on pollutant concentration, this model can accurately estimate the air quality index for a whole county, a state, or any bounded area.

In order to estimate the level of air pollutants at different places in Mumbai and Navi Mumbai using historical data from the meteorological department and Pollution Control Board, this research proposes an integrated model that uses artificial neural networks and kriging. The results of implementing and testing the suggested model with R for Kriging and MATLAB for ANN are given by (Kottur, S. V. et al, 2015).

The Multilayer Perceptron (ANN) Protocol and Linear Regression have been utilized by this system to estimate the pollution levels for the following day. The method assists in forecasting future pollution and predicting the next date of pollution details by evaluating pollution data and essential factors. Predicting air pollution and identifying future data points were two further applications of time series analysis by (RuchiRaturi, J.R (2018).

The suggested system accomplishes two significant goals. (i). determines the PM<sub>2.5</sub> concentrations using specified air values. (ii) Forecasts the PM<sub>2.5</sub> concentrations for a specific date. To determine whether a data sample is contaminated or not, one can apply logistic regression. Based on the historical PM<sub>2.5</sub> data, auto regression is used to forecast future PM<sub>2.5</sub> values. Predicting the City's air pollution level using the ground data collection is the main objective( Aditya, C. R. et al., 2018).

The data from Shenzhen, China, was used to demonstrate and depict the air quality map. A synthetic neural network. Molecular Design An analysis of the model's advantages and disadvantages was conducted using the following algorithms: Random Forest, Deep Belief Network, ANN Model, and decision tree (Gaganjot K. K. et al., 2018).

## 4. CASE STUDY: AIR POLLUTANT ANALYSIS OF BHUBANESWAR: A SMART CITY IN EASTERN INDIA



A smart city is a concept that refers to an urban area that uses technology and data-driven solutions to enhance the quality of life for its residents, optimize resource use, and improve overall efficiency of urban services. The goal of a smart city is to integrate various information and communication technologies (ICT) and Internet of Things (IoT) solutions to manage a city's assets, such as transportation systems, utilities, public services, and more, in an intelligent and efficient manner.

Bhubaneswar, the capital of the eastern Indian state of Odisha, is indeed one of the cities in India that has been actively working towards becoming a smart city. The Bhubaneswar Smart City Limited (BSCL) is responsible for implementing and overseeing various smart city projects in the city. Here are some key aspects of the smart city initiative in Bhubaneswar.

#### 4.1 Data set of air quality prediction in smart city

Creating a dataset for air quality prediction in a smart city involves collecting comprehensive and relevant data on various pollutants, meteorological conditions, and other factors influencing air quality. Below are some categories of data that can be included in an air quality prediction dataset for a smart city:

#### 4.2 Air Quality Parameters:

Concentrations of key air pollutants such as Particulate Matter (PM10, PM2.5), Nitrogen Dioxide (NO<sub>2</sub>), Sulfur Dioxide (SO<sub>2</sub>), Carbon Monoxide (CO), Ozone (O<sub>3</sub>), etc.

Timestamps indicating when each measurement was taken.

Meteorological Data:

Temperature: Ambient air temperature.

Humidity: Percentage of water vapor in the air.

Wind Speed and Direction: Speed and direction of the wind.

Atmospheric Pressure: Pressure exerted by the atmosphere.

Geographical Data:

Latitude and Longitude: Location coordinates of air quality monitoring stations.

Altitude: Elevation above sea level.

Land Use Data: Information about the surrounding environment, such as residential, industrial, or commercial areas.

Time-Related Information:

Date and Time: Timestamps indicating when each data point was recorded.

Day of the week, month, and year.

Traffic Data:

Traffic Density: Number of vehicles on the road.

Traffic Flow: Speed and movement patterns of vehicles.

Road Network Information: Details about road types, intersections, and traffic signal data.

Industrial Activity Data:

Data on industrial emissions, including types of industries, production levels, and emission control measures in place.

Emission Source Information:

Information on major emission sources such as factories, power plants, and transportation hubs.

Data on the types and quantities of pollutants emitted by each source.

Land Use and Urban Features:

Land cover types: Percentage of land covered by vegetation, buildings, water, etc.

Urban density: Population density and building density.

Health Data (optional):

Health-related data for the population in the area, such as respiratory illness rates.

Hospital admissions or emergency room visits related to air quality issues.

Historical Data:

Historical records of air quality parameters for model training and analysis.

Long-term weather patterns or seasonal trends.

Event Data:

Special events or occurrences that might affect air quality, such as festivals, parades, or construction projects.

It's important to note that the availability and quality of data may vary based on the location, resources, and infrastructure of the smart city. Governments, environmental agencies, research institutions, and private organizations may collaborate to collect and share data for air quality prediction purposes. Additionally, open data



initiatives and platforms may provide access to publicly available datasets related to air quality in certain regions. Always ensure that data collection and usage comply with privacy and ethical standards.

### 4.3 Impact of air pollution

Air pollution can have significant and wide-ranging impacts on a smart city, affecting both the well-being of its residents and the efficiency of various systems. Here are some key impacts of air pollution in a smart city:

**Public Health:** Poor air quality is a major threat to public health. Respiratory diseases, cardiovascular problems, and other health issues can arise or worsen due to exposure to pollutants like particulate matter (PM), nitrogen dioxide (NO<sub>2</sub>), sulfur dioxide (SO<sub>2</sub>), and ozone. Smart cities, with their focus on data and technology, may implement real-time air quality monitoring systems to provide residents with timely information and authorities with insights to take corrective actions.

**Smart Infrastructure:** Air pollution can degrade the infrastructure in a city. For example, pollutants can accelerate the deterioration of buildings and bridges, impacting the longevity of infrastructure investments. Regular monitoring and maintenance become crucial in smart cities to address these issues promptly.

**Transportation Systems:** Inefficient transportation contributes significantly to air pollution. Smart cities often emphasize intelligent transportation systems, including electric vehicles, traffic management, and real-time data analysis to optimize traffic flow and reduce emissions. Implementing eco-friendly public transportation options can also be part of the solution.

**Energy Efficiency:** Air pollution is often linked to energy production and consumption. Smart cities leverage technologies to improve energy efficiency, promote renewable energy sources, and reduce the environmental impact of power generation. This includes smart grids, energy management systems, and the integration of clean energy sources.

**Data-Driven Decision Making:** Smart cities rely on data to make informed decisions. Air quality data can be used to identify pollution sources, assess the effectiveness of pollution control measures, and formulate evidence-based policies to improve air quality.

**Quality of Life:** Air pollution can have a direct impact on the quality of life for city residents. Smart cities focus on creating environments that enhance well-being, and addressing air quality issues is a crucial aspect of this goal. Parks, green spaces, and sustainable urban planning can be integral components of a smart city's strategy to mitigate the impact of air pollution.

**Emergency Response:** Air pollution events, such as smog or high levels of pollutants, may require immediate action. Smart cities can use data analytics and communication technologies to quickly respond to emergencies, issue alerts to residents, and coordinate efforts to mitigate the impact of severe air quality events.

However, air pollution affects various aspects of a smart city, and addressing these challenges involves a combination of technological solutions, data-driven decision-making, and proactive urban planning to create a healthier and more sustainable urban environment.

Wireless Sensor Networks (WSNs) play a crucial role in controlling air pollution in smart cities by providing real-time monitoring, data collection, and communication capabilities. Here are several ways in which WSNs contribute to managing and mitigating air pollution in a smart city.

Soft computing refers to a set of computational techniques that model and solve complex problems using methods inspired by the human mind's ability to reason and learn in an uncertain and imprecise environment. In the context of controlling air pollution in a smart city, soft computing plays a significant role in several aspects.

Machine learning (ML) plays a crucial role in controlling air pollution in smart cities by enabling the development of predictive models, optimization strategies, and intelligent decision support systems. Here are several ways in which machine learning contributes to managing and mitigating air pollution.

### 4.4 Dataset

The dataset contains air pollutant data of Bhubaneswar smart city which collects from different sources. There are three data sets. Data set1 contains 5 attributes and eight rows, data set2 contains five attributes and fourteen rows and data set3 contains nine attributes and eleven rows.

### 4.5 Exploratory Data Analysis

Python is used for data analysis and categorization using support vector machines. Figure 1 depicts fuel usage for various vehicle models based on the type of fuel used. The fuel consumption of two-wheelers is lowest and that of commercial vehicles is largest. Figure 2 displays the fuels used by homes, lodging establishments, and residents of

slum areas. Hotels use the most fuel, whereas residents of slum areas use less fuel. Figure 3 illustrates the various sectors' petrol emissions. Most of them were released by the gas (Co), which is toxic to humans.

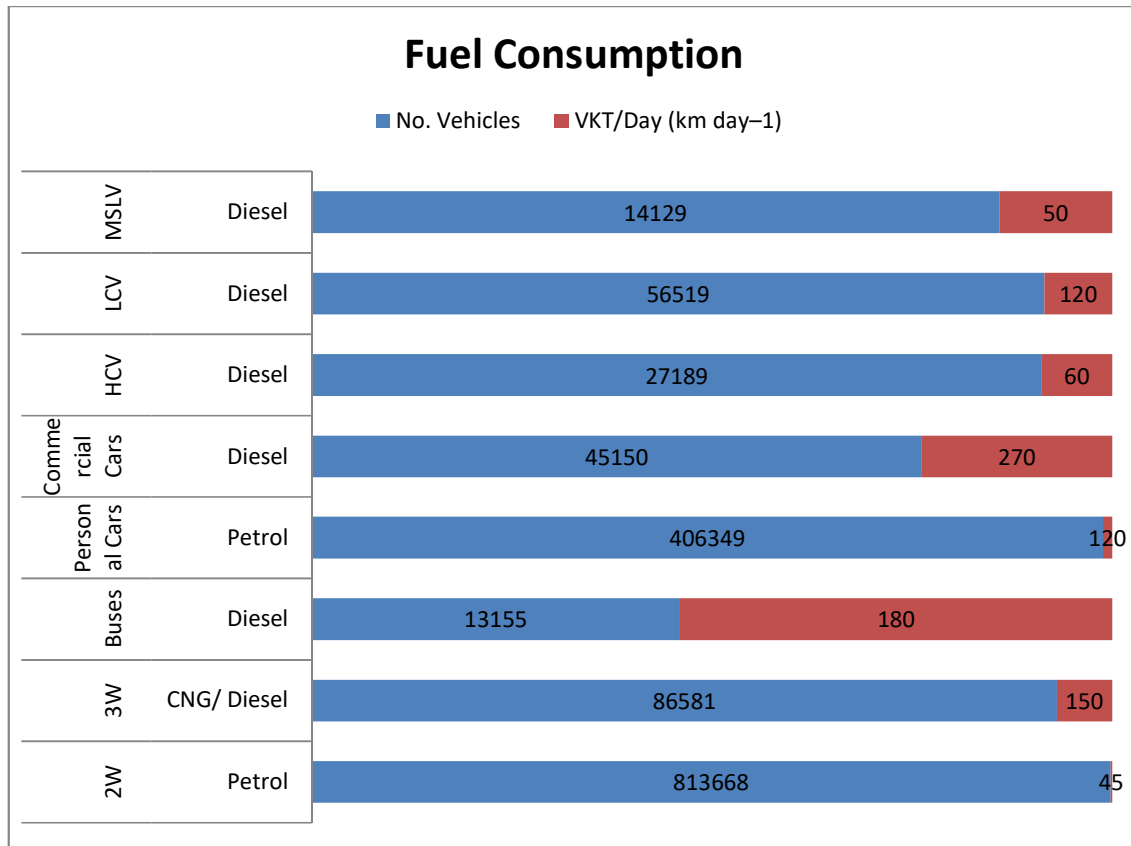


Figure 1: Fuel consumption by vehicles

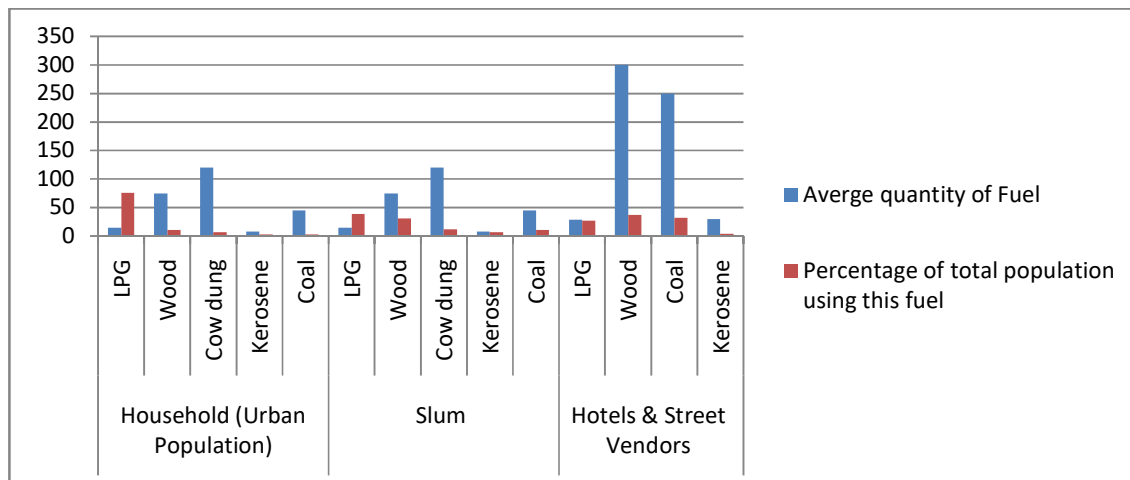


Figure 2: Fuel type used by different sub sectors

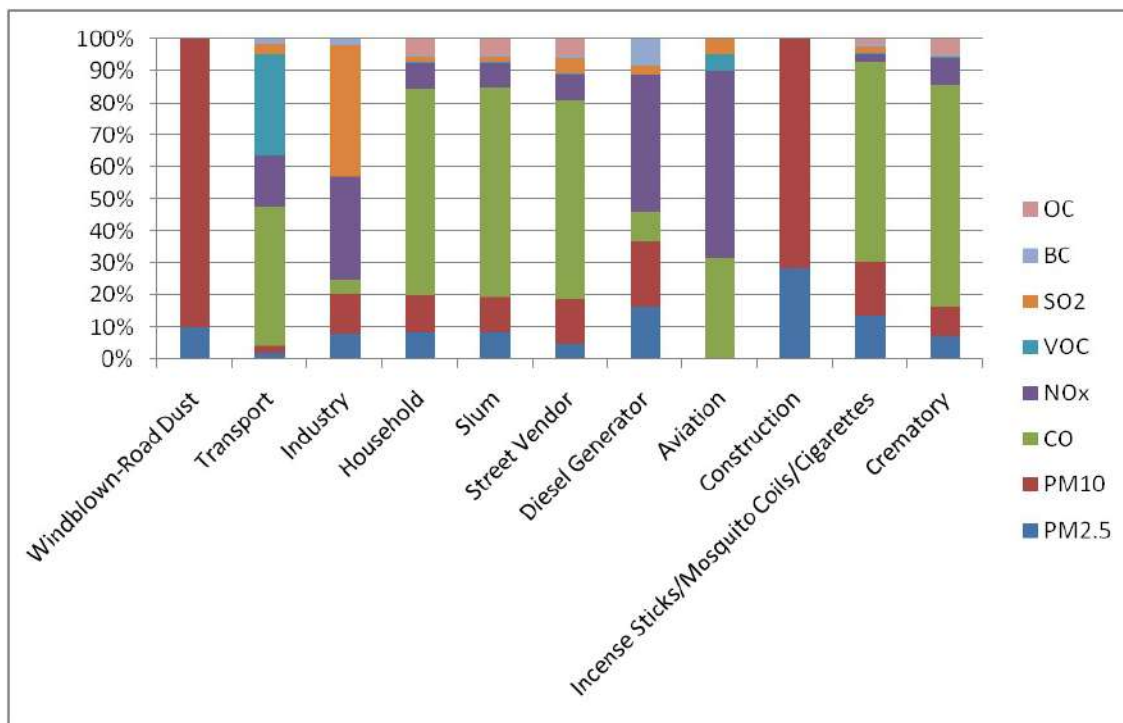


Figure 3: Sector wise air pollution

## 5. CONCLUSION

The number of potential application domains for wireless sensor networks has increased during the past ten years. A few examples of these applications are the nationwide smart grid systems, large-scale precision agriculture, security-focused industrial process monitoring, and life-critical healthcare supervision. In this chapter, we reviewed the most recent developments in the creation of energy-efficient WSN solutions while considering the needs of the application. First, we classified the various WSN applications and determined their unique requirements. Then we supplied the reader with a thorough examination of how various strategies can affect the performance of applications, along with the introduction of a new taxonomy of energy saving approaches. Finally, we looked at some strategies that have been used in the past to achieve trade-offs between various needs for effective and long-lasting sensor networks. The case study of smart city, Bhubaneswar shows air pollutants sources and its impact on people of this area.

## REFERENCES

- Abolarinwa, J. A., Abdul Latiff, N. M., Syed Yusof, S. K. and Fisal, N. (2014). Learning-based algorithm for energy-efficient channel decision in cognitive radio-based wireless sensor networks. In *Frontiers of Communications, Networks and Applications (ICFCNA 2014-Malaysia)*, International Conference on, *IET*, 1-6.
- Aditya, C. R., Deshmukh, C. R., Nayana, D K, Vidyavastu, P. G (2018). Detection and Prediction of Air Pollution using Machine Learning Models. *International Journal of Engineering Trends and Technology (IJETT)*, 59 (4).
- Bagci, H., and Adnan Y. (2013). An energy aware fuzzy approach to unequal clustering in wireless sensor networks. *Applied Soft Computing*.13(4), 1741-1749.
- Dandekar, D., Deshmukh, P. (2013). Energy balancing multiple sink optimal deployment in multi-hop Wireless Sensor Networks, in: *IEEE 3rd Int. Advance Computing Conference*, Ghaziabad, pp. 408–412.

- Daniel, R., and Kuda N. R. (2015). An optimal power conservation cluster based routing algorithm using Fuzzy Verdict Mechanism for Wireless Sensor Networks. In Electrical, Electronics, Signals, Communication and Optimization (EESCO), 2015 International Conference on, IEEE, pp. 1-9.
- Dietrich, I., Dressler F. (2009) On the life time of wireless sensor networks, ACM Transactions on Sensor Network 5 (2009).
- Ergen, S., Varaiya, P. (2006). Optimal Placement of Relay Nodes for Energy Efficiency in Sensor Networks. *IEEE Int. Conf. On Communications*, Istanbul, 3473–479.
- Fouad, M. M., Snasel, V. and Hassanien, A. E. (2015). Energy-Aware sink node localization algorithm for wireless sensor networks. *International Journal of Distributed Sensor Networks*, 134.
- Gaganjot, K. K., ZeyuGao J., Chiao S., Lu, S. and Xie, G. (2018). Air Quality Prediction: Big Data and Machine Learning Approaches. *International Journal of Environmental Science and Developmen.*, 9 (1).
- Gajjar, S, Sarkar, M. and Dasgupta K. (2015). FAMACRO: Fuzzy and Ant Colony Optimization based MAC/Routing Cross-layer Protocol for Wireless Sensor Networks. *Procedia Computer Science* . 46, 1014-1021.
- Gajjar, S, Sarkar, M. and Dasgupta K. (2014). Cluster Head Selection Protocol using Fuzzy Logic for Wireless Sensor Networks. *International Journal of Computer Applications*. 97 (7), 38-43.
- Gnana, S. A., Gnana J., Akshaya A.C (2019). Indian Air Quality Prediction And Analysis Using Machine Learning. *International Journal of Applied Engineering Research*, 14( 11).
- Hu, Y., Ding, Y., Hao, K., Ren, L., and Han H. (2014). An immune orthogonal learning particle swarm optimisation algorithm for routing recovery of wireless sensor networks with mobile sink. *International Journal of Systems Science*. 45(3), 337-350.
- Izadi, D, Jemal H. A., Sara G., and Tutut H. (2015). A Data Fusion Method in Wireless Sensor Networks. *Sensors*. 15(2), 2964-2979.
- Jaradat, T., Driss B. Balakrishnan M. and Fuqaha A. (2013). Energy efficient cross-layer routing protocol in wireless sensor networks based on fuzzy logic. In Wireless Communications and Mobile Computing Conference (IWCMC), 2013 9th International, *IEEE*. pp. 177-182.
- Jennifer, Y., Mukherjee, B. and Ghosal, D. (2008). Wireless sensor network survey. *Computer networks*. 52(12), 2292- 2330.
- Jones, C. E., Sivalingam, K., Agrawal, M. P., Chen, J. C. (2001). A Survey of Energy Efficient Network Protocols for Wireless Networks, *Wireless Networks*. 7.
- Khan, M. I. and Rinner, B. (2014). Energy-aware task scheduling in wireless sensor networks based on cooperative reinforcement learning. In Communications Workshops (ICC), 2014 IEEE International Conference, *IEEE*. 871-877.
- Kong, L., Chen, C., Shih, H., Lin, C., He, B. and Pan, J. (2014). An energy-aware routing protocol using cat swarm optimization for wireless sensor networks. In Advanced Technologies, *Embedded and Multimedia for Human-Centric Computing*, Springer , 311-318.
- Kong, L., Pan, J., Tsai, P., Vaclav, S., and Ho, J. (2015). A Balanced Power Consumption Algorithm Based on Enhanced Parallel Cat Swarm Optimization for Wireless Sensor Network. *International Journal of Distributed Sensor Networks*.
- Kottur, S. V., Mantha, S. S (2015). An Integrated Model Using Artificial Neural Network (Ann) And Kriging For Forecasting Air Pollutants Using Meteorological Data. *International Journal of Advanced Research in Computer and Communication Engineering*. 4(1), 2319-5940.
- Kumar, S. S. and Vishwas S. (2015). GDFEC Protocol for Heterogeneous Wireless Sensor Network. In Computational Intelligence in Data Mining, *Springer*. 1, pp. 345-354.
- Lee, J., Choi, B. S. and Lee, J. J. (2011). .Energy-efficient coverage of wireless sensor networks using ant colony optimization with three types of pheromones. *Industrial Informatics, IEEE Transactions*. 7( 3), 419-427.
- Lester, H. J. (2003). System architecture for wireless sensor networks. PhD diss., University of California, Berkeley.
- Liu, A., Ren, J., Li X., Chen, Z., Shen, X. S (2012). Design principle and improvement of cost function based energy aware routing algorithms for wireless sensor networks. *Computer Networks*. 56, 1951–1967.
- Liu, X. (2014). A transmission scheme for wireless sensor networks using ant colony optimization with unconventional characteristics. *Communications Letters, IEEE*. 18(7), 1214- 1217.
- Liu, X. and He D. (2014). Ant colony optimization with greedy migration mechanism for node deployment in wireless sensor networks. *Journal of Network and Computer Applications*, 39, 310-318.
- Lu, Y. M. Wong, V. W. S. (2007). An energy efficient multi path routing protocol for wireless sensor networks. *International Journal of Communication Systems*, 20, pp.747–766.
- Misra, S., Majd, N. E., Huang, H. (2011). Constrained Relay Node Placement in Energy Harvesting Wireless Sensor Networks, *IEEE 8th Int. Conf. On Mobile Adhoc and Sensor Systems*, Valencia, 2011, 2155–6806.

- Mohajerani, A. and Davood G. (2015). An ant colony optimization based routing algorithm for extending network lifetime in wireless sensor networks. *Wireless Networks*, pp: 1-11.
- Radi, M. Dezfouli, B. Bakar, K. A., Lee, M. (2012). Multipath routing in wireless sensor networks: survey and research challenges, *Sensors*. 12 ,650–685.
- RuchiRaturi, J.R (2018). Recognition Of Future Air Quality Index Using Artificial Neural Network. *International Research Journal of Engineering and Technology (IRJET)*. 05 (3).
- Sabitha, R., K., Bhuma, T. and Thyagarajan T (2015). Design and Analysis of Fuzzy Logic and Neural Network Based Transmission Power Control Techniques for Energy Efficient Wireless Sensor Networks. In Proceedings of the 3rd International Conference on Frontiers of Intelligent Computing: Theory and Applications (FICTA) 2014, *Springer*, pp. 295-303.
- Sert, S. A., Hakan, B., and Adnan, Y. (2015). MOFCA: Multi- objective fuzzy clustering algorithm for wireless sensor networks. *Applied Soft Computing*, 30 (2015): 151-165.
- Shih, H. C., Ho, J. H., Liao, B. Y. and Pan. J. S. (2013). Fault node recovery algorithm for a wireless sensor network. *Sensors Journal, IEEE* ,13( 7), 2683-2689.
- Shokouhifar, M., and Jalali. A. (2015). A new evolutionary based application specific routing protocol for clustered wireless sensor networks. *AEU-International Journal of Electronics and Communications*, 69(1), 432-441.
- Stefania, M. and Ferrari, G. (2013). Particle swarm optimization for auto-localization of nodes in wireless sensor networks. In Adaptive and Natural Computing Algorithms, *Springer*, pp. 456-465.
- Temel, S., Unaldi, N. and Kaynak, O. (2014). On deployment of wireless sensors on 3-D terrains to maximize sensing coverage by utilizing cat swarm optimization with wavelet transform. *Systems, Man, and Cybernetics: Systems. IEEE Transactions*, 44( 1), pp. 111- 120.
- Wang, Z. Bulut, E., Szymanski, B. (2009). Energy Efficient Collision Aware Multipath Routing for Wireless Sensor Networks. Int. Conf. On Communications, Dresden. *IEEE* , pp.1–5.
- Yadav, R, and Saxena S. (2015). Improved Leach Routing Protocol with Soft Computing. In Advances in Computing and Communication Engineering (ICACCE), Second International Conference, *IEEE*, pp. 261-266.
- Yang, J., Zhang, H., Ling, Y., Pan, C., and. Sun, W. (2014). Task allocation for wireless sensor network using modified binary particle swarm optimization. *Sensors Journal, IEEE*, 14( 3), 882-892.
- Younis, M., Akkaya, K. (2008). Strategies and techniques for node placement in wireless sensor networks: A survey. *AdHoc Networks*. 6 , 621–655.
- Zhang, Q., Sun, Z. and Zhang, F. (2014). A clustering routing protocol for wireless sensor networks based on type-2 fuzzy logic and ACO. In Fuzzy Systems (FUZZ-IEEE), 2014 IEEE International Conference on. *IEEE*. pp. 1060-1067.

## A SURVEY ON TRACKING CYBER CRIME USING ARTIFICIAL INTELLIGENCE -PHISHING

**Mrs. Jayshree Bajaj,**

Dr. C.V. Raman University, Bilaspur, Chhattisgarh, India.

(jaybjkun@gmail.com)

**Mr. Vaibhav Sharma,**

Dr. C.V. Raman University, Bilaspur, Chhattisgarh, India.

(sharma.vaibhav11@gmail.com)

Phishing attacks are increasing and getting more sophisticated and are spreading beyond Emails to text messages and other forms of personal communication. Phishing attacks, where a cybercriminal sends a deceptive message that's designed to fool a user into providing sensitive information such as credit card number or to launch malware on the user's system, are on the rise. In today's digital landscape, where cyber threats continue to evolve, phishing is one of the most pervasive and damaging attacks. Real-time phishing attacks pose a significant risk to individuals and organization alike as they attempt to deceive users into disclosing sensitive information such as passwords, credit card details or personal data. Tracking cybercrime phishing using AI requires a comprehensive framework that includes multiple stages and components. So Machine learning has been described as an effective measure in avoiding most cyber-attacks. The development of AI has therefore promoted increased security for most computer attacks so that Phishing attacks which are risky can be prevented through AI-based solutions.

Keywords: Phishing, Machine Learning, cyber-attacks, AI.

### 1. INTRODUCTION

In recent years, Internet had an enormous growth and there has been also enormous growth of web service. Even web attacks have increased in large numbers and even improved in quality. One of the popular attacks which is growing since many years is Phishing and is carried out to steal user's personal and important information such as credit card details, passwords and other important files which may cause harm to user if used for illicit activities. Phishing is done with different communication forms such as instant messaging, email, SMS, etc. But mostly users get tricked by phishing attack is caused through uniform resource locator (URL). A phishing attack is among the most common types of cyber security attacks. This type of attack involves some type of social engineering where the attacker sends fraudulent messages tricking the victim into providing his credentials.

However, with the advancement of technology and the implementation of real-time techniques, it is possible to bolster security measures and effectively detect and combat these malicious schemes. This blog will explore the importance of real-time methods in detecting phishing attacks and how they can enhance overall security.

### 2. PHISHING OVERVIEW

Phishing is a type of cybercrime whereby cyber criminals send spam messages containing malicious links, designed to get targets to either download malware or follow links to spoof websites. These messages were traditionally emails, but have since been employed through texts,



social media and phone calls. Phishing remains the most common form of cybercrime. Of UK businesses that suffered a cyber-attack in 2022, 83% say the attack was phishing. Globally, 323,972 internet users fell victim to phishing attacks in 2021. This means half of the users who were a victim of cybercrime fell for a phishing attack. This is despite Google's cyber security measures blocking 99.9% of phishing attempts from reaching users. With an average of \$136 lost per phishing attack, this amounts to \$44.2 million stolen by cyber criminals through phishing attacks in 2021. Phishing attacks largely target victims through emails. In 2021, there was a global average of 16.5 leaked emails per 100 internet users. These breached databases are sold on black marketplaces on the dark web, meaning cyber criminals can purchase them and use the addresses in phishing attacks. Nearly 1 billion emails exposed, affecting 1 in 5 internet users in 2021. This may partly explain the continued prevalence of phishing attacks. It is more important than ever for businesses to take cyber security seriously. A 2019 study highlighted that spear phishing was the most popular avenue for attack for cyber criminals. These phishing campaigns were used by 65% of all known groups. The primary motive for these attacks was overwhelmingly intelligence gathering, with 96% of groups using targeted attacks for this reason. In 2022, the most common URL included in phishing emails links to websites with the '.com' domain, at 54%. The next most common domain is '.net' at less than 8.9%. The most common domain names with '.com' for Q2 2022 are:

- Adobe
- Google
- Myportfolio
- Backblaze2
- Weebly

The risk that phishing poses is clear. A data breach that exposes 10 million records costs businesses \$50 million on average. An attack that compromises 50 million records can cost as much as \$392 million. The growing cost-of-living crises experienced by economies globally are providing fertile ground for cyber criminals to launch phishing campaigns. In the UK, scammers impersonated the energy regulator Ofgem in their attempts to harvest financial information. In response, Ofgem contacted all UK energy suppliers and asked them to update their websites with information advising customers what actions to take if they encounter a scam.

### **3. REAL-TIME TECHNIQUES THAT BLOCK POTENTIAL PHISHING THREATS**

Detecting phishing attacks in real time allows for immediate response and mitigation, minimizing the potential damage caused. Traditional security measures, such as static blocklisting or periodic scanning, must be revised to combat phishing attacks' rapidly evolving nature. Real-time detection techniques provide the ability to monitor incoming traffic, identify suspicious patterns, and analyze various indicators to identify and block potential threats swiftly.

#### **i. Behavior-based Analysis**

Behavior-based analysis is a powerful technique employed in real-time phishing attack detection. Security systems can establish a baseline of normal user activities by continuously monitoring user behavior, such as browsing patterns, mouse movements, and keystrokes.

Any deviation from this baseline can be flagged as a potential phishing attempt. For example, suppose a user suddenly receives an email with a suspicious link and immediately clicks on it without hesitation. In that case, the system can recognize this as abnormal behavior and trigger



an alert. By analyzing behavior in real-time, security systems become more adept at identifying sophisticated phishing attacks that try to mimic actual user actions.

**(a) ii. Machine Learning and Artificial Intelligence**

Machine learning (ML) and artificial intelligence (AI) are pivotal in enhancing real-time phishing attack detection. ML algorithms can analyze large volumes of data, including email content, website characteristics, and user interactions, to identify patterns and trends associated with phishing attacks. By training these algorithms on historical phishing data, they can learn to recognize common phishing indicators and adapt to new and emerging attack techniques. Through continuous learning, ML-powered systems improve their accuracy in detecting real-time phishing attacks while reducing false positives, ensuring more effective protection against evolving threats.

**(b) iii. URL and Domain Reputation Analysis**

Real-time detection systems employ URL and domain reputation analysis to identify potentially malicious links and websites. These systems compare URLs against known phishing databases and block lists, assessing their reputation and trustworthiness. Suspicious links that match known phishing patterns are immediately flagged, preventing users from accessing them. Additionally, real-time systems can employ machine learning models to analyze the structure of URLs, looking for telltale signs of phishing attempts, such as slight misspellings or extra characters in domain names. By scrutinizing URLs in real time, security systems can thwart phishing attacks before users unknowingly interact with dangerous websites.

**(c) iv. Email and Content Analysis**

Real-time analysis of email content is a critical component of detecting phishing attacks. Security systems scan incoming emails and assess elements, such as email headers, attachments, and embedded links, to identify potential threats. Advanced algorithms analyze email content for phishing indicators, including suspicious keywords, misspelled domains, grammar errors, or requests for sensitive information. By examining emails in real-time, security systems can promptly flag suspicious messages and prevent users from falling victim to phishing attempts. Additionally, analyzing attachments and embedded links allows systems to identify malicious files or redirect attempts, safeguarding users from potential malware infections.

**v. Collaboration and Threat Intelligence Sharing**

Real-time detection systems thrive on collaboration and the sharing of threat intelligence. By actively participating in threat intelligence networks and leveraging information from other security platforms, these systems gain access to a vast pool of real-time threat data. This collaborative approach enhances their ability to detect emerging phishing attack vectors and stay current with the latest techniques cybercriminals use. By sharing insights, indicators, and patterns of real-time phishing attacks, security platforms collectively contribute to a more robust defense against these threats. This collaborative intelligence sharing ensures that organizations

can proactively protect their users from evolving phishing attacks, further bolstering their security posture.

#### 4. LITERATURE REVIEW

Almomani, A. et.al. (2013) According to this proposal various authors proposes a new framework called Phishing Dynamic Evolving Neural Fuzzy Framework (PDENF). The framework expects to detect and predict unknown "Zero days" Phishing Email with decrease the level of false positive rate of ham email and false negative rate of phishing emails. This is to increase the level of accuracy and increase the performance of classification and prediction the phishing email values in online mode, and long-life working with footprint consuming memory.

Selma, D. et.al. (2015) According to the authors application of AI techniques are already being used to assist humans in fighting cybercrimes, as they provide flexibility and learning capabilities to IDPS (Intrusion detection and prevention system) software. It has become obvious wide knowledge usage in decision making process requires intelligent decision support in cyber defence which can be successfully achieved using AI methods. For future work in enhancing IDPSs, unsupervised learning algorithms and new techniques will be considered together to create hybrid IDPS which will improve the performance of anomaly intrusion detection. Moreover, combining all kinds of AI technologies will become the main development trend in the field of anti-virus technology.

Basit, A. et.al. (2020) The survey enables researchers to comprehend the various methods, challenges and provide a comprehensive and easy-to-follow survey focusing on deep learning, machine learning, hybrid learning, and scenario-based techniques for phishing attack detection. An efficient detection system ought to have the option to identify phishing attacks with low false positives. With high computational expenses, heuristic and data mining methods have high FP rates, however better at distinguishing phishing attacks. Classification methods such as RF, SVM, C4.5, DT, PCA, k-NN are also common and are highlighted in this paper which are most useful and effective for detecting the phishing attack.

Sharma, P. et.al (2022) According to the Authors the Anti-phishing algorithms have proven very effective in detecting phishing attacks. Technologies developed from these algorithms have proven to be effective in preventing phishing attacks and constantly changing. The prevention is associated with ensuring that the user has been notified of such attacks. The research describes how phishing attacks have been rising for a long time. Detecting phishing attacks through anti-phishing algorithms is an effective approach to protecting most users. Adopting the anti-phishing algorithms across different sectors and technologies will also ensure that the number of phishing attacks has been reduced significantly.

Pingle, Y. et.al (2020) The authors proposed the feature set that can easily classify the URLs, whether it is malicious URL or not. The motive of this technique is to reduce damage caused by phishing attacks and provide better security for personal information. They tested several machine learning algorithms and determined that best classifier was ID3. Their method achieved an accuracy for detecting malicious activity. This technique helps the user to not be a victim of malicious URL. The motive of dividing the project into small modules so that the implementation can be easier.

Basnet, R .et.al(2008) The research insights into the effectiveness of using different machine learning algorithms for the purpose of classification of phishing emails. Soft Computing techniques are increasingly being used to address a gamut of computational problems. The authors employ a few novel input features that can assist in discovering phishing attacks with

very limited a-prior knowledge about the adversary or the method used to launch a phishing attack.

T. Chandrakala, et.al.(2020) The authors contributed in writing audit of DM (data mining) and AI applications in the field of criminologists. Four distinct territories of corruption with various seriousness were analyzed through crafted by scientists in the area and their utilization of DM (data mining) to add to bringing down crime percentage through distinguishing, decreasing, or keeping crime from occurring. Various methods of DM (data mining) were likewise utilized at various phases of information assortment, examination, and formation of models.

Singh, P.et.al.(2015) The purpose of this is to prevent the customer from online transaction by using specific technique i.e. based on Data Mining and Artificial Intelligence technique. The risk score is calculated by Bayesian Learning Approach to analyze whether the transaction is genuine or fraudulent based on the two parameters: Customer Spending Behaviour and Geographical Locations. The customer than spending behaviour that can be identified by KMEAN clustering algorithm and in geographical location the current geographical location is compared with the previous location. Jenkins, A. et.al(2022) The authors here propose a novel phishing-advice tool, PhishEd, which accepts reports from users of potential phishing emails, uses artificial intelligence (AI) to parse out contextual phishing features, and quickly responds back to the user with advice that uses the content of the reported email to explain the reasoning or frame the decision the user needs to make.

Ansari, M.F.et.al.(2022) The paper, showcases the effectiveness of AI-based cyber security training and how it may influence cyber-attacks. AI-based Cyber security awareness ensures that users understand how they can use AI to promote security against phishing attacks. The methods that AI-based Cyber security uses in avoiding Cyber security also ensures users can avoid phishing attacks such as social engineering. This approach ensures that people avoid mistakes which result in them being attacked.

Quest, L.et.al(2018) According to the authors ,Increased use of AI tools for crime prevention could also cause external risks to cascade in unexpected ways. A company could lose its credibility with the public, regulators, and other stakeholders in myriad ways .Soni, V.D. According to the researcher, it is concluded that artificial intelligence was introduced as a concept to mimic human brains. AI technology is used to enhance customer interaction and experience, enhance the efficiency of banking processes, and develop security and risk control.

Dash, B.et.al(2022) According to the researchers Cybersecurity systems can include AI algorithms to ensure that the response time has increased significantly and that data has remained protected. The author examined that scenario for an intrusion detection machine-learning-based security model. Detection, prediction, and response time skills are among the several features which are discussed here. As a result, businesses and consumers should recognize that establishing a robust defence against cybercrime is best accomplished with AI technology.

## 5. CONCLUSION

As real-time phishing attacks continue to pose a significant threat, adopting proactive security measures that leverage advanced techniques is crucial. By embracing real-time detection methods such as behavior-based analysis, machine learning, URL and domain reputation analysis, email and content analysis, and collaboration with threat intelligence platforms, organizations can enhance their security posture and protect against the ever-evolving landscape of phishing attacks. Prioritizing real-time detection empowers individuals and organizations to stay one step ahead of cybercriminals, safeguarding their valuable information and maintaining a robust defense against real-time phishing attacks. With all the above selected reviews it is also

analyzed that AI technologies are very beneficial for the tracking and preventing the cybercrime like Phishing.

## 6. REFERENCE

- ALmomani , A.,Gupta , B.B, Wan,T ., Altaher,A. and Manickam,S. (2013) ,“Phishing Dynamic Evolving Neural Fuzzy Framework for Online Detection “Zero-day” Phishing Email” Vol: 6 ,Issue: 1 , ISSN:0974-6846 Indian Journal of Science and Technology.
- Dilek,S. , Çakır,H. and Aydın,M. (2015), “APPLICATIONS OF ARTIFICIAL INTELLIGENCE TECHNIQUES TO COMBATING CYBER CRIMES: A REVIEW” Vol. 6, No. 1, International Journal of Artificial Intelligence & Applications (IJAIA)
- Basit, A., Zafa , M., Liu,X., Javed, A.R., Jalil, Z. and Kifayat, K. (2020), “A comprehensive survey of AI-enabled phishing attacks detection techniques”
- Sharma, P.K. , Dash, B. and Ansari, M.F. (2022), “Anti-Phishing Techniques – A Review of Cyber Defence Mechanism” International Journal of Advanced Research in Computer and Communication Engineering (IJARCC) ISSN (O) 2278-1021, ISSN (P) 2319-5940
- Pingle,Y., , Bhatkar , S.N. and Patil,S. (2020), “Detection of Malicious Content using AI” 7th International Conference on “Computing for Sustainable Global Development”.
- Basnet ,R., Mukkamala ,S. and Sung ,A.H.(2008), ”Detection of Phishing Attacks: A Machine Learning Approach “.
- T. Chandrakala, S. Nirmala Sugirtha Rajini , K. Dharmarajan, K. Selvam(2020) “DEVELOPMENT OF CRIME AND FRAUD PREDICTION USING DATA MINING APPROACHES”, International Journal of Advanced Research in Engineering and Technology (IJARET) Volume 11, Issue 12
- Singh, P. and Singh, M. (2015),”Fraud Detection by Monitoring Customer Behavior and Activities , International Journal of Computer Applications (0975 – 8887) Volume 111 – No 11.
- Jenkins, A., Kökcuyan,N. and Vanica,K.(2022) ,“PhishED: Automated contextual feedback for reported Phishing”.
- Ansari,M.F. , Sharma,P. K. and Dash,B.(2022), “Prevention of Phishing Attacks Using AI-Based Cybersecurity Awareness Training” International Journal of Smart Sensors and Ad Hoc Networks (IJSSAN), ISSN No. 2248-9738 , Vol-3, ISSUE-3.
- Quest,L., Charrie, A. and Roy, S.(2018),”THE RISKS AND BENEFITS OF USING AI TO DETECT CRIME”.
- Soni, V.D., “ROLE OF ARTIFICIAL INTELLIGENCE IN COMBATING CYBER THREATS IN BANKING” Engineering Journal For Research And Development, E-ISSN NO:-2349-0721 ,Vol.4,Issue 1.
- Dash, B., Ansari,M.F.,Sharma,P.k and Ali,A.(2022)”THREATS AND OPPORTUNITIES WITH AI-BASED CYBER SECURITY INTRUSION DETECTION: A REVIEW” International Journal of Software Engineering & Applications(IJSEA),Vol.13,No.5.

# A PRE-TRAINED CONVOLUTIONAL NEURAL NETWORK-BASED MODEL FOR SKINDISEASECLASSIFICATION

**Nikita Kashyap,**

Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India.  
(nikita2010k@gmail.com)

**Arun Kumar Kashyap,**

Govt. E Raghavendra Rao PG. Science College, Bilaspur, Chhattisgarh, India.  
(akkbiotech@gmail.com)

Skin diseases pose significant challenges in healthcare diagnosis, necessitating efficient and accurate classification methods. In this study, we propose a novel approach for skin disease classification using pre-trained Convolutional Neural Networks (CNNs) – specifically, the VGG19 and ResNet-50 architectures. The utilization of pre-trained models enhances the model's ability to extract relevant features from dermatological images, facilitating improved classification accuracy. The VGG19 and ResNet-50 architectures serve as powerful feature extractors, capturing intricate patterns and textures crucial for discriminating between different skin conditions. The models are fine-tuned on a comprehensive dermatological dataset to adapt to the nuances of skin diseases, ensuring robust performance. The primary objective of our project was to categorize five different skin illnesses using input images. By providing our model with pictures of affected skin regions, we aimed to detect ailments like Eczema, Nail fungus, Melanoma, Bullous, and Vascular Tumor. The classification accuracy, precision, and recall metrics showcase the model's proficiency in accurately identifying various skin diseases. This streamlined approach significantly aids in timely and accurate diagnosis, crucial for early intervention and treatment of various skin conditions.

**Keywords:** skin disease, deep learning, convolutional neural network, Image processing.

## 1. INTRODUCTION

Skin diseases are highly prevalent worldwide, necessitating dermatologists to possess extensive knowledge and precision in their diagnoses. It has become increasingly common and pose a significant threat if left untreated. In India, a large segment of the population suffers from severe skin conditions, which can inflict significant emotional and psychological distress, surpassing the physical impacts (Kavita et al., 2017 & Jagtap et al., 2021). People often underestimate the seriousness of these conditions and resort to household remedies, which may worsen the problem if not suitable. The spread of skin diseases from person to person is also a concern, highlighting the need for early control and prevention. The impact of these diseases extends beyond physical harm, affecting mental health and self-esteem, making them a prominent public health issue (Yew et al., 2020). The financial burden of treating even minor skin issues adds strain to families, as they must allocate limited resources to cover medical expenses, often compromising their ability to afford necessities like food.

Numerous studies have focused on identifying skin conditions, including skin cancer and tumors. However, accurate diagnosis remains challenging due to factors such as poor lesion-to-skin contrast and visual similarities between affected and unaffected areas (Jagtap et al., 2021). To address this, a computer-aided skin disease diagnostic model is proposed, aiming to provide unbiased and reliable assessments. System has been developed that utilizes patient-provided images of infected skin to identify diseases and provide appropriate treatments or advice. The prototype employs image processing techniques to analyze the input image and displays the detected disease as the output.

## 2. LITERATURE REVIEW

Numerous researchers have advocated for diverse applications of deep learning in image processing for the identification of various skin disorders. Shanthi et al. (2020) introduced a novel convolutional neural network (CNN) architecture capable of identifying four specific classes—acne, keratosis, Eczema herpeticum, and urticaria—from the DermNet dataset. Their study demonstrated an enhanced accuracy in recognizing skin conditions, ranging from 98.6% to 99.04%.

Additional contributions by Velasco et al. (2023) and Agarwal et al. (2023) delved into the integration of transfer learning to improve classification performance across diverse datasets in dermatology. Transfer learning proves particularly beneficial in scenarios where acquiring a large and varied labeled dataset is challenging. The studies

showcased the model's remarkable ability to accurately classify various skin diseases, leveraging pretrained CNNs to expedite training and capture intricate patterns specific to skin pathology.

**Bhadoria et al. (2020)** proposed an effective skin disease classification approach, leveraging pretrained CNNs and transfer learning. The research emphasized the model's proficiency in utilizing knowledge from large datasets for general image recognition tasks, especially advantageous in the context of dermatology where obtaining diverse labeled datasets is difficult. Rigorous evaluations on relevant dermatological datasets highlighted superior performance in disease classification.

**Alenezi et al. (2019)** and **Hameed et al. (2018)** introduced a method using pre-trained CNNs and SVM for disease detection, showcasing the model's effectiveness through extensive experimentation on diverse datasets. Integration of attention mechanisms enhanced feature extraction, resulting in state-of-the-art performance. **Chen M. et al. (2020)** proposed a real-time and dynamic system for skin disease detection, combining self-learning with a data filter algorithm to enhance network efficiency. LeNet-5, AlexNet, and VGG-16 models were employed, with communication delays assessed for authenticity and dependability.

**Liao et al. (2016)** suggested a deep CNN-based approach using advanced architectures like VGG-16, VGG-19, and GoogleNet, comparing their performances on Dermnet and OLE datasets. **Srinivasu et al. (2021)** coupled MobileNet V2 and LSTM to classify skin diseases with an 85% claimed accuracy using the HAM10000 dataset. They also proposed a web application for skin lesion classification.

**Rao et al. (2021)** aimed to detect common skin lesions using a novel approach involving pre-processing, deep learning algorithms, model training, and classification. Their experiments on over 10,000 images achieved a 93% accuracy for seven-class classification using CNNs with the Keras Application API.

**Nigar et al.'s (2020)** latest findings focused on addressing the black-box nature of deep learning models by incorporating visualization techniques and attention mechanisms for interpretability. The trend towards multimodal techniques combining imaging and clinical data, along with explainable AI approaches, aims to ensure a clear decision-making process for healthcare experts. However, challenges like the need for extensive datasets, ethical concerns, and real-world validation persist. These collective studies represent a promising advancement in utilizing deep learning for skin disease diagnosis, showcasing technological developments and a growing understanding of real-world applications in clinical settings.

### 3. EXPERIENTIAL WORK

The procedure begins with the collection of the dataset. The following step is to perform Image processing, which includes Image resizing, segmentation and filtering. The skin disease is then predicted using the Pre-trained Convolutional Neural Network:VGG19 and ResNet-50. The block diagram of the system is shown in Figure 1.

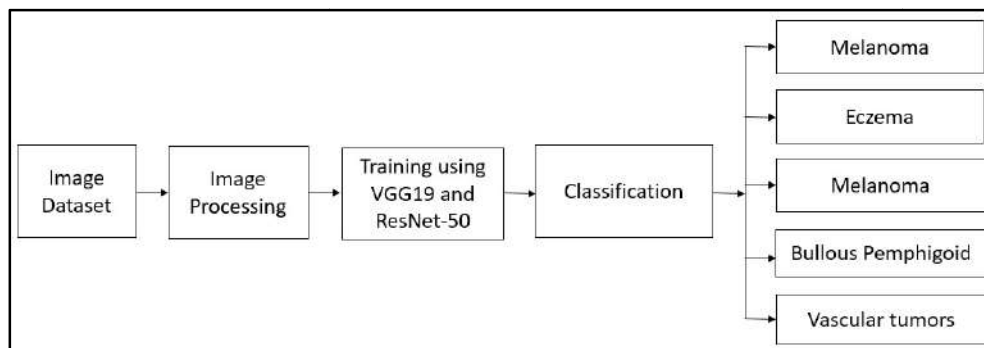


Figure 1:Block Diagram of Proposed System

#### 3.1 Data Set

We prepared our dataset by gathering photos from two distinct sources named DermNet and HAM10000. From these datasets, five specific types of skin diseases: Melanoma, Eczema, Nail fungus, Bullous Pemphigoid, and Vascular Tumors, have been sorted and separated. Additionally, all images include demographic details of the respective patients, encompassing gender and age. The anatomical location of the potentially diagnostically relevant lesion is also provided. To partition the dataset for model training and evaluation, we employed the hold-out technique. Specifically, 70% of the dataset was randomly selected as a training set to facilitate the training of all tested models. The remaining 30% of the dataset was divided into the validation and testing sets. This strategic



division ensured that the models were evaluated on new data that had not been encountered during the training phase. For a concise overview of the dataset's different classes, refer to Table 1. Additionally, Figure 2 presents samples of skin lesion images from various classes within the utilized dataset.

	<b>Melanoma</b>	<b>Eczema</b>	<b>Nail Fungus</b>	<b>Bullous Pemphigoid</b>	<b>Vascular tumors</b>	<b>Total</b>
<b>Training images</b>	2578	1590	858	434	478	5938
<b>Validation images</b>	487	320	197	107	115	1226
<b>Test images</b>	60	40	30	20	25	175



**Figure 2:** Sample Images of Dataset: (a) Melanoma, (b) Eczema, (c) Nail fungus, (d) Bullous Pemphigoid, and (e) Vascular Tumors.

### 3.2 Image processing

Image preprocessing is a crucial step in preparing dermatoscopic images from the HAM10000 dataset for effective use in skin disease classification models. The three main stages of image preprocessing for this dataset typically include:

**3.2.1 Image Resizing:** Dermatoscopic images in the HAM10000 dataset may have varying resolutions, and resizing is essential to ensure uniformity and computational efficiency during model training. Resizing involves adjusting the dimensions of each image to a standardized size, commonly used in the chosen convolutional neural network (CNN) architecture. A common practice is to resize images to a square shape, preserving the aspect ratio to prevent distortion. This standardization facilitates consistent processing and helps the model learn features efficiently across all images in the dataset.

**3.2.2 Segmentation:** Segmentation involves isolating regions of interest within the dermatoscopic images. In the context of skin disease classification, segmentation can be particularly useful for extracting specific lesions or areas indicative of the targeted skin conditions. Automated or semi-automated segmentation techniques can be applied to identify and isolate relevant structures, enhancing the model's ability to focus on critical features. Properly



segmented images contribute to the model's precision in capturing disease-specific patterns and textures, reducing noise and irrelevant information.

**3.2.3 Filtering:** Filtering techniques are applied to enhance or suppress certain image features, contributing to improved feature extraction during model training. In dermatoscopic images, filtering may involve noise reduction, edge enhancement, or emphasizing specific textures associated with skin conditions. Common filters include Gaussian filters for smoothing, Sobel filters for edge detection, or texture-based filters. Filtering aims to improve the clarity and informativeness of the images, aiding the model in learning discriminative features for accurate classification.

Implementing these three main stages of image preprocessing on the HAM10000 dataset ensures that the input data is standardized, relevant features are extracted, and noise is minimized. This optimized dataset can then be fed into a skin disease classification model, enhancing its ability to learn and generalize across various dermatological conditions.

### 3.3 Convolution Deep Learning Model for Feature Extraction Process

With the preprocessed images, the VGG19 and ResNet-50 architectures are leveraged for feature extraction. In the following, the architecture of these models is briefly outlined.

#### VGG19

VGG19 is a convolutional neural network (CNN) architecture that emerged from the Visual Geometry Group at the University of Oxford. It was designed for the ImageNet Large Scale Visual Recognition Challenge (ILSVRC) in 2014. What distinguishes VGG19 is its deep structure, comprised of 19 layers. Among these layers, 16 are convolutional layers and the remaining 3 are fully connected layers. The convolutional layers utilize small 3x3 filters, while max-pooling layers with 2x2 filters are employed to downsample spatial dimensions.

The architecture unfolds as follows:

- **Input Layer:** Accepts RGB images with dimensions 224x224x3.
- **Convolutional Layers:** A stack of 16 convolutional layers, each featuring 3x3 filters and ReLU activation functions.
- **Max Pooling:** Applied after every pair of consecutive convolutional layers.
- **Fully Connected Layers:** The architecture concludes with three fully connected layers, culminating in the final output.

VGG19 played a pivotal role in advancing deep learning for image recognition, particularly in its era. While newer architectures like ResNet, Inception, and EfficientNet have since surpassed VGG models in terms of performance, VGG models continue to be studied for their simplicity and serve as benchmarks in the field of computer vision.

#### ResNet-50

ResNet-50 stands as a convolutional neural network (CNN) architecture within the ResNet family, a groundbreaking development by Microsoft Research outlined in the paper "Deep Residual Learning for Image Recognition" from 2015. This architectural paradigm aimed to surmount challenges associated with training exceptionally deep neural networks.

The distinguishing feature of ResNet is the incorporation of residual blocks, introducing skip connections or shortcuts. These connections allow the network to bypass one or more layers during training, enabling the model to learn residual functions. This mechanism mitigates the vanishing gradient problem and facilitates the training of deeper networks.

Outlined below is a concise summary of ResNet-50:

- **Input Layer:** Designed to handle RGB images, typically of size 224x224x3.
- **Initial Convolutional Layer:** A 7x7 convolutional layer equipped with 64 filters, followed by batch normalization and ReLU activation.
- **Residual Stages:** The network is segmented into various residual stages, each containing multiple residual blocks.
- **Residual Blocks:** These blocks consist of stacked convolutional layers, often utilizing 3x3 filters. The skip connection incorporates the input with the output of the convolutional layers.
- **Pooling Layers:** Max pooling is employed after specific residual blocks to reduce spatial dimensions.
- **Fully Connected Layer:** The conclusive layer for classification, featuring softmax activation.

ResNet-50, along with the broader ResNet architecture, has made a substantial impact in the realm of deep learning. The introduction of residual connections has paved the way for effectively training extremely deep networks, leading to enhanced performance across diverse computer vision tasks. Notably, ResNet-50 is frequently employed as a pre-trained model for transfer learning, where the model undergoes fine-tuning on a specific task using a more limited dataset.

In the process of feature extraction and classification using the VGG19 and ResNet-50, the first step involves importing the necessary libraries and loading the dataset. Subsequently, feature extraction begins with the application of pre-trained VGG19 and ResNet-50 models, initialized with weights from ImageNet. The fully connected layers are removed, leaving the convolutional bases intact. Dermatoscopic images are then processed through the modified architectures, and the resulting feature vectors are flattened to capture relevant information. The extracted features from both VGG19 and ResNet-50 are concatenated, forming a comprehensive feature vector that encapsulates a diverse range of image characteristics. A classification head is added to the model, consisting of fully connected layers with appropriate activation functions, and an output layer tailored to the number of skin disease classes for classification. Following this, the model undergoes training on the designated training set, with validation on a separate set to monitor performance. The model's weights are fine-tuned based on the dermatological dataset.

### 3.4 Evaluation metrics

Evaluation of the VGG19 and ResNet-50 models are conducted on the test set to measure classification performance, utilizing metrics such as accuracy, precision, recall, and F1-score by following formulae:

$$Precision = \frac{TP}{TP + FP} \tag{1}$$

$$Recall = \frac{TP}{TP + FN} \tag{2}$$

$$F1\ Score = 2 * \frac{P * R}{P + R} \tag{3}$$

$$Accuracy = \frac{TP + TN}{TP + FP + FN + TN} \tag{4}$$

Where TP represents True Positive, FP represents False Positive, TN represents True Negative and FN represents False Negative. Similarly, P, R, represents precision and recall respectively.

## 4. RESULTS

The skin diseases classification model, utilizing pre-trained Convolutional Neural Networks (CNNs) VGG19 and ResNet-50, has exhibited noteworthy outcomes in its implementation on the DermNet and HAM10000 datasets. This dataset encompasses a diverse range of dermatoscopic images, encompassing conditions like Melanoma, Eczema, Nail Fungus, Bullous, and Vascular Tumors.

The amalgamation of VGG19 and ResNet-50 architectures played a pivotal role in empowering the model to extract varied and informative features from dermatological images, thereby enhancing its capacity to discern distinct skin conditions. The integration of features from both networks proved to be particularly effective in capturing intricate patterns, textures, and lesion characteristics crucial for precise diagnosis. Table 2 shows performance evaluation results for both the Model- VGG19 and ResNet 50.

**Table 2: Test Performance of Skin Disease Detection System**

	Model	Melanoma	Eczema	Nail Fungus	Bullous Pemphigoid	Vascular tumors
<b>Precision (%)</b>	VGG19	92.39	85.56	81.67	80.93	81.98
	ResNet 50	98.96	93.12	89.03	88.14	88.12
<b>Recall (%)</b>	VGG19	86.15	81.32	79.95	78.92	75.71
	ResNet 50	95.00	88.92	85.01	85.12	82.82
<b>F1-score (%)</b>	VGG19	86.23	82.90	79.52	80.63	78.68
	ResNet 50	96.00	90.89	85.82	86.90	84.56
<b>Accuracy (%)</b>	VGG19	85.08	82.07	81.35	80.30	79.12
	ResNet 50	97.04	91.07	87.32	85.84	83.90

From Table 2, it can be observed that the value of accuracy, precision, recall, and F1-score are higher in the case of the ResNet 50 Model which means ResNet 50 provide better performance than VGG19 Model.

The performance matrix of our system is shown in the graph Figure 3. Examining the graph reveals that a substantial portion of the predictions align accurately with the designated categories, with only a minimal number of inaccuracies.

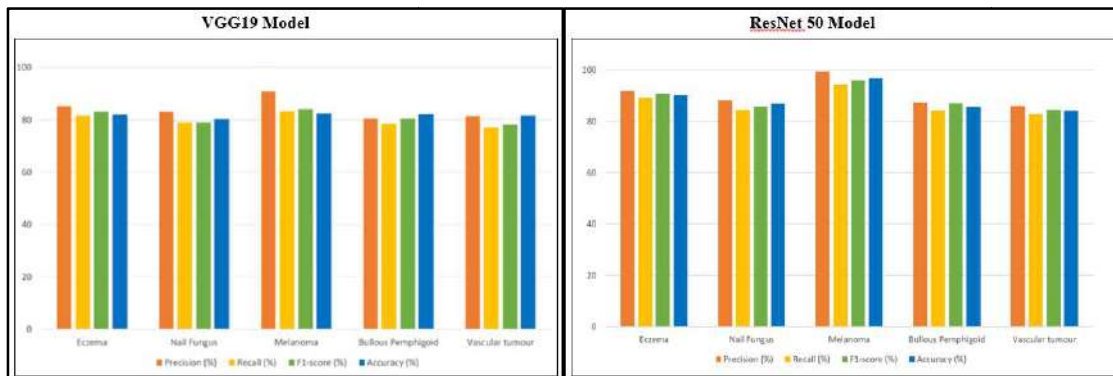


Figure 3: Performance Graph

## 5. CONCLUSION

In conclusion, the implementation of a skin diseases classification model utilizing pre-trained Convolutional Neural Networks VGG19 and ResNet-50 has shown promising results. The model's capacity to extract intricate features from dermatological images contributed to its high accuracy and effectiveness in distinguishing various skin conditions. The VGG19 and ResNet-50 architectures proved beneficial, highlighting the importance of leveraging pre-trained models for enhanced diagnostic capabilities in dermatology. However, these promising outcomes should be viewed as a foundation for ongoing refinement and validation. Future exploration could encompass the investigation of additional preprocessing techniques, fine-tuning of model parameters, and expansion of the dataset to ensure the model's adaptability to a broader spectrum of dermatological cases. Additionally, integrating explainability techniques for model interpretability and conducting clinical validations would contribute to the model's practical utility within healthcare contexts.

## REFERENCES

- Agarwal, Raghav & Godavarthi, Deepthi. (2023). Skin Disease Classification Using CNN Algorithms. *EAI Endorsed Transactions on Pervasive Health and Technology*. Vol. 9.
- Alenezi, Nawal. (2019). A Method of Skin Disease Detection Using Image Processing And Machine Learning. *Procedia Computer Science*. 163. 85-92. 10.1016/j.procs.2019.12.090.
- Bhadoria, Riddhi & Biswas, Suparna. (2020). A Model for Classification of Skin Disease Using Pretrained Convolutional Neural Network. 10.1007/978-981-15-2188-1\_14.
- Blum A., C.U. Brand, U. Ellwanger, B. Schlagenhauff, W. Stroebel, G. Rassner, C. Garbe. (1999). Awareness and early detection of cutaneous melanoma: an analysis of factors related to delay in treatment. *British Journal of Dermatology*, 141 (5), 783–787.
- Chen M., Zhou P., Wu D., Hu L., Hassan M.M., Alamri A. (2020). AI-skin: Skin disease recognition based on self-learning and wide data collection through a closed-loop framework. *Inf. Fusion*, 54, 1-9
- Hameed, Nazia & Shabut, Antesar & Hossain, Alamgir. (2018). Multi-Class Skin Diseases Classification Using Deep Convolutional Neural Network and Support Vector Machine. 1-7. 10.1109/SKIMA.2018.8631525.
- Jagtap T.K., Shinde H.P., Gaware O.V., Maurya S.R. (2021). Skin Disease prediction. *IJARIE*, 7 (3), ISSN(O)-2395-4396.
- Kavita, Thakur JS, Narang T. (2017). The burden of skin diseases in India: Global burden of disease study. *Indian J Dermatol Venereol Leprol*, 89, 421-5.
- Liao, Haofu. (2016). A deep learning approach to universal skin disease classification. *University of Rochester Department of Computer Science, CSC*.
- N. Nigar, M. Umar, M. K. Shahzad, S. Islam and D. Abalo. (2022). A Deep Learning Approach Based on Explainable Artificial Intelligence for Skin Lesion Classification. *IEEE Access*, 10, 113715-113725, doi: 10.1109/ACCESS.2022.3217217.
- Rao K. S., Yelkar P.S., Pise O. N., Borde S., (2021). Skin Disease Detection using Machine Learning, *International journal of engineering research & technology (IJERT)* NTASU, 09 (03).
- Shanthi T., Sabeenian R.S., Anand R. (2020). Automatic diagnosis of skin diseases using convolution neural network. *Microprocessors and Microsystems*, 76, 103074.
- Srinivasu P.N., SivaSai J.G., Ijaz M.F., Bhoi A.K., Kim W., Kang J.J. (2021). Classification of skin disease using deep learning neural networks with MobileNet V2 and LSTM. *Sensors*, 21 (8), p. 2852.
- Velasco Jessica S., Catipon Jomer V., Monilar Edmund G., Villamor M. Amon, Glenn C. Virrey, Lean Karlo S. Tolentino. (2023). Classification of Skin Disease Using Transfer Learning in Convolutional Neural Networks. *International Journal of Emerging Technology and Advanced Engineering*, 13 (04).
- Yew YW, Kuan AHY, Ge L, Yap CW, Heng BH. (2020). Psychosocial impact of skin diseases: A population-based study. *PLoS ONE* 15(12): e0244765.

# ALGO TRADING: TRANSFORMATION OF TRADING TECHNIQUES TO USES OF ARTIFICIAL INTELLIGENCE IN THE SECURITIES MARKET

**Manharan Anant,**

Govt Naveen College, Jatga, Korba, Chhattisgarh, India.  
([anantmanna@gmail.com](mailto:anantmanna@gmail.com))

**Gaurav Sahu,**

Atal Bihari Vajpayee University, Bilaspur, Chhattisgarh, India.  
([gauravsahu296@gmail.com](mailto:gauravsahu296@gmail.com))

**Kalpana Kanwar**

Govt E.V.P.G. College, Korba, Chhattisgarh, India.  
([kkanwar.kanwar@gmail.com](mailto:kkanwar.kanwar@gmail.com))

Artificial Intelligence (AI) means making machines think, learn, and process information like humans. The goal is to create systems that can do tasks that usually need human intelligence. AI is commonly used in tasks with a defined process, like manufacturing cars, processing food, or packing goods. It covers various technologies and can be categorized into two types: narrow AI, which is specific to particular tasks, and strong AI, which aims to have human-like abilities. In the technology-driven world, AI, especially in the form of algorithmic trading, has become crucial in financial markets. It provides advanced tools to analyze data, make predictions, and execute trades in stock markets.

Algorithmic trading, or algo trading, is when computers use algorithms to automate trading financial assets like stocks, commodities, bonds, or currencies. The main goal is to execute trades at specific prices based on predefined criteria and market momentum. Algo trading has gained popularity due to its ability to execute trades quickly, accurately, and efficiently. However, it comes with challenges, including the need for effective risk management, technical expertise, and ethical considerations, especially in high-frequency trading. While algorithmic trading brings precision to trading, it poses challenges for retail traders and investors. It's a powerful tool that has transformed the financial landscape, providing both opportunities and complexities in the ever-evolving global markets.

**Keywords:** Algo Trading, Artificial Intelligence, Securities Market, SEBI,

## 1. Introduction:

Algorithmic trading, or algo trading, started in the early 1970s when electronic stock exchanges began. The NASDAQ, launched in 1971, was the first electronic stock market, replacing traditional trading methods with automated systems. This led to the development of algorithms that could trade faster and more efficiently than manual methods. Over time, algo trading evolved due to advancements in computer technology, financial modeling, and quantitative analysis. Today, it is a vital part of global financial markets, used by big investors, hedge funds, and individual traders to make trades, manage portfolios, and implement various trading strategies.

Algo trading includes different strategies, from simple rule-based algorithms to complex machine learning models. These algorithms are designed to make trades based on factors like price changes, market trends, statistical patterns, and economic indicators. High-frequency

trading (HFT) is a specific type of algo trading that involves making a large number of trades very quickly, often within microseconds. Algo trading helps with risk management and optimizing portfolios, giving investors control over trade details to manage risks and achieve financial goals. It is used in various asset classes, including stocks, bonds, currencies, and commodities.

The regulatory body Securities and Exchange Board of India (SEBI) have set guidelines to regulate algo trading. These rules aim to ensure fair markets, transparency, and integrity, addressing concerns like market manipulation and systemic risks. The benefits of algo trading include improving market liquidity, speeding up trade execution, and creating opportunities for arbitrage and market-making. However, there are challenges, such as biases in algorithms, vulnerabilities in systems, and the potential for market disruptions. Striking a balance between innovation and risk management is crucial. Algo trading is not limited to big players; it's now accessible to everyday traders through online platforms. As technology advances and data-driven decisions become more crucial in financial markets, algo trading is expected to have an even more significant impact on the future of trading and investing.

## **2. Review of literature:**

1. Algorithms using artificial intelligence (AI) can improve liquidity and make trading information more useful. To attract these algorithms, trading venues can reduce the costs of developing and implementing them. For instance, exchanges can provide useful information to algorithms at a low cost. Allowing algorithmic traders to place their servers in the market's data center is another way to attract them. Additionally, offering various order types, like pegged orders, can help ease the infrastructure pressures that algorithms might bring (Hendershott, T., Jones, C. M., & Menkveld, A. J. 2011).

2. Researchers studied the impact of changing stock prices from fractions to decimals on daily transaction volume and volatility in the stock market. Their findings suggest that decimalization increased daily transaction volume and decreased intraday volatility. This indicates that moving to decimal pricing had a significant effect on how people trade and how the market behaves, making it more efficient and liquid (Talukdar, B., Bhuyan, R., Hamid, S. S., & Zhao, L. 2022).

3. Another study looked into how seasonal patterns affect how accurately analysts can predict a company's future performance. The research shows that seasonal factors influence analysts' ability to forecast accurately. The study emphasizes the importance of considering seasons when analyzing financial data to improve forecasting models' accuracy (Ayres, D., & Dolvin, S. 2022).

4. A research paper explored how algorithmic trading affects the liquidity of financial markets. The findings suggest that algorithmic trading can have both positive and negative effects on market liquidity. While it can improve liquidity by increasing market participation and reducing bid-ask spreads, it may also contribute to liquidity deterioration during volatile market conditions (Hendershott, T., & Riordan, R. 2013).

5. A study focused on how transaction fees impact market liquidity. The researchers found that when market makers pay fees for liquidity-taking orders, it can lead to more price competition, higher trading volumes, and improved liquidity. On the other hand, when market makers charge fees for liquidity-providing orders, it can reduce trading volumes and liquidity (Foucault, T., Kadan, O., & Kandel, E. 2013).

6. The research paper discusses the impact of artificial intelligence (AI) on security. It suggests that AI has the potential to significantly change the nature of security threats and defenses in the future. AI can create new security technologies but may also pose new risks, such as AI-powered cyber-attacks. Policymakers and security experts need to stay ahead of these developments and consider the ethical and strategic implications of AI in security (Sweijts, T. 2018).

7. The research paper "Foundations of Technical Analysis: Computational Algorithms, Statistical Inference, and Empirical Implementation" looks into using computational algorithms and statistical methods in technical analysis of financial markets. The authors provide an overview of how these techniques are applied, contributing to a better understanding of technical analysis in financial markets (Lo, A. W., Mamaysky, H., & Wang, J. 2000).

8. "Algorithmic Trading in the Foreign Exchange Market" explores the growing influence of algorithmic trading on the foreign exchange market. The authors find that algorithmic trading has become increasingly prevalent in high-frequency trading and has impacted market dynamics. The paper raises questions about its effects on market functioning and efficiency (Chaboud, A. P., Chiouine, B., Hjalmarsson, E., & Vega, C. 2014).

9. This research paper examines the implications of artificial intelligence in today's digital economy. It highlights the growing influence of algorithms in various aspects of our lives and raises important questions about their impact on society. The paper urges for a more comprehensive understanding of AI and its consequences, emphasizing the need for critical perspectives and ethical considerations (Prodnik, J. A. 2021).

10. The research paper provides a detailed examination of using advanced mathematical techniques in algorithmic trading. It explores how stochastic control and mutually exciting processes can be applied to develop more effective trading strategies. The authors aim to contribute to the advancement of algorithmic trading methodologies (Cartea, Á., Jaimungal, S., & Ricci, J. 2018).

11. This research paper examines the impact of high-frequency trading firms being physically close to stock exchanges on market liquidity. The study finds that being in close proximity to the exchange significantly improves liquidity for certain stocks. However, the benefits are less pronounced for other stocks. Overall, the research highlights the varying effects of proximity on liquidity and provides insights into high-frequency trading and market quality (Brogaard, J., Hagströmer, B., Nordén, L., & Riordan, R. 2015).

### **3. Evolution of Algo Trading:**

Algorithmic trading, or algo trading, has evolved in several stages:

1. Early Automation (1970s-1990s): Algo trading started when electronic exchanges like NASDAQ began in 1971. Early algorithms focused on automating manual trading tasks, especially order execution.

2. Rise of High-Frequency Trading (HFT): In the late 20th and early 21st centuries, there was a shift to high-frequency trading. This involves algorithms making a lot of trades very quickly,



often within microseconds, to take advantage of small price differences and market inefficiencies.

3. Advancements in Technology (2000s-Present): Technology got better, with more computing power and faster networks. This allowed the development of complex algorithms that could analyze large amounts of market data, use sophisticated strategies, and adapt to changing market conditions in real-time.

#### **4. Challenges of Algo Trading:**

1. Biases in Algorithms: Algorithms might unintentionally include biases from past data, leading to unfair outcomes. It's crucial to address these biases to make sure trading practices are fair.

2. Worries About Market Manipulation: Algorithms work fast and deal with a lot of data, which raises concerns about manipulating the market. Global regulators have put in measures to find and stop any unfair practices in algo trading.

3. Risks in Operations: Because algo trading depends on technology, there are risks like technical problems, connection issues, and mistakes in data. To manage these risks well, having strong plans and making sure systems can handle challenges is very important.

4. Regulation Challenges: As algo trading grows quickly, regulators need to keep up by making and adjusting rules to keep the market fair and stable. This balancing act between allowing innovation and keeping an eye on the market is an ongoing challenge.

5. Big Risks for the Whole System: Because financial markets are connected, and many use algo trading, there's a higher chance of big risks affecting the entire system. Sudden problems in one part of the financial system can spread to other areas.

6. Adapting to Changes in the Market: Algo trading systems must quickly adjust to shifts in the market. Making sure algorithms keep working well and making a profit in a changing environment needs constant monitoring and tweaking.

7. Lack of Transparency: Some advanced algorithms are not easy to understand, and this lack of transparency is a problem. Regulators and market players want to know how algorithms make decisions, so more clarity is important for everyone involved in algo trading.

In dealing with these challenges, the future of algo trading will involve more tech improvements, better teamwork between those in the market and regulators, and a strong commitment to using algorithms responsibly and ethically in financial markets.

#### **5. Use of Artificial Intelligence in trading:**

Artificial Intelligence (AI) has changed how trading works by using smart tools and methods that use computer learning, data analysis, and lots of computing power. AI in trading covers different parts of finance, like using computer programs to trade, manage risks, and make decisions. Here are some important points about how AI is used in trading:

1. **Algorithmic Trading:** AI helps a lot in algorithmic trading. This means using smart computer programs to trade based on certain rules or learning from past data. Programs can change and get better over time using machine learning, like neural networks and decision trees.
2. **Predictive Analytics:** AI is used to predict what might happen in the market, like trends, prices, and good trading chances. It looks at big sets of data and finds patterns to make predictions. This helps traders make smarter choices.
3. **Quantitative Analysis:** AI makes analyzing data easier and faster. It looks at big sets of data, finds patterns, and gives insights that might not be easy to see without computers.
4. **Risk Management:** AI helps manage risks better by looking at market conditions, what's in a portfolio, and other factors. It uses machine learning to find the best balance between risk and return and reduce exposure to unexpected events.
5. **Natural Language Processing (NLP):** AI uses NLP to understand and get insights from things like news, social media, and financial reports. Traders can use this info to understand market feelings and make choices based on what people are saying.
6. **Sentiment Analysis:** AI tools analyze feelings in the market by looking at text data. This helps traders predict market moves based on how people feel.
7. **Fraud Detection and Compliance:** AI is used to find fraud and make sure everyone follows the rules. It looks for strange patterns or behaviors in trading to keep an eye on things.
8. **High-Frequency Trading (HFT):** AI is very important in high-frequency trading, where speed is super important. HFT firms use smart AI models to trade really quickly and take advantage of very small chances in the market.
9. **Portfolio Management:** AI helps make portfolios better by suggesting things like how much to invest in different assets, when to change things, and what decisions to make based on past performance and market conditions.
10. **Robo-Advisors:** AI-driven robo-advisors use computer programs to give automated investment advice. They use AI to create and manage different investment plans based on what each investor wants.

Even though AI has lots of benefits, there are challenges too, like making sure it's fair, dealing with biases in the computer programs, and explaining how the AI makes decisions. As technology gets better, AI will keep growing in trading, bringing more chances and things to think about for people in the market.

## **6. Algorithmic Trading Adoption in India:**

The regulatory body, SEBI, introduced guidelines in 2010 to ensure fair markets. Key players, like institutional investors and brokerages, actively use algorithms for different strategies, especially in the stock market. Technology, like fast data feeds, supports this growth. High-frequency trading (HFT), where algorithms make many quick trades, is common. Algorithmic

trading has improved overall market liquidity and efficiency. Various strategies, like market-making and trend following, are used. Efforts are made to make algorithmic trading accessible to regular investors too. SEBI regularly updates regulations to keep up with changes and ensure responsible practices.

Artificial intelligence (AI) is becoming more popular in India's stock market. Big players, like institutional investors and brokerages, use AI for trading, predicting trends, managing risks, and optimizing portfolios. SEBI, the regulatory body, guides the use of AI to ensure it's done responsibly. AI technologies, such as machine learning and natural language processing, help analyze market sentiment, detect fraud, and ensure compliance. The use of AI has boosted market efficiency, liquidity, and the development of advanced trading strategies. This marks a significant change in how India's financial markets operate.

### **7. Opportunities of Algo Trading:**

1. **Efficiency and Speed:** Algo trading makes trades quick and efficient, avoiding mistakes and delays. It can execute complex plans very fast, taking advantage of good chances in the market.
2. **Liquidity Improvement:** Algo trading adds more money flow in the market because algorithms quickly match people wanting to buy with those wanting to sell. This helps traders by making it cheaper to buy or sell a lot of shares.
3. **Diversification of Strategies:** Traders can use many different plans with algorithms, like following trends, using statistics, or being market-makers. This variety helps manage risks better and adapt to different market situations.
4. **Access to Global Markets:** Algo trading lets people trade in markets around the world easily. This allows diversifying investments in different types of assets and regions.
5. **Risk Management:** Algorithms can automatically manage risks by setting rules for how much risk to take and when to stop trading. This helps avoid big losses and keeps a disciplined approach to trading.
6. **Increased Market Efficiency:** Algo trading makes markets work better by quickly adjusting to new information and reacting to market changes in real-time. This means prices are more accurate, and markets work smoother.

### **8. Regulatory Considerations on Algo Trading in India:**

In India, the Securities and Exchange Board of India (SEBI) oversees algo trading and has set rules to make sure it's fair, transparent, and managed well. These rules were introduced in 2010, and they require anyone involved in algo trading to follow certain guidelines, including controlling risks, managing the number of orders to trades, and having monitoring systems. The goal of these guidelines is to prevent any cheating in the market, keep the market honest, and make sure everyone has a fair chance. SEBI keeps updating these rules to deal with new problems and changes in technology. Following SEBI's rules is very important for anyone involved in algo trading in India. It helps make sure that algo trading is done safely and smoothly while reducing possible risks.

### **9. Future Trends and Implications:**

Looking ahead, algo trading in India has some exciting trends and effects. With ongoing progress in artificial intelligence and machine learning, algorithms used for trading are expected to get even better at managing risks and making trades more efficiently. More people are likely to join algo trading, especially regular investors, because technology is making it easier for them. Regulators and those involved in the market will work together to make rules that keep the market fair. Algorithms will also start considering things like the environment, social issues, and good governance, following what's happening globally. Even though these changes can help the market grow, there are still challenges, like biases in algorithms, lack of transparency, and ethical concerns. This makes it crucial for regulators to keep adapting rules responsibly to make sure algo trading is fair and trustworthy.

### **10. Conclusion:**

The combination of AI and algo trading has changed how trading works in India. This shift is a big change, affecting how trades are done, portfolios are managed, and how the market responds. As more people use algo trading, the financial markets in India are changing a lot. This brings both good and challenging things. A key point in wrapping up algo trading in India is the strong impact of AI on trading methods. AI, which includes machine learning and data analysis, has made algorithms smarter. These algorithms can now handle complex market situations, adjust to trends, and make decisions based on data. The change brought by algo trading in India is clear in how fast and accurate trades happen. Algorithms can quickly process a lot of market data, making trades happen faster than before. This not only makes the market work better but also lets traders take advantage of quick opportunities and avoid risks.

AI in algo trading has not just sped up trades but also made strategies more varied. Traders can now use different algorithms for different purposes, like making quick decisions, following trends, or analyzing statistics. This variety helps traders adjust their strategies to different market situations, adapting to changes. AI is now crucial in managing risks in algo trading, making it more precise and personalized. Algorithms can automatically change risk settings, set limits on losses, and adjust investment portfolios based on what's happening in the market. This makes trading more disciplined and controlled, reducing risks and improving overall performance. As algo trading becomes more common in the Indian securities market, the rules have also changed. The Securities and Exchange Board of India (SEBI) has set guidelines to control algo trading. These rules aim to keep the market fair, transparent, and following good practices. SEBI is actively working to support innovation while making sure there are rules to follow.

But even with the good changes, challenges are still there. Things like biases in algorithms, ethical concerns, and issues with being transparent and clear are still problems. This means that a careful and flexible approach is needed. Striking a balance between encouraging new ideas and managing risks is crucial for algo trading to keep growing and being stable in India. In summary, putting AI into algo trading has transformed how trading works in India. The future will see more changes, with AI-based strategies evolving to fit the needs of a changing financial world. As traders go through this big change, working together with regulators, industry experts, and technology innovators will be key to creating a responsible and dynamic future for algo trading in India. Moving from old trading methods to using AI in algo trading isn't just a technology upgrade; it's a complete change in how financial markets operate.

### **References:**

- HENDERSHOTT, T., JONES, C. M., & MENKVELD, A. J. (2011). Does Algorithmic Trading Improve Liquidity? *The Journal of Finance*, 66(1), 1–33. <http://www.jstor.org/stable/29789770>
- TALUKDAR, B., BHUYAN, R., HAMID, S. S., & ZHAO, L. (2022). Intraday Transactions, Volume and Volatility in Pre- and Post-Decimalization Regimes. *Quarterly Journal of Finance and Accounting*, 60(3/4), 101–146. <https://www.jstor.org/stable/27224941>
- AYRES, D., & DOLVIN, S. (2022). Seasonality and Analyst Forecasting. *Quarterly Journal of Finance and Accounting*, 60(1/2), 1–28. <https://www.jstor.org/stable/27224932>
- Hendershott, T., & Riordan, R. (2013). Algorithmic Trading and the Market for Liquidity. *The Journal of Financial and Quantitative Analysis*, 48(4), 1001–1024. <http://www.jstor.org/stable/43303831>
- FOUCAULT, T., KADAN, O., & KANDEL, E. (2013). Liquidity Cycles and Make/Take Fees in Electronic Markets. *The Journal of Finance*, 68(1), 299–341. <http://www.jstor.org/stable/23324398>
- Sweijs, T. (2018). Artificial Intelligence and Its Future Impact on Security. Hague Centre for Strategic Studies. <http://www.jstor.org/stable/resrep19348>
- Lo, A. W., Mamaysky, H., & Wang, J. (2000). Foundations of Technical Analysis: Computational Algorithms, Statistical Inference, and Empirical Implementation. *The Journal of Finance*, 55(4), 1705–1765. <http://www.jstor.org/stable/222377>
- CHABOUD, A. P., CHIQUOINE, B., HJALMARSSON, E., & VEGA, C. (2014). Rise of the Machines: Algorithmic Trading in the Foreign Exchange Market. *The Journal of Finance*, 69(5), 2045–2084. <http://www.jstor.org/stable/43612951>
- Prodnik, J. A. (2021). Algorithmic Logic in Digital Capitalism. In P. Verdegem (Ed.), *AI for Everyone?: Critical Perspectives* (pp. 203–222). University of Westminster Press. <http://www.jstor.org/stable/j.ctv26qjjhj.14>
- Cartea, Á., Jaimungal, S., & Ricci, J. (2018). Algorithmic Trading, Stochastic Control, and Mutually Exciting Processes. *SIAM Review*, 60(3), 673–703. <http://www.jstor.org/stable/45109321>
- Brogaard, J., Hagströmer, B., Nordén, L., & Riordan, R. (2015). Trading Fast and Slow: Colocation and Liquidity. *The Review of Financial Studies*, 28(12), 3407–3443. <http://www.jstor.org/stable/43866006>
- Mc Laren, E. (2018). Implementing and comparing various algorithmic trading strategies.
- Mukerji, P., Chung, C., Walsh, T., & Xiong, B. (2019). The impact of algorithmic trading in a simulated asset market. *Journal of Risk and Financial Management*, 12(2), 68.
- Seo, J. Y., & Chai, S. (2013). The role of algorithmic trading systems on stock market efficiency. *Information Systems Frontiers*, 15, 873–888.
- Kutchu, V. (2018). Growth and future of algorithmic trading in india. *Gavesana Journal of Management*, 10(2), 83–93.
- RAMKUMAR, G. (2018). A STUDY ON THE SIGNIFICANCE OF ALGORITHMS TRADINGS IN INDIAN STOCK MARKET.
- Gupta, Anupriya. (2018). Algorithmic trading in India: History, Regulations and Future retrieved from <https://www.quantinsti.com/blog/algorithmic-trading-india>
- Khandelwal, Nitesh, (2018). 3 Myths About Algorithmic Trading retrieved from <http://www.businessworld.in/article/3-Myths-about-Algorithmic-Trading/13-10-2018-162113/>
- Nidhi Aggarwal and Susan Thomas, (2014), The causal impact of algorithmic trading on market quality, IGIDR Working paper retrieved from <http://www.igidr.ac.in/pdf/publication/WP-2014-023.pdf>
- Saravan, P. (2018). Stock Markets: Know how algorithmic trading can benefit individual investors retrieved from

# AN EMPIRICAL ANALYSIS OF MONTH AND TRADING MONTH EFFECTS ON THE BOMBAY STOCK EXCHANGE FOR 2000-2023

Dr Surya Dev,  
IMIS, Bhubaneswar, India  
(suryadev@imis.ac.in)

The Bombay Stock Exchange is the oldest in India. This study examines the impact of the month and trading month on various indices of the Bombay Stock Exchange, including both broad-based market and sectoral indices, from 2000 to 2023. The study uses the closing prices of daily data to calculate log returns and test stationarity through Augmented Dicky Fuller tests. Additionally, the study conducts an Ordinary Least Squares-based regression using dummy variables to evaluate the calendar effects. The study shows that November and December provide higher returns than the other months in the Indian Stock Markets. The presence of the trading month effect is observed across indices.

**Keywords:** Seasonality, Stock Exchanges, Anomalies, Dummy Variables, January effect, Trading Month effect.

## 1. INTRODUCTION

Research on calendar effects related to different stock markets across different countries is well-documented. This research aims to discover how stocks or a group of stocks deviate from the assumptions of the efficient market hypothesis. The researchers have observed seasonal anomalies like the weekend, turn-of-the-month, intra-month, turn-of-the-year, and Halloween effects. The monthly effect exhibits varying returns for different months, with January generally demonstrating higher returns than other months. The studies like Sewraj et al. (2010), Rosa Borges (2009), Floros (2008), Asterioua and Kavestos (2006), Raj and Kumari (2006), Guletkin and Guletkin (1983), Keim (1983), Rozeff and Kinney (1976) confirm the presence of the January monthly effect. Gao and Kling (2005) mention higher returns in China in February and November. Dash, Dutta and Saharwal (2011) and Selvarani and Jeneffa (2009) observe the absence of the January effect but the presence of the monthly effect. Floros (2008) observed the presence of the trading month effect in the Greek markets, i.e. likely higher returns in the earlier days of the month than in the later days. The present study follows the research conducted by Floros (2008), Gultekin and Gultekin (1983), and Selvarani and Jeneffa (2009). This paper investigates the existence of stock market anomalies, i.e., the monthly and trading month effects in the Indian stock market. The data on various indices is collected from the Bombay Stock Exchange daily from April 1, 2000, to 31, March 2023.

The paper is divided further into various sections. Section 2 focuses on the literature review on monthly and trading effects. The section 3 focuses on the data and methodology used in this study. The sections 4 and 5 cover the empirical results and concluding remarks respectively.

## 2. LITERATURE REVIEW

The literature on calendar anomalies shows that various researchers have studied anomalies across various countries. We have classified these papers based on the market where they have been studied, i.e., in the Indian context and other countries' context.

Deyshappriya (2014) studied the stock market anomalies in the Colombo Stock Exchange for 2004-13. He observed a negative Monday effect and a positive January effect, but December did not display negative returns. He applied GARCH models and confirmed the presence of the day-of-the-week and January effects during the war period. Sewraj et al. (2010), using linear regression, GARCH and EGARCH models, found positive January effects in the Stock Exchange of Mauritius.

Rosa Borges (2009) observed lower returns in August and September in her study across 17 European countries from 1994 to 2007. These are country-specific observations. Floros (2008) observed no January effect in the Athens Stock Exchange from 1996-2002. However, the trading month effect is present, i.e., higher returns in the first fortnight of the month. He observed that the crisis had no impact on the calendar effects. Asterioua and Kavestos (2006) found the January effect for eight transition economies: Czech Republic, Hungary, Lithuania, Poland, Romania, Russia, Slovakia and Slovenia from 1991-2003.



In their study, Guletkin and Guletkin(1983) analyzed the returns of January in 17 countries, including the US. They found that the returns were higher in January than in other months. Similarly, Keim (1983) observed the same trend in the portfolio of stocks of small firms. Rozeff and Kinney (1976) conducted a study of the NYSE between 1907 and 1974. They discovered that January had higher returns than other months.

Many studies have also been carried out in India. There are mixed findings on Calendar effects in the Indian capital markets. Harshita, Shveta and Yadav (2019) have found the month-of-the-year effect in India concerning November/December and April/May. Amarnani and Vaidya (2014) studied the day-of-the-week, turn-of-the-month and month-of-the-year effects using daily data of BSE Sensex and NSE Nifty from 1993-2013. Their findings show an absence of the day-of-the-week effect and monthly return effect. Only the turn-of-the-month stands valid. Archana, Mohammed and Kevin (2014), in the study on the Bombay Stock Exchange Index for Jan 2008 to Dec 2012, showed a significant weekend effect, but the turn-of-the-month and turn-of-the-year effects are minimally visible.

Minimol, Makesh, and Radhika(2013) studied the calendar impact on CNX Nifty from 3rd January 2002 to 31st December 2012. They studied the day-of-the-week effect and monthly effect on the National Stock Exchange. They observed that there is a March, September, and December effects. They also observe a day-of-the-week effect as the returns of Monday and Wednesday are found to be significant. Dash, Dutta and Saharwal (2011) have shown monthly return effects on BSE Sensex. It shows positive impacts in November, August and December while negative March effect. They have also found that market crashes reduce seasonal effects.

Selvarani and Jenefa (2009) examined the National Stock Exchange calendar anomalies from 2002 to 2007. They have employed parametric and non-parametric tests to test the equality of mean returns and standard deviations of returns. They observed strong evidence of April and January effects. Raj and Kumari (2006) studied the day-of-the-week and monthly effects on BSE SENSEX and CNX NIFTY for 1987-98 and 1990 -98, respectively. They observed that the negative Monday effect and Positive January effect are not present in the Indian Markets. They find that it is Tuesday that provides negative returns in the Indian markets, and December does not provide negative returns.

Most studies have focussed on broad market indices rather than sectoral indices. This study captures the broad-based indices and a few selected sectoral indices of the Bombay Stock Exchange for 2000-2023.

### 3. Data and Methodology

#### 3.1 Data Set

There are two categories of BSE indices taken in the study. They are broad-based indices and sectoral indices. The broad-based indices used in the study are S&P-BSE-SENSEX, S&P-BSE-100, S & P-BSE 200, and S & P-BSE 500. The sectoral-indices taken in the study are S&P-BSE-Capital Goods, S&P-BSE-Consumer Durables, S&P-BSE-FMCG, S&P-BSE-Healthcare, S&P-BSE-IT, S &P-BSE-PSU, S&P-BSE-Oil Gas, and S&P-BSE-Auto. The period taken in the study is April 1, 2000, till 31st March 2023.

#### 3.2 Methodology

##### Return

In the first instance, the natural logarithm of the daily closing prices is calculated, and then it is followed by the calculation of Return using the formula given in Equation 1.

$$R_t = \ln P_t - \ln P_{t-1} \text{ ----- eq ( i)}$$

Where  $R_t$  = Return of index on day t,  $P_t$  is the price of index on day t;  $P_{t-1}$  is the price of index on day t-1.

##### Stationarity

The calculation of returns is followed by Augmented Dicky Fuller stationarity tests for none, intercept and trend and intercept at level and first differences. The following first difference equations give three possible forms of the ADF test. (Asteriou& Hall, 2011).

$$\Delta P_t = \alpha + \sum_{i=1}^p \beta_i \Delta P_{t-i} + \epsilon_t \text{ ----- (ii)}$$

$$\Delta P_t = \alpha_0 + \alpha_1 P_{t-1} + \sum_{i=1}^p \beta_i \Delta P_{t-i} + \epsilon_t \text{ -----(iii)}$$

$$\Delta P_t = \alpha_0 + \alpha_2 P_t + \alpha_1 P_{t-1} + \sum_{i=1}^p \beta_i \Delta P_{t-i} + \epsilon_t \text{ -----(iv),}$$



where  $R_t$  denotes the variable at time t. These three equations are, however, based on three different assumptions regarding the presence of the deterministic elements  $\alpha_0$  and  $\alpha_2$ . The ADF test procedure has been undertaken by examining the optimal lag length using Schwartz Information Criterion before proceeding to identify the probable order of stationarity.

The null hypothesis states that the series has unit root in other words it is non-stationary, whereas according to the alternative hypothesis the series is assumed to be stationary.

**Ordinary Least Squares Regression Using Dummy Variables**

**Monthly Effect:**

The following model is used to check the monthly effect.

$$R_t = \sum_{i=1}^{12} \alpha_i D_{it} + \alpha_0 + \varepsilon_t \text{-----(v)}$$

Where,

$R_t$  =Return of index on day t

$D_{it}$  =1 if the Return at time t belongs to month i or 0 if any other month

$\alpha_i$  =Mean return of the month i

$\varepsilon_t$  =Error term.

The null hypothesis is coefficients are equal to zero is tested against the alternative hypothesis that one of the month is significantly different from zero. The sign of the coefficient shows whether the monthly effect displays positive or negative returns.

**Trading Month Effect:**

The following model is used to check the trading month effect.

$$R_t = \sum_{i=1}^2 \alpha_i D_{it} + \alpha_0 + \varepsilon_t \text{-----(vi)}$$

Where,

$R_t$  = Return of index on day t;

$D_{it}$  = 1 if the Return at time t belongs to the first fortnight of the month and 0 if any other month

$\alpha_i$  = mean return of the month i and

$\varepsilon_t$  = Error term.

We are testing the null hypothesis that the coefficient is equal to zero. The alternate hypothesis is that the coefficient is significantly different from zero. The sign shows a positive or negative return for the given month.

**4. Empirical results**

**Results for Stationarity**

The ADF test results given in table 1, indicate that all the time series, with and without intercept, constant, or linear trend, are stationary, rejecting the null hypothesis.

**Table 1: Results for ADF tests**

	Intercept	Prob	Constant and Linear trend	Prob	None	Prob
BSE SENSEX	-71.198	0.000	-71.192	0.000	-71.138	0.000
BSE100	-69.951	0.000	-69.945	0.000	-69.900	0.000
BSE200	-69.227	0.000	-69.221	0.000	-69.170	0.000
BSE500	-68.431	0.000	-68.426	0.000	-68.373	0.000
BSEAUTO	-68.248	0.000	-68.249	0.000	-68.161	0.000
BSE Capital Index	-66.970	0.000	-66.980	0.000	-66.883	0.000
BSE Consumer Durables	-66.970	0.000	-66.980	0.000	-66.883	0.000
BSE FMCG	-73.858	0.000	-73.855	0.000	-73.766	0.000
BSE Healthcare	-68.465	0.000	-68.460	0.000	-68.380	0.000
BSEIT	-54.572	0.000	-54.598	0.000	-54.559	0.000

BSEPSU	-66.977	0.000	-66.993	0.000	-66.949	0.000
BSE Oil and Gas	-70.319	0.000	-70.330	0.000	-70.271	0.000
Jan	-10.890	0.000	-10.890	0.000	-9.875	0.000
Feb	-10.985	0.000	-10.987	0.000	-10.035	0.000
Mar	-10.700	0.000	-10.704	0.000	-9.680	0.000
Apr	-11.842	0.000	-11.841	0.000	-10.917	0.000
May	-11.192	0.000	-11.189	0.000	-10.239	0.000
Jun	-10.722	0.000	-10.725	0.000	-9.714	0.000
Jul	-10.704	0.000	-10.705	0.000	-9.684	0.000
Aug	-10.847	0.000	-10.848	0.000	-9.857	0.000
Sep	-10.947	0.000	-10.946	0.000	-9.962	0.000
Oct	-11.515	0.000	-11.515	0.000	-10.507	0.000
Nov	-11.030	0.000	-11.029	0.000	-10.050	0.000
Dec	-11.388	0.000	-11.389	0.000	-9.835	0.000
TM	-69.066	0.000	-69.062	0.000	-69.065	0.000

### Results of Monthly Effect in Broad Based Indices

The results of OLS in Table 2 show that the broad-based indices, i.e., BSE SENSEX, BSE 100, BSE 200, and BSE 500, display significant positive returns for November and December. The months of January, February, and March have provided negative returns, even if they are not significant. The other months show positive returns, even if they are not significant.

	Sensex	P-Value	BSE 100	P-Value	BSE 200	P-Value	BSE 500	P-Value
Jan	-0.0002	0.737	-0.00035	0.5952	-0.00039	0.5405	-0.00044	0.4891
Feb	-0.00038	0.5255	-0.00046	0.4947	-0.0004	0.5512	-0.00044	0.504
Mar	-0.00032	0.699	-0.00036	0.5872	-0.00032	0.621	-0.00036	0.5792
Apr	0.000773	0.296	0.000849	0.2171	0.000988	0.1458	0.001089	0.1047
May	0.000176	0.8271	0.000199	0.7598	0.000247	0.7007	0.000286	0.6526
Jun	0.000566	0.3362	0.000369	0.5701	0.000329	0.6079	0.000297	0.64
Jul	0.000842	0.1457	0.000789	0.22	0.000785	0.2161	0.000768	0.221
Aug	0.000664	0.2028	0.000854	0.1934	0.000856	0.1866	0.000915	0.1533
Sep	0.000405	0.5262	0.0003	0.6504	0.000301	0.6452	0.000278	0.6672
Oct	0.000343	0.6412	0.000239	0.7198	0.000265	0.6879	0.000245	0.7068
Nov	<b>0.001188</b>	0.0445	<b>0.001275</b>	0.0569	<b>0.00126</b>	0.0564	<b>0.00129</b>	0.0482
Dec	<b>0.001087</b>	0.0308	<b>0.001255</b>	0.0554	<b>0.001323</b>	0.0406	<b>0.001369</b>	0.0322

Note: The figures in bold are significant figures.

### Results of Monthly Effect in Sectoral Indices

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
BSE Auto	-0.0001	-0.0001	-0.001	<b>0.002</b>	0.0004	0.0001	0.0005	0.001	0.001	0.001	<b>0.001</b>	0.001
P-Value	0.860	0.896	0.114	0.015	0.602	0.869	0.470	0.069	0.134	0.243	0.038	0.118
BSE Capital Index	-0.0001	0.0001	-0.0003	0.001	<b>0.002</b>	0.001	0.000	0.001	0.000	0.001	0.001	0.001
P-Value	0.927	0.907	0.717	0.071	0.032	0.269	0.793	0.324	0.960	0.255	0.112	0.140
BSE Consumer Durables	-0.0001	0.0001	-0.0003	0.001	<b>0.002</b>	0.001	0.000	0.001	0.000	0.001	0.001	0.001

P-Value	0.927	0.907	0.717	0.071	0.032	0.269	0.793	0.324	0.960	0.255	0.112	0.140
BSE FMCG	-	-	0.0004	0.001	0.0003	0.001	0.001	0.001	0.0003	-0.001	<b>0.001</b>	0.001
P-Value	0.603	0.776	0.454	0.185	0.639	0.145	0.070	0.175	0.639	0.284	0.050	0.096
BSE Healthcare	-0.001	-	0.0003	0.001	-	0.001	<b>0.001</b>	<b>0.001</b>	0.001	0.000	0.001	<b>0.001</b>
P-Value	0.039	0.577	0.602	0.023	0.516	0.241	0.039	0.026	0.372	0.813	0.078	0.019
BSE IT	-	-	-0.001	-	-	0.001	0.001	0.002	-	0.001	0.002	0.001
P-Value	0.911	0.731	0.175	0.154	0.827	0.260	0.484	0.079	0.654	0.502	0.066	0.141
BSE PSU	-	-	-	0.001	0.001	-	0.0004	0.0001	-	0.001	0.001	<b>0.002</b>
P-Value	0.856	0.747	0.791	0.141	0.404	0.733	0.576	0.877	0.817	0.400	0.160	0.029
BSE OIL & GAS	-	-	0.0005	<b>0.002</b>	0.0004	0.0001	0.0004	0.001	0.0004	0.0004	0.0004	0.001
P-Value	0.920	0.728	0.537	0.043	0.580	0.936	0.558	0.335	0.591	0.607	0.652	0.126

Note: The figures in bold are significant figures.

The results of OLS in Table 3 show that the BSE Auto Index displays positive significant returns for April and November. January, February and March have provided negative returns, though not significant. The other months show not significant positive returns. The BSE Capital Goods and Consumer durables index shows positive significant returns in May. The months of January and March display negative returns. The BSE FMCG Index displays positive significant returns for November. The months of January, March and October display negative returns. The BSE Healthcare Index displays positive significant returns for July, August and December. January displays significant negative returns. The BSE IT, PSU, OIL and Gas Index show positive significant returns in April, November and December.

#### Trading Month Effect

The results from Table 4 show the presence of the trading month effect, i.e., the first fifteen days of the month provide higher returns than the last fifteen days, except for the BSE IT index, which displays the trading month or half-month effect. The BSE FMCG Index displays higher returns in the second half of the month.

Indices	BF	P-Value	EF	P-Value
Sensex	0.00047	0.080	0.00039	0.138
BSE 100	<b>0.00052</b>	0.056	0.00031	0.243
BSE 200	<b>0.00058</b>	0.031	0.00030	0.261
BSE 500	<b>0.00061</b>	0.022	0.00028	0.285
BSE Auto	<b>0.00085</b>	0.003	0.00032	0.250
BSE Capital Index	<b>0.00096</b>	0.003	0.00040	0.215
BSE Consumer Durables	<b>0.00096</b>	0.003	0.00040	0.215
BSE FMCG	0.00027	0.258	<b>0.00064</b>	0.007
BSE Healthcare	<b>0.00065</b>	0.005	0.00027	0.237
BSE IT	0.00010	0.801	0.00048	0.205
BSE PSU	<b>0.00069</b>	0.022	0.00007	0.825
BSE OIL & GAS	<b>0.00076</b>	0.019	0.00022	0.489

Note: The figures in bold are significant figures..

## 5. Conclusion

The present study agrees with the other finance researchers about the Monthly and trading month effects on the Bombay Stock Exchange. There is no January effect on the Indian Stock Market. The behaviour of the markets has been different for different periods. November and December are the most critical months, which have generated significantly positive returns. These months are the third quarter of the year and festival season in India, which usually yields better results. Returns in December may be high because of the investment of FIIs. Subsequent selling in January and investing in other markets show higher returns in January in other countries and negative Returns in India.

The trading month effect or half-month effect is present in the Bombay Stock Exchange. It may be due to results and other information linked to companies being declared early in a month. Thus, assuming with certainty that these rules would help one earn profits is only sometimes valid; it varies from sector to sector depending on economic conditions. This study can also be extended to individual companies.

## REFERENCES

- Amarnani, N., & Vaidya, P. (2014). Study of Calendar Anomalies in Indian Stock Markets. Perspectives on Financial Markets and Systems.
- Archana, S., Mohammed, S., & Kevin, S. (2014). A Study on Market Anomalies in Indian Stock Market. International Journal of Business and Administration Research Review, Vol.I, Issue No.3, Jan-March, pp- 128- 137.
- Asteriou, D., & Hall, S. (2011). Applied Econometrics. UK: Palgrave Macmillan.
- Asterioua, D., & Kavetsos, G. (2006). Testing for the existence of the 'January effect' in transition economies, Applied Financial Economics Letters, Volume 2, Issue 6, pp.- 375-381.
- Dash, M., Dutta, A., & Sabharwal, M. (2011). Seasonality and Market Crashes in Indian Stock Markets. Asian Journal of Finance & Accounting, Vol. 3, No. 1: E11, pp 174-184.
- Deyshappriya, N. P. (2014). An Empirical Investigation on Stock Market Anomalies: The Evidence from Colombo Stock Exchange in Sri Lanka. International Journal of Economics and Finance, Vol. 6, No. 3, 177-187.
- Floros, C. (2008). The Monthly and trading month effects in Greek Stock market returns: 1996-2002. Managerial Finance, Vol. 34 No. 7, pp 453-464.
- Gao, Lei and Kling, Gerhard (2005), Calendar Effects in Chinese Stock Market, Annals of Economics and Finance, 6, (1), 75-88
- Gultekin, M., & Gultekin, N. (1983). Stock Market Seasonality - International Evidence. Journal of Financial Economics, 12, pp. 469-481.
- Harshita, Singh, Yadav (2019) Unique Calendar Effects in the Indian Stock Market: Evidence and Explanations, Journal of Emerging Market Finance, 18(1S), pp. 35S-58S
- Keim, D. (1983). Size-Related Anomalies and Stock Return Seasonality: Further Empirical Evidence. Journal of Financial Economics, 12 (1), June, pp. 13-32.
- Minimol, M. C., Makesh, K. G., & Radhika, A. (2013). Seasonality in Emerging Economies: Evidences from Indian Stock Market. International Journal of Financial Management, Volume 3, Issue 3, July, pp-26-36.
- Raj, M., & Kumari, D. (2006). Day-of-the-week and the market anomalies in the Indian stock market. International Journal of Emerging Markets, Vol. 1 No. 3, pp 235-246.
- Rosa Borges, M. (2009). Calendar Effects in Stock Markets: Critique of Previous Methodologies and Recent Evidence in European Countries. <http://pascal.iseg.utl.pt/~depeco/wp/wp372009.pdf>.
- Rozeff, M., & Kinney, W. (1976). Capital Market Seasonality: The Case of Stock Returns. Journal of Financial Economics, 3, pp. 379-402.
- Selvani, M., & Jeneffa, L. (2009). Calendar Anomalies in National Stock Exchange Indices. The IUP Journal of Applied Finance, Vol 15, No 1, pp 56-67.
- Sewraj, D., Seetanah, B., Sannasee, V., Soobadur, U., & Seetanah, B. (2010, April 23). Calendar Effects On Stock Market Returns: Evidence From The Stock Exchange Of Mauritius. Retrieved November 16, 2014, from <http://papers.ssrn.com>: [http://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=1594871](http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1594871)

# OPTIMIZING MEDICAL X-RAY IMAGE CLASSIFICATION USING ENSEMBLE TRANSFER LEARNING

**Deepak Kant Netam,**

Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India.  
(deepaknetam@gmail.com)

**Rajesh Mahule,**

Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India.  
(rmahule71@gmail.com)

Medical X-ray image recognition is a critical component of modern healthcare diagnostics. This study presents an innovative approach to optimizing the evaluation metric ROC curve (receiver operating characteristic curve) in medical X-ray image classification through the integration of ensemble learning and transfer learning techniques. The proposed methodology harnesses the power of ensemble methods to combine predictions from multiple pre-trained models, each leveraging transfer learning from a source domain. By aggregating diverse predictions, the ensemble model demonstrates enhanced generalization and robust performance on target medical X-ray datasets.

The ensemble transfer learning framework is systematically explored and evaluated on a comprehensive set of medical X-ray images, encompassing various pathological conditions and imaging modalities. Transfer learning is employed to leverage knowledge from a pre-trained model on a related domain, fine-tuning its parameters to adapt to the intricacies of medical X-ray data. The ensemble learning strategy further boosts performance by mitigating individual model biases and capturing complementary information from diverse sources. Experimental results showcase the effectiveness of the proposed approach in achieving improved performance metrics, including the ROC curve in comparison to individual models. Additionally, the ensemble transfer learning framework exhibits superior resilience to variations in imaging conditions and dataset characteristics.

This research contributes to the advancement of medical X-ray image recognition methodologies, offering a robust and adaptable solution for healthcare practitioners. The synergistic combination of ensemble learning, and transfer learning not only optimizes diagnostic accuracy but also enhances the reliability and generalization of medical X-ray image classification models, ultimately contributing to improved patient care and diagnostic decision-making.

**Keywords:** Medical X-ray Image Recognition, Ensemble Learning, Transfer Learning, ROC Curve, Pathological Conditions

## 1. INTRODUCTION

Medical X-ray image recognition plays a pivotal role in modern healthcare diagnostics, enabling the timely and accurate detection of various pathological conditions (Wang et al., 2020; Ozturk et al., 2020; Kermany et al., 2018). By analyzing X-ray images, healthcare experts has the ability to detect irregularities, evaluate the advancement of diseases, and provide guidance for treatment choices.(Kermany et al., 2018).The significance of medical X-ray image recognition is underscored by its widespread applications in various medical fields, including radiology, cardiology, pulmonology, and orthopedics (Yalmar et al., 2021)

One of the key challenges in medical X-ray image recognition lies in optimizing the evaluation metric ROC curve (receiver operating characteristic curve) (Krupinski, 2017).Plotting the true positive rate (TPR) against the false positive rate (FPR) across several thresholds, the ROC curve offers a thorough evaluation of a classifier's performance. Optimizing the ROC curve is crucial for ensuring that medical

X-ray image recognition models achieve high sensitivity and specificity, minimizing false positives and maximizing true positives (Carter et al., 2016;Junge & Dettori, 2018).

Several factors contribute to the importance of optimizing the ROC curve in medical X-ray image recognition:

- **Improved Diagnostic Accuracy:** By optimizing the ROC curve, healthcare professionals can rely on more accurate diagnostic tools, leading to better patient outcomes (Carter et al., 2016;Junge & Dettori, 2018).
- **Reduced False Positives:** Minimizing false positives is critical to avoid unnecessary diagnostic procedures, patient anxiety, and potential overtreatment (Obuchowski, 2003;Zweig & Campbell, 1993).
- **Enhanced Specificity:** Optimizing the ROC curve ensures that true positives are correctly identified, reducing the risk of missed diagnoses and delayed treatment (Taylor et al., 2018; Lindsey et al., 2018).
- **Informed Treatment Decisions:** With the use of an optimized ROC curve, medical X-ray image identification becomes accurate, enabling healthcare providers to customize treatment plans for each patient.(Sahu et al., 2023).

In conclusion, medical X-ray image recognition holds immense value in healthcare diagnostics, and optimizing the ROC curve is essential for ensuring the reliability and accuracy of these tools. By maximizing sensitivity and specificity, medical X-ray image recognition can contribute to improved patient care and enhanced diagnostic decision-making.

### **Problem Statement**

In the realm of modern healthcare diagnostics, the pivotal role played by medical X-ray image classification is indispensable, offering precise detection capabilities for a range of pathological conditions; however, the effectiveness of individual models is hampered by multiple challenges inherent in the classification process. These challenges can be broadly categorized into three main areas:

#### **(d) Data-related Challenges**

- **Data Variability:** Medical X-ray images exhibit inherent variability due to factors such as differences in imaging equipment, patient positioning, and disease presentation (Moreira, 2023;Samei et al., 2005). This variability can hinder the generalization of models and make it difficult to capture the full range of variations in real-world data (Tang et al., 2020).
- **Limited Data Availability:** Acquiring large datasets of medical X-ray images is often challenging due to privacy concerns and the resources required for data collection and annotation (Bustos et al., 2020). Poor generalization performance and overfitting might result from limited data availability. (Karystinos et al. , 2000).
- **Class Imbalance:** In medical X-ray image classification, certain classes may be underrepresented compared to others, leading to class imbalances (Szankin et al., 2022). This imbalance can bias models towards the majority classes and make it difficult to accurately classify minority classes (Ali et al., 2019).

#### **(e) Model-related Challenges**

- **Feature Extraction:** Extracting meaningful and discriminative features from medical X-ray images is a crucial step in the classification process ( Zare, M., et al. , 2013). Traditional feature extraction methods may not be effective in capturing the complex relationships and subtle patterns within X-ray images (Li, Y., et al., 2023).
- **Model Complexity:** Designing and training complex models for medical X-ray image classification can be computationally expensive and time-consuming (Bacellar, G. C., et al. ,2021; Livieris, I. E., et al., 2018). Overly complex models may also lead to overfitting and poor generalization (Nannen, V.,2003; Salman, S., et al. ,2019).
- **Explainability:** Medical X-ray image classification models often lack transparency, making it difficult to understand their decision-making process (Salahuddin, Z., et al., 2022). This lack of explainability can hinder trust and acceptance of these models in clinical settings (Singh, A., et al., 2020).



**(f) Limitations of Individual Models**

- **Sensitivity to Noise:** Individual models may be sensitive to noise and artifacts present in medical X-ray images, leading to misclassifications (Mooney, S. J., et al., 2012).
  - **Lack of Robustness:** Individual models may not be robust to variations in imaging conditions, such as differences in lighting, contrast, and exposure (Kao, W. C., et al., 2010).
  - **Susceptibility to Bias:** Individual models may be susceptible to biases inherent in the training data, leading to unfair or discriminatory outcomes (Mehrabi, N., et al., 2021; Rajkomar, A., et al., 2018).
- Addressing these challenges requires a multifaceted approach that includes data augmentation techniques, improved feature extraction methods, and the development of more robust and explainable models (Gu, S., et al., 2019). Additionally, ensemble learning techniques can lessen the drawbacks of individual models and enhance overall performance by combining predictions from several models. (Ponomaryov, V. I., et al., 2021).

**2. LITERATURE REVIEW**

Convolutional Neural Networks (CNNs) have undergone significant evolution, marked by breakthroughs in architecture design, optimization techniques, and parallelization methods. This literature review aims to provide an integrated overview of key contributions in CNN architecture development, merging related ideas across different papers and exploring the evolution of convolutional networks for image recognition from the early 2010s to recent advancements in 2020.

• **Importance of Network Depth and GPU Optimization**

The work of Krizhevsky et al. (2012) emphasized the significance of network depth and GPU optimization. This idea resonates with subsequent papers, highlighting the critical role of efficient GPU implementation for training large networks (Krizhevsky, 2014).

• **Transition to Vision Transformers (ViTs)**

Liu et al. (2022) explored the transition from traditional ConvNets to Vision Transformers (ViTs) in computer vision, introducing Swin Transformer. This aligns with the shift observed in Dosovitskiy et al. (2020), where attention-based transformers were directly applied to sequences of image patches, achieving excellent results in image classification.

• **Dense Connectivity and Reduction of Parameters**

The introduction of DenseNet by Huang et al. (2017) proposed connecting each layer to every other layer, promoting dense connectivity. This approach effectively reduced the number of parameters, echoing the efficiency theme of SqueezeNet (Iandola et al., 2016), which achieved AlexNet-level accuracy with significantly fewer parameters.

• **Scaling Methods for Improved Efficiency**

EfficientNet (Tan & Le, 2019) presented a way of scaling depth, width, and resolution that is consistent, showcasing improved efficiency. This idea aligns with the efficiency-driven approach of MobileNetV2 (Sandler et al., 2018), where inverted residuals and linear bottlenecks were employed for improved performance with reduced model size.

• **Integration of Transformers and Convolutions**

MaxViT (Tu et al., 2022) introduced multi-axis attention, integrating attention models with convolutions to create a hierarchical vision transformer. This approach aligns with the concept introduced by Swin Transformer (Liu et al., 2021), combining Transformers with shifted windows for global vision representation throughout the network.

• **Neural Architecture Search for Mobile Devices**

MnasNet (Tan et al., 2019) proposed a multi-objective neural architecture search approach optimized for both accuracy and real-world latency on mobile devices. This complements with the mobile-centric focus of MobileNetV3 (Howard et al., 2019), where hardware-aware network architecture search was complemented by novel architecture advances for improved performance.

• **Network Design Spaces and Simplified Architectures**



Radosavovic et al. (2020) presented a network design paradigm, exploring network design spaces and arriving at RegNet. This pursuit of simplified architectures that work well across a wide range of flop regimes, as demonstrated by RegNet models outperforming popular EfficientNet models (Radosavovic et al., 2020).

- **Residual Learning Framework for Improved Optimization**

The residual learning framework introduced by He et al. (2016) proposed reformulating layers as residual functions, easing the training of deep networks. This idea resonates with the aggregated residual transformations of ResNeXt (Xie et al., 2017), where a modularized network architecture aggregated transformations for improved optimization.

- **Efficient CNN Architecture Design**

ShuffleNet V2 (Ma et al., 2018) proposed practical guidelines for efficient CNN architecture design, evaluating metrics directly on the target platform. This aligns with the broader theme of designing efficient architectures, as seen in the mobile-centric approaches of MobileNetV2 and MobileNetV3.

- **Scaling Depth and Width for Improved Accuracy**

Zagoruyko and Komodakis (2016) represented Wide Residual Networks (WRNs), decreasing depth and increasing width for improved accuracy. This aligns with the findings of EfficientNet (Tan & Le, 2019), where uniform scaling of depth and width contributed to improved accuracy.

This integrated review highlights the evolution of CNN architectures for image recognition, emphasizing key themes such as network depth, efficiency, integration of transformers and convolutions, and the pursuit of optimized architectures for specific platforms. The amalgamation of concepts from several articles yields a holistic comprehension of the progressions influencing the domain of deep learning in computer vision. As hardware capabilities continue to evolve, these integrated concepts contribute to ongoing progress in convolutional network design.

### 3. RESEARCH OBJECTIVE

This study aims to optimize the ROC curve, a crucial evaluation metric in medical X-ray image classification, by employing an innovative approach that integrates transfer learning and ensemble learning technique. By combining the strengths of these two methodologies, the study seeks to enhance the accuracy and generalizability of medical X-ray image classification models, ultimately contributing to improved diagnostic decision-making.

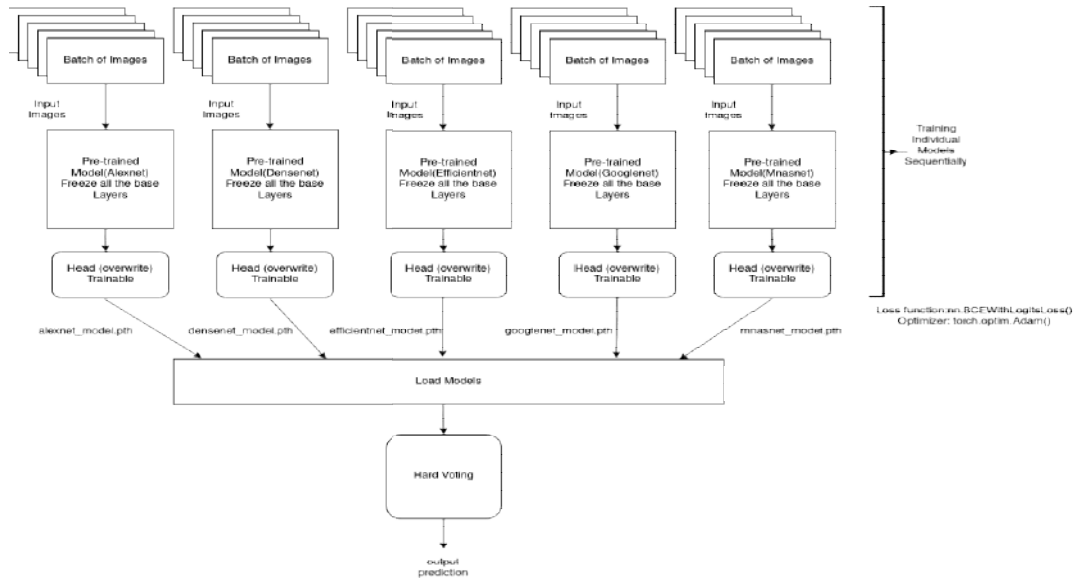
### 4. RESEARCH METHODOLOGY

#### *Data Set*

MURA dataset, which consists of a total of 40,561 musculoskeletal radiographs derived from 14,863 individual studies. Each radiograph is meticulously labeled by radiologists according to its classification as normal or abnormal. Furthermore, an additional set of labels from six board-certified Stanford radiologists, encompassing 207 studies, was employed for the purpose of robust model evaluation. The gold standard for this evaluation was determined through a majority vote among the radiologists. To address the task of abnormality detection and localization, a 169-layer DenseNet baseline model was trained. This model yielded promising results, with an AUROC of 0.929, a sensitivity of 0.815, and a specificity of 0.887. In order to assess the model's performance in comparison to radiologists, Cohen's kappa statistic was utilized. The results indicated that the model's performance was comparable to that of radiologists in finger and wrist studies. However, it demonstrated lower performance in studies related to the elbow, forearm, hand, humerus, and shoulder. The authors of this study duly emphasize the challenges that lie ahead for future research in this domain. Furthermore, they have generously made the MURA dataset freely accessible, with the intention of encouraging advancements in the field (Rajpurkar et al., 2017).

## Proposed Methodology

The proposed methodology for medical X-ray image classification combines transfer learning using Alexnet by Krizhevsky et al. (2012), Densenet by Huang et al. (2017), Efficientnet by Tan & Le (2019), Googlenet by Szegedy et al. (2015), Mnasnet by Tan et al. (2019) and ensemble learning to enhance generalization and robust performance. Ensemble learning leverages the collective knowledge of multiple pre-trained models, each trained on a different source domain, to address the limitations of individual models. By combining diverse perspectives and mitigating individual biases, ensemble



learning strengthens the overall classification performance.

**Figure 1:** Ensemble Model Architecture

Transfer learning involves leveraging the knowledge gained from a pre-existing model trained in a similar field, and adjusting its parameters to suit the unique attributes of medical X-ray data. This approach effectively transfers relevant knowledge while preserving domain-specific nuances, enhancing the ability to generalize across different medical X-ray datasets.

The integration of ensemble learning and transfer learning creates a synergistic effect that addresses the challenges faced in medical X-ray image classification. Ensemble learning enhances the generalization ability by combining diverse perspectives, while transfer learning provides a robust foundation by leveraging knowledge from related domains. This combined approach leads to improved accuracy, generalizability and robustness in classifying medical X-ray images.

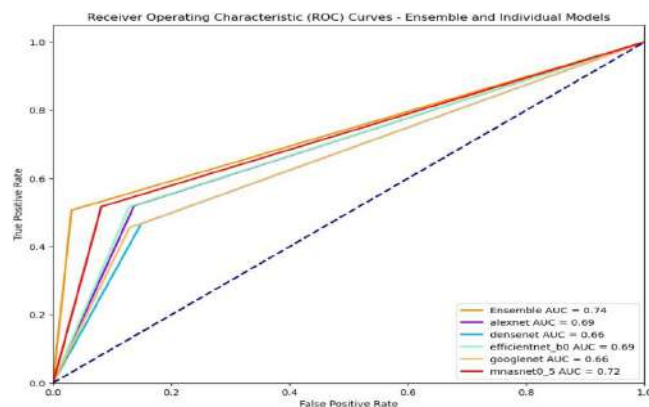
Specifically, the proposed methodology involves:

- **Pre-training:** Multiple models are pre-trained on different source domains, each domain providing valuable insights and perspectives relevant to medical X-ray image classification.
- **Feature Extraction:** Each pre-trained model extracts features from the medical X-ray images, capturing different aspects of the data and providing a rich representation for classification.
- **Domain Adaptation:** In the framework of supervised learning, knowledge is transferred from one domain to another by training a model on a source domain and then adapting it to the specific characteristics of the target domain at the classifier level.
- **Ensemble Learning:** The final prediction is chosen by the consensus of the individual models through a majority vote. In essence, the class label that garners the most number of votes is selected as the ultimate forecast of the ensemble.

## 5. RESULTS & DISCUSSION

**Significance:** This research significantly contributes to the advancement of medical X-ray image recognition methodologies by introducing a robust and adaptable solution for healthcare practitioners.

The synergistic combination of ensemble learning and transfer learning not only optimizes diagnostic accuracy but also enhances the reliability and generalization of medical X-ray image classification models.



**Figure 2:** Ensemble and Individual model AUC

**Key findings:** The proposed ensemble transfer learning approach for medical X-ray image classification demonstrates superior performance compared to individual models, achieving significant improvements in key evaluation metrics, including the ROC curve.

**ROC Curve:** The proposed approach significantly enhances the performance of the classifier, as evidenced by the ROC curve, which provides a complete indication of its effectiveness. The ensemble model demonstrates a significant improvement in its capacity to differentiate between genuine and false positives, as evidenced by the increased area under the ROC curve (AUC) compared to the individual models.

These improvements in ROC curve indicates the effectiveness of the proposed ensemble transfer learning approach in medical X-ray image classification, providing a more reliable and accurate tool for healthcare practitioners.

## REFERENCES

- Ali, H., Salleh, M. N. M., Saedudin, R., Hussain, K., & Mushtaq, M. F. (2019). Imbalance class problems in data mining: A review. *Indonesian Journal of Electrical Engineering and Computer Science*, 14(3), 1560-1571.
- Bacellar, G. C., Chandrappa, M., Kulkarni, R., & Dey, S. (2021). Covid-19 chest x-ray image classification using deep learning. *MedRxiv*, 2021-07.
- Bustos, A., Pertusa, A., Salinas, J. M., & De La Iglesia-Vaya, M. (2020). Padchest: A large chest x-ray image dataset with multi-label annotated reports. *Medical image analysis*, 66, 101797.
- Carla, Moreira. (2023). Arithmetic Optimization Algorithm with Deep Learning-Based Medical X-Ray Image Classification Model. Doi: 10.1007/978-981-19-7402-1\_40
- Dosovitskiy, A., Beyer, L., Kolesnikov, A., Weissenborn, D., Zhai, X., Unterthiner, T., ... & Houlsby, N. (2010). An image is worth 16x16 words: Transformers for image recognition at scale. arXiv 2020. arXiv preprint arXiv:2010.11929.
- Elizabeth, A., Krupinski. (2017). Receiver Operating Characteristic (ROC) Analysis. doi: 10.14786/FLR.V5I2.250
- Gu, S., Pednekar, M., & Slater, R. (2019). Improve image classification using data augmentation and neural networks. *SMU Data Science Review*, 2(2), 1.

- Haiming, Tang., Nanfei, Sun., Steven, S., Shen. (2020). Improving generalization of deep learning models for diagnostic pathology by increasing variability in training data: experiments on osteosarcoma subtypes. medRxiv, doi: 10.1101/2020.09.10.20192294
- He, K., Zhang, X., Ren, S., & Sun, J. (2016). Deep residual learning for image recognition. In Proceedings of the IEEE conference on computer vision and pattern recognition (pp. 770- 778).
- Howard, A., Sandler, M., Chu, G., Chen, L. C., Chen, B., Tan, M., ... & Adam, H. (2019). Searching for mobilenetv3. In Proceedings of the IEEE/CVF international conference on computer vision (pp. 1314-1324).
- Huang, G., Liu, Z., Van Der Maaten, L., & Weinberger, K. Q. (2017). Densely connected convolutional networks. In Proceedings of the IEEE conference on computer vision and pattern recognition (pp. 4700-4708).
- Iandola, F. N., Han, S., Moskewicz, M. W., Ashraf, K., Dally, W. J., & Keutzer, K. (2016). SqueezeNet: AlexNet-level accuracy with 50x fewer parameters and < 0.5 MB model size. arXiv preprint arXiv:1602.07360.
- Jane, V., Carter., Jianmin, Pan., Shesh, N., Rai., Susan, Galandiuk. (2016). ROC-ing along: Evaluation and interpretation of receiver operating characteristic curves. Surgery, doi: 10.1016/J.SURG.2015.12.029
- Kao, W. C., Hsu, M. C., & Yang, Y. Y. (2010). Local contrast enhancement and adaptive feature extraction for illumination-invariant face recognition. *Pattern Recognition*, 43(5), 1736-1747.
- Karystinos, G. N., & Pados, D. A. (2000). On overfitting, generalization, and randomly expanded training sets. *IEEE Transactions on Neural Networks*, 11(5), 1050-1057.
- Kermany, D. S., Goldbaum, M., Cai, W., Valentim, C. C., Liang, H., Baxter, S. L., ... & Zhang, K. (2018). Identifying medical diagnoses and treatable diseases by image-based deep learning. *Cell*, 172(5), 1122-1131.
- Krizhevsky, A., Sutskever, I., & Hinton, G. E. (2012). Imagenet classification with deep convolutional neural networks. *Advances in neural information processing systems*, 25.
- Krizhevsky, A. (2014). One weird trick for parallelizing convolutional neural networks. arXiv preprint arXiv:1404.5997.
- Li, Y., Zhang, C., Sun, S., & Yang, G. (2023). X-ray Detection of Prohibited Item Method Based on Dual Attention Mechanism. *Electronics*, 12(18), 3934.
- Lindsey, R., Daluiski, A., Chopra, S., Lachapelle, A., Mozer, M., Sicular, S., ... & Potter, H. (2018). Deep neural network improves fracture detection by clinicians. *Proceedings of the National Academy of Sciences*, 115(45), 11591-11596.
- Liu, Z., Lin, Y., Cao, Y., Hu, H., Wei, Y., Zhang, Z., ... & Guo, B. (2021). Swin transformer: Hierarchical vision transformer using shifted windows. In Proceedings of the IEEE/CVF international conference on computer vision (pp. 10012-10022).
- Liu, Z., Mao, H., Wu, C. Y., Feichtenhofer, C., Darrell, T., & Xie, S. (2022). A convnet for the 2020s. In Proceedings of the IEEE/CVF conference on computer vision and pattern recognition (pp. 11976-11986).
- Livieris, I. E., Kanavos, A., Tampakas, V., & Pintelas, P. (2018). An ensemble SSL algorithm for efficient chest X-ray image classification. *Journal of Imaging*, 4(7), 95.

- Mark, Junge., Joseph, R., Dettori. (2018). ROC Solid: Receiver Operator Characteristic (ROC) Curves as a Foundation for Better Diagnostic Tests. *Global Spine Journal*, doi: 10.1177/2192568218778294
- Ma, N., Zhang, X., Zheng, H. T., & Sun, J. (2018). Shufflenet v2: Practical guidelines for efficient cnn architecture design. In *Proceedings of the European conference on computer vision (ECCV)* (pp. 116-131).
- Mehrabi, N., Morstatter, F., Saxena, N., Lerman, K., & Galstyan, A. (2021). A survey on bias and fairness in machine learning. *ACM computing surveys (CSUR)*, 54(6), 1-35.
- Mooney, S. J., Pridmore, T. P., Helliwell, J., & Bennett, M. J. (2012). Developing X-ray computed tomography to non-invasively image 3-D root systems architecture in soil. *Plant and soil*, 352, 1-22.
- Mossman, D. (1994). Assessing predictions of violence: being accurate about accuracy. *Journal of consulting and clinical psychology*, 62(4), 783.
- Nancy, A., Obuchowski. (2003). Receiver Operating Characteristic Curves and Their Use in Radiology. *Radiology*, doi: 10.1148/RADIOL.2291010898
- Nannen, V. (2003). *The paradox of overfitting* (Doctoral dissertation, Faculty of Science and Engineering).
- Ozturk, T., Talo, M., Yildirim, E. A., Baloglu, U. B., Yildirim, O., & Acharya, U. R. (2020). Automated detection of COVID-19 cases using deep neural networks with X-ray images. *Computers in biology and medicine*, 121, 103792.
- Ponomaryov, V. I., Almaraz-Damian, J. A., Reyes-Reyes, R., & Cruz-Ramos, C. (2021, April). Chest x-ray classification using transfer learning on multi-GPU. In *Real-Time Image Processing and Deep Learning 2021* (Vol. 11736, pp. 111-120). SPIE.
- Radosavovic, I., Kosaraju, R. P., Girshick, R., He, K., & Dollár, P. (2020). Designing network design spaces. In *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition* (pp. 10428-10436).
- Rajkomar, A., Hardt, M., Howell, M. D., Corrado, G., & Chin, M. H. (2018). Ensuring fairness in machine learning to advance health equity. *Annals of internal medicine*, 169(12), 866-872.
- Rajpurkar, P., Irvin, J., Bagul, A., Ding, D., Duan, T., Mehta, H., ... & Ng, A. Y. (2017). Mura: Large dataset for abnormality detection in musculoskeletal radiographs. *arXiv preprint arXiv:1712.06957*.
- Reza Zare, M., Mueen, A., Awedh, M., & Chaw Seng, W. (2013). Automatic classification of medical X-ray images: hybrid generative-discriminative approach. *IET Image Processing*, 7(5), 523-532.
- Sahu, H., Kashyap, R., & Dewangan, B. K. (2023, February). Hybrid Deep learning based Semi-supervised Model for Medical Imaging. In *2022 OPJU International Technology Conference on Emerging Technologies for Sustainable Development (OTCON)* (pp. 1-6). IEEE.
- Salahuddin, Z., Woodruff, H. C., Chatterjee, A., & Lambin, P. (2022). Transparency of deep neural networks for medical image analysis: A review of interpretability methods. *Computers in biology and medicine*, 140, 105111.
- Salman, S., & Liu, X. (2019). Overfitting mechanism and avoidance in deep neural networks. *arXiv preprint arXiv:1901.06566*.
- Samei, E., Dobbins III, J. T., Lo, J. Y., & Tornai, M. P. (2005). A framework for optimising the radiographic technique in digital X-ray imaging. *Radiation Protection Dosimetry*, 114(1-3), 220- 229.

- Sandler, M., Howard, A., Zhu, M., Zhmoginov, A., & Chen, L. C. (2018). Mobilenetv2: Inverted residuals and linear bottlenecks. In Proceedings of the IEEE conference on computer vision and pattern recognition (pp. 4510-4520).
- Simonyan, K., & Zisserman, A. (2014). Very deep convolutional networks for large-scale image recognition. arXiv preprint arXiv:1409.1556.
- Singh, A., Sengupta, S., & Lakshminarayanan, V. (2020). Explainable deep learning models in medical image analysis. *Journal of imaging*, 6(6), 52.
- Szankin, M., & Kwasniewska, A. (2022). Can AI see bias in X-ray images?. *International Journal of Network Dynamics and Intelligence*, 48-64.
- Szegedy, C., Liu, W., Jia, Y., Sermanet, P., Reed, S., Anguelov, D., ... & Rabinovich, A. (2015). Going deeper with convolutions. In Proceedings of the IEEE conference on computer vision and pattern recognition (pp. 1-9).
- Szegedy, C., Vanhoucke, V., Ioffe, S., Shlens, J., & Wojna, Z. (2016). Rethinking the inception architecture for computer vision. In Proceedings of the IEEE conference on computer vision and pattern recognition (pp. 2818-2826).
- Tan, M., Chen, B., Pang, R., Vasudevan, V., Sandler, M., Howard, A., & Le, Q. V. (2019). Mnasnet: Platform-aware neural architecture search for mobile. In Proceedings of the IEEE/CVF conference on computer vision and pattern recognition (pp. 2820-2828).
- Tan, M., & Le, Q. (2019, May). Efficientnet: Rethinking model scaling for convolutional neural networks. In International conference on machine learning (pp. 6105-6114). PMLR.
- Tu, Z., Talebi, H., Zhang, H., Yang, F., Milanfar, P., Bovik, A., & Li, Y. (2022, October). Maxvit: Multi-axis vision transformer. In European conference on computer vision (pp. 459- 479). Cham: Springer Nature Switzerland.
- Taylor, A. G., Mielke, C., & Mongan, J. (2018). Automated detection of moderate and large pneumothorax on frontal chest X-rays using deep convolutional neural networks: A retrospective study. *PLoS medicine*, 15(11), e1002697.
- Wang, D., Mo, J., Zhou, G., Xu, L., & Liu, Y. (2020). An efficient mixture of deep and machine learning models for COVID-19 diagnosis in chest X-ray images. *PloS one*, 15(11), e0242535.
- Xie, S., Girshick, R., Dollár, P., Tu, Z., & He, K. (2017). Aggregated residual transformations for deep neural networks. In Proceedings of the IEEE conference on computer vision and pattern recognition (pp. 1492-1500).
- Yalmar, Ponce, Atencio., Julio, Huanca, Marin., Edgar, Holguin, Holguin., Fidel, Ticona, Yanqui., Manuel, Ibarra, Cabrera. (2021). Image Processing Techniques for Medical Applications. doi: 10.1109/ICECCME52200.2021.9591045
- Zagoruyko, S., & Komodakis, N. (2016). Wide residual networks. arXiv preprint arXiv:1605.07146.
- Zare, M. R., Seng, W. C., & Mueen, A. (2013). Automatic classification of medical x-ray images. *Malaysian Journal of Computer Science*, 26(1), 9-22.
- Zweig, M. H., & Campbell, G. (1993). Receiver-operating characteristic (ROC) plots: a fundamental evaluation tool in clinical medicine. *Clinical chemistry*, 39(4), 561-577.



## **FOOD SECURITY OF INDIA: ROLE OF PUBLIC DISTRIBUTION SYSTEM (PDS) AND ANTI-POVERTY PROGRAM**

**Asha Devi. J.,**

Institute of Management in Kerala (IMK), University of Kerala, Kerala, India.  
(ashadevij@gmail.com)

**Dr. K.S Chandrasekar**

Institute of Management in Kerala (IMK), University of Kerala, Kerala, India.  
(kscnair@gmail.com)

The Public Distribution System delivers food grains to the people in our country. The public Distribution System is a Government-sponsored program commissioned to circulate basic food and nonfood commodities to the underprivileged sections of society at a meager price. Food Corporation of India manages and provides Public Distribution System that distributes rice, wheat, sugar, kerosene, and other food grains through Ration and fair-price shops. The public Distribution System controls the Food security of the nation. It is a supporting pillar for India's food security. To protect the weaker sections of the farm workers and urban laborers, essential commodities such as rice, wheat, imported edible oils, sugar, and kerosene are distributed below market price through a network of fair-price shops. This is an essential element of the Government's safety net for low-income people. On March 31, 1992, the country had over four lakh such outlets. Of these, 3.05 lakh are in rural areas, and 0.94 lakhs are in urban areas. On average, one fair price is envisaged to cover a population of 2000. In a re-organized system from January 1992, launched in about 1700 blocks falling in the drought-prone, desert-integrated tribal development project areas and certain designated hill areas, additional commodities like tea, soap, pulses, and iodized salt are also envisaged to be distributed. Since procurement prices are also supported, market prices are below support prices. The Public Distribution System (PDS) supplies no doubt have contained the vigor of inflation. The essence of the study is to identify the Functioning of the Public Distribution System, Anti-Poverty Program, and Food Security in India.

Key Words: Anti-poverty program, Food Grains, Food Security, India, Public Distribution System

### **INTRODUCTION**

The Public Distribution System delivers food grains to the people in our country. The public Distribution System is a Government-sponsored program commissioned to circulate basic food and nonfood commodities to the underprivileged sections of society at a meager price. Food Corporation of India manages and provides Public Distribution System that distributes rice, wheat, sugar, kerosene, and other food grains through Ration and fair price shops. The public Distribution System controls the Food security of the nation. It is a supporting pillar for India's food security. To protect the vulnerable sections of the farm workers and urban laborers, essential commodities such as rice, wheat, imported edible oils, sugar, and kerosene are distributed below market price through a network of fair-price shops. This is an essential element of the Government's safety net for the poor. On March 31, 1992, the country had over four lakh such outlets. Of these, 3.05 lakh are in rural areas and 0.94 lakhs are in urban areas. On average, one fair price is envisaged to cover a population of 2000. In a re-organized system from January 1992, launched in about 1700 blocks falling in the drought-prone, desert-integrated tribal development project areas and certain designated hill areas, additional commodities like tea, soap, pulses, and iodized salt are also envisaged to be distributed. Since procurement prices are also supported, market prices are below support prices. The Public Distribution System (PDS) evolved to manage scarcity by distributing food grains at affordable prices. Over the years, PDS has become an essential part of the



Government's policy for the management of the food economy in the country. PDS is supplemental and is not intended to make available the fundamental requirement of any of the commodities distributed under it to a household or a section of society. The Central and State/UT governments share responsibility for PDS's operation. Through the Food Corporation of India (FCI), the Focal Government has taken care of the obtainment, stockpiling, transportation, and mass distribution of food grains to the State Legislatures. The functional obligation, including circulation inside the State, recognizable proof of qualified families, issue of Ration Cards, and oversight of the working of Fair Price Shops (FPSs), rest with the State Legislatures. Under the PDS, wheat, rice, sugar, and lamp oil items are designated to the States/UTs for appropriation. Through the PDS outlets, some States and UTs also distribute additional items for mass consumption, such as pulses, edible oils, iodized salt, spices, etc.

Antodaya Anna Yojana (AAY) was a step toward TPDS's goal of reducing hunger among the poorest BPL populations. According to the findings of a National Sample Survey Exercise, approximately 5% of the nation's total population sleeps without eating two meals per day. This part of the populace could be designated "hungry." To make TPDS more engaged and focused on towards this populace classification, the "Antyodaya Anna Yojana" (AAY) was started in December 2000 for one crore most unfortunate of the low-pay families. AAY involved the recognizable proof of one crore least fortunate of the low-pay families from among the quantity of BPL families covered under TPDS inside the States and giving them food grains at a profoundly financed pace of Rs.2/- per kg. for rice and Rs. 3/kg for wheat. The cost of distribution, which included a margin for dealers and retailers and the cost of transportation, was borne by the States and UTs. As a result, consumers received the entire food subsidy through the scheme. The issuing scale was initially 25 kg per family per month, but on April 1, 2002, it was raised to 35 kg per family per month. Based on the studies, the suggestions for improved targeting of poor and vulnerable sections are the Exclusion of income taxpayers, salaried employees in Government, public and private sector, telephone-owning families, etc. Another criticism of the Public Distribution System is related to the non-parity of the percapita distribution of food grains in different states with the percentage of the population below the poverty line. Regarding the food subsidy problem, some policy changes are necessary because the budget for 1993-94 is Rs. 3000 crores. One possibility could be to limit subsidy to a fixed quantum of annual allocation, say 16 million tonnes of food grains. The states would then have the choice to procure additional quantities at the economic cost or the prevailing market prices. Then the report of the Eighth Plan finds out that there is some scope to contain the food subsidy by making the operations of the Food Corporation of India (FCI) more efficient. It is possible to reduce the carrying cost of food grains through efficient procurement and market intervention operations.

To some extent, the FCI also has to discharge its function of balancing the effects of fluctuations in the production of food grains by higher procurement and market intervention operations; reducing the carrying cost of food grains is possible. To some extent, the FCI also has to discharge its function of balancing the effects of fluctuations in the production of food grains by higher procurement during years of sub-normal output. Wheat and rice are the two main kinds of cereal that constitute the crux of food security. The public distribution of these staple food grains is the centerpiece of Government intervention to ensure basic food requirements' availability and price stability. The Government announces procurement prices to confirm the availability and price stability of basic food requirements. Procurement prices announced by the Government are based on the Commission for Agricultural Costs and Prices (CACP) recommendations. The CACP, after examining the cost structure of crop production and other relevant factors, recommends minimum support prices for seven portions of cereal- paddy, wheat, jawar, bajra, maize, ragi, and barley; four pulses- gram,

rather, moong, and urad; seven oil seeds and four other crop products- sugarcane, cotton, jute, and tobacco.

The public Distribution System is a primary channel for issuing food grains delivery. During the Covid-19 pandemic, 1.7 lakh crores of relief packages were announced on March 26, 2020, to support 12 Million tons of food grain under Pradhan Mantri Garib Kalyan Anna Yojana. This package was delivered to nearly 800 million citizens through the Targeted Public Distribution System, enabling outreach to India's most vulnerable. The public Distribution System (PDS) was introduced during World War II; before 1960, the distribution through Public Distribution System depended on food grain imports. It was expanded in the 1960s to handle the food shortage and control food allocation. The Food Corporation of India and the Commission of Agricultural costs and prices were positioned by the Government of India to enhance domestic procurement and storage of food grains. During the 1970s, Public Distribution System evolved as a universal scheme for food distribution. The public Distribution System (PDS) significantly protects the poor from increasing food prices. Indian households consume 45% of their income on food, and many low-income families depend on Government's subsidy grains for their requirements. The schedules that alleviate flops from food price shocks are critical to India's social protection system. In 2017, the Government spent 16 billion dollars on the program, or almost one percent of the GDP. In 2004-2005, just 22.4% of Indian households reported buying food grains from fair shops. It increased to 44.5% in 2011-2012, the most improved in 1997 when the targeted Public Distribution System was introduced. In 2016, the National Food Security Act's implementation followed, and the coverage was further expanded. The Administrative data of 2016 indicates that 74% of Indian households possess a ration card. In 2012, nearly six out of ten low-income families purchased grains from the PDS. The above improvements protect poor homes from food price hikes and alleviate poverty during drought and high food inflation. In contrast, India's decline in leakage has been moderate, going from 58% in 2004/2005 to 43%. In 2012, leakage reduction was notably substantial in the low-income states with historically inefficient administrative capabilities of Bihar, Odisha, Jharkhand, and Chhattisgarh. Micro surveys executed in low-income states in 2016 and 2017 discovered that citizens obtained nearly 90% of the subsidized grains to which they were permitted.

In a poverty-ridden country, especially in rural areas, it is honest that the public distribution system (PDS) of food grains protects the poor. In India, the PDS applies an explicit subsidy of more than Rs 2,400 crore, though procedure designers plan to decrease this. These are the problems concentrated upon by K. R. Venugopal, a bureaucrat aware of food economy-related difficulties. The current PDS is predominantly urban and allows only the middle and affluent sections. Excluding Kerala, Tamil Nadu, and Andhra Pradesh, where the PDS has outstretched to rural areas as well, the public distribution system in the rest of the country needs to be more targeted and help the rural poor. Further attempts to circulate food to the rural poor via anti-poverty programs such as the National Rural Employment Programme, Rural Labour Employment Guarantee Programme, and Integrated Rural Development Programme failed because food allocation was never given preference. The PDS must be dramatically re-structured to concentrate on the rural poor. These areas need food security regarding monetary access, not the urban wealthy and middle classes. For the non-poor urban population, the availability aspect minus the subsidies. Handling the country's food economy should entail assembling food grains reasonable to the rural poor and unrestricted to the non-poor in urban areas.

Food security refers to a difficulty when all people, at all periods, have physical, social, and monetary access to adequate, secure, and healthy food that fulfills their dietary necessities and food intentions for an active and healthy life. Food insecurity can be comprehended as an immensity that moves from tension and nervousness about access to adequate and proper

food at the household level to the extreme situation of starvation among children because they do not have sufficient to eat. The experience of food insecurity is more potent in low-income communities and for those who already experience poor health. While factors contributing to poverty are essential when assessing food insecurity, it is not the only determinant. Further consequences contain a policy, food allocation across populations, countries, and regions, unstable political conditions, and climate change-induced harmful environmental conditions such as severe droughts, lack of water, and soil degradation and erosion.

### **National Food Security Act (NFSA) 2013**

National Food Security Act 2013 was enacted by the Parliament, and Government declared the National Food Security Act 2013 on September 10, 2013, with the intent to supply food and nutritional protection to the human by assuring access to a sufficient quantity of quality food at reasonable prices to individuals to live a life with dignity. The Act gives coverage to up to 75% of the rural population and up to 50% of the urban population for subsidized foodgrains based on the Targeted Public Distribution System (TPDS). It encircles about two-thirds of the people. The qualified persons will be permitted to bring 5 Kg of foodgrains per month at subsidized Rs. 3 or 2 or 1 per Kg for Rice and other food grains. The current Antyodaya Anna Yojana (AAY) households, which constitute the poorest of the poor, will still receive 35 Kg of foodgrains per household monthly. The Act also focuses on nutritional support for women and children. Except for meals to pregnant women and lactating mothers during pregnancy and six months after childbirth, they can also acquire maternity benefits of not less than Rs. 6,000. Children up to 14 are moving to be permitted nutritional meals per the specified dietary norms. The beneficiaries will obtain a food security allowance for the non-supply of allowed food grains or meals. The Act also contains provisions for fixing grievance redressal mechanisms at the District and State levels. Separate provisions have also been made to ensure transparency and accountability.

The Ministry of Consumer Affiliation has two Departments:

1. Food and Public Distribution
2. Consumer Affairs.

Distribution to the Ministry accounts for 4% of the central Government's budget in 2020-21.

### **Food Security in India**

Although overall rates of food insecurity have decreased worldwide, a significant population of people living in sub-Saharan Africa and South Asia are still experiencing food insecurity. Most of the time, the most affected nations have high rates of disease and death due to nutritional deficiencies and poverty. In spite fast financial development throughout recent many years, numerous Indians have not profited from the monetary improvement and keep on encountering food uncertainty and craving, a high weight of unhealthiness and undernourishment, and expanding stoutness; Over 190 million people were reported to be malnourished in 2016, the most of any country.

The Public authority of India has taken on different arrangements throughout recent years to reinforce food security. One of the basic reactions to food weakness and craving in India is the dissemination of food grains through the Public authority controlled Public Conveyance Framework (PDS). The PDS is the world's most extensive universal distribution system for the supply of subsidized food grains. Following World War II, it was established to increase domestic agricultural production and improve food security. The food safety net program aims to supplement essential household supplies like wheat, rice, sugar, and kerosene through a federal and state governments partnership. Nonetheless, as different answers for food shortage, this program isn't planned to give all necessary family food sources yet rather to give merchandise to enhance bought or cultivated products. The Food Corporation of India (FCI) is a central nodal agency that buys food grains from farmers at a price that is often

higher than the market price to make distribution easier. State governments then purchase the food grains from the FCI at a subsidized price known as the "central issue price"; these merchandise are then conveyed to customers by means of fair cost or proportion shops.

### **OBJECTIVES**

1. To find out the anti-poverty program and food security provided by India's Public Distribution System (PDS).
2. To understand the Government support provided to the Public Distribution System (PDS) in India.

### **RESEARCH METHODOLOGY**

An empirical study through a systematic Literature Review is taken for this research. This is a well known academic method for finding and evaluating relevant literature on the Public Distribution system, antipoverty program and food security in India. Peer assessed research articles are gathered from the web through google search and science direct. Search terms connected with the various studies or research conducted in India's Public Distribution System (PDS) and the Food Corporation of India (FCI).

### **LITERATURE REVIEW**

The expanded access to the PDS has reduced poverty and improved the country's food security. The contribution to the overall poverty reduction increased by 3.1% during 2011–2012, composed of a 3.8% reduction in rural regions and 1.4% in urban areas. PDS is mainly intended to improve physical access to food and enhance food security, and it has saved more than 40 million people from poverty (Kumar and Ayyappan, 2014). The most straightforward way of analyzing the outcome of PDS on poverty in the rural region is through implicit subsidy, although PDS is not just an implicit subsidy alone (Dreze and Khera, 2013). The state of Chhattisgarh was taken as the sample area of the study by Dreze and Khera. It is clear that the system functions relatively well there, and it has a substantial impact on poverty in the state through poverty measures like the poverty gap index, which is also true in the case of the states of Tamil Nadu and Andhra Pradesh, with a relatively efficient PDS (Dreze and Khera, 2013). But this cannot apply to the states like Bihar, where the PDS is still in a weak shape, which is evident from an instance analysis of the proportion of BPL households skipping meals during the three months before the survey, which was 70% in Bihar and 17% in Chhattisgarh. While focusing on a single state to estimate the poverty impact, there is little difficulty. However, while taking many states, the adjustment of states-specific poverty lines comes to concern (Dreze and Khera, 2013). The impact of rural poverty in India varies across the states. Odisha impacts above the All-India average; in Rajasthan, it is below the all-India average. The PDS impact on poverty is least in the states of Bihar, Jharkhand, Uttar Pradesh, and West Bengal (Dreze and Khera, 2013).

The reduction in poverty and food insecurity has gotten more attention in the world's developing countries with the United Nations' Millennium Development Goals, 2000 (Suryanarayana and Silva, 2008). Although the targeted PDS has led to a low incidence of poverty in some states of India, it has led to a high prevalence of food insecurity. Regional imbalances exist inside the developed states or, for that matter, even in weaker conditions. A negative correlation exists between the incidence of poverty and the alternative measures of cereal deprivation in rural regions. The negative correlation is seen among eastern Maharashtra, Uttar Pradesh, Madhya Pradesh, West Bengal, Orissa, Bihar, and rural Assam. In these states, the concentration of poverty is higher, and in eastern Maharashtra, unlike the other forms, cereal deprivation is higher (Suryanaryana and Silva, 2008). The effect on the extent of headcount ratio and severity measured by poverty gap rates was better in states with higher per capita income. These states include Kerala and Andhra Pradesh and moderate in Tamil Nadu and Karnataka. As expected, the proportion of the last three poor conditions among the poor who moved out of poverty due to PDS was 6.2%, comprising one-third of the

poor in India. By contrast, the share of Kerala and Andhra Pradesh in the poor who reduced poverty was 32%, whereas they together accounted for less than 10% of the poor in the country (Radhakrishna and Subbarao, 1997). This shows a wide divergence between the poor who moved out of poverty in the state and the share of poor in the state out of the total poor in India. The food subsidy provision in India reflects the Government's program for providing nutritional support for the targeted population and maintaining price stability. PDS is also essential to carry out the Government of India's economic policy to serve the poor and vulnerable (Thomas.S, 2017).

An evaluation of the impact of the income quintal preceding the fiscal transfer shows that food share is highly income regressive. The poorest PDS user increased the food share by 7.1%, the next quintal by 5.1%, and the third by 2.7%. Hence, this analysis shows that for the poorest, fiscal subsidies received using PDS are more than proportionately meant for food security. In contrast, for the upper-income class, the food subsidies are more on nonfood items as the distribution through PDS decreases their expenditure (Tritah, 2003). The food subsidy through PDS is an essential means for increasing food security and has accounted for an augmenting impact on food consumption (Tritah, 2003).

The study established that the efficacy of PDS has improved eventually, and it has emerged as an essential channel in targeting the two problems of poverty and undernourishment in India. As an impact of PDS transfers, the decline in poverty has increased over time, with a 1.5% poverty reduction in 1993–1994 to 3.5% in 2011–2012, with the extent of poverty reduction more in rural areas than in urban areas. The impact of PDS plays a significant role in decreasing the poverty gap index that shows similar trends to the headcount ratio, which implies that the PDS has achieved greater heights not only in reducing the number of poor people but also in the extent to which they are poor (Kumar et al., 2014). The average impact on the poverty gap during 2004–2005 was estimated at 5.96 percentage points for Antyodaya beneficiaries and 2.27 percentage points for BPL (Kumar et al., 2014). The impact remained more or less uniform during 2011–2012, with estimates of 5.90 percentage points and 3.02 percentage points, respectively, for the two target groups. The analysis showed that the poverty rate at the All India level was reduced by around 3.5% in 2011–2012 because of PDS subsidy transfers. In contrast, such an impact was invasive across rural or urban with regional variations across the country (Kumar et al., 2014). The efficiency of PDS as a tool to alleviate poverty was found to increase gradually with observed maximum impact in 2011–2012, and the PDS also contributed to improving the nutrition intake of Himanshu and Sen (2011) noted that the targeted public distribution system was far from adequate. Their findings suggest that the targeted public distribution system has not successfully assisted the targeted population living below the poverty line. A significant concern is that almost half of the targeted population has to spend their savings to cover their nutritional needs (Panigranhi and Pathak 2015).the households (Kumar et al., 2014).

## **RESULTS AND ANALYSIS**

India is one of many countries looking for ways to combat food insecurity. Similar to India, China has a large population and an expanding economy. In spite of monetary development in China over ongoing years, similar to India, China is home to one of the biggest populaces of hungry individuals. China has paid a lot of attention to programs that aim to redistribute wealth and non-food-based social security, whereas India relies on the PDS to reduce food insecurity. Additionally, diet patterns are changing in China, which is affecting agricultural production and land use. The agricultural sector in Brazil is also being transformed by the situation of food insecurity. Brazil's population, like those in China and India, consumes increasingly diverse foods, necessitating a shift in farming practices. However, the government is supporting this transition as well as school meal programs and cash transfers to address the growing problem of food insecurity, and the first signs point to some success. A



single solution is unlikely to be effective within or across these nations due to the large numbers of people in need. To effectively evaluate these programs in the future, it is essential to collect comprehensive and complete data. The Social Protection for a Changing India, which was launched here today, says, according to the News Paper report. In addition, social protection programs take up more than 2% of India's gross domestic product (GDP). The spending dispensed to each provincial family on major midway supported plans is critical at 40% of the yearly country neediness line in 2004-2005; The poor are unable to fully benefit from these vital investments. It asserts that poorer states may have greater administrative capacity in addition to a variety of implementation issues. While states with higher neediness are allotted additional assets from the focal financial plan, the report adds that they have the least ability to really spend. The World Bank's first comprehensive review of India's critical anti-poverty and social protection programs, including the Public Distribution System (PDS), Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREG), Indira Awaas Yojana (IAY), and Indira Gandhi National Old Age Pension Scheme (IGNOAPS), was conducted at the request of the Indian government. India has introduced a number of new social protection programs over the years. The purpose of this review, which was conducted at the Government's request, is to examine the current state of these programs' implementation. At almost one percent of GDP, the Public Distribution System (PDS) continues to consume a significant amount of public resources. According to the National Sample Survey data, while it covers up to 25% of households, its benefits for the poor have been limited. There is a lot of grain leakage and diversion from the PDS. According to the NSS for the years 2004 and 2005, households receive only 41% of the grains distributed by the government, with some states performing significantly worse. The Planning Commission estimated this BPL grain leakage at 58% nationally in 2001. The report suggests providing households with the option of receiving cash while maintaining food-based support for specific situations, such as disaster relief, areas where access is difficult, and particular vulnerable groups, in the medium to long term. This change wouldn't dispose of the requirement for food support stocks.

### **Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREG)**

A report says that the Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREG) for a number of innovations, such as the central role played by communities and Panchayati Raj Institutions (PRI) and social audits of its performance in states like Andhra Pradesh and Rajasthan. and ensuring that its implementation has a dedicated budget and a well-defined program structure. When compared to previous public works programs, the coverage that the MGNREG has achieved is impressive. Data from the government indicate that approximately 50% of women workers and 31% of Scheduled Castes (SC) and 25% of Scheduled Tribes (ST) have participated in this program. The report adds that MGNREG can be used as a model for other programs that fight poverty and provide a safety net.

Even though it only covered 200 districts, MGNREG generated nearly 43 person days of employment per household in its first year, compared to 26 person days generated by the pan-India Sampoorna Grameen Rozgar Yojana (SGRY) in 2005-06. This is significantly more than any other wage employment program in the past. In any case, the report adds that unfulfilled interest for work is high, and the program doesn't yet ensure 100 days of work for each rustic family. In terms of the percentage of participating households and the number of person days of employment generated per rural household, states like Andhra Pradesh, Chhattisgarh, Madhya Pradesh, and Rajasthan stand out as performing well. However, the program has not yet significantly reduced poverty and hunger in states like Bihar and Orissa, indicating that supply-side constraints rather than a lack of demand are likely to blame. In addition, Andhra Pradesh, Gujarat, Tamil Nadu, and Rajasthan claim to have implemented MGNREG in significant new ways, such as by focusing on accountability and community involvement in

oversight, financial inclusion, and IT-based monitoring and planning. When compared to other social protection programs, the utilization rate of MGNREG funds is also fairly high. In any case, the report says field studies demonstrate defers in moving assets to gram panchayats. Although the capacity of states to spend on MGNREG varies significantly, approximately 25% of MGNREG funds were not utilized in 2008-2009. Store use rates range from 56% in Tamil Nadu to 89 percent in Rajasthan. There are additionally critical varieties across locale inside states, for certain regions (e.g., in Orissa and Karnataka) detailing consumptions over accessible assets. Inaccurate muster rolls, incomplete job cards, and account passbooks are examples of accountability mechanisms that need to be fixed as intended, as shown by nationwide field studies. Additionally, wages are reported to be paid behind schedule or below standards in several studies.

The RashtriyaSwasthyaBimaYojana, or RSBY, is a pension, insurance, and safety net program that covers less than 10% of the workforce in India. The Indian government introduced the RashtriyaSwasthyaBimaYojana, or RSBY, a targeted health insurance program for the poor to fill this gap in public policy. For a registration fee of Rs 30 per year and a limit of Rs 30,000 per family, the program provides subsidized hospitalization coverage. Even though the BPL list isn't very good, the report says that the first year or so has been good because it has shown that the target population can be reached. The report proposes that a future need ought to be to fortify its ability to regulate and oversee the program's development through the basic oversight of a specific organization. More than 70 million low-income individuals now have access to the RSBY, which is growing. According to the report, the RSBY makes an effort to simultaneously take into account the perspective of the poor, focuses on obtaining the appropriate incentives for the various players who must deliver the benefits, and encourages changes over time based on evidence.

## **CONCLUSION**

From this study, it is identified that the public Distribution System (PDS) fundamentally shields the poor from expanding food costs. Indian households spend 45 percent of their income on food, and many low-income families get their food from grain subsidies provided by the government. The timetables that ease flops from food cost shocks are basic to India's social insurance framework. In 2017, the Public authority burned through 16 billion bucks on the program, or just about one percent of the Gross domestic product. Only 22.4% of Indian households reported purchasing food grains from fair shops between 2004 and 2005. In 2011 and 2012, it reached 44.5%, the highest level since the introduction of the targeted Public Distribution System in 1997. In 2016, the National Food Security Act's execution followed, and the inclusion was additionally extended. The Managerial information of 2016 shows that 74% of Indian families have a proportion card. Nearly six out of every ten low-income families bought grains from the PDS in 2012. The above enhancements safeguard unfortunate homes from food cost climbs and mitigate neediness during dry season and high food expansion. Over the past 60 years, the Indian government has implemented various policies to improve food security. The food safety net program aims to supplement essential household supplies like wheat, rice, sugar, and kerosene through a partnership between the federal and state governments. Nonetheless, as different answers for food shortage, this program isn't planned to give all necessary family food sources yet rather to give merchandise to enhance bought or cultivated products. The Food Corporation of India (FCI) is a central nodal agency that buys food grains from farmers at a price that is often higher than the market price to make distribution easier. The food grains are then purchased by state governments from the FCI at a subsidized price known as the "central issue price"; these merchandise are then conveyed to customers by means of fair cost or proportion shops.

A nation's food security is ensured if everyone has access to enough nutritious food, everyone can buy food of an acceptable quality, and there is no barrier to food access. Food insecurity



may be a constant problem for those living below the poverty line, while better-off individuals may also become food insecure as a result of calamity or disaster. In spite of the fact that a large number of people in India suffer from food and nutrition insecurity, the groups that are most severely impacted are landless or land-poor households in rural areas, workers in low-paying occupations, and seasonal workers in urban areas. Food insecurity affects a disproportionate number of people in certain parts of the country, such as economically disadvantaged states with high rates of poverty, tribal and remote areas, areas that are more susceptible to natural disasters, and so on. In addition to PDS, various programs to alleviate poverty were launched, one of which was food security. Integrated Child Development Services (ICDS) is one of these programs; Work-for-Eat (FFE); Late morning Dinners; Antyodaya Anna Yojana (AAY) and so forth. Through effective procurement at the Minimum Support Price (MSP), the storage and distribution of food grains, the availability of foodgrains, sugar, and edible oils through appropriate policy instruments, including the maintenance of buffer stocks of foodgrains, and making foodgrains accessible at reasonable prices, particularly to the weakest and poorest members of the society under a Targeted Public Distribution System (TPDS), the primary goal of the Public Distribution System (PDS) is to guarantee India's food security. The National Food Security Act's introduction in 2013 was a positive step toward bolstering the PDS. Addressing a shift from a conventional government assistance way to deal with a methodology supported by the acknowledgment of the common freedom to food and sufficient sustenance, the NFSA formalizes the point of the PDS to give financed food grains to north of 800 million individuals, or roughly 66% of India's populace. The wide idea of the NSFA permitted some current food safety efforts to be placed into regulation. The NSFA is based on a life cycle approach; It takes into account the nutritional requirements of the population across all age groups. It incorporates widespread angles accessible to all Indians, for example, the Late morning Dinner Plan and the Coordinated Kid Advancement Administrations Plan, while holding PDS focusing on. Under the NSFA, 75% of the provincial and 50 percent of the metropolitan populace are qualified for 5 kg of food grains each month at Rs 3, Rs 2, and Rs 1 for a kg of rice, wheat, and millet, individually (100 Rupees (Rs) is equivalent to 1.39 USD).

## REFERENCES

- Amutha, D., &Rathi, D. (2017). Role and Effectiveness of Public Distribution System in India. Available at SSRN 3039010.
- Chakraborty, S., &Sarmah, S. P. (2019). India 2025: the public distribution system and national food security act 2013. *Development in Practice*, 29(2), 230-249.
- Chowdappa, C. B. (2018). PUBLIC DISTRIBUTION SYSTEM IN ERADICATING IN RURAL POVERTY: A CRITICAL ANALYSIS. Department of Commerce Bangalore University, 77.
- Das, S., &Masiero, S. (2019, January). The datafication of anti-poverty programmes: evidence from the public distribution system in Karnataka. In *Proceedings of the Tenth International Conference on Information and Communication Technologies and Development* (pp. 1-5).
- Dev, S. M. (1998). Public distribution system: Impact on poor and options for reform.
- Drèze, J., &Khera, R. (2013). Rural poverty and the public distribution system. *Economic and Political Weekly*, 55-60.
- Jha, R., Gaiha, R., Pandey, M. K., &Kaicker, N. (2013). Food subsidy, income transfer and the poor: A comparative analysis of the public distribution system in India's states. *Journal of Policy Modeling*, 35(6), 887-908.

- Kira, T. (2018). Aadhaar-a transparency mechanism for food security in India: An analysis using the fair price shop sale transactions. *International Journal of Management, IT and Engineering*, 8(6), 318-327.
- Kumar, A., & Ayyappan, S. (2014). Food security and public distribution system in India. *Agricultural Research*, 3, 271-277.
- Kumar, A., Parappurathu, S., Bantilan, M. C. S., & Joshi, P. K. (2015). Public Distribution System in India: Implications for poverty and food security. *International Food Policy Research Institute*, New Delhi, accessed through <http://vdsa.icrisat.ac.in/Include/MiniSymposium/12.pdf>.
- Masiero, S. (2020). Biometric infrastructures and the Indian public distribution system. *South Asia Multidisciplinary Academic Journal*, (23).
- Prasad, K. (2013). Targeted public distribution system and the food security debate. *Journal of Governance & Public Policy*, 3(1), 45.
- Radharkrishna, R., & Subbarao, K. (Eds.). (1997). *India's Public Distribution System: A national and international perspective* (Vol. 380). World Bank Publications.
- Saini, K. S., & Ahlawat, S. (2019). Food policy in India: a historical appraisal. *Asian Journal of Multidimensional Research (AJMR)*, 8(6), 234-242.
- Santhanakrishnan, D. (2020). *Food Security Goals and Public Distribution System: Potential for Outcome Improvement through the Digitization of India's Distribution Regime* (Doctoral dissertation, University of Saskatchewan).
- Singh, S. (2006). *Food Security–Effectiveness of the Public Distribution System in India*. MBA thesis, Faculty of Economics, University of Ljubljana, Slovenia.
- Suri, S. (2014). Public Distribution System: An arrangement for food security in India. *ZENITH International Journal of Business Economics & Management Research*, 4(2), 39-46.
- Suryanarayana, M. H., & Silva, D. (2008). Poverty and food insecurity in India: A Disaggregated regional profile. *Chap. 7*, 217-52.
- Thomas, S. (2017). Redesigning the Public Distribution System in India: A Comparative Analysis of the States. *Asian Journal of Research in Social Sciences and Humanities*, 7(11), 222-239.
- Tritah, A. (2003). *The Public Distribution System in India: Counting the poor from making the poor count*. Toulouse, France: Universite des Sciences Sociales, Groupe de Recherche en Economie Mathématique et Quantitative.
- Verma, A., Rathore, A. S., & Kumari, A. C. (2018). An automated approach to public distribution system using internet of things. *Procedia computer science*, 132, 288-296.
- Zhou, Z. Y., & Wan, G. (2006). The public distribution systems of foodgrains and implications for food security. *Research Paper No*, 98.

## AN ANALYSIS OF THE IMPACT OF INFORMATION AND COMMUNICATION TECHNOLOGY ADVANCEMENT ON THE PERFORMANCE OF RETAIL FIRMS IN SMALL AND MEDIUM ENTERPRISES

**Dr. Vandana Gupta,**

L M College of Science & Technology (Autonomous), Jodhpur, India.

([vandanag20@gmail.com](mailto:vandanag20@gmail.com))

**Dr. Sanjeev Kumar Saxena,**

Assam University (A Central University) Silchar, India.

([saxenaprarak@rediffmail.com](mailto:saxenaprarak@rediffmail.com))

**Dr. Abhilasha Mathur,**

L M College of Science & Technology (Autonomous), Jodhpur, India.

([drabhilashamathur@gmail.com](mailto:drabhilashamathur@gmail.com))

**Junaid Hushain,**

Jai Narain Vyas University, Jodhpur, India.

([Hussainjan26.junaid@gmail.com](mailto:Hussainjan26.junaid@gmail.com))

**Prof. Sunil Kumar Gupta,**

Central University of Haryana, Mahendragarh, India.

([registrar@cuh.ac.in](mailto:registrar@cuh.ac.in))

In today's rapidly changing business environment, small and medium-sized enterprises (SMEs) face critical decisions regarding the adoption of Information and Communication Technology (ICT) to enhance their performance. This study explores the impact of ICT advancements on SMEs, considering variables like digital advancement, organizational framework, innovative entrepreneurship, and market conditions. Data of 240 respondents was collected from SMEs by using close-ended questionnaire in Uttar Pradesh, India, and analyzed using structural equation modeling. The findings reveal that ICT advancements positively influence SME success, with entrepreneurs playing a vital role in leveraging technology for growth. However, the organizational framework and market conditions showed mixed results in their impact on SME performance. The study underscores the importance of ICT adoption for SMEs in emerging economies and suggests that government policies and training programs can further enhance their capabilities. Future research opportunities include examining technology transfer and its effects on SME performance. Overall, this study contributes to the understanding of how SMEs can harness ICT to remain competitive and adaptive in today's dynamic business landscape.

**Keywords:** ICT, Retail Management, MSME, Technology advancement, Organisational Framework.

### 1. Introduction

In the contemporary dynamic environment, several businesses encounter a predicament regarding the decision to either revise or entirely substitute their current strategies (Joensuu-Salo et al., 2018; Oladimeji et al., 2017). The use of information communication technology (ICT) has become a viable path for the creation of job prospects in contemporary times. Social networking platforms have played a significant role in enabling novel methods for individuals to establish connections (Roztocki & Weistroffer Roland, 2011).

However, the adoption and usage of Information and Communication Technology (ICT) exhibit variations as a result of certain moderating variables, such as the level of innovativeness shown by entrepreneurs and the prevailing business climate. The

aforementioned criteria are of significant importance in influencing the relationship between IT advancement and the overall success of enterprises (Alexandra & Kassim, 2013; Yunis, Tarhini, & Kassar, 2018). The advancements in Information and Communication Technologies (ICTs) provide opportunities for novel company possibilities and establish the foundation for innovative entrepreneurial activities (Kossai&Piget, 2014). Innovative strategies may include using information technology (IT) to establish new markets and gain a competitive advantage by improving interactivity, reducing transaction costs, and fostering direct interaction with partners and customers (Hoque et al., 2016; Zhu et al., 2018).

Small and medium-sized enterprises (SMEs) in developing countries face considerable obstacles in the realm of technical advancement as a result of their limited scale and the unpredictable economic landscapes within which they operate (Wamuyu, 2015). Companies are increasingly dependent on information technology (IT) to achieve and sustain competitiveness, improve efficiency, and succeed in the ever-changing markets of today (Apulu, Latham, & Moreton, 2011; Yunis et al., 2018). According to Igun (2014), the aforementioned modifications have stimulated advancement endeavours that are centred on technology and intended to improve overall efficiency. Nevertheless, despite the extensive use of information and communication technology (ICT) by organizations in diverse industries, several survey results suggest that a significant number of firms encounter difficulties in advancing through the different phases of company expansion (Amankwah-Amoah, 2018).

The Indian government has acknowledged the significance of information and communication technology (ICT) and internet access as drivers of socio-economic progress and advancement. According to Kevin, Sonny, Tigineh, and Sriram (2017), the implementation of the e-Citizen web portal and customer service centres has been undertaken to enhance the efficiency of e-government services by consolidating them in a single area.

Notwithstanding the progress made in the information and communication technology (ICT) industry, small and medium-sized enterprises (SMEs) in developing countries persistently encounter significant obstacles, including hindered expansion, a diminishing trajectory in technical progression, and a notable rate of business failure (Bunyasi, Bwisa, & Namusonge, 2014). Based on a survey study conducted by the Ministry of Finance, it has been observed that small and medium-sized enterprises (SMEs) make very little contribution to the Gross Domestic Product (GDP). Despite constituting more than 60% of the production and employment sector, small and medium-sized enterprises (SMEs) have a failure rate that varies between 70% and 80%. Numerous small and medium-sized enterprises (SMEs) in developing nations exhibit a deficiency in their ability to engage in innovative practices and capitalize on the advantages offered by emerging technologies (KNBS, 2016; Mumbi, 2017). The rising relevance of ICT advancement in SMEs and its potential to alter the retail business prompted this investigation. Businesses, politicians, and researchers may influence strategic choices, public policies, and academic debate by understanding how ICT advancements affect SME retail enterprises. As technology evolves, retail SMEs must constantly evaluate their relationship with ICT to be competitive and adaptive.

This study addresses crucial topics like:

1. How do SME retail enterprises use ICT advancements, and how does this vary by business model and context?
2. What quantifiable performance measures can ICT advancement affect in SME retail enterprises, and how does this affect their success and growth?
3. What obstacles and possibilities do ICT advancements in retail provide for SMEs?
4. How can SME retail enterprises use ICT advancement to gain while minimizing risks and drawbacks?

The subsequent sections of this article are organized in the following manner: Section 2 offers a comprehensive examination of the current body of literature. In this section, the theoretical underpinning of the investigation is presented. The study methodology and the acquired findings are elaborated in sections 4 and 5, respectively. Section 6 of the paper delves into the obtained results and delineates the ramifications, deductions, constraints, and recommendations for further investigations.

## **2. Literature Reviews and Theoretical Framework**

The conceptual model developed by Ritchie et al. (2005) investigates the changes in interfaces and connections inside small and medium firms that occur as a consequence of their adoption and integration of information and communication technologies. A considerable body of literature about research on small and medium-sized enterprises (SMEs) has suggested that the degree to which firms adopt and employ Internet and information and communication technologies (ICT) differs based on various factors, including firm size, industry categorization, and the educational qualifications of the CEO (Burke, 2010). The primary aim of the study conducted by Mgijima et al. (2012) was to investigate the notable impact exerted by owners or managers of small and medium hospitality companies (SMEs) and ascertain the variables that they ought to consider to augment the efficacy of implementing Internet technology in their enterprises. The primary aim of the research undertaken by Ramdani et al. (2013) was to examine the empirical correlation between the components of technology-organisation-environment (TOE) and the adoption of enterprise applications (EA) within the context of small to medium-sized businesses (SMEs). The research done by Colombo et al. (2013) investigates the impact of broadband Internet technology implementation on the productivity results of small and medium enterprises (SMEs). The research done by Ross et al. (2015) examines the influence of Cloud technologies on the progression of entrepreneurship in small- and medium-sized enterprises (SMEs) from a global perspective. The authors examine the impact of Cloud technologies on small and medium-sized enterprises (SMEs), specifically in terms of their ability to expand their reach in global markets, minimize opportunity costs, and promote cooperation and creativity within a globally networked environment. The objective of the research undertaken by Vasiljeva (2016) is to determine the key factors that contribute to and impact the adoption of cloud computing (CC) services among small and medium-sized organizations (SMEs) in Latvia. The present research aims to get a comprehensive understanding of the concept of CC, including its related benefits and challenges, its impact on corporate performance, and its potential future possibilities. The primary aim of the research undertaken by Wismantoro et al. (2017) was to examine the degree to which female entrepreneurs use internet-based strategies to enhance their marketing effectiveness. The main objective of the research undertaken by Okundaye et al. (2019) is to investigate the use of information and communication technology (ICT) adoption as a strategic strategy among leaders of small-to-medium-sized firms (SMEs) in Nigeria. This research aims to examine the impact of adoption on profitability and global competitiveness. A further noteworthy contribution may be seen in the research conducted by Redmond et al. (2008).

According to Gunday, Ulusoy, Kilic, and Alpan (2011) and Modimogale and Kroeze (2011), the term "information communication technology" (ICT) refers to the technological systems that are used to transmit, store, process, display, generate, and automate the distribution of information. These technologies include things like television, fixed telephone lines, mobile phones, radio, satellite systems, video; computers, network software and hardware; and the equipment and services related to these technologies, such as emails, video-conferencing, blogs, and social media (Ali, Jabeen, & Nikhitha, 2016). Television is one of the most common examples of these technologies. According to Luppardini (2005),



technology advancement is defined as the methodical use of all sources of structured information, including literature, science, and the arts, to improve organizational performance.

The primary objective of this study is to fill the existing research void by investigating the impact of information technology advancement on company performance.

This investigation takes into account the relatively limited degree of technical advancement and the substantial rate of business closures seen in developing nations. The present study aims to address the following research inquiries: Is there a consistent relationship between information technology advancement and enhanced corporate performance? What is the impact of entrepreneurs on information technology advancement to improve the performance of firms?

## **2.1 Theoretical Framework**

Numerous studies have explored ICT adoption and implementation at the organizational level, including theories and frameworks (Chen & Kamal, 2016; Findik& Tansel, 2015; Haller & Siedschlag, 2014; Hartoyo& Daryanto, 2016). Some theoretical models emphasize external environmental aspects, while others include technical elements (Zahra, 2008, 2011). Previous studies have investigated the adoption of technology theories, focusing on individual IT usage in developed nations (Momani & Jamous, 2017; Taherdoost, 2018). The dissemination of invention (DoI) by Rogers (1995) and the technology adoption model (TAM) by Davis (1989) are frequently utilized in information-related research and dominate managerial technology research (Zheng, 2015).

The present research utilizes two prominent theoretical frameworks: the five-stage growth model, first proposed by Churchill and Lewis in 1983, and the product-process advancement model, developed by Utterback and Afuah in 1995. The growth model proposed by Churchill and Lewis is specifically designed for small and growing firms, and it outlines five clearly defined phases of development. According to Gupta (2013), this model presents a systematic viewpoint on the many stages that a firm experiences during its development.

### **2.1.1. Five-Stage Growth Model**

The "firm existence stage," which involves attracting and serving clients, is the first stage of a company's growth (Churchill & Lewis, 1983). Startups' focus on invention and strategy helps advance technology today. Starting a firm from scratch is risky, time-consuming, and uncertain (Rahman, Yaacob, & Radzi, 2016). Due to fierce competition from fresh ideas and technology, 25% of startups fail in their first year (Bunyasi et al., 2014).

Advancement isn't the only factor in success since organizations are now leveraging technology to improve and grow their goods and services. Thus, advancement and entrepreneurship may boost startup performance (Gupta, 2013). Creating a sustainable business process and answering critical questions about how the firm can break even and survive is the second step. Technology allows SMEs to develop and compete, according to Tidd and Bessant (2010). Advancement helps SMEs develop and perform better than those that don't (Rahman et al., 2016). Startups are failing more, hence SMEs must be prioritized (Bunyasi et al., 2014). Advancement in technology improves survival (Tidd & Bessant, 2010). Entrepreneurs must aggressively promote advancement since a business's success and survival depend on it (Varis & Littunen, 2010). Technology may help SMEs survive and expand. Success is the third phase when owners must determine whether to keep the company's momentum and grow or retain profitability while investigating other business opportunities (Churchill & Lewis, 1983). This phase may last forever if environmental

changes don't undermine the company's market niche or inadequate management doesn't destroy its competitive advantage (Chattopadhyay & Bhawsar, 2017). As business practices develop, "big beating small" is becoming "fast beating slow". Most successful organizations outperform their rivals (Varis & Littunen, 2010).

Takeoff/growth, the fourth phase, accelerates corporate development and secures finance (Favaretto & Meirelles, 2015). At the growth stage, SMEs must expand and develop to boost revenues and risk resilience, creating a virtuous loop (Mothe & Thi, 2010). Technological advancement, marketing, and cost reduction should be SMEs' priorities (Pratali, 2003). Growing SMEs need a technological advancement plan as technology grows and changes (Favaretto & Meirelles, 2015).

The fifth level is resource maturity, which involves the organization leveraging its size, management skills, and financial resources (Runyan, Huddleston, & Swinney, 2007). According to Rahman et al. (2016), mature SMEs want to sustain and stabilize their market share, technical leadership, staff structure, revenue, and other advantages. The level of technical advancement in SMEs is linked to economic productivity and sustainable growth (Pratali, 2003). At maturity, a company's advancement performance relies on its potential for technical advancement (Churchill & Lewis, 1983).

According to Macvaugh and Schiavone (2010), technical advancement is not only tied to its progress but also to its diffusion inside an organization. Technology drives invention and continuously improves previous advancements (Chattopadhyay & Bhawsar, 2017). The five-stage growth model outlines a company's economic returns' exponential development phase and ultimate fall, encouraging organizations to embrace technology for advancement and performance improvement (Zheng, 2015). SME development involves many difficulties, opportunities, resource demands, and management techniques (Churchill & Lewis, 1983). It evolves from an entrepreneurial attitude through team building and advancement, ultimately resulting in company performance (O'Farrell & Hitchens, 1988).

### **2.1.2. Product-Process Model**

Utterback and Afuah's (1995) product-process advancement model ties advancement rates to a company's product-based development stage (Meissner & Kotsemir, 2016). In this regard, Gremyr et al. (2014) separate process and product advancements.

Early product alterations are driven by non-standardized production and performance competitiveness (Butler, 1988). Firms emphasize outdoing competitors over product performance in the second phase (segmental stage) (Kraja & Osmani, 2015). Company climate and rivalry motivate owner-managers to innovate (Amankwah-Amoah, 2018). Due to volume-ready manufacturing equipment, process advancements increase while product advancements decline (Utterback & Afuah, 1995).

Slower development reduces process and product advancements at the final systemic stage (Lester & Parnell, 2005). When manufacturing methods can't react to product changes, be cost-conscious. Technology fosters price-based competition since advancement is always changing (Yanes-est, Mar, & Ram, 2018).

In this research, the product-process model is significant since the stage of development directly affects a product's competitive advantage (Butler, 1988). For example, the segmental stage spans product creation through obsolescence (Utterback & Afuah, 1995). The product/service's nature should lead the producer's design for its implementation (Butler,



1988). The model explains how a product or service is created and supplied to clients. A product or service may be produced, marketed, delivered, and supported using a mix of techniques, capabilities, and technologies (Utterback & Afuah, 1995). Both methods are relevant to our study since IT advancement supports strategic organizational goals including operational excellence and product/service launches (Jiménez & Zheng, 2017). Owner-managers should integrate IT advancements with an entrepreneurial attitude to boost their company's value and competitiveness (Irungu, Mbugua, & Muia, 2015; Ahn, Minshall, & Mortara, 2015).

### 2.1.3 Conceptual Model

The study's conceptual model includes models for IT advancement, entrepreneurial inventions, market conditions, organizational framework, and corporate success. These components are shown in Figure 1. This model offers a thorough theoretical framework for organizational IT advancement distribution and adoption (Akinwale, Adepoju, & Olomu, 2017). The model shows that an entrepreneur's capacity to manage formal and informal workforce administration and communication inside the firm affects their creativity (Seun, Kalsom, & Raheem, 2017). Entrepreneurship traits including resource management and creativity affect company performance (Laguir & Besten, 2016). Competitiveness, supplier pressures, customer wants, and entrepreneur experience might impact technological advancement implementation (Rahim & Zainuddin, 2016).

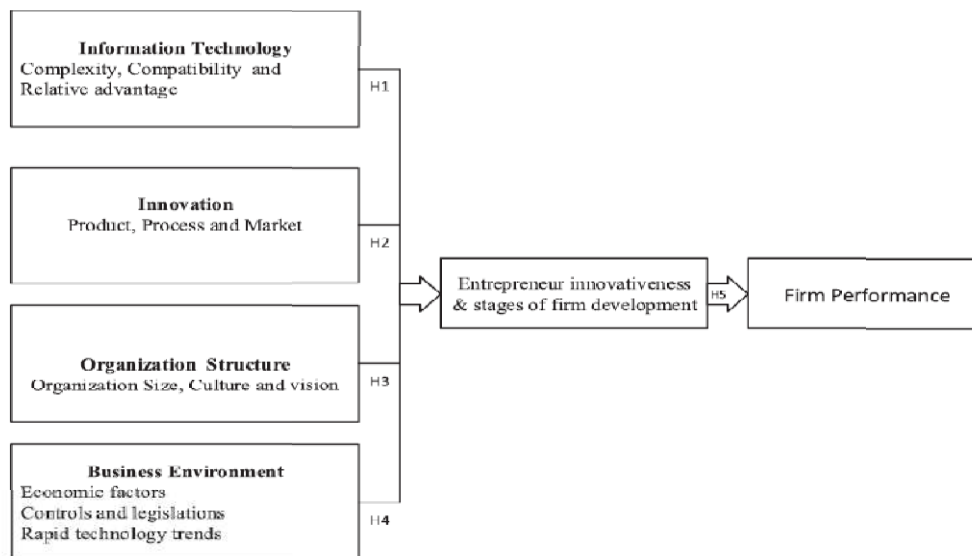


Fig.1 Conceptual Framework for this research

Source: <https://doi.org/10.1080/02681102.2019.1573717>

## 2.2. Derivatives Hypothesis

### 1. Digital Advancement and SME Success

Digital Advancement strategies for goods and methods are influenced by several variables, such as the demand for enhanced business performance (Mihalic & Bousinakis, 2013; Novacuddec, Enache, & Sbughea, 2011). According to Rogers (2003), Digital portability encompasses how well new advancements align with current norms, user interfaces, and

demands. The integration of ICT with existing work practices boosts SME technology advancement (Ntwoku et al., 2017). According to Rogers (2003), SMEs regard digital advancement as complex and difficult to understand and apply. Roberts and Amit (2003) state that creative businesses have a competitive edge, resulting in high revenues and sustainability (Atuahene-Gima, 2004). Advancement impacts products, processes, markets, production variables, and organizational structures (Roach, Ryman, & Makani, 2016).

SMEs have five unique growth phases as they evolve (Churchill & Lewis, 1983). IT advancement has a crucial role in corporate development and should be considered by managers in strategic decision-making throughout the life cycle (Utterback & Afuah, 1995). SMEs must adopt new technologies and creative techniques to go through development stages (Chaston, 2010; Gupta, 2013). Technology advancement involves the development and spread of inventions inside an organization (Churchill & Lewis, 1983). Technology drives advancement and improves existing ones, leading to new inventions. The five-stage growth model demonstrates how companies' economic returns undergo exponential growth and decrease, driving enterprises to use technology for advancement and improved performance (Churchill & Lewis, 1983). The following hypotheses are derived based on the above discussion:

**H<sub>a1</sub>: Digital Advancement is positively correlated with the SMEs' success.**

**H<sub>a2</sub>: The usage of digital advancement in ICT has positively influenced SMEs' success.**

## **2. Organisational Framework and SMEs' performance**

Csaszar (2009) asserts that the arrangement of an organization's structure is a pivotal factor in influencing its overall success. The inhibiting effect on the creative and inventive capacities of the workforce due to an inadequately designed organizational structure has been acknowledged by Lunenburg (2012) and Mintzberg (1992). The impact of organizational structures on a company's financial success and its ability to efficiently manage its people has been underscored by Setiawan, Putrawan, Murni, and Ghazali (2016). According to Trez and Luce (2012), the organizational structure serves to delineate the coordination of duties and tasks among people and teams inside the corporation.

According to the research conducted by Marija, Stevanović, and Belopavlović (2014), the management structure prevalent in SMEs is often characterized by a high degree of centralization, including a wide array of controls, limited specialization, and low departmentalization. According to Hao, Kasper, and Muehlbacher (2012), the Owner-manager in this particular arrangement accepts accountability for all crucial decisions and supervises all operational facets of the organization. The organizational paradigm described has notable benefits, including well-defined control mechanisms and a significant level of flexibility, as highlighted by Trez and Luce (2012). According to Muduenyi, Oke, and Fadenyi (2015), there is a research consensus that the selection of a framework for operation in a company has a substantial impact on the levels of Information Technology (IT) advancement and the overall success of the business.

In the start-up phase, Churchill and Lewis (1983) suggest small company owners prioritize clients and chances to sell goods and services. The organizational structure is simple: the boss oversees every subordinate directly (Churchill and Lewis, 1983). The structure may anticipate essential needs, including owner time commitment at start-up, delegation, and management position changes as SMEs develop (Churchill & Lewis, 1983). Predicting a company's development trajectory needs ongoing competition throughout its existence, survival, success, take-off, maturity, and transition stages (Churchill and Lewis 1983). The absence of a formal organizational structure and competent employees hinders the company's growth (Peng, 2012). Literature suggests the following:

**H<sub>a3</sub>: Organisational Framework has positively influenced the SMEs' performance.**

#### **4. Innovative Entrepreneurship and SME Performance**

Entrepreneurs innovative by exploring fresh opportunities and goods and eliminating outdated processes to stay ahead of their rivals (Wambugu & Gichira, 2015). Managers' ICT skills and expertise are essential for generating innovative ideas and promoting company growth (Wamuyu, 2015). Yunis et al. (2018) define entrepreneur innovativeness as the manager's ability to identify and capitalize on chances to enhance resource utilization and company performance. Kuratko (2017) defines entrepreneurial inventiveness as a vision-directed approach that rejuvenates and shapes the organization's scope of activities via the utilization of commercial prospects.

Churchill and Lewis (1983) found that the owner-managers importance is maintained throughout firm development, even as their positions change. According to Churchill & Lewis (1983), Majumdar (2008) indicates that a business's development depends on the entrepreneur's vision and positioning, which vary. In 2010, Pitelis noted that experienced managers' project planning and execution skills determine a company's success. Management resources, notably the ability to coordinate operations and incorporate new technology, limit the company's growth (Pitelis, 2010). Early business growth requires skills development, personal devotion, risk-taking, and a clear vision (Adizes, 1979). As the company evolves, executives concentrate on business sustainability by using effective planning, technology, and processes to meet performance goals. Literature suggests these are the most important aspects.

**H<sub>a4</sub>: Advancement Entrepreneurship has positively impacted the SMEs' performance.**

#### **5. Market Conditions and SMEs Performance**

In 2016, Rahim and Zainuddin noted that rapid technical improvements and market volatility pose dangers to product and service development. Technological advances, market needs, and fierce rivalry all affect a business's success (Yanes-est et al., 2018; Zahra, 2011). Three business perspectives have emerged from research (Akanni, 2015). The first view of an organization's external entities includes consumers, competitors, suppliers, and government laws (Sroufe, 2003). The second approach emphasizes external elements' complexity, dynamism, and interconnection (Jong, Phan, & Ees, 2011). External environmental influences may affect a firm's market orientation and performance (Ting, Wang, & Wang, 2012). The third aspect is management views on environmental issues (Raymond, 2012). Alignment between internal and external environmental elements may limit corporate success (Akanni, 2015; Lumpkin & Dess, 2001; Roberts, 2010). Alignment between internal and external environmental elements may limit corporate success (Akanni, 2015; Lumpkin & Dess, 2001; Roberts, 2010).

Churchill and Lewis (1983) suggest that small enterprises should prioritize agility throughout expansion by adapting to environmental, market, and incentive changes to keep up with advancements and avoid stagnation. Levie and Lichtenstein (2010) assert that corporations may expand in response to changes in their both internal and external contexts, unlike live creatures.

Businesses can adapt to changing environments for sustained development and survival. According to Leitch, Hill, and Neergaard (2010), understanding the company's development phases with its environment is crucial (Pitelis, 2010). Literature suggests the following:

**H<sub>a5</sub>: Market conditions have positively impacted the performance of SMEs.**

### 3. Research Methodology

The study adopts an approach to quantitative research and utilises a semi-structured questionnaire as the major tool for data gathering. The development of the questionnaire was informed by pertinent literature sources, including works by Babin and Carr (2010), Kothari (2004), Mugenda and Mugenda (1999), and Yu (2012).

This research uses non-probability sampling, using convenience sampling as the sampling technique. The samples were collected from the managers of MSME in Uttar Pradesh. There are various reasons for the selection of UP for sample collection. First, UP is the largest state, contributing 14.20% of the total MSME in India (MSME, Annual Report, 2021-22). Second, the government has taken many initiatives to improve the connectivity of the internet in the state. Third, the maximum number of MSMEs is related to the agriculture sector, this will help to analyse the impact of ICT on MSMEs related to agriculture. The size of the sample plays a crucial role in assuring the representativeness and appropriateness of the sample for conducting the necessary statistical analyses. Israel (2012) argues that research conducted with a large population may employ more straightforward equations to determine the optimal size of the sample to collect. When doing high-impact research using multiple linear regression or covariance analysis, an adequate sample size is regarded to be between 200 and 500 individuals. To choose a sample size of 297 different businesses, the researcher opted for a method of selection that was not random.

The researcher adapted variables from earlier studies to meet the current setting while measuring variables. The research amended Premkumar and Roberts' (1999) technological context variables (complexity, relative advantage, and compatibility). Technology advancement variables (product, process, and market) were sourced from Jong (2000) and Simiyu (2013). Organizational context variables came from Thong et al. (1996). The variables for owner-manager ICT knowledge and advancement were sourced from Thong and Yap (1995). Environment elements were sourced from Ramsey and Mccole (2005), Al-Qirim (2005), Rahayu and Day (2015), and Thong (1999). The assessment of SME performance was determined by Fazli et al. (2013) and Margarita et al. (2013). A five-point Likert scale (1 = strongly disagree, 5 = strongly agree) was used to rate variables, with higher scores indicating higher construct rankings. The research examined respondents' age and gender using years or a binary variable (1 = male, 0 = female) (Cooper & Schindler, 2003).

The survey was divided into two sections. In the initial portion, respondents provided information about themselves and their firms, covering aspects such as age, experience, education, industry, legal registration status, business size, and location. The second part of the study delved into the technical context, considering elements like compatibility, complexity, and relative advantage, as well as progress in terms of product, process, and market advancements. The questionnaire drew insights from sources including Coudel et al. (2017), Wu & Zhang (2013), organizational structure, owner-manager progression, and environmental influences. A total of 297 questionnaires were issued to small and medium enterprises (SMEs) in the state of Uttar Pradesh. A total of 249 questionnaires were gathered, with 240 of them being deemed usable.

## 4. Results and Interpretation

### 4.1 Descriptive Statistics

*Table 1 Respondent's Profile*

	Classification	Frequency	Percentage (%)
Gender	Male	84	35%
	Female	156	65%
Age (years)	18-24	28.8	12%
	25-30	170.4	71%
	31-36	9.6	4%
	Above 37 years	31.2	13%
Business experience	Less than one year	9.6	4
	1-2 years	24	10
	3-4 years	96	40
	5-6 years	84	35
	More than 6 years	26.4	11
Education level	Primary level	36	15%
	Secondary level	120	50%
	Bachelors	19.2	8%
	Masters	60	25%
	PhD	4.8	2%
	Diploma	60	25%
Industry category	Agriculture	108	45%
	Service	48	20%
	Manufacturing	84	35%
Firm Size	1-5 employees	211.2	88%
	6-10 employees	28.8	12%
	11-15 employees	24	10%
	Over 15 employees	0	0

Source: Author's work

According to the findings shown in Table 2, it is evident that 65% of the participants identified as female, with the remaining percentage being male responses. This data suggests that female entrepreneurs may have a greater likelihood of engaging in commercial activities in rural areas. Most respondents were aged 25-34 (71%), while 13% were over 35. Most responders (50%) had secondary education, with 2% holding master's degrees, 8% with degrees, 25% with diplomas, and 15% with elementary education. More than half of respondents only completed secondary school, a low percentage. Previous research indicates that most small company owners only have secondary education (UNESCO, 2016). The research included respondents' education level, which impacted their interpretation of the questions. Most SMEs (88%) had 1-5 workers, followed by businesses (6-10 employees) (12%). The study found that most sample companies were small businesses with less than 10 workers. The majority of firms (65%) were in manufacturing and agriculture. Rural SMEs have a substantial impact oneconomic development via informal employment (ILO, 2015).

#### 4.2 Reliability Measurement

#### 4.3

Table 2 Reliability Analysis

Cronbach's alpha	Number of Items
.859	52

Source: SPSS output

According to Nunnally (1978), a Cronbach's alpha value over 0.70 is deemed satisfactory in terms of the suitability of data for research endeavours. The research yielded a Cronbach's alpha value of 0.859, above the designated threshold. This indicates a high level of consistency and is deemed satisfactory and commendable for the study.

**5.3 Results**

IBM SPSS Amos software was used for data processing and statistical analysis (Carver & Nash, 2011; Meyers, Gamst, & Guarino, 2013). The research identified latent components in the original 38 measure items using exploratory analysis. The Promax maximum likelihood technique Kaiser normalisation is employed because it standardises parameter estimation difficulties. that can handle several estimating situations (Meyers et al., 2013). The variable Explanatory factor analysis reduced components to one factor (Katou & Budhwar (2008).

*Table 3 KMO and Bartlett's Test*

<b>Kiser-Meyer-Olkin Adequacy</b>	<b>Measure of Sampling</b>	.929
<b>Bartlett's Test of Sphericity</b>	Chi-Square	624.345
	df	105
	Sig.(p)	.000

Source: SPSS output

The KMO value shown in Table 3 is 0.929, above the permissible threshold of 0.6. This indicates that the sample size is sufficient for conducting a factor analysis. Bartlett's test of sphericity in table 3 yields a statistically significant result of 0.000, indicating a strong correlation among the components retrieved from the data.

*Table 4 Total Variance Explained*

<b>Initial Eigenvalues</b>			
<b>Components</b>	<b>Total</b>	<b>% Of variance</b>	<b>Cumulative %</b>
Information Technology	6.27	29.838	29.838
Technology Advancement	3.73	17.751	47.590
Organization Structure	2.30	10.945	58.535
Entrepreneur Innovativeness	1.80	8.566	67.101
Business Environmental	1.06	4.790	71.891

Source: SPSS output

Five significant factors were extracted in the Total Variance Explained analysis with more than one eigenvalue. These five factors represent 71.89% of the total variance, which is greater than 60% according to Hair et al., 2010 is acceptable for the further process, as mentioned in table 4. *Table 5 Rotated Component Matrix*

	<b>Variable Constructs Measures</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
A.	<b>Digitalisation/ Information technology</b>						
1	If necessary, the company has access to the internet.	.833					
2	The software we use now is quite user-	.928					



	friendly.						
3	A new system in the company has replaced certain older apps.	.437					
4	Some applications were replaced by a new system in the firm	.816					
5	In the corporate world, technology is employed to increase productivity.	.844					
6	To provide faster service to clients, technology is used.	.696					
7	Obtaining market data has never been easier thanks to technological advancements.	.505					
<b>B.</b>	<b>Digital Advancement/Technology Innovativeness</b>						
1	Invention or a new crossbreed	.582					
2	Increasing a product's worth by making it better	.928					
3	Introducing brand-new practices and protocols	.785					
4	Adopt cutting-edge tools and resources for your company.	.777					
5	Focus on cutting-edge plans and digital marketplace applications	.916					
6	The emergence of ICT-enabled new markets	.881					
7	Technology-enabled farm product promotion	.932					
8	Farm produce ICT marketing tools	.599					
<b>C.</b>	<b>Structure of Organisation</b>						
1	Business leaders who share a vision for the future of ICT adoption		.855				
2	Adaptable and efficient channels of interaction.		.542				
3	It is simple to get technological resources		.760				
4	Leadership can shift gears as necessary.		.501				
5	A staff that rallies behind a mission		.747				
<b>D</b>	<b>Entrepreneur Innovativeness</b>						
1	Competitiveness and tech-savvy			.445			
<b>E</b>	<b>Market Conditions</b>						
1	ICT policy and support from the government				.600		
2	Availability of Information and Communication Technology Facilities				.874		
3	Organizational requirements for and pursuits of ICT advancement				.652		
4	An advantage over rivals is gained via the usage of ICT.				.628		
5	The weather and the stock market are two areas that benefit from ICT.				.717		



6	Having access to both regional and international markets is made possible by ICT.					.765	
F	<b>Firm Performance</b>						
1	Profitability					.859	
2	Sale Volume					.767	
3	Employee member					.737	

Source: SPSS output

The rotated component matrix used Promax maximum likelihood technique Kaiser normalisation for factor loading. Table 5 shows the factor loading of all the statements. The loading of all the statements is more than 0.7, which is considered satisfactory (Malhotra & Dash, 2014), and it can be concluded that the factors were suitable for further analysis.

Initially, a solution including seven factors was created. The constructions that failed to meet the recommended minimum level of 0.30 (Hair, Black, Babin, Anderson, & Tatham, 2010) were excluded from the model. significant variables, resulting in a more robust and accurate model. The recommended threshold, as suggested by Hair, Black, Babin, and Anderson (2010), is more than 0.30. Ultimately, a total of 29 items persisted in the given context. The subsequent model follows these sequential phases.

Cronbach's alpha ( $\alpha$ ) was used in the research to assess the reliability and validity of the variables. It is advised to have an alpha value that exceeds 0.70. The findings indicate that all constructions of the research variables have an alpha value over 0.6. The research examined convergent validity. The research's validity was confirmed by observing that all 29 items in the study had loadings greater than 0.7, meeting the predetermined criteria (Su, Peng, Shen, and Xiao, 2013). In the study, the results indicated high levels of internal consistency for all the measured variables. Furthermore, the average variances extracted (AVE) for each variable construct were found to be greater than 0.50, demonstrating acceptable levels of dependability has been seen (Hair, Black, Babin, Anderson, & Tatham, 2010), as shown in Table 6.

Table 6 Factor loading, Average variance extracted and Composite Reliability

	Variable Constructs Measures	Cronbach alpha	AVE	CR
A.	Digitisation/information technology	0.878	0.567	0.878
B.	Digitalisation advancement	0.930	0.698	0.976
C.	Organisation' Structure	0.862	0.567	0.856
D	Entrepreneur Innovativeness	0.843	0.675	0.845
E	Market Conditions	0.788	0.508	0.834
F	Firm Performance	0.764	0.653	0.821

Source: SPSS output

### 5.3.1 Structural Model Estimation (SME)

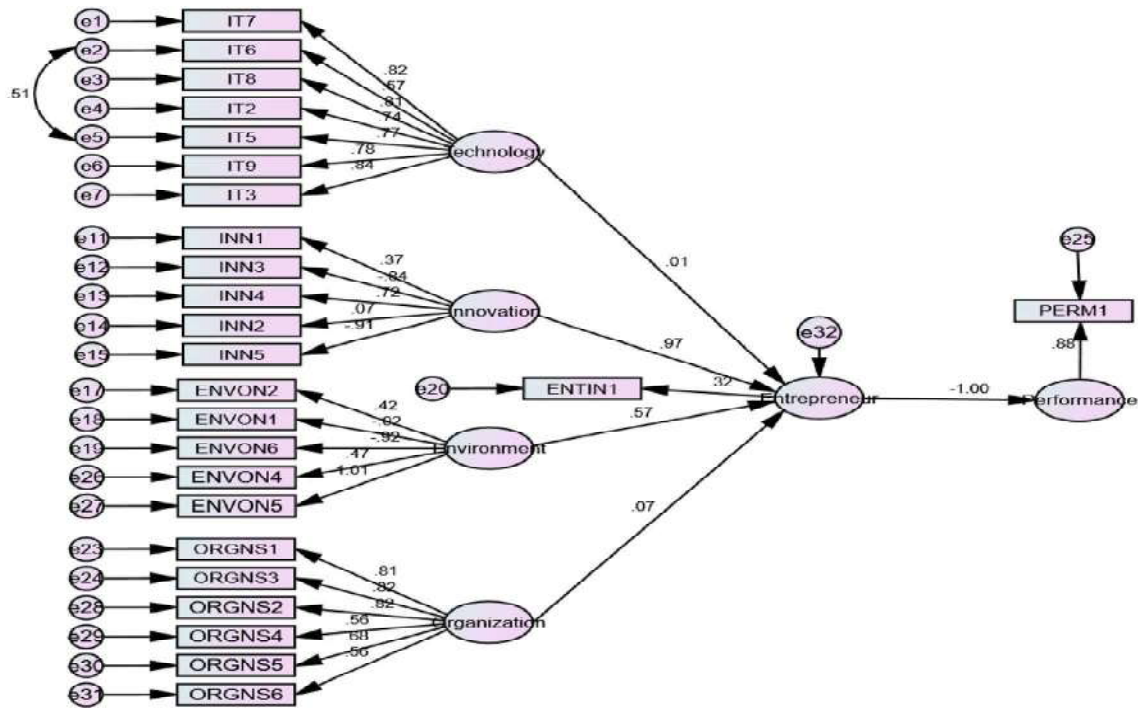


Fig: 2 Structural model  
Source: SPSS output

The model fit indices indicated that the measurement model demonstrated validity. The fit indices and variance explained estimations were examined via the use of structural equation modelling (SEM). According to Table 4, it can be seen that the fit indices of the structural equation model (SEM) and the suggested threshold values are used for evaluating the overall fit of the model.

Table 7 Structural Model Fit Indices

Index	Value	Cut-off Value
Chi <sup>2</sup> /df	2.103	<3
CFI	0.958	>0.9
NFI	0.924	>0.9
GFI	0.913	>0.9
RMSEA	0.068	<0.08

Source: Spss output

### 5.3.2. Test of Hypothesis

The structural linkages and their path coefficients were examined since the overall fit indices of the structural equation modelling show a satisfactory match. As demonstrated in Table 6 and Figure 3, path coefficients and standard estimates permitted hypothesis testing.

#### Ha1: Digital Advancement is positively correlated with the SMEs' success. (Accepted)

The results of the hypothesis testing indicated that there was a significant positive correlation between digital advancement ( $\beta = 0.469$ ,  $p = 0.00$ ) on the SMEs' success. Therefore, the first hypothesis (H1) was deemed valid.

#### Ha2: usage of digital advancement in ICT is positively influenced in SMEs success (Accepted)

Testing the second hypothesis, usage of digital advancement ( $\beta = 0.264$ ,  $p = 0.00$ ) positively influences in SMEs success. The second hypothesis (H2) was accepted. This indicates that technical advancement significantly impacts SME performance.

**Ha3: Organisational Framework has positively influenced the SMEs' performance.(Rejected)**

Concerning the third hypothesis, the findings indicate that there is no significant impact of the organizational framework ( $\beta = 0.189$ ,  $p = 0.098$ ) on SME performance. Therefore, the third hypothesis (H3) lacks support.

**Ha4: Advancement Entrepreneurship has positively impacted the SMEs' performance. (Accepted)**

The findings provided evidence in favour of the fourth hypothesis, indicating that there is a positive influence of Advancement Entrepreneurship ( $\beta = 0.534$ ,  $p = 0.00$ ) on the association between SME performance. Therefore, the acceptance of the fourth hypothesis (H4) was confirmed. The observed outcomes regarding the correlation between the innovativeness of entrepreneurs and the success of small and medium-sized enterprises (SMEs) may be influenced by many other variables, including the propensity of entrepreneurs to undertake risks, their level of experience, their capabilities, consumer wants, and the presence of a suitable market. According to Zahra (2011).

**Ha5: Market conditions have positively impacted the performance of SMEs. (Reject)**

Concerning the fifth hypothesis, the findings suggest that there was no statistically significant impact of the Market conditions ( $\beta = 0.017$ ,  $p = 0.640$ ) on the association between ICT advancement and company performance. Therefore, the fifth hypothesis (H5) was rejected. The ability of owner-managers to effectively incorporate technological advancement within the business environment has the potential to positively impact company profitability. The findings presented are corroborated by research done by Akanni (2015), which demonstrates a robust correlation between the operational context and the performance of organizations.

*Table 8 Path Analysis for Hypothesis testing*

Hypothesis	Independent variables	Dependent variables	Estimate	S.E.	t-stat	p-value	Results
Ha1	Digital Advancement	SMEs Performance	0.496	0.114	4.728	***	Accept
Ha2	Usage of digital advancement	SMEs Performance	0.264	0.067	4.375	***	Accept
Ha3	Organisational Framework	SMEs Performance	0.189	0.056	1.667	0.098	Reject
Ha4	Advancement Entrepreneurship	SMEs Performance	0.534	0.087	5.943	***	Accept
Ha5	Market Conditions	SMEs Performance	0.017	0.024	0.472	0.064	Reject

Source: SPSS output

## 6. Discussion and Implications

Technological advancement constantly opens doors for new businesses (Yunis et al., 2018). The delayed adoption of new technology has led to the closure of several businesses within a few years (Bunyasi et al., 2014). Rapid technology releases may benefit or harm businesses depending on their operational environment (Peres et al., 2010). The influence of technological advances on small and medium-sized enterprises was examined using the consolidated five-stage model of small company development (Churchill & Lewis, 1983) and product-process advancement models (Utterback & Afuah, 1995).

SME success relies on their capacity to leverage economic possibilities via fast technological advancement, supporting prior research by Akinwale et al. (2017) and Razavi et al. (2016).

The first hypothesis was confirmed: ICT advancement directly impacts SME performance. The results align with Chung and Wang (2004). Table 6 shows that using various ICT advancement techniques in the working environment enhances corporate success. Technology advancement significantly impacts SME performance, supporting both the first and second hypotheses. ICT is crucial in closing the gap between developed and developing nations in commercial organizations. According to studies by Mohr, Sengupta, and Slater (2010) and Al-Jabri and Sohail (2012), anticipated comparative advantage encourages SMEs to adopt ICT and predicts the process.

Using ICT in business results in improved profitability and incentives for SMEs to innovate (Kotler & Keller, 2012). Premkumar (2003) suggests that SMEs' adoption of technological advancement is limited by its compatibility with labour practices, particularly in developing nations. Environmental elements that boost company competition may inform IT advancement initiatives in the present multinational business model (Ting et al., 2012). The findings in the third hypothesis indicate that organizational structures do not significantly impact the association between IT advancement and company success. Developing nations confront hurdles in implementing information communication technology, including poor organizational structures, limited ICT skills, and inadequate infrastructure (Apulu et al., 2011). Research indicates that successful implementation of ICT in organizations relies on organizational structures, channels, and government backing (Kleine, 2015).

The training improves entrepreneurs' capacity to adapt technology for company success (Matofari, 2015). Entrepreneurs' capacity to screen environmental elements is crucial when launching new products, processes, or markets (Neneh & Zyl, 2012). Entrepreneurs must take measured risks and do rigorous environmental screening to adapt to changing technologies and client preferences (AlBar & Hoque, 2017; Apulu et al., 2011). The lack of a substantial correlation between the business environment and IT advancement and SME success may be due to entrepreneurial creative thinking, rather than the environment (Franco & Garcia, 2017). The entrepreneur impacts the utilization of IT advancement in the company (Kossai&Piget, 2014). SMEs' adoption of ICT depends on a government regulatory framework, which may either assist or hinder implementation (Franco & Mario, 2017).

This suggests that SMEs should implement an IT system in their operational environment (Zahra & Das, 1993), showing that technological advancement may be dangerous due to environmental variables and performance (Brustbauer, 2016; Kraja & Osmani, 2015). The effect of ICT on SME performance depends on the innovative environment in which the firm works (Chattopadhyay & Bhawsar, 2017). Entrepreneur capacity impacts the connection between environmental conditions and business performance, as indicated by Chen et al. (2014) and Gupta (2007), who found a correlation between performance and ICT.

The study's theoretical implications could boost ICT investigations into SMEs in underdeveloped nations. The research concluded that although ICT offers advantages to SMEs via diverse applications, its implementation is a problem that restricts these advantages. Government ICT policies and assistance programs should encourage SMEs to innovate in ICT to enhance economic growth and food security. The government should enhance ICT access and create incentive-based programs to enhance the skills and capacities of SMEs' owners and staff. Effective ICT skills and expertise help SMEs reach global markets with innovative technology and digital tools. Government strategy should prioritize ICT infrastructure, SMEs' technical adverse effects, resource centres, and advancement dissemination to enhance SME performance. To improve ICT infrastructure in underdeveloped nations, studies suggest using organizational activities including training, decentralized action plans, and benchmarking to acquaint personnel with the newest technologies. Government strategies for SMEs in emerging economies should prioritize sustainability and profitability via incentives for advancement. To boost SME performance,

government agencies should encourage SMEs via entrepreneurial and ICT training, company incubation, role modelling, and marketing. Educational practitioners should update the ICT curriculum to align with worldwide trends and help students adapt to technological developments. Governments should promote technology transfer to bridge the digital gap between developed and poor nations. This will improve worldwide cooperation and encourage corporate re-engineering via ICT interconnection.

## 7. Conclusion and Future Research

This study has shown the interdependence of the variables under examination, yet its limitations bring up new research opportunities. First, the research used a sampling method that may limit generalizability. The approach was selected because it was suitable for gathering data from SMEs. Semi-structured surveys may also have construct validity issues (Avolio, Yammarino, & Bass, 1991). The businesses' management and personnel were given the surveys, but IT advancement and company performance may change. Future research should examine how technology transfer affects SME performance in underdeveloped nations, expanding this study.

The purpose of this research was to examine how IT advancement affects corporate performance. In the competitive business climate, entrepreneurs must create new methods to ensure good company performance and exceed client expectations. The research found that IT advancement impacts SME success, with entrepreneurs playing a crucial role in this connection. To retain a competitive edge, SMEs may use IT advancement and the enthusiasm and competencies of entrepreneurs throughout the firm's evolution.

## Reference

- Adizes, I. (1979a). Organizational passages—Diagnosing and treating lifecycle problems of organizations. *Organizational Dynamics*, 8(1), 3–25. [https://doi.org/10.1016/0090-2616\(79\)90001-9](https://doi.org/10.1016/0090-2616(79)90001-9)
- Adizes, I. (1979b). Organizational passages—Diagnosing and treating lifecycle problems of organizations. *Organizational Dynamics*, 8(1), 3–25. [https://doi.org/10.1016/0090-2616\(79\)90001-9](https://doi.org/10.1016/0090-2616(79)90001-9)
- Ahn, J. M., Minshall, T., & Mortara, L. (2015). Open advancement: a new classification and its impact on firm performance in innovative SMEs. *Journal of Advancement Management*, 3(2), 33–54. [https://doi.org/10.24840/2183-0606\\_003.002\\_0006](https://doi.org/10.24840/2183-0606_003.002_0006)
- Akanni, P. O., Oke, A. E., & Akpomemie, O. (2015). Impact of environmental factors on building project performance in Delta State, Nigeria. *HBRC Journal*, 11(1), 91–97. <https://doi.org/10.1016/j.hbrj.2014.02.010>
- Akrich, M., Callon, M., Latour, B., & Monaghan, A. (2002). THE KEY TO SUCCESS IN ADVANCEMENT PART I: THE ART OF INTERESSEMENT. *International Journal of Advancement Management*, 06(02), 187–206. <https://doi.org/10.1142/s1363919602000550>
- Akter, S., D'Ambra, J., & Ray, P. (2010). Service quality of mHealth platforms: development and validation of a hierarchical model using PLS. *Electronic Markets*, 20(3–4), 209–227. <https://doi.org/10.1007/s12525-010-0043-x>
- AlBar, A. M., & Hoque, M. R. (2017). Factors affecting the adoption of information and communication technology in small and medium enterprises: a perspective from rural Saudi Arabia. *Information Technology for Development*, 25(4), 715–738. <https://doi.org/10.1080/02681102.2017.1390437>



- Al-Jabri, I. M., Fahd, K., & Sohail, M. S. (2012). MOBILE BANKING ADOPTION: APPLICATION OF DIFFUSION OF ADVANCEMENT THEORY. *Journal of Electronic Commerce Research*, 13(4), 379. [https://www.researchgate.net/profile/Ibrahim\\_Al-Jabri/publication/258515458\\_Mobile\\_Banking\\_Adoption\\_Application\\_of\\_Diffusion\\_of\\_Advancement\\_Theory/links/0deec52bdc807da02e000000.pdf](https://www.researchgate.net/profile/Ibrahim_Al-Jabri/publication/258515458_Mobile_Banking_Adoption_Application_of_Diffusion_of_Advancement_Theory/links/0deec52bdc807da02e000000.pdf)
- Al-Qirim, N. (2005). An Empirical Investigation of an e-commerce Adoption-Capability Model in Small Businesses in New Zealand. *Electronic Markets*, 15(4), 418–437. <https://doi.org/10.1080/10196780500303136>
- Amankwah-Amoah, J., Boso, N., & Antwi-Agyei, I. (2016). The Effects of Business Failure experience on successive entrepreneurial Engagements: An Evolutionary Phase model. *Group & Organization Management*, 43(4), 648–682. <https://doi.org/10.1177/1059601116643447>
- Barnard, S., Kritzing, B., & Krüger, J. (2011). Location decision strategies for improving SMME business performance. *Acta Commercii*, 11(1). <https://doi.org/10.4102/ac.v11i1.156>
- Berisha, G., & Pula, J. S. (2015). Defining Small and Medium Enterprises: a critical review. *Academic Journal of Business, Administration, Law and Social Sciences*, 1(2), 17–28. <http://iipcccl.org/wp-content/uploads/2015/03/Ajbals-17-28.pdf>
- Binu, V. S., Mayya, S. S., & Dhar, M. (2014). Some basic aspects of statistical methods and sample size determination in health science research. *Ayu*, 35(2), 119. <https://doi.org/10.4103/0974-8520.146202>
- Bruque, S., & Moyano, J. (2007). Organisational determinants of information technology adoption and implementation in SMEs: The case of family and cooperative firms. *Technovation*, 27(5), 241–253. <https://doi.org/10.1016/j.technovation.2006.12.003>
- Brustbauer, J. (2014). Enterprise risk management in SMEs: Towards a structural model. *International Small Business Journal*, 34(1), 70–85. <https://doi.org/10.1177/0266242614542853>
- Bunyasi, G., Kenyatta, J., Bwisa, H. M., & Namusonge, G. (2014). Effect of Access to Business Information on the Growth of Small and Medium Enterprises in Kenya. *International Journal of Business and Social Science*, 5(10), 121–128. [https://ijbssnet.com/journals/Vol\\_5\\_No\\_10\\_1\\_September\\_2014/15.pdf](https://ijbssnet.com/journals/Vol_5_No_10_1_September_2014/15.pdf)
- Burke, K. (2010). The Impact of Internet and ICT Use among SME Agribusiness Growers and Producers. *Journal of Small Business and Entrepreneurship*, 23(2), 173–194. <https://doi.org/10.1080/08276331.2010.10593480>
- Carver, R. H. F., & Nash, J. M. (2008). *Doing Data Analysis with SPSS: Version 18.0*. <http://ci.nii.ac.jp/ncid/BA79153621>
- Chege, S. M., Wang, D., & Suntu, S. L. (2019). Impact of information technology innovation on firm performance in Kenya. *Information Technology for Development*, 26(2), 316–345. <https://doi.org/10.1080/02681102.2019.1573717>
- Chang, H. H. (2006). Technical and management perceptions of enterprise information system importance, implementation and benefits. *Information Systems Journal*, 16(3), 263–292. <https://doi.org/10.1111/j.1365-2575.2006.00217.x>
- Chaston, I. (2010). *Entrepreneurial management in small firms*. <https://doi.org/10.4135/9781446211380>
- Chattopadhyay, U., & Bhawsar, P. (2017). Effects of changing business environment on organization performance: the case of HMT Watches Ltd. *South Asian Journal of Business and Management Cases*. <https://doi.org/10.1177/2277977917698309>
- Chen, Q., Zhang, W., Nan-Shun, J., Wang, X., & Dai, P. (2022). Digital Transformation Evaluation for Small- and Medium-Sized Manufacturing Enterprises using the Fuzzy

- Synthetic Method DEMATEL-ANP. *Sustainability*, 14(20), 13038. <https://doi.org/10.3390/su142013038>
- Chen, T. T., Honda, T., Hosoda, E., & Hayase, K. (2014). The Relationship between Environmental Management and Economic Performance: A New Model with Accumulated Earnings Ratio. *Journal of Human Resource and Sustainability Studies*, 02(02), 59–69. <https://doi.org/10.4236/jhrss.2014.22006>
- Chen, W., & Kamal, F. (2016). The impact of information and communication technology adoption on multinational firm boundary decisions. *Journal of International Business Studies*, 47(5), 563–576. <https://doi.org/10.1057/jibs.2016.6>
- Colombo, M. G., Croce, A., & Grilli, L. (2013). ICT services and small businesses' productivity gains: An analysis of the adoption of broadband Internet technology. *Information Economics and Policy*, 25(3), 171–189. <https://doi.org/10.1016/j.infoecopol.2012.11.001>
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *Management Information Systems Quarterly*, 13(3), 319. <https://doi.org/10.2307/249008>
- De Jong, G., Phan, T. B. T., Van Ees, H., & Phan, T. T. (2011). Does the meta-environment determine firm performance? Theory and evidence from European multinational enterprises. *International Business Review*, 20(4), 454–465. <https://doi.org/10.1016/j.ibusrev.2010.08.003>
- De Jong, J., & Vermeulen, P. (2004). Determinants of product advancement in small firms: A Comparison Across Industries. *RePEc: Research Papers in Economics*. <https://EconPapers.repec.org/RePEc:eim:papers:n200410>
- Devaraj, S., & Kohli, R. (2000). Information technology payoff in the Health-Care industry: a longitudinal study. *Journal of Management Information Systems*, 16(4), 41–67. <https://doi.org/10.1080/07421222.2000.11518265>
- Dibrell, C., Davis, P., & Craig, J. B. (2008). Fueling Advancement through Information Technology in SMEs. *Journal of Small Business Management*, 46(2), 203–218. <https://doi.org/10.1111/j.1540-627x.2008.00240.x>
- Duncan, M. J., Spence, J. C., & Mummery, W. K. (2005). Perceived environment and physical activity: a meta-analysis of selected environmental characteristics. *International Journal of Behavioral Nutrition and Physical Activity*, 2(1). <https://doi.org/10.1186/1479-5868-2-11>
- Dunn, P., & Cheatham, L. R. (1993). FUNDAMENTALS OF SMALL BUSINESS FINANCIAL MANAGEMENT FOR START-UP, SURVIVAL, GROWTH, AND CHANGING ECONOMIC CIRCUMSTANCES. *Managerial Finance*, 19(8), 1–13. <https://doi.org/10.1108/eb013737>
- Elbeltagi, I., Sharji, Y. A., Hardaker, G., & Elsetouhi, A. (2013). The role of the Owner-Manager in SMEs' adoption of information and communication technology in the United Arab Emirates. *Journal of Global Information Management*, 21(2), 23–50. <https://doi.org/10.4018/jgim.2013040102>
- Erumban, A. A., & De Jong, S. B. (2006). Cross-country differences in ICT adoption: A consequence of Culture? *Journal of World Business*, 41(4), 302–314. <https://doi.org/10.1016/j.jwb.2006.08.005>
- Etezadi-Amoli, J., & Farhoomand, A. F. (1996). A structural model of end-user computing satisfaction and user performance. *Information & Management*, 30(2), 65–73. [https://doi.org/10.1016/0378-7206\(95\)00052-6](https://doi.org/10.1016/0378-7206(95)00052-6)
- Fornell, C., & Larcker, D. F. (1981). Evaluating Structural Equation Models with Unobservable Variables and Measurement Error. *Journal of Marketing Research*, 18(1), 39–50. <https://doi.org/10.1177/002224378101800104>



- Franco, M., & García, M. G. (2017). Drivers of ICT acceptance and implementation in micro-firms in the estate agent sector: influence on organizational performance. *Information Technology for Development*, 24(4), 658–680. <https://doi.org/10.1080/02681102.2017.1379378>
- Galloway, L. (2007). Can broadband access rescue the rural economy? *Journal of Small Business and Enterprise Development*, 14(4), 641–653. <https://doi.org/10.1108/14626000710832749>
- Ganzer, P. P., Chais, C., & Olea, P. M. (2017). Product, process, marketing and organizational advancement in industries of the flat knitting sector. *RAI: Revista De Administração E Inovação*, 14(4), 321–332. <https://doi.org/10.1016/j.rai.2017.07.002>
- Gërguri-Rashiti, S., Ramadani, V., Abazi-Alili, H., Dana, L., & Ratten, V. (2015). ICT, Advancement and Firm Performance: The Transition Economies Context. *Thunderbird International Business Review*, 59(1), 93–102. <https://doi.org/10.1002/tie.21772>
- Ghobakhloo, M., Hong, T. S., Sabouri, M. S., & Zulkifli, N. (2012). Strategies for successful information technology adoption in small and medium-sized enterprises. *Information*, 3(1), 36–67. <https://doi.org/10.3390/info3010036>
- Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P., & Kyriakidou, O. (2004). Diffusion of Advancements in service Organizations: Systematic review and recommendations. *Milbank Quarterly*, 82(4), 581–629. <https://doi.org/10.1111/j.0887-378x.2004.00325.x>
- Gremyr, I., Witell, L., Löfberg, N., Edvardsson, B., & Fundin, A. (2014a). Understanding new service development and service advancement through advancement modes. *Journal of Business & Industrial Marketing*, 29(2), 123–131. <https://doi.org/10.1108/jbim-04-2012-0074>
- Gremyr, I., Witell, L., Löfberg, N., Edvardsson, B., & Fundin, A. (2014b). Understanding new service development and service advancement through advancement modes. *Journal of Business & Industrial Marketing*, 29(2), 123–131. <https://doi.org/10.1108/jbim-04-2012-0074>
- Günday, G., Ulusoy, G., Kılıç, K., & Alpkan, L. (2011). Effects of advancement types on firm performance. *International Journal of Production Economics*, 133(2), 662–676. <https://doi.org/10.1016/j.ijpe.2011.05.014>
- Gupta, S., Modgil, S., & Gunasekaran, A. (2019). Big data in lean six sigma: a review and further research directions. *International Journal of Production Research*, 58(3), 947–969. <https://doi.org/10.1080/00207543.2019.1598599>
- Gupta, V. K. (2007). Strategic Thinking And Contemporary Business - Thoughts From An Ancient Indian Thinker. *Paradigm*, 11(2), 77–82. <https://doi.org/10.1177/0971890720070212>
- Gustafsson, P., Franke, U., Johnson, P., & Lilliesköld, J. (2008). Identifying IT impacts on organizational structure and business value. *Business/IT Alignment and Interoperability*, 344, 44–57. <http://ceur-ws.org/Vol-336/paper4.pdf>
- Hair, J. F. (2010). Multivariate data analysis: a global perspective. In *Pearson eBooks*. <https://ci.nii.ac.jp/ncid/BB03463866>
- Haller, S., & Siedschlag, I. (2011). Determinants of ICT adoption: evidence from firm-level data. *Applied Economics*, 43(26), 3775–3788. <https://doi.org/10.1080/00036841003724411>
- Hammawa, Y. M., & Hashim, N. (2015). Mediating Role of Training on the relationship between Micro- Finance Factors and Women micro Entrepreneurs' business performance in Gombe Nigeria: a Conceptual Framework. *IOSR Journal of Business*

- and Management Ver.*, 17(12). <http://www.iosrjournals.org/iosr-jbm/papers/Vol17-issue12/Version-2/I0171225661.pdf>
- Hilmersson, M. (2013). Small and medium-sized enterprise internationalisation strategy and performance in times of market turbulence. *International Small Business Journal*, 32(4), 386–400. <https://doi.org/10.1177/0266242613497744>
- Hung, K. P., & Chiang, Y. H. (2010). Open advancement proclivity, entrepreneurial orientation, and perceived firm performance. *International Journal of Technology Management*, 52(3/4), 257. <https://doi.org/10.1504/ijtm.2010.035976>
- Igun, S. E. (2014). The strategic impact of ICT on modern-day banking in Nigeria. *International Journal of Strategic Information Technology and Applications*, 5(4), 78–93. <https://doi.org/10.4018/ijstia.2014100105>
- Jiménez, A., & Zheng, Y. (2017). Tech hubs, advancement and development. *Information Technology for Development*, 24(1), 95–118. <https://doi.org/10.1080/02681102.2017.1335282>
- Joensuu-Salo, S., Sorama, K., Viljamaa, A., & Varamäki, E. (2018). Firm Performance among Internationalized SMEs: The Interplay of Market Orientation, Marketing Capability and Digitalization. *Administrative Sciences*, 8(3), 31. <https://doi.org/10.3390/admsci8030031>
- Katou, A. A., & Budhwar, P. (2008). The effect of business strategies and HRM policies on organizational performance: The Greek experience. *Global Business and Organizational Excellence*, 27(6), 40–57. <https://doi.org/10.1002/joe.20235>
- Klein, V., & Todesco, J. L. (2021). COVID-19 crisis and SMEs responses: The role of digital transformation. *Knowledge and Process Management*, 28(2), 117–133. <https://doi.org/10.1002/kpm.1660>
- Kossai, M., & Piget, P. (2014). Adoption of information and communication technology and firm profitability: Empirical evidence from Tunisian SMEs. *The Journal of High Technology Management Research*, 25(1), 9–20. <https://doi.org/10.1016/j.hitech.2013.12.003>
- Kraja, Y. B., & Osmani, E. (2015). IMPORTANCE OF EXTERNAL AND INTERNAL ENVIRONMENT IN THE CREATION OF COMPETITIVE ADVANTAGE TO SMEs. (CASE OF SMES, IN THE NORTHERN REGION OF ALBANIA). *European Scientific Journal*, ESJ, 11(13). <https://eujournal.org/index.php/esj/article/download/5641/5467>
- Kuratko, D. F. (2017). Corporate Entrepreneurship 2.0: research development and future directions. *Foundations and Trends in Entrepreneurship*, 13(6), 441–490. <https://doi.org/10.1561/03000000082>
- Laguir, I., & Besten, M. D. (2016). The influence of entrepreneur's characteristics on MSEs growth through advancement. *Applied Economics*, 48(44), 4183–4200. <https://doi.org/10.1080/00036846.2016.1153792>
- Leitch, C., Hill, F., & Neergaard, H. (2009). Entrepreneurial and business growth and the quest for a “Comprehensive theory”: tilting at Windmills? *Entrepreneurship Theory and Practice*, 34(2), 249–260. <https://doi.org/10.1111/j.1540-6520.2010.00374.x>
- Lingling, L., & Li, Y. (2023). The impact of digital empowerment on open advancement performance of enterprises from the perspective of SOR. *Frontiers in Psychology*, 14. <https://doi.org/10.3389/fpsyg.2023.1109149>
- Liu, Z., & Zhou, X. (2023). Can Direct Subsidies or Tax Incentives Improve the R&D Efficiency of the Manufacturing Industry in China? *Processes*, 11(1), 181. <https://doi.org/10.3390/pr11010181>

- Lumpkin, G. T., & Dess, G. G. (2001). Linking two dimensions of entrepreneurial orientation to firm performance. *Journal of Business Venturing*, 16(5), 429–451. [https://doi.org/10.1016/s0883-9026\(00\)00048-3](https://doi.org/10.1016/s0883-9026(00)00048-3)
- Lutfi, A., Alkelani, S. N., Al-Khasawneh, M. A., Alshira'h, A. F., Alshirah, M. H., Almaiah, M. A., Alrawad, M., Alsyouf, A., Saad, M., & Ibrahim, N. (2022). Influence of digital accounting system usage on SMEs performance: The Moderating Effect of COVID-19. *Sustainability*, 14(22), 15048. <https://doi.org/10.3390/su142215048>
- Majumdar, S. (2008). Modelling growth strategy in small entrepreneurial business organisations. *Journal of Entrepreneurship*, 17(2), 157–168. <https://doi.org/10.1177/097135570801700204>
- Mallinguh, E., Wasike, C., Bilan, Y., & Zéman, Z. (2022). The impact of firm characteristics, business competitiveness, and technology upgrade hurdles on R&D costs. *Problems and Perspectives in Management*, 20(4), 264–277. [https://doi.org/10.21511/ppm.20\(4\).2022.20](https://doi.org/10.21511/ppm.20(4).2022.20)
- Manzoor, F., Wei, L., & Sahito, N. (2021). The role of SMEs in rural development: Access of SMEs to finance as a mediator. *PLOS ONE*, 16(3), e0247598. <https://doi.org/10.1371/journal.pone.0247598>
- Mgijima, B., & Flowerday, S. (2012). Internet success for the small and medium hospitality enterprise: Influence of the owner or manager. *African Journal of Business Management*, 6(37). <https://doi.org/10.5897/ajbm12.570>
- Mohr, J. J., Sengupta, S., & Slater, S. F. (2001). *Marketing of High-Technology products and Advancements*. <http://ci.nii.ac.jp/ncid/BA70800504>
- Momani, A. M., & Jamous, M. M. (2017). The evolution of Technology Acceptance Theories. *Social Science Research Network*. [https://papers.ssrn.com/sol3/Delivery.cfm/SSRN\\_ID2971454\\_code1450767.pdf?abstr=actid=2971454&mirid=1](https://papers.ssrn.com/sol3/Delivery.cfm/SSRN_ID2971454_code1450767.pdf?abstr=actid=2971454&mirid=1)
- Mothe, C., & Thi, T. U. N. (2010). The link between non-technological advancements and technological advancement. *European Journal of Advancement Management*, 13(3), 313–332. <https://doi.org/10.1108/14601061011060148>
- Ndesaulwa, A. P., & Kikula, J. (2017). The Impact of advancement on the performance of small and medium Enterprises (SMEs) in Tanzania: a review of empirical evidence. *Journal of Business Management*, 4(1), 1–6. <https://doi.org/10.12691/jbms-4-1-1>
- Neil, C. H., Lewis, C., & Virginia. (2002). The Five Stages of Small Business Growth. *Social Science Research Network*. <http://jroan.com/Harvard%20Business%20Review%20-%20The%205%20Stages%20Of%20Small%20Business%20Growth.pdf>
- Neneh, N., & Van Zyl, J. (2012). Achieving optimal business performance through business practices: evidence from SMEs in selected areas in South Africa. *Southern African Business Review*, 16(3), 118–144. [https://www.unisa.ac.za/contents/faculties/service\\_dept/docs/Sabview\\_16\\_3\\_chap\\_6.pdf](https://www.unisa.ac.za/contents/faculties/service_dept/docs/Sabview_16_3_chap_6.pdf)
- Ng, H. S., & Kee, D. M. H. (2012). The issues and development of critical success factors for the SME success in a developing country. *International Business Management*, 6(6), 680–691. <https://doi.org/10.3923/ibm.2012.680.691>
- Nguyen, T. H., Newby, M., & Macaulay, M. (2013). Information Technology adoption in small business: Confirmation of a proposed framework. *Journal of Small Business Management*, 53(1), 207–227. <https://doi.org/10.1111/jsbm.12058>
- Ntwoku, H., Negash, S., & Meso, P. (2017). ICT adoption in Cameroon SME: application of Bass diffusion model. *Information Technology for Development*, 23(2), 296–317. <https://doi.org/10.1080/02681102.2017.1289884>

- O'Farrell, P. N., & Hitchens, D. (1988). Alternative Theories of Small-Firm Growth: A Critical review. *Environment and Planning A*, 20(10), 1365–1383. <https://doi.org/10.1068/a201365>
- Obasan, K. A. (2014). The impact of business environment on the survival of small scale businesses in Nigeria. *International Journal of Management and Business Research*, 4(3), 165–170. [https://ijmbr.srbiau.ac.ir/article\\_2872\\_f5a57eda0505aee5514ba69f540bcfa.pdf](https://ijmbr.srbiau.ac.ir/article_2872_f5a57eda0505aee5514ba69f540bcfa.pdf)
- Okundaye, K. E., Fan, S. K., & Dwyer, R. J. (2019). Impact of information and communication technology in Nigerian small-to-medium-sized enterprises. *Journal of Economics, Finance and Administrative Science*, 24(47), 29–46. <https://doi.org/10.1108/jefas-08-2018-0086>
- Oladimeji, M. S., Ebodaghe, A. T., & Shobayo, P. (2017). Effect of globalization on small and medium Enterprises (SMEs) performance in Nigeria. *International Journal of Entrepreneurial Knowledge*, 5(2), 56–65. <https://doi.org/10.1515/ijek-2017-0011>
- Osabohien, R., Worgwu, H., & Al-Faryan, M. a. S. (2022a). Social entrepreneurship, technology diffusion and future employment in Nigeria. *Social Enterprise Journal*. <https://doi.org/10.1108/sej-03-2022-0032>
- Osabohien, R., Worgwu, H., & Al-Faryan, M. a. S. (2022b). Social entrepreneurship, technology diffusion and future employment in Nigeria. *Social Enterprise Journal*. <https://doi.org/10.1108/sej-03-2022-0032>
- Pratali, P. (2003). Strategic management of technological advancements in the small to medium enterprise. *European Journal of Advancement Management*, 6(1), 18–31. <https://doi.org/10.1108/14601060310456300>
- Premkumar, G. (2003). A Meta-Analysis of Research on information Technology implementation in Small business. *Journal of Organizational Computing and Electronic Commerce*, 13(2), 91–121. [https://doi.org/10.1207/s15327744joc1302\\_2](https://doi.org/10.1207/s15327744joc1302_2)
- Premkumar, G., & Roberts, M. (1999). Adoption of new information technologies in rural small businesses. *Omega*, 27(4), 467–484. [https://doi.org/10.1016/s0305-0483\(98\)00071-1](https://doi.org/10.1016/s0305-0483(98)00071-1)
- Qing-Min, H., Kasper, H., & Muehlbacher, J. (2012). How does organizational structure influence performance through learning and advancement in Austria and China? *Chinese Management Studies*, 6(1), 36–52. <https://doi.org/10.1108/17506141211213717>
- Quinlan, Christina & Zikmund, William & Babbin, Barry & Carr, Jon & Griffin, Mitch. (2015). *Business Research Methods*.
- Quinn, R. E., & Cameron, K. S. (1983). Organizational life cycles and shifting criteria of effectiveness: Some preliminary evidence. *Management Science*, 29(1), 33–51. <https://doi.org/10.1287/mnsc.29.1.33>
- Rahim, F. B. T., & Zainuddin, Y. (2016). Moderating effect of environmental turbulence on firm's technological advancement capabilities (TIC) and business performance in the automotive industry in Malaysia: A conceptual framework. *MATEC Web of Conferences*, 90, 01009. <https://doi.org/10.1051/mateconf/20179001009>
- Ramdani, B., Chevers, D. A., & Williams, D. A. (2013). SMEs' adoption of enterprise applications. *Journal of Small Business and Enterprise Development*, 20(4), 735–753. <https://doi.org/10.1108/jsbed-12-2011-0035>
- Rampersad, G., & Troshani, I. (2018). Impact of high-speed broadband on advancement in rural firms. *Information Technology for Development*, 26(1), 89–107. <https://doi.org/10.1080/02681102.2018.1491824>
- Ramsey, E., & McCole, P. (2005). E-business in professional SMEs: the case of New Zealand. *Journal of Small Business and Enterprise Development*, 12(4), 528–544. <https://doi.org/10.1108/14626000510628207>



- Razavi, S. M. H., Nargesi, G. R., Hajihoseini, H., & Akbari, M. (2016). The impact of technological advancement capabilities on the competitive performance of Iranian ICT firms. *Iranian Journal of Management Studies*, 9(4), 855–882. <https://doi.org/10.22059/ijms.2017.59912>
- Redmond, J., Walker, E., & Wang, C. (2008). Issues for small businesses with waste management. *Journal of Environmental Management*, 88(2), 275–285. <https://doi.org/10.1016/j.jenvman.2007.02.006>
- Ritchie, B., & Brindley, C. (2005). ICT adoption by SMEs: implications for relationships and management. *New Technology Work and Employment*, 20(3), 205–217. <https://doi.org/10.1111/j.1468-005x.2005.00154.x>
- Roach, D. C., Ryman, J., & Makani, J. (2016). Effectuation, advancement and performance in SMEs: an empirical study. *European Journal of Advancement Management*, 19(2), 214–238. <https://doi.org/10.1108/ejim-12-2014-0119>
- Roman, A., & Rusu, V. D. (2022). Digital technologies and the performance of small and medium enterprises. *Studies in Business and Economics*, 17(3), 190–203. <https://doi.org/10.2478/sbe-2022-0055>
- Ross, P. K., & Blumenstein, M. (2014). Cloud computing as a facilitator of SME entrepreneurship. *Technology Analysis & Strategic Management*, 27(1), 87–101. <https://doi.org/10.1080/09537325.2014.951621>
- Roztock, N., & Weistroffer, H. R. (2011). Information technology success factors and models in developing and emerging economies. *Information Technology for Development*, 17(3), 163–167. <https://doi.org/10.1080/02681102.2011.568220>
- Rye, S. A. (2009). Negotiating the symbolic power of information and communication technologies (ICT): The spread of Internet-supported distance education. *Information Technology for Development*, 15(1), 17–31. <https://doi.org/10.1002/itdj.20110>
- Saunila, M. (2016). Performance measurement approach for advancement capability in SMEs. *International Journal of Productivity and Performance Management*, 65(2), 162–176. <https://doi.org/10.1108/ijppm-08-2014-0123>
- Setiowati, R., Hartoyo, H., Daryanto, H. K., & Arifin, B. (2015). The effects of ICT adoption on marketing capabilities and business performance of Indonesian SMEs in the fashion industry. In *Journal of Business and Retail Management Research* (Vol. 10, Issue 1). [https://jbrmr.com/cdn/article\\_file/i-22\\_c-206.pdf](https://jbrmr.com/cdn/article_file/i-22_c-206.pdf)
- Spithoven, A., Clarysse, B., & Knockaert, M. (2011). Building absorptive capacity to organise inbound open advancement in traditional industries. *Technovation*, 31(1), 10–21. <https://doi.org/10.1016/j.technovation.2010.10.003>
- Su, Z., Jisheng, P., Shen, H., & Xiao, T. (2013). Technological capability, marketing capability, and firm performance in turbulent conditions. *Management and Organization Review*, 9(1), 115–137. <https://doi.org/10.1017/s1740877600003193>
- Tarutè, A., & Gatautis, R. (2014). ICT impact on SMEs performance. *Procedia - Social and Behavioral Sciences*, 110, 1218–1225. <https://doi.org/10.1016/j.sbspro.2013.12.968>
- Teece, D. J. (2012). Dynamic Capabilities: Routines versus Entrepreneurial Action. *Journal of Management Studies*, 49(8), 1395–1401. <https://doi.org/10.1111/j.1467-6486.2012.01080.x>
- Terziovski, M. (2010). Advancement practice and its performance implications in small and medium enterprises (SMEs) in the manufacturing sector: a resource-based view. *Strategic Management Journal*, n/a. <https://doi.org/10.1002/smj.841>
- Ting, H. (2012). The moderating role of environmental dynamism on the influence of advancement strategy and firm performance. *International Journal of Advancement, Management and Technology*. <https://doi.org/10.7763/ijimt.2012.v3.288>

- Urbinati, A., Chiaroni, D., Chiesa, V., & Frattini, F. (2018). The role of digital technologies in open advancement processes: an exploratory multiple case study analysis. *R & D Management*, 50(1), 136–160. <https://doi.org/10.1111/radm.12313>
- Utterback, J. M., & Afuah, A. (1998). The Dynamic ‘Diamond’: A Technological advancement perspective. *Economics of Advancement and New Technology*, 6(2–3), 183–200. <https://doi.org/10.1080/10438599800000019>
- Vasiljeva, T., Shaikhulina, S., & Kreslins, K. (2017). Cloud Computing: Business Perspectives, benefits and Challenges for small and medium Enterprises (Case of Latvia). *Procedia Engineering*, 178, 443–451. <https://doi.org/10.1016/j.proeng.2017.01.087>
- Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: four longitudinal field studies. *Management Science*, 46(2), 186–204. <https://doi.org/10.1287/mnsc.46.2.186.11926>
- Wang, Y., & Shi, X. (2009). E-business assimilation in SMEs of China. *International Journal of Electronic Business*, 7(5), 512. <https://doi.org/10.1504/ijeb.2009.028154>
- Wu, B., & Zhang, L. (2013). Farmer advancement diffusion via network building: a case of winter greenhouse diffusion in China. *Agriculture and Human Values*, 30(4), 641–651. <https://doi.org/10.1007/s10460-013-9438-6>
- Yunis, M. M., Tarhini, A., & Kassar, A. (2018). The role of ICT and advancement in enhancing organizational performance: The catalysing effect of corporate entrepreneurship. *Journal of Business Research*, 88, 344–356. <https://doi.org/10.1016/j.jbusres.2017.12.030>
- Zahra, S. A. (2008). Being entrepreneurial and market-driven: implications for company performance. *Journal of Strategy and Management*, 1(2), 125–142. <https://doi.org/10.1108/17554250810926339>
- Zahra, S. A., & Das, S. (2009). ADVANCEMENT STRATEGY AND FINANCIAL PERFORMANCE IN MANUFACTURING COMPANIES: AN EMPIRICAL STUDY. *Production and Operations Management*, 2(1), 15–37. <https://doi.org/10.1111/j.1937-5956.1993.tb00036.x>

## HOW SOCIAL MEDIA INFLUENCE CHILDREN BEHAVIOUR

**Dr Ashish Mathur**

Jai Narain Vyas University, Jodhpur, India.  
([ashishmth@gmail.com](mailto:ashishmth@gmail.com))

**Ms. Sunita**

Jai Narain Vyas University, Jodhpur, India.  
([sunitabishnoi1796@gmail.com](mailto:sunitabishnoi1796@gmail.com))

Social media platforms serve as valuable tools for individuals seeking to maintain connections with their social network of friends and family members. Individuals have the ability to engage in communication and acquire knowledge through the act of accessing an application or a website. However, similar to numerous other subjects that individuals exhibit strong enthusiasm for, social networking possesses certain limitations. Numerous scholarly investigations assert that social media can exert detrimental effects on the cognitive well-being of youngsters and adolescents. Moreover, it is important to note that the potential damage incurred could have lasting and irreparable effects. Conversely, social media platforms have the potential to enhance individuals' social networks and facilitate cognitive adaptation to emerging technologies. The realm of social media is characterized by its perpetual evolution. It facilitates social interaction among young individuals, enabling them to communicate, articulate their thoughts, and share captivating material. The emergence of a novel cultural paradigm has had significant effects on technology and industry, thereby altering the dynamics of human interaction. This research aims to examine the diverse positive and negative impacts of social media on children and analyse the notion that social media is a dualistic phenomenon. While this technology offers numerous benefits, it is important to acknowledge that it can pose potential risks to children.

**KEYWORDS:** - Social media, numerous effects, Behaviour, Young Individuals.

### 1. INTRODUCTION

The fast evolution of social media makes it practically impossible to resist or avoid it. Peer socialization helps build social skills and encourages people to join larger societies, broadening their social networks. The impact of technology on communication and information retrieval has been significant. Facebook, Instagram, Twitter, YouTube, LinkedIn, and many blog formats allow users to communicate. Smartphone apps and photo and video digitization have made media production, editing, and sharing faster. The creator loses ownership of material posted to the digital cloud. Recent technical advances allow people to share personal information globally. Before social media, people could only communicate and share physically. Social media platforms provide adolescents with new ways to communicate and enjoy themselves, but their long-term effects are unknown. Thus, parents must become more conscious of this developing media landscape and its possible effects on their children, both positive and negative [1]. Teens are known for their social media use. Recent research shows that teens spend a lot of time on social media. This leads to questions and debates over how social networking sites (SNS) affect teenage development. This paper reviews scholars' theoretical frameworks for understanding teens and social media. This study combines studies from multiple fields on social networking sites (SNS) and social capital, privacy, juvenile safety, psychological well-being, and education.

**Social media and children**



Social media refers to the digital platforms utilized by individuals to establish connections with others, exchange media material, and construct social networks. Several widely used platforms include Facebook, Twitter, WhatsApp, Tumblr, Instagram, Pinterest, Skype, YouTube and Snapchat. The value that the user provided is 24. The utilization of social media platforms entails the act of uploading and disseminating various forms of material. The activities encompassed under this domain are the establishment of digital profiles, the dissemination of written remarks or interactive conversations, the uploading of visual media such as photographs and videos, the sharing of hyperlinks, the identification of individuals or content within visual media through the application of tags, the development and distribution of modifications to existing digital games, as well as the act of altering or repurposing pre-existing content and afterwards sharing it with others [2][3].

### **The adverse impacts of social media on children**

Social media influences young people's thoughts and actions. Children are innocent and can't tell well from bad.

- Information on social media is enormous and uncontrollable. Thus, children may see harmful or inappropriate stuff that influences their thinking.
- Online bullying has escalated, notably on social media and messaging apps. By creating fear and guilt, it may hurt children.
- Kids become addicted to wasting time, reducing productivity. Addictions can affect health.
- Technology and internet addiction, including gaming addiction, can waste kids' time and prevent productivity. Addictions can affect health.
- Social media addiction may make it hard for your child to make friends.

### **The positive impacts of social media on children**

Social media facilitates global connectivity by enabling individuals to establish connections with individuals from various regions across the globe. One of the notable aspects of social media is its potential to exert a positive impact on children [3] [4].

- Assists children in establishing connections with their extended relatives and friends.
- Assisting individuals in cultivating enhanced perspectives on diverse matters Acquire novel knowledge and engage in the exchange of ideas.
- It facilitates the provision of an efficient platform for the child to engage in the exploration of their knowledge.
- Facilitating the development of effective communication skills in youngsters serves as a catalyst for enhancing their motivation and subsequently fostering the cultivation of self-expression.
- The utilization of social media platforms enables the youngster to enhance their technical proficiency and gain practical knowledge in the field of technology.

## **2. REVIEW OF LITERATURE**

Damit, N. et al. (2018) observed that social media has arisen as a rapidly growing platform that enables communication, self-expression, and knowledge sharing among young folks. The incorporation of social media platforms and mobile devices has become a fundamental

component of our daily rituals. There is a growing trend of children being exposed to technology and the internet at increasingly early stages of their development. The advent of a new cultural paradigm has led to a profound alteration of the sociological and behavioral terrain, as well as the dynamics of interpersonal engagements. The technology of social media exhibits a dichotomous character, encompassing both helpful and negative attributes. Although it presents certain advantages, it also has the capacity to inflict adverse effects on young individuals. A variety of internet platforms, such as Facebook, Twitter, Instagram, YouTube, LinkedIn, and many blogging formats, is readily available to individuals, facilitating relationships across different dimensions. These platforms exert a substantial influence on individuals' behavior, psychological well-being, and interpersonal interactions. The influence of social media on children is contingent upon a multitude of elements, including their distinct personalities, gender, family and social environment traits, and individual life experiences. The responsibility for overseeing various concerns, such as cyberbullying, online grooming, FOMO (fear of missing out), depression, anxiety, increasing narcissism, sexting, and exposure to inappropriate content, rests upon both society and lawmakers. The primary objective of this essay is to analyse the various positive and negative effects on children and assess methods for augmenting these advantages, with a specific emphasis on the legal protections in ASEAN countries.

Bozzola, E. et al. (2022) realized that social media has become part of our daily lives, especially influencing younger people. Media device and internet connectivity adoption has increased since the COVID-19 epidemic. Teens generally utilize Instagram, TikTok, and YouTube for consultation and interaction. During "lockdown," the Internet enabled interpersonal communication and the continuation of various activities, including educational instruction. However, media use may have negative effects, especially on vulnerable groups like youth. This analysis examines the risks of children and adolescents using social media, focusing on new challenges and prevention strategies. The scoping review followed PRISMA guidelines and searched PubMed for "social media" or "social network", "health", and "pediatrics". After removing irrelevant reports, 68 were found. The poll found 19 people with depression, 15 with eating issues, and 15 with psychological issues. These findings imply that psychological concerns are the most commonly cited social media risk. Sleep disruptions, addiction, anxiety disorders, sexual dysfunction, behavioral issues, body dissatisfaction, lack of physical activity, online grooming, vision impairments, headaches, and tooth decay were also discovered. This issue requires public and medical awareness and new preventive measures. This initiative should involve health professionals, caregivers, and website and app developers. Pediatricians must understand the risks of problematic social media use among youth. They should also be able to spot early warning signs in youngsters and work with the family to avert problems.

Natwarsinh, K. (2014) revealed that the influence of media on children's behavior can be both detrimental and beneficial. One primary concern regarding the impact of media on children is the presence of violence within media content. The majority of psychological research on the media has primarily focused on investigating the influence of televised violence and violence depicted in video games on children. The findings consistently indicate that exposure to media and video game violence is associated with heightened levels of aggression. This effect has been observed in both the short-term and long-term, particularly when individuals are excessively exposed to such content. Parents frequently articulate apprehension over advertising targeted at children, as they see it as a potential catalyst for discord with their children. This arises from the children's insistence on acquiring things that are promoted through advertisements, which parents may deem unsuitable. Additionally, parents harbor

concerns that exposure to such advertising may engender the adoption of excessively materialistic ideals among their children. The media plays a significant role in the socialization processes of children, as it serves as a means to impart cultural values and beliefs to them. The media also plays a significant role in the education of children and their understanding of global issues. Parental mediation plays a crucial role in enhancing the positive impact of media on children and mitigating the negative consequences associated with media exposure.

Serwaa, N. A., et al. (2015) examined the potential effects of social media usage on child behavior in a primary school setting in Ghana. A survey was administered to students, educators, and parents affiliated with the institution. A total of 56 students were administered questionnaires, and interviews were conducted with 10 teachers and 22 parents. The results of the study indicate that Facebook is the social media platform that is most favored among users. Approximately 50% of the students surveyed reported that the models they encounter on social media platforms have not exerted any influence on their behavior. Parents and instructors have noted several favorable implications, including enhancements in reading habits, attire, and communication skills. Additional negative repercussions that have been noted include the diversion of students' focus away from their academic pursuits, the frequent utilization of Pidgin English, and an undue preoccupation with fashion. The study suggests that it would be beneficial for parents to engage in monitoring their children's online social interactions by actively visiting the profiles of their children's friends to observe the content they share and receive. In addition, it is imperative for educators to elucidate the benefits and potential risks associated with the utilization of social media platforms for young individuals while also providing guidance on identifying and engaging with advantageous online resources.

### **3. OBJECTIVE**

This research assess the positive and negative impact of social media among children following with, this research has following objectives:

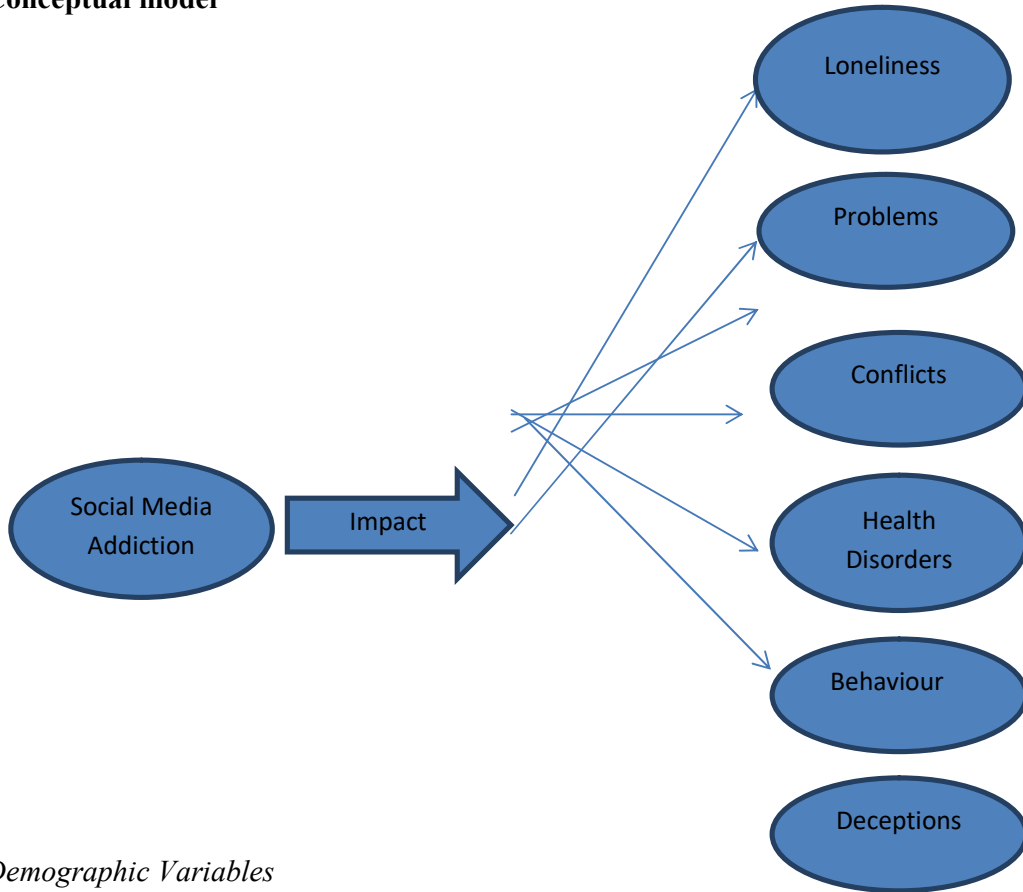
- To investigate the factors like internet addiction,among children.
- To investigate the effects of social media among children.

### **4. METHODOLOGY**

The research is descriptive and analytical based. The data have been collected from 50 respondents) for this research based on objectives.To investigate the effects of social media among children. Through this research, several significantdiscoveries have been made, providing insights into the complex relationship and their positive and negative effects between social media and young individual users.

## 5. DATA ANALYSIS AND INTREPRETATION

### Conceptual model



### Demographic Variables

We have taken the respondents of different age, gender and their child social media status.

Variables	Frequency	Percentage (%)	M	SD
<b>Age:</b>				
<30	10	20	16.66	6.79
31-40	14	28		
40>	26	52		
<b>Gender:</b>				
Male	12	24		
Female	30	60	16.66	9.56
Other	8	16		
<b>Educational Qualification:</b>				

<HSC	1	2		
UG-PG	25	50	16.66	11.08
Others	24	48		
<b>Occupation:</b>				
Govt. Employee	6	12		
Private Employee	24	48		
Self-Employed	20	40		
<b>Monthly Income:</b>				
<45,000	2	4		
45,000-80,000	21	42	16.66	10.65
>1,00,000	27	54		

**Table 1: Demographic Variables**

From the table 1, it can be analysed that the researcher visits to the selected respondents having 54% people income more than, 100,000 per month. 24% respondents were Male. Most of the respondents (60%) belong to private employees. Out of survey, 50% respondents were highly educated.

ISSUES	N	%
Depression	18	36%
Diet	12	24%
Cyber bullying	15	30%
Psychological Problems	18	36%
Sleep	10	20%
Addiction	12	24%
Anxiety	7	14%
Sex Related	11	22%

Behavioral Problems	9	18%
Body Image	9	18%
Physical Activity	7	14%
Online Grooming	12	24%
Sight	2	4%
Headache	3	6%
Dental Caries	4	8%

**TABLE 2**

The table2 summarizes the harmful social media themes for children and teenagers. The frequency of these concerns is computed as a percentage based on 50 relevant reports. This study investigates social media's detrimental effects on children. The table summarizes all the issues detected in this investigation. Eighteen studies focused on depression, the main issue of the study, accounting for 36%. Fifteen works examined cyberbullying, while eighteen examined psychological concerns. Sleep disorders were studied ten times, whereas addiction and anxiety were studied twelve times each. Eleven studies examined sex issues, while seven examined behavioral abnormalities. Nine studies explored body image distortion, whereas seven focused on the effects of inactivity. Twelve reports examined how online grooming affects visual impairments. Nine studies examined headache prevalence, whereas four discussed dental caries. Mental health issues like depression, anxiety, and addiction were the main concerns. Sleep disruptions, diet and nutrition deficiencies, cyberbullying, psychological variables, behavioral issues, sexual health concerns, distorted body image, inadequate physical activity, risks of online grooming, visual impairments, headaches, and dental decay should also be considered.

*Social media impact on children*

<b>Predicators</b>	<b>t-value</b>	<b>p-value</b>
Loneliness	0.243	0.0006
Health disorder	0.687	0.701
Behaviour	3.789	0.0153
Problems	0.311	0.0002
Deception	0.612	0.5481
Conflict	0.553	0.1221

## Table 2: SOCIAL MEDIA IMPACT ON CHILDREN

Table 2 illustrates the impact of social media on children. A significant proportion of children who engage with social media platforms report experiencing feelings of loneliness. Children may experience health disorders, life challenges, and conflict. The findings derived from this dataset also indicate a shift in children's behaviour.

## 6. CONCLUSION AND FUTURE SUGGESTIONS

### *Conclusion*

The COVID-19 pandemic and health crises have increased children's and teenagers' social media use. Social media provides benefits, but excessive or incorrect use can harm mental health and cause depression, anxiety, and addiction. Since social media ads may promote unhealthy eating choices, they may be linked to poor diets. Thus, this exposure may cause weight gain, obesity, dental cavities, and bad eating behaviors. Sedentary lifestyles, obesity, non-physiological postures, and physical ailment progression are linked. Conversely, social media use has been linked to body image perception and acceptability issues, particularly in low-self-esteem young women. These people may intentionally seek out content that encourages rapid weight loss, increasing anorexia prevalence. Children and adolescents who use social media daily are more likely to experience behavioral issues like cyberbullying, online grooming, sleep disturbances, and eye-related problems like myopia, eye fatigue, dryness, blurry vision, irritation, burning sensation, conjunctival injection, ocular redness, and dry eye disease. They may also have headaches. Consider the link between problematic social media use and depression, obesity, unhealthy eating habits, psychological issues, sleep disturbances, addiction, anxiety, sexual issues, behavioral issues, body image concerns, physical inactivity, online grooming, visual impairments, headaches, and dental caries. It can help parents choose appropriate content for their children. This can be done by analysing ratings, reviews, plot descriptions, and screening the material.

### *Future Suggestions*

- Unregulated social media use can lead to sexting, explicit content; unwelcome sexual content, and early sexual activity, hence, children should be kept away off social media.
- Social media users, especially those with higher digital proficiency, face more online hazards. This issue needs more public and medical awareness and new preventive actions. This should start with doctors, caregivers, and website and app designers.
- Families must learn about the risks and concerns associated with their children's and teens' internet use. Health practitioners and others who teach families about social media use must be trained.
- Researchers must screen for media exposure, both quantity and type, during routine checkups.
- Parents should be informed about the risks of digital commerce, particularly with respect to bad food choices, inadequate nutrition, and sugary items. This is essential to combating obesity.
- Conversely, a balanced diet, enough exercise, and enough sleep are essential. Pediatricians can prevent cyberbullying by educating teens and their families about online safety and privacy.



- It's also important to promote face-to-face connections while restricting social media use. Researchers may advise parents to set media and social media rules for the home and daily lives.

## REFERENCES

- Sharma, P. (2018). Impact of social media on children. [https://www.academia.edu/36220658/IMPACT\\_OF\\_SOCIAL\\_MEDIA\\_ON\\_CHILDREN](https://www.academia.edu/36220658/IMPACT_OF_SOCIAL_MEDIA_ON_CHILDREN)
- Reid Chassiakos, Y. (linda), Radesky, J., Christakis, D., Moreno, M. A., Cross, C., Hill, D., Ameenuddin, N., Hutchinson, J., Levine, A., Boyd, R., Mendelson, R., Swanson, W. S., & COUNCIL ON COMMUNICATIONS AND MEDIA. (2016). Children and adolescents and digital media. *Pediatrics*, 138(5). <https://doi.org/10.1542/peds.2016-2593>
- Bhargavi, P. (2015). The impact of social media on children: Positive & negative. MomJunction. [https://www.momjunction.com/articles/negative-effects-of-social-media-on-children\\_00353633/](https://www.momjunction.com/articles/negative-effects-of-social-media-on-children_00353633/)
- Ahmad, N., Abdullah, R., & Damit, N. (2018). The impact of social media on children: An overview. *Ijcwed.com*. Retrieved August 24, 2023, from [https://www.ijcwed.com/wp-content/uploads/2018/11/IJCWED5\\_28.pdf](https://www.ijcwed.com/wp-content/uploads/2018/11/IJCWED5_28.pdf)
- Bozzola, E., Spina, G., Agostiniani, R., Barni, S., Russo, R., Scarpato, E., Di Mauro, A., Di Stefano, A. V., Caruso, C., Corsello, G., & Staiano, A. (2022). The use of social media in children and adolescents: Scoping review on the potential risks. *International Journal of Environmental Research and Public Health*, 19(16), 9960. <https://doi.org/10.3390/ijerph19169960>
- Rajput, M., & Natwarsinh, K. (2014). Effect of media on children behaviour: Media psychological perspective. *Ijip.In*. Retrieved August 24, 2023, from <https://ijip.in/wp-content/uploads/2019/02/16-Mr.-Rajput-Kiransinh-Natwarsinh.pdf>
- Serwaa, N. A., & Dadzie, P. S. (2015). Social media use and its implications on child behaviour: a study of a basic school in Ghana. *International Journal of Social Media and Interactive Learning Environments*, 3(1), 49. <https://doi.org/10.1504/ijsmile.2015.068441>

## PROSPECTS OF THE EFFECT The BLOCKCHAIN ON ACCOUNTING, TAXATION, AND AUDITING

**Dr. Muthanna A. NASER,**

Farahidi University Baghdad, IRAQ  
([muthana6644@gmail.com](mailto:muthana6644@gmail.com))

**Dr. Salim SwadiHammood AL-Mohammedawi**  
Imam Ja'afar Al-Sadiq University, Baghdad, IRAQ  
([Salim.swadi@sadiq.edu.iq](mailto:Salim.swadi@sadiq.edu.iq))

**Dr. Ahmed Dakhil Abed Alabbas ,**  
Karbala University,IRAQ  
([ahmeddakhil1991@gmail.com](mailto:ahmeddakhil1991@gmail.com))

**Dr. Muayad Saleh Mahdi,**  
University ofKerbala, IRAQ.  
([muayad.s@uokerbala.edu.iq](mailto:muayad.s@uokerbala.edu.iq))

**Maher KareemALimari,**  
Farahidi University Baghdad, IRAQ  
([ma.acc1992@gmail.com](mailto:ma.acc1992@gmail.com))

Blockchain applications for crypto assets, smart contracts, and ICOs have experienced record growth in recent years. Taxpayers have encountered an unexpectedly high tax bill as a consequence of misconceptions over how to tax these transactions, exposing many investors, trading platforms, and prospectors in various nations to uncertainty as well as a surprise during tax season. New areas that tax authorities, financiers, and researchers are looking to understand in light of the massive developments in the financial cryptocurrency industry. This research aims to identify potential problems in taxation, accounting and auditing for applications of blockchain technology. The research found that there are many problems related to tax legislation and the problem of lack of accounting standards or auditing guidelines. At the international level, it has been found that many countries impose taxes on blockchain activities and operations, whether they are taxes on profits, trading operations, or capital gains taxes. Also, each country has a different tax treatment for cryptocurrencies according to the country's classification of the cryptocurrency.

**Keywords:** Tax Concerns, Blockchain, Cryptocurrency, Accounting, International Tax Systems.

### 1. INTRODUCTION

The Internet has altered our world and revolutionized how information is exchanged. Technological advancements, particularly those related to information and value, are the most significant data of the current century, and reliance on them in business organizations is a manifestation of adaptation and development. The quick rate of digital progress has resulted in the creation of blockchains as a distributed network between two or more parties, although it has turned out to be less beneficial in the domain of value exchange (Wiatt, 2019) The mechanism by which the Blockchain operates, whereby everyone presents or connected to the Blockchain network is the observer of transactions made using cryptocurrencies, has enjoyed a high degree of confidence and an advanced level of security even though there is no entity or regulatory and regulatory authority for the Blockchain. The network data and activities are updated frequently, about every ten minutes, and are logged on all linked devices. The individual who makes the decision to hack the network, steal, falsify coins, or rob someone else's property is required to hack all of the devices that are connected to the network, or at least two-thirds of them at the same time, in order to erase the data that has already been recorded on it and either replace it or create other data for him. This is a task that is nearly impossible to accomplish in less than ten minutes. Numerous experts in the fields of computer science and network security are of the opinion that hacking the Blockchain is more challenging than the cyber heist of the Federal Reserve in the United States(Makhdoom,2019).

The use of blockchain technology and its applications raises several challenges for tax authorities, represented by many questions about the tax treatment of producing, storing, trading and dealing with cryptocurrencies, smart contracts and initial coin offerings, and what are the control and collection procedures in the event of taxes being imposed on blockchain applications. the digital economy, crypto assets are becoming increasingly important in generating value and as a result, it has become easier to avoid taxes by shifting those assets to low-tax countries or tax havens, as fintech companies use the big data they have collected to transform their business models into assets. Encrypted through algorithms, unlike physical assets, moving digital assets across borders only requires a smart contract on blockchain technology (Carpentieri& P. P., 2019). These developments have increased the motivations of professional bodies and accounting and auditing offices, as great efforts are being

made to investigate how traditional accounting systems can indeed be supplanted or altered to integrate with blockchain technology (Vetter,2018), and all four of the major accounting and auditing companies (Prisco, 2017) have taken significant initiatives. Despite these preparations, it is uncertain how much the disciplines of accounting and auditing will be impacted by future blockchain technology adoption modifications to auditing. The study (Alarcon,& N. C., 2018)indicates that this technology tends to present two opposing viewpoints, namely enthusiasm and scepticism, and therefore the widespread adoption of this technology depends on the degree of response to the concerns raised by sceptics and providing solutions that eliminate or reduce these fears. From the perspective of blockchain technology proponents, they think that if the Internet has supplied the infrastructure for controlling data exchange, then blockchain technology will serve as a new infrastructure for regulating value transactions in the future and it will fundamentally transform how transactions are processed, recorded, and evaluated (Bonsón, & B. M., 2019).

However, from a sceptic's perspective, technology is only useful if it can be trusted, and they contend that this technology is currently unreliable for users, regulators, and professionals. They also warn that the technology lacks maturity, scalability, and standards, and risks are necessary for the event that data is compromised or stolen, and they raise concerns that it could be subordinate to software bugs or security breaches due to a lack of techniques to ensure that the system functions as intended. The creation of new methods of supervision, security, and privacy is evidence of how numerous professional organizations have joined forces to advance definitions of industry standards and improve collaboration while the world is developing quickly (Kokina, & P. D., 2017). The main objective of the research is to explore and study the potential challenges of blockchain technology on tax, accounting and auditing, and this goal can be achieved by studying relevant previous literature.

## **2. HOW ARE CRYPTOCURRENCIES TREATED IN INDIA AND OTHER COUNTRIES?**

Speculative products to India's "Virtual Digital Assets" (VDAs) Gains from cryptocurrency trading are subject to a 30% tax rate on profits, with no further deductions allowed outside the acquisition cost. Moreover, the profits from one cryptocurrency transaction cannot offset the losses from another cryptocurrency transaction (Jain& A., 2022).

Different countries have different classifications for digital currencies. For instance, the United States, France, and Australia treat cryptocurrencies as intangible assets. Sweden, the Netherlands, Spain, Malta, Thailand, Belgium, and the United Kingdom treat them as securities. Canada, Portugal, and Japan treat them as payment methods. The United Kingdom, Germany, and the Philippines treat them as private money. Switzerland's currency is regarded as a foreign one.

Value-added tax does not apply to cryptocurrency operations in any of the member states of the European Union, in the United States and Australia, in Japan under barter agreements, in the Philippines, Singapore, or any other nation that treats cryptocurrencies as intangible assets exempt from tax on goods and services. Except for tax havens like Singapore, Malta, and the Philippines, or revenue from a professional activity like Belgium and Switzerland, mining is generally taxed on personal income as a normal activity.

Profits from cryptocurrency trading and disposal are taxed differently depending on whether they are long- or short-term investments (as in the US, Canada, and Italy), commercial or private investments (as in Germany and the Netherlands), and whether they are professional or non-professional individual investors for currency trading. While certain tax systems, including those in the US, Canada, Japan, and Australia, are interested in how cryptocurrencies are taxed and how fair value is determined, others are not.

## **3. THE POTENTIAL TAX CONCERNS WITH BLOCKCHAIN TECHNOLOGY**

### **3.1. Concerns with Tax Legislation**

The tax legislation that has been drafted according to the nature of the activities and operations of the traditional economy, faces shortcomings in the tax treatment of the digital economy in general, and technological applications in particular. In other words, there is a legislative gap as follows:

The Problem of a Subject to Tax or Exemption: Perspectives differed about the tax treatment of the blockchain and its applications, as some see imposing taxes on the activities and operations of the blockchain and its applications for the following justifications (Rijswijk & A. R.,2018):

- Not subjecting or exempting crypto-digital asset transactions to taxes will violate the principle of tax fairness.

- Not being subject to or exempting transactions of encrypted digital assets leads to the loss of part of the revenues needed to finance the state's public expenditures, especially with the growth of digital economy activities.
- Keeping pace with contemporary tax systems and achieving international tax compatibility, as there is a global trend to subject encrypted digital asset transactions to taxes. While some opinions tend not to subject or definitively exempt block activities and operations on encrypted digital asset transactions in more than one chain of state and its applications to taxes for the following justifications (Krivtsov, 2019):
  - Encouraging investors and business organizations to carry out digital economy activities, in a way that helps to catch up with contemporary technological applications
  - Avoiding the problem of double taxation that may occur as a result of the imposition of the tax
  - Avoiding the problem of the difficulty of inventory and tax examination of encrypted digital asset transactions due to their special nature

### 3.2. Concerns with the Occurrence of International Double Taxation

Blockchain technology relies on the abolition of time and places restrictions in its dealings, and with the different tax regulations and legislation between countries, which presents a different concept of tax sovereignty, after the tax was limited to the interest or borders of a single state, it exceeded it to become an extension of the international interest, and in light of the inability of national legislation In keeping with these new challenges posed by the blockchain and its applications, international double taxation may occur.

### 3.3. Concerns with an Imbalance in Tax Justice

An imbalance in tax justice has begun to arise as a result of the widening disparity in global transactions and tax rates, as well as the flexibility of the movement of encrypted digital currencies facilitated by blockchain technology. permanently from taxes, whereas others just exempt it for a short time.

### 3.4. Concerns with Control and Collection

In light of the usage of blockchain technology and its applications, the following are the key control and collection concerns:

**The difficulty of Inventorying the Tax Community:**Due to the use of blockchain technology, it is difficult to identify financiers who engage in a commercial as well as financial transactions through the public blockchain network. This results in a lack of evidence that the tax administration uses to complete the tax accounting process. This evidence is used to determine the extent to which the financier is subject to tax consequences. Whether or not there is a tax, in addition to the fact that natural and legal people that trade in encrypted digital currencies do not have a recognized physical presence on the market.

**Lack of Proof Evidence for Blockchain Transactions and its Applications:** Tax legislation depends on documenting commercial transactions, but in light of the use of the blockchain and its applications and the electronic transfer of data and values on the network, paper or electronic documents for financial or commercial transactions may not be available, and block technology also depends. Chen on smart contracts and the digital fingerprint in the implementation of commercial transactions and remittances, and thus the inability of the tax authorities to prove contracts, and this requires a review of the means of proof and tax examination.

**The Problem of the Difficulty of Identifying Dealers on the Blockchain Network:** When using the Blockchain, the two parties to the transaction do not see each other on the network, and they may not know all the basic information about each other, as is the case in traditional business transactions. As a result, the tax community may find it difficult to complete tax filings that legislative authorities restrict compliance with. Some financiers may take advantage of this to evade tax by not recording these transactions in the legal accounting books.

## 4. THE POTENTIAL ACCOUNTING AND AUDITING CONCERNS WITH BLOCKCHAIN TECHNOLOGY

Although Blockchain technology provides many different features and appears to be secure and enjoys a high level of confidentiality, many current challenges require addressing and addressing it so that it can be relied upon in the field of accounting and auditing, which can be addressed as follows:

**The Problem of Lack of Standards for Accounting Treatment:** The absence of a standard or interpretation that governs the accounting treatment of money transactions using blockchain technology is a problem that is represented by this issue. In addition, there are differences of opinion among researchers as well as professional accounting organizations regarding the classification of these currencies in terms of whether or not they should be considered cash or something similar. Alternatively, you might think of it as a financial asset that is not cash, or you could think of it as an investing tool, or you could think of it as an intangible asset, or you could think of it as a commodities stock, which may imply that a new category of assets could develop.(Kokina, & P. D., 2017).

**Lack of Standards or Guidelines for Review Under the Blockchain:** There are no standards or guidelines issued by professional organizations to review the uses and applications of blockchain technology, such as reviewing the processes of using encrypted digital currencies in money transfers, the use of smart contracts to transfer ownership of assets, and asset verification. and digital obligations (AICPA, 2017).

**The Issue of Integration with other Information Systems:** Another problem raised by blockchain technology is the problem of blockchain compatibility with project information systems such as the resource planning system, which often includes a variety of functional units such as accounting, control, procurement, supply, warehousing, manufacturing, project management, quality management and others. These systems are widely used in industries today (Weigand& d. K. J. 2020). The researchers add, the importance of the previous data for companies that need to be included in the blockchains when companies adopt the technology of all blockchains.

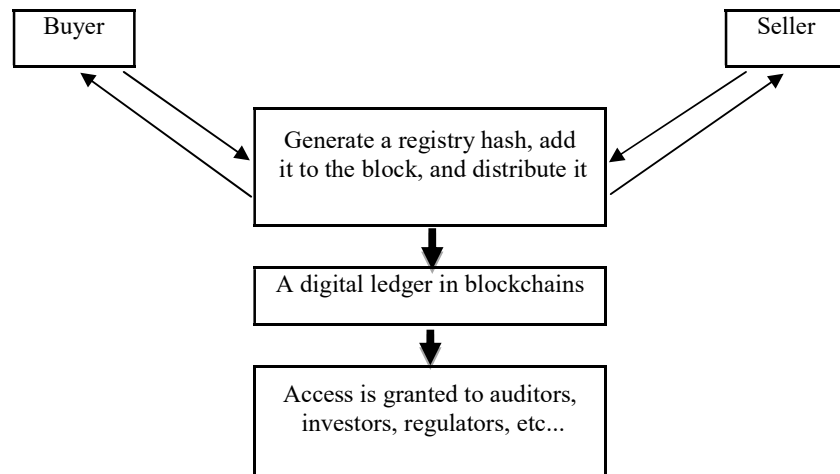
**System Power and Operating Speed:** One of the main challenges to blockchain technology is the issue of scalability, which means the ability of a system to continue to function well when size changes. In the context of blockchains, scalability arises when the number of participants increases over time, and scalability includes several elements. , including the latency, which is the “transaction confirmation time” (Croman, 2016), and in the current period, the confirmation period takes at least 10 minutes for Bitcoin blockchains and 14 seconds for Ethereum blockchains and is substantially larger than current payments operating systems Moreover, 13% of transactions at the level of public blockchains exceed 20 minutes (Kanaracus, 2016). In the same context, the study (Nyumbayire, 2017) considers that the restrictions imposed on the number of one-second transactions lead to a decrease in the flexibility of the system and that any future development needs to be supported by the majority of users participating in a single network, this problem is of greater importance in the structural construction for public blockchains, although they are more manageable in smaller private designs (Ølnes& J. M. 2017). Therefore, the speed of transaction execution is a potential challenge, mainly because the blockchain system needs approval, add more transactions to the chain and make more copies, costs may rise, and consequently, restrictions and challenges arise on the speed of performance, in addition to that speed may It is affected by the method of processing blockchain technology, which is difficult to improve in the future, and therefore one of the challenges facing this technology is how to reduce costs in light of the multiple copies of transactions without affecting the speed of performance. Also, size and storage capacity are other important components that must be developed and depending on the nature of blockchain design, distributed ledgers contain transactions since the block was formed, so as the number of users and transactions grows, the size of all ledgers increases.

**Challenges associated with implementation costs:** The price of adopting blockchain technology within the organization might be substantial in addition to the costs of scalability, although proponents of this technology believe that the transaction costs under this technology will be lower than the current model (Dai,2017), claims Fuller's study (Fuller,2019), that certain assertions need a thorough investigation to back them up, that it is impossible to confirm if they refer to particular accounting transaction fees as opposed to just transaction fees for electronic payments, and therefore that cost of installation and accounting transaction fees might be quite high. Even before the invention of blockchain technology, comprehensive prior research has shown that companies frequently display strong resistance if they seek to upgrade and alter their information systems, particularly if a new blockchain system requires to be merged with old systems. (Lapointe,2005). Users frequently perceive significant concerns in technological change and frequently exhibit a predisposition for the status quo, and such opposition has both behavioural and practical bases. (Kim,2009). The massive cost and transformation efforts of companies, when companies adopt new technology, especially one that affects the accounting function in the company, many associated costs occur. In the accounting field, achieving the requirements of adequate control over the company’s activities to a sufficient degree is mandatory, and those activities require the occurrence of substantial costs, and it is not clear whether companies are willing to bear the costs of transformation to achieve the expected benefits from blockchain technology.

## 5. THE CHALLENGES ASSOCIATED WITH ACCOUNTING AND AUDITING

Since one of the promising potential benefits supplied by blockchain technology and reliability of accounting data, which attracts the firm's accountants, the growing trend towards financial reporting systems based on this technology has significant implications for many professionals who are involved in the accounting function

within companies as well as auditors. The two-party verification process is used by auditors, investors, and other parties to ensure the accuracy of accounting information because the counterparty to a company's transaction serves as an external auditor of the transaction and is a third party to the company. Because this auditor is not biased in favour of the company like a manager of the company, this is why it is thought to be a source of support for the confidence of accounting information. It is believed that blockchains might revolutionize the external evaluation of confirmed transactions (Lazanis, 2015; Yermack, 2017).



**Figure 1** Two-way verification in a blockchain-based accounting system. Source: (Deloitte 2016).

Since all transactions in the system based on blockchains are anticipated to be confirmed and validated by a third party as a result of the role of the verifier embedded in the blockchains, we find that many areas of audit (such as cash, accounts receivable, obligations, etc.) can be reviewed through evidence collected through the balances of companies that represent the third party. Several audit companies have depended on external recognition for such accounts and industry-wide blockchain verifiers (Zhao, 2018). Two-way verification of transactions may improve the collecting of audit evidence in many areas where auditors may now track transaction information, in addition to replacing the evidence connected with the balance sheet. Instances include the collection of cash income and the payment of operational and capital expenses in cash. Most of this is already in place. Since assignments are now carried out by reviewers without consideration for third-party verification, at the very least, the quality of audit evidence gathered in these areas is likely to improve.

Consider the following scenario: Let's say one of the businesses you work with has integrated blockchain technology into its accounting systems. As a result, all aspects of the business's transactions with suppliers are verified twice before being finalized, even though the purchase order has only been sent once. price, shipping, receipt, as well as payments made associated with the transaction, resulting in a significant improvement in the quality of available data to auditors compared to internal company documents lacking third-party verification, which are currently used as audit guides for choosing particulars and are gathered in many areas,

As a result, the time needed for accountants and auditors to confirm these transactions is decreased as a result of this application, and resources are given for audit areas that call for personal and professional judgement while also providing more audit evidence. As a consequence, the company's both auditors and accountants can evaluate each transfer of funds as well as its historical background more efficiently (Deloitte 2016). Reliance on the blockchain network and integrity in the face of possible mistakes and fraud (Newman, 2018), may also cause the formation of other associated dangers. The system's internal control must be evaluated, as well as the audit risks posed by relying only on the data it produces.

Figuring out who will bear the implementation costs is one of the crucial factors that must be taken into account for there to be a growth in the number of businesses that use blockchain technology since the potential advantages increase with the increase in the number of businesses that use this technology, and then the means of value exchange is accessible through it. As it has previously been said, Bitcoin miners are paid to participate in the form of Cryptocurrency, the advantages of blockchain should be seen as increasing the costs of participation, and these benefits include as mentioned earlier. Data encryption is digital, because involvement in information chains may not involve straightforward payments made to participate in the blockchain, rather, the participants in the information chains should see this. There is no doubt that the use of blockchains across a wide range of parties will encounter significant resistance due to the high cost of ,2017integrating blockchains



with accounting applications, as it may be challenging to analyse the relationship between expected costs and benefits at this time. Data reliability, flexibility, as well as potential cost reductions for accounting and auditing functions in the long run., as it is one of the biggest challenges facing the wide spread of accounting applications based on blockchains (Yermack, 2017).

The researchers consider that, despite the advantages and positive repercussions that result from the application of blockchain technology in accounting, it is known that technology is a double-edged sword, and therefore the study (Coyne, 2017) identified the potential disadvantages of applying this technology as a tool in The field of financial reporting, which is the confidentiality of public blockchains, threats from manipulation of private blockchains, and limited transaction-related verification.

One drawback of public blockchains is that anybody may access them without a user's permission, which raises concerns about confidentiality. However, this problem can be solved simply by substituting transactions in blockchain technology with such a signature of hashes (with that signature substituting for the transaction if desired to be shown to a specific party) to protect confirming a transaction without revealing personal information to the public, Approved private (decentralized) blockchains, according to (Anderson, 2017), maybe more acceptable for enterprises, but they also create a new issue with technology acceptance, claim (Coyne,2017). Regardless of whether every participant in the supply chain uses blockchain technology, various businesses may choose to use different kinds of blockchains. This would compel the business to maintain many duplicated databases of blockchain technology, making the problem more challenging to solve. As this technology evolves, the availability of defined classifications following the business reporting extensible language built on blockchain technology is one of the suggested solutions to this problem. Accordingly, the current security and monitoring measures in this technology are insufficient, placing overall control of the system in the hands of an unauthorized person (Coyne, 2017). As a result, the main challenge is to maximize self-control over the structure intended to reduce cyberattack threats.

## 6. IMPLICATIONS FOR ACCOUNTING AND AUDITING FIRMS

The adoption of blockchain technology by business projects has some effects on audit firms a As a result of the fast growth of corporate and business reporting, a research (Axelsen, 2017) has shown that the future would be defined by an unprecedented level of organizational and information complexity. If auditors and audit firms are eager to stay up with these developments and the present development of technological advances, accounting firms need to consider what the auditing process will look like in the future as well as whether or not the audit team has the necessary capabilities(MacManus, 2017) .

Indeed, towards real steps to becoming familiar with technological developments and their implications for the activities they practice, and the evidence for this is that the Big Four companies have already invested in the use of new technologies such as data analysis programs and artificial intelligence programs and started serious projects in the field of blockchains, as the four accounting firms expressed The Big Four expressed its interest in blockchain technology, and this interest was reflected in many of the projects that were launched, the prominent professional and financial organizations have collaborated on several projects to investigate the impact of this technology on accounting and auditing practices.

As an illustration, the global accounting and auditing firm Deloitte has introduced Rubix, the first blockchain-based software system, which enables users to design unique blockchains and smart contracts. Customers of Deloitte can already utilize this platform. The company also continuously automates portions of its audits for its clients for a variety of applications, including financial consolidations between internal teams or corporate partners, assurance of real-time examination of financial accounts, and property registration software. Deloitte claimed to already have completed a blockchain audit in 2017 by applying current audit standards to review the processes approved for using blockchains (Das, 2017).

Faster, safer, automating processes, and lowering costs (KPMG, 2018). KPMG and Microsoft collaborated to build their digital ledger services, and their present efforts are focused on developing prototype models to address blockchain deployment issues in the financial products, healthcare, as well as public sectors (Kokina, & P. D., 2017). Similar to this, Ernst & Young is participating in Libra, a blockchain-based initiative that emphasises distributed ledger technology (Allison,2015). EY Ops, which concentrates on payment transactions, billing, inventory data, and pricing, has also been developed by the company. and Integration of Digital Contracts . A paper on blockchain challenges concerning energy has also been released by PWC (PWC,2017). Additionally, it has developed a platform called De Novo that focuses on integrating blockchain into the blockchain.

International auditing companies anticipate significant reductions in auditing expenses and turnaround times (T.K. (2017). As a result, these (8) companies are actively developing blockchain technology to take advantage of the benefits it produces. For instance, Ernst & Young announced the creation of the EYOps platform, a collection of tools and services to assist businesses in utilizing blockchain technology to drive operations and spur development (Alarcon, & N. C. 2018). KPMG also disclosed a protocol for collaboration with Microsoft,



the world's largest software provider, to develop several innovations and other efforts for Apps of Blockchain Technology and N9. In a similar spirit, Deloitte announced the creation of a blockchain team made up of 800 people from 20 different countries with the EMEA Blockchain Lab located in Dublin. In particular, the Rubix project is an illustration of work performed on operational Collaboration Connectivity, Scalability, Speed, Security, as well as Accountability in Audit PwC has developed a Global Blockchain Team that collaborates with industry specialists at a global level. Recent research by PwC of managers in 15 countries revealed that 84% of them thought their organizations were already engaged in a blockchain project (PwC, 2017). In the same vein, another poll by Deloitte was also released. 41% of the 1,053 CEOs of businesses with yearly revenue of much more than \$500 million in 7 countries think their organizations will utilize technology in the upcoming year (Deloitte, 2018).

## **7. A REGULATOR'S PERSPECTIVE ON BLOCKCHAIN TECHNOLOGY**

According to a study (Brender & S. A., 2018) that focused on external auditors, 85% of the study sample felt that more guidance should be added to auditing standards to address the effects of technological advancements and contract strings on those standards and the professional bodies that issue them. Blockchain reviews are currently not guided by any review standards, and it is unknown at this time how frequently and to what degree review standards will be updated when blockchain technology and other forms of technology, such as data analysis and artificial intelligence, are used more widely.

In March 2018, a paper on the potential impacts of blockchain technology on audit and professional assurance services, how the audit of financial statements can change in light of blockchain, and the possibility of offering new assurance services was published by the Association of Chartered Accountants in America and Canada, the University of Waterloo, and Deloitte experts. Considering the future development of new jobs for auditors (Canada, 2018). It concluded that while blockchain technology is unlikely to completely replace the professional judgments of auditors in accounting and auditing firms, auditors still need to keep an eye on developments in the field because they will have an impact on the technology of information systems owned by their clients. They also need to work with experts to review complex technical risks related to blockchains (Canada, 2018), and auditors should be conscious of the opportunities that can be seized from clients' adoption of blockchain technology, to enhance the data collection process during the audit process, and to take into account whether blockchain technology allows them to create automated review procedures.

The success of auditors and the businesses they support depends, according to Gord Bell, Executive Vice President of Research, Guidance and Support at the Institute of Chartered Accountants of Canada, on early comprehension and integration with novel technology innovations. To fulfil the anticipated demand of the business community with the proliferation of enterprises using blockchain technology, auditors must enhance their skills and expertise. As a result, auditors and others working in professional assurance face new challenges and opportunities. In a related vein, the NASBA and the Wall Street Blockchain Alliance have launched a joint effort to study the effects of blockchain technology on accountants and how it might benefit both the industry and its members. The "International Auditing and Assurance Standards Board" has initiated the process of increasing awareness that is now underway. A presentation on blockchain technology was given by Mr. Chuck Landes, who is the Chair of the Innovation Working Group. Additionally, the Data Analytics Working Group had a session in which they discussed the increasing use of technology. The committee suggested that the International Assurance and Auditing Standards Board incorporate digital advances in technology into competent auditing guidelines in the audit, with a particular emphasis on data analysis. Additionally, the committee suggested that the board take into consideration other technological advancements, such as blockchains, that have an impact on auditing and warrant further research. The United States Public Company Accounting Oversight Board made an announcement in December 2017 regarding a plan to establish data and technology task forces. This was done in response to the growing utilization of data analytics and new tools that are based on "the Public Company Accounting Oversight Board (PCAOB)" of the Technology Foundation. The purpose of these task forces is to investigate the necessity of new guidance, updating and changing standards issued by the Board, or other regulatory actions. (PCAOB, 2018).

## **8. HOW MIGHT AN INVESTOR PROCEED?**

- Individuals who wish to trade or invest in VDAs currently need to get familiar with the new tax laws and, in the best-case scenario, speak with a tax professional before starting such operations. If consumers wish to trade VDAs, they would ideally do so on exchanges or marketplaces rather than through off-market deals. Without official direction, this can aid in determining the VDA's fair market value.
- Also, to be considered by taxpayers is the fact that their losses cannot be offset by other profits. However, revenues from VDAs cannot be used to offset capital expenses like the price of cryptocurrency mining or the price of minting NFTs.

- To assess whether the relevant NFTs are VDAs for income tax legislation, anyone looking to buy or deal with NFTs must be cautious and adhere to government regulations.

## 9. CONCLUSION

Blockchain applications, new forms of commerce, enterprises, and business methods that were not previously acclimated to have been imposed as a result of the growth of information technology. It is time for tax regulations to catch up with the phenomena of different business rules, just as business rules are different. This has left many investors, trading platforms and prospectors in some countries suffering from uncertainty and surprise during the tax season, taxpayers have found themselves facing an unexpectedly large tax bill as a result of misconceptions surrounding how to tax these transactions. The potential in tax for blockchain technology applications. The research found that there are many problems related to tax legislation and the problem of the lack of accounting standards or auditing guidelines. On the international level, it was found that many countries impose taxes on blockchain activities and operations, whether taxes on profits, trading operations or imposing capital gains taxes. Also, each country has a different tax treatment for encrypted currencies according to the country's classification of the encrypted currency.

The study also found that some nations, like the United States, France, and Australia, treat cryptocurrencies as intangible assets, while others, like Sweden, the Netherlands, Spain, Malta, Thailand, Belgium, and the United Kingdom, treat them as securities; other nations, like Canada, Portugal, and Japan, treat it as a payment method; and other nations, like the United Kingdom, Germany, and the Philippines, treat it as private money; The tax treatment of cryptocurrency activities and businesses is decentralized in European Union nations. Depending on how each nation defines cryptocurrencies, each country has a varied tax treatment for them. In the case of the United Kingdom, cryptocurrency is treated as private assets or funds, while in Germany it is Classification of cryptocurrency as private money.

Thus, it is recommended, audit companies must either train and develop the skills of their auditors on the applications of blockchains, or appoint and seek advice from data analysis specialists to provide advice to audit clients, and thus blockchain technology affects the knowledge structure of auditors, as current technological developments impose a change in the personal components of auditors. , due to the use of advanced technology by the auditees.

The Indian Association of Accountants and Auditors shall conduct seminars and training sessions for accounting and auditing firms to increase public awareness of the profession's future state and take proactive measures to close the knowledge gap that surrounds it. the need to broaden external auditors' skill sets to meet the demands of blockchain technology and prepare them for many of the newly created professions of the future.

To enable accounting and auditing firms to play a leading role in this industry, professional and regulatory bodies that oversee the accounting and auditing profession must update audited accounting standards to reflect technological advancements and address some of the issues raised by these techniques. Accounting and auditing courses must take into account the effects of technological advancements, such as blockchains, on the accounting and auditing profession to clarify the current state of affairs and the impossibility of predicting the profession's future status. This will allow these offices to be better prepared for the challenges that may arise in the future.

## REFERENCES

- Wiatt, R. G. (2019). From the mainframe to the blockchain. *Strategic Finance*, 100(7), 26-35.
- Makhdoom, I. A. M. A. H., & N. W. (2019). Blockchain's adoption in IoT: The challenges, and a way forward. *Journal of Network and Computer Applications*, 125, 251-279.
- Carpentieri, L. M. S. & P. P. (2019). Overhauling corporate taxation in the digital economy. CEPS Policy Insights No 2019-15/October 2019.
- Vetter, A. (2018). Blockchain is Already Changing Accounting. *Accounting Today*. Retrieved from <https://www.accountingtoday.com/opinion/blockchain-is-already-changing-accounting>.
- Prisco, G. (2017). Big four accounting firm EY launches ops chain platform, opens blockchain lab in NYC. Retrieved from <https://cryptoinsider.com/big-four-accounting-firm-ey-launches-ops-chain-platform-opens-blockchain-lab-nyc/>.
- Alarcon, J. L. & N. C. (2018). Blockchain and the future of accounting. *Pennsylvania CPA Journal*, 88(4), 26-29.
- Bonsón, E. & B. M. (2019). Blockchain and its implications for accounting and auditing. *Meditari Accountancy Research*.

- Kokina, J. M. R. & P. D. (2017). Blockchain: Emergent industry adoption and implications for accounting. *Journal of Emerging Technologies in Accounting*, 14(2), 91-100.
- Jain, J. M. B. & A. (2022). How Cryptocurrencies Are Taxed In India. Retrieved from [https://www-forbes-com.translate.goog/advisor/in/tax/how-cryptocurrencies-are-taxed-in-india/?\\_x\\_tr\\_sl=en&\\_x\\_tr\\_tl=ar&\\_x\\_tr\\_hl=ar&\\_x\\_tr\\_pto=sc](https://www-forbes-com.translate.goog/advisor/in/tax/how-cryptocurrencies-are-taxed-in-india/?_x_tr_sl=en&_x_tr_tl=ar&_x_tr_hl=ar&_x_tr_pto=sc).
- Rijswijk, L. V. H. H. & A. R. (2018). Exploring the future of taxation: A blockchain scenario study. In TARC workshop, 23-24 April 2018.
- Krivtsov, A. I. (2019). Taxation of Digital Financial Assets. In *Growth Poles of the Global Economy: Emergence, Changes and Future Perspectives*. Springer, Cham, 1231-1239.
- AICPA (2017). Blockchain technology and its potential impact on the audit and assurance profession. Retrieved from <https://www.aicpa.org/>.
- Weigand, H. B. I. & d. K. J. (2020). Shared ledger accounting—implementing the economic exchange pattern. *Information Systems*, 90, 101437.
- Croman, W. R. (2016). On scaling decentralized blockchains. In *International conference on financial cryptography and data security*.
- Kanaracus, C. (2016). Don't believe the blockchain hype: Examining the weaknesses and risks. Retrieved from <https://www.zdnet.com/article/dont-believe-the-blockchain-hypeexamining-its-weaknesses-and-risks/>.
- Nyumbayire, C. (2017). Blockchain technology innovations part 1. Retrieved from [www.interlogica.it/en/insight/blockchain-technology-innovations-part-i/](http://www.interlogica.it/en/insight/blockchain-technology-innovations-part-i/).
- Ølnes, S. U. J. & J. M. (2017). Blockchain in government: Benefits and implications of distributed ledger technology for information sharing. *Government Information Quarterly*, 34(3), 355-364.
- Dai, J. a. V. M. (2017). Toward Blockchain-based accounting and assurance. *Journal of Information Systems*, 31(3), 5–21.
- Fuller, S. H. a. A. M. (2019). Should accountants care about blockchain? *Journal of Corporate Accounting and Finance*, 1-13.
- Lapointe, L. a. S. R. (2005). A multilevel model of resistance to information technology implementation. *MIS Quarterly*, 29(3), 461–91.
- Kim, H. W. a. A. K. (2009). Investigating user resistance to information systems implementation: A status quo bias perspective. *MIS Quarterly*, 33, 567–82.
- Lazanis, R. (2015). How Technology Behind Bitcoin Could Transform Accounting As We Know It. *Techvibes*. Retrieved from <https://techvibes.com/2015/01/22/how-technology-behind-bitcoin-could-transform-accounting-as-we-know-it-2015-01-22>.
- Yermack, D. (2017). Corporate Governance and Blockchains. *Review of Finance*, 7-31.
- Deloitte (2016). Blockchain Technology: A game-changer in accounting? Retrieved from <https://www2.deloitte.com/>.
- Zhao, W. (2018). All —Big Four Auditors to Trial Blockchain Platform for Financial Reporting Coindesk. Retrieved from <https://www.coindesk.com/all-big-four-auditors-trial-blockchain-platform-for-financial-reporting>.
- Newman, D. (2018). 3 ways Blockchain can help combat fraud. *Forbes*. Retrieved from <https://www.forbes.com/sites/danielnewman/2018/04/17/3-ways-blockchain-can-help-combat-fraud/#15a590692a4b>.
- Coyne, J. G. a. M. P. L. (2017). Can Blockchains serve an accounting purpose? *Journal of Emerging Technologies in Accounting*, 14(2), 101–111.
- Anderson, A. (2017). CPA, 4 keys to the future of audit. Thomson Reuters White paper.

- Axelsen, M. G. P. C. P. a. R. G. (2017). Explaining the information systems auditor role in the public sector financial audit. *International Journal of Accounting Information Systems*, 24, 15-31.
- MacManus, E. (2017). The audit of the future. *The Journal of the Global Accounting Alliance*.
- Das, S. (2017). Big four giant Deloitte completes successful blockchain audit. Retrieved from [www.cryptocoinsnews.com/bigfour-giant-deloitte-completes-successful-blockchain-audit/](http://www.cryptocoinsnews.com/bigfour-giant-deloitte-completes-successful-blockchain-audit/).
- KPMG (2018). The pulse of fintech 2018, Biennial global analysis of investment in fintech. Retrieved from <https://assets.kpmg.com/content/dam/kpmg/xx/pdf/2018/07/h1-2018-pulse-of-fintech.pdf>.
- Allison, I. (2015). The work of auditors in the age of Bitcoin 2.0 technology. *International Business Times*, Deloitte, Libra, Accenture. Retrieved from <https://www.ibtimes.co.uk/deloitte-libraaccenture-work-auditors-age-bitcoin-2-0-technology-1515932>.
- PWC (2017). Blockchain – an opportunity for energy producers and consumers? Retrieved from [www.pwc.com/gx/en/industries/assets/pwc-blockchain-opportunity-for-energy-producers-and-consumers.pdf](http://www.pwc.com/gx/en/industries/assets/pwc-blockchain-opportunity-for-energy-producers-and-consumers.pdf).
- T.K. (2017). 5 key issues that merit CPAs attention. In AICPA ENGAGE conference, Snapshot from Las Vegas.
- Deloitte (2018). Breaking blockchain open, Deloitte's 2018 global blockchain survey. Retrieved from <https://www2.deloitte.com/content/dam/Deloitte/us/Documents/financial-services/us-fsi-2018-global-blockchain-survey-report>.
- Brender, N. G. M. M. J. H. & S. A. (2018). The Potential Impact of Blockchain Technology on Audit Practice. *Journal of Strategic Innovation and Sustainability*, 14(2), 35-59.
- Canada, C. (2018). New White Paper Identifies Blockchain Implications for Audit and Assurance. PR Newswire, New York.
- PCAOB (2018). What Auditors Need to Know about Blockchain and Other Emerging Technologies: A Regulator's Perspective. Retrieved from <https://pcaobus.org/News/Speech/Pages/what-auditors-need-to-know-blockchain>.

# UNVEILING THE PATH TO THE FUTURE OF FINANCE: AN ANALYSIS OF FACTORS INFLUENCING THE INTENTION TO ADOPT INFORMATION AND COMMUNICATION TECHNOLOGY FOR BANKING SERVICES

**Dr. Ashish Mathur,**

Central University of Haryana, Mahendragarh, Haryana, India.

ORCID 0000-0002-2324-0504

**Dr. Gyanendra B. S. Johri,**

Indira Gandhi National Tribal University, Amarkantak, Madhya Pradesh, India.

ORCID 0009-0001-5821-2909

**Dr. Divya,**

Central University of Haryana, Mahendragarh, Haryana, India.

ORCID 0000-0002-3996-1023

**Prof. R.P. Das,**

Krishna Kanta Handique State Open University (KKHSOU), Assam, India.

ORCID 0009-0008-9396-8403

In the contemporary landscape, the integration of ICT for banking services and commerce has emerged as an essential facet of financial services, hence prompting inquiries about the acceptability and use of such technological advancements. The primary objective of this study is to investigate the factors influencing the adoption of ICT for banking services in the Northern States of India. Specifically, the study aims to examine the extent to which individuals' desire to use ICT for banking services may be attributed to their perceptions of its ease of use and utility, as outlined in the technological acceptance model. In order to facilitate the study objectives, a survey analytic methodology was used on a sample consisting of 282 employed individuals residing in the Northern states. To enhance the credibility of the findings, the composition of the sample was adjusted to align with the gender and age distribution of the population. Logistic regression models were used to examine the study hypothesis. The findings of the study provide confirmation that both components of the technological acceptance model have a substantial effect on the level of acceptability seen towards ICT for banking services within the areas of Northern states of India. The adoption and use of ICT for banking services are influenced by demographic and economic aspects as well as individual perceptions. The findings indicate that the adoption of ICT for banking services are influenced by both components of the technological acceptance model.

**Keywords:** ICT, Technology Adoption Model, Logistic Regression model, banking services

## 1. Introduction

The banking sector, which plays a crucial role in contemporary economies, finds itself at a critical juncture in its ongoing evolutionary trajectory. In the current era, which is marked by the swift digitization of financial services, the utilization of Information and Communication Technology (ICT) has transitioned from being a discretionary choice to an absolute necessity. Banking institutions worldwide are currently faced with the imperative to adopt technological advancements in order to maintain competitiveness, improve operational efficiency, and meet the continuously evolving demands of their customers.

The advent of Information and Communication Technology (ICT) has brought about a paradigm shift, fundamentally reshaping the nature of the banking industry. The ongoing transformation of traditional brick-and-mortar institutions into digital-first entities is



primarily motivated by the potential benefits of enhanced accessibility, accelerated processes, heightened security measures, and increased personalization. In the contemporary landscape of banking, customers have developed a heightened expectation for online and mobile banking experiences that are characterized by their seamless nature. Simultaneously, regulatory bodies have imposed rigorous standards pertaining to data security and compliance. Within the present context, the focal point revolves around the inclination to embrace information and communication technology (ICT) within the banking industry. This inclination holds significant importance as it serves as the foundation for the sector's capacity to adjust and flourish within the era of digitalization.

The incorporation of information and communication technology (ICT) holds significant importance in the area of banking services, as it has witnessed a multitude of technological advancements aimed at augmenting user participation. Online banking refers to a banking practice wherein customers can conveniently access and conduct financial operations on their bank accounts through their computers, providing them with the flexibility to do so at their preferred time. The ICT for banking services enables customers to engage in various financial activities, including transferring funds, making payments, checking account balances, reviewing account statements, accessing account details, customizing print options, and printing bank statements.

Many researchers have used the technology acceptance model (TAM), a widely employed framework in the examination of information system acceptance, to elucidate the determinants that impact the adoption and utilization of information and communication technology (ICT) among the general populace. According to Pikkarainen et al. (2004), the Technology Acceptance Model (TAM) posits that the actual use of a system is influenced by the perceived utility and perceived ease of use, which in turn affect the attitude towards using the system, leading to the intention to use and ultimately resulting in real behaviour (Pikkarainen et al. (2004). Put simply, if individuals see the use of information and communication technology (ICT) in the banking sector as uncomplicated and advantageous, it is likely to positively influence their inclination to engage in ICT for banking services. The Technology Adoption Model (TAM) is anticipated to explain the adoption and use of this particular service, taking into account the specific characteristics of consumers, both demographic and psychological in nature.

The Technology Acceptance Model (TAM), developed by Fred Davis in the late 1980s, is now a standard for assessing corporate technology adoption. TAM offers a solid foundation for analyzing user technology adoption. TAM helps bankers understand ICT adoption. This study uses the TAM framework to examine the complex aspects that affect banking ICT adoption. TAM helps us understand bankers' and employees' technology adoption and usage choices. TAM's key notions of perceived ease of use and perceived usefulness give a systematic way to analyzing how these aspects affect ICT adoption intentions.

This research seeks to contribute not only to the theoretical underpinnings of technology adoption but also to offer practical insights to banking practitioners, policymakers, and stakeholders. By comprehensively analyzing how TAM constructs interact with the unique characteristics of the banking sector, we aspire to unlock the keys to a more efficient, customer-centric, and technology-enabled financial future.

Following the introductory section, this study presents a theoretical framework and a comprehensive evaluation of the relevant literature. Subsequently, an empirical analysis is conducted to examine the applicability of the technological acceptance model in the context of ICT for banking services adoption in the Northern States of India. Following the presentation of the findings, a conclusive statement and a suggestion for further study are provided.

## 2. Theoretical background.

### 2.1. Review of literature

(Zhu et al., 2022) propose an extended Technology Acceptance Model and test the relationships between Perceived Usefulness, Perceived Ease of Use, Attitude, Behavioural Intention, Self-efficacy, Technology Anxiety, and Social Support in older adults' smartphone use by confirmatory factor analysis (CFA); and analyses the specific differences between primary, medium, and advanced use level groups in each construct by Q-cluster and ANOVAs. (Li et al., 2022) investigated 284 patients with HIV/AIDS in area six of Sanmenxia City. The analysis revealed three distinct factors related to nurses' expectations of PAEHR improves the quality of care PAEHR improves the quality of the work environment and risk and fears concerning patients' well-being (Cajander et al, 2022). The working of these EMRs requires their acceptance and use by medical and paramedical personnel. The purpose of (Lipenguet et al., 2022) was to empirically evaluate the intention of health professionals to use these EMRs. (Malodia et al., 2022) aim to examine customers' willingness to engage in service interactions enabled by artificial intelligence (AI) controlled voice assistants (VA). (Aldharman et al., 2023) studied online health information seeking by individuals with physical disabilities caused by neurological conditions in Saudi Arabia. A sectional, online, self-administered, questionnaire study was conducted in Saudi Arabia. (Li, 2023) studied the integrated method of synaesthesia in the Internet of Things for power distribution maintenance. A fusion method of low-voltage power lines and micro-power wireless communication is proposed. (Nie et al., 2023) aim to explore the factors that affect continuous usage intentions of mHealth services and their mechanism of action. (Zheng et al., 2023) aimed to (1) apply the extended DeLone and McLean Information Systems Success Model (D&M model) that incorporates IPC culture to examine how technical factors like information quality, system quality, and service quality, as well as organizational culture factors affect clinicians' use intention, satisfaction, and perceived net benefits, and (2) identify which factors are the most important for clinicians' use intention. (Sen et. al., 2023) apply the extended theory of planned behaviour (ETPB) to explore factors that shape the behavioural intention of migrant labourers returning to the coastal region of Thừa Thiên Huế province during the peak of the COVID-19 pandemic to remigrate.

The objective of (Rahi et. al., 2019) is to ascertain determinants of ICT for banking services adoption using a unified theory of acceptance and use of technology (UTAUT) and electronic service (e-service) quality, which accounts for changes in user's intention to adopt ICT for banking services. To identify which factors affect user intention to adopt ICT for banking services (Rahi et al., 2019) develop an amalgamated model based on technology and social psychological literature. (Ayaz et. al., 2020) study analysis on the unified theory of acceptance and use of technology theory (utaut): acceptance of electronic document management system (EDMS). Data was analyzed by using the R software program and Structural Equation Modelling (SEM). Other influential work includes (Turel et al., 2007), (Schikofsky et al., 2020).

#### 2.1.1. Research Gap

Limited research has been undertaken on the adoption of ICT for banking services in northern states of India. Specifically, there is a dearth of studies exploring the application of the Technology Acceptance Model (TAM) in these contexts. Hence, the primary objective of this study is to ascertain whether the inclination towards using ICT for banking services, can be elucidated by factors such as the perceived ease of use and perceived utility, in addition to the demographic and economic attributes of the consumers. This study aims to investigate the factors influencing the adoption of ICT for banking services in the Northern states of India where most respondents are working.



## 2.2. Theoretical Framework and Research Model

### 2.2.1. Technology Adoption Model (TAM)

The adoption of ICT in banking services is now essential in financial services. Technology user acceptability has always been crucial to examine. Many models have been suggested to forecast system usage, but Fred Davis' 1985 PhD thesis technology acceptance model (TAM) has garnered the greatest attention (Chuttur, 2009). A model suggests that system usage is driven by user motivation, which is impacted by external stimuli such as the system's features and capabilities. This approach is popular for its emphasis on information systems and psychology theory to determine the motivation for utilizing them. Davis (1985) identified three elements that motivate users: perceived ease of use (PEOU), perceived usefulness (PU), and attitude towards the system. In Figure 1, the relationship between the elements is mentioned in the model.

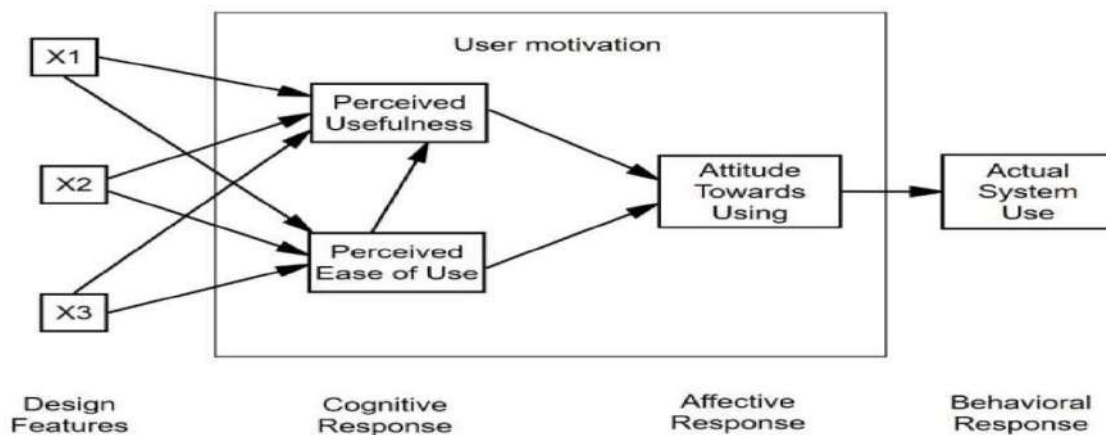


Fig.1 The original TAM proposed by Fred Davis

Source: [https://www.researchgate.net/figure/This-figure-shows-original-technology-acceptance-model-TAM-as-adopted-from-Davis-et-al\\_fig1\\_292966263](https://www.researchgate.net/figure/This-figure-shows-original-technology-acceptance-model-TAM-as-adopted-from-Davis-et-al_fig1_292966263)

The Technology Acceptance Model (TAM) underwent subsequent developments, wherein Davis (1985) made refinements to the model by incorporating additional variables and modifying the interrelationships among them during later stages of experimentation. Several other researchers have also put forth additional proposals to the Technology Acceptance Model (TAM), thereby solidifying its position as a prominent model for elucidating and forecasting the utilization of systems. Subsequent advancements in the model encompassed the incorporation of behavioural intention as an additional variable, which is directly influenced by the perceived usefulness and perceived ease of use of a system, as proposed by Davis et al. (1989). Both components of the original Technology Acceptance Model (TAM) were observed to exert a direct impact on individuals' behavioural intentions. Consequently, the final iteration of the TAM underwent only a single modification in comparison to its original form, which entailed substituting the attitude toward using the construct with the behavioural intention construct. According to Venkatesh and Davis (1996), various external variables can have an impact on the perceived usefulness and perceived ease of use of a system. These variables encompass system characteristics, sociodemographic characteristics, marketing efforts, training, and user involvement in design, among others. The ultimate iteration of the Technology Acceptance Model (TAM) is visually represented in Figure 2.

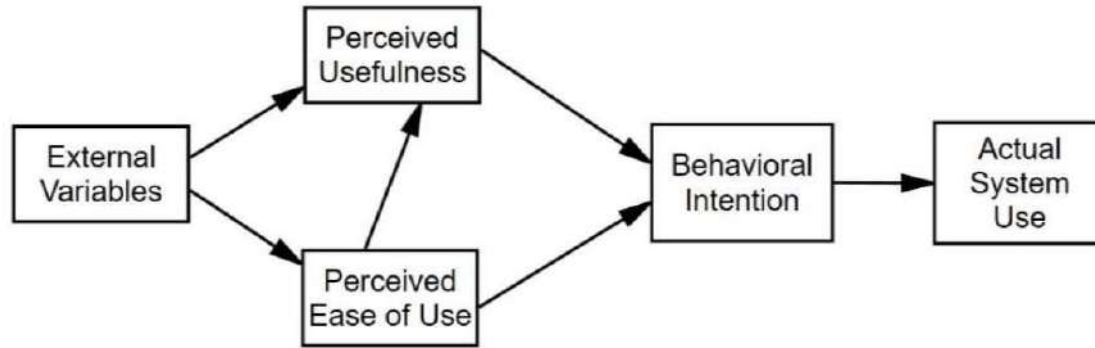


Figure 2. Modified version of TAM

Source: [https://www.researchgate.net/figure/Technology-Acceptance-Model-TAM-Venkatesh-Davis-1996\\_fig1\\_327258014](https://www.researchgate.net/figure/Technology-Acceptance-Model-TAM-Venkatesh-Davis-1996_fig1_327258014)

### 2.2.2 Derived Hypothesis

To assess how users embrace new technology, various behavioural decision theories and intentional models have emerged in the scientific literature over the past forty years. In alignment with the objectives of this research and its significance in understanding the factors of adopting ICT in banking services, we have applied attitudinal models and theories rooted in social psychology. One notable example is the Technology Acceptance Model (TAM), as introduced by Davis, Bagozzi, and Warshaw in 1989. The TAM model, stemming from the theory of reasoned action, aims to predict the acceptance and use of new information technologies and systems by identifying what drives success in a company's information systems and their suitability for work needs (Davis et al., 1989). These attitudinal models emphasize the benefits of information systems while minimizing their drawbacks. They describe the information processing characteristics that influence individuals' intentions to adopt or reject technological innovations. The TAM model is widely considered the most robust and influential model in innovation acceptance behaviour (Davis et al., 1989; Pavlou, 2003). Hence, we consider it the foundation for our study. It posits that attitudes toward new technology adoption are influenced by perceived usefulness and ease of use.

#### Perceived Usefulness

Davis (1989) defines perceived utility as an individual's belief that a technology would enhance job performance. The perception of customers that ICT services would improve their banking performance or activity (Bashir & Madhavaiah, 2014). Much research demonstrates that PU increases ICT adoption intentions (Heryani et al., 2020). Intention to utilize ICT was most influenced by this factor (Jeong & Yoon, 2013; Kaur & Malik, 2019; Vuković et al., 2019). It also affects ICT adoption readiness. Customers will employ a service if they think it will improve their performance.

**H<sub>a1</sub>**: Perceived usefulness of ICT influenced positively on the intention to adopt ICT for banking services.

#### Perceived Ease of Usefulness

It's a measure of how comfortable consumers feel using ICT services (Baber, 2019; Davis, 1989). According to the research of Akturan and Tezcan (2012), user preferences can be gauged by looking at their PE predict attitude. Furthermore, Venkatesh and Davis (1996) argued that, theoretically, knowing what triggers PE is essential for choosing whether or not to employ it. People who have PE are more prone to use ICT, according to many studies

(Davis, 1989; Kaur & Malik, 2019; Vukovi'c et al., 2019). The convenience of not having to wait in long lines at the bank or branch is another advantage of PE for ICT users (Govender & Sihlali, 2014). Customers are therefore prompted to engage in a wide variety of transactions (Abbad, 2013).

**Ha2:** Perceived Ease of Use of ICT affects positively the intention to adopt ICT for banking services

**Demographic and Economic Variables of the Respondents**

Demographic and economic variables include age, gender, level of education, income and internet experience of the respondents of the Northern states of India. Considering these variables impact the acceptance, and use of ICT for banking services and acceptance of ICT for banking services.

**Ha3:** Individuals' demographic and economic variables impact their adoption and usage of ICT for banking in northern India.

**3. Research Methodology**

**Research Design**

This research is conducted in the various cities of the northern states of India including Punjab, Himachal Pradesh, Delhi, Uttarakhand, Haryana, and Jammu and Kashmir, with consideration that the cities of the states have functional bank branches with ICT enabled. This type of research is exploratory research which is conducted to examine the effect between the variables in the hypothesized (Cooper & Emory, 1998) and logistic regression models will be used to test the research hypothesis by using structured and close-ended questionnaires.

**Research Instrument**

The study used a survey analysis to gather data on both the primary TAM features and individual characteristics of respondents. The questionnaire was distributed through social media, email, and print to non-internet users from April to July 2023. The survey has 16 questions. The survey is divided into categories based on perceived ease of use, utility of ICT, and individual characteristics of respondents. The application of TAM will be assessed by asking questions about the desire to utilize ICT for banking services. To assess agreement with PEOU and PU statements, a 1-5 Likert scale (1=strongly disagree, 5=strongly agree) was used. Table 1 displays the research instrument description and variables.

**Table 1 Research Instrument Description**

Code	Item
PEOU1	ICT for banking services is simple to understand, in my opinion
PEOU2	I think ICT is easy to grasp (at least for me).
PEOU3	ICT is effortless for me.
PEOU4	I think it's simple to learn ICT for banking abilities.
PU1	I find ICT for banking services useful
PU2	I feel it overcomes geographical limits.
PU3	I think ICT for banking saves time
PU4	I think ICT for banking saves money
PU5	ICT for banking boosts productivity, I think.

Source: Author's work

## Data

The research is based on the population of the Northern states of India as mentioned above. A sample size of 383 was initially calculated based on a 0.95 confidence interval and a 0.05 margin of error. However, not all surveys were completed, and the final sample size ended up being 282 working residents. This new sample size corresponds to a 0.90 confidence level and a 0.05 margin of error.

The sample consisted of 51.42% female respondents and 48.58% male respondents, with an equal distribution of both groups across five distinct age categories. The sample methodology used in this study may be characterized as a hybrid approach, including elements of both stratified and quota sampling techniques. The population was first stratified into various groups, and then, a random sample was selected from each stratum in a manner that is proportional to its size compared to the whole population, according to the guidelines established by Teddlie and Yu in 2007 as shown in the table below:

**Table 2: Sample Structure by Gender and Age**

Age	No. (%)	Female	Male	Total
<= 24 years	No.	28	24	52
	(%)	9.9%	8.5%	18.4%
25-34 years	No.	27	31	58
	(%)	9.6%	11 %	20.6%
35-44 years	No.	30	26	56
	(%)	10.6%	9.2%	19.9%
45-54 years	No.	30	28	58
	(%)	10.6%	9.9%	20.6%
55-64 years	No.	30	28	58
	(%)	10.6%	9.9%	20.6%
TOTAL	No.	145	137	
	(%)	51.4%	48.6%	

Source: Author's work

A majority of the participants in the survey are well-educated, accounting for 56.7% of the total, while the remaining 43.3% have primary and secondary education backgrounds. When it comes to monthly income, the largest portion of respondents (30.1%) earn between Rs. 10,000 and Rs.50,000, closely followed by those earning between Rs. 50,001 and Rs 75,000 (27%). A mere 11% of the respondents have a monthly income exceeding 10,000 HRK. In terms of Internet usage duration, the majority (49.3%) have been using the Internet for more than 11 years, whereas only a small fraction (5.7%) have less than 2 years of Internet experience.

## Statistics

The data collected from the survey will be subjected to a comprehensive analysis using two statistical software programs, namely SPSS 26.0 and Stata 18.0. In the first stage, we will provide descriptive statistics about the use of ICT features in banking. The purpose of this step is to provide an analysis of the key characteristics of ICT for banking services that have generated significant interest among individuals.

Following this, the exploratory factor analysis will be used to reveal the latent structure among the variables being investigated. Considering the presence of several factors that assess the perception of ease of use and utility, it is conceivable that these variables may demonstrate connections among themselves. To effectively handle this issue, it is necessary to arrange and categorize the variables, grouping those that exhibit strong correlations nearby.

It is expected that two variables will arise, one for each element of the Technology Acceptance Model (TAM), namely perceived ease of use (PEOU) and perceived usefulness (PU). In this study, new composite measures will be developed to reflect distinct clusters of variables (Hair et al., 2010). These composite measures will be used in future hypothesis testing.

Additionally, reliability analysis will assess variable consistency using Cronbach's alpha coefficients (Hair et al., 2010). Finally, logistic regression models will assess the study hypothesis. Two models will be examined, one for each TAM element. The dependent variable for both models is ICT adoption, which is binary. The first model will include perceived ease of use, demographic, and economic factors, while the second model will include perceived usefulness, demographic, and economic characteristics of users. The variables' perceived ease of use and perceived usefulness will be employed as composite measures based on component analysis.

#### 4. Result and Discussion

Table 3 shows the prevalence of ICT use among 189 ICT users and 93 non-users. The statistics show that most ICT for banking services customers examine account balances and transaction history. They also use ICT for banking services for local and international payments. These developments are expected because these services are free and do not need account withdrawals. Additionally, many like to monitor all account activity to keep financial management.

The usual user pays bills and shops numerous times a month, therefore domestic and overseas payments are the second most utilized capability. ICT for banking services makes these transactions easy, fast, and efficient. Milanović Glavan and Ćibarić (2015) found similar use trends in Croatia, as well as in China (Yiu et al., 2007) and New Zealand (Chung and Paynter, 2002). This is due to respondents' main motivations for adopting ICT for banking services, which include time savings and 24/7 accessibility.

**Table 3** Frequencies of certain uses of ICT

	Using for transaction and balance check	Payments and transfer of funds	Investing in funds and shares via ICT	Depositing funds	Checking Account statement	For domestic use
Almost everyday	38 (20.10%)	11 (5.82%)	1 (0.52%)	1 (0.52%)	6 (3.17%)	1 (0.52%)
A few weeks	64 (33.86%)	39 (20.63%)	4 (2.11%)	0	5 (2.64%)	0
A few months	66 (34.92%)	96 (50.79%)	17 (8.90%)	1 (0.52%)	25 (13.22%)	3 (1.58%)
Less than once in a month	20 (10.58%)	21 (11.11%)	54 (28.57%)	44 (23.28%)	81 (42.85%)	10 (5.29%)
Never	1 (0.52%)	22 (11.64%)	113 (59.78%)	143 (75.66%)	72 (38.09%)	175 (92.59%)
Total	189	189	189	189	189	189

Source: Author's work

**Factor Analysis**

The aforementioned three supplementary hypotheses were developed to investigate whether or not demographic and economic variables, as well as individual perspectives, impact the usage of ICT for banking. The Technology Acceptance Model (TAM) will be applied to the field of banking services based on these assumptions using logistic regression analysis.

To test the first auxiliary hypothesis, that demographic and economic factors have an effect on ICT for banking services adoption, we will use two different regression models to analyze the relative importance of perceived ease of use (PEOU) and perceived usefulness (PU), respectively.

Factor analysis must be used to develop composite measures of PEOU and PU before running these regression models. Table 4 displays the outcomes of the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test. Exploratory factor analysis (EFA) correlation matrices are used to evaluate these metrics of sample adequacy.

**Table 4 KMO and Bartlett' test**

<b>Kiser-Meyer-Olkin Measure of Sampling Adequacy</b>		.876
<b>Bartlett's Test of Sphericity</b>	Chi-Square	3260.58
	df	36
	Sig.	.000

A KMO value of 0.50 falls within the factor analysis range of 0 to 1. Valid component analysis requires a statistically significant Bartlett's test of Sphericity chi-square result (Taherdoost et al., 2014). This sample has a high KMO score of 0.924 and a significant chi-square value (p=0.001). Thus, factor analysis suits this data set.

Principal Components Analysis using Varimax rotation extracted two components in this investigation. This method captures overall variation while reducing unique and incorrect variances in derived components (Hair et al., 2010). Reducing the number of components simplifies the study instrument (Taherdoost et al., 2014).

The factor analysis showed two factors: "perceived ease of use" (PEOU1, PEOU2, PEOU3, and PEOU4) and "perceived usefulness" (PU1, PU2, PU3, PU4, and PU5). All components have strong factor loadings, above the 0.40–0.70 limit (Costello and Osborne, 2005). The variables' item communalities were substantially over 0.8, suggesting strong item linkages. The factor analysis findings show high factor loadings and substantial similarities, supporting all item retention. Both extracted factors are strong since all factor loadings surpass 0.50. Table 5.

**Table 5 Rotation Component Matrix**

Item	Factor	
	1	2
<b>PEOU1</b>		0.887
<b>PEOU2</b>		0.867
<b>PEOU3</b>		0.896
<b>PEOU4</b>		0.889
<b>PU1</b>	0.845	
<b>PU2</b>	0.851	
<b>PU3</b>	0.869	
<b>PU4</b>	0.834	
<b>PU5</b>	0.845	

Source: Author's Work



**The reliability analysis**

A reliability study utilizing Cronbach's alpha coefficients assessed the variables' internal consistency. Many publications recommend an alpha range of 0.65 to 0.70, while others recommend a value of 0.60. Most publications recommend alpha values between 0.70 and 0.95 (Tavakol and Dennick, 2011). Table 6 reveals that both factors' Cronbach's alpha values are over 0.95, indicating internal consistency. All adjusted item-total correlations are over 0.40, indicating a good scale. Additionally, each factor's Cronbach's alpha is smaller than the factor's if any item is eliminated, indicating that none should be removed (Shelby, 2011).

**Table 6 Cronbach’s Alpha (Reliability Test)**

Factor	Variables	Cronbach’s alpha	Corrected item-total Correlation	Cronbach’s Alpha Item deleted
PEOU	PEOU1	0.987	0.850	0.879
	PEOU2		0.854	0.880
	PEOU3		0.965	0.890
	PEOU4		0.976	0.976
PU	PU1	0.946	0.834	0.934
	PU2		0.812	0.924
	PU3		0.910	0.924
	PU4		0.823	0.922
	PU5		0.878	0.976

Source: Author’s Work

**Models of logistic regression**

Logistic regression models tested the study hypothesis. Robust standard errors were estimated to account for heteroscedasticity (Mood, 2010). One model was utilized for PEOU and PU, both TAM components. The dependent variable in both models is ICT adoption for banking services, which is binary. The variable "Do You Intend to Start or Continue Using ICT Services for Banking in the Future?" is a survey question with two potential responses (no or yes). One model's primary independent variables are PEOU, PU, and user demographics and economics. Regression models use composite measures of perceived ease of use and usefulness from earlier component analysis.

Table 7 shows both regression models' outcomes. All factors, except for gender, have a considerable impact. Perceived simplicity of use positively impacts ICT adoption, with respondents who think that ICT for banking services is simple to learn, clear, and comprehend, and easy to use and obtain skills for utilizing increasing the likelihood of adoption. Higher agreement with ICT's perceived utility, such as reducing spatial limits, boosting productivity, and saving time and money, increases ICT adoption. Older respondents are less likely to adopt ICT. Education hinders ICT adoption. One group represents basic and secondary education, the other higher education. The reference category is first. Thus, elementary or secondary school graduates were less likely to use ICT. The second approach has less education effect. Income and Internet use strongly correlate, with more income and online time promoting ICT adoption.

**Table 7 Logistic Regression Model**

	Model 1		Model 2	
ICT Adoption	Coefficient (p-	Odds Ratio	Coefficient (p	Odds Ratios



	<b>value)</b>		<b>value)</b>	
PEOU	0.608*** (0.000)	1.836	_____	_____
PU	_____	_____	0.675*** (0.001)	1.956
Gender	-0.354 (0.370)	0.789	-0.476 (0.203)	0.614
Age	-0.0605*** (0.001)	0.943	-0.0371* (0.046)	0.966
Level of Education	-0.824** (0.050)	0.450	-0.714 (0.114)	0.467
Internet Usage	0.196*** (0.000)	1.256	0.213*** ( 0.000)	1.267
Income	0.0001*** (0.016)	1.000202	0.000808*** (0.011)	1.000189
Constant	2.186* (0.053)		1.166 (0.305)	
N	282		282	
R	0.3328		0.3378	

Source: Author’s Work

Note: \*p < 0.10, \*\*p < 0.05, \*\*\*p < 0.01

The study found that perceived simplicity of use and usefulness favourably impact the acceptability of ICT for banking services. Previous studies have also shown that the more a person believes that ICT for banking is beneficial and simple to use, the more motivated they are to utilize it. This applies to TAM in the context of ICT for banking services to Northern Indian workers. The theory is somewhat supported by demographic and economic considerations, since gender is not important in either model and education is significant in one. Several demographics and characteristics were important in both models. The core hypothesis that demographic, economic, and individual perspectives affect ICT acceptance and banking use is supported since all three auxiliary hypotheses are confirmed.

**Table 8 Hypothesis Acceptance or Rejection**

S.N	Hypothesis	Accepted/Rejected
1.	Perceived usefulness of ICT influenced positively on the intention to adopt ICT for banking services.	<b>Accepted</b>
2.	Perceived Ease of Use of ICT affect positively on the intention to adopt ICT for banking services	<b>Accepted</b>
3.	Individuals' demographic and economic variables impact their adoption and usage of ICT for banking in northern India.	<b>Accepted</b>

Source: Author’s Work

### 5. Conclusion

The purpose of this research was to determine whether the adoption of ICT for banking services in northern India is due to perceived ease of use and usefulness, the essential components of the technological acceptance model..To conduct the study, a survey analysis was used, consisting of questions about both the primary parts of the Technology Acceptance Model (TAM) and the unique features of each participant. The sample size consisted of 282

individuals who were employed inhabitants. The hypothesis was tested using logistic regression models. The results of the study indicated that there is a significant impact of perceived ease of use, perceived usefulness, as well as demographic and economic factors on the adoption of ICT for banking services. The study revealed that those who were younger had higher levels of education, had more experience using the Internet, earned higher incomes, and expressed more agreement with statements on the ease of use and utility of ICT for banking services were more inclined to use this form of banking.

The aforementioned results align with prior studies that used perceived ease of use, perceived utility, demographic factors, and other features as predictors in their models to examine the adoption of ICT for banking services. The majority of research studies have shown a favourable impact of these characteristics on the adoption of ICT for banking services. However, it is worth noting that Chong et al. (2010) discovered an anomaly in their findings, as they observed that the perceived ease of use did not affect the use of ICT for banking services. Regarding the demographic and other characteristics of users, previous research has commonly utilized variables such as gender and age (Safeena et al., 2014; Yousafzai and Yani-de-Soriano, 2012; Sadeghi and Farokhian, 2011; Polasik and Wisniewski, 2009). Additionally, some studies have included other variables such as income (Patsiotis et al., 2012), level of internet experience, urbanization of the residential area, and educational attainment (Polasik and Wisniewski, 2009). Several researchers have also identified various factors such as security and perceived risk, social influence, website design, and personality traits as predictors of ICT for banking services adoption (Yoon and Barker Steege, 2013; Pikkarainen et al., 2004; Safeena et al., 2014; Kesharwani and Bisht, 2012; Gounaris and Koritos, 2008; Makarević, 2016). The study demonstrated that each of these characteristics has an impact on the adoption of ICT for banking services. In contrast to other scholarly investigations, the present study aims to examine the Technology Acceptance Model (TAM) by assessing its primary components, namely perceived ease of use and perceived utility. Additionally, the study also considers certain demographic and economic aspects of the users. In contrast to Polasik and Wisniewski (2009), this study has considered age and income as quantitative factors rather than binary variables. This research includes Internet experience as a key predictor of International Business (IB) adoption since it has not been frequently examined.

Given the limited amount of research available on the adoption of ICT for banking services in Croatia and other countries with a relatively low number of users, particularly concerning the application of the Technology Acceptance Model (TAM), this study addresses a significant gap in the existing literature within this scientific domain.

Hence, through an investigation into the factors influencing the adoption of ICT for banking services, this study examines the extent to which perceived ease of use, perceived usefulness, and demographic and economic characteristics of users contribute to the motivation for utilizing ICT for banking services (Vukovic and Kundid, 2019). The findings reveal that despite the relatively lower number of ICT for banking services users, the influential factors driving adoption align with those observed in other countries.

It is also evident that there are minimal disparities in the manner in which these factors impact the adoption of ICT for banking services and nations with a larger population of users engaged in online banking services. The impact of gender on ICT adoption, is shown to be statistically insignificant, in contrast to other nations. These findings may also assist bank management in comprehending the determinants of ICT for banking services adoption and

formulating strategies for growth, particularly in nations with a smaller user base. Based on the findings that have been established, it is evident that individuals who engage in ICT for banking services tend to be younger, possess higher levels of education, exhibit more familiarity with Internet use, and possess higher incomes. In light of these observations, it is recommended that banks undertake diverse marketing initiatives to enhance the adoption of their ICT for banking services across a broader range of people. In addition, financial institutions should explore educational initiatives aimed at promoting the use of ICT for banking services among elderly individuals. Furthermore, offering more advantageous terms and conditions to consumers who utilize this service might be a viable strategy.

Nevertheless, the study does have several limitations about the sample size. Due to the distribution of the printed survey to those who do not have access to the Internet, a portion of the respondents were selected from acquaintances. Consequently, the sample may not be completely representative and impartial. Furthermore, it is essential to perform a comprehensive study including several cities in Croatia to ensure the generalizability of the research results to the whole nation.

To enhance the robustness of future investigations, it is advisable to augment the sample size to achieve greater statistical significance. Additionally, it is suggested to explore the use of the Technology Acceptance Model (TAM) in conjunction with a broader range of explanatory factors. The approach has the potential to be extended to include structural equation modelling. Enhanced comprehension of the determinants influencing the acceptability of ICT for banking services and the subsequent methods used by banks may lead to a broader implementation of ICT for banking services. This will result in enhanced efficiency in banking and commercial growth, hence yielding advantages for both financial institutions and their clientele. Future studies in this domain and the expanded implementation of ICT for banking services are anticipated to provide manifold advantages for all stakeholders concerned.

## Reference

- Aldharman, S. et.al. (2023). Online Health Information Seeking By Individuals With Physical Disabilities Caused By Neurological Conditions in Saudi Arabia. *Cureus*, 15(3), e22827.
- Ayaz, A., & Yanartaş, M. (2020). An analysis on the unified theory of acceptance and use of technology theory (UTAUT): Acceptance of electronic document management system (EDMS). *Computers in Human Behavior Reports*, 2, 100032. <https://doi.org/10.1016/j.chbr.2020.100032>
- Cajander, Å., et.al. (2022). Effects of Patient Accessible Electronic Health Records on Nurses' Work Environment: A Survey Study on Expectations in Sweden. *BMJ Open*.
- Chavan, J. (2013). ICT for banking services – benefits and challenges in an emerging economy. *International Journal of Research in Business*, 1(1), 19-26.
- Chong, A. Y., Ooi, K., Lin, B., & Tan, B. I. (2010). Online banking adoption: an empirical analysis. *International Journal of Bank Marketing*, 28(4), 267–287. <https://doi.org/10.1108/02652321011054963>.
- Chung, W., Paynter, J. (2002). An Evaluation of ICT for banking services in New Zealand. In *Proceedings of the 35th Hawaii International Conference on System Sciences* (pp. 2410-2419). IEEE Computer Society Washington, DC, USA.
- Chuttur, M. Y. (2009). Overview of the Technology Acceptance Model: Origins, Developments and Future Directions. *Sprouts: Working Papers on Information*

- Systems*, 9(37), *Indiana University, USA*. <http://globelegislators.org/pdfjs/test/pdfs/TAMReview.pdf>
- Costello, A. B., & Osborne, J. W. (2005). Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. *Practical Assessment, Research and Evaluation*, 10(1), 1–9. <https://doi.org/10.7275/jyj1-4868>
- Croatian Bureau of Statistics (2017). Census of Population, Households and Dwellings 2011. Retrieved from [https://www.dzs.hr/Hrv\\_Eng/publication/2012/SI-1468.pdf](https://www.dzs.hr/Hrv_Eng/publication/2012/SI-1468.pdf) (Accessed on September 20, 2016).
- Davis, F. (1985). A technology acceptance model for empirically testing new end-user information systems: theory and results. *Doctoral thesis, MIT Sloan School of Management*, Cambridge, MA.
- Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer Technology: A comparison of two theoretical models. *Management Science*, 35(8), 982–1003. <https://doi.org/10.1287/mnsc.35.8.982>
- Eurostat. (2018). Individuals use the Internet for Internet banking. Retrieved from <http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&plugin=1&pcode=tin00099&language=en>
- Gounaris, S., & Koritos, C. (2008). Investigating the drivers of Internet banking adoption decision: A comparison of three alternative frameworks. *International Journal of Bank Marketing*, 26(5), 282-304.
- Guraău, C. (2002). Online banking in transition economies: the implementation and development of online banking systems in Romania. *International Journal of Bank Marketing*, 20(6), 285–296. <https://doi.org/10.1108/02652320210446742>
- Hair, J. F. (2010). Multivariate data analysis: a global perspective. In *Pearson eBooks*. <https://ci.nii.ac.jp/ncid/BB03463866>
- Hanafizadeh, P., Keating, B., & Khedmatgozar, H. R. (2014). A systematic review of Internet banking adoption. *Telematics and Informatics*, 31(3), 492–510. <https://doi.org/10.1016/j.tele.2013.04.003>
- Harris, L., & Spence, L. J. (2002). The ethics of Ebanking. *Journal of Electronic Commerce Research*, 3(2), 59-66.
- Ibok, N., & Ikoh, I. M. (2013). Determinants of Customer Satisfaction with Internet Banking Services. *British Journal of Arts and Social Sciences*, 14(2), 178-185.
- Kesharwani, A., & Bisht, S. S. (2012). The impact of trust and perceived risk on internet banking adoption in India. *International Journal of Bank Marketing*, 30(4), 303–322. <https://doi.org/10.1108/02652321211236923>
- Kundid, D. (2017). Factors of acceptance of Internet banking among the population in the City of Split (Master thesis). *University of Split, Faculty of Economics, Business and Tourism*. Retrieved from <https://repositorij.efst.unist.hr/islandora/object/efst%3A1177/datastream/PDF/view>
- Li, C., Wang, P., Zhang, M., Qu, M., Cai, Q., Meng, J., Fan, H., & Sun, L. (2022). Analysis of intention and influencing factors on mobile information follow-up service in HIV/AIDS in a city in China. *Frontiers in Public Health*, 10. <https://doi.org/10.3389/fpubh.2022.997681>
- Liébana-Cabanillas, F., Marinković, V., & Kalinić, Z. (2017). A SEM-neural network approach for predicting antecedents of m-commerce acceptance. *International Journal of Information Management*, 37(2), 14–24. <https://doi.org/10.1016/j.ijinfomgt.2016.10.008>
- Lipenguët, G. M., Ngoungou, E., Roberts, T., Ibinga, E., Gnamien, P. A., Engohang-Ndong, J., & Wittwer, J. (2022). Evaluation of the intention to use the electronic medical

- record (EMR) by health professionals in healthcare facilities of Libreville and Owendo in Gabon. *JAMIA Open*, 5(4). <https://doi.org/10.1093/jamiaopen/ooac096>
- Malodia, S., Ferraris, A., Sakashita, M., Dhir, A., & Gavurova, B. (2022). Can Alexa serve customers better? AI-driven voice assistant service interactions. *Journal of Services Marketing*, 37(1), 25–39. <https://doi.org/10.1108/jsm-12-2021-0488>
- Milanović Glavan, Lj., & Ćibarić, A. (2015). Analiza korištenja Internet bankarstvamedustudentskom populacijom u Republici Hrvatskoj [Analysis of the use of Internet banking among student population in the Republic of Croatia]. In D. Zlatović (Ed.), *Proceedings of The Polytechnic in Šibenik*, 3-4, 69-79.
- Mood, C. (2009). Logistic regression: why we cannot do what we think we can do, and what we can do about it. *European Sociological Review*, 26(1), 67–82. <https://doi.org/10.1093/esr/jcp006>
- Nie, L., Oldenburg, B., Cao, Y., & Wang, R. (2023). Continuous usage intention of mobile health services: model construction and validation. *BMC Health Services Research*, 23(1). <https://doi.org/10.1186/s12913-023-09393-9>
- Patsiotis, A., Hughes, T., & Webber, D. J. (2012). Adopters and non-adopters of internet banking: a segmentation study. *International Journal of Bank Marketing*, 30(1), 20–42. <https://doi.org/10.1108/02652321211195686>
- Pikkarainen, T., Pikkarainen, K., Karjaluoto, H., & Pahlila, S. (2004). Consumer acceptance of online banking: an extension of the technology acceptance model. *Internet Research*, 14(3), 224–235. <https://doi.org/10.1108/10662240410542652>
- Polasik, M., & Wisniewski, T. P. (2009). Empirical analysis of internet banking adoption in Poland. *International Journal of Bank Marketing*, 27(1), 32–52. <https://doi.org/10.1108/02652320910928227>
- Rahi, S., Ghani, M. A., & Ngah, A. H. (2019). Integration of unified theory of acceptance and use of technology in internet banking adoption setting: Evidence from Pakistan. *Technology in Society*, 58, 101120. <https://doi.org/10.1016/j.techsoc.2019.03.003>
- Rahi, S., Mansour, M. M. O., Alghizzawi, M., & Alnaser, F. M. (2019). Integration of UTAUT model in internet banking adoption context. *Journal of Research in Interactive Marketing*, 13(3), 411–435. <https://doi.org/10.1108/jrim-02-2018-0032>
- Sadeghi, T., & Farokhian, S. (2011). Services quality model for online banking services by behavioural adoption theories and comparative study. *African Journal of Business Management*, 5(11), 4490-4499.
- Safeena, R., Date, H., Hundewale, N., & Kammani, A. (2013). Combination of TAM and TPB in internet banking adoption. *International Journal of Computer Theory and Engineering*, 146–150. <https://doi.org/10.7763/ijcte.2013.v5.665>
- Safeena, R., Kammani, A., & Date, H. (2013). Assessment of Internet Banking Adoption: An Empirical Analysis. *Arabian Journal for Science and Engineering*, 39(2), 837–849. <https://doi.org/10.1007/s13369-013-0707-x>
- Schikofsky, J., Dannewald, T., & Kowald, M. (2020). Exploring motivational mechanisms behind the intention to adopt mobility as a service (MaaS): Insights from Germany. *Transportation Research Part A-policy and Practice*, 131, 296–312. <https://doi.org/10.1016/j.tra.2019.09.022>
- Sen, L. T. H., Bond, J., Nguyen, T. D., Nguyen, T. H. M., Hoang, D., Van, C. N., Nguyet, T. T. A., & Nguyen, Q. P. (2023). To stay or re-migrate after the pandemic shock? Labor re-migration intention to the coastal areas of Thừa Thiên Huế province in Vietnam. *Heliyon*, 9(8), e18765. <https://doi.org/10.1016/j.heliyon.2023.e18765>
- Shelby, L. B. (2011). Beyond Cronbach's Alpha: considering confirmatory factor analysis and segmentation. *Human Dimensions of Wildlife*, 16(2), 142–148. <https://doi.org/10.1080/10871209.2011.537302>



- Škrinjarić, B., Budak, J., & Rajh, E. (2019). Perceived quality of privacy protection regulations and online privacy concern. *EkonomskiIstrazivanja-economic Research*, 32(1), 982–1000. <https://doi.org/10.1080/1331677x.2019.1585272>
- Taherdoost, H., Sahibuddin, S., & Jalaliyoon, N. (2014). Exploratory factor Analysis; Concepts and theory. In *HAL (Le Centre pour la Communication ScientifiqueDirecte)*. French National Centre for Scientific Research. <https://hal.archives-ouvertes.fr/hal-02557344>
- Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education*, 2, 53-55.
- Teddlie, C., & Yu, F. (2007). Mixed Methods sampling. *Journal of Mixed Methods Research*, 1(1), 77–100. <https://doi.org/10.1177/1558689806292430>
- Tokić, I. (2014). Usage of Internet Banking among Legal Entities in the Republic of Croatia (Master thesis). *University of Split, Faculty of Economics, Business and Tourism*.
- Venkatesh, V., & Davis, F. D. (1996b). A model of the antecedents of perceived ease of use: Development and test. *Decision Sciences*, 27(3), 451–481. <https://doi.org/10.1111/j.1540-5915.1996.tb01822.x>
- Vuković, M., Pivac, S., & Kundid, D.. (2019). Technology Acceptance Model for the Internet Banking Acceptance in Split. *BSRJ*, 10(2), 124–140. <https://doi.org/10.2478/bsrj-2019-022>
- Yiu, C. S., Grant, K., & Edgar, D. (2007). Factors affecting the adoption of Internet Banking in Hong Kong—implications for the banking sector. *International Journal of Information Management*, 27(5), 336–351. <https://doi.org/10.1016/j.ijinfomgt.2007.03.002>
- Yoon, H. S., & Steege, L. M. (2013). Development of a quantitative model of the impact of customers' personality and perceptions on Internet banking use. *Computers in Human Behavior*, 29(3), 1133–1141. <https://doi.org/10.1016/j.chb.2012.10.005>
- Yousafzai, S., & Yani-De-Soriano, M. M. (2012). Understanding customer-specific factors underpinning internet banking adoption. *International Journal of Bank Marketing*, 30(1), 60–81. <https://doi.org/10.1108/02652321211195703>
- Zheng, F., Wang, K., Wang, Q., Yu, T., Wang, L., Zhang, X., Wu, X., Zhou, Q., & Tan, L. (2023). Factors influencing clinicians' use of hospital information systems for infection prevention and Control: Cross-Sectional study based on the extended DeLone and McLean model. *Journal of Medical Internet Research*, 25, e44900. <https://doi.org/10.2196/44900>
- Zhu, X., & Cheng, X. (2022). Staying connected: smartphone acceptance and use level differences of older adults in China. *Universal Access in the Information Society*. <https://doi.org/10.1007/s10209-022-00933-4>

# COMPARING THE EFFICACY OF OMKAR INTERVENTION AND POSITIVE PSYCHOLOGY INTERVENTION ON DEPRESSION AND SELF-ESTEEM

**Dr. Hemlata Joshi**

Jai Narain Vyas University, Jodhpur, India.  
(joshi.hemlata1981@gmail.com)

**Ms. Anuradha Ramawat**

Jai Narain Vyas University, Jodhpur, India.  
(anuradhavaishnav67@gmail.com)

Omkar is an ancient Indian practice to bring serenity and peace to the mind. Positive Psychology Interventions are modern-day therapy procedures or deliberate activities that attempt to create good feelings, behaviors, and cognitions in individuals. A pre-post, quasi-experimental design was adopted to compare the efficacy of the two interventions in college students. Results showed that there was a reduction in depression and increase in self-esteem levels of students in both experimental groups (PPIs and Omkar intervention). Thus, the efficacy of interventions was proven. The result also indicates that Omkar was found to be relatively more beneficial in reducing depression in comparison to PPIs. It is a simple and adaptable technique for improving college students' mental health.

Keywords: Positive Psychology Interventions, Omkar Intervention, Depression, Self-esteem

## 1. Introduction

Mental health refers to a person's overall well-being, including his emotional, psychological, and social well-being. It includes many facets of a person's life, like his thoughts, feelings, actions, relationships, and capacity to handle stressful situations and life's problems. For a person to be happy and to have a high quality of life, they must have good mental health.

According to the WHO, "mental health is an integral part of health; it is more than the absence of mental illnesses. It is the foundation for the well-being and effective functioning of individuals. It includes mental well-being, prevention of mental disorders, treatment, and rehabilitation"(WHO, 2022).

Mental health exists on a spectrum ranging from complete mental well-being to serious mental diseases. It is not static. Like physical health, mental health fluctuates over time, being influenced by many factors. Positive qualities like resilience, emotional intelligence, self-esteem, and the capacity to adjust in adverse environments are all examples of positive mental health. Mental illness, sometimes known as psychiatric disorders can affect a person's thoughts, feelings, behavior, and day-to-day activities. These are depression, anxiety issues, bipolar illness, schizophrenia, and eating problems. Many people, regardless of age, gender, or background, suffer from mental illnesses. If left untreated, they are a main contributor to disability and can significantly affect a person's life and may even lead him to take drastic steps like suicide. In recent years, mental health concerns in India have increased. The inspiration to take up the present study, came from the unfortunate rising suicide rates in Kota, Rajasthan (Hindustan Times, 2023). Certain NCRB reports highlight female students as being more suicidal and depressed (Mohan, 2022).

The Indian government, governmental organizations (NGOs), and mental health experts are collaborating to raise awareness, reduce stigma, and improve access to mental healthcare. Several studies suggest that focusing on predictors of mental health can naturally enhance well-being. In a survey conducted among 1530 students, it was found that 28% and 33% had positive symptoms of depression and anxiety respectively which increased to 36% and 39%



by the end of the first year of college. First-year university students commonly experience mental health issues that impact both their academic performance and overall well-being negatively. Researchers have recommended the implementation of an approach toward health that includes early targeted interventions, and a university-wide prevention plan, as well, as relevant research endeavors(Duffy et al., 2020).

The word "predictors of mental health" refers to factors or conditions that are related to or have the potential to affect individual mental health. It is important to understand these predictors to identify risk and protective variables that may affect the results of mental health interventions. In previous studies, data showed that many risk and protective factors affect individual mental health. A variety of risk factor variables can cause mental health issues, such as genetics, early experiences of birth, trauma, chronic stress, depression, drug misuse, and a family history of mental disease. Protective factors can encourage resilience and good mental health. A strong social support, good relationships, high self-esteem, effective coping mechanisms, accessibility to mental healthcare, and supportive communities are a few examples of these variables(Beard et al., 2007; Mir et al., 2023; Nanda et al., 2022; Santini et al., 2020; Singhal & Prakash, 2021).

In the present paper, the researcher used mental health predictors like one risk factor which is depression, and one protective factor which is self-esteem.

### **Depression:**

World Health Organization (WHO) states that depression is the leading cause of illness worldwide (7.5%) and anxiety disorder is at the sixth position (3.4%). Around 800,000 people die because of suicide each year, depression being the primary cause. Depression has affected 300 million individuals worldwide and 4.4% of the world's population(WHO, 2022). The symptoms of depression include feeling low, sadness, a lack of interest or enjoyment, a sense of guilt or low self-worth, interrupted sleep or food, a sense of exhaustion, and difficulty concentrating. Long-lasting or recurring depression might severely hamper an individual's capacity to perform at work or school or deal with daily life. Suicide may result from severe depression (WHO, 2017).

A global burden of disease rating showed that women have a higherrate of depression than men. Women are around 50% more likely than men to experience depression. More than 10% of expectant mothers and new mothers experience depression globally(WHO, 2023). The COVID-19 pandemic has significantly impacted the mental health of young people, particularly women, who are at a higher risk for anxiety and depressive symptoms.

### **Self-esteem:**

Self-esteem refers to a subjective evaluation of one's value and worth. It involves one's perception of himself,one's capabilities, and one's overall sense of self-worth. Self-esteem can have an impact on aspects of one's life, such as one's emotional well-being, relationships, and individual accomplishments.

According to APA, self-esteem is "the degree to which the qualities and characteristics contained in one's self-concept is perceived to be positive" (APA Dictionary, 2023)

Self-esteem is a predictor of mental health and is a protective factor against mental illness. Self-esteem helps individuals develop emotional resilience, manage stressful situations and maintain a sense of self-worth, even in challenging times. Many studies have shown that improving self-esteem can have a positive effect on one's mental health and psychological well-being. In one study, Mann et al. (2004)studied the significance of self-esteem as a protective factor. Results showed that low self-esteem is related to various mental illnesses and social issues, including internalizing and externalizing problems like depression, suicidal ideation, eating disorders, and anxiety. In another study Li et al. (2010)studied adolescent's physical and mental health relation with self-esteem in Chinese students (N = 1945) from four secondary schools in various locations. According to this study, a significant percentage

of Hong Kong's adolescent population shows depressive symptoms. Results showed a correlation between adolescents' self-esteem and their physical and mental health.

Mental health problems are treatable, and with the correct therapy and support, many people show improvement. Medication, counseling (psychotherapy), a change in eating habits, and self-help techniques are all possible forms of treatment. Good mental health requires engaging in self-care activities. This might include activities such as exercise, stress management, mindfulness, social relationships, and getting help when necessary. Many countries are developing different types of therapies to improve mental health. Mental health therapies and treatments differ across countries, depending upon the cultural, historical, and healthcare system factors. In the United States, focus psychotherapy, medication, support groups, and alternative therapies are common. On the other hand, Japan emphasizes cultural practices like mindfulness and meditation. India uses yoga and meditation for stress management, while Germany offers psychotherapy, medication, and holistic approaches. South Korea offers counseling services, focusing on talk therapies, despite high stigma. Brazil has a tradition of psychoanalysis and mindfulness, while Australia emphasizes community mental health services

The two interventions selected for this study are the old Indian Om practice and the Western intervention positive psychology exercise.

**Om Chanting:** A major component of Hindu and Buddhist spiritual traditions is the recitation of "Om" (also written "Aum"). It is regarded as a strong and sacred syllable that represents the essence of the cosmos and ultimate truth. Om is thought to help people connect with the divine, higher awareness, and their inner selves when chanted or meditated on. 'OM' is a spiritual mantra that is excellent for bringing serenity and peace to the human mind. Chanting the OM mantra alleviates psychological stress and worldly worries and helps draw positive energy into the body. Repetition of the OM mantra raises one's consciousness. According to several studies, practicing meditation techniques, such as the Om, may help lessen the signs and symptoms of anxiety and sadness. Individuals can become more emotionally stable and have a more optimistic attitude toward life by regularly practicing meditation. Rajagopalan et al. (2023) studied how Om chanting and Yoga Nidra affected depression, anxiety, stress, sleep quality, and autonomic systems in people with hypertension. In hypertensive patients, the results verify the effectiveness of Om chanting and Yoga Nidra in lowering depression, anxiety, and stress, as well as increasing sleep quality and autonomic functioning. As a result, these treatments might be regarded as a safer kind of adjunct therapy for stress and hypertension management. Pundir & Chauhan (2023) conducted an extensive review of the literature on the effects of Om chanting on mental health. According to the findings of this review, Om chanting has a considerable effect on reducing feelings of anxiety, depression, and tension, as well as promoting relaxation. Om chanting is a basic and very simple technique that may be easily included in one's everyday life.

**Positive Psychology Intervention:** Positive psychology, a relatively new subject, was launched in 1994, when Martin Seligman became president of the American Psychological Association. Martin Seligman, Mihaly Csikszentmihalyi, Peterson, and others have done extensive research in the positive psychology area since 1994. Positive psychology interventions (PPIs) are therapeutic methods and approaches intended to improve well-being and to advance good mental health (Gilman, 2009). Positive Psychology Interventions (PPIs) are therapy procedures or deliberate activities that attempt to create good feelings, behaviors, or cognitions. These programs concentrate on developing strong character traits, resilience, and general life satisfaction. According to research, PPIs can benefit mental health in several ways. It has been discovered that several PPIs lessen depressive symptoms. People who struggle with depression can decrease their symptoms and avoid relapse using gratitude writing and mindfulness meditation. PPI emphasizes a person's strengths and positive traits

which help to increase the self-esteem and self-worth of an individual, which is beneficial for mental health. Previous researches have found that people who have a higher self-esteem handle the difficulties of life in a better way. In one meta-analysis study, researchers examined the efficacy of positive psychology interventions (PPIs) in the treatment of depression. Researchers found that PPIs are an effective intervention for depressive symptoms, with a significant decrease in depression scores of experimental group, when compared to the control group (Pan et al., 2022). Brouzos et al. (2023) studied the effectiveness of a group online positive psychology intervention (OPPI) aimed at reducing the psychological effects of the COVID-19 pandemic. The intervention helped reduce the pandemic's effects and also helped boost participants' resilience. More precisely, the intervention group exhibited substantial decrease in all measures of psychosocial distress (anxiety, depression, loneliness, and fear) and significant gains in empathy, resilience, and pleasant emotional experience.

### **Problem:**

Is there any significant impact of Om chanting (Indian intervention) and PPI (Western intervention) on the depression and self-esteem levels of university students?

Is there any significant difference in the impact of Om chanting (Indian intervention) and PPI (Western intervention) on the depression and self-esteem levels of university students?

### **Objective:**

1. To study the effect of om chanting (indian intervention) on depression and self-esteem of university students.
2. To study the effect of positive psychology intervention – PPI (Western intervention) on depression and self-esteem of university students.
3. To compare the efficacy of om chanting and PPI with regard to depression and self-esteem levels.

### **Hypotheses:**

1. Om chanting will significantly reduce the levels of depression among university students.
2. Om chanting will significantly enhance the levels of self-esteem among university students.
3. Positive Psychology Intervention will significantly reduce the levels of depression among university students.
4. Positive Psychology Intervention will significantly enhance the levels of self-esteem among university students.
5. Om chanting will be significantly more effective than positive psychology intervention in reducing depression.
6. Om chanting will be significantly more effective than positive psychology intervention in enhancing self-esteem.

### **Variables:**

#### **Independent Variable:**

1. OM chanting (Indian Intervention)
2. Positive Psychology Intervention (Western Intervention)

#### **Dependent Variable:**

1. Depression
2. Self-esteem

## **Tools:**

**Patient Health Questionnaire (PHQ-9):** This scale measures depression. This self-report measure has nine items to test students' symptoms of depression. The PHQ-9 is an easy-to-use and reliable instrument for assessing the severity of depression (Kroenke et al., 2001; Löwe et al., 2004). This scale is a widely used depression screening tool that has been approved for use in Indian settings (Ganguly et al., 2013). PHQ-9 asks about a variety of symptoms associated with depression over the past 15 days or a 2-week period, such as feeling hopeless, difficulty in sleeping, lack of energy or not enjoying activities, and lack of focus. The responses are scored from 0 to 3, recorded as "not at all," "less than one week," "one week or more," and "nearly every day,". PHQ-9 ranges from 0 to 27 depression symptoms score (Kroenke et al., 2001).

**Rosenberg Self-Esteem Scale (RSES):** This scale is used to measure self-esteem of an individual. This scale is a ten-item scale that tests both positive and negative thoughts about oneself to evaluate one's overall self-esteem. It is well known as a valid and accurate quantitative self-worth assessment tool. The Likert scale is scored from 0 to 3, with 0 being strongly disagree and 3 being strongly agree; items 3, 5, 8, 9, and 10 are evaluated in reverse. To find out self-esteem level of an individual, scores obtained on each of the items are added up. A score below 15 indicates low self-esteem. Moderate self-esteem is indicated by a score between 15 and 25, and high self-esteem is indicated by a score over 25. The RSES's original goal was to measure high school students' self-esteem. Since its creation, the scale has been applied to individuals of all ages, including adults (Rosenberg, 1965)

## **Sample**

The research was done on a purposive sample of female university students (N = 60) in the age range of 18–25 years, from a Girls' College of Jodhpur, Rajasthan. Tests (patient health questionnaires for depression and the Rosenberg self-esteem scale) were administered to 300 subjects and out of these 60 subjects were selected randomly for Group A and Group B. Indian intervention (Om chanting) as Group A (N = 30) and Western intervention (PPI) as Group B (N = 30).

## **Design**

A two-group quasi-experimental pre-post research design was used to study the effect of independent variables - omkar and positive psychology interventions, on dependent variables of depression and self-esteem.

## **Procedure**

1: Screening phase and pre-test: The concerned heads of the department of the college were first asked for their permission for collection of data from students. Thereafter, consent was sought from the students themselves. After that, all 300 students (aged 18 to 25) received the tools. For each question, the students were instructed to provide an honest response and select the best choice from the scales. They were instructed to respond to all questions. They received suitable test instructions and assurances that the information they provided would be kept confidential. The assessment was administered and scored by the test manual's guidelines.

2: Intervention phase: After screening, 60 subjects were selected for intervention, a self-esteem pre-test measure was done. Thereafter, the subjects were randomly divided into two groups. Each group consisted of 30 students.

Group A did Om chanting (Indian Intervention) for 20 minutes.

Group B engaged in Positive Psychology Intervention (Western Intervention ) which included some activities and homework.

3: Post-test: After the intervention phase, a post-test was administered to the female students again. PHQ-9 and RSES scores were measured again.

### Statistical Analysis

Student’s t-test was used to analyze all data.

### Result

Effect of Intervention on depression:

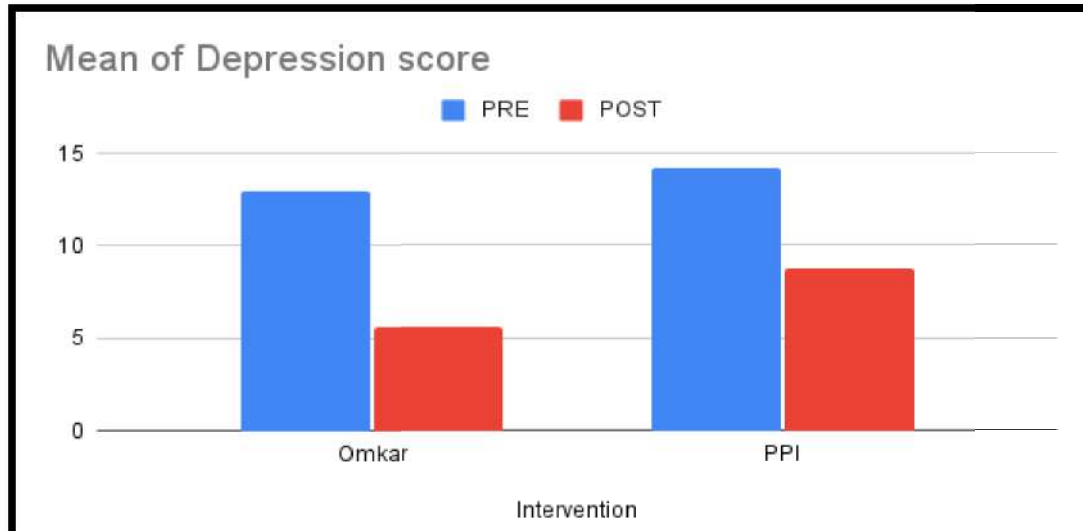
**Table 1: Mean, SD, and t value of Pre-test and post-test of Depression Scores in Group A and Group B**

Parameter	Measure	Group A Indian intervention					Group B Western intervention				
		M	N	SD	t	Sig	M	N	SD	T	Sig
Depression	Pre	13.0	30	3.25	13.66	0.01	14.17	30	3.56	7.32	0.01
	Post	5.60	30	1.81			8.73	30	2.13		

It can be observed from Table 1 that the mean score for depression in the pre-measure is 13.00 and in the post-measure, it is 5.60 in Group A (Om chanting, Indian intervention). This shows a decrease in depression scores. In Group B (PPI, western intervention), the mean score for depression in the pre-measure is 14.17, and in the post-measure, it is 8.73. It also indicates a decrease in depression scores.

Further, t values were calculated to study the significance of difference in the pre test - post test measures of depression in Group A (om chanting, Indian intervention) and Group B (PPI, western intervention). Result Table 1 shows that in Group A, the t value was found to be 13.66, which exceeds the critical value at .01 level. It shows that there is a significant positive effect of Indian intervention (Om chanting) on depression levels. Table 1 further indicates that in Group B, the t value was found to be 7.32, which exceeds the critical value at .01 level. It shows that there is a significant positive effect of Western intervention (PPI) on depression. Graph 1 also shows similar results.

### Graph 1: Comparison between Pre Intervention Depression Scores and Post Intervention Depression Scores in Group A and Group B



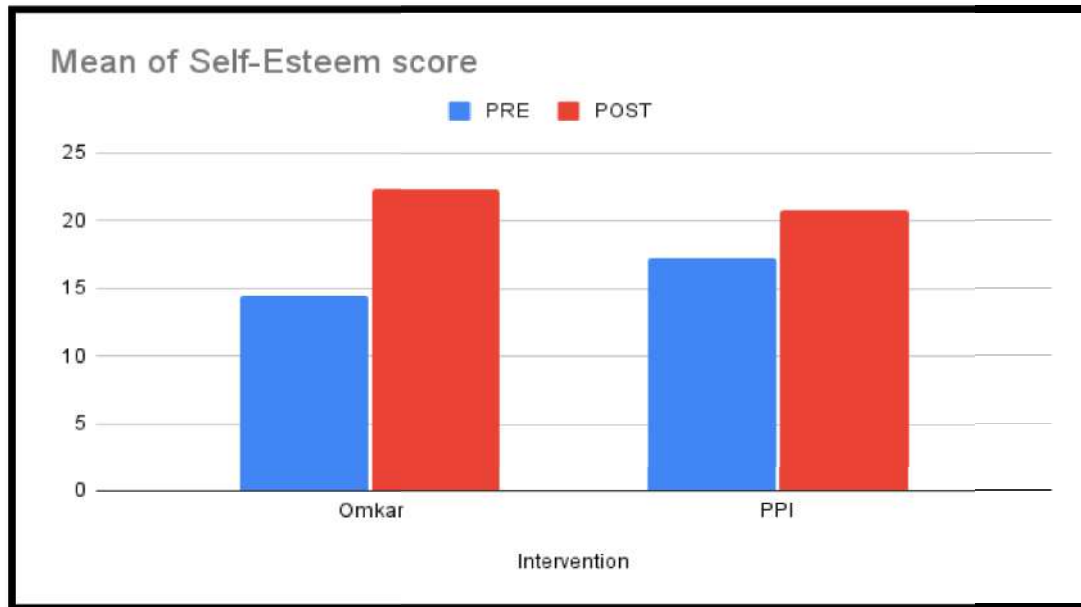
**Intervention effect on self-esteem:**

**Table 2: Mean, SD, and t value of Pre-test and Post-test of self-esteem scores in Group A and Group B**

Parameter	Measure	Group A Indian intervention					Group B Western intervention				
		M	N	SD	T	Sig	M	N	SD	T	Sig
Self-esteem	Pre	14.47	30	4.47	9.48	0.05	17.27	30	5.31	3.23	0.05
	Post	22.03	30	3.51			20.77	30	3.76		

It can be observed from Table 2, that for Group A (om chanting, Indian intervention), the mean score of self-esteem in the pre-measure is 14.47 and in the post-measure, 22.03. This reflects an enhancement in self-esteem scores. In Group B (PPI, western intervention), the mean score for self-esteem in the pre-measure is 17.27, and in the post-measure, it is 20.77. This too shows an enhancement in self-esteem scores

**Graph 2: Comparison between Pre Intervention Psychological Self-esteem Scores and Post Intervention Self-esteem Scores in Group A and Group B**



Further, *t* values were calculated to study the significance of difference in the pre test - post test measures of self-esteem in Group A (om chanting, Indian intervention) and Group B (PPI, western intervention). Results revealed that in Group A, the *t* value concerning self-esteem was found to be 9.48, which is significant at .01 level. Group B's *t* value of self-esteem was found to be 3.23, which is significant at the .05 level. This result indicates that there is a significant positive effect of Om chanting and PPI on self-esteem. Graph 2 shows that the Omkar group has larger mean difference than PPI.

**Comparison of both interventions:**

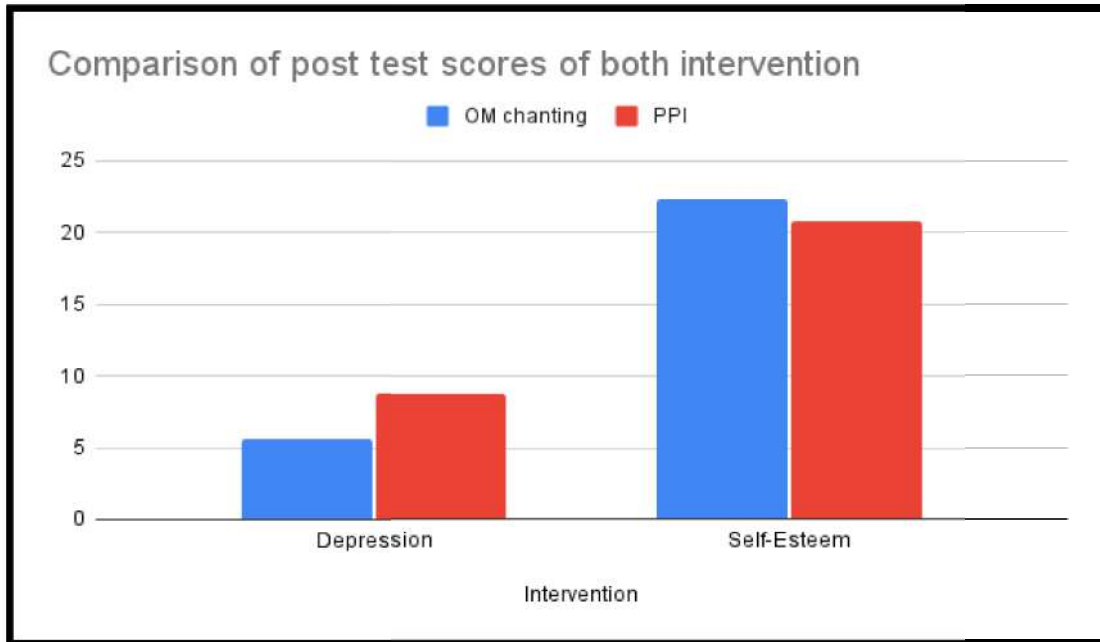
**Table 3: Mean, SD, and *t* value of post-tests of depression and self-esteem Scores in both interventions.**

Intervention	Depression					Self-esteem				
	<i>M</i>	<i>N</i>	<i>SD</i>	<i>T</i>	<i>Sig</i>	<i>M</i>	<i>N</i>	<i>SD</i>	<i>T</i>	<i>Sig</i>
Indian Intervention (Om chanting)	5.60	30	1.81	6.13	0.05	22.03	30	3.51	1.34	Not sig
Western Intervention (PPI)	8.73	30	2.13			20.77	30	3.76		



In Table 3, a comparison has been drawn between the post-test scores of both the groups with regard to both the variables of depression and self-esteem. Results indicate that the mean post-test score for group A for depression is 5.60. For group B, the post-test score for depression is 8.73. This shows that, compared to PPI(Western intervention), Om chanting (Indian intervention) decreases depression levels to a greater extent. The results in Table 3 also show that the mean post-test self-esteem scores for group A are 22.03, and for group B they are 20.77. This shows that the improvement in self-esteem scores in both groups is almost equal, but, as the om chanting (Indian intervention) score is slightly higher than the PPI (Western intervention), one may decipher that om chanting (Indian intervention) is more effective.

**Graph 3: Comparison between Indian Intervention Post-test Scores and Western intervention Post-test scores in Depression and Self-esteem**



Further, a t value was calculated to study the significance of the difference between post-test measures of om chanting (Indian intervention) and PPI (Western intervention). It can be observed from Table 3, that the t value for the variable of depression is 6.13, which is significant at .01 level. The value of self-esteem was found to be 1.34, which is not significant. This shows that there is a significant difference in the post-test measures of depression across the two groups, but no significant difference in the post-test measures of self-esteem of the two groups. Graph 3 clearly shows the significant results in case of depression. Even for self-esteem, though, the results may not be significant, om chanting seems to enhance self-esteem more than does PPI.

## 2. Discussion

The results of the present research show that the levels of depression decreased as a result of om chanting. Thus, the hypothesis that, om chanting, will reduce depression ( $t = 13.66$ ,  $p < .01$ ) levels has been proven to be correct. Previous studies also support the present research. The practice of Om chanting develops vibrations that lead to emotional balance, concentration, and peace, and help reduce stress, fear and anxiety, and enhance insight and sensory awareness. (Dwivedi & Singh, 2016; Gurjar et al., 2009; Singh, 2012).

Another research showed that chanting can lead to a reduction in depression, anxiety, and stress (Rajagopalan et al., 2023). In one study, it was observed that there was a significant

decrease in the depression, anxiety, and stress scores of elderly women (Amin et al., 2016). This practice helps with the management of negative emotions. In one study, researchers studied the behavioral and ERP responses to unpleasant and neutral images while performing Om chanting. The behavioral results showed an effect of Om chanting on regulating emotional responses, showing reduced unpleasant and arousal ratings for the negative stimuli in the group performing Om practice (Zhang et al., 2022).

The second hypothesis, that PPI (western intervention) will reduce depression levels has also been proven to be correct ( $t = 7.32, p < .01$ ). Meta-analysis study indicates that positive psychology interventions significantly improved subjective and psychological well-being and reduced depression symptoms (Bolier et al., 2013). Recently a study was undertaken to see the effects of online positive psychology interventions on Greek adult. The results indicated that the intervention group exhibited significant reductions in all measures of psychosocial distress (anxiety, depression, loneliness, and fear) and significant gains in empathy, resilience, and pleasant emotion experience (Brouzos et al., 2023).

The present study has highlighted that Indian intervention also enhances the self-esteem levels of students. This enhancement in self-esteem scores is statistically significant ( $t = 9.48, p < .01$ ). The result confirms the acceptance of the hypothesis that there would be significant increase in the self-esteem levels of subjects, as a result of om chanting. In previous research, it was shown that Om practice increases self-esteem. In one study, it was shown that two weeks of OM practice along with some yoga may help reduce anxiety and sadness and increase self-esteem in orphanage adolescents and young adults (Tejvani et al., 2016). In another study, it was proved that mindfulness practice is beneficial for schoolchildren as it improves their attention, concentration, memory, motor speed, and self-esteem levels (Gulati et al., 2019).

The Western intervention (PPI) result indicates a significant ( $t = 3.23, p < .01$ ) improvement in the self-esteem of female students. So, it can be said that the hypothesis, that PPI would significantly enhance self-esteem of students has been proven to be correct. Narafshan & Noori (2018) found a statistically significant improvement in the experimental group's self-esteem, after finishing the course, showing good pathways from positive psychology to identifying strengths and effectively managing weaknesses. In one study, it was indicated that the intervention led the students of the PPI to a significant improvement in positive emotions, resilience, and slightly in self-esteem (Kounenou et al., 2022). So the findings of the present study are in line with previous results.

Thus, both om chanting and PPI produced significant results with regard to the variables of depression and self-esteem. However, while comparing the post-test results of both the groups, a significant difference was found across the two groups only for the variable of depression. ( $t = 6.13, p < .05$ ). As the mean post-test score for group A was found to be higher than that of the mean post-test score of group B, the hypothesis that om chanting will prove to be better than PPI in reducing depression can be accepted. The hypothesis that om chanting will be better than PPI in enhancing self-esteem levels of students is rejected.

According to the manual of the PHQ-9 depression level, mild depression comes on a score of 5 to 9 and moderate depression comes on a score of 10 to 14, so in om chanting we see depression level decreases at the lowest level of mild depression from moderate level, whereas in PPI it is at the borderline of moderate depression, so it proved that om chanting is more impactful than PPI based on depression, but in self-esteem, both interventions got the same mean score, so we can say that both intervention groups are equally impactful on the self-esteem level of students.

Indian intervention (Om chanting) has been found to affect depression more, which has been proven to play an important role in good mental health. Many researchers have shown that depression and self-esteem are significant predictors of mental health. According to the

present result it was proven that Om chanting and positive psychology interventions would have a significant effect on depression and self-esteem.

### 3. Conclusion

Thus, the results of the present research led to the conclusion that om chanting (Indian intervention) is more effective in decreasing depression in comparison to PPI (western intervention). Whereas both interventions are equally effective on the self-esteem of students. The results indicated that PPI and OM chanting did not significantly differ from each other in increasing self-esteem. The present results show that people who practice OM chanting and PPI have better mental health and well-being. From a broader, more general perspective, the findings add to the research by implying that college-based programs may promote students' mental health outside the typical curriculum. A college-based program is an innovative strategy for preparing and teaching future generations by supporting and cultivating mental health skills, and it should be regarded as a feasible choice in addition to a curriculum owing to the possible added advantages. More study is needed to examine potential short- and long-term impacts experimentally.

### References

- Amin, A., Kumar, S. S., Rajagopalan, A., Rajan, S., Mishra, S., Reddy, U. K., & Mukkadan, J. K. (2016). Beneficial effects of OM chanting on depression, anxiety, stress and cognition in elderly women with hypertension. *Indian Journal of Clinical Anatomy and Physiology*, 3(3), 253. <https://doi.org/10.5958/2394-2126.2016.00056.6>
- APA Dictionary. (2023). APA Dictionary of Psychology. <https://dictionary.apa.org/>
- Beard, J. R., Heathcote, K., Brooks, R., Earnest, A., & Kelly, B. (2007). Predictors of mental disorders and their outcome in a community based cohort. *Social Psychiatry and Psychiatric Epidemiology*, 42(8), 623–630. <https://doi.org/10.1007/s00127-007-0182-3>
- Bolier, L., Haverman, M., Westerhof, G. J., Riper, H., Smit, F., & Bohlmeijer, E. (2013). Positive psychology interventions: A meta-analysis of randomized controlled studies. *BMC Public Health*, 13(1), 119. <https://doi.org/10.1186/1471-2458-13-119>
- Brouzos, A., Vassilopoulos, S. P., Baourda, V. C., Tassi, C., Stavrou, V., Moschou, K., & Brouzou, K. O. (2023). “Staying Home – Feeling Positive”: Effectiveness of an on-line positive psychology group intervention during the COVID-19 pandemic. *Current Psychology*, 42(4), 2749–2761. <https://doi.org/10.1007/s12144-021-01613-x>
- Duffy, A., Keown-Stoneman, C., Goodday, S., Horrocks, J., Lowe, M., King, N., Pickett, W., McNevin, S. H., Cunningham, S., Rivera, D., B., L., Bowie, C. R., Harkness, K., & Saunders, K. E. A. (2020). Predictors of mental health and academic outcomes in first-year university students: Identifying prevention and early-intervention targets. *BJPsych Open*, 6(3), e46. <https://doi.org/10.1192/bjo.2020.24>
- Dwivedi, M., & Singh, P. (2016). SCIENTIFIC ANALYSIS OF AUM MANTRA IN KNOWING SELF. *Aatmbodh Journal of Rajarishi School of Management & Technology*, XIII, 64–69.
- Gilman, R. (Ed.). (2009). *Handbook of positive psychology in schools* (1. ed). Routledge.
- Gulati, K., Sharma, S. K., Telles, S., & Balkrishna, A. (2019). Self-Esteem and Performance in Attentional Tasks in School Children after 4½ Months of Yoga. *International Journal of Yoga*, 12(2), 158–161. [https://doi.org/10.4103/ijoy.IJOY\\_42\\_18](https://doi.org/10.4103/ijoy.IJOY_42_18)
- Gurjar, A. A., Ladhake, S. A., & Thakare, A. P. (2009). *Analysis Of Acoustic of “OM ” Chant To Study It's Effect on Nervous System*.
- Hindustan times. (2023). *Another student dies by suicide in Kota; fifth this month*. Hindustan Times. <https://www.hindustantimes.com/cities/jaipur-news/16yearold-neet-aspirant->

- dies-by-suicide-in-kota-fifth-case-this-month-concerns-raised-over-coaching-process-and-mental-stress-101685190381644.html
- Kounenou, K., Kalamatianos, A., Garipi, A., & Kourmoussi, N. (2022). A positive psychology group intervention in Greek university students by the counseling center: Effectiveness of implementation. *Frontiers in Psychology*, *13*. <https://www.frontiersin.org/articles/10.3389/fpsyg.2022.965945>
- Kroenke, K., Spitzer, R. L., & Williams, J. B. W. (2001). The PHQ-9. *Journal of General Internal Medicine*, *16*(9), 606–613. <https://doi.org/10.1046/j.1525-1497.2001.016009606.x>
- Li, H. C. W., Chan, S. L. P., Chung, O. K. J., & Chui, M. L. M. (2010). Relationships among Mental Health, Self-esteem and Physical Health in Chinese Adolescents: An exploratory study. *Journal of Health Psychology*, *15*(1), 96–106. <https://doi.org/10.1177/1359105309342601>
- Mann, M. (Michelle), Hosman, C. M. H., Schaalma, H. P., & de Vries, N. K. (2004). Self-esteem in a broad-spectrum approach for mental health promotion. *Health Education Research*, *19*(4), 357–372. <https://doi.org/10.1093/her/cyg041>
- Mir, I. A., Ng, S. K., Mohd Jamali, M. N. Z., Jabbar, M. A., & Humayra, S. (2023). Determinants and predictors of mental health during and after COVID-19 lockdown among university students in Malaysia. *PLOS ONE*, *18*(1), e0280562. <https://doi.org/10.1371/journal.pone.0280562>
- Mohan, S. (2022, September 2). *1 Every 9 Minutes: NCRB Data Bares India's Female Suicide Problem*. TheQuint. <https://www.thequint.com/fit/mind-it/1-every-9-minutes-ncrb-data-bares-indias-female-suicide-problem-women-deaths-housewives-students>
- Nanda, A., Tuteja, S., & Gupta, S. (2022). Chapter Seven—Machine learning based analysis and prediction of college students' mental health during COVID-19 in India. In S. Jain, K. Pandey, P. Jain, & K. P. Seng (Eds.), *Artificial Intelligence, Machine Learning, and Mental Health in Pandemics* (pp. 167–187). Academic Press. <https://doi.org/10.1016/B978-0-323-91196-2.00001-6>
- Narafshan, M. H., & Noori, S. (2018). Enhancing Self-Esteem in Classroom Language Learning: The Potential of Implementing a Strength-Based Positive Psychology Intervention at Higher Education. *International Journal of Language Teaching and Education*, *2*(3), Article 3. <https://doi.org/10.22437/ijolte.v2i3.5593>
- Pan, S., Ali, K., Kahathuduwa, C., Baronia, R., & Ibrahim, Y. (2022). Meta-Analysis of Positive Psychology Interventions on the Treatment of Depression. *Cureus*, *14*(2). <https://doi.org/10.7759/cureus.21933>
- Pundir, A., & Chauhan, A. (2023). *Positive Effects of 'AUM' Chanting on Mental Health Well-Being*.
- Rajagopalan, A., Krishna, A., & Mukkadan, J. K. (2023). Effect of Om chanting and Yoga Nidra on depression anxiety stress, sleep quality and autonomic functions of hypertensive subjects – a randomized controlled trial. *Journal of Basic and Clinical Physiology and Pharmacology*, *34*(1), 69–75. <https://doi.org/10.1515/jbcpp-2022-0122>
- Rosenberg, M. (1965). *Rosenberg Self-Esteem Scale* [dataset]. <https://doi.org/10.1037/t01038-000>
- Santini, Z. I., Stougaard, S., Koyanagi, A., Ersbøll, A. K., Nielsen, L., Hinrichsen, C., Madsen, K. R., Meilstrup, C., Stewart-Brown, S., & Koushede, V. (2020). Predictors of high and low mental well-being and common mental disorders: Findings from a Danish population-based study. *European Journal of Public Health*, *30*(3), 503–509. <https://doi.org/10.1093/eurpub/ckaa021>
- Singh, D. M. (2012). *A Comparative Study of Effect of Pran Dharana and Om Chanting On Anxiety of College Students*. *3*(7), 3.

- Singhal, S., & Prakash, N. (2021). Relationship between Self-esteem and Psychological Well-being among Indian College Students. *Journal of Interdisciplinary Cycle Research, XII*, 748–756.
- Tejvani, R., Metri, K. G., Agrawal, J., & Nagendra, H. R. (2016). Effect of Yoga on anxiety, depression and self-esteem in orphanage residents: A pilot study. *Ayu, 37*(1), 22–25. [https://doi.org/10.4103/ayu.AYU\\_158\\_15](https://doi.org/10.4103/ayu.AYU_158_15)
- WHO. (2017). *Depression and Other Common Mental Disorders*. <https://www.who.int/publications-detail-redirect/depression-global-health-estimates>
- WHO. (2022). *Depressive disorder (depression)*. <https://www.who.int/news-room/fact-sheets/detail/depression>
- WHO. (2023). *Depressive disorder (depression)*. <https://www.who.int/news-room/fact-sheets/detail/depression>
- Zhang, Z., Peng, Y., & Chen, T. (2022). Om chanting modulates the processing of negative stimuli: Behavioral and electrophysiological evidence. *Frontiers in Psychology, 13*. <https://www.frontiersin.org/articles/10.3389/fpsyg.2022.943243>

# AN ANALYSIS OF INDIAN PUBLIC SECTOR BANKS'S FINANCIAL PERFORMANCE: CAMEL MODEL

**CA Shashi Kumawat**

Govt. Shakambhar P.G. College Sambhar Lake, Jaipur, India.

The financial sector's ability to deliver services is a key factor in a nation's ability to maintain a robust economy. The majority of the financial services industry is driven by the banking sector. Public banks encourage public savings, which has a big impact on the financial services sector. This study's goal is to use the CAMEL model to analyse the financial performance of the selected public sector banks which had been merged from 2015 to till date and includes State Bank of India (SBI), Canara Bank, Indian Bank, PNB and UBI. From 2015–2016 through 2022–2023, Prowess IQ data has gathered for financial performance analysis. This study's framework is based on the five financial analysis criteria used in this study: capital adequacy, assets quality, management ability, earnings and liquidity. T-tests on paired samples have been employed to evaluate the statistical importance of various parameters. The overall results show that Canara Bank and SBI's financial performance did not considerably improve following the merger and Indian Bank, PNB & UBI's financial performance improve considerably following the merger.

**Keywords:** CAMEL model, Public Sector Banks, Financial performance analysis, pre and post-merger,

## 1. Introduction:

In recent decades, there have been a number of mergers in the global economy. Mixed results came from these mergers. Gandhi and Mehta (2020) analysed that the banking industry is crucial to preserving the nation's financial stability. In Indian banks, mergers and acquisitions are beneficial if they benefit all parties involved. Studies on merger success have been done, however the findings are inconsistent. Banu and Vepa (2021) comparing the Indian economy's government sectors, the banking system has perhaps had the fastest growth. Depositors are not the only stakeholders who are impacted by a bank's solvency and livelihoods; employees, customers, shareholders, and the nation at large also have a role. Zuhri, Fahlevi, Abdi and Maemunah (2020) the financial system facilitates the efficient operation of international trade and business, highlighting the essential need for fast and consistent oversight. Analysing the financial and operational performance of the Indian banking industry is the goal of this study. This study looks into whether merging public banks results in improved financial performance. The study makes an effort to identify the regions where banks fared better after mergers. The mergers listed in Table 1 below were carried out by public sector banks on or after 2015 till today with the goal of realising synergies.

**Table 1: Public Sector Banks merged on or after 2015 till 2023**

S.NO.	Acquirer Bank	Merged Bank	Merger Date
1.	State Bank of India	State Bank of Patiala	31 March 2017
		State Bank of Hyderabad	
		State Bank of Bikaner & Jaipur	
		Bharatiya Mahila Bank Ltd.	
		State Bank of Mysore	
		State Bank of Travancore	
2.	Punjab National Bank	United Bank of India	31 March 2020



		Oriented Bank of Commerce	
3.	Union Bank of India	Corporation Bank	31 March 2020
		Andhra Bank	
4.	Indian Bank	Allahabad Bank	31 March 2020
5.	Canara Bank	Syndicate Bank	31 March 2020

SOURCE: Prowess IQ, Centre for Monitoring Indian Economy Pvt. Ltd.

The CAMEL model is used in this study to examine how mergers affect financial performance both before and after the merger. In the table below, Table 1.1, each component of this model is described in detail.

**Table 1.1 CAMELModel**

Variable	Explanation	Acceptance level
<b>Capital Adequacy</b> <ul style="list-style-type: none"> <li>❖ Capital Adequacy Ratio</li> <li>❖ Total Advances to Total Assets</li> </ul>	<ul style="list-style-type: none"> <li>❖ It depicts that whether the bank has adequate capital to tackle the unpredicted losses. It also withholds the bank from going insolvency.</li> <li>❖ It shows that part of total assets which is given as loans and advances</li> </ul>	<ul style="list-style-type: none"> <li>❖ Banks should maintain at least 9% capital adequacy ratio.</li> <li>❖ Higher ratio shows better profitability.</li> </ul>
<b>Assets Quality</b> <ul style="list-style-type: none"> <li>❖ Gross NPA</li> <li>❖ Govt. Securities to Investment</li> </ul>	<ul style="list-style-type: none"> <li>❖ It shows that part of loans and advances which becomes non-performing assets.</li> <li>❖ It shows the relationship between investments in govt. securities to total investment.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Gross NPA ratio should be lower since it represents the bank's loan asset which is not repaid by customers.</li> <li>❖ Higher the ratio better it is since it shows the low risk to bank.</li> </ul>
<b>Management Ability</b> <ul style="list-style-type: none"> <li>❖ Employee Utilisation ratio</li> <li>❖ Business Per Employee</li> </ul>	<ul style="list-style-type: none"> <li>❖ It depicts the percentage of Employee utilisation ratio.</li> <li>❖ It depicts the business per employee during the one financial year.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Higher the ratio is better since it shows that bank gives more utilisation of employees</li> <li>❖ Higher the ratio is good because bank has receive more benefits from its employees.</li> </ul>
<b>Earning Ability</b> <ul style="list-style-type: none"> <li>❖ Return on Assets</li> <li>❖ Return on Net Worth</li> </ul>	<ul style="list-style-type: none"> <li>❖ It shows the net earnings created by bank from its total resources.</li> <li>❖ It shows the proportion of profit which is generated by the shareholder's money.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Higher Ratio reflects better utilisation of its total resources.</li> <li>❖ High ratio is better since it shows the better employment of shareholder's money</li> </ul>
<b>Liquidity Analysis</b> <ul style="list-style-type: none"> <li>❖ Investment to Deposit</li> <li>❖ Current Assets to Total Assets</li> </ul>	<ul style="list-style-type: none"> <li>❖ It depicts the portion of amount that is invested from deposits.</li> <li>❖ It indicates how much amount of total assets is invested for operating day to day activities.</li> </ul>	<ul style="list-style-type: none"> <li>❖ Higher ratio signally that bank is directing their deposits in different profitable portfolios.</li> <li>❖ Lower ratio shows that bank is able to fund their operational activities in little amount of current assets. Lower ratio is better.</li> </ul>

## 2. Literature Review:

Adhikari, Kavanagh and Hampson (2023) conducted a study on “Analysis of the pre-post-merger and acquisition financial performance of selected banks in Nepal” has examined that the banks and financial institutions (BFIs) in Nepal consolidate to strengthen their capital base, broaden their operations, and attain financial stability; mergers and acquisitions (M&A) have emerged as a potent strategic tool. This study examines how mergers and acquisitions between 2013 and 2020 affected the financial performance of two commercial banks using paired sample t-tests and 12 accounting ratios. The first bank's statistics reveal that, despite notable gains in return on equity, net interest margin, and



earnings per share, the merger's effects on financial performance indicators are mixed. With the exception of dividends per share (DPS) before and after the M&A, the influence of the M&A transaction on the financial metrics is minimal in the second row.

Gupta, Raman and Tripathy (2023) conducted a study on "Impact of merger and acquisition on financial performance: Evidence from construction and real estate industry of India" has examined that this article's goal is to investigate the effects of mergers and acquisitions (M&A) on the financial performance of the building and real estate sectors over a broad spectrum of financial indicators. The paired t-test method was utilised, and the study's time frame spanned from 2011 to 2020. Before and after M&A, there will certainly be considerable differences. The investigation's findings revealed considerable improvements in the profitability ratio and liquidity ratio but no change in the debt ratio. Fixed asset turnover has improved greatly in terms of efficiency ratios, whereas total asset turnover and current asset turnover have only slightly improved. The study comes to the conclusion that acquiring businesses' overall financial performance in the Indian construction and real estate sectors increased during the post-M&A period. This study demonstrates that the synergy theory, which claims that mergers and acquisitions improve synergies after mergers and acquisitions because they integrate the resources of two organisations, is supported by the construction industry.

Saroj&Koti (2023) conducted study on "Quantitative Analysis on Financial Performance of Merger and Acquisition of Indian Companies" has examined that all across the world, mergers and acquisitions (M&A) are growing more frequent. To offer information on profitability, liquidity, leverage, and efficiency, particularly to improve visibility, lower business risk, diversify your portfolio, and enter new markets and geographies, How to use economies of scale to strengthen your business principal figure. The T-test is a cumulative analysis, and it is often examined using techniques for gathering information that take into account all 17 proportions. The final component includes a comprehensive financial performance analysis and a general philosophy of scientific outcome. Analysts are unable to conduct full-scale investigations, so it was done on a small scale. Numerous organisations with a wide range of company activities and unconventional business practises are part of the research community.

Nurlaila, Kuswati and Muttaqin (2022) conducted a study on "Comparison of the Financial Performance of Bank Syariah Indonesia Pre and Post Merger during the Covid-19 Pandemic" has examined that the banking industry has also been impacted by the COVID-19 pandemic, which could hurt Islamic banks' ability to compete. Through the use of the ratios of ROA, NPF, FDR, BOPO, and CAR, this study compares the financial performance of Sharia Indonesia Banks before and after their merger during the Covid-19 period. Quantitative data are used in this study's comparative research methodology using t-test analysis with paired samples. Information was gathered from the BSI website. According to the study, while BSI's financial performance before and after the merger differed in terms of ROA, net NPF, FDR, and BOPO, there was no difference in the CAR ratio. According to these findings, additional researchers should expand their use of research allocation variables and financial performance data from the previous year.

Hertina and Arizona (2022) conducted a study on "Comparison Analysis Of Financial Performance Before And After The Merger (Case Study at PT. Bank Danamon Indonesia Tbk and PT. Bank Syariah Indonesia Tbk)" has examined that the goal of this research is to evaluate PT's financial performance before and after the 2019 merger with Danamon Bank Indonesia Tbk. In 2021, a merger of Sharia Indonesia Bank Tbk is anticipated. This study uses secondary data from each bank's official website and utilises a quantitative methodology. Current ratio, return on total assets, return on equity, debt to equity ratio, and total asset turnover are the evaluation variables employed in this study.

Normality tests and paired samples t-tests are the analytical techniques utilised to address the hypotheses. According to hypothesis testing, there were no appreciable discrepancies between PT. Danamon Bank Indonesia Tbk and PT. Sharia Bank Indonesia Tbk's financial metrics.

Ansari, Bilal, Khan and Tahir (2021) conducted a study on “The effect of mergers and acquisitions on the financial performance of micro finance banks” has examined that this study's primary goal is to determine how mergers and acquisitions affect Pakistan's microfinance institutions' financial performance. Rapid technology advancements are requiring financial institutions, which are crucial to the economy of any nation, to alter their business models. In this study, 13 financial ratios were computed. This suggests that the financial performance of Pakistan's microfinance institutions is not significantly impacted by mergers and acquisitions. Financial ratios are used to measure some indicators, and paired t-tests are used to compare results. The three years of data, including two before and one after his mergers and acquisitions, make up the sample.

Borodin, Sayabek, Islyam, &Panaedova (2020) conducted study on “Impact of mergers and acquisitions on companies' financial performance” has examined that this article looks at how M&A deals affect the financial health of US and European businesses. We looked at 138 M&A deals that happened in these two areas between 2014 and 2018. Analyse the relationship between return on sales (ROS) and elements like the equity-to-company value ratio. Additionally, we see how the financial crisis has affected the sector and how M&A parties have taken centre stage. Results of the merged business, the majority of the businesses investigated in both the US and Europe was successful and remained profitable even after mergers and acquisitions. Despite the fact that positive results for the investigated variables were discovered, analyses of the sample mean values revealed a significantly worsening of ROS in both locations. This outcome makes it unclear whether M&A has a unique effect on the target firm's performance after the acquisition.

Zuhri, Fahlevi, Abdi and Maemunah (2020) conducted a study on “The impact of merger and acquisition on financial performance in Indonesia” has examined that the company acquiring or managing the assets and liabilities is referred to as the acquiring company or bidder, while the company being acquired is referred to as the target company. Mergers and acquisitions are two types of corporate combinations. There was no discernible difference in the financial indicators return on equity and debt-to-equity ratio before and after the merger and acquisition, according to the statistical analysis of the rank test signed by Wilcoxon. We also discover that the pre-M&A return on equity median and mean are higher than the post-M&A return on equity. The test's findings demonstrate that even the median and average ratios from before mergers and acquisitions are lower and regarded as preferable.

Patel (2018) conducted a study on “Pre & post-merger financial performance: An Indian perspective” has examined that selected Indian banks' long-term profitability before and after mergers from 2003–2004 to 2013–2014. A variety of factors are used to evaluate financial performance. According to the study, mergers had a detrimental effect on net profit margin, return on equity, return on assets, return on down payment, and return on invested capital. Earnings per share, earnings per employee, and business per employee, on the other hand, all showed a positive trend and increased following the merger. Ex-ante return on equity and post-merger return on equity for Bank of Baroda and Oriental Commercial Bank both fell below the average for all banks. In comparison to the industry average, State Bank of India and IDBI Bank has larger clientele and better profits per employee.

The analysis mentioned above makes it evident that no in-depth research has been done to evaluate public sector bank's financial situation from the standpoint of long-term viability, covering the three years before and after the merger. In order to close this gap, this study is being conducted.

**Objective of the study:**

This study's primary goal is to use the CAMEL model to analyse how the merger has affected public sector bank's financial performance both before and after the merger.

**Research Methodology:**

**Research Design:**

In this study descriptive research design and exploratory research design have been used.

**Type of Data and Data Collection:**

Secondary data were used in this study and were gathered from a number of databases, including Capital IQ, the Bombay Stock Exchange (BSE), the National Stock Exchange (NSE), and the Centre for Monitoring Indian Economy's (CMIE) Prowess IQ database. The company's financial information was taken from the Capitaline IQ database.

**Period of study:**

Financial success is judged in After M&A based on this viewpoint and studies by Saroj and Koti (2023), Patel (2018), Abdi and Maemunah (2020), Raman and Tripathy (2023), etc. Therefore, the time frame covered by the study is from 2014 to 2023. The 3-year pre- and 3-year post-M&A periods would vary from one sample firm to another based on the year of the merger because the year of the merger of sample companies is inconsistent. The duration was chosen taking into consideration the availability of 3-year pre- merger & acquisition and 3-year post-Merger & Acquisition data of the acquiring company. As a result, the study considers all sample firms over ten financial years, from 2014 to 2023, to enable the data analysis and comparison.

**Analysis Tool:**

The CAMEL model approach was utilised to assess financial performance utilising several accounting metrics. To examine the statistical significance of the data, a paired samples t-test was employed. Additionally used were the mean, standard deviation, and mean difference.

A thorough picture of long-term profitability and post-M&A success was provided by the study by taking into consideration a range of accounting variables. In this article, several measures are discussed, including capital adequacy, assets quality, management ability, earnings and liquidity (CAMEL). The significance of differences between the pre- and post-merger and acquisition periods was also examined using a paired two-sample t-test.

**Hypothesis:**

H0: There is no significant difference on financial performance of selected public sector banks during pre and post-merger period using CAMEL model.

H1: There is a significant difference on financial performance of selected public sector banks during pre and post-merger period using CAMEL model.

3. Data Analysis and Interpretation:

Table 2: Canara Bank’s financial performance during pre and post-merger period

Particulars	Ratio	Duration	Mean	Std. Deviation	t	sig	H0
<b>C-Capital Adequacy</b>	Capital Adequacy Ratio	Pre	12.92	0.91	-1.961	.189	Accept
		Post	14.92	1.75			
	Advances to Total Assets Ratio	Pre	62.45	1.25	1.175	.361	Accept
		Post	59.35	3.51			
<b>A-Assets Quality</b>	Gross Non-Performing Assets	Pre	9.63	1.94	4.529	.045	Reject
		Post	7.26	1.80			
	Govt. Securities to Total Investment	Pre	89.93	1.40	-19.417	.003	Reject
		Post	93.53	1.48			
<b>M-Management Ability</b>	Employees utilisation ratio(times)	Pre	8.60	0.53	2.848	.104	Accept
		Post	6.97	0.46			
	Business Per Employee	Pre	165.03	14.93	-6.153	.025	Reject
		Post	201.67	21.66			
<b>E-Earning Ability</b>	Return on Assets	Pre	-0.34	0.41	-3.903	.060	Accept
		Post	0.51	0.29			
	Return on Net Worth	Pre	-13.30	8.83	-8.294	0.014	Reject
		Post	10.89	5.32			
<b>L-Liquidity</b>	Investment to Deposit	Pre	27.06	1.36	1.255	.336	Accept
		Post	26.30	0.66			
	Current Assets to Total Assets	Pre	12.11	0.75	-1.534	.265	Accept
		Post	15.88	3.61			

Table 2 shows the comparative overall performance of Canara Bank. The average Capital Adequacy Ratio (CAR) increased from 12.92% to 14.92% after the merger. The t-value (-1.961) and p-value (0.189) reveals that there is no significant impact of merger on Capital Adequacy ratio. The reason behind it may be there is no optimal utilisation of capital after the merger period. The Advances to Total Assets Ratio decreased from 62.45% to 59.35% after the merger. The t-value (1.175) and p-value (0.361) implies that there is no significant impact of merger on Advances to Total Assets. The Gross Non- Performing Assets Ratio also decreases from 9.63% to 7.26%. The t-value (4.529) and p-value (0.045) shows the significant impact of merger on Gross NPA. The Gross NPA decreases due to better management of Assets in the post-merger period. The Govt. Securities to Total Investment ratio has been increased from 89.93% to 93.53% after the merger period. The t-value (-19.417) and the p-value (0.003) reveals that there is a significant impact on Govt. Securities to Total Investment ratio due to merger. The reason behind the improvement in this ratio may be that the Govt. Securities offers better returns in post-merger period. The Average Employees Utilisation ratio before the merger has been 8.60 times which decreased to 6.97 times in post-merger period. The t-value (2.848) and p-value (0.104) reveals that there is no significant impact of merger on Employees Utilisation ratio. Business per Employee ratio increases from 165.03 to 201.67 in post-merger period. The t-value (-6.153) and p-value (0.025) reveals that there is a significant impact of merger on Business per Employees in post-merger period. The Return on Assets increases from -0.34% to 0.51% after the merger. The t-value (-3.903) and the p-value (0.060) reveals that there is no significant difference on Return on Assets due to merger. Reason behind it may be that there is no proper utilisation of assets in post-merger period. The Return on Net worth increased from -13.30% to 10.89% after the merger period. The t-value (-8.294) and p-value (0.014) implies that there is a significant impact of merger on Return on Net

worth. The Investment to Deposit ratio slightly decreases from 27.06% to 26.30% in post-merger period. The t-value (1.255) and p-value (0.336) reveals that there is no significant impact of merger on Investment to Deposit ratio. The reason behind it may be that there is less opportunity available for investment in post-merger period. The Current Assets to Total Assets ratio increases from 12.11% to 15.88% after the merger period. The t-value (-1.534) and p-value (0.265) reveals that there is no significant impact of merger on current assets to total assets ratio after the merger period. Now it has been concluded that for the following ratios merger have significant impact such as Gross Non-performing Assets, Govt. Securities to total investment, Business per employee, Return on Net worth and for the following ratios merger have no significant impact such as Capital Adequacy ratio, Advances to total assets, Employees utilisation ratio, Return on assets, Investment to deposit and Current assets to total assets ratio.

**Table 3: Indian Bank’s financial performance during pre and post-merger period**

Particulars	Ratio	Duration	Mean	Std. Deviation	t	sig	H0
<b>C-Capital Adequacy</b>	Capital Adequacy Ratio	Pre	13.29	0.79	-10.046	.010	Reject
		Post	16.24	0.46			
	Advances to Total Assets Ratio	Pre	64.87	1.33	2.531	.127	Accept
		Post	60.61	2.83			
<b>A-Assets Quality</b>	Gross Non-Performing Assets	Pre	7.12	0.25	-0.973	.433	Accept
		Post	8.09	1.98			
	Govt. Securities to Total Investment	Pre	85.40	2.49	-3.093	.091	Accept
		Post	90.92	0.65			
<b>M-Management Ability</b>	Employees utilisation ratio(times)	Pre	9.61	0.37	8.351	.014	Reject
		Post	6.81	0.26			
	Business Per Employee	Pre	216.40	30.31	-4.632	.044	Reject
		Post	250.10	24.25			
<b>E-Earning Ability</b>	Return on Assets	Pre	0.30	0.21	-1.833	.208	Accept
		Post	0.63	0.14			
	Return on Net Worth	Pre	4.05	2.64	-9.131	0.012	Reject
		Post	7.85	3.36			
<b>L-Liquidity</b>	Investment to Deposit	Pre	30.78	3.73	0.048	.966	Accept
		Post	30.72	1.83			
	Current Assets to Total Assets	Pre	7.63	1.19	-3.323	.080	Accept
		Post	10.77	2.61			

Table 3 shows the comparative overall performance of Indian Bank. The average Capital Adequacy Ratio (CAR) increased from 13.29% to 16.24% after the merger. The t-value (-10.046) and p-value (0.010) reveals that there is a significant impact of merger on Capital Adequacy ratio. The reason behind it may be there is an optimal utilisation of capital after the merger period. The Advances to Total Assets Ratio decreased from 64.87% to 60.61% after the merger. The t-value (2.531) and p-value (0.127) implies that there is no significant impact of merger on Advances to Total Assets. The Gross Non- Performing Assets Ratio slightly increases from 7.12% to 8.09%. The t-value (-0.973) and p-value (0.433) shows that there is nosignificant impact of merger on Gross NPA. The Gross NPA increases due to worst management of Assets in the post-merger period. The Govt. Securities to

Total Investment ratio has been increased from 85.40% to 90.92% after the merger period. The t-value (-3.093) and the p-value (0.091) reveals that there is no significant impact on Govt. Securities to Total Investment ratio due to merger. The reason behind the improvement in this ratio may be that the Govt. Securities offers better returns in post-merger period. The Average Employees Utilisation ratio before the merger has been 9.61 times which decreased to 6.81 times in post-merger period. The t-value (8.351) and p-value (0.014) reveals that there is a significant impact of merger on Employees Utilisation ratio. Business per Employee ratio increases from 216.40 to 250.10 in post-merger period. The t-value (-4.632) and p-value (0.044) reveals that there is a significant impact of merger on Business per Employees in post-merger period. The Return on Assets increases from 0.30% to 0.63% after the merger. The t-value (-1.833) and the p-value (0.208) reveals that there is no significant difference on Return on Assets due to merger. Reason behind it may be that there is no proper utilisation of assets in post-merger period. The Return on Net worth increased from 4.05% to 7.85% after the merger period. The t-value (-9.131) and p-value (0.012) implies that there is a significant impact of merger on Return on Net worth. The Investment to Deposit ratio slightly decreases from 30.78% to 30.72% in post-merger period. The t-value (0.048) and p-value (0.966) reveals that there is no significant impact of merger on Investment to Deposit ratio. The reason behind it may be that there is less opportunity available for investment in post-merger period. The current assets to total assets ratio increased from 7.63% to 10.77% after the merger period. The t-value (-3.323) and p-value (0.080) reveals that there is no significant impact of merger on current assets to total assets ratio after the merger period. Now it has been concluded that for the following ratios merger have significant impact such as Capital Adequacy ratio, Employees utilisation ratio, Business per employee, Return on Net worth and for the following ratios merger have no significant impact such as Gross Non-performing Assets, Govt. Securities to total investment, Advances to total assets, Return on assets, Investment to deposit and Current assets to total assets ratio.

**Table 4: Punjab National Bank’s financial performance during pre and post-merger period**

Particulars	Ratio	Duration	Mean	Std. Deviation	t	Sig	H0
<b>C-Capital Adequacy</b>	Capital Adequacy Ratio	Pre	11.02	2.71	-3.127	.089	Accept
		Post	14.77	0.64			
	Advances to Total Assets Ratio	Pre	57.86	1.42	1.554	.260	Accept
		Post	56.05	1.75			
<b>A-Assets Quality</b>	Gross Non-Performing Assets	Pre	16.03	2.13	8.666	.013	Reject
		Post	11.55	2.70			
	Govt. Securities to Total Investment	Pre	80.81	4.31	-4.080	.055	Accept
		Post	88.36	1.42			
<b>M-Management Ability</b>	Employees utilisation ratio(times)	Pre	7.97	1.51	0.697	.558	Accept
		Post	7.20	0.43			
	Business Per Employee	Pre	165.60	17.13	-7.822	.016	Reject
		Post	199.67	14.76			
<b>E-Earning Ability</b>	Return on Assets	Pre	-0.94	0.71	-2.260	.152	Accept
		Post	0.20	0.05			
	Return on Net Worth	Pre	-32.60	23.76	-2.085	0.172	Accept
		Post	0.43	1.35			



<b>L-Liquidity</b>	Investment to Deposit	Pre	31.75	2.18	-0.531	.648	Accept
		Post	32.97	2.34			
	Current Assets to Total Assets	Pre	12.01	1.99	-0.188	.868	Accept
		Post	12.29	0.65			

Table 4 shows the comparative overall performance of Punjab National Bank. The average Capital Adequacy Ratio (CAR) increased from 11.02% to 14.77% after the merger. The t-value (-3.127) and p-value (0.089) reveals that there is no significant impact of merger on Capital Adequacy ratio. The reason behind it may be there no optimal utilisation of capital after the merger period. The Advances to Total Assets Ratio slightly decreased from 57.86% to 56.05% after the merger. The t-value (1.554) and p-value (0.260) implies that there is no significant impact of merger on Advances to Total Assets. The Gross Non- Performing Assets Ratiodecreases from 16.03% to 11.55%. The t-value (8.666) and p-value (0.013) shows that there is asignificant impact of merger on Gross NPA. The Gross NPA decreases due to bettermanagement of Assets in the post-merger period. The Govt. Securities to Total Investment ratio has been increased from 80.81% to 88.36% after the merger period. The t-value (-4.080) and the p-value (0.055) reveals that there is no significant impact on Govt. Securities to Total Investment ratio due to merger. The reason behind the improvement in this ratio may be that the Govt. Securities offers better returns in post-merger period. The Average Employees Utilisation ratio before the merger has been 7.97 times which decreased to 7.20 times in post-merger period. The t-value (0.697) and p-value (0.558) reveals that there is no significant impact of merger on Employees Utilisation ratio. Business per Employee ratio increases from 165.60 to 199.67 in post- merger period. The t-value (-7.822) and p-value (0.016) reveals that there is a significant impact of merger on Business per Employees in post-merger period. The Return on Assets increases from -0.94% to 0.20% after the merger. The t-value (-2.260) and the p-value (0.152) reveals that there is no significant difference on Return on Assets due to merger. Reason behind it may be that there is no proper utilisation of assets in post-merger period. The Return on Net worth increased from -32.60% to 0.43% after the merger period. The t-value (-2.085) and p-value (0.172) implies that there is a significant impact of merger on Return on Net worth. The Investment to Deposit ratio slightly increases from 31.75% to 32.97% in post-merger period. The t-value (-0.531) and p-value (0.648) reveals that there is no significant impact of merger on Investment to Deposit ratio. The reason behind it may be that there is less opportunity available for investment in post-merger period. The current assets to total assets ratio slightly increased from 12.01% to 12.29% after the merger period. The t-value (-0.188) and p-value (0.868) reveals that there is no significant impact of merger on current assets to total assets ratio after the merger period. Now it has been concluded that for the following ratios merger have significant impact such as Gross Non-performing Assets, Business per employee and for the following ratios merger have no significant impact such as Capital Adequacy ratio, Employees utilisation ratio, Return on Net worth Govt. Securities to total investment, Advances to total assets, Return on assets, Investment to deposit and Current assets to total assets ratio.

**Table 5: Union Bank of India’s financial performance during pre and post-merger period**

Particulars	Ratio	Duration	Mean	Std. Deviation	t	Sig	H0
<b>C-Capital Adequacy</b>	Capital Adequacy Ratio	Pre	12.02	0.71	-3.659	.067	Accept
		Post	14.37	1.74			
	Advances to Total Assets Ratio	Pre	58.87	1.60	0.672	.571	Accept
		Post	57.37	2.46			



<b>A-Assets Quality</b>	Gross Non-Performing Assets	Pre	14.95	0.79	3.094	.090	Accept
		Post	10.79	3.12			
	Govt. Securities to Total Investment	Pre	75.43	4.74	-0.008	.994	Accept
		Post	75.46	2.25			
<b>M-Management Ability</b>	Employees utilisation ratio(times)	Pre	12.17	0.58	6.498	.023	Reject
		Post	8.11	0.50			
	Business Per Employee	Pre	188.93	11.19	-3.967	.058	Accept
		Post	209.50	19.97			
<b>E-Earning Ability</b>	Return on Assets	Pre	-0.73	0.30	-14.878	.004	Reject
		Post	0.48	0.21			
	Return on Net Worth	Pre	-22.89	11.21	-6.171	0.025	Reject
		Post	8.08	2.68			
<b>L-Liquidity</b>	Investment to Deposit	Pre	31.47	2.03	-0.682	.566	Accept
		Post	33.34	2.79			
	Current Assets to Total Assets	Pre	12.70	0.89	0.923	.454	Accept
		Post	11.79	0.81			

Table 5 shows the comparative overall performance of Union Bank of India. The average Capital Adequacy Ratio (CAR) increased from 12.02% to 14.37% after the merger. The t-value (-3.659) and p-value (0.067) reveals that there is no significant impact of merger on Capital Adequacy ratio. The reason behind it may be there is optimal utilisation of capital after the merger period. The Advances to Total Assets Ratio slightly decreased from 58.87% to 57.37% after the merger. The t-value (0.672) and p-value (0.571) implies that there is no significant impact of merger on Advances to Total Assets. The Gross Non- Performing Assets Ratio decreases from 14.95% to 10.79%. The t-value (3.094) and p-value (0.090) shows that there is no significant impact of merger on Gross NPA. The Gross NPA decreases due to better management of Assets in the post-merger period. The Govt. Securities to Total Investment ratio has been slightly increased from 75.43% to 75.46% after the merger period. The t-value (-0.008) and the p-value (0.994) reveals that there is no significant impact on Govt. Securities to Total Investment ratio due to merger. The reason behind the improvement in this ratio may be that the Govt. Securities offers better returns in post-merger period. The Average Employees Utilisation ratio before the merger has been 12.17 times which decreased to 8.11 times in post-merger period. The t-value (6.498) and p-value (0.023) reveals that there is a significant impact of merger on Employees Utilisation ratio. Business per Employee ratio increases from 188.93 to 209.50 in post-merger period. The t-value (-3.967) and p-value (0.058) reveals that there is no significant impact of merger on Business per Employees in post-merger period. The Return on Assets increases from -0.73% to 0.48% after the merger. The t-value (-14.878) and the p-value (0.004) reveals that there is a significant difference on Return on Assets due to merger. Reason behind it may be that there is a proper utilisation of assets in post-merger period. The Return on Net worth increased from -22.89% to 8.08% after the merger period. The t-value (-6.171) and p-value (0.025) implies that there is a significant impact of merger on Return on Net worth. The Investment to Deposit ratio slightly increases from 31.47% to 33.34% in post-merger period. The t-value (-0.682) and p-value (0.566) reveals that there is no significant impact of merger on Investment to Deposit ratio. The reason behind it may be that there is less opportunity available for investment in post-merger period. The current assets to total assets ratio slightly decreased from 12.70% to 11.79% after the merger period. The t-value (0.923) and p-value (0.454) reveals that there is no significant impact of merger on current assets to total assets ratio after the merger period. Now it has been concluded that for the following ratios merger

have significant impact such as Employees utilisation ratio, Return on assets, Return on Net worth and for the following ratios merger have no significant impact such as Gross Non-performing Assets, Business per employee, Capital Adequacy ratio, Govt. Securities to total investment, Advances to total assets, Investment to deposit and Current assets to total assets ratio.

**Table 6: State Bank of India’s financial performance during pre and post-merger period**

Particulars	Ratio	Duration	Mean	Std. Deviation	t	sig	H0
<b>C-Capital Adequacy</b>	Capital Adequacy Ratio	Pre	13.43	0.59	1.722	.227	Accept
		Post	12.91	0.20			
	Advances to Total Assets Ratio	Pre	61.58	2.84	1.128	.376	Accept
		Post	58.76	1.95			
<b>A-Assets Quality</b>	Gross Non-Performing Assets	Pre	5.88	1.43	-1.036	.409	Accept
		Post	8.20	2.45			
	Govt. Securities to Total Investment	Pre	79.13	2.68	-0.562	.631	Accept
		Post	79.76	1.31			
<b>M-Management Ability</b>	Employees utilisation ratio(times)	Pre	7.56	0.25	1.238	.341	Accept
		Post	6.87	0.73			
	Business Per Employee	Pre	142.30	19.53	-34.848	.001	Reject
		Post	188.40	21.76			
<b>E-Earning Ability</b>	Return on Assets	Pre	0.52	0.14	1.842	.207	Accept
		Post	0.07	0.29			
	Return on Net Worth	Pre	5.04	2.86	2.321	0.146	Accept
		Post	-6.12	5.83			
<b>L-Liquidity</b>	Investment to Deposit	Pre	33.76	3.48	-0.285	.802	Accept
		Post	34.91	3.75			
	Current Assets to Total Assets	Pre	12.08	0.39	-0.069	.951	Accept
		Post	12.12	0.75			

Table 6 shows the comparative overall performance of State Bank of India. The average Capital Adequacy Ratio (CAR) decreased from 13.43% to 12.91% after the merger. The t-value (1.722) and p-value (0.227) reveals that there is no significant impact of merger on Capital Adequacy ratio. The reason behind it may be there is no optimal utilisation of capital after the merger period. The Advances to Total Assets Ratio slightly decreased from 61.58% to 58.76% after the merger. The t-value (1.128) and p-value (0.376) implies that there is no significant impact of merger on Advances to Total Assets. The Gross Non- Performing Assets Ratio increases from 5.88% to 8.20%. The t-value (-1.036) and p-value (0.409) shows that there is no significant impact of merger on Gross NPA. The Govt. Securities to Total Investment ratio has been slightly increased from 79.13% to 79.76% after the merger period. The t-value (-0.562) and the p-value (0.631) reveals that there is no significant impact on Govt. Securities to Total Investment ratio due to merger. The reason behind the improvement in this ratio may be that the Govt. Securities offers better returns in post-merger period. The Average Employees Utilisation ratio before the merger has been 7.56 times which decreased to 6.87 times in post-merger period. The t-value (1.238) and p-value (0.341) reveals that there is no significant impact of merger on Employees Utilisation ratio. Business per Employee ratio increases

from 142.30 to 188.40 in post- merger period. The t-value (-34.848) and p-value (0.001) reveals that there is a significant impact of merger on Business per Employees in post-merger period. The Return on Assets decreases from 0.52% to 0.07% after the merger. The t-value (1.842) and the p-value (0.207) reveal that there is a significant difference on Return on Assets due to merger. Reason behind it may be that there is no proper utilisation of assets in post-merger period. The Return on Net worth decreased from 5.04% to -6.12% after the merger period. The t-value (2.321) and p-value (0.146) implies that there is a significant impact of merger on Return on Net worth. The Investment to Deposit ratio slightly increases from 33.76% to 34.91% in post-merger period. The t-value (-0.285) and p-value (0.802) reveals that there is no significant impact of merger on Investment to Deposit ratio. The reason behind it may be that there is less opportunity available for investment in post-merger period. The current assets to total assets ratio slightly increased from 12.08% to 12.12% after the merger period. The t-value (-0.069) and p-value (0.951) reveals that there is no significant impact of merger on current assets to total assets ratio after the merger period. Now it has been concluded that for the Business per employee ratio has significant impact and for the following ratios merger have no significant impact such as Employees utilisation ratio, Return on assets, Return on Net worth Gross Non-performing Assets, Capital Adequacy ratio, Govt. Securities to total investment, Advances to total assets, Investment to deposit and Current assets to total assets ratio.

**Table 7: Comparative Analysis of selected public sector bank’s financial performance during pre and post-merger period**

Particulars	Ratio	Duration	Canara	Indian	PNB	UBI	SBI	Average
<b>C-Capital Adequacy</b>	Capital Adequacy Ratio	Pre	12.92	13.29	11.02	12.02	13.43	12.54
		Post	14.92	16.24	14.77	14.37	12.91	14.64
	Advances to Total Assets Ratio	Pre	62.45	64.87	57.86	58.87	61.58	61.13
		Post	59.35	60.61	56.05	57.37	58.76	58.43
<b>A-Assets Quality</b>	Gross Non-Performing Assets	Pre	9.63	7.12	16.03	14.95	5.88	10.72
		Post	7.26	8.09	11.55	10.79	8.20	9.18
	Govt. Securities to Total Investment	Pre	89.93	85.40	80.81	75.43	79.13	82.14
		Post	93.53	90.92	88.36	75.46	79.76	85.61
<b>M-Management Ability</b>	Employees utilisation ratio(times)	Pre	8.60	9.61	7.97	12.17	7.56	9.18
		Post	6.97	6.81	7.20	8.11	6.87	7.19
	Business Per Employee	Pre	165.03	216.40	165.60	188.93	142.30	175.65
		Post	201.67	250.10	199.67	209.50	188.40	209.87
<b>E-Earning Ability</b>	Return on Assets	Pre	-0.34	0.30	-0.94	-0.73	0.52	-0.24
		Post	0.51	0.63	0.20	0.48	0.07	0.38
	Return on Net Worth	Pre	-13.30	4.05	-32.60	-22.89	5.04	-11.94
		Post	10.89	7.85	0.43	8.08	-6.12	4.23
<b>L-Liquidity</b>	Investment to Deposit	Pre	27.06	30.78	31.75	31.47	33.76	30.96
		Post	26.30	30.72	32.97	33.34	34.91	31.65
	Current Assets to Total Assets	Pre	12.11	7.63	12.01	12.70	12.08	11.31
		Post	15.88	10.77	12.29	11.79	12.12	12.57

**4. Conclusions:**

Table 7 represents the comparative analysis of all the selected five banks on the basis of average. Canara Bank and Indian Bank have higher Capital Adequacy ratio than the average of all the rest banks in pre and post-merger period. All the rest banks have lower CAR than the average of all the banks in pre and post-merger period. PNB and UBI have lower advances to total assets ratio than the average of rest of the banks and overall average also. Canara Bank, Indian Bank and SBI have better advances to total assets ratio. Canara Bank, Indian Bank and SBI have lower Gross NPA ratio than the overall average of the banks and PNB, UBI have higher gross NPA than the average of overall banks which is not a good sign for the bank. Canara Bank and Indian Bank have higher govt. securities to total investments than the overall average of the banks and PNB, UBI, SBI have lower govt. securities to total investments ratio. Only the PNB has higher employee utilisation ratio than the overall average of the banks and rest of the banks, the other banks have lower ratio than the average which is not a good indicator for the banks. Indian bank and UBI have higher business per employee ratio than the overall average of the banks and rest of the banks, the other banks such as Canara bank, PNB, SBI have lower the business per employee. SBI and Indian Bank have higher Return of Assets than the overall average of the banks and rest of the banks. SBI and Indian Bank have higher Return of net worth ratio than the overall average of the banks and rest of the banks. PNB, UBI and SBI have higher investment to deposit ratio than overall average of the banks and rest of the banks. Except Indian bank, the rest bank has higher current assets to total assets ratio than overall average of the banks.

#### References:

- Adhikari, B., Kavanagh, M., & Hampson, B. (2023). Analysis of the pre-post-merger and acquisition financial performance of selected banks in Nepal. *Asia Pacific Management Review*.
- Ansari, M. A. A., Bilal, A., Khan, A. J., & Tahir, M. S. (2021). The effect of mergers and acquisitions on the financial performance of micro finance banks. *Review of Education, Administration & LAW*, 4(4), 833-845.
- Banu, M., & Vepa, S. (2021). A Financial Performance of Indian Banks Using CAMELS Rating System. *Journal of Contemporary Issues in Business and Government* Vol, 27(1).
- Borodin, A., Sayabek, Z. S., Islyam, G., & Panaedova, G. (2020). Impact of mergers and acquisitions on companies' financial performance. *Journal of International Studies*, 13(2).
- Gandhi, V., Chhajer, P., & Mehta, V. (2020). Post-merger financial performance of Indian banks: CAMEL approach. *International Journal of Banking, Risk and Insurance*, 8(2), 1.
- Gupta, I., Raman, T. V., & Tripathy, N. (2023). Impact of merger and acquisition on financial performance: Evidence from construction and real estate industry of India. *FIIB Business Review*, 12(1), 74-84.
- Hertina, D., & Arizona, L. Z. (2022). Comparison Analysis Of Financial Performance Before And After The Merger (Case Study at PT. Bank Danamon Indonesia Tbk and PT. Bank Syariah Indonesia Tbk). *Enrichment: Journal of Management*, 12(5), 3479-3485.
- Nurlaila, R., Kuswati, I., & Muttaqin, I. (2022, July). Comparison of the Financial Performance of Bank Syariah Indonesia Pre and Post Merger During the Covid-19 Pandemic. In *Annual International Conference on Islamic Economics and Business (AICIEB)* (Vol. 2, No. 1, pp. 198-211).
- Patel, R. (2018). Pre & post-merger financial performance: An Indian perspective. *Journal of Central Banking Theory and Practice*, 7(3), 181-200.

- Saroj, N. G., &Koti, K. V. (2023).Quantitative Analysis on Financial Performance of Merger and Acquisition of Indian Companies. *International Journal of Advanced Engineering, Management and Science*, 9(8).
- Zuhri, S., Fahlevi, M., Abdi, M. N., Irma, D., &Maemunah, S. (2020). The impact of merger and acquisition on financial performance in Indonesia. *Journal of Research in Business, Economics, and Education*, 2(1).

# ANALYSIS OF LIQUIDITY RISK MANAGEMENT ON BANKS PERFORMANCE - WITH SEEMINGLY UNRELATED REGRESSION METHOD ON PANEL DATA

**C Prabhavathi,**

Christ (Deemed to be University), Bengaluru, India.

**Dr N Mukund Sharm,**

BNM Institute of Technology, Bengaluru, India.

For banks all around the world, maintaining the ideal level of liquidity in the banking system has never been easy. When larger denomination currencies were demonetized in November 2016, Indian banks that were experiencing a liquidity deficit switched to having an excess of liquidity. While a surplus can undermine monetary transmission and cause asset bubbles to form, a lack of liquidity can cause systemic instability. This paper aims to investigate the impact of liquidity risk on the bank's performance for ten years (2014-2023) by examining evidence from leading public sector banks. This study is grounded on econometric panel data using the Seemingly Unrelated Regression (SUR) Model, to view the impact of Liquidity Risk Variables on Bank's Performance Variables. The result showed that some Liquidity Risk variables have an impact on the Bank's Performance with the SUR Model.

**Keywords: Liquidity Risk, Bank's Performance, Seemingly Unrelated Regression Method, Public Sector Banks**

## **1. Introduction and Conceptual Background of the Study**

The Banking Industry assumes a fundamental part in the development and improvement of the economy as it is the significant wellspring of money in the economy. The financial business has ventured from a managed economy to a liberated market economy. Besides, the monetary emergency fundamentally affected the Indian Financial Area. Hence, to support monetary sufficiency of a bank in lengthy run, there is desperate need to zero in on risk and pain in financial area. Albeit the banks are presented to fluctuated sorts of dangers. This paper is an endeavour to study on the liquidity risk in Indian Financial Industry.

The ability of a bank to turn its assets into cash and pay its debts on schedule is referred to as bank liquidity. The incapacity of a bank to pay its debts when they become due without endangering the bank's financial stability is known as liquidity risk. This kind of financial risk occurs when there is insufficient market activity for a certain financial asset or commodity without causing its price to fluctuate. The investors or company may not be able to convert assets into cash by losing their capital and income due to a lack of purchasers or insufficient demand. Losses could result from not meeting payment obligations on time or in an economical manner in such a scenario. A liquidity crisis can impact multiple institutions at once, even though it may only impact one. The 2007–2008 financial crisis has shown how market participants' combined actions can increase liquidity risk, which in turn can exacerbate economic instability. Efficient management of liquidity risk guarantees a bank's ability to meet its obligations on time and minimizes the likelihood of unfavourable circumstances.

Bank performance can be significantly impacted by risk exposure. Losses from high-risk exposure can lower a bank's profitability and capital sufficiency. The bank may find it challenging to fulfill its responsibilities to creditors and depositors as a result.

For these reasons, research on the correlation between bank risk exposure and performance is crucial. Initially, banks may find it easier to comprehend and control their risks. Secondly, it can assist regulators in creating frameworks for banks that effectively manage risk. Thirdly, it can support investors in making well-informed financial choices.



This study will look at the performance of six top PSU banks concerning bank risk exposure towards liquidity risk. It's an investigation of liquidity risk influence on the performance of banks. The reference period of the study is 10 financial years, i.e. 2014 to 2023.

As a result, the focus of this study was on analysing how liquidity affects banking sector profitability. This brought up the research question: What effect does liquidity have on the banking industry's profitability?

The research study work's structure begins with responding to these questions, which will help in understanding the banking sector's exposure to interest rate risk. Next, the literature pertinent to the topic is reviewed, and the study's data, model, and approach are listed along with the results and a discussion of the analysis conducted, as well as the research study's conclusion.

## 2. Review of Literature

Despite being a well-known concept in the finance literature, liquidity lacks a consensus definition. Both the ease of making investments and the ease of obtaining funds to trade securities, the former being referred to as market liquidity and the latter as funding liquidity, can be used to define liquidity. The goal of this study of the literature is to provide an overview of how liquidity affects bank performance. As a result, it is important to consider liquidity's risk and its effects on return on equity (ROE) and return on assets (ROA).

The study shows that there is no evidence of a long-run relationship between net interest income and provision for bad debts. That are reported in this article are consistent with the view that there is a significant negative relationship between net interest margin and funding liquidity risk (Marozva, 2015). The main aim of the study is to first measure the bank risk exposure by the capital market approach and assess the level of interaction between these risks by using VAR analysis along with variance decomposition and IRF analysis (Agrawal & Sehgal, 2018). A recent study examining the effects of credit risk management and liquidity on MENA banks is summarized in this article. There is a non-linear relationship between managing credit risk and the performance of the markets, even though credit risk management by itself has little effect on accounting performance. Unexpectedly, there is little effect from solo liquidity risk management. On the other hand, integrating credit and liquidity risk management has a big effect on both performances (Harb et al., 2022). The results illustrate that the capitalization ratio, performance, credit risk, and liquidity risk are all strongly correlated with the investment diversification of Islamic banks. On the other hand, conventional banks' investment diversification is significantly impacted by size, capital to total assets ratio, liquidity, and credit risks. Furthermore, Islamic banks' diversification strategies are less susceptible to macroeconomic factors. Considering the governance variables, the findings reveal that the number of executive directors, foreign directors, and the size of the board all significantly affect the investment diversification of Islamic banks. According to this study, experiencing financial stress helps us to comprehend the relationship between "performance-risks and diversification" better (Gafrej & Boujelbéne, 2022). Financial success is strongly correlated with each of the three risks. The nonperforming loans (NPLs) ratio has a negative effect on the financial performance of the bank, whereas the Zscore has a favorable effect, according to the authors. According to liquidity risk studies, the loan-to-deposit (LTD) and current ratios have an effect on financial performance, but in various directions. However, financial performance is enhanced by operational risk. The authors further address the important implications that the co-occurrence of liquidity and credit issues has for financial performance (Hunjra et al., 2022). This paper offers in studying the variables determining liquidity risk and how they determine the banking system's profitability. The writers stress the need for modern risk managers to have enough cash on



hand in order to reduce liquidity risk. This will lessen the need for the repo market by closing the liquidity gap. Multiple regression analysis reveals that the two variables which enhance liquidity risk—the liquidity gap and non-performing assets—have an extensive effect on bank profitability. Their relationship with profitability seems negative (Arif & Nauman Anees, 2012). Through an analysis of empirical data from an emerging market, this study intends to comprehend the impact of credit risk, liquidity risk, and bank capital on bank profitability during a nine-year period (2010–2018). The econometric panel data used in this study was obtained by GMM techniques. The findings suggest that bank profitability is influenced by credit risk, liquidity risk, and bank capital variables. It must for local and international bank managers to learn about the Basel rules and their significance since enforcing them can protect the bank from risk and boost profitability and efficiency (Saleh & Abu Afifa, 2020). Using Auto-Regressive Distributed Lag (ARDL) regression, this study examines the effects of several policymaker interventions to preserve the optimal liquidity while additionally shielding the profitability of banks and overall economic growth from the policy's detrimental effects. It is discovered that while lending rates have no effect on liquidity deficit, the fiscal deficit has a negative relationship with both GDP growth and liquidity deficit while increasing bank profits. A rise in deposit rates has a favorable effect on the liquidity imbalance, a negative effect on bank profits, and a positive correlation with GDP growth that becomes negative after three lags. In the same way, the credit rate of growth lowers bank profits, increases GDP growth, and has a positive relationship with the liquidity deficit (Satya Krishna Sharma et al., 2022). Thus, this study proposes to build an intervention framework with liquidity risk variables for the selected Public Sector banks with an impact on the profitability variables of the bank.

### 3. Data, Model & Methodology

The present research study attempts to analyse and examine the influence of the liquidity risk on the bank's performance. The quantitative study uses the numerical data from the financial reports of the banks. This study used the financial numerical data for the period 2014 to 2023 obtained from Bloomberg Database. The top performing six public sector banks are selected for the analysis based on the market capitalization during 2023. The liquidity risk variable proxies are total loan to total deposit ratio (TLTDR), total loans to total asset ratio (TLTAR) and total deposits to total asset ratio (TDTAR) and performance variable proxies are return on equity (RTOE) and return on assets (RTOA).

The initial research study analysis is performed using a regression model to inspect the deterministic relationship between performance variables i.e return on equity (RTOE) and return on assets (RTOA) of the selected banks and the liquidity risk variables total loan to total deposit ratio (TLTDR), total loans to total asset ratio (TLTAR) and total deposits to total asset ratio (TDTAR). The study includes two performance variables, therefore in an attempt to evaluate more than one multiple regression equation, the Seeming Unrelated Regression (SUR) model is used to analyze regression equations that are linked statistically but not structurally.

Three hypotheses were constructed and applied to ascertain the effect of liquidity on profitability based on these five variables.

#### 3.1 Regression Model

A statistical method for examining the relationship between one dependent variable and multiple independent variables is called multiple regression. Using known values for the independent variables to forecast the value of the single dependent variable is the goal of multiple regression analysis. The liquidity risk variable proxies are total loan to total deposit ratio (TLTDR), total loans to total asset ratio (TLTAR) and total deposits to total asset ratio

(TDTAR) and performance variable proxies are return on equity (RTOE) and return on assets (RTOA) are included in this formula in equation 1 (RTOE) and equation 2 (RTOA) for linear regression framework.

$$\text{Equation 1: } RTOE_{it} = \alpha + \beta_1(TLTDR_{it}) + \beta_2(TLTAR_{it}) + \beta_3(TDTAR_{it}) + \varepsilon_{it}$$

$$\text{Equation 2: } RTOA_{it} = \alpha + \beta_1(TLTDR_{it}) + \beta_2(TLTAR_{it}) + \beta_3(TDTAR_{it}) + \varepsilon_{it}$$

Hypothesis 1: The loan to total deposit ratio (TLTDR), total loans to total asset ratio (TLTAR) and total deposits to total asset ratio (TDTAR) significantly influence the return on equity (RTOE).

Hypothesis 2: The loan to total deposit ratio (TLTDR), total loans to total asset ratio (TLTAR) and total deposits to total asset ratio (TDTAR) significantly influence the return on equity (RTOA).

### 3.2 Seemingly Unrelated Regression Model (SUR)

A seemingly unrelated regression (SUR) system is a collection of equations with contemporaneous cross-equation error correlation, meaning that the regression equations' error terms are correlated. Although the equations appear unrelated at first glance, the correlation in errors shows that the equations are interrelated. The liquidity risk variable proxies are total loan to total deposit ratio (TLTDR), total loans to total asset ratio (TLTAR) and total deposits to total asset ratio (TDTAR) and performance variable proxies are return on equity (RTOE) and return on assets (RTOA) are included in this formula in equation 1 (RTOE) and equation 2 (RTOA) for integrated for the SUR Model.

## 4. Results and discussion

### 4.1 Regression Model

The liquidity risk variable proxies are total loan to total deposit ratio (TLTDR), total loans to total asset ratio (TLTAR) and total deposits to total asset ratio (TDTAR) and performance variable proxies are return on equity (RTOE) and return on assets (RTOA) are included in this formula in equation 1 (RTOE) and equation 2 (RTOA) for linear regression framework.

Equation 1: Results

Dependent Variable: ROA  
 Method: Panel Least Squares  
 Date: 12/05/23 Time: 23:24  
 Sample: 2014 2023  
 Periods included: 10  
 Cross-sections included: 6  
 Total panel (balanced) observations: 60

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.822375	10.79779	-0.353996	0.7247
DEPOSITS_ASSETS	0.046181	0.128203	0.360214	0.7200
TOTAL_LOANS_TOTAL_ASSETS	-0.122493	0.159117	-0.769828	0.4446
TOTAL_LOANS_TOTAL_DEPOSITS	0.099800	0.133483	0.747661	0.4578
R-squared	0.088096	Mean dependent var		0.001790
Adjusted R-squared	0.039244	S.D. dependent var		0.832444
S.E. of regression	0.815946	Akaike info criterion		2.495403
Sum squared resid	37.28300	Schwarz criterion		2.635026
Log likelihood	-70.86210	Hannan-Quinn criter.		2.550017
F-statistic	1.803319	Durbin-Watson stat		1.240655
Prob(F-statistic)	0.157067			

## Equation 2: Results

Dependent Variable: ROE  
 Method: Panel Least Squares  
 Date: 12/05/23 Time: 23:28  
 Sample: 2014 2023  
 Periods included: 10  
 Cross-sections included: 6  
 Total panel (balanced) observations: 60

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-64.46516	182.2474	-0.353723	0.7249
DEPOSITS_ASSETS	0.777867	2.163842	0.359484	0.7206
TOTAL_LOANS_TOTAL_ASSETS	-2.111921	2.685618	-0.786382	0.4350
TOTAL_LOANS_TOTAL_DEPOSITS	1.717120	2.252959	0.762162	0.4492
R-squared	0.094466	Mean dependent var	-0.251877	
Adjusted R-squared	0.045955	S.D. dependent var	14.09949	
S.E. of regression	13.77171	Akaike info criterion	8.147450	
Sum squared resid	10620.96	Schwarz criterion	8.287073	
Log likelihood	-240.4235	Hannan-Quinn criter.	8.202064	
F-statistic	1.947310	Durbin-Watson stat	1.224171	
Prob(F-statistic)	0.132451			

The results from Panel Least Square indicates that the Liquidity risk Variables total loan to total deposit ratio (TLTDR), total loans to total asset ratio (TLTAR) and total deposits to total asset ratio (TDTAR) have no influence on the Bank Performance Variables return on equity (RTOE) and return on assets (RTOA). As the p value are greater than 0.05, the Ho is accepted and the alternative hypothesis (H1 and H2) are rejected.

**4.2 Seemingly Unrelated Regression Model (SUR)**

Although the equations appear unrelated at first level analysis, we use the SUR Models to analyse the correlation in errors shows that the equations are interrelated. The liquidity risk variable proxies are total loan to total deposit ratio (TLTDR), total loans to total asset ratio (TLTAR) and total deposits to total asset ratio (TDTAR) and performance variable proxies are return on equity (RTOE) and return on assets (RTOA) are included in this formula in equation 1 (RTOE) and equation 2 (RTOA) forintegrated for the SUR Model.

## Equation 1: Results

Dependent Variable: ROA  
 Method: Panel EGLS (Cross-section SUR)  
 Date: 12/05/23 Time: 23:42  
 Sample: 2014 2023  
 Periods included: 10  
 Cross-sections included: 6  
 Total panel (balanced) observations: 60  
 Linear estimation after one-step weighting matrix  
 White diagonal standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.667630	2.585373	-1.418608	0.1616
DEPOSITS_ASSETS	0.047342	0.031097	1.522420	0.1335
TOTAL_LOANS_TOTAL_ASSETS	-0.092082	0.037923	-2.428163	0.0184
TOTAL_LOANS_TOTAL_DEPOSITS	0.075977	0.031588	2.405203	0.0195
Weighted Statistics				
R-squared	0.170106	Mean dependent var	0.457357	
Adjusted R-squared	0.125648	S.D. dependent var	1.306730	
S.E. of regression	0.967490	Sum squared resid	52.41810	
F-statistic	3.826179	Durbin-Watson stat	1.586296	
Prob(F-statistic)	0.014540			
Unweighted Statistics				
R-squared	-0.061158	Mean dependent var	0.001790	

The results of the SUR Cross section analysis state that liquidity risk variable total loan to total deposit ratio (TLTDR) and total loans to total asset ratio (TLTAR) have an impact on the bank performance variables i.e ROA, as the P values are less than 0.05.

## Equation 2: Results

Dependent Variable: ROE  
 Method: Panel EGLS (Cross-section SUR)  
 Date: 12/05/23 Time: 23:40  
 Sample: 2014 2023  
 Periods included: 10  
 Cross-sections included: 6  
 Total panel (balanced) observations: 60  
 Linear estimation after one-step weighting matrix  
 White diagonal standard errors & covariance (d.f. corrected)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-76.58058	47.21387	-1.621993	0.1104
DEPOSITS_ASSETS	0.965573	0.571656	1.689079	0.0968
TOTAL_LOANS_TOTAL_ASSETS	-1.877521	0.670939	-2.798348	0.0070
TOTAL_LOANS_TOTAL_DEPOSITS	1.542891	0.558040	2.764838	0.0077
Weighted Statistics				
R-squared	0.263559	Mean dependent var	0.607574	
Adjusted R-squared	0.224107	S.D. dependent var	1.530222	
S.E. of regression	0.979740	Sum squared resid	53.75391	
F-statistic	6.680481	Durbin-Watson stat	1.575558	
Prob(F-statistic)	0.000619			
Unweighted Statistics				
R-squared	-0.009846	Mean dependent var	-0.251877	
Sum squared resid	11844.42	Durbin-Watson stat	1.022147	

The results of the SUR Cross section analysis state that liquidity risk variable total loan to total deposit ratio (TLTDR) and total loans to total asset ratio (TLTAR) have an impact on the bank performance variables i.e ROE, as the P values are less than 0.05.

## 5. Conclusions and recommendations

In the panel dataset, this work used seemingly unrelated regression method. This analysis's choice is to examine the simultaneous correlation, a regular regression assumption that is violated (Jannah et al., 2021). SUR is a suitable and effective strategy in this instance for panel data with several individuals (6) less than several periods of time (10). It can be sure that the liquidity risk between commercial banks is correlated. While the aggregate results substantially defy theoretical assumptions, they are consistent with findings from earlier studies on the impact of liquidity risk on bank performance.

## Bibliography

- Agrawal, T. J., & Sehgal, S. (2018). Dynamic Interaction of Bank Risk Exposures: An Empirical Study for the Indian Banking Industry. *IIM Kozhikode Society and Management Review*, 7(2), 132–153. <https://doi.org/10.1177/2277975218767543>
- Arif, A., & Nauman Anees, A. (2012). Liquidity risk and performance of banking system. *Journal of Financial Regulation and Compliance*, 20(2), 182–195. <https://doi.org/10.1108/13581981211218342>
- Gafrej, O., & Boujelbéne, M. (2022). The impact of performance, liquidity and credit risks on banking diversification in a context of financial stress. *International Journal of Islamic and Middle Eastern Finance and Management*, 15(1), 66–82. <https://doi.org/10.1108/IMEFM-09-2020-0488>
- Harb, E., El Khoury, R., Mansour, N., & Daou, R. (2022). Risk management and bank

- performance: evidence from the MENA region. *Journal of Financial Reporting and Accounting*, 21(5), 974–998. <https://doi.org/10.1108/JFRA-07-2021-0189>
- Hunjra, A. I., Mehmood, A., Nguyen, H. P., & Tayachi, T. (2022). Do firm-specific risks affect bank performance? *International Journal of Emerging Markets*, 17(3), 664–682. <https://doi.org/10.1108/IJOEM-04-2020-0329>
- Jannah, W., Sulvianti, I. D., Indahwati, Silvianti, P., & Kurnia, A. (2021). Analysis of Credit Bank Distribution with Seemingly Unrelated Regression Method on Panel Data. *Journal of Physics: Conference Series*, 1863(1). <https://doi.org/10.1088/1742-6596/1863/1/012057>
- Marozva, G. (2015). Liquidity And Bank Performance. *International Business & Economics Research Journal (IBER)*, 14(3), 453. <https://doi.org/10.19030/iber.v14i3.9218>
- Saleh, I., & Abu Afifa, M. (2020). The effect of credit risk, liquidity risk and bank capital on bank profitability: Evidence from an emerging market. *Cogent Economics and Finance*, 8(1). <https://doi.org/10.1080/23322039.2020.1814509>
- Satya Krishna Sharma, R., Bijoy, K., & Sahay, A. (2022). Issues in liquidity management in banking system: An empirical evidence from Indian commercial banks. *Cogent Economics and Finance*, 10(1). <https://doi.org/10.1080/23322039.2022.2122190>



## **ANALYSIS AND ACTIONS OF CHHATTISGARH STATE INDUSTRIAL DEVELOPMENT CORPORATION (CSIDC) IN INDUSTRIAL DEVELOPMENT**

**Ravi Kumar Gahi**

Dr.C.V. RamanUniversity Kargi, Road, Bilaspur, Chhattisgarh, India.

**Dr. Priyank Mishra**

Dr.C.V. RamanUniversity Kargi, Road, Bilaspur, Chhattisgarh, India.

The primary organization for promoting industrial development in the state is the Chhattisgarh State Industrial Development Corporation (CSIDC), an agency of the government founded under the Companies Act of 1951. The Department of Commerce and Industry is in the position of overseeing it. Promoting industrial investment and exports, carrying out surveys of suitable industrial sites, assigning land to enterprises, encouraging entrepreneurship, educating entrepreneurs, forming social partnerships, and maintaining and modernizing industrial sites are among CSIDC's core tasks.

**Keywords:** CSIDC, Natural Resources, Industry, Industrial Development, Government Organization, Entrepreneurship, Social Partnership, Management Commerce, Chhattisgarh State, Local Small-Scale

### **1. Introduction:**

The CSIDC made the decision to lower obstacles in the way of small, medium, and large-scale firm development in the area. The process of creating an action plan aids in organizing the work involved in building and maintaining the region's industrial infrastructure. CSIDC has played a significant role as a development hub for Urla, Siltara, Sirgitti, Borai, and other significant industrial growth centers over the years. [1] In addition, the establishment of Foods Park, Steel Park, Technology Park, and Industrial Automation Cluster are now underway. Through lab work and equipment testing, CSIDC also certifies and tests manufacturing and other commodities. It provides local small-scale businesses and other sectors with coal, iron, and steel, among other resources. [2]

#### **Large-scale projects:**

Center for Industrial Development Industrial Development Center's Urla Approximately 375 hectares make up Urla, which is located next to National Highway 200 on the outskirts of Raipur. And it encompasses, among other localities, Sarora, Sondongri, Gondwara, and Gogaon. The assigned land is fully turned over and sufficiently developed.

11259 people now have job chances thanks to the 418 units that have been established, with an estimated Rs 425 crore spent in the project. [3]

#### **The Siltara Development Corporation Center:**

Siltara Industrial Development Center, is situated 13 kilometers away from Raipur. In this domain, Rs 716 crore have been expended thus far. within the Siltara Industrial Development Center complex, which has ferromagnetic alloy, cooking gas, and scrap iron factories. Mandhar's closest train station is located around 3 km away on the Mumbai-Howrah main line. The total area covered by it is around 1185 hectares. 48 units are present. At a cost of Rs 716 crore, it was founded and gave 2772 persons employment opportunities.

#### **The Sirgitti Industrial Development Centre:**

The Sirgitti Industrial Development Centre is situated in the vicinity of Bilaspur, close to National Highway 200. It covers an area of around 338 hectares. The building of 324 units cost about Rs 447 crore, and 4431 people were directly hired as a consequence.

### **Borai Industrial Development Centre:**

Borai Industrial Development Centre Nine kilometers from Durg, on the Bypass National Highway 6, is the Borai Industrial Development Centre. The primary route between Mumbai and Howrah leads to the nearest train station, which is 0.5 km away from Rasmada. The area of land where it is located is around 451 hectares. At a cost of around Rs 136 crore, 44 units were established, employing 1495 people. This region is well developed. This location provides year-round access to groundwater supplies.

### **Bhanpuri-Ranwabhata:**

Ranwabhata is a location close to the Raipur commercial district Bhanpuri. It covers around 200 hectares. This region is well developed.

### **Tifra Industrial Area:**

Tifra Industrial Area is situated near to National Highway 200 on the outskirts of Bilaspur. It takes up around 65 hectares of space to be fully constructed. Anjani Industrial Area: Following the creation of the state of Chhattisgarh, this industrial area was established. It was founded in the Bilaspur district, close to Anjani village. Its location encompasses an area of around 48 hectares.

### **Harinchhapra IIDC:**

The Area Division, WBM Road, Culvert, and Research projects have all been finished. dispersed throughout around 21 hectares. It is situated 110 kilometers away from Raipur.

### **IIDC Birkoni:**

Situated on approximately 86 hectares of land. It is located at a distance of 35 kilometers from Raipur on National Highway 6.

**Nayanpur Girwarganj:** About 51 hectares is covered by IIDC.

### **Projects in progress:**

#### **Metal Park:**

The state of Chhattisgarh provides a reliable base for metal based companies. The state is home to several power, cement and iron and steel facilities. In view of the increasing need of downstream goods, a metal park is being built on 87.57 hectares of land in Rawabhata, 12 km from Raipur. 20 hectares of land has been developed in the first phase in Metal Park. Downstream metal based (raw material and semi raw material) industries like tower production, wind power, nut studs, handling equipment, steels, fittings, cutlery, automotive parts, equipment production, piping systems, cordage, transformers, welding electrodes, portable furniture/ The industries employed in the module furniture metal park include kitchens, control rooms etc. size of plots

Ranging from 1000 square meters to 10,000 square meters. The metal park has roads, a reliable water supply, street lighting, and other businesses and public services, with the initial phase of work now finished.

#### **Engineering Park:**

Bhilai Steel Plant in Durg district is the reason for the presence of metallurgical units in the entire region, which has developed as a metallurgical hub in the last 50 years. An engineering park was already created over an area of 121 hectares to promote the production of engineering goods in this region. A total of 150 units will be set up here for the production of engineering goods, industrial machinery, car parts, casts and weldments.

## **2. Upcoming Projects:**

### **Electronics Manufacturing Cluster:**

Sector 22 in Naya Raipur is developing into a concentration of electronic manufacturing facilities. The Department of Electrical Engineering and Communication Systems,

Government of India has given its final approval. The composite processing plant is being made accessible at one location in Naya Raipur, which is on its way to becoming India's first smart city. Under this facility, electronic manufacturing business will be provided shared infrastructure facility. Under this, world class facilities will be available at one place for electronic manufacturing units. It will have space for tool room, product design house, testing, certification, calibration, printing and packaging. The total cost of this project will be Rs 92 crore, of which the Government of India will contribute Rs 43 crore. Buildings are being constructed for infrastructure.

#### **Food Park:**

Food Park is being built in Dhamtari, the highest paddy producing area of the state. Furthermore, horticultural products and fish production are famous in the region. Food centers are being built in Banjari and Bagaud villages. It is located about 1.5 km from National Highway 30, making it easy to transport raw materials between Raipur, Jagdalpur and Hyderabad. This will make it much easier to transfer content and charts. This region is part of the Mahanadi basin, which is considered the lifeblood of Chhattisgarh. Mahanadi is in Dhamtari region. With the establishment of food park, value added plantation items like mango and tomato etc. can be possible in the surrounding areas. The process of land allotment has started here.

#### **Plastic Park:**

Some items of plastic industry were added to the priority sector in Chhattisgarh Industrial Strategy 2014-19. Construction of such plastic parks has been suggested by CSIDC under the Plastic Parks Program of the Government of India to support the plastics sector of the state. The project will be undertaken by the SPV as per the Plastic Park Programme. The Government of India has provided lump sum funding for the project. Establishment of a plastic park in the area has been proposed by CSIDC to the Government of India. In principle, the Government of India has approved it.

#### **Textile Park:**

The Cotton Park planned at Tilda aims to provide support, welfare and infrastructure for setting up integrated textile manufacturing units at one location. For the textile manufacturing units to succeed, the proposed textile park will offer top class ecology and infrastructure. According to CSIDC, textile park will be developed on 30 hectare land in village Khapri tehsil Tilda of Raipur. The planned textile park will have core facilities as well as common infrastructure facilities.

### **3. Functions of CSIDC:**

CSIDC Marketing is committed to promoting small scale manufacturing. The Chhattisgarh Store Purchase Regulations were created for this purpose, and they stipulate that 65 products must be acquired from small-scale manufacturing units in the state by government agencies, educational institutions, public undertakings and municipal bodies.

#### **Activities:**

1. By tender, the rates of items reserved under Store Purchase Rules are determined.
2. Raw materials (coal and wire rods) are supplied to the small industrial units of the state through raw material warehouse and coal cell.
3. Industrial goods are classified and tested in testing laboratories.
4. A factory manufacturing agricultural equipment is administered and managed.

Restrictions for store purchases

As per the store purchasing guidelines, you can view the database of reserved products.

#### **Raw Material Store:**

CSIDC has a raw material store at Bhilai which accepts steel and iron through SAIL's Bhilai Division Sales Office. Annual distribution is given to this store by the Steel Department of the Government of India. Which is made as per the demand of small scale manufacturing components noted in the input material store and according to the sale. Distribution is done as per allocation. At Bilaspur, CSIDC has a coal cell which distributes coal of various grades to small industrial units and listed units under non-linkage arrangement. CSIDC has an annual contract with South Eastern Coal Fields Limited which is allocated a fixed quantity of coal by the Ministry of Coal under the conditions. After that, the coal is provided to the establishments established under the Controller of Mines, Government of Chhattisgarh.

### **Testing Laboratory:**

Chhattisgarh State with the aim of multi-dimensional operation aimed at promoting and developing the industrial sector.

The Grade Marking and Testing Laboratory is run by the State Industrial Development Corporation, an agency of the Government of Chhattisgarh. It is the only NABL grading marking and testing laboratory and recognized laboratory of the Government of Chhattisgarh.

### **Export:**

Bhilai accounts for 75% of the total exports of the state, the remaining 25% comes from Urla, Bhanpuri, Sirgitti etc. Iron, handloom, mixed yarn, food and agricultural goods, iron, aluminium, cement, minerals, and engineering items are the top exports of the state.

## **4. Conclusion:**

CSIDC is a project that comes under the administrative supervision of Commerce and Industry Division of the Government of Chhattisgarh and acts as the central organization of the state to encourage industrial development. The primary activities of CSIDC include encouraging industrial investment and exports, conducting industrial potential surveys, allocating land to various industries, promoting entrepreneurship and training entrepreneurs, developing public-private partnerships and maintaining and upgrading industrial areas. It is dedicated to removing barriers to industrial growth and acts as a promoter for the growth of small, medium and large companies in the state. By making various action plans, it helps in preparing the work of creation and maintenance of diverse industrial appropriate infrastructure in the state. As well as testing, certifying industrial and other goods, producing furniture and agricultural equipment through testing laboratories, CSIDC also supplies iron, steel and coal to small and other companies in the vicinity.

### **References:**

- Anjali Pandey and Tara Trivedi, Role of Micro, Small and Medium Enterprises in India's Economic Development, International Journal of Advanced Research and Development, 2019, 89-91.
- Arun Prasad, Status of Small Scale Industries in India, International Journal of Applied Research, 2020, 74-77.
- ShahedaSiddiqui and Deepika Gupta, Major problems and solutions of workers working in carpet industry, International Journal of Scientific Research in Science Engineering and Technology, 2018, 739-740.
- Babli, Importance of micro credit in rural development, International Journal of Applied Research, 2018, 69-79.
- David L. Berkley and Mark S. Henry, Rural Industrial Development, Review of Agricultural Economics, 2018, 308-325.
- Ashish Kumar, Development of Micro and Small Industries through Entrepreneurship: An Exploratory Study, Socrates Research Journal, 2014, 167-183.

- NeelimaGoyal Small and Cottage Industries – Analysis. International Journal of Research and Analytical Review, 2018, 176-177.
- Sushil Kumar Small and Cottage Industries of India, International Journal of Research in Economic and Social Science, 2020, 257-264.
- JayaprakashPrajapati, Prospects and Challenges of Small Scale Industries, Inspira-Journal of Modern Management and Entrepreneurship, 2017, 313-318.
- SubodhShukla, Impact of globalization and industrial development on the Indian economy, International Journal of Review Research in Social Science, 2020, 167-172.
- SarikaDewangan, Analysis of causes and consequences of contribution of industrial clusters of Chhattisgarh to industrial development, International Journal of Review Research in Social Science, 2019, 97-100.
- DeepaDewangan Role of rural industries in economic development- International Journal of Review Research in Social Science, 2018, 183-186.
- Sachin Sharma and SatishJaiswal, Study of Development of Industrial Sector, UdgamVigayatiIdyllic Institute of Management, 2015, 293-296.
- Rajesh Aggarwal and AshishDubey, Study of industrial policy of Chhattisgarh state after state formation, Research Journal Humanities and Social Science, 2014, 366-368.
- Kamal Sharma and Harisingh Gaur, Real, relative and regional dimensions of development of Chhattisgarh, International Journal of Advanced in Social Science, 2016, 13-27.
- Tularam Thakur, Role of mineral resources in the economic development of Chhattisgarh, International Journal of Advanced in Social Science, 2016, 143 -148.
- KirtiSrivastava, Contribution of mineral resources in the economic development of Chhattisgarh, Paripex Indian Journal of Research, 2018, 133-135.

## AN ANALYTICAL STUDY ON IMPACT OF DAIRY COOPERATIVES ON SUSTAINABLE GROWTH OF DAIRY FARMERS WITH SPECIAL REFERENCE TO BILASPUR DISTRICT.

**Jayanta Roy,**

Dr. C.V. Raman University, Bilaspur, Chhattisgarh, India.

**Dr. Priyank Mishra,**

Dr. C.V. Raman University, Bilaspur, Chhattisgarh, India.

Between May 2021 to December 2021, researchers in Bilaspur looked at the social and economic effects of the city's dairy cooperative. Response from 224 milk producing farmers were randomly gathered, saved and evaluated using Microsoft excel programme. Main crop, cash crop, dairy goat farming, and service in organisations are the most common types of revenue documented and assessed. It was shown that 55% of rural farmers' revenue came from dairy production. Dairy was also determined to be the community's emblem of pride, distinction, and religious importance.

**Keywords:**Social and Economic Effects, Dairy Cooperative, Religious Importance.

### 1. INTRODUCTION

Gopal Bansi, some 4000 years ago, is credited with introducing cows to India. His Excellency Jung Bahadur Rana, Prime Minister of India, took the first move in this direction in the modern age, in 1850 A.D. (Upadhyaya et al, 2001). Two-thirds of the country's Agricultural GDP (CBS, 2010) comes from the dairy industry, making it the second most significant source of revenue behind only the federal government. More than 80% of rural people who do not have access to sufficient land rely on it as their primary source of income. Due to the difficulty of marketing milk separately due to its short shelf life, Milk Producers Cooperatives (MPC) were formed. Dairy cooperatives are defined as the organisation of at least 25 milk producing farmers who provide milk to the customers or to the processors. The primary goal of cooperatives is to pool resources for the benefit of all members. Milk's profitability depends on supply and demand. As the metropolitan population continues to expand, so does the need for milk. Milk production and distribution via dairy cooperatives are vital to the economic well-being of rural communities. Milk producing producers are expected to have 90876 in the nation. There are a total of 59841 male and 31035 female farmers that produce milk. It's projected that the dairy industry brings in NRs.9,000,000 each day to the countryside from the cities.

When more farmers in the same village start milking cows, it will have a greater economic and social influence on the community. The opening of a plant with consistent collection and payment has been demonstrated to raise living standards in both the farming community and the surrounding community (FAO, 1972). People's homes, sanitation facilities, bio-plant, education, employment, and access to finance have all improved as a result of the income from milk and animal production.

#### The Social and Economic Impact of the Dairy Industry

The inhabitants' main source of income comes from livestock husbandry, particularly dairying. Chart 1 shows the comprehensive socioeconomic significance of animals and animal byproducts, including their economic worth (via sales of animals and milk cash, fertiliser, draught power, and biogas, among other things).



**Figure 1: Conceptual framework of Socioeconomic relation of Dairy Cooperative**

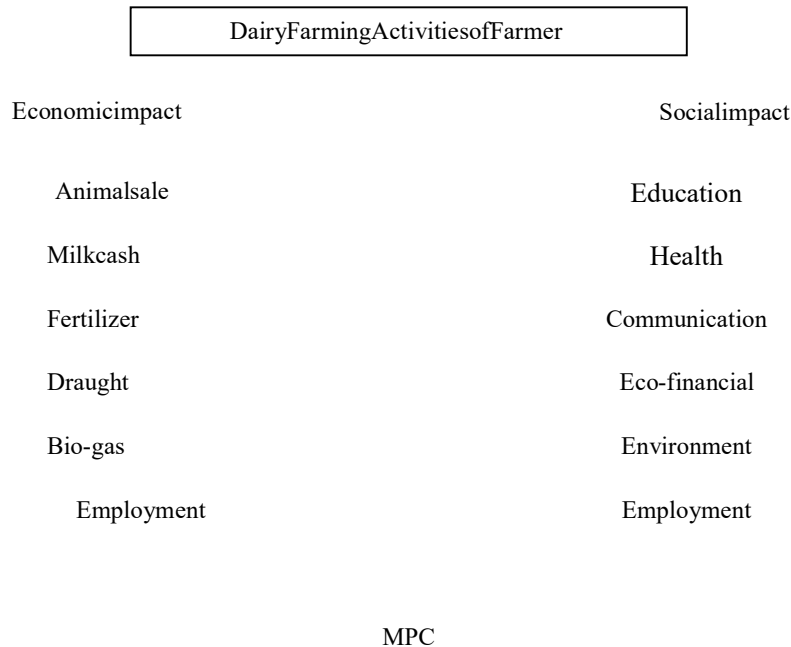


Figure-1 classifies repercussions into two broad categories: economic and social. The social effect examines how individuals' economic success in dairying is tied to the success of society as a whole, whereas the economic impact focuses on individual success. Income from selling animals, milk cash, fertiliser, draught, and biogas are all interconnected in terms of societal effect, as indicated in chart 1. They will help improve people's lives by investing in areas like healthcare and education. The following is a description of a few of the elements that make up the conceptual framework.

Farmers in the dairy cooperative sell both purebred and hybrid dairy animals. Heifers are sold to consumers at a premium, while old and ineffective cattle are culled at a cheap cost. However, there aren't many calves sold for natural service because of buyer demand.

Milk is a cash crop because farmers may sell it twice a day for maximum profit. Every two weeks, farmers bring their milk supply to Milk Producers Cooperatives (MPCs), where they are paid in cash based on the milk's fat and SNF content, as well as its volume.

Fertiliser: Shed slurry and animal faeces are being mixed to create farmyard manure. This fertiliser makes the land more fruitful rather than artificial fertilisers.

Draught: Ox and male buffalo is source for pulling cart and tilling the field. Without them, farmers would not be able to finish their fields.

The village's alternative energy source is biogas, which is used for both cooking and lighting. Some of the homes of the dairy farmers in Mahuli have combustible levels of methane, a byproduct of dung decomposition.

The production of milk requires a steady workforce to ensure its success. In Mahuli, farmers are stuck with no choices outside the dairy industry. As a result, farming is directly responsible for the existence of jobs in all of these homes.



Income from livestock sales, milk cash, fertiliser, draught, and biogas all contribute to a household's ability to pay for healthcare and education. People become more civilised and healthier as a result of the ripple effect that education has on society. Farmyard manure, made from agro by-products like dung, urine, and litter, is an integral part of a positive natural cycle that helps the environment by increasing plant life and decreasing pollution. Dairy farming provides jobs to work at shed, feeding, housing etc. Technical positions, accounting positions, managerial positions, etc., are all created in the dairy cooperative as a result. An employer is a great communicator because they put individuals in touch with the resources they need. At end, all these directly and indirectly have an affect to the society.

## 2. RESEARCH METHODOLOGY

224 Bilaspur dairy farmers provided both quantitative and qualitative information. Milk producers and members of a dairy cooperative provided the primary data, while reports from a variety of other sources provided the secondary data. Questionnaires, interview schedules, and in-field observations were all used to collect primary data.

Dairy farming, feeding, milking, economic effect, care and management system, milk transport, hygiene and sanitation, everyday activities of farmers and staff at cooperative; these were included in the main data questionnaire. After being collected from the field, the data was processed and analysed using descriptive and analytical methods. Based on interviews and questionnaires with farmers in the same area, we compared the situation before and after the cooperative's assistance to form an accurate picture for assessing the significant effects on the residents of Bilaspur.

## 3. RESULT AND DISCUSSION

Based on this statistics, the topic is broken down into the following sections.

### Respondents' Professions

Table-1 shows that the majority of the respondents' household was involved in raising livestock, going to school, working in agriculture, providing a service, or working as a labourer.

**Table1:DifferentOccupationofRespondentFamily(5YearandAboveAge)**

SN	Occupation	Male		Female		Total	
		Number	Percent	Number	Percent	Number	Percent
1.	Agriculture	18	14.5	21	21	39	17.4
2.	Service	7	5.7	2	2	9	4.0
3.	Livestock	55	44.4	51	51	106	47.3
4.	Student	42	33.8	26	26	68	30.4
5.	Labour	2	1.6	0	0	2	0.9
	<i>Total</i>	<i>124</i>	<i>100</i>	<i>100</i>	<i>100</i>	<i>224</i>	<i>100</i>

There were 224 active farmers (aged 5 and above), with 124 men and 100 women. The majority of the populace (47.3%) was involved in cattle farming. However, only a small fraction of the population (0.9% to be exact) was engaged in manual employment. While men made up the majority in agriculture, a larger share of women (21% vs. 14.5%) worked in the

sector. Male students numbered more (33.8%) than female students (26.9%), although their overall contribution ranked second (30.4%) to females'.

Dairy farming was a primary source of income for the top income bracket (52%, \$40-\$80,000) of households. The dairy industry has generated the largest share of total revenue (55.1% on average) among the five major contributors. The proportion of total revenue that came from the leasing of irrigated land to grow staple crops like rice and wheat was the lowest (3.7%). Regarding the revenue from goat farming and services/wage, the contribution was virtually equal. Comparatively, those in the income bracket of more than \$200,000 contributed much more (14.6% of the total) than those in the lower income brackets (11%).

The same statement of income source were noted by Dhanapala (1988) observing that dairy cooperatives have relevance and they play a valuable function in supporting rural development, specifically they may aid the growth of rural economics, thus it upgrades quality of life of the poor.

The Social Impact Cooperative is frequented by those who bring milk in the morning and evening, making it an ideal setting for the rapid dissemination of ideas, even if they are not universally accepted. The same is true for every individual who hosts a successful event: both financially and socially, the host benefits. Niraula (2003) concurs that dairy cooperatives have a mostly good effect on society and the economy. Farmers are more sociable now that they are forced to band together in dairy cooperatives. He goes on to say that the money they make from milk and cattle husbandry has allowed them to invest in things like clean toilets, bio-plants, televisions, and schools, among other cultural advancements.

The nature of physical impact is evolving rapidly from what it was. Some of the physical changes that have occurred in the region investigated are shown in Figure-1. There has been an increase in the availability of DW, power, and sanitation facilities. Fourteen percent of those who were asked about alternative energy sources mentioned biogas.



Stronger and more long-lasting than thatched homes, homes constructed from corrugated (CG) and brick walls have mostly supplanted them. Ninety-four percent of respondents said they watch TV for fun. Many respondents noted that landline and mobile phone adoption was increasing in their communities.

#### Resulting Costs

Figure 2 shows that when asked about the financial effect of dairy farming, 64% of respondents reported an increase in their financial situation, while 26% reported just receiving "normal" assistance. On the other hand, for over 10% of the sample, dairy farming had no positive effect.

#### Impact on the Economy

Farmers and residents in rural India recognise the economic value of the animal industry, particularly dairy. The Agricultural Perspective Plan (APP) of India projected dairy sub-sector as a rapidly expanding generally acknowledged industry which gives extra revenue to the farmers for their family costs. The usage of money from dairy in the region of this research is indicated in Figure 3.

Figure 3 shows how the dairy industry's financial gains are being put to use: on groceries, in



the classroom, on the farm, in the bank, and to pay off debt. Sixty-four percent of farmers polled indicated they used their dairy money to buy food. Similarly, 20% went towards debt repayment, 6% for tuition, and 6% towards savings. However, only a small percentage of respondents (4%) actually spent their dairy revenue on land.

Joshi (1990) also reported a similar source of income. It has been established that the revenue of rural milk producers in the project area has increased dramatically after the formation of dairy development Corporation (DDC) for milk collecting activities. The change and difference in income between "DDC participating" and "DDC non-participating" farmers were compared and was found that the DDC participants farmers have benefited not only in terms of increased level of income but also it has produced social benefit, improved nutrition and status of the people. The people living in the region where the initiative was conducted reaped economic, environmental, and social benefits as a result.

Each farmer is connected to money, status, and faith, and owns at least four dairy cows. Those who had a larger quantity of milking animals saw greater financial rewards. Farmyard manure is created from shed waste and is more reliable than artificial fertilisers in boosting production and improving soil texture. Panchamrit, a holy drink used in Hindu rituals, is crafted from five different kinds of milk. Cow dung is used to purify and sanctify the kitchen before every meal. She buffaloes are very helpful animals in Mansir due to their sweet milk flavour and high protein content, whereas cows are highly valued at Laxmi Puja, Janai Purnima, Baisakh Purnima, and Dhani Purnima. When compared to Bilaspur, the positive social and economic effects of dairy operations in VDCs where dairy co-ops do not exist are less convincing.

#### 4. CONCLUSION

The cooperative approach to achieving a shared objective that characterises rural dairy farming is an excellent example of the notion. The farmers typically get together twice a day,

once in the morning and once in the evening, for milk delivery at the dairy cooperative. Therefore, consistent gatherings have allowed them to work together harmoniously and to discuss the positive social and economic effects they have had. Cooperative dairy farming promotes social order, peace, and usefulness. The farmers benefit from the dairy cooperative's efforts to raise health, sanitation, and education levels. It's a great tool for spreading awareness of and support for initiatives that empower women.

## References

- Central Bureau of Statistics (CBS), the Government of India (2010). *Statistical pocket book of India, 2010*. Kathmandu: Author.
- Dhanapala, S.B. (1988). *Dairy development through cooperative structure*, file:/E:/Internet/Dairy Development through Cooperative Structure.
- FAO (1972). *Payment for milk on quality*. Rome: Author
- Joshi, D.D. (1990). *Impact evaluation of dairy development corporation milk collection activity on income rural milk product*, FAO, 31- 32
- Niroula, C.K. (2003). *Socio-economic status and impact of dairy farming among dairy farmers in Budhbare area, Jhapa*. An unpublished thesis submitted to the Faculty of Humanities and Social Science in Partial Fulfillment of the Requirements for the Master's Degree in Geography, Central Department of Geography TU, 102-105.
- Prakash, D. (2007). Report on education makes cooperatives strong and vibrant. *Sahakari Sambad, Annual Issue 2007*, National Cooperative Development Board (NCDB), India. 17 (2), 5-8.
- Shrestha, R.G. (2006). *Quality Milk Collection, Constraints and Approach for the stakeholder of National Dairy Development Board*, Hariharbhawan, Pulchowk.
- Singh, S.B. (2000). *Strategies and alternative approaches for future growth of the livestock sector in India*. Proceedings of 3rd National Animal Science convention, India Animal Science Association (NASA), India, 1-2.
- Upadhyaya, R.M., Joshi, D.D., & Thapa, T.B. (2001). *History of dairy development in India*. National Dairy Development Board, India, 5-7.

# A CRITICAL EXAMINATION OF THE SOCIO-ECONOMIC DEVELOPMENT IMPACT OF NMDC LIMITED'S CORPORATE SOCIAL RESPONSIBILITY INITIATIVES: A SOCIO-ECONOMIC STUDY OF DANTEWADA DISTRICT

**Adarsh Rathore,**

Dr. C. V. Raman University, Bilaspur, Chhattisgarh, India.

**Dr. Anshul Shrivastav,**

Dr. C. V. Raman University, Bilaspur, Chhattisgarh, India.

**Dr. Priyank Mishra,**

Dr. C. V. Raman University, Bilaspur, Chhattisgarh, India.

The term "Corporate Social Responsibility" (CSR) refers to efforts made by businesses to evaluate and account for their impact on the economic, social, and environmental well-being of society at large. This includes the company's internal and external communities, as well as its customers, employees, and shareholders. Corporate social responsibility (also known as "corporate citizenship") refers to a set of practises where a firm foregoes short-term profits in order to make long-term contributions to society and the environment.

Keywords – Corporate Social Responsibility, Corporate Citizenship, Society and Environment.

## 1. Introduction

In addition to the foregoing, CSR may be seen as the method by which a company deliberates on and develops its connections with stakeholders for the greater good, and then shows its dedication to this cause by implementing suitable business procedures and strategies.<sup>1</sup> CSR initiatives may span a wide range of topics, from education to water access (including clean drinking water), healthcare to health awareness campaigns, and even environmental protection, social justice, and cultural enrichment. The Government has recommended certain areas of need which should become the target of CSR, such as the eradication of hunger and poverty; maternal and child health; interventions for tackling diseases like HIV, tuberculosis, and malaria; and the promotion of gender equality and environmental sustainability, but companies are free to develop their own social investment strategies, choose the projects and areas to invest in, and decide the kind of programmes to implement.

Given the substantial sums spent on CSR initiatives, it is imperative that governments, corporations, and other stakeholders have accurate information on the effectiveness of the delivery mechanism in realising the policies that are supposed to result from these expenditures. The impact evaluations of CSR concentrate on the impacts of such investments and exhibit the concrete and intangible benefits of CSR programmes to the stakeholders. Understanding the intervention's concrete and intangible effects on recipients and their surrounding ecosystems is facilitated by conducting an impact assessment.<sup>2</sup> As a result, management is better able to decide how much to spend in CSR in the future, and stakeholders have a clearer picture of the project's overall effect. Community engagement is boosted, and the role of public policy in advancing CSR initiatives is made more clear, thanks to this impact assessment process.

National Minerals Development Corporation Limited's Corporate Social Responsibility Efforts

The National Mineral Development Corporation (NMDC) has become a leading mining company committed to environmental sustainability and a leading manufacturer of high-quality steel with an eye towards promoting social progress. The company's stated goal is to "maintain its leadership as the largest iron ore producer and exporter in India, while establishing itself as a quality steel producer and expanding its business by acquiring and operating various iron ore, coal, and other minerals in India and abroad," with the goal of maximising the happiness of all of the company's stakeholders.

In addition, between fiscal years 2014–2015 and 2019–2020, Navratna Central Public Sector Enterprise (CPSE) NMDC Ltd. allocated almost Rs. 1109.52 crores to different CSR programmes. According to an evaluation of 5059 firms in India for the financial year 2015–16, the Ministry of Corporate Affairs (MoCA) reports that NMDC Ltd. spent Rs. 210 crores on CSR throughout the year, making it the eighth largest amount on CSR spent in India. The National Mineral Development Corporation (NMDC) spent Rs. 188.7 crores for the 2014–2015 fiscal year, placing it eighth among the 7,334. CSR expenditure as a percentage of average PBT was 2.17 percent in 2016–17 and is projected to rise to 3.39 percent in 2019–20. This is one of the biggest CSR budgets among Indian corporations and demonstrates the firm's growing commitment to corporate social responsibility.

## 2. Literature Review

In literature, CSR strategies have been linked to various firm level outcomes such as improvements in operational performance (Hategan&Curea-Pitorac, 2017; Lau et al., 2018), corporate brand credibility and reputation (Hur et al., 2014), credit ratings (Jiraporn et al., 2014), customer choice and perceptions (Luo & Bhattacharya, 2006; Saeidi et al., 2015), and shared value creation (Porter & Kramer, 2011). Stakeholder theory, resource-dependence theory, agency theory (see Aguinis&Glavas, 2012), institutional theory (Bice, 2017; Campbell, 2007), and the transaction cost viewpoint (King, 2007) were all considered by academics in their studies on corporate social responsibility.

Despite extensive theoretical foundations, the CSR field currently lacks a unified theory of CSR and stakeholder theory remains a commonly utilised lens (Frynas&Yamahaki, 2016). The stakeholder theory postulates that stakeholders exert influence on corporations via several means. One of the most pressing needs in the extraction industry is the identification of key stakeholder interests. Based on the work of Rodrigues and Mendes (2018), this study uses a concept of corporate social responsibility (CSR) as a set of policies and procedures under which businesses take accountability for their effects on the community and the environment. Therefore, CSR in the mining business must take into account the needs of the local population and the environment (Frederiksen, 2018; Rodrigues & Mendes, 2018). Scholarship on CSR has brought to light significant difficulties in comprehending local CSR actions necessary to fulfil these characteristics (Bice, 2017). Social performance, as well as gaining legitimacy and credibility in the eyes of the local community, may be greatly aided by cultivating positive relationships with key stakeholders (Rodrigues & Mendes, 2018).

To attract additional resources, boost future performance, and establish competitive advantage, a company's CSR practises should be aligned with the legitimate interests of the local community and broader society expectations (Fombrun et al., 2000). Trust among stakeholders may be improved by the adoption of excellent social practises (Lamberti & Lettieri, 2009), and social capital can be cultivated and put to use during difficult times (Lins et al., 2017). Slowly but surely, corporate social responsibility becomes an integral and powerful aspect of business operations. Companies with strong CSR ratings do better than those with poor CSR ratings during situations of confidence crisis. Reputation, profits, staff



motivation, and loyalty may all gain greatly from CSR practises if they are handled well (Huber &Schormair, 2021). As influential parties, governments increasingly steer CSR by positive measures and policies (Huber &Schormair, 2021). The Indian government shifted policy in 2014 to encourage private sector involvement in combating social concerns including unemployment, healthcare, sanitation, and illiteracy. In order to see these plans through to fruition, however, it is necessary to adjust the internal and external networks of stakeholders, governance (Husted, 2003), and monitoring (Elembilassery&Gurunathan, 2018).

**3. Objectives of the study**

- To determine whether the impact created matches with the planned objective and output of the initiative undertaken
- To suggest measures for improvement, if any
- To suggest alternative courses of action, NMDC undertook an Impact Assessment exercise with respect to its CSR initiatives.

**4. Research Methodology**

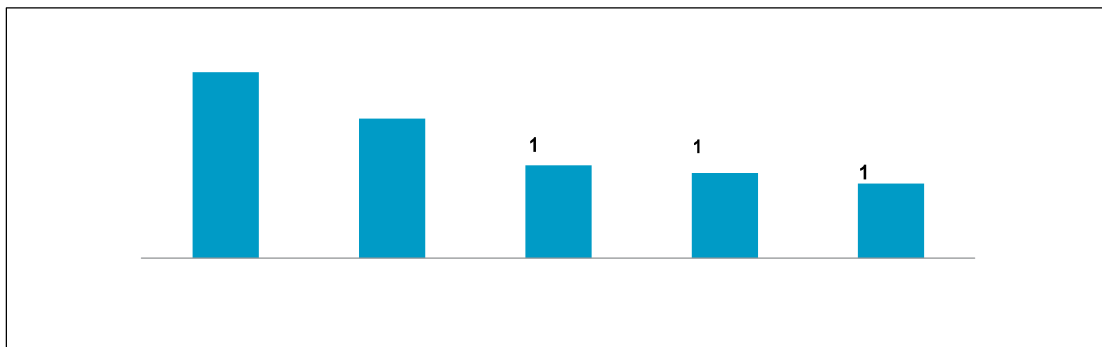
This study employs a variety of research techniques, including a main survey, in-depth interviews, case studies, and focus groups. There are a total of 492 CSR activities, with the majority of them taking place in Dantewada according to a cross-tabulation of the different CSR efforts for all priority areas and significant sites of CSR activities.

**5. Data Analysis and interpretation**

**Initiatives at NMDC**

Students have acknowledged an elevated level of familiarity with NMDC CSR programmes. Construction projects for classrooms, dorms, boundary walls, bathrooms, and other common areas were cited as the source of almost half of all claimed benefits at educational institutions. Students benefited in other ways as well, including access to clean water, financial aid, and the distribution of study materials at no cost. Awareness of NMDC CSR efforts was also present amongst other recipients. The relative relevance of the different means of information gathering (General, OBC, SC, and ST) is the same. Over 80% of replies come from personal networks like as friends, family, and neighbours; the next most common sources are Gramme Sabha workers/meetings, NMDC awareness camps, and NMDC staff.

Non-student Beneficiaries of NMDC CSR Initiatives: A Breakdown of Where They Heard About It (in Percentages).



Source: IHD Field Survey



Solution proposals favoured constant NMDC oversight, followed closely by checks by school and dorm administrators. Once the facility has been turned over per the terms and conditions of the MoA, Operation and Maintenance are transferred to the State Authorities. The availability of basic infrastructure, sporting facilities (such as playgrounds), access to clean water, and adequate sanitation were at the top of students' wish lists of perks. Among others, satisfaction ratings were excellent and very few kinds of projects had any criticism. Most of these projects include upkeep of previously functional infrastructure, such as solar hand pumps, solar pump and equipment, water treatment facilities, and roadways. Drinking water, health services, irrigation, and electricity that help individual homes topped the list of desired sorts of initiatives, while public amenities like roads and other infrastructure development ranked lower.

The human right to clean drinking water was first established by the UN General Assembly and the Human Rights Council as part of a binding international law in 2010 (UN, 2010). Having access to clean water at home and at the office has been shown to improve health and productivity. Furthermore, having access to clean water at school decreases absenteeism (UNDP, 2019: 3).

In 2015, 29% of the world's population lacked access to a properly treated water supply (UNDP, 2019: 18). Those already at a financial disadvantage must pay extra for water since municipal piped systems don't provide it. It is more expensive to provide this service to populations located in more distant locations, such as indigenous and ethnic communities (UNDP, 2019: 41). The physical means by which water is acquired or supplied are implicit in the concept of water accessibility. People use wells and community water delivery systems in areas where piped water is not accessible because it is the most cost-effective conveyance mode (UNDP, 2019: 2).

Water systems are still underdeveloped in more remote places. Institutional capabilities, such as resource mobilisation and budget allocations, are inadequate, leaving millions of women, men, and children without access to clean water (UNDP, 2019: 5). To guarantee that no one is without access to clean water, it is crucial to enhance water resource management and access to water supply in order to address the numerous social and economic disparities (UNDP, 2019: 11). The provision of water connections and the upkeep of existing pipes necessitates costly and infrequent capital expenditures. Bringing the price of clean water down is one way to make it more accessible to more people. This may be achieved via the use of cutting-edge technology, improved systems of leadership, and strategic use of limited resources (UNDP, 2019: 4).

## **6. Conclusion**

People in underdeveloped areas have had many of their needs met by NMDC, including those related to education, water, health care, farmers' welfare, irrigation, sanitation, electricity, and other infrastructure improvements. According to the study of adult beneficiaries, those who participated benefited from NMDC CSR efforts beyond only the ones asked about in the survey. It boosts the effect of NMDC programmes as well as recall values on recipients. A mix of high profile CSR projects coupled with numerous other activities that satisfy diverse needs of people appears to be a smart combination that has to be perpetuated. The effect and memory value among recipients might be diluted if too much weight is placed on a large number of minor CSR projects that serve a bigger population. The requirements of the people living closest to NMDC's mining and manufacturing operations should be met first, and then those services should be expanded to other regions to maximise the CSR program's effect.

## References

- Aguinis, H., & Glavas, A. (2012). What we know and don't know about corporate social responsibility: A review and research agenda. *Journal of Management*, 38(4), 932–968. <https://doi.org/10.1177/0149206311436079>
- Apaydin, M., Jiang, G. F., Demirbag, M., & Jamali, D. (2021). The importance of corporate social responsibility strategic fit and times of economic hardship. *British Journal of Management*, 32(2), 399–415. <https://doi.org/10.1111/1467-8551.12402>
- As sterlite plant expands, a city erupts in protest. (2018, April 4). *The Wire*. <https://thewire.in/environment/anti-sterlite-protestsfuelled-by-weak-sanctions-and-political-connections>
- Bastian, M., Heymann, S., & Jacomy, M. (2009). Gephi: An open source software for exploring and manipulating networks. *Association for the Advancement of Artificial Intelligence*. <https://gephi.org/>
- Bice, S. (2017). Corporate social responsibility as institution: A social mechanisms framework. *Journal of Business Ethics*, 143(1), 17–34. <https://doi.org/10.1007/s10551-015-2791-1>
- Blondel, V. D., Guillaume, J.-L., Lambiotte, R., & Lefebvre, E. (2008). Fast unfolding of communities in large networks. *Journal of Statistical Mechanics: Theory and Experiment*, 2008(10), P10008. <https://doi.org/10.1088/1742-5468/2008/10/P10008>
- Campbell, J. L. (2007). Why would corporations behave in socially responsible ways? An institutional theory of corporate social responsibility. *Academy of Management Review*, 32(3), 946–967. <https://doi.org/10.5465/amr.2007.25275684>
- Cappelli, P., Singh, H., Singh, J., & Useem, M. (2010). The India way: Lessons for the U.S. *Academy of Management Perspectives*, 24(2), 6–24. <https://doi.org/10.5465/amp.24.2.6>
- Carley, K. M., Columbus, D., & Landwehr, P. (2013). *Automap user's guide 2013* (Technical Report No. CMU-ISR-13-105). Center of the Computational Analysis of Social and Organization Systems, Carnegie Mellon University. <http://www.casos.cs.cmu.edu/publications/papers/CMU-ISR-13-105.pdf>
- Dhanesh, G. S. (2015). Corporate social responsibility (CSR) in India: A dialectical analysis of the communicative construction of the meanings and boundaries of CSR in India. *Public Relations Inquiry*, 4(3), 287–303. <https://doi.org/10.1177/2046147X15609393>
- Dorobantu, S., & Odziemkowska, K. (2017). Valuing stakeholder governance: Property rights, community mobilization, and firm value: Valuing stakeholder governance. *Strategic Management Journal*, 38(13), 2682–2703. <https://doi.org/10.1002/smj.2675>
- Elembilassery, V., & Gurunathan, L. (2018). Mandated CSR and mode of implementation: The Indian context. *Social Responsibility Journal*, 14(4), 701–718. <https://doi.org/10.1108/SRJ-08-2016-0147>
- Faust, K. (1997). Centrality in affiliation networks. *Social Networks*, 19(2), 157–191. [https://doi.org/10.1016/S0378-8733\(96\)00300-0](https://doi.org/10.1016/S0378-8733(96)00300-0)
- Fieseler, C., Fleck, M., & Meckel, M. (2010). Corporate social responsibility in the blogosphere. *Journal of Business Ethics*, 91(4), 599–614. <https://doi.org/10.1007/s10551-009-0135-8>
- Fombrun, C. J., Gardberg, N. A., & Barnett, M. L. (2000). Opportunity platforms and safety nets: Corporate citizenship and reputational risk. *Business and Society Review*, 105(1), 85–106. <https://doi.org/10.1111/0045-3609.00066>

## **A STUDY OF RECENT TRENDS IN FUNDS MOBILISED IN EQUITY ORIENTED SCHEMES OF MUTUAL FUNDS**

**Keshav Dutt Bunker,**

Jai Narain Vyas University, Jodhpur, India.

**Dr. Sandeep Kumar,**

Onkarmal Somani College of Commerce, Jodhpur, India.

Over the past ten years, mutual funds have grown in popularity as financial tools in India. It has become one of the most profitable and high-yield investing techniques in the country. In order to maximize safety and profits, a mutual fund is set up to aggregate the funds of several participants and then allocate those funds among a wide range of assets, including stocks, bonds, and other government securities. Currently, the Indian mutual fund business is crucial in attracting savings and investments. Individual investors are becoming more and more interested in unique financial products. The importance of professionally managed assets has increased, and mutual funds have become increasingly crucial. Financial instruments called mutual funds assist individual investors in diversifying their holdings in an effort to generate profitable returns. The performance of mutual funds will be examined in this research study along with the many methods of data analysis on assets under in equity oriented schemes, net resources mobilized by mutual funds will be used to evaluate mutual fund investments.

**KEYWORDS:-** Mutual Fund, AAUM (Average Asset Under Management), Equity oriented schemes.

### **1. INTRODUCTION:-**

The Indian mutual fund business currently plays a significant role in attracting savings and investments. Mutual funds offer investors higher returns and are among the highest paying investment options. Mutual funds are collections of resources that have been invested separately and collectively by several individuals. Institutional investment funds are established to offer all investors a chance for participation in the capital market. Individual investors typically lack the time, information, training, and skills to access capital markets directly, making it difficult for them to make informed investment decisions and benefit from the resulting expertise.

It's a trust that pools investor capital to invest into the capital markets, allowing investors to own a portion of the assets of mutual funds. Many investors putting their money together to form mutual funds make up the funds. The management of that money will be provided by an experienced fund manager who uses his investment expertise to invest it in a variety of finance instruments. The leverage offered by mutual funds allows for greater returns to be earned with minimal savings. The income generated by these investments and the realized capital gains are distributed among the unit holders of mutual funds in accordance with the quantity of units they possess.

### **2. LITERATURE REVIEW: -**

**Sharpe (1966)**, in his analysis, a low expense ratio, rather than fund size, was the key to good performance. According to him, the expenditure ratio and fund performance are inversely related.

**Jensen (1968)**, the study focused on returns that were risk-adjusted. He comes to the conclusion that the fund managers' poor stock picking skills contributed to the unsatisfactory performance of mutual funds.

**Vidyashankar (1990)**, He discovered that because of SEBI regulation, investors prefer mutual funds over bank or business deposits because they offer better investor protection. In his opinion, mutual funds would soon play a significant role in the Indian capital market.

**Jambodekar (1996)**, study was evaluating investor awareness of mutual funds, to identify the information path affects the purchasing decisions of individuals, and to identify the variables influencing the selection of certain funds.

**Krishnamurthi (1997)**, He emphasized that mutual funds are the most excellent investment medium, particularly for small and medium income investors who have a small amount of funds and inadequate knowledge of how to involve your-self for investment in capital markets. Mutual funds have the expertise and capacity to make the best decisions in order to generate consistent returns.

**Singh and Chander (2003)**, concluded that the choice of mutual funds and schemes is significantly influenced by past performance. Investors anticipated open communication, a repurchase option, and suitable information from mutual funds. Investors keep faith on these funds because of their good and solid performance record.

**Singh (2006)**, He concluded how investors perceived mutual funds and came to the conclusion that a number of elements, including the mutual fund's good performance record, credit-rating, expansion prospects, market assumption and the disclosure of ample information, have an effect on the decision to invest in it.

**Shah & Verma (2011)**, this research concentrated on young investors and their stock market behavior. The comparison focused on the young people's shifting investment choices throughout the pre- and post-recession periods. Additionally, the impact of demographic variables on their portfolio choices was examined in this article. It was concluded that the gain and the stock's fundamentals were what really influenced their choice.

### 3. OBJECTIVES OF THE STUDY: -

A comprehensive review of the literature on mutual funds reveals that most recent research articles focus more on the market timing expertise of fund managers and risk-return analysis than they do on the growth aspect. Therefore, it was imperative to carry out an additional study in order to identify the mutual fund industry's growth pattern. The main purpose/aim of the current study is to demonstrate the development of the Indian mutual fund sector in terms of the quantity of money raised, and the assets under management. The study mainly focused to analyze the growth of the funds mobilised and total assets in equity oriented schemes of mutual funds in past few years.

### 4. RESEARCH METHODOLOGY: -

The process of methodically solving a research problem is called research methodology. The plan, the data collection process, the hypothesis, and the steps taken to gather and analyze data in order to answer the research question are all included in the research methodology.

(i) **DATA COLLECTION:-** The study is focused on secondary data from official government websites is preferred. All of the company-related data that was examined and interpreted in this study is collected from SEBI's websites.

(ii) **HYPOTHESIS:-** Research is a goal-oriented endeavor since it cannot be completed without an objective. All a researcher works toward is the research question, which is the hypothesis. The investigator is enthusiastic about determining the hypothesis' response. This study aims to ascertain how mutual funds have grown in India over the last five years.

H0: The growth in the funds mobilization in Equity oriented mutual funds has not increased significantly in India.

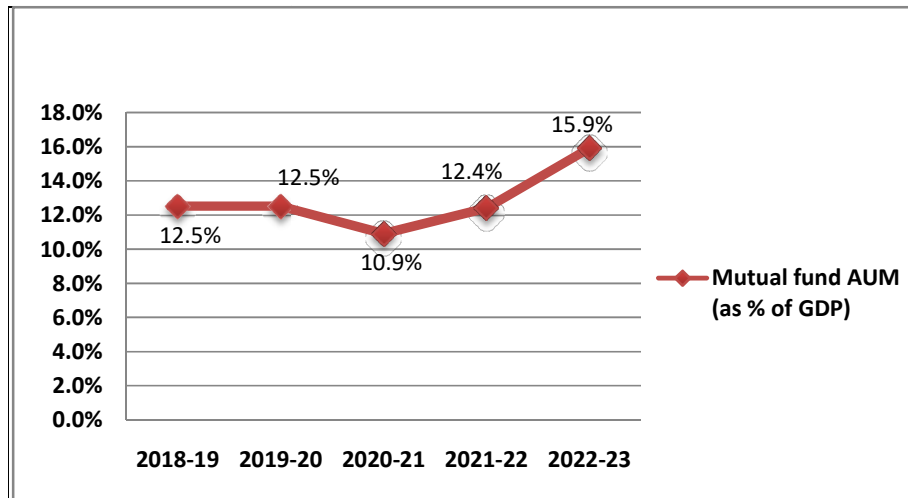
H1: The growth in the funds mobilization in Equity oriented mutual funds has increased significantly in India.

(iii) **RESEARCH PERIOD:-** In this study, Data collected and compared from the previous five year latest by F.Y. 2018 to F.Y. 2022.

**5. ANALYSIS OF THE STUDY:-**

Interpretation and analysis of the research based on the growing number of investment inflow in the mutual funds in India. The quantity of assets incorporated into the mutual funds across various schemes can be utilized to assess the growth. The data and information has collected from SEBI and AMFI official sites.

**Mutual fund AUM (as % of GDP):-**



\*(Based on end of fiscal, AUM and GDP at current prices)

Source:- AMFI data.

The percentage of India's GDP that is allocated to assets under management (AUM) grew over time, rising from 12.5% in 2018–19 to 15.9% in 2022–2023. However, it remains much lower than the ratio found in developed nations where the AUM highest GDP percentage in comparison to India. However, provided its low penetration level and AUM to GDP ratio, India has a lot of space to grow in the years to come.

**Funds Mobilised and Total Assets- Public & Private sector mutual funds -**

Year	Private sector mutual funds	Public sector mutual funds	Total funds mobilised (Rs. in Crore)
2018-19	1921800.26	457783.87	2379584.13
2019-20	1759175.31	467027.56	2226202.87

2020-21	2594987.86	547775.68	3142763.54
2021-22	2676185.62	561799.46	3237985.08
2022-23	3135405.32	806625.36	3942030.68

Table No. 1: Fund mobilized by Private &amp; Public sector mutual funds

\*<https://www.sebi.gov.in/statistics/mutual-fund/mf-fund-mobilised-public.html> on 09-12-2023

The official website of SEBI, that provides average assets under management for the years from 2018–19 to 2022–23. The schedule and graphical data representation demonstrate the growth of fund mobilized in all types of mutual funds. There has been a significant increase in the mutual fund industry year by year. The table below illustrates how, despite a slight decline in investment volume during the Corona Pandemic i.e. 2019–20, people continued to purchase mutual funds. Every year, the average asset under management rises, and the investment percentage increases significantly. According to a thorough study, 2020–2021 was the greatest year since mutual funds saw a notable percentage increase as shown in the table 1.

#### Amount and % changes in funds mobilized in Equity oriented schemes of mutual funds:-

Year	Funds Mobilised (Rs. in crore)	Increase	Increase %
2018-19	892101.02	-	-
2019-20	602961.58	-289139.44	-32.41
2020-21	1001120.76	398159.18	66.03
2021-22	1373728.50	372607.74	37.22
2022-23	1523282.20	149553.70	10.89

Table No. 2: Year wise amount and % changes in funds mobilized in Equity oriented schemes of mutual funds.

In addition with the previously discussed analysis, Table No. 2 represents the funds mobilized in Equity oriented schemes of mutual funds from the year 2018-19 to 2022-23. The growth has also been expressed as a percentage, indicating a significant 66.03 percent highest increase in 2020-21 just after corona pandemic and 32.41% decrease in 2019–20 in comparison to just previous year due to Corona Pandemic was the cause of this year's low investment rate. Aside from that, people are aware of it and the rate is increases in upcoming years. The volume of investment may also be influenced by other factors, such as people's increased awareness of and willingness to take on greater risk in stocks or their fear of a pandemic market failure. The overall amount has increased even with all of these explanations. The most recent year's investment, 2022–2023 is 10.89%, indicating a reasonably strong growth rate but decreasing trends from 2020-21 due to global issues and amid worries about inflation and expectations for rate hikes, markets remained volatile. Following 2020–21, investors shifted their investments from Equity-oriented mutual funds to Debt/Corporate bonds oriented schemes, Hybrid schemes, Index funds, Gold and other ETFs, indicating a profit-making move in the 2021–22 and 2022–23 periods.

#### 6. FINDINGS OF THE STUDY:-

As per findings, there has been a positive increase in mutual fund growth in India, and people are becoming more aware of investing due to improving levels of education. This reveals the trust on mutual funds among people while also emphasizing areas for improvement. The data study clearly reveals the significant boost in mutual funds, showing that AAUM continues to



rise annually despite a disastrous pandemic. The findings from the study indicate that investors are more attracted to Equity oriented mutual funds because they are interested in investing their money to expect strong returns in these areas. The primary cause is that everyone wants to combat inflation since everyone is aware that it ultimately reduces money value; in India, the average annual inflation rate over the last ten years (2012-22) has been approximately 6.01%. When FDs and other traditional methods are compared, they typically yield an average annual return of 7 to 8%. In contrast, equity-oriented mutual funds have produced returns of 15% and higher on average over the past ten years. During the data analysis in this study reveals that after corona pandemic people more investment made in equity related mutual funds at low levels for handsome return. If we compare the data from 2018-19 to 2022-23, overall increase of funds mobilizing only into equity oriented mutual funds calculating around 70.75% in last five years. Based on the data analysis, the study's H1 hypothesis has been satisfied, indicating a significant rise in the growth of funds mobilized in equity-oriented mutual funds in India.

## 7. CONCLUSION: -

A thorough analysis reveals that more and more people are becoming invested in mutual funds, as evidenced by the annual increase in AAUM of Equity oriented schemes of mutual funds. The industry related to mutual funds in India has a great deal of open space to grow in the future. Now days, many international AMC's firms are entering the Indian stock market. Our mutual fund industries has experienced exponential growth in terms of the quantity of funds raised, quantity of schemes over the years, which has led to increased competition amongst the Asset Management Companies. In conclusion, investing in equity-oriented mutual funds one can help to beat the inflation and a sound strategy can help to generate healthy returns. So that the study concludes on the basis of high returns on equity, investors in Indian mutual funds are expected to pour more money into Equity-indexed funds in the coming years. India still offers a large range of mutual fund options. However, people must be made aware of the risk and advantages of mutual funds.

## REFERENCES: -

- Mishra, B. (2002), Selectivity and Timing Skills of Mutual Funds in India: An Empirical Analysis, *The ICAI Journal of Applied Finance*, 8 (5), 5-16.
- Ramesh Chander (2002), Evaluate the performance of mutual funds in India according to the advice of Sharpe, Treynor and Jensen, *International Journal of Management Research and Business Strategy*, 2 (2) 56-78.
- Sodhi, H.J., & Jain, P.K. (2005), *Financial Management of Private and Public Equity Mutual Funds*. Presented on Regional Student's Conference (pp. 49-55). New Delhi: ICWAI
- Sapar, Narayan Rao and Madava, Ravindran, *Performance Evaluation of Indian Mutual Funds* Available at SSRN: <http://ssrn.com/abstract=433100>.
- Rao, D.N. (2006), *Investment Styles and Performance of Equity Mutual Funds in India*. New Delhi Excel Books.
- Singh, B.K., & Jain, A.K., (2009), An empirical study on awareness & acceptability of mutual fund. Presented on Regional Student's Conference (pp. 49-55) New Delhi: ICWAI.
- Agarwal, D. Pratidar, D. (2009), *Measuring Performance of Indian Mutual Funds*. *Prabandhan*, 12 (3), 179-185.
- Singh, B.K., (2012), A Study on investors attitude towards mutual funds as an investment option. *International Journal of Research in Management*, 2 (2), 61-70



- Mehta and Sushil Kumar (2019), Analysis of SBI mutual funds schemes outperformed UTI's in the 2007-2008 period, International Journal of Multidisciplinary Research, 1 (1), 14-29.
- Prof. Dr. Yulendra Kumar Rajput and Vidhi Chhabra (2023). A Study on the Performance of Mutual Fund in India, International Journal of Research Publication and Reviews, Vol 4, no 10, pp 2706-2709 October 2023

## **EXPLORING THE IMPACT OF FOMO ON CONSUMER BEHAVIOR AND DECISION MAKING IN THE DIGITAL ECONOMY**

**Dr. Ashish Mathur,**

Jai Narain Vyas University, Jodhpur, India.

**Sona Soni,**

JaiNarain Vyas University, Jodhpur, India.

In the fast-paced and interconnected world of the digital economy, the phenomenon of "Fear of Missing Out" (FOMO) has gained significant prominence. FOMO is characterized by an individual's anxiety over missing out on experiences, products, or opportunities, primarily driven by the constant exposure to information and choices in the digital realm. This study provides an overview of the research that delves into the profound impact of FOMO on consumer behavior and decision making.

### **OBJECTIVE OF RESEARCH:**

This paper aims at investigating how FOMO driven marketing strategies and social media influence consumer choices, and their implications on businesses and individuals.

Apart from this, this study examines how FOMO influences consumer behavior and shapes decision-making processes. It investigates the psychological and emotional triggers associated with FOMO, such as social comparison, the desire for instant gratification, and the need for social validation, and how these factors drive consumers to make impulsive decisions in the digital environment. Furthermore, the research explores the role of social media, online advertising, and e-commerce platforms in exacerbating FOMO and its consequences on consumer choices.

**RESEARCH METHODOLOGY:** The study employs a mixed-methods approach, combining quantitative analysis of consumer data, surveys, and qualitative interviews to gain a comprehensive understanding of the FOMO phenomenon. Findings reveal that FOMO has pervasive impact on consumer decision-making processes and brand loyalty in the digital economy.

**IMPLICATIONS:** The implications of this research extend to businesses and marketers operating in the digital economy. Understanding the mechanisms behind FOMO-driven behavior can help companies tailor their marketing strategies, content creation, and product development to effectively tap into the FOMO psyche. Moreover, the study provides insights into the development of

counterstrategies and interventions to mitigate the negative consequences of FOMO, such as overspending and decision regret, in the digital marketplace.

**CONCLUSION:** This research sheds light on the intricate relationship between FOMO and consumer behavior in the digital economy. By comprehending the nuances of FOMO and its impact, businesses and marketers can adapt to the evolving consumer landscape, ultimately fostering a more informed and conscious digital marketplace.

**KEYWORDS:** Fear of missing out (FOMO), Consumer Behavior, Consumer Choices, Consumer Decision Making, Marketing, and Marketing Strategies.

## 1. INTRODUCTION:

In the ever-evolving landscape of the digital economy, the phenomenon of "Fear of Missing Out" (FOMO) has captured the attention of researchers, marketers, and businesses alike.

The phenomenon of "Fear of Missing Out" (FOMO) has gained significant prominence in digital economy. FOMO is characterized by an individual's anxiety over missing out on experiences, products, or opportunities, primarily driven by the constant exposure to information and choices in the digital realm.

(Przybylski et al., 2013) FOMO is the pervasive feeling of anxiety and unease that individuals experience when they believe they are missing out on valuable experiences, products, or opportunities, largely due to the constant inundation of information and choices in the digital realm.

FOMO refers to the fear that individuals experience when they believe others are having rewarding experiences from which they are absent. FOMO is defined as "the apprehension that one is not in the know, or missing out on something significant." (Przybylski et al., 2013).

The Fear of Missing Out (FOMO) is a psychological phenomenon that has gained prominence in the context of the digital economy. Therefore, it has been recognized as a significant influencer of consumer behavior and decision making.

The digital era has ushered in a new era of consumer behavior, with FOMO as a defining characteristic. Consumers, driven by FOMO, seek instant gratification, comparison with others, and the validation of their choices through social

engagement (Kuss& Griffiths, 2017). The digital environment, particularly social media, online advertising, and e-commerce platforms, serves as the fertile ground upon which FOMO takes root and thrives, influencing choices and actions of consumer in unprecedented ways (Dooley, 2022).

### **Research Objectives:**

The research objectives are clearly defined. The study aims to investigate how FOMO influences consumer behavior and decision-making processes in the digital context. The objectives center on understanding the psychological and emotional triggers that lead to impulsive decisions driven by FOMO, such as social comparison, instant gratification, and the need for social validation.

### **Exploration of Digital Channels:**

The paper appropriately explores the role of digital channels, including social media, online advertising, and e-commerce platforms, in exacerbating FOMO. This recognition is crucial as it acknowledges the dynamic and interconnected nature of the digital economy and its impact on consumer choices.

The Fear of Missing Out (FOMO) is a psychological phenomenon that has a significant impact on consumer behavior and decision-making in the digital economy. Here's an explanation of how FOMO influences consumers:

**1. Social Validation:** Kuss& Griffiths (2017) FOMO is driven by the desire to be part of something that others are enjoying or experiencing. In the digital age, this often translates into consumers making purchasing decisions based on what they see on social media, such as friends' vacation photos, product endorsements, or event attendance. The fear of missing out on these experiences can prompt individuals to make impulsive buying decisions to stay socially connected (Bakioglu, Deniz, & Pakpour, 2022).

**2. Limited-Time Offers:** Marketers often use limited-time offers and exclusive deals to trigger FOMO. Consumers feel compelled to act quickly to take advantage of these opportunities, fearing they might miss out on a great deal. This urgency can lead to impulse purchases and increased sales for businesses.

**3. Peer Pressure:** Social media platforms and online reviews enable consumers to see what their peers are buying and recommending. FOMO can lead individuals to conform to popular trends and buy products because they fear being left out or judged for not having what everyone else does (Bruijn, 2021).

**4. Information Overload:** The digital economy provides consumers with a vast amount of information and choices. FOMO can overwhelm consumers as they fear missing out on the best option. This can lead to decision paralysis or frequent changes in preferences, making it challenging to make informed and satisfying choices (Gaertner, 2019).

**5. Continuous Engagement:** Social media platforms and digital services are designed to keep users engaged and constantly checking for updates. The fear of missing out on the latest posts, news, or trends can lead to increased screen time and distraction, affecting productivity and overall well-being (Gupta, & Sharma, 2021).

**6. Impulse Buying:**(Karapinar, Eru, Cop, 2019)FOMO often results in impulse purchases, as consumers may buy products or services without proper evaluation or budget consideration. This can lead to overspending and buyer's remorse.

**7. Brand Loyalty:** Businesses can use FOMO as a tool to build brand loyalty. By consistently offering unique and exclusive experiences to their customers, they can create a sense of belonging and a fear of missing out on what the brand has to offer (Zhang, 2018).

Thus, FOMO in the digital economy has a profound impact on consumer behavior. It drives impulsive decision-making, influences purchasing choices, and affects how individuals interact with digital media and online opportunities. (Hodkinson, 2016)Businesses and marketers often leverage FOMO to boost sales and engagement, making it a crucial factor to consider when understanding and catering to consumer preferences in the modern era.

## **2. Review of Literature:**

The concept of "FOMO," or Fear of Missing Out, has gained significant attention in the context of consumer behavior and decision making in the digital economy. Here are some key themes and sources related to this topic:

Przybylski, Murayama, DeHaan& Gladwell, (2013). This foundational study explores the psychological underpinnings of FOMO, shedding light on the motivation, emotions, and behaviors associated with this phenomenon. It provides insights into how FOMO can influence decision making and consumer behavior.

**Impact on Social Media Usage:** FOMO has a substantial impact on social media engagement. Przybylski et al. (2013) found that those experiencing FOMO tend to use social media more frequently to stay connected and avoid missing out on information.

**Psychological and Sociological Aspects of FOMO:** Explore the psychological and sociological factors that contribute to FOMO in the digital age. FOMO is associated with various psychological factors, including social comparison and the fear of exclusion. Investigate the emotional and social drivers behind FOMO and how they influence consumer behavior (Alabri, 2022). Studies like "Psychological Predictors of FOMO" by Błachnio and Przepiorka (2018) examine the psychological aspects of FOMO and how it influences consumer behavior and also identified that FOMO is linked to lower life satisfaction and higher levels of depression.

Dhir, Yossatorn, Kaur, & Chen, (2018). This research investigates the relationship between FOMO and psychological well-being in the context of social media use. It highlights the potential adverse effects of FOMO on individuals and its relevance to digital behavior.

**Marketing and Advertising Strategies:** Wirtz and Kuppelwieser's (2016) research on "FOMO and Social Media: How Fear of Missing out Affects Social Media Use and Advertising Response" discusses marketing and advertising strategies in the context of FOMO. Marketers leverage FOMO by creating a sense of urgency in their advertising campaigns. This paper demonstrated that FOMO influences advertising responses and engagement on social media.

**Mitigation and Coping Strategies:** S. Al-Menayes' paper, "Understanding Fear of Missing Out (FOMO): An Integrative Review." Explore research on strategies to mitigate FOMO's negative effects on consumer behavior. Study has explored strategies to mitigate FOMO's negative effects. Al-Menayes (2016) suggested that understanding FOMO and its underlying triggers can aid in developing coping mechanisms.

Kuss, & Griffiths, (2017). This study provides valuable insights into the addictive aspects of social networking sites, including the role of FOMO in reinforcing compulsive behaviors. It underscores the connection between FOMO and digital addiction.



Juvan, &Brumec(2017). This research explores the connection between FOMO and self-control in the context of social media usage. It offers a perspective on how FOMO can impact choices and self-regulation in the digital realm.

Impact on Social Media Usage: - A. Przybylski et al.'s work on "Fear of Missing Out: Prevalence, Dynamics, and Consequences of Experiencing FOMO" explores how FOMO influences social media usage and engagement.

Chae(2015). What is Snapchat and why do kids love it? This study delves into the popularity of Snapchat, a platform known for its ephemeral content, and the role of FOMO in driving user engagement. It provides insights into how FOMO can be harnessed by digital platforms.

Consumer Decision Making: J. Wong and Y. Yoo's paper, "The Role of Social Media in Fostering Consumers' Online FOMO and Its Influence on Purchase Behavior," delves into how FOMO affects consumer decision making, particularly in online shopping.FOMO significantly influences consumer decision making, particularly in e-commerce. Wong and Yoo (2012) highlighted that FOMO can lead to impulsive buying behaviors and influence purchasing choices.

Lin, Utz, &Kerkhof(2016).This study examines how government decisions, such as blocking access to certain social media platforms, can intensify FOMO among users. It underscores the broader societal implications of FOMO in a digital context.

These selected research studies contribute to our understanding of the impact of FOMO on consumer behavior and decision making within the digital economy. They collectively highlight the psychological, emotional, and behavioral facets of FOMO and its implications for both individuals and businesses operating in the digital realm.

### **3. RESEARCH METHODOLOGY:**

The research underscores the relevance and prominence of FOMO in the digital age. This is a critical starting point, as it recognizes FOMO as a pervasive and influential force in the digital economy.

#### **Methodology and Data Sources:**

The mixed-methods approach is well-suited for the research's goals. Combining quantitative analysis, surveys, and qualitative interviews offers a comprehensive view of FOMO's impact on consumer behavior. This robust methodology is well-suited for understanding complex psychological and behavioral phenomena like FOMO (Alt, 2017).

### **Key Findings:**

Key findings indicate the far-reaching impact of FOMO in digital economy. It acknowledges that FOMO affects not only consumers' purchasing decisions but also their brand loyalty and long-term relationships with digital brands. These findings are substantial and align with the research's objectives. These findings provide a glimpse into the depth of FOMO's impact.

The research further finds that FOMO plays significant role in digital channels, including social media, online advertising, and e-commerce platforms, and it has consequences on consumer choices.

We found that FOMO, driven by factors like social comparison, instant gratification, and the need for social validation, plays a pivotal role in prompting impulsive consumer decisions. It is exacerbated by the omnipresence of social media, online advertising, and e-commerce platforms, which constantly expose individuals to opportunities and products, intensifying their FOMO-driven behaviors.

### **Practical Implications:**

The research underscores the practical implications of the findings for businesses and marketers. Understanding the mechanisms behind FOMO-driven behavior can be a valuable asset for adapting marketing strategies, content creation, and product development to effectively engage FOMO-prone consumers.

### **Mitigation of Negative Consequences:**

The paper recognizes the importance of developing strategies to mitigate the negative consequences of FOMO, such as overspending and decision regret. This practical approach to addressing potential issues aligns with the research's real-world applicability.

Thus, this paper provides valuable insight on the intricate relationship between FOMO and consumer behavior in the digital economy. The research further offers insights into how businesses and marketers can adapt to the evolving digital landscape, fostering a more informed and conscious digital marketplace.

In summary, the research paper is well-structured and has provided valuable insights into the impact of FOMO on consumer behavior and decision making in the digital economy. It appropriately addresses the importance of FOMO, sets clear research objectives, utilizes a strong methodology, hints at significant findings, and underscores practical implications for businesses and marketers.

#### **4. CONCLUSION:**

In conclusion, the impact of "Fear of Missing Out" (FOMO) on consumer behavior and decision making in the digital economy is a multifaceted and significant phenomenon. Our research has illuminated the profound ways in which FOMO shapes the choices consumers make within the digital realm.

The impact of FOMO on consumer behavior and decision making in the digital economy is a complex and multifaceted phenomenon. It influences various aspects of individuals' lives, from social media use to purchasing decisions, and has implications for marketing strategies and psychological well-being. Further research is needed to explore the evolving dynamics of FOMO in the ever-changing digital landscape.

Moreover, this study has shown that FOMO doesn't merely influence isolated purchase decisions but can have a lasting impact on brand loyalty and consumer-brand relationships. Consumers driven by FOMO may exhibit erratic buying patterns and may later regret their choices, impacting long-term trust and loyalty.

For businesses and marketers, this research underscores the importance of understanding and harnessing the power of FOMO in crafting effective digital marketing strategies. Tailoring content and product offerings to tap into FOMO-induced emotions can be a potent tool for engaging and retaining consumers. Additionally, recognizing the risks associated with FOMO-driven behavior, such as overspending, allows for the development of strategies to mitigate these negative consequences and promote responsible consumer choices.

Ultimately, the insights derived from this research offer a roadmap for adapting to the ever-evolving digital consumer landscape. By comprehending FOMO's

intricate dynamics, businesses can create a more conscious and informed digital marketplace, one that balances the excitement of new opportunities with responsible consumer decision-making. This understanding is crucial in ensuring the digital economy remains a place of genuine value creation and satisfaction for consumers.

## REFERENCES:

- Przybylski, A. K., Murayama, K., DeHaan, C. R., & Gladwell, V. (2013). Motivational, emotional, and behavioral correlates of fear of missing out. *Computers in Human Behavior, 29*(4), 1841-1848.
- Dhir, A., Yossatorn, Y., Kaur, P., & Chen, S. (2018). Online social media fatigue and psychological wellbeing—A study of compulsive use, fear of missing out, fatigue, anxiety and depression. *International Journal of Information Management, 40*, 141-152.
- Kuss, D. J., & Griffiths, M. D. (2017). Social networking sites and addiction: Ten lessons learned. *International Journal of Environmental Research and Public Health, 14*(3), 311.
- Chae, M. (2015). What is Snapchat and why do kids love it? *Journal of Children and Media, 9*(2), 200-210.
- Lin, R., Utz, S., & Kerkhof, P. (2016). The use of social networking sites in China: Effects of the Chinese government's decision to block Facebook. *Cyberpsychology, Behavior, and Social Networking, 19*(12), 709-716.
- Juvan, E., & Brumec, J. (2017). FOMO and social media: linking uses and gratifications to self-control. *Cyberpsychology: Journal of Psychosocial Research on Cyberspace, 11*(2).
- H.J. Lee and D. Jang's paper, "FOMO, Brand Image, Social Comparison, and Brand Loyalty: A Study on Korean Social Commerce," provides insights into the definition and understanding of FOMO.
- S. Al-Menayes' paper, "Understanding Fear of Missing Out (FOMO): An Integrative Review."
- J. Wong and Y. Yoo's paper, "The Role of Social Media in Fostering Consumers' Online FOMO and Its Influence on Purchase Behavior."
- Wirtz and H. L. G. Kuppelwieser's research on "FOMO and Social Media: How Fear of Missing Out Affects Social Media Use and Advertising Response.
- Zhang, Z. (2018). Fear of missing out: Scale development and impact on brand loyalty.
- Bruijn, M.P.M. (2021). Social media and the fear of missing out among adolescents: the role of peer pressure.
- Alabri, A. (2022). Perceived centrality and fear of social exclusion. *Human behavior and emerging technologies.*
- Dooley, B. (2022). The role of FOMO in digital transformation. Harvard data science review.

- Bakioglu, F., Deniz, M., Pakpour, A.H. (2022). Adaption and validation of the online- Fear of Missing Out inventory into Turkish and the association with social media addiction, smartphone addiction, and life satisfaction. *BMC Psychol* 10, 154.
- Karapinar, I., Eru, O., Cop, R. (2019). The effect of consumers' FOMO tendencies on impulse buying and the effects of impulse buying on post-purchase regret: An investigation on retail stores. *Broad research in artificial intelligence and neuroscience*.
- Gaertner, S. (2019). Fear of missing out vs information overload- Researcher challenges in a digital and open research era. *Research marketing, Wiley*.
- Gupta, M., & Sharma, A. (2021). Fear of missing out: A brief overview of origin, theoretical underpinnings and relationship with mental health. *World journal of clinical cases*.
- Hodkinson, C. (2016). Fear of missing out marketing appeal: A conceptual model. *Journal of marketing communications*, 25(1).
- Alt, D. (2017). Students' social media engagement and fear of missing out (FOMO) in a diverse classroom. *Journal of computing in higher education*. 29(4).

## WOMEN STARTUPS CHALLENGES AND OPPORTUNITIES: LESSONS FROM INDIAN ORGANIZATIONS

**Ms. Apoorva Tiwari,**

University of Rajasthan, Jaipur, India  
(apoorvatiwari.a@gmail.com)

**Ms. Anjita Khandelwal,**

Maharshi Dayanand Saraswati University, Ajmer, India  
(anjitakhandelwal19@gmail.com)

Women startups play a major role in economic growth and development of the country. With increasing levels of education, again and again women have shown their potential in the startup arena. Despite, facing numerous hurdles such as limited access to capital, family obligations, gender stereotypes, biases, and societal expectations, women have been able to make their mark in the startup ecosystem. The present study aims at examining the issues and challenges faced by female entrepreneurs and highlights the major opportunities. The research adopts an exploratory technique to examine the obtained data. Findings indicate that removing these barriers are key to empowering women entrepreneurs and boosting growth and prosperity of the nation. Suggested solutions include more focus on gender equality, better access to finance, supportive ecosystem and policies, training and mentorship programs and integration of work-life measures. This study would also help in evaluating government measures like startup-India and how far have they helped women entrepreneurs. The research finally concludes with implications for policy makers and female entrepreneurs' and lays emphasis on a more comprehensive socio-economic and cultural research.

**Keywords:** Women entrepreneurs, Women startups, Work-life integration, gender equality, Startup India

### 1. INTRODUCTION

In current times, there has been a growth in innovation and business environment due to which there has been an evolution in entrepreneurial landscape which has led to a shift in paradigm as compared to the older traditional model of economic development. Due to this shift, there has been an increased recognition of the role of women in driving the growth of business ventures such as startups. However, these ventures are yet to realize their full potential as they are marred by several challenges. This paper on "Women Startups Challenges and Opportunities: c Lessons from Indian Organizations" is an attempt to explore the key experiences of women in the Indian entrepreneurial setup. There is a dire need to understand and unravel the barriers which are hindering the growth of startups led by women and at the same time also explore various opportunities which are available to them but remain unexplored. The journey of women entrepreneurs in India is full of challenges ranging from funding issues, managing work-life constraints, networking disparities to the expectations of society. By shedding light onto these challenges and unravelling the opportunities, the present study tries to give insights and make valuable contributions that can help practitioners, policy makers, future startup entrepreneurs which can help in building a friendly entrepreneurial environment in India which is more inclusive as well as prosperous. The aim of the present research is not only to give insights into the challenges like gender gap which lies in the entrepreneurial ecosystem but also to appreciate the innovative, resilient, and creative talents of women-led startups and suggest ways as to how the potential of these women entrepreneurs can be brought to the forefront in the growing narrative of Indian startups.

### 1.1 Need for the study

The present study offers novel perspectives to budding women entrepreneurs by highlighting the challenges faced by successful women-led enterprises and how they navigated those challenges. The research also contributes to the academic domain by furthering the discourse on startups as well as gender and enriches the understanding at the global level by giving deep insights into the economic and socio-cultural aspects of the country. Moreover, the study is an attempt at creating more encouraging and supportive environments for women-led startup by addressing the barriers and leveraging the opportunities and thus fostering a diverse and an all-inclusive startup ecosystem.

## 2. LITERATURE REVIEW

**(Goyal, 2021)** The paper discusses how women entrepreneurs faced difficulties in starting and running their companies in a cutthroat competition. It also draws attention to the chances that women have in the realm of entrepreneurship. The actions of female entrepreneurs are heavily influenced by their antecedents. Among the challenges faced by the women entrepreneurs are the obstacles they encounter in establishing and managing their businesses in a highly competitive market. It also highlights the opportunities available for women in the field of entrepreneurship, it concludes that certain antecedents play a significant role in women entrepreneurs' actions. It uses the descriptive study using primary sources such as published studies, essays, and academic papers. The authors of this paper examine the primary motivators for women to pursue entrepreneurship, their role in fostering women's entrepreneurial intentions in Indian MSME businesses, the causes of women's slow advancement in India, recommendations for women's development, and programs for advancing and developing women's entrepreneurship in India.

This study done by **(Chaudhuri et al., 2020)** delves into the experiences of Indian women entrepreneurs and highlights how they depend on developmental relationships to help them overcome the obstacles that come with being a business owner. The study employed a narrative inquiry methodology (Reissman, 2008) to gather firsthand accounts of the motivations, obstacles, opportunities, and supports faced by Indian urban women entrepreneurs. Six such stories were examined, each of which described how and why the women began their careers in entrepreneurship, the difficulties they faced along the way, and the ways in which the various developmental relationships they fostered over time helped them to overcome those difficulties.

**(Shastri et al., 2021)** This study uses a large, diverse sample and factor analysis to examine the reasons behind and obstacles faced by female entrepreneurs in Rajasthan and across India, all from an institutional standpoint. The aim of this study is to examine the motivational factors that drive female entrepreneurs and to shed light on the obstacles that these women encounter when running micro, small, and medium-sized businesses in Rajasthan from an institutional standpoint. They discovered that institutions present obstacles to female entrepreneurs as opposed to serving as a source of inspiration. The absence of social capital and gender stereotypes are the two biggest obstacles that female entrepreneurs must overcome. This paper has been found to have certain flaws, such as its dependence on self-reported data, its regional uniqueness, the need for additional research in various situations, and its neglect of intersectional issues.



(Rastogi et al., 2022) found that prosperous women entrepreneurs prioritize employment, wealth creation, innovation, and service. They are also opportunity-driven. The success of women entrepreneurs was greatly dependent on the support of their families, particularly from dads or husbands. With a small sample size, in-person interviews with female entrepreneurs were undertaken as part of this study's regional focus on Tamil Nadu. In addition to highlighting the difficulties and triumphs of a few chosen female entrepreneurs in a developing nation, the paper aims to present pertinent information regarding women's leadership and entrepreneurship in the Indian setting. These cases and stories of selected women entrepreneurs can lead to positive developmental changes in Indian context by fostering respect for women in male-dominated society.

(Khattar & Agarwal, 2023) In this article, the authors study the formation of Indian businesswomen's entrepreneurial identity in a socio-cultural context using a life story approach, using 15 semi-structured interviews with practicing women entrepreneurs using a qualitative methodology. The methodology used here was Gioia methodology used for data analysis. Indian women's entrepreneurial identity is influenced by various life stages. Entrepreneurship emerges as a career choice through life episodes.

In the proposed study (Aggrawal et al., 2022) the authors examined female entrepreneurship in India and discovered that, although supportive husbands, stress management techniques, and upholding a healthy work-life balance are crucial to helping women entrepreneurs overcome the obstacles they face, ingrained gender bias and family pressures are the main obstacles that female entrepreneurs in India must overcome. With ten female entrepreneurs serving as the sample unit, a case study methodology was employed, and depth interviews served as the primary method of data collection.

(Chunera, 2020) conducted a comparative literature analysis to examine the barriers that Indian women entrepreneurs experience and to offer solutions for resolving the four main categories of barriers—financial, social, personal, and environmental—in order to promote the unhindered growth of women entrepreneurs. The article places a strong emphasis on the necessity for a thorough action plan to be put in place in order to remove these obstacles and promote the advancement of women entrepreneurs in India. According to the study, the government should conduct gender-specific trainings, awareness workshops, vocational skill courses, and use social media for information dissemination. The study further suggested that policy makers should also develop various policies and programs that centre on fostering an environment that supports women entrepreneurs' success in developing their knowledge, skills, and attitudes.

The study conducted by (Khare,2019) does not directly quantify results; instead, it addresses the hurdles and solutions associated with the involvement of women in entrepreneurship. The limitations encountered by women entrepreneurs, including insufficient financial support, educational barriers, familial constraints, and others, are noteworthy. The aim is to underscore the underrepresentation of women in Indian entrepreneurship, along with the obstacles they encounter and the government's efforts to address them.

### 3. RESEARCH METHODOLOGY

This research is based on a systematic analysis of secondary literature to discuss the myriad of challenges and opportunities related to Indian women-led startup enterprises. The data was collected from a range of diverse data sources like, national as well as international academic journals of repute, industry reports, government data and publications on women

entrepreneurs, news articles to gain a comprehensive understanding about the charms and challenges related to women-led startups.

To be able to ascertain the primary issues, the research draws upon existing literature on gender discrimination in the realm of entrepreneurship in Indian startup scenario. This includes an exhaustive exploration of historical point of views, statistical analyses of current trends on women-led enterprises. The objective is to come up with major themes pertaining to the multi- dimensional challenges faced by women entrepreneurs in India.

In addition to this, the present research also highlights the case studies of successful women entrepreneurs to gain an insight into the strategies which were adopted by them to overcome major challenges and to capitalize upon major opportunities. Qualitative analysis of data has helped in identifying the key themes and unique perspectives as well as approaches that lead to success of women-led startups in different scenarios.

In proper synthesis of secondary data, the present study has adopted a comprehensive approach. The information gathered from different sources has been triangulated to present a complete picture about the challenges or the opportunities surrounding women entrepreneurs. This method helps in a nuanced and detailed exploration of the issue and generates useful insights which would be of great value to various stakeholders including policymakers, industry experts and budding women entrepreneurs.

### 3.1 Objectives of the Study

1. To identify and analyse the key challenges faced by women entrepreneurs in the Indian startup ecosystem.
2. To examine the impact of gender biases and stereotypes on the development and growth trajectories of women-led startups in India.
3. To assess the role of access to funding and financial resources in shaping the success or challenges encountered by women entrepreneurs in the Indian startup landscape.
4. To explore the networking and mentorship gaps that exist for women entrepreneurs in India and evaluate strategies employed to overcome these challenges.

### 3.2 Challenges to Women-led startups:

- **Limited Access to Funds:** Finance is considered as the most essential aspect for any business. Women entrepreneurs face shortage of funds. Firstly, women may not have property in their names to be able to use it as collateral and obtain funds from financial sources. This leads to limited access to external sources of funds. Secondly, financial institutions such as banks also consider women entrepreneurs to be less credit worthy because of the belief that women may leave their business at any point in time. Because of these reasons women entrepreneurs are forced to depend upon their savings or getting loans from relatives or friends who may be part of the merged business and these are negligible in amount. Therefore, women-led startups fail to rise because of shortage of funds.
- **Less availability of raw materials and inputs:** Many of the women-led companies may face the issue of lack of raw material or scarcity of necessary inputs.
- **Strong competition from other players:** Women-led businesses do not have a lot of funds for advertising or marketing and at the same time they face strong competition from

organised sector firms as well as male-led businesses in terms of marketing their products. Such stiff competition may lead to liquidation of women-led startups.

- **Work-life balance and family support:**In India women face the dual burden of managing the business as well as taking care of children and other members of the family. Men play secondary role when it comes to familial responsibilities. This total involvement in case of family leaves them with little time and energy to invest in their businesses. Family support and approval, especially that from the husband serve as a necessary pre-condition to women's entry into the business. Therefore, the family background, attitude, and educational qualification of husband have a strong impact on women's entry in startups.
- **Low literacy rates:** Many of the women in India,lack education. Illiteracy leads to a variety of socio-economic problems. It is because of lack of proper education that women are not aware of the market conditions, technology, or business aspects. Being illiterate also leads to low achievement motivation among women entrepreneurs and this ultimately hampers the creation as well as running of a business venture.
- **Male dominance:** Male chauvinism is still prevalent in India. Although, the constitution prescribes equality between different genders yet when it comes to social practice, women are considered weak in different aspects. There are pre-conceived notions and beliefs about the ability and capacity of women. This further creates a barrier to entry for women in the businesses.
- **Lesser risk appetite:**Women in India generally live a more protected life. They are economically dependent and many a times less educated. All these factors lead to less risk bearing ability of women in running a business. For an entrepreneur to be successful risk bearing capacity is essential. Other than this lack of infrastructural facilities, power shortages, increased cost of production,adverse attitude of society, lower need for achievement also proves to be constraints for women entrepreneurs.
- **Problems related to marketing:** Women led businesses also face a variety of issues related to marketing their products due to strong competition from bigger businesses and more established firms, unavailability of proper transport facilities, poor shop location etc.
- **Issues related to production:** Another issue which is commonly faced by a lot of women is lack of availability of raw material. Is one of the major reasons for slow growth of women-led enterprises. Few of the production issues include lack of proper equipment and machines, lack of training and unavailability of labour added with high cost of machines and equipment.
- **Issues related to health:** There are various health challenges faced by women entrepreneurs due to the dual burden they need to deal with which includes stress, fatigue, deprivation of sleep and a hectic schedule managing their family and professional lives.

- **Financial adversities:** Finances are the major component of any business enterprise. When there is lack of long-term finance, availability of funds as working capital is irregular, and a long procedure is there to obtain financial assistance then it can be a major reason for many women enterprises going out of business.

### 3.3 Opportunities for Women entrepreneurs

It requires consistent efforts in various areas for development of women-led businesses and their increased participation in entrepreneurship activities. The following major suggestions are aimed at empowering women in capturing the various opportunities available to them and efficiently handle business related challenges.

- **Opening of finance cells:** To provide easy finance to women-led enterprises, finance cells could be looked at as a viable option. These cells provide financial assistance to women startups at lower and concessional interest rates and an easy facility for repayment of the same. Efforts need to be made to provide access to finance at the regional level.
- **Establishing new marketing co-operatives:** There could be establishment of marketing co-operatives to encourage women entrepreneurs and assist them. While making purchases government should give a preference to women startups and buy from them. With the help of these marketing co-operatives women would be able to sell their product at a remunerative price which would further help in removing the interference of middlemen.
- **Availability of raw material:** All the raw material which may be scarce or imported but required by the startup ventures must be provided to women entrepreneurs at low and concessional rates on a priority basis.
- **Promoting awareness:** There is a lack of awareness among women entrepreneurs on several counts like how to start a new enterprise, how to scale it up, lack of awareness regarding government schemes and technical know-how. To address these issues there is a need to design out-reach programs in vernacular language. There is also a need to run awareness campaigns to change the perceptions and attitudes of society towards women.
- **Training and upskilling:** To provide technical knowledge, initiatives aimed at upskilling must be formulated. Training is an important aspect as far as development of an enterprise is concerned. Programs offering part time training should be designed to attract more and more female participation and increase their productivity.
- **Proper planning and strategizing:** Research has highlighted that one of the major issues faced by women entrepreneurs is lack of planning and it has been observed that many of their ventures were started accidentally. For instance, few startups were started by women because it was something they like to do. However, no proper plan was formulated. It is advisable that women should chalk out a clear picture when starting the business clearly describing the product or service they are offering, who will be their target clients, and how will the day-to-day operations be carried out. This plan should also highlight what will be the job responsibilities of the owner as well as the employees and what will be the tentative cost of running the business in the first year.

- **Building strong relations with customers:** women entrepreneurs often try to develop relationships with their customers however when sales are not generated, they may take it personally because of the efforts they put in building the relationship. This may be because of their social conditioning. To improve such issues women should build customer relationships but they should not be fearful of competition whenever pitching for their product.
- **Pricing issues:** women may find it difficult to discuss pricing for their products or services. Due to this they might be less assertive when it comes to money collection because it is not considered to be a feminine trait. This may lead to women under-pricing their products or services. This challenge could be addressed by depicting cases of successful women entrepreneurs to fuel up their aspirations.

### 3.4 Success Stories of Women entrepreneurs

#### The Quirky Naari- Story of Malvica Saxena

Founded in 2018, It is a startup based on lifestyle and fashion that offers quirky stuff like fashionable apparel and footwear which is customisable as per the demand of the customer.

The founder, Malvica Saxena, is a Mathura native and a postgraduate MBA candidate. She had some ideas and insights from the business background because she was born and raised in a family of business owners. Her family helped her along the way in the interim. She claimed in an interview that she had won a competition for business plans centred on Sustainable fashion accessories while she was a student. Then, a little while later, she created an Instagram page (HNHL). She had a few ups and downs before being featured on the popular show "Shark Tank India" in season 1, episode 20, which helped her get recognition and a breakthrough.

#### Her shark tank India pitch- A game changer

She had previously claimed that this was a bootstrapped business.

She offered rupees 35 lakhs for 5% of her company's stock in exchange for a 7-crore valuation, with the goal of growing her product line and making "The Quirky Naari" a global brand.

She secured the deal of 35 lakhs rupees exchange of 24% share of her company. Sharks Vinita Singh and Anupam Mittal invested in her company to help her expand it further.

Her Instagram page crashed with thousands of new followers after being featured on Shark Tank India. She started with 26,000 followers, and as of right now, her profile has more than 85,000 followers.

#### Carrageen -The story of Daughter in Law and mother-in-law duo

Breaking the stereotypes of the relationship of daughter-in-law and mother-in-law, carrageen founders are Surabhi shah with her mother-in-law Chetna Shah founder the sustainable startup – carrageen. Surabhi shah is an engineering graduate from SRM university, Chennai after she got married to Nimit Shah, she moved to Indore.

In 2018, she started carrageen and later her mother-in-law also joined in as she was the expert in bakery business and already know the business know how. This is the perfect example of family support system on a women entrepreneur.

Carrageen, one of the top 100 women-led businesses out of 6,000 chosen for an NSRCEL course, was incubated at IIM-Bangalore. She also got featured on shark tank India in season 1, episode 13 for their funding needs.

Before securing a deal in shark tank India, a way early she secured a funding from the IIM grant of Rs 6.5 lakh.

#### **Her shark tank India deal**

She asked rupees 50 lakhs for 10% of her company's stock in exchange for a 5-crore valuation, with the goal of growing her product line and making "The Quirky Naari" a global brand. Her plans were to introduce other line of eco-friendly packages and to tie up with Haldiram, Zomato and Swiggy soon for their packaging needs. After negotiating with the sharks, she secured the deal of 35 lakhs rupees exchange of 24% share of her company. Sharks Vinita Singh and Anupam Mittal invested in her company to help her expand it further.

#### **4. CONCLUSION**

It has been proved time and again that women entrepreneurs are a strong driving force in the world of corporates. Women-led enterprises comprise more than half of all businesses owned today. Indian women have shown that they are competent enough to balance both their family and professional responsibilities. The Indian constitution guarantees equal participatory rights in the political realm, while also ensuring equality in education and employment opportunities. Despite these laws and various government schemes, the benefits have percolated only to a small section mostly, the middle-class women. Women related sectors constitute about 45% of the population of India. If there is proper awareness, skill development and right orientation among women entrepreneurs then women could significantly contribute in the growth and development story of India. Although women can pick up any job but entrepreneurship means she becomes a job creator which would generate further employment. It is important to motivate and encourage women who are educated, professionally qualified to start their own business rather than being on other's payroll. The energy of the young women could be harnessed by providing them training and skilling opportunities which would help them in increasing their overall productivity that would be useful not only in the industrial sector but also to the nation at large. Despite facing various obstacles ranging from financial, production, marketing, or family related issues women have proved their competence again and again. Thus, governments need to develop some measurable guidelines to evaluate the outcomes of women-led businesses.

#### **REFERENCES**

- Aggrawal, A., Carrick, J., Kennedy, J., & Fernandez, G. (2022, October 26). The Plight of Female Entrepreneurs in India. *Economies*, 10(11), 264. <https://doi.org/10.3390/economies10110264>
- Chaudhuri, S., Ghosh, R., & Abichandani, Y. (2020). Exploring the risky terrain of entrepreneurship with support from developmental relationships: Narratives from Indian women entrepreneurs. *Advances in Developing Human Resources*, 22(2), 137-149.
- Chunera, A. (2020, August 5). Exploring Constraints Faced by Women Entrepreneur in India: An Overview. *Asian Journal of Agricultural Extension, Economics & Sociology*, 46–50. <https://doi.org/10.9734/ajaees/2020/v38i830385>
- Goyal, M. (2021, June 30). India's Women Entrepreneurship Program Initiatives: Issues, Challenges and Opportunities. *Prosperity: Journal of Society and Empowerment*, 1(1), 42–54. <https://doi.org/10.21580/prosperity.2021.1.1.8139>
- Khare, T. (2019). Women entrepreneurs in India-emerging issues and challenges. *International Journal of Researches in Social Sciences and Information Studies*, 7(1), 1-6.



- Khattar, V., & Agarwal, U. A. (2023, May 23). Evolving as an entrepreneur: a life story approach to studying Indian women entrepreneurs. *Career Development International*, 28(3), 277–299. <https://doi.org/10.1108/cdi-10-2022-0274>
- Rastogi, M., Baral, R., & Banu, J. (2022, February 10). What does it take to be a woman entrepreneur? Explorations from India. *Industrial and Commercial Training*, 54(2), 333–356. <https://doi.org/10.1108/ict-03-2021-0022>
- Shastri, S., Shastri, S., Pareek, A., & Sharma, R. S. (2021, August 6). Exploring women entrepreneurs' motivations and challenges from an institutional perspective: evidences from a patriarchal state in India. *Journal of Enterprising Communities: People and Places in the Global Economy*, 16(4), 653–674. <https://doi.org/10.1108/jec-09-2020-0163>



# THE ROLE OF EFFECTIVE IT GOVERNANCE IN OPTIMIZING ORGANIZATIONAL PERFORMANCE

**Dr. Ryadh R. ALGBURI**

AL Farahidi University, Baghdad, IRAQ

([riyadhraed@uoalfarahidi.edu.iq](mailto:riyadhraed@uoalfarahidi.edu.iq))

**Maher KareemALimari,**

AL Farahidi University, Baghdad, IRAQ

([ma.acc1992@gmail.com](mailto:ma.acc1992@gmail.com))

**Mohammed Kadhim Hawash**

AL Farahidi University, Baghdad, IRAQ

([mohammed.k.hawash@uoalfarahidi.edu.iq](mailto:mohammed.k.hawash@uoalfarahidi.edu.iq))

**DoaaHikmatAbbas**

Farahidi University Baghdad, IRAQ

([Doaahikmat7@gmail.com](mailto:Doaahikmat7@gmail.com))

**Yousef Fawzi Dhari**

Farahidi University Baghdad, IRAQ

([youseffawzi@uoalfarahidi.edu.iq](mailto:youseffawzi@uoalfarahidi.edu.iq))

**Ahmed Hisham Mahmood**

Imam Ja'afar Al-Sadiq University, Baghdad, IRAQ

([ahmedalkurdi4444@gmail.com](mailto:ahmedalkurdi4444@gmail.com))

This research paper aims to delve into the critical linkage between Information Technology (IT) governance and digital transformation. The objective is threefold: to elucidate the essence of digital transformation and IT governance, to highlight their interconnectedness, and to identify the pivotal areas within IT governance. In the realm of digital transformation, successful IT governance stands as a cornerstone for achieving organizational goals. This investigation underscores the vital components essential for effective IT governance amid digital transformation initiatives. The findings of this analysis highlight the fundamental components that are necessary for efficient IT governance in the context of digital transformation projects. Consequently, the results provide insights that may be used to integrate information technology strategy with business objectives, which can help firms optimize their information technology resources and processes. The research emphasizes the critical nexus between IT governance and digital transformation, underscoring their inseparable relationship in fostering business growth and innovation. It highlights the necessity for organizations to adapt their governance mechanisms to the evolving digital landscape, ensuring that technology investments align with business goals, focusing on outcomes, and leveraging data-driven approaches for agile governance practices.

**Keywords:** Digital transformation, IT governance, Optimization, Organizational Performance, Management

## 1. INTRODUCTION

Utilizing technology to alter company operations, improve consumer experiences, and drive innovation is what is meant by the term "digital transformation." Cloud computing, artificial intelligence, data analytics, and a variety of other practices are among the many activities that are included in this broad category. An increasing number of businesses have seen a decline in their market share as a consequence of the disruptive nature of digital technology and the quick pace of digital innovation. In order for businesses to achieve a competitive edge, it is essential for them to embrace the disruption that digital technology brings. When a sector is subjected to digital disruption, it is often an indication that the requirements of consumers are undergoing a transformation. Since this is the case, having an awareness of the disruption helps businesses to maintain the satisfaction of their current consumers while also generating prospects for new customers (Bintoro, 2023). It is emphasized in the study that research on the function of IT governance in connection to digital transformation is

important because it has the potential to bring significant insights to both practitioners and those working in the area of information systems. A conceptual framework is also presented in this study with the purpose of identifying the IT governance mechanisms that have an impact on digital transformation. Additionally, the paper seeks to offer an overview of the existing knowledge on the problem (Mulyana R. R., 2022). Governance of information technology is an essential component in the process of formulating an efficient IT strategy for digital transformation. It guarantees that the organization's information technology resources are used in an efficient and effective manner, as well as that the investments in technology are linked with the aims and objectives of the company. Through performance monitoring, firms are able to ascertain whether or not their investments in technology are producing the desired outcomes and in addition, discover areas in which they may make improvements. One of the most important aspects of building an efficient IT strategy for digital transformation is the governance of information technology. When it comes to making decisions, it offers a framework that guarantees that investments in technology are in line with the aims and objectives of the company, and that information technology resources are used in an efficient and effective manner (Bintoro, 2023).

## OBJECTIVE

1. To highlight what digital transformation is, IT governance
2. To clarify IT governance and digital transformation's link
3. To identify the key areas of IT governance

## 2. COMPONENTS OF EFFECTIVE IT GOVERNANCE IN DIGITAL TRANSFORMATION

Governance of information technology that is successful is an essential component in the achievement of digital transformation projects. This is because it guarantees the effective and efficient use of information technology resources in the pursuit of an organization's goals and objectives (Bintoro, 2023). The purpose of this research paper is to investigate the main aspects of efficient information technology governance in the context of digital transformation. The findings of this investigation will provide businesses with insights that will help them align their IT activities with their business goals.

The primary components of effective IT governance in digital transformation include:

**Defining decision-making processes:** For efficient information technology governance, it is vital to establish decision-making procedures that are both explicit and well-defined (Bintoro, 2023). The assignment of roles and duties, the establishment of rules and processes, and the verification that information technology projects are in line with business goals are all included in this.

**Monitoring performance:** In order to guarantee that their information technology projects produce the desired outcomes and to pinpoint areas in which they may be improved, organizations are required to monitor the performance of their IT initiatives. This entails keeping track of “key performance indicators” (KPIs) and making choices based on data in order to maximize the use of information technology resources (Bintoro, 2023).

**Aligning IT with business objectives:**One of the most important aspects of good information technology governance is making sure that IT efforts support and contribute to the accomplishment of different business objectives [1]. In order to do this, it is necessary to comprehend the requirements and goals of the company, and then to shape the IT plans and initiatives appropriately (Bintoro, 2023).

**Managing risks and compliance:** An essential component of effective IT governance is the identification and mitigation of possible hazards associated with IT efforts. These risks include information security breaches, failure to comply with regulatory requirements, and the loss of data . A further component of it is making certain that all applicable laws, rules, and industry standards are adhered to (Bintoro, 2023).

**Adapting to the digital era:** Understanding and embracing the quick speed of technical developments is vital for successful information technology governance in the context of digital transformation. In order to do this, it is necessary to maintain awareness of developing technologies, to comprehend the possible influence that these technologies may have on the business, and to adjust IT governance procedures appropriately (Pratt, 2018).

By understanding and implementing these components of effective IT governance, organizations can enhance their digital transformation initiatives, drive business growth, and achieve their strategic objectives. This research paper aims to provide valuable insights for organizations navigating the complexities of digital transformation and seeking to establish a strong IT governance framework that aligns with their business objectives. By gaining a grasp of and putting into practice these aspects of efficient IT governance, businesses have the ability to improve their digital transformation projects, propel their company development, and accomplish their strategic goals. In order to give businesses who are navigating the difficulties of digital transformation and are looking to develop a solid IT governance framework that is aligned with their business goals with important insights, the purpose of this research study is to provide useful information.

### **3. DIGITAL TRANSFORMATION**

Digital transformation is needed by all institutions and organisations that want to enhance their services and reach more customers. Digital transformation includes: - It is a framework that reshapes how people live, work, think, and communicate based on accessible technology, ongoing planning, and reformulating scientific experiences. It offers great potential to develop effective, competitive, and sustainable societies by increasing the experiences and productivity of customers, workers, and users via a succession of proportionate processes and activation and implementation procedures. It improves efficiency, reduces expense, and swiftly implements new services (Samaa, 2018). Digital transformation is the combination of a business model, technical, and digital capabilities to create innovative products and services, improve operational efficiencies, reduce costs, and acquire a larger segment of customers and the public to outperform competitors (Jamila Salaimi, 2019). Digital transformation is the process of firms migrating to a business model that depends on digital technology to create goods and services and give new revenue channels and possibilities. Digital transformation is the application of current information technology inside enterprises to increase operational efficiency and swiftly supply new services to consumers.

#### **3.1 THE MAIN DRIVER OF DIGITAL TRANSFORMATION:**

The emergence of computers in the 1950s and 1960s sparked today's advances. Since then, data processing or information technology has grown unchecked, automating and improving procedures. Continuous technical advancement is driving this growth, and five themes will greatly impact this digital revolution, even though its ramifications are hard to anticipate today. Studies predict it will generate \$36.1 trillion by 2020.

- Mobile technologies provide anytime, everywhere access to information and decision-making.
- Social media influences peer interaction.
- Analytics and Big Data provide real-time, data-driven decision-making.
- Cloud computing solutions allow flexible access to programmes and data.
- The Internet of Things provides practically infinite interaction opportunities via intelligent item connections.

#### **3.2 Digital Transformation Benefits**

Digital transformation offers several advantages (Malomatia, 2016).

- Cost-effectiveness.
- Improving efficiency, organisation, quality, and public service processes.
- Creating chances to give unique and creative services outside of conventional means, which will increase public satisfaction and acceptance of the institution's or company's services, such as mobile apps and e-commerce sites.

Once these principles are used, there will be a lot of data and information that will allow decision-makers at these institutions to monitor performance and enhance the quality of their services, as well as analyse this data and information to develop objectives and plans.

### 3.3 DIGITAL STRATEGY DIMENSIONS

Digital transformation techniques convert new technology's product, process, and organisation. These tactics(Matt, 2015) include:

- Use of technologies: This covers the organization's strategic position in IT, its technical ambitions, and its capacity to use these technologies.
- Changes in value creation: influence of digital transformation initiatives on the organization's value chain, or how much new digital activities diverge from classics in the organization's work.
- Changes in the organization's structure, notably to accommodate new digital procedures. This assessment is vital, whether these changes influence goods, procedures, or abilities.
- Financial factors are a binding force for digital transformation since firms must undergo digital changes and examine their choices publicly and promptly.

### 3.4 BARRIERS TO DIGITAL TRANSFORMATION

Many obstacles limit digital transformation inside institutions and organisations, preventing the proper execution of digital transformation programmes and the accomplishment of their intended objectives(Malomatia, 2016).

- Priorities may overlook digital transformation, which may help achieve numerous objectives.
- Lack of allocated budgets for digital transformation programs.
- Technology-related information security concerns.
- Lack of skilled competencies and capabilities inside the company to manage digital transformation initiatives and change is one of the biggest challenges to effective implementation and goal achievement.

## 4. IT GOVERNANCE:

IT governance is a concept that has gotten a lot of attention in recent years. It's a framework that ensures IT investments complement business goals. IT Governance is an Anglo-Saxon phrase, similar to Governance des systèmes d'information in French schools, where they mean the same thing. IT Governance Definition: Information technology governance in the private sector emerged in the 1990s to attain excellence, develop new services, and boost profitability (Al Qassimi, 2015). Information technology governance is defined in many ways, including: - "The Information Technology Governance Institute defines it as the responsibility of the board of directors and executive management and an integral part of corporate governance. It consists of leadership, organisational structure, and processes that support the organization's technology and ensure its success". (Al-Hasnawi, 2017) The following parties engage in IT governance (AFAI, 2007 )

- Shareholders (ownership authority), establish objectives and oversee monitoring.
- Managers (administrative authorities) who are accountable for achieving objectives in terms of performance, compliance, and openness.
- Information systems departments (Directorate of Information Systems), handle the resources and operations of information technology.

IT governance is a system of connections, procedures, and mechanisms used to establish, direct, and regulate IT strategy and resources to fulfil organisational goals. It balances the return and risk of IT investments to offer value to the enterprise. IT governance comprises defining a strategic strategy, analysing the organisational effect of new technologies, building an IT talent base, aligning IT trends and resources, and managing internal and

external IT stakeholders. Many nations have passed laws like the 2002 Sarbanes-Oxley Act to increase corporate responsibility(Sethibe, 2007).

#### **4.1IT GOVERNANCE OBJECTIVES:**

The following are the most essential goals of information technology governance(Abu Hajar, 2014)

- Ownership, management, and performance control are separated .
- Accessing and controlling computers physically.
- Determining the unit's objectives, how to attain them, and follow-up performance. Not to conflate executive management roles with board member tasks and obligations.
- Evaluating senior management's performance, boosting responsibility and confidence. Accounting and financial issues were avoided.
- Monitoring logical data access to prevent illegal use.
- Effectiveness, efficiency, secrecy, integrity, availability, compliance, compatibility, and dependability (reliability).
- Contribute to catastrophe plans.
- Improving internal control and monitoring systems.
- Information security and risk management.

#### **4.2 THE SIGNIFICANCE OF IT GOVERNANCE:**

IT governance helps achieve the following (Naglaa, 2013):

- Developing an IT strategy and conducting a strategic and operational review.
- Developing and administering IT systems and establishing best practices.
- Completing business initiatives and creating KPIs.
- IT techniques, means, and procedures.
- Application development management.
- Ensuring IT services convey strategy to business divisions for successful intra-productivity.
- Increasing IT's capacity to attract inventions and provide advantages.

#### **4.3IT GOVERNANCE AND CORPORATE GOVERNANCE:**

IT governance is a vital aspect of corporate governance, and the following points show the link (Rashwan, 2017):

- Corporate governance needs a broad definition that reflects its role in improving economic unit performance and protecting stakeholder rights.
- Using intellectual corporate governance factors to judge the significance of IT governance norms.
- Relying on IT quality as a tool for corporate and IT governance.
- Identifying the link between corporate governance and IT quality standards to determine corporate governance's involvement in attaining quality. Corporate governance involves a set of principles that improve the quality of information and information technology.

Corporate governance and IT governance standards may be linked directly or indirectly. One of the intellectual parts of corporate governance may result in the attainment of IT governance standards, or corporate governance may necessitate IT governance standards. The need for IT quality standards shows the link between corporate and IT governance.

## **5. THE NEXUS BETWEEN IT GOVERNANCE AND DIGITAL TRANSFORMATION**

The nexus between IT governance and digital transformation has become a critical area of focus for organizations seeking to leverage technology to drive business growth and innovation. Several studies have highlighted the importance of IT governance in the context of digital transformation, emphasizing the need for organizations to adapt their governance mechanisms to the demands of the digital era(Reinitz, 2019).

Research has shown that mature IT governance activities can significantly impact the adoption of digital technologies, with well-governed organizations being better prepared for digital transformation(Mulyana, 2021). However, the traditional IT governance mechanisms may no longer be valid in the digital era, and organizations need to adapt their governance practices to the rapidly changing technological landscape.Effective IT governance involves defining decision-making processes, assigning roles and responsibilities, establishing policies and procedures, and monitoring performance to ensure that technology investments are aligned with business goals and objectives. It also requires organizations to manage risks and compliance, adapt to the digital era, and focus on outcomes rather than fixed processes(IvyPanda, 2023).In the digital era, traditional control-based IT governance practices may no longer be sufficient to meet the needs of fast-paced digital business, and organizations need to adopt a more flexible and adaptable governance approach that is focused on outcomes and driven by data and analytics. This requires organizations to work closely with their C-suite counterparts and board directors to bring governance practices into the digital age and ensure that IT strategy aligns and supports the organization's overall vision(IvyPanda, 2023).

The nexus between IT governance and digital transformation is a critical area of focus for organizations seeking to leverage technology to drive business growth and innovation. Effective IT governance practices are essential to ensure that technology investments are aligned with business goals and objectives, and that organizations are able to adapt to the rapidly changing technological landscape of the digital era.

## **6. CHALLENGES AND OPPORTUNITIES IN IMPLEMENTING IT GOVERNANCE FOR DIGITAL TRANSFORMATION**

The implementation of IT governance for digital transformation presents both challenges and opportunities. Several studies have highlighted the importance of IT governance in the context of digital transformation, emphasizing the need for organizations to adapt their governance mechanisms to the demands of the digital era (Gupta, 2022). Research has shown that mature IT governance activities can significantly impact the adoption of digital technologies, with well-governed organizations being better prepared for digital transformation(Bintoro, 2023). However, the traditional IT governance mechanisms may no longer be valid in the digital era, and organizations need to adapt their governance practices to the rapidly changing technological landscape(Gupta, 2022).

Challenges in implementing IT governance for digital transformation (Hai, 2021)include:

- Cultural change: Digital transformation requires a fundamental shift in organizational culture, as organizations must move from a centralized approach to a more agile and collaborative one.
- Skills shortage: Organizations may not have the skills necessary to successfully implement digital transformation, such as IT skills and change management skills.
- Cost: Digital transformation can be costly, as it may require investment in new technology and employee training.
- Uncertainty: Digital transformation is always associated with some degree of uncertainty, as it can be difficult to predict its outcomes

Opportunities in implementing IT governance for digital transformation (Jöhnk, 2020)include:

- Improved efficiency: Digital transformation can help improve organizational efficiency by automating tasks and improving communication.
- Increased innovation: Digital transformation can help organizations innovate and develop new products and services.

- Enhanced customer experience: Digital transformation can help organizations enhance the customer experience by providing more seamless and efficient services.
- Increased competitiveness: Digital transformation can help organizations stay ahead of the competition and attract new customers.

## 7. CONCLUSION

This comprehensive study delves into the intrinsic connection between IT governance and digital transformation, elucidating their interplay and pivotal roles in organizational success. The objectives were threefold: to clarify the essence of digital transformation and IT governance, to establish their interconnectedness, and to identify the critical domains within IT governance. Effective governance of information technology is indispensable for the triumphant execution of digital transformation endeavors. It ensures the efficient utilization of IT resources to align with an organization's overarching goals and objectives. The primary components identified for effective IT governance within digital transformation encompass defining decision-making processes, monitoring performance, aligning IT with business objectives, managing risks and compliance, and adapting to the evolving digital landscape.

Understanding and implementing these components empower organizations to fortify their digital transformation initiatives, fostering business growth, and actualizing strategic objectives. This research endeavors to furnish valuable insights for organizations navigating the intricate terrain of digital transformation, aiming to construct a robust IT governance framework congruent with their business objectives. By embracing and implementing these facets of efficient IT governance, businesses can elevate their digital transformation projects, propel company development, and realize their strategic milestones. The exploration of digital transformation showcases its pivotal role in reshaping societal, work, and communication paradigms through technology's ubiquitous accessibility and continual evolution. It highlights the integration of business models, technical capabilities, and digital innovations to drive innovation, improve operational efficiencies, and gain competitive advantages, while emphasizing the pivotal role of digital technology in offering new revenue channels and opportunities.

Delving into IT governance, the research defines its significance in aligning IT investments with business objectives, thereby contributing to organizational excellence and profitability. It elucidates the essential objectives and functions of IT governance, showcasing its role in separating ownership and management, ensuring security, evaluating performance, and enhancing internal controls and information security. The study underscores the symbiotic relationship between IT governance and corporate governance, highlighting their correlation and mutual dependence in achieving quality, performance, and organizational goals. It elucidates how these governance standards interconnect, emphasizing the importance of IT quality standards in elevating both corporate and IT governance. Additionally, the research emphasizes the critical nexus between IT governance and digital transformation, underscoring their inseparable relationship in fostering business growth and innovation. It highlights the necessity for organizations to adapt their governance mechanisms to the evolving digital landscape, ensuring that technology investments align with business goals, focusing on outcomes, and leveraging data-driven approaches for agile governance practices. However, this study recognizes the challenges and opportunities inherent in implementing IT governance for digital transformation. Challenges such as cultural change, skills shortages, costs, and uncertainty stand as impediments, while opportunities including enhanced efficiency, innovation, improved customer experience, and heightened competitiveness emerge as potential rewards for adeptly managing IT governance within digital transformation initiatives.

## References

Abu Hajar, a. A. (2014). The role of information technology governance mechanisms in reducing information security risks to limit electronic financial manipulation in government units under the e-government system. *The Fifth Annual Conference of the Accounting Department, pp. 8-17, Cairo: Faculty of Commerce, Cairo University.*



- AFAI, I. (2007 ). *Tutorial: Information system governance*. Paris : Publications de l'Afai – Isaca.
- Al Qassimi, N. &. (2015). IT governance in a public organization in a developing country: A case study of a governmental organization. *Procedia Computer Science*, 64, 450-456.
- Al-Hasnawi, a. A.-M. (2017). The role of information technology governance in reducing the risks of auditing electronic accounting information systems under the framework of the COBIT framework for internal control,. *Journal of the College of Administration and Economics for Economic, Administrative and Financial Studies*.
- Bintoro, H. (2023). *IT Governance for Digital Transformation*. Retrieved from linkedin: <https://www.linkedin.com/pulse/governance-digital-transformation-haryo-bintoro>
- Gupta, A. (2022). *5 Key Digital Transformation Challenges Government CIOs Must Tackle*. Retrieved from gartner: <https://www.gartner.com/en/articles/5-key-digital-transformation-challenges-government-cios-must-tackle>
- Hai, T. N. (2021). Digital transformation: Opportunities and challenges for leaders in the emerging countries in response to COVID-19 pandemic. *Emerging Science Journal*, 5(1), 21-36.
- IvyPanda. (2023). *Information Governance and Digital Transformation*. Retrieved from ivypanda: <https://ivypanda.com/essays/information-governance-and-digital-transformation/>
- Jamila Salaimi, a. Y. (2019). Digital transformation between necessity and risk. . *Journal of Legal and Political Sciences*, 10 (2).
- Jöhnk, J. (2020). Managing digital transformation: Challenges and choices in organizational design and decision-making . *Doctoral dissertation*.
- Malomatia. (2016). Retrieved from Malomatia: <https://www.malomatia.com/ar/>
- Matt, C. H. (2015). Digital transformation strategies. . *Business & information systems engineering*, 57(5), 339-343.
- Mulyana, R. R. (2021). IT Governance Mechanisms Influence on Digital Transformation: A Systematic Literature Review. In *Twenty-Seventh Americas' Conference on Information Systems (AMCIS), Digital Innovation and Entrepreneurship, Virtual Conference*.
- Mulyana, R. R. (2022). IT Governance Mechanisms that Influence Digital Transformation: A Delphi Study in Indonesian Banking and Insurance Industry. In *Pacific Asia Conference on Information Systems (PACIS), AI-IS-ASIA* .
- Naglaa. (2013). The Role of Information Technology Governance in Controlling Enterprise Risks in the Saudi Banking Sector,. *Accounting Thought Journal*.
- Pratt, M. K. (2018). *The keys to effective IT governance in the digital era*. Retrieved from cio.: <https://www.cio.com/article/222613/the-keys-to-effective-it-governance-in-the-digital-era.html>
- Rashwan. (2017). Analysis of the relationship between the application of corporate governance and information technology governance and its impact on increasing the quality of accounting information. *Journal of Financial, Accounting and Administrative Studies*.
- Reinitz, B. (2019). *Digital Transformation and Enterprise IT: The Role of IT Governance*. Retrieved from er.educause: <https://er.educause.edu/blogs/2019/3/digital-transformation-and-enterprise-it-the-role-of-it-governance>
- Samaa, A. b. (2018). Digital transformation as a strategic anchor for driving economic transformation. Retrieved from <https://www.mile.org/images/2018/citc.pdf>
- Sethibe, T. C. (2007). IT governance in public and private sector organisations: examining the differences and defining future research directions. . *ACIS 2007 Proceedings*, 118.

## FRAUDULENT ACTIVITIES DISCOVERY AND PREVENTION IN INDUSTRIES

**Dr.(CA) Hemant Kaduniya,**  
SMB Govt. P.G. College, Nathdwara, India.  
(hemantkaduniya@gmail.com)

Frauds detection and prevention nowadays are needful task of a organization. The article aims to explain the current state of financial information fraud and deception. We went into detail on the critical need for forensic accountants. One of the primary causes of accounting advancements is fraud. The potential fraudster would have the required knowledge, information, or insufficient internal controls. Corporate espionage is the fraud of a different kind. Fraud is difficult to spot when doing audits. Material misrepresentation of information while ignoring internal safeguards is considered fraud. Six factors can be changed to reduce crime as analysed in the paper. Businesses should establish a compliance and risk committee as well as a fraud prevention policy for improved management and control.

Key words: Fraud, Accounting advancement, Internal control, financial information, misstatement

### **Fraudulent activities discovery and prevention in Industries**

We have seen financial scandals and the fraudulent demise of numerous large corporations since the year 2000. WorldCom, Prmalat, Enron, Credit Suisse, the worldwide crisis of 2007, and Satyam are a few instances. <sup>(1)</sup> Although further research is required to properly understand the causes of the collapse, widespread fraud may be a contributing factor.

Many questions concerning the management and financial information previously released for the majority of the country's operational enterprises were raised by the collapse of the banking industry, which was the most significant and leading sector in the country. <sup>(2)</sup> Did these management teams make an effort to "beautify" their financial statements to strengthen their standing financially or in terms of profits? Did the auditing firms modify the companies' accounts to mislead the revenue figures to avoid paying taxes?

To achieve this, management, auditors, and staff members rely on inventive accounting techniques by exploiting gaps in the accounting standards. This undermines the goal of those statements, which is to provide accurate and pertinent information while also, as has been recently observed, increasing the number of lawsuits.

The article aims to explain the current state of financial information fraud and deception. We went into detail on the critical need for forensic accountants—accounting specialists—who can utilize their knowledge, morality, abilities, and research to stop financial statement fraud and other fraudulent activity.

One of the primary causes of accounting advancements is fraud. Over the last ten years, there have been encouraging developments and growth in the accounting field. On the other hand, this growth could occasionally give rise to fresh scams. The definition of "fraud" according to the Latin Oxford Dictionary is as follows:

“wrongful or criminal deception intended to result in financial or personal gain”

Created by Donald Cressey in 1953, the Fraud Triangle is the most popular theory regarding the reasons behind fraud. <sup>(3)</sup> According to the Fraud Triangle theory, if financial pressure, opportunity perception, and justification are all present, then a person is more likely to engage in fraudulent activities. The first factor is the overall stress brought on by money issues. A possible fraudster has to believe that they are alone and that the strain is not something they can share. The potential fraudster would have the required knowledge, information, or insufficient internal controls in this scenario, which is represented by the second aspect of the triangle: opportunity.

Rationalization makes up the third and final component. From the perspective of the fraudster, circumstances, and motivations—typically private ones—justify the fraud. An inadvertent fraudster

may become a regular fraudster, and a fraudster who steals to ease financial strain may be enticed to steal more and make more money.

Following the Enron and WorldCom incidents in 2001 and 2002, respectively, accounting fraud has gained international attention and is now a significant concern. An extensive body of literature explains that the most common forms of fraud seen, particularly in developing nations, include cash embezzlement, financial record manipulation, and bribery.<sup>(1)</sup>

Frauds are committed to go undetected. Sometimes the cause is the avarice of some people, who may alter transactions or fabricate documents to profit themselves.<sup>(4)</sup> The Enron tax scam is a prime illustration of deception. Evidence and discussions revealed that the ex-president Jeffrey Skilling and the company's founder, Kenneth Lay, had planned to conceal the millions of losses and exaggerate profits to conceal the real financial state of the business. As a result of these acts, company funds were misappropriated for private use.

False transactions are used to make profits in the majority of accounting crimes. Bribery, blackmail, and conflicts of interest are a few prevalent and real-world instances of this deception. Financial statement fraud is the deliberate falsification of financial or non-financial information to deceive other stakeholders who rely on it for making economic decisions. Examples of this type of fraud include over- or underestimating income, liabilities, or expenses.

Fraud can happen in any industry; Lehman Brothers was a global investment bank and supplier of various financial services, and Enron was an energy firm. However other frauds are unique to a certain industry. Every industry has its own unique methods of fraud, such as when health insurance corporations concoct bogus claims and falsify medical diagnoses. In the real estate industry, dishonest deals in pyramid schemes—also referred to as Ponzi schemes—entail deceptive statements or promises of large returns in a short amount of time. There are programs in financial institutions for opening new mortgage accounts and loans.<sup>(5)</sup>

Corporate espionage is the fraud of a different kind. It happens when confidential information about clients, products, or business strategies is given to uninvited parties. We can also identify the danger of disclosing private information to rival businesses or using it for one's gain.<sup>(6)</sup>

To stop these scams, organizations take steps like implementing internal controls and employing forensic accountants. Companies of all shapes and sizes, from small businesses to global corporations, turn to forensic accountants for assistance, including insurers, attorneys, and government organizations. They also offer expert testimony in legal proceedings. In many cases of fraud and embezzlement, such as those involving insurance, commercial disputes, and business interruption, they are essential and regarded as expert support.<sup>(7)</sup>

Accounting and control: The primary cause of human avarice, which arises when people exploit a lack of control or are dissatisfied with what they have, is fraud.<sup>(8)</sup>

Accounting fraud is the deliberate manipulation of a business's accounting data, either by providing false information to stakeholders and investors by withholding certain information to lower profits and taxes, or to enrich oneself or a third party.<sup>(9)</sup>

Providing accurate and pertinent information about an organization's financial situation and operations is accounting's primary goal. From an accounting perspective, the purpose of the control activity is to guarantee the accurate recording of accounting transactions, accurate recording of financial statements, and preparation and disclosure of financial statements following established guidelines or generally accepted principles/standards. Many companies' names have been associated with fraud in recent years, suggesting that the external and internal control measures that are currently in place have failed on a national and even worldwide scale, endangering the company's relationship with investors. Corporate fraud is having a significant and wide-ranging impact on nearly every stakeholder of the company as well as the economy at large.<sup>(10)</sup>

Fraud is difficult to spot when doing audits. Rather, auditors will evaluate the control environment to protect the company's brand and image. Auditors will analyze internal controls for tracking and reporting business activities, as well as their efficacy in preventing errors and verifying the accuracy of information provided to stakeholders.<sup>(11)</sup> Material misrepresentation of information while ignoring internal safeguards is considered fraud. To identify present and potential weaknesses in the system, one must comprehend its control structure. 2018's Wulandari and Nuryatno study demonstrated how an organization's ability to prevent fraud would be enhanced by its internal control systems' efficacy.<sup>(12)</sup>

The goal of internal control is to design preventive measures to lower the risk of fraud to "help organizations carry out adequate controls, evaluating their effectiveness and efficiency and encouraging continuous improvement".<sup>(13)</sup> Weak corporate governance, a lax internal control framework, and unethical management and/or staff action motivated by self-interest can all lead to corporate fraud. Since all operations will be conducted following the law, a strong internal audit will produce financial statements and information that are more accurately represented.

The network of coordinated activities that "designs and implements the accounting processes and internal controls" is known as the internal control environment. The primary resources in this environment are effectively coordinated and guided by business procedures, policies, standards, and plans." Internal control is "a process, effected by an entity's board of directors, management, and other personnel, designed to provide reasonable assurance regarding the achievement of objectives relating to operations, reporting, and compliance," according to the Committee of Sponsoring Organizations of the Transportation Commission (COSO).<sup>(14)</sup>

Any form of organization, regardless of its industry, nature of company, or nature of commerce, is susceptible to fraud. No matter how many safeguards are in place, there will always be circumstances that could push someone to commit fraud, as Cressey's triangle of fraud model from 1953 illustrates. Whatever the compensation, there is always pressure to succeed or maintain a high quality of living. Employees who have been with the company for a long time and are regarded as reliable typically take advantage of their inefficiency by knowing about internal controls. Other management choices may be impacted by the effectiveness of internal control over management guidance.

Criminal fraud causation is based on both the Fraud Triangle and Rational Choice Theory. Most individuals, says economist Adam Smit, depend on hard labor to achieve success. Nonetheless, some people are also more likely to turn to illegal tactics to obtain their desired outcomes because of their avarice and immorality. "These rational criminals weigh the potential benefits and consequences of their acts, choosing to commit a crime if they believe that doing so will yield immediate benefits without the threat of long-term risks". The likelihood of being discovered and prosecuted, the psychological high of performing a crime undetected, and the impression of making quick money are the main factors that influence a person's decision to engage in criminal conduct, including fraud. They are more likely to conduct more crimes if the incentives are large, the perceived danger is low, and the excitement is high.

Mechanisms to Fight Fraud: Research on rational choice theory and deterrence focuses on situational crime prevention.

Six factors can be changed to reduce crime:

- (1) making it harder to commit a crime,
- (2) making it riskier to conduct a crime,
- (3) making it less rewarding to commit a crime,
- (4) making people feel guilty or ashamed,
- (5) making less of a threat, and
- (6) making fewer excuses or justifications.

Here, we'll concentrate on the first two variables. Initially, the government has the power to hinder criminal activity. The usual method for achieving this is "hardening the target".

This might include installing forensic accounting systems, bolstering cyber security, and upgrading firewalls in the context of corporate fraud. Second, the government has the power to raise the stakes for breaking the law. This would entail doing away with government corruption in the area of corporate fraud and raising the possibility of frequent forensic audits.

Effective internal control and sound corporate governance enhance organizational performance and lower the chance of fraud. To lower organizational fraud, an efficient internal control system is necessary. For instance, public companies that file reports with the Securities & Exchange Commission in the United States are required to undergo an annual audit under the Sarbanes-Oxley Act of 2002. Additionally, such businesses had to submit a management report that covers their internal control framework. In contrast, Australia's ASA 210 mandates that auditors analyze internal control system design to determine fraud risk. The management has put in place preventative, investigative, or remedial mechanisms to mitigate this risk internally.

Vaughan and Vaughan, in 2008, defined risk as: "a condition in which there is a possibility of an adverse deviation from a desired outcome that is expected or hoped for whether physically, morally and ethically."<sup>(15)</sup>

Moral risks are associated with immoral activity, such as lying or fraud, while physical risks are tied to acts or behaviors. On the other hand, moral hazards are associated with situations or conditions that have the potential to encourage individuals or organizations to take more negligent or dangerous activities. Neglecting risks could expose the company to severe negative consequences. Adopting fraud-fighting strategies is required to reduce the risk of fraud.

Audit firms also carried out fraud surveys in addition to reading scholarly literature. Deloitte carried out a fraud surveillance survey in 2020. The outcomes demonstrated that the techniques implemented include monitoring, detection, inquiry, rectification, and prevention. A survey on the Global Research Report on Economic Fraud and Crime was carried out by PwC in 2018. The study found that the use of passwords, antivirus software, and protection software is essential for prevention as well. It also demonstrated how technology can be an ally in the fight against fraud through predictive analysis, voice recognition, natural language generation, natural language processing, and machine learning. The firewall and system updates make sure that data isn't stolen by outside or inside users using phishing or other fraudulent methods.

In conclusion, businesses must include additional safeguards like corporate training against fraud. In the encouragement of any worker's ignorance. It's critical to keep staff members informed and compliant with their duties at all times, particularly when handling sensitive and secret data.

**Effectiveness in Fighting Fraud:** Throughout the world, fraud is a crime that carries a fine or jail sentence. As a result, businesses take steps to uphold the values of their code of ethics in the workplace. Anonymous channels that facilitate whistleblowing and offer complete protection to the individual disclosing the fraudulent scheme should be a part of these procedures. Businesses should be able to respond appropriately to any scenario by dealing with complaints in a highly confidential manner. Fraud should have consequences for those who consider it, and they should be handled seriously. Because investors and other external stakeholders rely on the accuracy and timeliness of the information provided in financial reports, research on accounting fraud is crucial.

Businesses should establish a compliance and risk committee as well as a fraud prevention policy for improved management and control. Additionally, businesses should implement internal controls, general administrative rules, human resources policies, and IT with a focus on security policy. Employees must receive explicit explanations of these policies, methods, and measures via workshops, training, or reading each employee the regulation so they are knowledgeable about the topic. Information asymmetry is another element that creates the conditions for fraud. This asymmetry will make it easier for scammers to take advantage of others and pursue their own goals at the expense of other people.

Effective internal and external audits ensure that there is less information asymmetry and that the company's operations are being monitored more closely, both of which will lower risk and help to prevent fraud cases.

According to Suleiman and Ahmi, forensic accounting is a suitable technique for inquiries aimed at minimizing corruption within the public sector. Additionally, they discovered that forensic accounting investigations yield trustworthy conclusions that may be utilized in legal proceedings.

Okoye and Ndah established a link between fraud detection and prevention and fraud investigation. They discovered that fraud investigation and litigation procedures are crucial to preventing fraud in businesses after studying the connection between fraud litigation practices and fraud prevention.

Dada demonstrated the necessity of using forensic accounting to investigate and identify corruption instances. In 2021, Rehman and Hashim looked at how forensic accounting might be used to combat and lessen financial corruption. They demonstrated how forensic accounting has grown in significance and is now applied in numerous fields, including fraud prevention, financial corruption, legal consultation, corporate appraisal, and money laundering. They contend that bodies overseeing higher education should incorporate forensic accounting into the curricula of accounting majors at universities and colleges since it is an absolute necessity.

Conclusion and upcoming research



Fraud has many different forms and causes, but it is always illegal and immoral behavior. Financial accounting's primary function is to deliver accurate and pertinent data. A specific kind of fraud involves the publication of false financial information.

Fraud will always exist as long as there are legal and accounting rules gaps and the expense of uncovering fraud remains high. Although forensic accounting is a valuable tool in the battle against fraud and corruption, it cannot effectively combat these issues on its own. It ought to be combined with updates to the laws and accounting standards that are in place.

To develop preventive measures for these fraud threats, which happen and persist in all nations, more research is needed. Finally, a factor that might be crucial is that ethics is not examined in this work.

Reference:

- Hendieh, J., 2016. Board Of Directors' Diversity And Effect On Strategy. A Study Of The Lebanese Banking Industry. *European Scientific Journal*, 12(13), 257-281.
- Abouzeid, R., 2021. How Corruption Ruined Lebanon. Retrieved from The New York Times Magazine: <https://www.nytimes.com/2021/10/28/magazine/corruption-lebanon.html>
- Cressey, D., 1953. *Other People's Money: A Study in the Social Psychology of Embezzlement*. IL, USA: The Free Press: Glencoe.
- Mendes de Oliveira, D.K., J.O. Imoniana, V. Slomski, L. Reginato and V. Slomski, 2022. How do internal control environments connect to sustainable development to curb fraud in Brazil? *Sustainability*, 14(9): 5593.
- Rahmatika, D., M. Kartikasari, D. Indriasih, I. Sari and A. Mulia, 2019. Detection of Fraudulent Financial Statement; Can Perspective of Fraud Diamond Theory be applied to Property, Real Estate and Building Construction Companies in Indonesia? *European Journal of Business and Management Research*, 4(6): 1-9.
- Bera, D., O. Ogbanufe and D. Kim, 2023. Towards a thematic dimensional framework of online fraud: An exploration of fraudulent email attack tactics and intentions. *Decision Support Systems*, 113977.
- Kabwe, M., 2023. Fraudulent financial reporting and related party transactions: Evidence from a mining industry in a developing country. *International Journal of Research in Business and Social Science*, 12(2): 217-228.
- Imoniana, J. and R. Silva, 2013. Revisiting the concepts of forensic accounting and corporate fraud. *International Journal of Auditing Technology*, 1(2): 175-202.
- Dada, S., 2014. Forensic accounting technique: A means of successful eradication of corruption through fraud prevention, bribery prevention, and embezzlement prevention in Nigeria. *Kuwait Chapter of Arabian Journal of Business and Management Review*, 33(2579): 1-11.
- Okoye, E. and E.N. Ndah, 2019. Forensic accounting and fraud prevention in manufacturing companies in Nigeria. *International Journal of Innovative Finance and Economics Research*, 7(1): 107-116.
- Ozili, P.K., 2020. Advances and issues in fraud research: a commentary. *Journal of Financial Crime*, 27(1): 92-103.
- Wulandari, D. and M. Nuryanto, 2018. Pengaruh pengendalian internal, kesadaran anti-fraud, integritas, independensi, dan profesionalisme terhadap pencegahan kecurangan. *Jurnal Riset Akuntansi Mercu Buana*, 4(2): 117-125.
- Sawyer, L.B., M.A. Dittenhofer and J.H. dan Scheiner, 2014. *Internal auditing*. Diterjemahkan oleh: Desi Adhariani. Jakarta: Salemba Empat.
- Imoniana, J., 2021. Ethics and Auditing Competence in Assurance of Risk of Frauds - An Interpretive Phenomenographic Analysis. *Middle-East Journal of Scientific Research*, 29(1): 30-48.
- Vaughan, E.J. and T. Vaughan, 2008. *Fundamentals of risk and insurance*. New Jersey: John Wiley & Sons.

# COMPARATIVE EXPLORATION OF THE FINANCIAL PERFORMANCE OF SELECT PNB AND CBS BANKS

**Dr. ANIL VERMA**

Jai Narain Vyas University, Jodhpur , India.

**RAMESH KUMAR JABDOLIA**

Jai Narain Vyas University, Jodhpur, India.

The comparative analysis of the financial performance of a limited group of institutions that operate inside both the PNB and CBS banking systems has heightened significance in the present context. A range of financial indicators is used to evaluate the profitability, liquidity, efficiency, and solvency of both PNB and CBS banks for the period spanning from 2017 to 2022. A total of 20 institutions were examined throughout the specified time period. The company's improved asset quality, decreased administrative expenses, and heightened operational efficiency have enabled them to assume this position. Nevertheless, financial institutions operating under governmental oversight have had challenges in sustaining their profitability. Nevertheless, public sector banks have had challenges in maintaining profitability due to their lower loan recovery rates and higher levels of non-performing assets (NPAs). Nevertheless, empirical evidence has shown that public sector banks exhibit superior liquidity ratios, including metrics such as cash-to-deposit and current ratios. The aforementioned ratios indicate a higher level of available cash reserves within public sector banks, enabling them to effectively fulfill their immediate financial responsibilities. The primary reason for this phenomenon is the fact that public sector banks, which get consistent financing from the government via ownership and aid, often possess the ability to sustain elevated levels of cash reserves.

**Keywords:** Banking, Financial Reports, Risk, Ratios.

## 1. INTRODUCTION

Banks' investment and financial services boost economies. The Indian banking system includes several branches for personal finance. Financial performance determines modern firms' profitability and industry stature. PNB and CBS bank financial performance must be compared. This research evaluates 2017–2022 PNB and CBS bank financial performance. The research will use financial ratios, graphics, and statistical analysis to assess bank liquidity, profitability, efficiency, leverage, and other indicators. This survey educates lenders, managers, and investors on the finest banking sector. A company's financial success impacts investment, economic, and overall health. Comparing public and private banks' finances is important due to rising banking industry competitiveness. Every nation's economy relies on banking. The Indian banking industry provides several financial services via its vast branch network. This research covers a few PNB and CBS banks' 2017–2022 financial performance. The research will use financial ratios, graphics, and statistical analysis to assess bank liquidity, profitability, efficiency, leverage, and other indicators. To enlighten lenders, managers, and investors, this research seeks the finest banking industry. The research will evaluate numerous public and private entities' five-year financial performance. Assessing cash flow, income, and balance sheets will determine bank financial soundness. This study investigates bank financial performance determinants and their implications on banking. This will be done via regression and t-tests.

This research will aid banking stakeholders in lending, investment, and management. Policymakers may use the study to identify banking sector opportunities and formulate



strategy. Finally, our analysis should assist stakeholders evaluate public and private banks' financial health. Examine balance sheet ratios for debt coverage, income, growth, liquidity, efficiency, and debt coverage. The ratios will assess bank expenses, revenue, profitability, equity, liabilities, and assets. Graphs will uncover data patterns and assess banks' financial performance. Competition in banking has spurred innovation. PNB and CBS bank financial performance must be understood by stakeholders to make informed choices and stay competitive. This study's banking sector financial performance comparison benefits scholars, legislators, and businesses. This research should boost India's banking industry.

New laws and technology have changed India's financial sector. Bank finances concern politicians, management, and investors. This research intends to improve banking sector financial performance and company growth metrics. Bank investors may make informed selections using this research. Research may assist bank management boost financial performance and competitiveness. This research might help governments reorganize banks and develop viable solutions. The study's financial performance assessment of comparable organizations may aid researchers and academics. This research examines how PNB and CBS banks' financial performance impacts banking. This study will offer new frameworks and research methods to Indian banking sector financial performance literature. The research analyzes public and private bank 2017–2022 financials. This report will inform stakeholders' finance, investment, and management choices. The findings will improve India's banking industry and spur financial performance research.

## 2. LITERATURE REVIEW

**Anand** (2015) offers a comprehensive depiction of the banking sector, highlighting its significance as a prominent player in the financial markets and its integral role within the broader financial system. The development of any economy necessitates the formation of a dependable financial system that can effectively aggregate individuals' savings and allocate them towards productive ventures. Financial institutions has the capacity to not only provide the necessary monetary capital for growth, but also to exercise a certain level of influence on the allocation and use of these resources. The post-liberalization era in India has ushered in a new age of wealth and progress. Simultaneously, it has also presented a plethora of challenges.

**According to Priyadarshan, K., and Sarvamangala, R.(2022)**, the success of any financial economy may be predicted based on how well banks are doing their jobs. In India, financial institutions belonging to both the public sector and the private sector have had considerable success. The SBI, which is a public sector bank, and HDFC Bank, which is a private sector bank, are both prominent financial institutions in India, and this research study examines and contrasts their performance over the last two years utilizing secondary data. It might be difficult to ascertain the recital dimension of the many different financial organizations since frequent performance metrics tend to endure. The researcher makes use of operational profit, net profit, EPS, net positive asset growth, and return on assets as coordinated indicators. In addition, the tested hypotheses, the simple mean, and the standard deviation (SD) are calculated using this data.

**P. Kanagaraj and D. Arunkumar authored the 2021** study. According to correctly organizing the link between the items of the asset report and the benefit and difficulty accounts, a bank's financial effect shows both its strengths and its deficiencies. The topic of the research study is the financial performance of SBI (State Bank of India). The purpose of this research paper is to conduct an analysis of the SBI's financial implementation during the

course of the six years 2015–2020. The purpose of business banks is to raise the value of the assistance they provide. In order to conduct the evaluation, we made use of a wide range of instruments, some of which were as follows: recent quantity, net benefit percentage, stock turnover quantity, and other implementation extents. The ideas demonstrate that the association has to find the necessary channels to gain regular income and, as a result, maintain consistent efficiency; this may be accomplished by following the essential steps.

**According to Vikraman, A., and Kanagaraj, P. (2021),** the bank's primary objective was to reduce the complexity of India's financial transactions and overall supervision. It serves as the essential medium of exchange that maintains the connectivity of all aspects of our country's economic systems and fosters expansion. A planned expansion of a bank in the banking sector results in an increase in the number of bank branches, deposits, credit, and other banking-related products and services. The current investigation is responsible for managing the assessment of HDFC Bank's performance in terms of their financial assets. This review was approved based on the financial evidence, aid, and catastrophe accounts period that spans the six years from 2015 to 2020. to look at the relationship that exists between the capital and the reserves.

### **Outline of CSB Bank**

Indian private sector bank CSB Bank Limited is headquartered in Thrissur, Kerala. Catholic Syrian Bank opened in 1920. It became CSB Bank in 2019. It provides personal banking, NRI banking, company banking, and MSMEs banking within its broad banking umbrella.

By 2021, the bank would have over 400 branches and 250 ATMs across India. Internet banking, mobile banking, and Unified Payments Interface payment services are among the new digital banking technologies the bank has adopted to improve customer experience. Digital banking is a bank focus.

CSB Bank has won many accolades for performance, customer service, and digitization. It frequently ranks among India's top private banks. It also scored well overall. The bank won Best Small Bank at the 2021 Business Today and Money Today Financial Awards.

Fiscal results have grown for CSB Bank over its history. The bank had 22,869 crore in assets and 218 crore in net profit as of March 2021. The bank's net interest income rose 20% to INR 762 crore, while its gross non-performing asset ratio fell to 2.69% from 3.42%.

One of India's top private sector banks, CSB Bank prioritizes digital innovation and client service. Due to its rising trajectory and consistent financial performance, stakeholders invest in the company.

### **Outline of Punjab National Bank**

Indian multinational Punjab National Bank provides banking and financial services. It is owned by India and headquartered in New Delhi. One of India's major banks, it was founded in 1894.

PNB provides personal, corporate, international, and investment banking. This bank provides savings, checking, fixed deposits, recurring deposits, loans, and credit cards. The company also provides insurance, demat, and mutual funds.

PNB is well-established abroad as well as domestically. Locations include the UK, US, China, and Canada. The bank has Dubai, Hong Kong, and Bhutan representative offices. PNB has won multiple honors for its excellent service. Forbes Global 2000 ranked it India's second-largest public sector bank and it received the 2020 CNBC-TV18 "Best Public Sector Bank Award". Both were 2020 prizes. Digital efforts earned the bank the Banking Technology Awards' "Best Digital Initiative Award" in 2020.

As of September 2021, PNB India has 11,000 branches and 13,000 ATMs. This bank employed 70,000 people and earned Rs. 77,124 crores in 2020–2021.

### 3. RESEARCH METHODOLOGY

Financial analysts assess a company's productivity, production, profitability, liquidity, fixed asset, working capital, money flow, and social performance. Financial performance is used by internal users to evaluate their firms and compare them to others. Financial performance is assessed for external users to propose investment possibilities and company viability. Financial statement analysis is required before calculating performance-determining financial indicators.

#### RESEARCH OBJECTIVES:

- To contrast the efficiency and financial results of banks in the PNB and CBS banks
- To provide recommendations for enhancing the monetary analysis.
- To Researching the connection between PNB and CBS banks' effectiveness management and liquidity
- To research the PNB and CBS banks' financial results and profitability growth.

#### 4. DATA ANALYSIS:

The process of gathering secondary data will include considering citations from publications, research papers, and journals.

#### LIMITATIONS:

- The primary focus of this study is a subset of PNB and CBS banks, with the banks chosen on the basis of their market capitalization.
- The study takes five years to determine which bank performs best, ranks the banks according to performance, and examines the impact of liquidity management. Statistical tools are also employed for analysis to provide a more comprehensive picture of the impact of liquidity management in PNB and CBS banks.

**TABLE 1.FINANCIAL ANALYSIS CSB BANK**

Year	Total Assets	Total income	Total Advances(Net)	Total Deposit
2017-18	15870	1422	9337	14691
2018-19	16911	1483	10615	15124
2019-20	18864	1731	11366	15791
2020-21	23337	2175	14438	19140
2021-22	25356	2285	15815	20188

CHART 1.FINANCIAL ANALYSIS CSB BANK

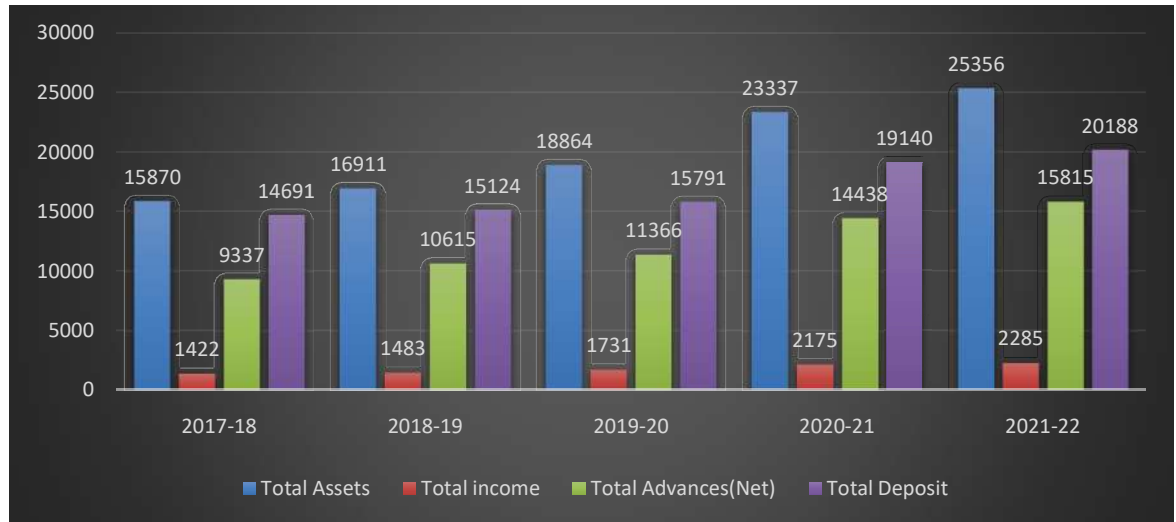
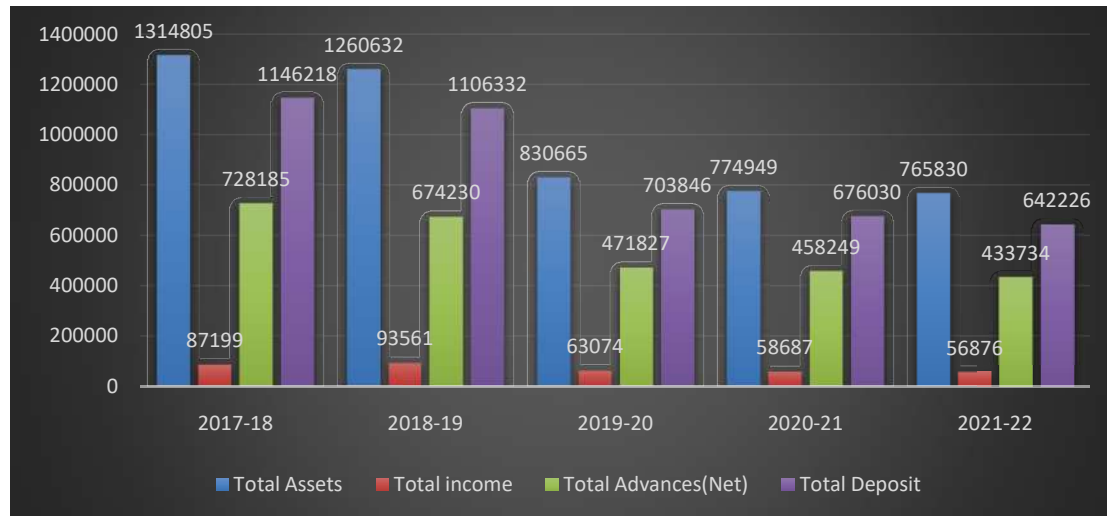


TABLE 2.FINANCIAL ANALYSIS PNB BANK

Year	Total Assets	Total income	Total Advances(Net)	Total Deposit
2017-18	1314805	87199	728185	1146218
2018-19	1260632	93561	674230	1106332
2019-20	830665	63074	471827	703846
2020-21	774949	58687	458249	676030
2021-22	765830	56876	433734	642226

CHART 2.FINANCIAL ANALYSIS PNB BANK



## 5. FINDINGS

### CSB Bank

- In fiscal year 2021, CSB Bank reported a net profit of Rs. 218.4 crores, a considerable rise over the previous year's net loss of Rs. 198.4 crores. The banking company earned Rs. 1,853.5 crores this fiscal year, up 7.5% from last year. In fiscal year 2021, net interest income (NII) rose 18.3% to Rs. 720.3 crores, indicating a favourable trend.
- The bank's gross non-performing assets (NPA) ratio decreased from 4.87% in 2020 to 2.61% in 2021, indicating improved asset quality. During the same time, the net NPA ratio fell from 2.61% to 1.24%.
- The financial performance of CSB Bank has seen notable improvement in recent times. After experiencing consecutive years of losses, the bank had a positive outcome in the fiscal year 2021. The bank has achieved these favourable results by its strong emphasis on improving the quality of its assets, increasing net interest income, and maintaining a solid capital adequacy ratio.

### Punjab National Bank

- The net interest income (NII) of PNB exhibited a consistent growth trajectory across its primary business operations, increasing from INR 31,555 crore in the fiscal year 2018-19 to INR 40,292 crore in the fiscal year 2020-21.
- The operating profit of Punjab National Bank (PNB) had a noteworthy rise, escalating from INR 9,621 crore during the fiscal year 2018-19 to INR 16,865 crore in the fiscal year 2020-21. This growth may be primarily attributed to enhanced operational efficiency.
- In the fiscal year 2020-21, Punjab National Bank (PNB) recorded a net profit of INR 3,586 crore, which stands in stark contrast to the net loss of INR 12,283 crore incurred in the preceding fiscal year 2019-20. The observed result may be attributed to the rise in successful recoveries during the year and the decrease in provisions made for non-performing loans.
- The Gross Non-Performing Asset (NPA) ratio of PNB saw a little decrease from 14.14% in March 2020 to 14.06% in March 2021, suggesting a modest improvement in the overall quality of assets.

## 6. CONCLUSION

After suffering losses for a number of consecutive years, CSB Bank finally posted a profit for the fiscal year ending in FY21, marking a considerable improvement in the institution's overall financial performance over the last several years. These favorable outcomes have been achieved by the bank as a direct consequence of the significant emphasis it has placed on enhancing the quality of its assets, growing its NII, and preserving a healthy CAR. PNB's core business operations and asset quality have both seen improvements in recent years, which has led to an overall improvement in the company's financial performance in recent years. To be able to maintain its growth over the long term, the bank will need to keep working toward its goals of lowering its nonperforming assets (NPAs) and increasing its overall efficiency.

## REFERENCE

- vol-6 issue-5 2020 ijariie-issn (o)-2395-4396 12652 www.ijariie.com 296 financial performance analysis – a comparative study of selected public sector and private sector banks. selvakumar.p1, dr. v.r.nedunchezian 2
- oct. 2016 vol. xi no. 2 impact factor 4.173 (isi) 3.860 (cosmos) issn (p): 0973-4503 (e) : 24541702 rni : upeng 2006/17831
- d. k. malhotra et al (2011), "evaluating the performance of commercial banks in india" in asia pacific journal of finance and banking research vol. 5. no. 5. 2011.
- anilkumarramasharenirmal., &purviderashri., (2020). a comparative study of india's two largest banks. *high technology letters gjstx*, 26(7), 394- 407.
- bangarupushpalatha (2020). financial performance analysis of sbi an empirical study. *journal of emerging technologies and innovative research*, 7(2), 192-196.
- bhawnamalhotra&vinodkumar (2017). india's private banks are the subject of a camel model analysis in the epra. *international journal of economic and business review*, 5 (7), 87–93.
- biswanathsukul (2017). non performing assets (npas): a comparative analysis of selected private sector banks. *international journal of humanities and social science invention*, 6(1), 47-53.
- brindadevi, v. (2013). a study on profitability analysis of private sector banks in india, *iosr journal of business and management (iosr-jbm)* e-issn: 2278-487x, p-issn: 2319-7668. 13(4), 45- 50.
- gupta (2014). an empirical assessment of the icici bank's financial performance- a comparative analysis. *journal of business studies (jbs)*, (1), 1–14.
- Irfan Ahmad,& Nisha Khan. (2019). A Comparative Analysis of NPA between SBI and ICICI Bank. *IOSR Journal of Economics and Finance (IOSR-JEF)*, 10(2), 17-22.



## THE FUTURE OF ACCOUNTING RESEARCH UNDER THE DEVELOPMENTS IN AI

**Dr. Salim SwadiHammood AL-Mohammedawi**

Imam Ja'afar Al-Sadiq University, Baghdad, Iraq

([Salim.swadi@sadiq.edu.iq](mailto:Salim.swadi@sadiq.edu.iq))

**Dr. Hesham Zakaria Mohmed Hassan**

Imam Ja'afar Al-Sadiq University, Baghdad, Iraq

[hesham\\_zakaria@arts.helwan.edu.eg](mailto:hesham_zakaria@arts.helwan.edu.eg)

**Hussein KadhimJebur**

Imam Ja'afar Al-Sadiq University, Baghdad, Iraq

[hk358101@gmail.com](mailto:hk358101@gmail.com)

The research paper addressed the difficulty of achieving a link between the three variables represented in research, accounting education, and AI, specifically in light of the widespread reliance on preparing research using many advanced methods of AI, and then increasing the connection between what research provides in terms of developing accounting science and what is repeated in different formats following AI methods, and it has been concluded that the relationship between the three variables is considered a close interconnected relationship. Without the first (accounting education), the development of the second (accounting education) stops, which is considered inappropriate for the current business environment for all its categories, whether teaching or learning. Both research and accounting education depend on the latter (AI) to provide technical, analytical support and classification of opinions to reduce repetition and avoid shortcomings in the feasibility of research in accounting education.

**Key words:** AI, Accounting, Education, Research, Difficulties in Accounting Education.

### 1. Introduction

The accounting is characterized by an advanced and renewable nature that does not stop at certain borders, but rather it is a flexible science that always seeks to relate to many fields, sciences, trends and surrounding environmental variables, which results in the emergence of new accounting branches that suit the course of the stage and keep pace with the current factors, circumstances and variables, and this is what Scientific research provides tools and means to address the appropriate and appropriate development of accounting science through the developments that accounting science is witnessing. Scientific research proceeds in parallel with it, which serves as an introduction to the development of accounting science directly. Therefore, the relationship between the future of scientific research, accounting education, and intelligence Artificial art does not stop, rather it is extended and continuous in multiple forms that require study from time to time.

### The Problem and questions of the research paper

The problem of the research paper is the difficulty of achieving a link between the three variables represented in research, accounting education, and AI, specifically in light of the widespread reliance on preparing and preparing research using many advanced methods of AI, such as the ChatGPT program, which is referred to with many question marks. Despite the fact that it has many scientific research advantages, which results in a widening gap between what research provides in terms of developing accounting and what is being repeated in a variety of different formats following AI methods, and in light of this, researchers can ask several questions that clarify the problem of the research paper is as follows:-

1. Does the use of AI methods work to develop and present modern aspects of accounting science when dealing with a specific issue?
2. Do the limits of AI depend on formulating scientific accounting research, or do they provide scientific solutions and proposals through the arrangement of ideas and points?
3. Is the researcher relying on AI seeking to provide solutions to a scientific research issue or just reducing momentary effort while benefiting from the capabilities of AI only?

### **Objectives of the research paper**

1. Explaining the shortcomings witnessed in accounting research in light of the use of AI methods
2. Establishing reliable specifications and requirements as dividing points between AI capabilities and providing solutions to accounting research issues other than research formulation.
3. Considering that AI is a partner and assistant to accounting research in generating ideas and achieving innovation and creativity, and not arranging them to avoid quotation and preface.
4. Achieving a link between both accounting research and AI to address accounting research issues in a different, non-traditional way that allows for continuation in the future.

### **The importance of the research paper**

The importance of the research paper is that the science of accounting, although it is a renewable science, is still affected by the surrounding environmental factors and developments that do not make it stop at a certain limit. Therefore, developing the scientific and research approach to accounting by following the developments of AI and digital transformation will reshape the conceptual framework of accounting, in general and its various branches in particular.

## **2. Literature Review**

A literature have addressed the importance and role of scientific research in developing the science of accounting according to what professional business environment is witnessing to accommodate the requirements of digital transformation, AI and its various methods.

(Atta, 2023) explains the role of AI and how to benefit from it in the field of scientific accounting research, by providing many unlimited possibilities characterized by its ability to achieve tangible results in developing and improving any educational field while evaluating and evaluating research performance and clarifying the relationship between the target and the investigator. Indeed, in ways and methods that are considered, in their content, capable of developing accounting curricula. This opinion recommended that the inclusion of AI can be limited only to the mechanism or method applied in research methods and recommendations for addressing accounting education for the beneficiary group only.

(Likewise&Riyad, 2019) explained the impact of using information and communications technology in developing the accounting education system to meet quality and accreditation requirements, by relying on dealing with it with scientific research and its methods based on AI in dealing with various research issues and displaying contents, allowing ease of dealing, access and reception. The accounting research and scientific content. Perhaps this opinion has identified the continuing gap in both the international standards for accounting education and the standards of the National Authority for Quality Assurance and Accreditation of Education on the one hand, and between the reality of accounting education methods used in educational institutions on the other hand. This opinion has concluded that the gap that may The face of scientific accounting research in the practical and professional reality is that

practical accounting research is a repetition of the proposed solutions and approaches, but in different formats that are consistent in content.

(Venkatesh, et al., 2023) addressed the role of developing the educational curriculum for accounting in general and management accounting in particular to make it appropriate to the practical and professional reality in absorbing technological and digital businesses, as reliance was placed on the analytical approach to the management accounting course through various research methods at both the Universities of Nebraska and the State of Nebraska. Missouri, in the United States of America, specializes in accounting in all of them, and I reached this opinion that there is a level of fundamental weakness in the educational curricula in relation to what the graduate may be exposed to in the field of accounting in general and the field of managerial accounting in particular, given that scientific research does not include an evaluation of accounting curricula in a comparative manner, and therefore the study recommended It is necessary to provide three training courses accredited by the Institute of Management Accountants (IMA), which the graduate must obtain to deal with the current digital and technological changes.

(Ng, 2023) agreed with the need for advanced data analytics, robotic process automation, and AI (AI) to be taught in the accounting educational program at the graduate level and post-doctoral research to address them more deeply and accurately, while redefining the skill sets required in the accounting profession. To prepare the researcher and scholar for accounting education, this opinion has concluded that the academic specialty of accounting must develop strategies to integrate data analytics and emerging technologies into the curriculum while using scientific research methods.

(AICPA, 2021) also addressed the necessity and importance of re-evaluating accounting education in a way that allows scholars and scientific researchers to learn how to link what is required in the labor market and what is being studied. Therefore, this also contributes to reducing the educational gap in accounting, although this may affect the nature of The situation is related to supporting various professional certificates such as CPA, CMA and others, which are currently including digital transformation and AI within their practical and professional topics. (AAA, 2021) has supported this opinion through its vision that reducing the gap by relying on granting professional certificates only will lead to failure. Accounting programs in educational institutions prepare students in the field of accounting in an appropriate manner in accordance with the requirements of the current stage.

(Momen et al., 2021) explained that the development of various information technologies has greatly affected the accounting and auditing profession, and that continuing to follow the same method in scientific and educational research for accounting may push the technology itself to seek to exclude traditional accounting and replace it with AI, not only as applied methods, and then It gives an unrealistic appearance to some of the proposed methods that have been unsuccessfully applied in developing accounting education, and thus this opinion recommended that there is an urgent need to re-evaluate accounting education programs to meet the needs and requirements imposed by information technology.

(Susskind, 2020) agrees in what he discussed that the science and profession of accounting have changed and transformed significantly in recent times to rely on AI, specifically in light of what the world witnessed from the COVID-19 pandemic, with which accounting as a science and profession moved to depend on the digital form and the impact of this on Proposals and recommendations of scientific research based on AI itself, which in turn led to a reduction in traditional accounting scientific research and a shift towards accounting scientific research using technical methods.

(Mohammed, 2018) also discussed that the use of one of the methods of AI (Chat GPT) in preparing scientific accounting research has reduced the procedures and effort in preparing research in a way that does not support the true presentation of accounting problems and

issues and proposals for their solutions, but rather reflects a repetition of narrating them in a different format that avoids quotations, expressions, and the opinions of their relatives. Without providing new content in a scientific and research form that contributes to supporting these accounting problems and issues scientifically and research.

### **Research gap**

- i. The opinions addressed the development of accounting research by integrating the associated methods of AI and its digital transformation of accounting problems and issues. Perhaps the authors of this opinion have dealt with monitoring the phenomenon of accounting research by following AI methods in replicating previous solutions in a variety of different formats that do not provide New and modern solutions
- ii. The opinions addressed the shortcomings of AI methods in supporting accounting research except by providing more modern solutions and proposals that are different from those that were addressed in previous research, opinions, and proposals. That is, AI methods should be used to generate more modern solutions that are not repeated with their predecessors.

### **Section Two: Requirements for developing accounting education**

The accounting field differs specifically from the rest of the commercial fields in that it includes applied aspects, each of which is subject to professional organizations and different skills for the practitioners and practitioners of that profession, which is why many scientific and professional opinions seek to link education and learning in the accounting profession, and therefore to address the requirements of developing education. In order for an accountant to become suitable for the business environment in light of AI, the following must be addressed

### **Classifications of research in accounting education**

The nature of accounting education and its importance in influencing the accounting business environment is one of the most prominent fundamental points witnessed in research fields in recent times, as research in accounting education has been classified in terms of a set of skills, each of which defines several aspects of the specializations (Lee and Casterella, 2023). Accounting work is constantly and continuously relied upon by other fields. The foundation of this work depends to a large extent on scientific research in accounting education, which represents its cornerstone (Apostolou et al., 2023).

Accordingly, some have determined that scientific research in accounting education can be classified according to the skills that must be possessed by the learner into a lot of levels(Xu et al, 2023), the lowest level of which is as follows It consists of the following:

1. **Classification according to the cognitive and skills of accounting**, clarifies the skills that the researcher acquires in accounting science, and is reflected in traditional accounting programs such as financial accounting science.
2. **Classification according to the behavioral skills of accounting science**, clarifies the skills that determine the skills of dealing with others and third parties, and what the behavioral and ethical aspects include, such as the science of auditing, accounting auditing, and others.
3. **Classification according to influencing skills**, clarifies the psychological influences and factors that make the researcher distinguished and capable of creative, independent, and logical thinking.
4. **Classification according to technical and technological skills**, clarifies the minimum technical and technological skills that the researcher must have that enable him to deal and link cognitive and scientific skills with AI methods in light of digital transformation.
5. **Classification according to professional and practical skills**, clarifies the skills that the researcher is looking for and that he must possess in order to practice the profession

(professional certificates). Perhaps this classification of accounting education is directed more towards those who practice the profession and its practice, and therefore professional organizations have the most prominent role in determining the required level. Passing the course

6. **Classification according to academic skills**, showing the skills that the researcher acquires through the academic or additional level after completing the educational minimum for accounting (bachelor's degree).

### **2-2 Indicators for measuring the quality of research in accounting education**

The indicators and standards that can be relied upon to evaluate the quality of scientific research in accounting education can be determined by the study categories of accounting programs through the following (Tawfik &Elmaasrawy, 2022; Velasco, 2019)

1. **Learning and teaching methods index**. The aspects that allow identifying the different styles of students' learning represent the accounting aspects that help them exploit their abilities to the maximum possible degree, overcome academic difficulties better and achieve more efficient educational performance, ensuring the desired interaction between the learner and the surrounding environment is achieved for understanding. And adapt to it.

2. **The study plan clarity indicator**, represents the aspects that determine the courses taught at each student level or stage. That is, in the first two stages, basic courses and accounting educational and training principles are presented for the following accounting study stages.

3. **An indicator of the relationship of the program's mission to its objectives**. It represents the aspects related to achieving the accounting educational goal in terms of reaching the goal of accounting education and training, which is to provide an accountant capable of dealing with accounting cases in the current and expected practical reality in the diverse and different business environment.

4. **The indicator of learning resources and compilation of scientific material**, which represents the aspects related to the preparation and compilation of the topics and points that it includes and which are related to the environmental variables that the graduate or trainee is likely to encounter and work with.

5. **Academic Guidance and Guidance Index**, representing the aspects that provide the student, trainee, or scientific researcher with a comprehensive explanation of the nature of the academic courses and the relationship of the academic topics to practical reality.

### **2-3 Disadvantages of research in accounting education**

The most prominent shortcomings of scientific research in accounting education can be identified in the following points:

1. **The separation of accounting research from economic reality**. Often, scientific research may address accounting issues and problems with proposals and solutions that are not consistent with reality (Salman & Ali, 2020). Perhaps the most prominent of these issues is related to evaluating an accounting standard or calling for amending the tax accounting law.

2. **The difficulty of linking accounting educational aspects to realistic cases**. Scientific accounting research may not be included in the academic curricula for accounting education (Velasco, 2019), as in all educational aspects still reliance is placed on considering the accounting student bound to the level of scientific literature without developments and innovations in accounting science. Which faces the difficulty of achieving a link between the educational aspects of accounting and their counterparts in real-life situations.

3. **There is relative flexibility in changing accounting research topics**, despite the usual flexibility in giving the student or researcher an accounting situation close to reality (Sebrina, 2018), but the flexibility of this behavior leads to setting hypothetical considerations that are subject to personal wisdom without scientific or research judgment.

4. **The diversity and multiplicity of variables surrounding economic units**. Recently, accounting scientific research depends on the variables surrounding it witnessed by



accounting science (Handoyo& Anas, 2019), and therefore many accounting scientific researches will depend on their impact or reliance in the near future, as It is seen as a stage that has been skipped and is only addressed to inform researchers of the researchers' proposals for solutions and recommendations.

**5. Research and evaluation does not include innovation and creativity.** Many scientific accounting researches are seen as devoid of innovation and creativity (Sebrina, 2018). This is evident in the fact that they provide graphical and statistical analysis and practical application and do not teach or assign accounting students to learn and use it in the accounting field scientifically. And practically.

**6. Scientific research methods in accounting education.** It is seen that scientific research methods in accounting education need to be developed, as continuing to rely on the same steps, stages and aspects that represent the pillars of scientific research may not make them suitable for development and improvement, which also makes them vulnerable to the creation of variables on them .

### **Motives for developing research in accounting education**

- i. Surrounding environmental variables
- ii. Difficulty in familiarizing yourself with professional and applied experiences
- iii. Preparing students of accounting courses to understand practical cases
- iv. Local and international requirements for developing scientific research in accounting education

### **3. The role of AI in developing research in accounting education**

The researchers can extract the role of AI through the following points, which are considered an introduction to arriving at the conclusions of the research paper as follows:

**i. Rationalizing expenditures, consumption of material, scientific and research resources.** Relying on AI supports cost leadership if it is relied upon to reduce the research period and facilitate access to the closest and most appropriate references and sources that support the development and improvement of accounting education.

**ii. Preparing the accounting field to absorb scientific and practical innovations.** Comparing opinions, references, and research and scientific viewpoints works to extract ideas and evaluate them in a way that allows innovation without repetition. Perhaps this is what is called crediting scientific ideas and opinions with accounting education.

**iii. Ease of analysis, retrieval, and building scientific and practical relationships between variables.** AI achieves the basic rule of information systems, which is the ease of analysis, retrieval, and prediction of logical future steps that tend to approach expectation, predict paths, and simulate future reality.

**iv. Achieving entrepreneurship and building developmental, research and behavioral strategies.** AI is consistent with the requirements and trends of entrepreneurship, creativity and innovation in various competitive strategies, specifically in the research field of accounting education, as it should be noted that entrepreneurship only works through the integration of more than one strategy whose aspects it represents. AI, accounting education, and scientific research.

**v. Verifying the legitimacy of relationships and practical transactions in accounting education.** AI depends on relationships between more than one aspect, and therefore omitting an aspect or variable leads to a deficiency in the relationship and legitimacy between those variables together.

**vi. -Supporting and improving the efficiency of research, scientific work and accounting work, professionally and scientifically.** AI in the research field of accounting education enables it to address accounting problems and issues more efficiently than before,



as it clarifies the development of those issues and proposals for solutions in contrast to repeating formulas without scientific content.

#### **4. Conclusions and Recommendations**

##### **4-1 Conclusions**

1. The relationship between the three variables represented in research, accounting education, and AI is a close and interconnected relationship. Without the first (i.e. accounting education) the development and improvement of the second (i.e. accounting education) stops, which is considered inappropriate for the current business environment for all its categories, whether teaching or learning. Or a trainee, and both scientific research and accounting education depend on the latter (i.e. AI) to provide analytical technical support and classify opinions to reduce repetition and avoid shortcomings in the feasibility of research in accounting education.

2. The groups that seek to use research methods in accounting education in light of AI must understand the defects and criticisms of AI methods in the research and scientific field before the advantages and benefits expected to be achieved when preparing scientific research, which, in light of ignoring these defects, may become a different, repeated formulation with more content. To prevent the aggravation of accounting problems and issues, solutions and proposals for solutions must be provided.

3. AI methods are many and varied, and relying on modification, distortion, or reformulation of written content reduces its characteristics and capabilities, and makes it a temporary development that is not worthy of being continued, which makes it lose interest in its services and benefits, which represents its point of superiority in the research and scientific field of accounting education. Perhaps it is in Recently, methods have emerged that discover the shortcomings and limitations of other methods based on AI.

##### **4-2 Recommendation**

1. The necessity of considering research as a moral and ethical trust that requires taking into account the use of brainstorming, creativity and innovation in conveying the content and the associated and practical interactive relationships with accounting education.

2. AI and its various and varied methods are considered temporary fame that may provide the opportunity in the future to ignore it due to the emergence of other competitors. The limits of science and technology will not stop, so it must be taken into account that what is built on this momentary transformation makes what depends on it end-of-effect as soon as the competitor achieves success.

#### **Resources & References**

- Abdul Hassani, Waad Hadi, Al-Attar, Haider Abbas, Al-Ajabi, Aqeel Dakhil, 2019, Accounting education curricula and their impact on the scientific and practical aspects of accountants in Iraqi government institutions, applied research on “a sample of accounting students and graduates working in government institutions,” Journal of the College of Administration and Economics, Al-Muthanna University, Republic of Iraq, available on the website: <https://www.researchgate.net/publication/330349629>, 11/14/2023
- Atta, Leila, 2023, AI and how to benefit from it in the teaching and testing process in universities and schools, a report published on the Remark Office platform, available on the website: <https://blog.remarkomrsoftware.com/ai-benefits-in-education>, 10/8/2023
- Marwan, Muhammad Al-Ashi, Hisham, Kamel Madi, Moamen, Al-Dabash (2021), Information Technology and the Development of Accounting Education, Journal of Financial and Business Economics, Martyr Hama Lakhdar Al-Wadi University, sixth

- issue, John, available on the website:<https://www.asjp.cerist.dz/en/downArticle/468/6/1/160175>, 11/20/2023
- Ajila, Muhammad, Ajila, Houria, 2019, The components and requirements of quality accounting education, the perspective of academic accreditation, a future vision, Al-Maqrizi Journal of Economic and Financial Studies, Issue 3, Volume 3, available on the website: <https://www.asjp.cerist.dz/en/downArticle/650/3/3/122541>,10/11/2023
- American Accounting Association (AAA) Education Committee. 2021. Comment Letter. Lakewood Ranch, FL: AAA Education Committee.
- American Institute of Certified Public Accountants (AICPA) and National Association of State Boards of Accountancy (NASBA). 2021a. CPA evolution model curriculum, available at [:https://thiswaytocpa.com/collectedmedia/files/cpa-evolution-model-curriculum.pdf](https://thiswaytocpa.com/collectedmedia/files/cpa-evolution-model-curriculum.pdf)
- Amirhom, Jihan Adel, 2022, The impact of using AI applications on the future of the accounting and auditing profession (field study), Journal of Financial and Commercial Research, Faculty of Commerce, Port Said University, Journal of Financial and Commercial Research, Volume 23, Issue Two, April, available on the website: [https://jsst.journals.ekb.eg/article\\_230448 .pdf](https://jsst.journals.ekb.eg/article_230448.pdf),11/15/2023
- Apostolou, B., Tatiana N., Hassell J., Matuszewski L., 2023, Accounting education literature review (2022), Journal of Accounting Education, Volume 63, June, 100831, available at <https://www.sciencedirect.com/science/article/abs/pii/S0748575123000039>, 20/8/2023
- Handoyo, S., Anas, S., 2019, Accounting Education Challenges in the New Millennium Era, Journal of Accounting Auditing and Business, Vol.2, No.1, 2019, available at [:https://www.researchgate.net/publication/330538777](https://www.researchgate.net/publication/330538777), 10/11/2023.
- Lee, L., Casterella, G., 2023, A mental model approach to teaching database querying skills with SQL and Alteryx, Journal of Accounting Education, Volume64, September, 100858, available at <https://www.sciencedirect.com/science/article/abs/pii/S0748575123000301>, 10/8/2023
- Mohamed, Wael Hussein, 2018, Using cloud computing services to develop university accounting education in Egypt, Journal of Accounting Thought, Faculty of Commerce, Ain Shams University, Issue 4, Volume 22, available on the website: [https://atasu.journals.ekb.eg/article\\_36645.html](https://atasu.journals.ekb.eg/article_36645.html), 10/11/2023
- Ng, C., 2023, Teaching Advanced Data Analytics, Robotic Process Automation, and AI in a Graduate Accounting Program, Journal Issues in Accounting Education, available at [:https://publications.aaahq.org/jeta](https://publications.aaahq.org/jeta), 15/8/2023
- Requirements for improving the quality of accounting education in Algeria (a standard study), <https://www.asjp.cerist.dz/en/downArticle/329/4/1/26313>,
- Riyad, Abeer Muhammad, 2019, The impact of using information and communications technology in developing the accounting education system to meet quality and accreditation requirements, Journal of Accounting Thought, Faculty of Commerce, Ain Shams University, Issue 1, Volume 23, available on the website:<http://search.mandumah.com/Record/964373/Details>,11/11/2023
- Sebrina, N., Serly, V. & Taqwa, S. ,2018, The determinant factors comprising students' performance in the digital era. A paper presented in the 1st International Conference On Economics Education, Economics, Business &Management, Accounting and Entrepreneurship (PICEEBA 2018). Advances in Economics, Business and Management Research, 57, available at [:https://www.atlantispress.com/proceedings/piceeba-18/25902713](https://www.atlantispress.com/proceedings/piceeba-18/25902713), 12/11/2023.

- Susskind, D. 2020. A World Without Work: Technology, Automation and How We Should Respond. New York, NY: Metropolitan Books, available at : <https://www.danielsusskind.com/a-world-without-work>, 20/8/2023
- Tawfik, O., Elmassrawy, H., 2022, Assessing the factors that affected the development of cloud-based accounting education and students' academic performance in Oman, Arab Gulf Journal of Scientific Research, Volume 41 Issue 2, available at : <https://www.emerald.com/insight/content/doi/10.1108/AGJSR-07-2022-0102/full/html>, 20/8/2023
- Velasco, M. Rodrigo, 2019, Factors Associated with Failure in Accounting: A Case Study of the Omani Students, International Journal of Higher Education, Vol. 8, No. 6; 2019, available at :<https://files.eric.ed.gov/fulltext/EJ1232208.pdf>, 11/11/2023.
- Venkatesh, R. Riley, J. Eldridge, S. Lawson, R. Church, K. , 2023, Management Accounting—A Rising Star in the Curriculum for a Globally Integrated, Technology-Driven Business Age, Journal Issues in Accounting Education, available at : <https://publications.aaahq.org/iae/article/doi/10.2308/ISSUES-2021-058/11393>, 25/8/2023
- Xu, H., Waldrup, B., Michenzi, A., 2023, Assessing the effectiveness of advisory boards in accounting programs, Journal of Accounting Education, Volume 63, June, 100847, available at :<https://www.sciencedirect.com/science/article/abs/pii/S0748575123000192>, 11/8/2023

# ANALYSES OF COMMON BEHAVIORAL BIAS AMONG INDO-ARABIAN INVESTORS AND HOW TO BETTER MANAGE THEM

**Dr. Hemant Bhanawat,**

SVKM's Narsee Monjee Institute of Management Studies, Chandigarh, India.

(hbhanawat89@gmail.com)

**Richard Sagor Mitra,**

Amity University Rajasthan, India.

(richard25mitra@gmail.com)

Behavioral Finance tries to understand and explain the reasons for irregularities in an investor's investment decision. This study aims to understand the behavioral biases common to Indo-Arabian investors and how finance managers and practitioners can better address these issues to attract potential investors and retain existing ones. The study conducts a systematic literature review to identify common biases and suggest ways to deal with them. The study finds that overconfidence, herding, and loss aversion are common biases displayed by investors in both countries, among other biases. It is suggested that overconfident investors should be provided with correct market information and made aware of the risks associated with unchecked investments. To check herding among investors, companies can customize portfolios in such a way that is suitable for individual customers according to their financial capacities so they become confident to make independent and bold decisions. And, loss averts investors need to be encouraged to see the brighter side of investment so that they are able to balance their emotions and fear of loss. It is recommended to further study the reasons for such similarities in the biases among the investors from a cultural perspective.

**Keywords:** *Behavioral Finance, Behavioral Bias, Indian Stock Market, Saudi Stock Market.*

## 1. Introduction

One of many economic assumptions is the idea of *economic man* (homo economicus) (Kenton, 2022). The assumption, as described by John Stuart Mill, states that man (humans) is a rational being, whose primary objective is to maximize his satisfaction from the given options (Kapoor & Prosad, 2017). There are three underlying assumptions to this; perfect information, absolute rationality, and maximizing self-interest. These assumptions lay the foundation for the *traditional financial framework*. It is sought that while making a financial decision the person has all and perfect information about the market or the options; only makes logical decisions; and, the primary objective of all his decisions is to maximize his satisfaction (maximum utility).

These assumptions help economists and financial practitioners create a theoretical world where the majority of the occupants display the assumed characteristics. This helps them to understand and predict a logical outcome, for a given hypothetical situation. However, the real world does not function that way. In reality, man is not always rational in their financial decisions. Not all of the decisions they make can be logically or mathematically explained. (Although this leads to a rather philosophical question of what is to be considered rational in finance, that is not the scope of this paper.)

*Behavioral Finance* tries to understand and explain the reasons for irrationalities in the investment decision of investors (Kapoor & Prosad, 2017). One of the classical financial theories is the *expected utility theory*. This theory holds that when making a decision under uncertainty a person or entity will first weigh (analyze) all the possible outcomes and then choose the course of action that gives the highest utility at any given point in time (Chen, 2022). While the explanation for the expression 'highest utility' from a financial viewpoint means that it brings maximum monetary benefit, in reality, there are other major aspects related to 'maximum utility'.

Behavioral experts refer to these irrationalities as biases. Numerous biases have been identified so far (Kumar & Goyal, 2015; Zahera & Bansal, 2018), with ongoing research in the field. The objective of this research is to identify the common behavioral biases present among investors in India and the Kingdom of Saudi Arabia, respectively. Given that companies depend on investors for raising capital for their operations, it is important that executives and financial practitioners understand the

behavioral bias that influences the investors' decision-making process. Hence, the novelty of this study.

The second part of the paper presents a brief review of important concepts in behavioral finance and bias, respectively. The third part presents the Indian and Saudi stock markets and the major biases in each country, respectively. Finally, the paper discusses the common biases found in these two countries and makes suggestions on how to deal with them. The paper ends with indications for further research and a conclusion.

## 2. Behavioral Finance and Biases

Olsen (1998) defined behavioral finance as a '*part of science, in that it starts from fundamental axioms and asks whether a theory built on the axiom can explain behavior in the financial marketplace.*' He also said that behavioral finance is not merely about asserting the rationality of a decision or label them as biases. On the contrary, it should try to '*understand and predict systematic financial market implications of psychological decision process.*'

In their review paper, Ricciardi & Simon (2000) mentioned that ideas of behavioral finance can be traced back to a few original books written back in the 1800s and 1900s. Some of those are MacKay's *Delusions And The Madness Of Crowds*, Le Bon's *The Crowd: A Study Of The Popular Minds*, and Selden's *Psychology Of The Stock Market*, to mention a few. The paper states that psychology, sociology, and finance form the foundations of behavioral finance. This presents the more wholesome inter-disciplinary approach to understanding the decision-making process.

Zahera & Bansal (2018) conducted an extensive review of literature on the behavioral bias and listed a total of 17 biases. Investors are influenced by various biases while making investment decisions. Those are overconfidence, disposition effect, herding effect, mental accounting, confirmation bias, hindsight bias, house money effect, endowment effect, loss aversion, framing, home bias, self-attribution bias, conservatism, regret aversion, recency, anchoring, and representativeness. These are some of the major biases identified so far with much research being carried out in the field.

Nagy & Obenberger (1994) conducted an empirical study to examine the influence of various utility -maximization and behavioral variables in the decision-making process. They asked the respondents to rank the importance of 34 given variables on the degree of their influence. The findings suggest the classical wealth-maximization criteria has major influences in investor's decision-making process. Top three variables that significantly influence decision-making process are *expected corporate earnings, diversification needs, and feelings for the firm's products and service*, among others. On the other hand, top three variables that have least influence on investment decision-making are *local operations, international operations, and family member opinions*, among others.

Since a fuller review of the concept of behavioral finance and its associated biases are not the aim of this paper, we do not present an in-depth review of literature but a short one.

## 3. Research Framework

Employing the systematic literature review method, this research compares and explores the common behavioral biases among investors in India and the Kingdom of Saudi Arabia. Data has been collected from secondary sources only. The first part of the paper will present the behavioral biases displayed by the investors of these countries and identify the common biases. The later part will discuss possible ways to work around those biases.

Comparison of stock markets helps develop a deeper and wider understanding of the investors and the opportunities present in a country. If the companies are aware of the investor's decision-making process, they can customize their offerings to better attract and sustain investors,

### 3.1. Choice of Nations

The bilateral relation between India and Saudi began in 1947. Since then, leaders of both the countries have made continuous effort to strengthen and benefit from the said relation. Back in February 2019, during India visit of Saudi's Crown Prince Mohammad bin Salman, he announced that Saudi has plans of investing approximately \$100 billion in India in various sectors, and also signed six MOUs. That same year in October, Prime Minister Narendra Modi visited Saudi and another twelve MOUs were signed between the two nations.<sup>i</sup>



Prominent investment options for Indians in Saudi are Saudi Aramco, SABIC, Alfanar Energy, Public Investment Fund, and Zamil Air Conditioners India Pvt. Ltd, to mention a few. Similarly, prominent investment options for the Arabians in India are Wipro, Tata Group, and Larsen & Toubro, to mention a few.<sup>ii</sup>

With such past, ongoing, and future international business collaboration in focus, this study justifies its relevance and importance to understand the behavioral biases that influence their decision making. Because, ultimately it is the investors who will invest in these endeavors and companies need to attract and retain investors.

#### **4. India, Indian Stock Market, and Investor's Behavioral Bias**

India is one of the largest countries of South Asia and 7<sup>th</sup> largest in the world. The country gained its independence in 1947 and is governed by a *Sovereign Socialist Secular Democratic Republic with a Parliamentary system of Government*, that is based on *The Constitution of India*. A total of 28 States and 8 Union Territories makes up the total administrative divisions of the country. The President is the constitutional head of the country, while the Prime Minister is the head of the government<sup>iii</sup>.

Historically, archeological art affects confirm that much of the northwestern regions were culturally influenced by the great Indus Valley Civilization. Cultural practices that developed based around this civilization are associated with Hinduism, making it the primary religion in the country. In addition, Buddhism, Jainism, Islam, Christianity is among major religions in the country, with many other regional and ethnic religious practices (Schwartzberg, 2023).

One of the most astonishing things about India is its cultural diversity. To begin with, the 28 States have their primary culture as each of these States are made up of their indigenous group of people. For example, the state of Chennai is primarily comprised of Tamilians, Punjab with Punjabis, and West Bengal with Bengalis, among others. Each indigenous group have their very own, distinguished and particular cultural practices and festivals. In general, the daily life-style of people including their financial decisions are highly influenced by their cultural and religious affiliations (Chan & Ananthram, 2019; Schwartzberg, 2023).

There are two major stock exchanges in India, namely, the Bombay Stock Exchange (BSE) and the National Stock Exchange (NSE), both situated in Mumbai. The currency of trading is Indian Rupee. The Securities and Exchange Board of India (SEBI) is the regulatory authority over the stock markets. At both exchanges, trading is facilitated by an open electronic limit order book. India is open to both domestic and foreign investors, subject to various regulations (Singh, 2022).

The BSE was established in 1875 and the NSE was incorporated in 1992, respectively. At present the BSE offers trading in equity, debt instruments, currencies, mutual funds, and derivatives<sup>iv</sup>. On the other hand, NSE offers 3 categories of product, namely, derivatives, fixed income securities and equities<sup>v</sup>. Thousands of well reputed companies listed with both the stock exchanges, respectively.

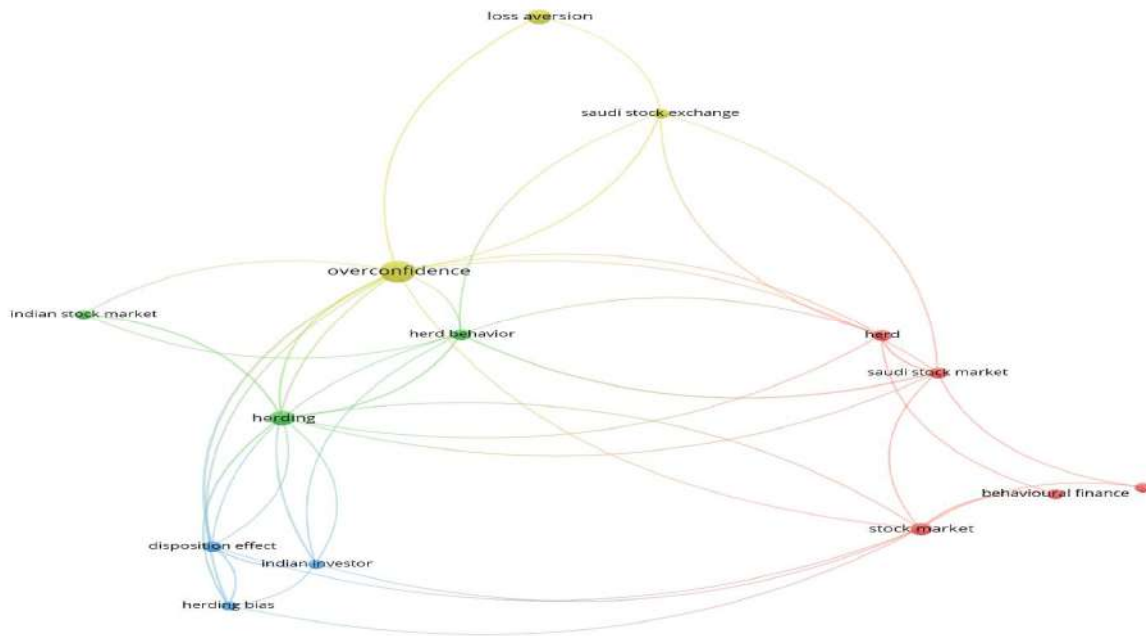
Studies done on Indian investors reveal the presence of various behavioral biases among investors. Major biases are overconfidence and self-attribution, anchoring bias, mental accounting, the disposition effect, representativeness, herding, emotional biases, loss aversion bias, availability bias, and regret aversion bias, among others (Baker et al., 2019; Chauhan et al., 2020; Prosad et al., 2015; Prosad et al., 2018; Kansal & Singh, 2018; Jain et al., 2020; Mushinada & Veluri, 2018; Kumar et al., 2016).

It is important to note that the respondents in these researches are from all over the country. That means, people from various cultural and religious background have displayed these behavioral biases. However, most of the investors are followers of some form of Hinduism or other local religious practice. Demographics presented by the above-mentioned studies state that the number of male traders is more than female traders. The average age group of investors lies between 25-45 years old, and mostly college graduates.

#### **5. Saudi Arabia, Saudi Arabian Stock Market, and Investor's Behavioral Bias**

The modern Kingdom of Saudi Arabia was established by King Abdulaziz Al-Saud in 1935. It is the largest country in the Arabian Peninsula. The country is an Arab and Islamic Sovereign State, with Islam as its state religion and is governed by the Holy Qur'an and the Sunnah as its constitution. The King is the head of the state, who is assisted by the Council of Ministers in discharging his duties<sup>vi</sup>.





Historically, the people in these regions lived in tribes, comprising mainly family members. The region has experienced its fair share of wars among these tribes for territory and control of resources. Saudi is the birth place of Islam, hence the primary religion of the country. The cultural and daily life of the people is based on Islamic principles, including food, cloths, and social associations. Beside these, Christians and Hindus form minor religious groups (Teitelbaum et al., 2023).

The Saudi Tadawul Group was established in 2021 and operates the Saudi Stock Exchange (SSE) as its subsidiary<sup>vii</sup>. However, the SSE was formed in 2007 as a joint stock company<sup>viii</sup> and is the only stock exchange in the country. The Capital Market Authority (CMA) is the regulatory authority to regulate and develop the stock market in the country. Investment opportunities are available to both national and international investors<sup>ix</sup>. At present the exchange offers equities, derivatives, bonds (sukuk) and exchange traded funds (ETF)<sup>x</sup>.

Figure:1

Studies reveal the presence of herding behavior, overconfidence, loss aversion, low opportunism, mimetism, sensitivity to rumors, and risk perception (Arabi & Abdelmageed, 2022; Alnajjar, 2013; Alsabban & Alarfaj, 2020; Rahman et al., 2015; Aljughaiman & Chebbi, 2022; Alquraan et al., 2016; Matoussi & Mostafa, 2016). Limited research has been done on the Saudi Stock Market.

Demographical data represent that, male investors are more than female investors. Majority are followers of Islam. The level of education has a positive impact on the quality of their investment decision, while age and gender have no such major influence.

## 6. Discussion

Based on the accessible literature it is observed that overconfidence, herding, and loss aversion are common behavioral biases exhibited by investors in both countries. Due to the limited access to related literature on the Saudi and Indian Stock Markets, respectively, a fuller analysis has not been feasible.

Figure:1 shows the network representation showing the interlink among the literature referred in this article. The network points out the common behavioral biases between Indian and Saudi investors. Herding, overconfidence, and loss aversion are the three main biases identified in the literature.

In this section we shall briefly mention the central idea of each of these three biases. In the next section we shall propose practical implications as to how financial practitioners can better manage their public offerings to retain existing and attract potential investors, respectively.

### 6.1 Overconfidence

The term is quite self-explanatory! An investor is said to displaying overconfident bias when they '*overestimate their ability and the accuracy of the information they have*' (Byrne et al., 2008). In doing so, they ignore the associated risk (or disregards the level of risk) an investment poses should it fail (Kumar & Goyal, 2015). They attribute the higher performing market to their personal performance and highly optimistic about future market outcomes (Zahera & Bansal, 2018). Overconfidence can be combined with self-attribution bias, which states that people attribute success to themselves (their skills), but consider it as a bad luck should they fail (Bondt et al., 2008).

Research also suggests that people with less or inadequate information also display overconfidence bias. This is because, almost everyone considers themselves better than an average person and estimate themselves better than how others look upon them. In addition, overconfidence has been described as a *situational phenomenon* that is mainly displayed when people (investors) need to make decisions under uncertainty (Kufepaksi, 2011).

Raheja & Dhiman (2020) suggest that people display overconfidence due to their long years of trading. They believe they are better in their speculations and can become careless about their choices. They assume they will continue to be correct. This means, elderly investors are more likely to display overconfident bias as compared to younger investors. However, at the same time, the younger investors might be more educated than elderly investors and tech oriented, thereby, consider themselves smarted and display overconfidence. This is a potential idea for future research.

### 6.2 Herding

The simple meaning of the word herding means to move as a group<sup>xi</sup>. The term is used to describe similar characteristics in behavioral finance. Investors are said to be displaying a herding bias when a single investor is not able to make their own decision and therefore does what other investors are doing (Raheja & Dhiman, 2020). In many instances, such investors do not make their own investment decisions but take advice and guidance from someone they consider wise or adequately knowledgeable on the matter (Jain et al., 2020).

Herding is also described as a strategy where the new or the middle-class investors closely monitor the investment pattern of the more experienced and wealthy investors, and simply follow their lead. Also, many a times investors can simply follow the crowd's investment pattern when they realize the potentiality for general market failure, described as *welfare losses* (Madaan & Singh, 2019). Research also suggests that when people are provided with the information of the decision made by other people, they tend to choose the option with highest selection rate; majority decision (Compen et al., 2022).

### 6.3. Loss Aversion

Loss aversion is one of the core assumptions of the prospect theory that was introduced by Kahneman and Tversky in 1979 (Schmidt & Traub, 2022). The theory states that people choose the option that gives them maximum satisfaction (utility) (Bao & Meng, 2017). When making a decision, '*the absolute subjective value of a specific loss is larger than the absolute subjective value of an equivalent gain*' (Ert & Erev, 2013). Meaning, a loss impacts a person with negative emotions more than the positive emotions if same amount of profit was made. Women are said to be more loss averse than man, while men are more overconfident than woman (Hassan et al., 2014).

## 7. Dealing with Biases

### 7.1 Managing Overconfidence Bias

Investors display overconfidence mainly under uncertainty and lack of proper (authentic) information. Companies need to see that they provide their clients with correct information about their company. Their financial statements should disclose all those figures that are necessary for computing various financial ratios and other market indicators so they can take informed decision instead of assumed decisions. Most Indian investors at least have a college degree (Baker et al., 2019; Sahi &

Arora, 2012). Which means they will be able to read and understand various technical aspects of trading if they are provided with the information.

Since overconfident investors tend to ignore the risks associated with their decision, companies can try to explicitly make the investors aware of the risks. In doing so they can aim to gain the investor's trust and a long-lasting relationship. Also, overconfident investors are risk takers and adventurous. Companies can try to create a niche market for that so called 'top 1% rich' into adventurous investment portfolios and harness the positive impact of overconfidence.

It is also found that men display more overconfidence than woman (Jain et al., 2020; Kufepaksi, 2011). Given that both India and Saudi are more of a paternal society, it is no surprise for them to display overconfidence. However, if companies (or brokerage firms) can encourage the investors to develop a practice of discussing their investment plans with their wife, theoretically, a more weighted decision is expected to be made as the overconfident husband will be advised by an underconfident wife who is most likely to point out the risks. Similar idea is proposed by Russo & Shoemaker (1992) who described the process as *counterargumentation*.

Finally, companies ought to focus at increasing the level of financial literacy of the investors. That doesn't mean everyone needs to get a bachelor degree in finance. The simple awareness about the influence of behavioral biases in investment decision making can help investors analyze themselves and avoid displaying such behavior.

### 7.2 Managing Herding Bias

Unlike overconfidence, herding can be a cause of *under-confidence*. Investors might not be confident on the market information or the company's financial statements. Which is why they feel safer with the majority. Providing them with correct and adequate information can provide them with the courage to make their own decisions.

If investors can be provided with combination of investment options that best suits their need and finances, they will not have anyone to follow as those combinations are only made for them. In such scenario they will have to make an independent decision.

Companies can harness the benefits of herding behavior. If a company can attract some major players in the market to invest in their stocks, that could attract other small scale investors. The share price of such a company is most likely to increase. This can be achieved by promoting proper company image, one that is ethical, eco-friendly, humanitarian (SCR activities), among others.

Herding can prove to be dangerous for the company if investors collectively decide to boycott investing in a particular company. There is a high possibility of witnessing this phenomena in Saudi, as there are certain products considered *haram* (sin product) according to the teachings of Islam (Alam et al., 2017). Similarly, many Indians are pro nature and prefer to invest in 'eco-friendly' companies these days, and boycott companies that they consider are harming nature. Companies should consider the socio-religious background of the investors.

### 7.3 Managing Loss Aversion Bias

The loss aversion bias is very subjective and hence it is difficult to suggest any technique to resolve it. People perceive happiness and sadness at different levels. Research shows that loss aversion can occur at both risky and riskless situations. Loss aversion increases with age, income and wealth (Gächter et al., 2022). This implies that young investors are less loss averse. The demographic information on these two countries shows that most of the investors are male and age between 25-35. Companies will need to prove themselves to attract investors as younger investors are tech-and-info savvy.

Companies need to project the benefits more than the potential loss (risk). However, that doesn't mean the company should trick the investors by selling lies or false hope. Loss averse investors need to be offered with investments with sure return.

## 8. Conclusion and Recommendations for Further Studies

Behavioral biases are global and unavoidable. Unless humans become cyborgs, there will always be some or the other kinds of bias in their decision-making, because, after all, emotion is what makes us human. This paper has identified the various behavioral biases displayed by Indian and Saudi Arabian investors, respectively, from existing literature. Among many, overconfidence, herding and

loss aversion are common biases noticed among investors of both the country. While biases can't be fully eradicated measures can be taken to reduce their impact in investment decision process. Financial literacy lies at the core in this endeavor (Adil et al., 2022). The simple awareness about these biases and how they are displayed rather unconsciously can help an investor analyze themselves to identify these biases and take corrective measures whenever necessary (Baker & Ricciardi, 2014). In addition, companies need to be mindful of the socio-cultural and religious affiliation of their target customers. They will be able to serve their clients better when they are aware of the biases that influence their decision making (Raheja & Dhiman, 2020).

Further study is recommended on the influence of culture on investors behavioral bias.

**9. Funding: - No Funding**

**10. Ethical Approval: This article does not contain any studies with human participants performed by any of the authors**

**11. Author's Contribution: Both of the authors worked together and concluded the article.**

**12. Conflict of interest: no conflict of interest**

**13. Data availability statement: Data used in the article is available on BSE, NSE and Saudi Stock Exchange.**

**14. Acknowledgment: NIL**

**15. References**

Adil, M., Singh, Y., & Ansari, M. S. (2022). How financial literacy moderate the association between behaviour biases and investment decision? *Asian Journal of Accounting Research*, 7(1), 17–30. <https://doi.org/10.1108/AJAR-09-2020-0086>

Alam, Md. M., Akbar, C. S., Shahriar, S. M., & Elahi, M. M., (2017). The Islamic Shariah Principles for Investment in Stock Market. *Qualitative Research in Financial Markets*, 9(2), pp. 132-156, <https://doi.org/10.1108/QRFM-09-2016-0029>

Aljughaiman, A. A., & Chebbi, K. E. (2022). Do Investor Overconfidence and Loss Aversion Drive Saudi Firm Market Performance? The Moderating Effect of Corporate Governance. *Sustainability (Switzerland)*, 14(16). <https://doi.org/10.3390/su141610072>

Alnajjar, M. I. M. (2013). Behavioral Inferences of Tadawul Investor. *International Journal of Business and Management*, 8(24), 17–24. <https://doi.org/10.5539/ijbm.v8n24p17>

Alquraan, T., Alqisie, A., & Al Shorafa, A. (2016). Do Behavioral Finance Factors Influence Stock Investment Decisions of Individual Investors? (Evidences from Saudi Stock Market). *American International Journal of Contemporary Research*, 6(3), 159–169. [www.aijcrnet.com](http://www.aijcrnet.com)

Alsabban, S., & Alarfaj, O. (2020). an Empirical Analysis of Behavioral Finance in the Saudi Stock Market: Evidence of Overconfidence Behavior. *International Journal of Economics and Financial Issues*, 10(1), 73–86. <https://doi.org/10.32479/ijefi.8920>

Arabi, K. A. M., & Abdelmageed, H. M. (2022). Is Herd Behavior Still Persistent in the Saudi Stock Market? *Archives of Business Research*, 10(2), 244–251. <https://doi.org/10.14738/abr.102.11886>

Baker, H. K., Kumar, S., Goyal, N., & Gaur, V. (2019). How financial literacy and demographic variables relate to behavioral biases. *Managerial Finance*, 45(1), 124–146. <https://doi.org/10.1108/MF-01-2018-0003>

Baker, H. K., & Ricciardi, V. (2014). How Biases Affect Investor Behaviour. *The European Financial Review*, 7–10.

Bao, H. X. H., & Meng, C. C. (2017). Loss aversion and housing studies. *Journal of Real Estate Literature*, 25(1), 49–75. <https://doi.org/10.1080/10835547.2017.12090454>

Bondt, W. F. M. De, Muradoglu, Y. G., Shefrin, H. and Staikouras, S. K. (December 3, 2008) Behavioral Finance: Quo Vadis?. *Journal of Applied Finance (Formerly Financial Practice and Education)*, Vol. 18, No. 2, 2008, Available at SSRN:<https://ssrn.com/abstract=2698614>

Byrne, A., Brooks, M., & Gifford, B. (2008). Behavioral Finance: Theories and Evidence. *Behavioral*

- Finance: Theories and Evidence*, 1979, 1–26. <https://doi.org/10.2470/rflr.v3.n1.1>
- Chan, C., & Ananthram, S. (2019). Religion-Based Decision Making in Indian Multinationals: A Multi-faith Study of Ethical Virtues and Mindsets. *Journal of Business Ethics*, 156(3), 651–677. <https://doi.org/10.1007/s10551-017-3558-7>
- Chauhan, Y., Ahmad, N., Aggarwal, V., & Chandra, A. (2020). Herd behaviour and asset pricing in the Indian stock market; Herd behavior and asset pricing. *IIMB Management Review*, 32(2), 143–152. <https://doi.org/10.1016/j.iimb.2019.10.008>
- Chen, J. (2022, October 14). Expected Utility: Definition, Calculation, and Examples. Investopedia. Retrieved March 21, 2023, from <https://www.investopedia.com/terms/e/expectedutility.asp>
- Compen, B., Pitthan, F., Schelfhout, W., & De Witte, K. (2022). How to elicit and cease herding behaviour? On the effectiveness of a warning message as a debiasing decision support system. *Decision Support Systems*, 152(August), 113652. <https://doi.org/10.1016/j.dss.2021.113652>
- Ert, E., & Erev, I. (2013). On the descriptive value of loss aversion in decisions under risk: Six clarifications. *Judgment and Decision Making*, 8(3), 214–235. <https://doi.org/10.1017/s1930297500005945>
- Gächter, S., Johnson, E. J., & Herrmann, A. (2022). Individual-level loss aversion in riskless and risky choices. *Theory and Decision*, 92(3–4), 599–624. <https://doi.org/10.1007/s11238-021-09839-8>
- Hassan, T. R., Khalid, W., & Habib, A. (2014). Overconfidence and loss aversion in investment decisions: A study of the impact of gender and age in Pakistani Perspective. *Research Journal of Finance and Accounting*, 5(11), 148–158. [www.iiste.org](http://www.iiste.org)
- Jain, J., Walia, N., & Gupta, S. (2020). Evaluation of behavioral biases affecting investment decision making of individual equity investors by fuzzy analytic hierarchy process. *Review of Behavioral Finance*, 12(3), 297–314. <https://doi.org/10.1108/RBF-03-2019-0044>
- Kansal, P., & Singh, S. (2018). Determinants of overconfidence bias in Indian stock market. *Qualitative Research in Financial Markets*, 10(4), 381–394. <https://doi.org/10.1108/QRFM-03-2017-0015>
- Kapoor, S., & Prosad, J. M. (2017). Behavioural Finance: A Review. *Procedia Computer Science*, 122, 50–54. <https://doi.org/10.1016/j.procs.2017.11.340>
- Kenton, W. (2022, December 13). What is an economic man? definition, use in analysis, and history. Investopedia. Retrieved March 21, 2023, from <https://www.investopedia.com/terms/e/economic-man.asp>
- Kufepaksi, M. (2011). The impact of overconfidence and gender on trading activity: How well do investors assess probability? *World Review of Entrepreneurship, Management and Sustainable Development*, 7(4), 440–462. <https://doi.org/10.1504/WREMSD.2011.042895>
- Kumar, A., Bharti, M., & Bansal, S. (2016). An Examination of Herding Behavior in an Emerging Economy– A Study of Indian Stock Market. In *Global Journal of Management and Business Research* (Vol. 16, Issue 5, pp. 1–9).
- Kumar, S., & Goyal, N. (2015). Behavioural biases in investment decision making – a systematic literature review. *Qualitative Research in Financial Markets*, 7(1), 88–108. <https://doi.org/10.1108/QRFM-07-2014-0022>
- Madaan, G., & Singh, S. (2019). An analysis of behavioral biases in investment decision-making. *International Journal of Financial Research*, 10(4), 55–67. <https://doi.org/10.5430/ijfr.v10n4p55>
- Matoussi, H., & Mostafa, A. (2016). *An investigation of Investors Bias on Saudi stock exchange*. 1–26.
- Mushinada, V. N. C., & Veluri, V. S. S. (2018). Investors overconfidence behaviour at Bombay Stock Exchange. *International Journal of Managerial Finance*, 14(5), 613–632. <https://doi.org/10.1108/IJMF-05-2017-0093>



- Nagy, A., & Obenberger, W. (1994). Influencing Individual Behavior Investor. *Financial Analysts Journal*, 50(4), 63–68.
- Olsen, R. A. (1998). Behavioral Finance and Its Implications for Stock-Price Volatility. *Financial Analysts Journal*, 54(2), pp. 10-18. <http://www.jstor.org/stable/4480062>.
- Prosad, J. M., Kapoor, S., & Sengupta, J. (2015). Behavioral biases of Indian investors: a survey of Delhi-NCR region. In *Qualitative Research in Financial Markets* (Vol. 7, Issue 3). <https://doi.org/10.1108/QRFM-04-2014-0012>
- Prosad, J. M., Kapoor, S., Sengupta, J., & Roychoudhary, S. (2018). Overconfidence and Disposition Effect in Indian Equity Market: An Empirical Evidence. *Global Business Review*, 19(5), 1303–1321. <https://doi.org/10.1177/0972150917726660>
- Raheja, S., & Dhiman, B. (2020). How do emotional intelligence and behavioral biases of investors determine their investment decisions? *Rajagiri Management Journal*, 14(1), 35–47. <https://doi.org/10.1108/ramj-12-2019-0027>
- Rahman, M. A., Chowdhury, S. S. H., & Shibley Sadique, M. (2015). Herding where retail investors dominate trading: The case of Saudi Arabia. *Quarterly Review of Economics and Finance*, 57, 46–60. <https://doi.org/10.1016/j.qref.2015.01.002>
- Ricciardi, V., & Simon, H. K. (2000). What is Behavioral Finance?. *Business, Education & Technology Journal*, 2(2), pp. 1-9, Available at SSRN: <https://ssrn.com/abstract=256754>
- Russo, E. J., & Shoemaker, P. J. (1992). Managing Overconfidence. *Sloan Management Review*, 33(2), 7–17.
- Sahi, S. K., & Arora, P. A. (2012). Individual investor biases: a segmentation analysis. *Qualitative Research in Financial Markets*, 4(1), 6–25. <https://doi.org/10.1108/17554171211213522>
- Schmidt, U., & Traub, S. (2022). An Experimental Test of Loss Aversion. *Journal of Risk and Uncertainty*, 25(3). pp . 233-249. <https://www.jstor.org/stable/41761121>
- Schwartzberg, J. E. , Calkins, . Philip B. , Subrahmanyam, . Sanjay , Thapar, . Romila , Wolpert, . Stanley A. , Raikar, . Sanat Pai , Alam, . Muzaffar , Srivastava, . A.L. , Dikshit, . K.R. , Spear, . T.G. Percival , Allchin, . Frank Raymond and Champakalakshmi, . R. (2023, March 25). India. *Encyclopedia Britannica*. <https://www.britannica.com/place/India>
- Singh, M. (2022, July 13). An Introduction to the Indian Stock Market. Investopedia. Retrieved March 31, 2023, from <https://www.investopedia.com/articles/stocks/09/indian-stock-market.asp>
- Teitelbaum, J., Ochsenwald, William, L. and Philby, Harry St. John Bridger (2023, March 25). Saudi Arabia. *Encyclopedia Britannica*. <https://www.britannica.com/place/Saudi-Arabia>
- Zahera, S. A., & Bansal, R. (2018). Do investors exhibit behavioral biases in investment decision making? A systematic review. *Qualitative Research in Financial Markets*, 10(2), 210–251. <https://doi.org/10.1108/QRFM-04-2017-0028>



## ANALYZING AND ESTIMATING SOME MONETARY POLICY TOOLS ON INFLATION RATES IN IRAQ FOR THE PERIOD (2010- 2018)

**Ghussoon Talfan Madloul**

Faculty of Economics and Business Administration, Farahidi University Baghdad, IRAQ  
(ghossontalfan@gmail.com)

**Amina Moayad Abd Alla**

Faculty of Economics and Business Administration, Farahidi University Baghdad, IRAQ  
(aminamoayed@yahoo.com)

**Doaa Hikmat Abbas**

Faculty of Economics and Business Administration, Farahidi University Baghdad, IRAQ  
(Doaahikmat7@gmail.com)

Monetary policy is an essential part of the general economic policy, as monetary policy seeks to achieve many economic goals through quantitative and qualitative tools to maintain stability and monetary balance, and its importance increased with the beginning of the twentieth century due to the increase and complexity of monetary and economic problems, Represented in the rise in the general price level, as it is considered one of the most important macroeconomic indicators around which the process of formulating monetary policies revolves for the welfare of consumers.

The study relied on the use of descriptive and analytical methods in analyzing the data as well as statistical method by using the program (SPSS) to find the effect between the independent and dependent variables during the period (2010-2018), the study also aims to identify the role of monetary policy in facing inflationary conditions, this policy is issued by the Central Bank, the most important of which is the legal reserve, the discount price, and open market operations through the three sections, which consist of general concepts about monetary policy tools and inflation. As for the practical section data for all variables was analyzed. Statistically, these results were proven to be identical to the economic theory.

Hence, the importance of monetary policy in solving economic problems has increased, given the multiplicity of effects that monetary policy leaves in various economic fields and aspects, including the impact on the performance of commercial banks by determining the amount of cash reserves in order to guarantee the rights of depositors and the safe use of funds and avoid risks, as well as open market operations which has an active role in curbing the increasing rates of inflation, as well as the discount price and its active role in controlling inflation therefore, the application of monetary policy tools is a preoccupation for banking departments, as banks can lose their customers as a result of the irrational and rational use of available financial resources, which is reflected Negatively on the levels of profits achieved and the financial position of the banking sector in particular and the overall economy in general, and this in turn affects the levels of inflation and limit the increase of its rates.

**Keywords: monetary policy, discount price, monetary reserve, open market operations, inflation.**

### **Research Problem:**

What is the reality of monetary policy and how effective it is in reducing inflation rates? In order to answer this fundamental question, we must first answer the following sub-questions:

- How effective is monetary policy in achieving economic stability and curbing inflation?
- What is the reality of monetary policy in Iraq and what are the reforms witnessed by this policy?
- Do monetary instruments (open market operations, legal reserve, "discount" policy price) have an effect on reducing inflation?

### **Research hypothesis:**

Monetary policy has a significant impact on reducing inflation through its indirect tools:

- Discount price.
- Open Market operations.
- Legal reserve.

The research stems from a hypothesis that: the existence of a direct or inverse moral correlation with statistically significant among monetary policy tools to reduce inflation during the period (2010- 2018).

### **Research Importance:**

1. The research derives its importance from the fact that it tries to deal with monetary policy tools and targeted inflation as indicators of economic activity and the possibility of monetary policy relies on them in directing its policies aiming to achieve the goal of price stability.
2. Knowledge of the monetary policy tools that are most effective in stimulating the overall economy, where the experiences of developing and developed countries have proven that the possibility of measuring monetary policy, and therefore the existing output gap on the one hand, and linking it to the monetary sector through the inflation targeting mechanism, represents a contemporary approach on one hand, and influences the construction of monetary policy on the other.

### **Research Goals:**

1. This study attempts to expose the hypotheses on which monetary policy is based to testing in the light of experience and quantitative analysis, and focuses in particular on inflation-targeting policies that have been adopted worldwide .
2. The experience concludes that targeting inflation may be consistent with the results of intervention in open market operations, the discount price, as well as the monetary reserve.

### **Search Limits:**

1. The spatial limits of the research: represented by the Iraqi economy (the Central Bank and Commercial Banks).
2. The time limits of the research: It covers the period (2010-2018).

## **The First Topic**

### **The concept of monetary policy, its importance and tools**

#### **The concept:**

Monetary policy is one of the most important economic policies, which plays an essential role in economic activity as it is one of the most fundamental functions of the central bank. Kent defined monetary policy as: "managing the expansion and reduction of the money supply to achieve a specific goal (Al-Quraishi, 2016: 16), so if the monetary authority wants to increase aggregate demand to achieve a high level of employment and wages, then it

should increase the money supply (expansionary monetary policy), and vice versa, if it wants to reduce aggregate demand, it follows a policy of shrinking the money supply ie, deflationary policy. It is also defined as "all measures taken by monetary authorities to make deliberately influence upon the nature and volume of funds to achieve the objectives of monetary policy by controlling the availability, cost and use of funds and credit (R.Cauvery and others, 2009: 234), That is, all actions taken by the Central Bank by using its tools to bring about the required change in the activity. Likewise, it also defined as "a group of monetary and banking regulations that have an influential role in controlling the amount of cash available in the economic system. In this sense, it includes all procedures that have been taken by a government, Central Bank and treasury intending to influence the amount of cash in terms of its provision, use, and credit (Al-Dulaimi, 1990: 54).

Monetary policy is a set of decisions and actions taken by the monetary authority to influence money and credit and regulate public liquidity in a deliberate manner to reach the final goals, it is the decisions issued by the Central Bank, which is the authority responsible for drawing and implementing monetary policy by using quantitative and qualitative monetary policy tools to influence monetary variables like "the exchange rate, interest rate and money supply" in a deliberate conduct to reach the final goals.

### **The Importance of Monetary Policy (Youssef, 2014, 22):**

1. The effectiveness of monetary policy is conditional on the financial depth and institutional status of the financial sector, as well as the real economy's structure in its production base and flexibility regarded the supply of goods and services.
2. The productivity, costs, and the variation in their growth between the concerned country and the world, and the different characteristics of non-internationally traded goods and services compared to the traded goods sector, all the above are affect the behaviour of the real exchange rate and thus the international competitiveness, the status of the current account of the balance of payment.
3. Reading it objectively in harmony with the rules of the empirical approach, there is no doubt that the interpretation of inflation after determining the factors governing the movement of the general level of prices, was one of the essential axes of the book's research in order to consider the potential role of monetary variables and the extent of the impact of monetary policy tools on liquidity and the latter on stability.
4. The concept of stability itself is brought up for discussion in light of the practical value of the current definition of this concept, amid the fundamental issues in the international financial relations of Iraq after 2003 is how to look at the reserves of the central bank in an oil economy, its possible function and its necessary size.

### **Monetary Policy Objectives**

Monetary policy aims to achieve a set of final goals, and the monetary policy strategy begins to achieve its goals by defining the monetary tools to be used to influence the primary targets, then influence the intermediate goals to reach the final goals drawn by the monetary authority. Among the most prominent final aims:

1. Achieving stability in prices: The technical authority seeks to control the general level of prices and prevent the occurrence of inflation or deflation, where violent and continuous changes in prices affect economic activity, so any change in price levels towards an increase in the case of inflation, for example, will lead to a decrease in the value of money and then a decrease in purchasing power, which results in harmful effects on the level of income, wealth and resource allocation, then increases investment risks and limits economic growth. (Abdul Hamid, 2013: 92).

2. Stability of exchange rates: The goal of stabilizing exchange rates is regarded as a goal linked to the first goal, which is the stability of internal prices, (Al-Douri, 2013: 188). Monetary policy can control exchange rates at the desired level through many measures, including increasing or decreasing interest rates in light of the free movement of capital because the rise in domestic interest rates compared to the outside world leads to the flow of capital into the country, which leads to an increase in demand on the local currency and the rise in its exchange rate and vice versa, the exchange rate is also affected by changes in the money supply, an increase in the money supply leads to a decrease in the value of the local currency, a decrease in its exchange rate against foreign currencies, and an increase in the number of paid units of the local currency in exchange for one unit of the foreign currency, and vice versa in the event of a decrease in the money supply (Shilmon, 2015: 5).

The monetary authority may resort to direct intervention to influence exchange rates through purchases and sales of the local currency with foreign currency, and this procedure guarantees that there will be no change in the local interest rates, thus that there will be no change in the investment inside the country.

3. Contribute to achieving external balance: i.e. achieving balance in the balance of payments so that it works in the interest of the state, since all countries, regardless of their degree of economic development, seek to make the balance of payments work in their interest, the deficit in the balance of payments means that the country pays foreign currencies abroad more than it receives, and this entails negative effects on the value of the currency in case of surplus, (Al-Dulaimi, 1990: 87).

Monetary policy contributes to reducing or fixing the deficit in the balance of payments, through the Central bank by raising the rediscount rate, for example, in the framework of following a contractionary monetary policy, and then raising the interest rate, this leads to attracts capital flows looking for profits, thus it works to reduce the severity of the deficit in the balance of payments, likewise, raising the interest rate leads to reduce the volume of credit and domestic demand for goods and services, then reducing the general level of prices in the country, while the decline in the prices of local commodities encourages the state's exports and reduces the individual's demand for the purchase of imported commodities, meaning that reducing the amount of money by the monetary authority can contribute to reducing deficit in the Balance of Payments, (Abdul Hamid, 2013: 101).

4. Contribute to Achieve Full Employment: It means that the monetary authority seeks to raise the level of economic activity by rising the rates of using natural and human resources, which is one of the most fundamental final goals that monetary policy seeks to achieve, noting that the natural rate of unemployment ranges between 3-5 (Abdul Qader, 2010: 196).
5. Participation in achieving a high growth rate: The goal of economic growth is linked to the aims of achieving full employment, where economic growth alone is capable of absorbing the surplus from the labor component, and the task of monetary policy here is to influence interest rates as one of the determinants of investment, as reducing interest rates raises investment rates and activates the economy by doubling investment, which enables the economy to reach the starting stage that Put the economy on the path of rapid growth, (Abdul Hamid, 2013: 22).
6. Stability of interest rates: The continuous fluctuations in interest rates generate a state of uncertainty in the economy, which makes it difficult for individuals and institutions to commit to future contracts, or to determine their size or term, which prompts the central bank to make the goal of stabilizing interest rates one of the most important goals that He seeks to achieve it (Basha, 176, 1985).

## **Tools Policy Monetary**

The monetary authority seeks to achieve its goals through a set of tools, which are divided into:

- Quantitative control tools.
- Quality control tools.
- 

### **First. Quantitative control tools:**

It is also called indirect tools and seeks to influence the size and quantity of means of payment, by influencing the liquidity owned by commercial banks or interest rates:

1. **Bank Rate Policy or Discount Rate:** It is the interest rate that the central bank charges from commercial banks in exchange for a rediscount securities it owns, or in return for what the Central Bank provides in terms of loans and advances to commercial banks, secured by commercial and financial papers in the possession of banks (Shendi,2010: 154), When using the policy of changing the rediscount rate as a tool to change the money supply, there are issues that limit its effectiveness. In certain cases, some banks may want to borrow from the central bank and consider it the last resort for borrowing (Abdul Muttalib, 2013: 27 ), Likewise, the change in the discount rate does not affect the volume of bank credit except in the case of the availability of a wide and regular discount market (financial market) in which dealing in financial and commercial papers is spread, this is more available in developed countries than it is in developing countries, and also the high discount rate in some These cases do not lead to a decrease in the demand for loans, especially if expectations are optimistic about an increase in demand and an increase in profits (Al-Janabi, 2017: 271).

If the country allows free movement of capital, then the change in the discount rate will also have an impact on the flow of capital when the discount rate is raised all interest rates in the market will rise, and the increase in interest rates on deposits leads to attracting short-term foreign capital to benefit from high interest rates, especially if the movement of capital is highly sensitive to changes in interest rates (H. Lahuja).

2. **Open Market Operations:**It is one of the most fundamental tools of monetary policy in many countries, especially the developed ones, open market operations are represented in their narrow sense by the central bank buying buy and sell government bonds, but in their broad sense means buying and selling securities, gold and foreign currencies in addition to buying and selling government bonds, (Al-Samarra'i, 2013: 204), the central bank through buying and selling operations aims to influence economic activity by influencing bank reserves and thus their ability to grant credit, which affects the money supply, and the other effect interest rates, when the central bank enters as a buyer of securities, this leads to an increase in the reserves of banks and thus an increase in their ability to lend and a decrease in interest rates. Open market operations also cause a change in the prices of securities, and the entry of the central bank as a buyer of bonds leads to an increase in their prices and a decrease in the return on them.

The effectiveness of open market operations depends on the availability of basic conditions(Hathlool, 2010: 18):

- a. The availability of an active technical market for trading these securities.
- b. The extent to which commercial banks respond to the desires of central banks.
- c. The existence of developed financial markets dealing in securities and the availability of government bonds (quantity and quality).

The open market policy, in cooperation with the discount rate policy, is used to control the movement of capital. If the monetary authority follows a

deflationary monetary policy by raising the discount rate, which leads to an increase in the interest rate, and since this procedure involves encouraging effects for the movement of foreign capital looking for profits, its entry into the country will feed the cash reserves of commercial banks, which will lead to an increase in the volume of means of payment (Al-Dulaimi, 1990: 60).

To achieve its goals, the monetary authority can use the open market policy to support the discount rate, so it is transferred to the money market as a seller of securities that will lead to the absorption of liquidity, as the decline in the prices of emerging securities will give an incentive to banks to use their liquidity to buy securities and prefer them over credit because of the return of these securities, thus the simultaneous use of the two tools leads to achieving a state of stability in prices and balance in the balance of payments (Al-Samarra'i, 2013: 201).

3. Statutory reserve ratio (mandatory): It can be define as the percentage imposed by the central banks on each deposit entered into the commercial banks, and the expression in this percentage leads to a change in the money supply through the change of the monetary multiplier, when this ratio increases, the value of the cash multiplier decreases, and the volume of deposits that can be granted decreases, and then the money supply decreases (Shendi, 2010: 167 ).

### **The money Supply Multiplier- The Legal Reserve Rate:**

The direct aim of imposing this percentage is to keep deposits with the Central Bank to ensure the safety of depositors' money, it is also used to lend to banks that are exposed to financial crises or lack of liquidity to maintain their financial position soundly, also, its main objective is to influence the money supply of commercial banks ( Hathlool, 2010:188).

The effectiveness of the policy of or the legal reserve ratio depends on (Taurus, 2011:200):

- a. No cash leakage.
- b. The absence of other methods for commercial banks to obtain monetary resources outside the framework of the central bank.
- c. The extent of the response and flexibility of the productive sectors to those changes applied by the monetary authorities.

The Central Bank can use this ratio to influence the reserves of commercial banks resulting from the movement of foreign capital into the country, rising this ratio leads to freezing a larger amount of reserves obtained by banks from abroad, hence, it limits its ability to grant credit, and vice versa, in the event of an outward migration of capital, here the central bank can compensate it by reducing the reserve ratio, because this helps banks to return their funds employed abroad and avoid imbalance in the balance of payments. (Al-Janabi,2014, 276).

## **The Second Topic Inflation, The Concept, Types and Implications**

### **The Concept of Inflation:**

Inflation can be defined: (as the continuous rise in the general level of prices). It is also known as (a lot of money chasing few commodities), meaning that the average growth rate of money income is greater than the average growth rate of production (Al-Dawsky, et al., 2011: 98-99).

There is another concept of inflation based on the quantity theory of money, it is every increase in the amount of money in circulation leads to a rise in the general level of prices, and this definition requires that the increase in the amount of money in circulation



is the reason for the occurrence of inflationary phenomena (Hatat, 2006: 28). It is also known as the reduction of purchasing power of consumers, thus the continuous decline in the real income of these people (Sharaf, Abu Araj, 1994: 105). It also defines by the French economist James as the increasing demand for commodities compared to supply potential, which results a continuous rise in prices and an increasing decrease in national resources of foreign currencies (Akkawi, 2009: 17 ). Briefly, inflation defines as a monetary phenomenon characterized by a continuous and escalating rise in the general level of goods and services prices over a relatively long period.

Inflation is characterized by several characteristics, the most important of which are:

1. The price increase is inclusive of all or most of the goods and services.
2. The price rise includes all regions of the same country and is not limited to some without others.
3. The wave of rising prices continues for a relatively long period and is not short-term seasonal.
4. The inability of money to fully performs its basic functions in economy.
5. Inflation expresses a state of imbalance in economic activity represented by the instability of price levels (Al-Tahir, Al-Khaleel, 2004: 130).

#### **Inflation's Types:**

There are several types of inflation, these are separate from each other, and may be based on the conditions of the inflation, its origin, its shape, or its severity, as follows:

#### **First. According to the state's intervention in setting prices:**

- a** Apparent or open inflation: It means inflation in which prices, wages and other expenses rise freely without the state's intervention in determining the price level.
- b** Repressed inflation: It is a hidden one under which prices rise or extend due to the economic factors not being allowed to operate freely because of the existence of direct government restrictions that are set to control the prices, such as compulsory pricing, the card system or appointment (Akkawi, 2009: 18).

#### **Second. In terms of severity of inflation:**

- a** Unbridled inflation: It is a enormous increase in prices followed by an increase in wages, which increases by its term production costs and decreases the profitability of businessmen, which necessitates a new rise in prices.
- b** Creeping inflation: it is part of the rise in prices resulting from the increasing in wages at a rate higher than the increase in production, and it is a slow and moderate gradual inflation associated with the natural forces of economic growth, but its continuity and the accumulation of its effects can lead to the occurrence of unbridled inflation (Al-Wadi, and others, 2009: 186 - 187).

#### **Third. According to the source of inflation:**

- a.** Domestic inflation: It is inflation that occurs as a result of internal economic or political factors, i.e. related to the conditions of local markets or economic politics, or as a result of having a structure within the economic activity (Al-Taher, Al-Khaleel, 2004: 134).
- b.** Imported inflation: It is inflation that results from the relationship between foreign trade and economic activity, especially when the ratio of imports to the volume of economic activity is high such inflation appears now in many developing countries as they seek to achieve the goal of economic and social development (Al-Taher, Al-Khalil: 135).

#### **Fourth. According economic sectors:**

- a. Commodity inflation: It is the type of inflation that occurs in the production of consumer goods, which leads to the prevalence of estimated profits in consumer goods production industries.
- b. Capital inflation: It is the inflation that occurs in the production of investment goods, which leads to the prevalence of estimated profits in the industries producing investment goods (Akkawi, 2009: 18-19).

**Inflation measurement:**

To measure the change in the general level of prices, several measures can be applied, that are statistically called numbers index, the most important of which are:

**1. The implicit deflator of gross domestic product (Deflator GDP):**

It is a standard number used to measure the rate of change in the prices of all goods and services included in the calculation of the gross domestic product. Therefore, it is considered a general measure of inflation rates per year.

It is calculated in the following way:

$$\text{GDP price} = \frac{\text{Nominal domestic product}}{\text{Real domestic product}} \times 100$$

**2. Consumer price index:**

For this purpose, the following ways, the most important of which are:

- a. The simple index: It is the ratio of the total prices of consumer goods and services in the current year compared to their prices in a previous year, It is called the base year according to the following equation:

$$\text{Simple index} = \frac{\text{Total prices for the current year}}{\text{Total prices for the base year}} \times 100$$

- b. Weighted index: It is calculated goods and services in the current year by the total weighted prices of the same goods and services in the base year according to the following equation:

$$\text{Weighted Index} = \frac{\text{Total (prices x weighted weights) for the current year}}{\text{Total (prices x weighted weights) base year) for the base year}} \times 100$$

- c. Consumer price index: In calculating this number, the total consumption expenditure is used at the prices of the current year, it is called the nominal consumption, and it is divided by the consumption expenditure itself divided by the prices of the base year, which is called the real consumption according to the following equation: (Al-Essa, Kataf, 2006: 258-262).

$$\text{General Index} = \frac{\text{Official consumer expenditure}}{\text{Real consumer expenditure}} \times 100$$

**The economic and social effects of inflation:**

**1. Economic Effects:**

- a. Inflation affects the redistribution of real income: when price levels rise, there will be a decrease in the purchasing power of individuals whose cash incomes have not changed or whose cash incomes have increased by less than the rate of price levels, such as retired individuals or those with limited income (Al-Ameen, Pasha, 1983: 200 ).

- b. Inflation affects the balance of payments: Inflation has a negative impact on the balance of payments, as the country that suffers from high inflation finds its products in a weak competitive position compared to the products of other countries with a lower price, and thus its imports increase and its exports decrease, which leads to a deficit in the trade balance compared to the balance of payments, or at least the surplus size decreases, (Al-Wadi, and others, 2009: 188).
- c. Inflation affects indebtedness: the debtor benefits from inflation, while the creditor is damaged, because the debtor borrows an amount of money and returns it at a later period at a lower real value, due to the continuous rise in prices (Al-Wadi and others, 2009: 188).
- d. Inflation affects economic growth: From a purely theoretical point of view, the owners of the first opinion see that monetary inflation has a positive effect on the levels of economic growth, through its positive impact on savings and investment rates, on the levels of the economy as a whole, then will lead to an increase in economic growth rates (Al-Samhour, 2012: 456-457).

## **2. Social effects of inflation:**

- a. The effect of inflation on social differentiation: Most specialists agree that sharp inflationary waves if they continue for continuous periods, lead to substantial social changes in the class structure, which in turn leads to significant changes in relative positions and social classes and may be associated with shifts in power relations between the different groups and segments of society.
- b. The deterioration of the value of productive work: As a result of the massive inflationary wave that swept all the countries of the Third World, there was a severe disturbance in the system of values, consumption patterns, and ways of life, and this resulted in an increasing waste of the social value of (productive work), this means that there is no longer a relative relationship between the increase in the level of income and the increase in the level of labour productivity.
- c. The spread of bribery: We find that those with fixed and limited incomes resort to this method in order to compensate for the deterioration that occurred in their social and living conditions in the field of bribery for example, we find that the employee in the government operates according to the authority entrusted to him by providing a legitimate service to individuals in return for a price, or he affords an illegal service in return for a certain return (Sharaf, Abu Araj, 1994: 118-116).

## **Appropriate policies to counter inflation:**

- 1. Monetary policy: The government, through the monetary authority, uses monetary tools through which it can restrict the amount of money in circulation to absorb cash liquidity from the hands of members of society, consequently the demand for goods and services declines, as a result of the decrease in purchasing power and then the reduction in prices, and among these policies is raising the legal reserve ratio in commercial banks and raising the rate of rediscounting commercial papers, raising the interest rate on loans and the entry of the central bank into the stock market as a seller of public debt bonds, and the sum of these monetary measures is called the contractionary monetary policy, because according to it, aggregate demand will shrink to a level that is commensurate with the proper supply of goods and services (Al-Tahir, et al., 2004: 146).
- 2. Fiscal Policy: Fiscal policy means the sets of procedures, methods and rules adopted by the government to manage its financial activity as efficiently as possible to achieve a set of economic, social and political goals during a certain period, and there are

important measures adopted by the state to execute fiscal policy in combating inflation, and among these measures are:

- a. Public spending control policy.
  - b. Tax control policy.
  - c. Public debt control policy (public loans).
  - d. Other supportive policies.
1. The policy of direct control of wages: The fiscal and monetary policy requires its application if inflation results from the growth in demand by reducing spending rates, while the solution for inflation resulting from the increase in costs will be direct control over wages, because it represents the most substantial element in increasing costs.
  2. Price control policy: You may prefer the price control policy over the wage control policy, this is because it requires direct intervention by the government to control the successive heights in prices inevitably leading to a demand for an increase in wages to keep pace with the standard of living that prevails in society (Al-Hadithi, 2011: 28-30).

### **The Third Topic**

#### **The development of monetary policy tools in Iraq and their role within the limits of the phenomenon of inflation, Analysis of the development of monetary policy tools:**

Monetary policy in Iraq witnessed many developments in the field of monetary policy and its tools, especially the changes that occurred in the legal monetary reserve, the discount rate, and open market operations as a result of changes in revenue volatility levels and political events.

Noting Table No. (1), these changes will be clear to us:

Table (1) Monetary Policy Tools

Years	Monetary Reserve%	Annual Rate of Change	Open Market Operations	Annual Rate of Change	Discount Price%	Annual Inflation Rate
2010	7155	(24.01)	42320	6.41	6.25	2.5
2011	7814	9.21	46563	10.03	6	5.6
2012	8624	10.37	56724	21.82	6	5.6
2013	9626	11.62	62067	9.42	6	1.9
2014	10576	9.87	61452	(0.99)	6	2.2
2015	9390	(11.21)	52721	(14.21)	6	1.4
2016	8707	(7.27)	39893	(24.33)	4.33	0.5
2017	6505	(25.29)	50219	25.88	4	0.2
2018	10409	60.015	56088	11.68	4	0.4

**Source: Column data (3),(4),(6), (7), Central Bank of Iraq Annual Statistical Bulletin Directorate General of Statistics and Research for the period (2010-2018).**

**Column data (3) & (5) were calculated by the researcher.**

**The numbers in brackets ( ) mean their sign is negative.**

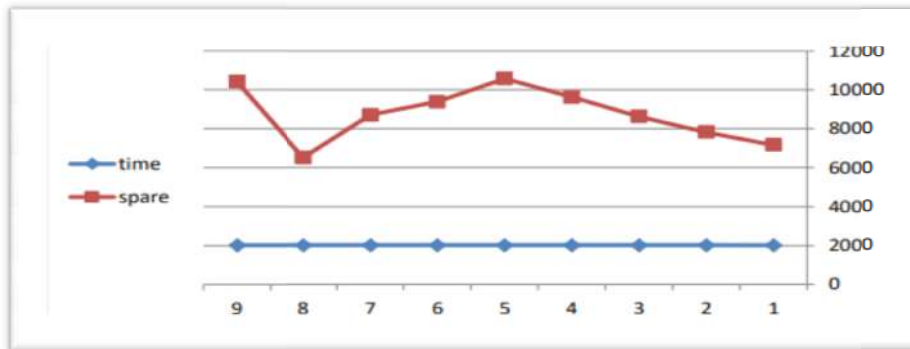
#### **First: The Evolution of the Legal Monetary Reserve:**

The legal monetary reserve is the measure by which central banks oblige commercial banks to keep a certain percentage of their deposits to protect depositors from the risks of bankruptcy and crises, which affects the ability of commercial banks to create credit (Kana'an, 2012: 268).

There is an annual adjustment to the legal reserve ratio of commercial banks at the central bank to control the effects of inflation (Hudgins & Rose, 2005: 371). If we go back to Table (1), we will notice the gradual increase in the monetary reserve in registration years. In the research where the year (2014) had recorded the highest percentage of reserves which amounted to (10576), this led to an inflation rise reaching the rate(2.2).Then inflation decreased in the subsequent years with complete clarity of the fluctuation of inflation during the period under discussion, While in the year (2017), the reserve ratio reached its lowest level, reaching (6505), so the decline in inflation seems clear as a result of increasing the legal reserve ratio.

We also note that during the period (2014-2017), which is the period that ISIS entered Iraqi lands and occupied some of its provinces, at that time the army and the Popular Mobilization Forces were preoccupied with fighting ISIS to expel it by force, and for that purpose, huge funds were spent during this period to fund military armament from one hand and to fund the expenses of American military operations for the same purpose from the other. All these expenses led to a decrease in the budget's monetary revenues during the mentioned years, also the decline in global oil prices, which led to a reduction in the legal cash reserve and a clear imbalance in the budget.

**This is evident in Figure (1) from right to left, which show a clear decline in years (2014- 2017):**

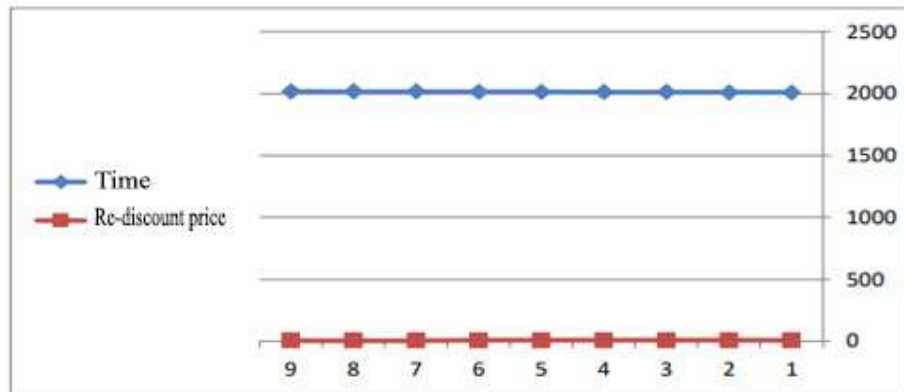


Source: The researcher's work based on the data of Table (1)

**Second. Evolution and analysis of the discount price for the period (2010-2018):**

As we have shown in the first topic, the relationship of the discount price in the stock market transactions between commercial banks, so if we note the period under discussion, we will find that there is clear stability in the rates of the discount price, especially in the first years under discussion, That is, in the years (2010-2015), the stability of the discount rate rates reached (6%), while for the years (2016-2018), the discount rate decreased to (4%), and this appears clearly in Figure (2).

**Figure (2) Trend charting of general predictive values for the evolution of the re-discount price:**



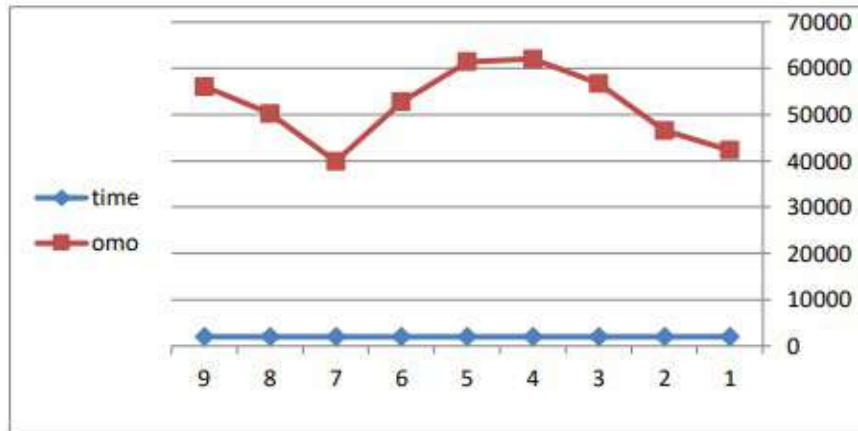
Source: The researcher's work based on the data of Table (1)

**Third. The development of open market operations:**

The Central Bank’s initiative to buy or sell government bonds in the short and long terms can be described as an intended credit policy, where in normal circumstances, the Central Bank’s sale of securities aims to reduce credit, while its purchase aims to expand credit:

(<https://unstats.un.org/sdgs/indicators/Globa>).

Figure (3) charts the overall trend predictive values of open market operations:



Source: The researcher's work based on the data of Table (1)

**Estimating and Analyzing the Relationship Between Open Market Operations and Inflation:**

The focus of the research has lied on the effect of open market operations, which is a tool of monetary policy as an independent variable, as well it affects inflation as a dependent variable in the Iraqi economy, where the main focus is on analyzing the relationship between open market operations and inflation in the Iraqi economy, the first stage includes: the description of the functional relationship and standard models that open market operations



enjoy, inflation, and estimated model tests, while the second stage includes: estimating and analyzing the results, then the third stage includes: analyzing the results of the relationship and estimated models (Al-Hadithi, 2011: 130).

**1. The Stage of Describing the Functional Relationships, Standard Models and Testing Them:**

- a. Description and formulation of the model:** To measure the relationship between public spending and inflation (econometrics) must be applied, so the functional relationship between public expenditure and inflation can be described as the relationship between one variable or several variables.

Describing the model means identifying the independent and dependent variables, the prior theoretical prediction of the value and sign of the parameters as well, this stage is regarded as one of the most significant stages because it depends on the experience and skill of the economist and this by turn enables him to gain economic knowledge, During this process, the economist uses economic theory to find the functional relationship between two variables to put it into the model, to achieve this end, he makes several hypotheses about the variables, depending on putting the relationship in a mathematical formula and estimating the model in the double logarithmic mode.

$$\text{Log}y = \text{Log}x$$

Where: Y= inflation

X= Open Market Operations

- b. Estimated Model Tests:** After estimating parameters' values, they must evaluate along with the test of the estimate's accuracy by using recognized statistical tools and methods. It is noteworthy that the model estimation method depends mainly on economic, statistical and standard tests. The passing of the model for these tests means that most or all the assumptions of the regression model are available, then, the desired characteristics and estimations will achieve because when the estimators are sound, the economic and statistical tests will be the same, because these tests depend in their evaluation on the values and variance of the correct estimates, so the model will accept as the best chosen models after testing it (Al-Zubaidi, Al-Fatlawi, 2011: 29-30).

The global economic standard estimates must base on the achievement of three criteria, namely:

- The economic criterion: Those are the facts, postulates, basic principles and laws that the theory reached when studying economic phenomena and variables, which are reflected in a standard way on the value and indication of estimations, if the estimated parameters are contrary to what the theory decides, we refuse them unless, there is a logical justification that leads to accepting their validity and rejecting what the theory decides, but if it is consistent with the logic of the economic theory, then these estimates will be accepted.
- Statistical standard (first class tests): they are statistical standards for what must achieve from statistical conditions that enable us to confess of what has be estimated statistically, and it includes the first main statistical hypotheses of the method of least squares and its testing, the most important of which are the coefficient of determination, the modified coefficient of determination, and the significant tests (T-test) and (F-test).
- Standard criterion (second-order tests): Statistical standards include a set of preliminary tests for basic least squares estimates, which is a set of assumptions and tests for the coefficient of determination ( $R^2$ ), the standard error of estimation, and (F), (t)tests and other basic tests. In this case, these capabilities can be used in Analysis

and inference and a statistical prediction, that is, the realization of the initial assumptions of the ordinary least squares (Al-Sifu, and others, 2006: 59-60).

- c. Analyzing the results of the relationship between open market operations and inflation: After describing and estimating the relationship between (omo) and inflation, it has been found that there has been a considerable and successive increase in open market operations' growth reflected in the degrees of liquidity, The model estimated through the dependent variable validated the hypothesis that (omo) is directly proportional to inflation, so the analysis corresponds to the logic of the economic theory (Al-Hadithi, 2011: 136).
- d. The stage of presenting and analyzing the results of the economic model: The focus on activating open market operations has a mutual effect on liquidity by opening the doors of loans and deposits, that the increase in liquidity leads to a direct impact on the increase in employee salaries, with an increase in purchasing power, which increases the inflation of the Iraqi economy, through The following estimated mode:

Estimating the relationship between inflation and open market operations, where:

Y= inflation

X<sub>1</sub>= time

X<sub>2</sub>= (omo)

A= fixed limit

Y= A+X<sub>1</sub>- X<sub>2</sub>

Y= 1195.94+ 3.061X<sub>1</sub>- 0.593X<sub>2</sub>

R<sup>2</sup>= 0.76=

F= 4.458

76%

F= 4.458

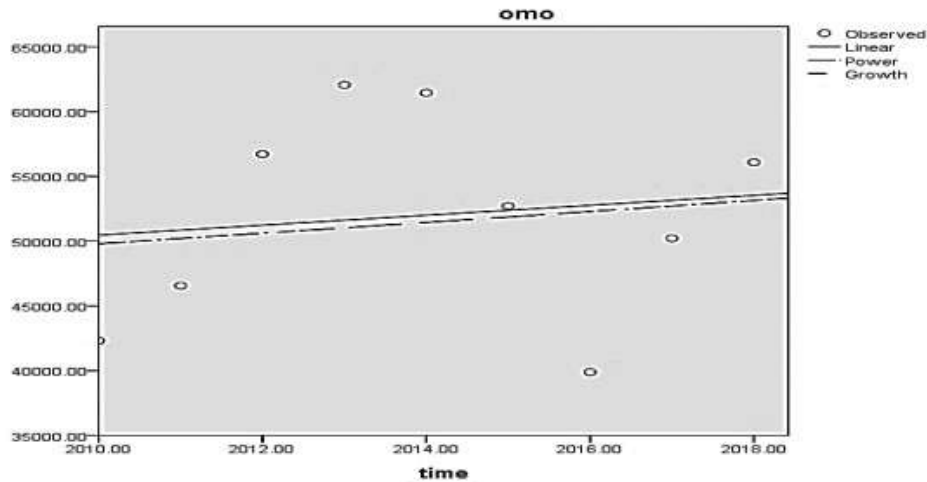
After analyzing the relationship between the independent and dependent variables, the following results have been reached:

The estimated model shows that the independent variable in the model was significant over the dependent variable, and it showed that 76% of the variables occur in inflation as a result of the change in R<sup>2</sup>, which is the coefficient for determining open market operations and time, while 24% of them are due to other factors that have not included in the model but have included in the random variable.

The calculated value of f= (458.4) indicates that the overall significance of the model is estimated from a statistical point of view the negative sign indicates a positive relationship with the model as well. During the period (2010-2018), open market operations increased with increasing time have led to decreased inflation.

The direct relationship is shown in Figure No. (4) that open market operations have a direct relationship with time due to the evident increase, according to the data in Table No. (1).

Figure (4):Trend line and predictive values of open market operations over time:



### Estimating the relationship between discount prices and inflation:

Discount price have regressive effects on inflation rates, this was observed through the estimated model using the statistical program, as the inverse relationship between discount rates, inflation appeared when the discount rate have increased by the central bank, this leads to a decrease in the monetary supply, which leads in turn to an inflation decline that this seems evident, in Figure (4).

The significance of the equation refers to the correlation's strength between the discount price and time, as they represent variables independent ( $X_1, X_2$ ), and dependent variable ( $y$ ) is inflation, where:

$X_1$ = time

$X_2$  = discount price

$Y$ = inflation

$A$ = fixed limit

$Y = A + X_1 - X_2$  estimated equation

$Y = 701.4 + 0.348 X_1 - 0.852 X_2$

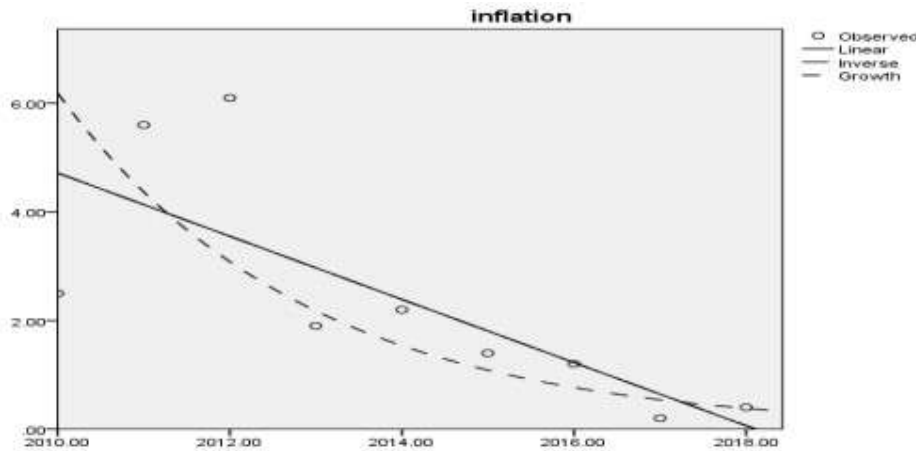
$R^2 = 0.75 = 75\%$

$F = 18.480$

According to the data of Table No. (3) the program (SPSS) has used to analyze and estimate the relationship between the variables, and used the program (OLS) to estimate the equation due to the simplicity of this model and the accuracy of the estimate, while estimated model shows that the independent variable in the model was significant over the dependent variable, in time where  $R^2$  in the determination coefficient indicated that (75%), of the variables occur in inflation as a result of the change in the discount price and time, and that (25%) of them were due to other factors that were not included in the model, so that is include within the concept of a random variable.

The calculated ( $f$ ) value indicates (480.18), and it expresses the overall significance of the model estimated from a statistical point of view, while the negative sign indicates the inverse relationship, where ,with the passage of time inflation decreases as a result of the decrease in the discount price, which is granted within the powers of the monetary policy issued by the Central Bank of Iraq.

This inverse relationship is illustrated by Figure (5), i.e. inflation on the one hand, and time and discount rate on the other:



Source: The researcher's work based on the analysis of the data of Table No. (1)  
Figure No. (5): General trend line and predictive value of inflation over time

## Conclusions and recommendations:

### Conclusions:

1. The practical part, has been shown to estimate the relationship between the monetary policy tools such as (the discount rate and inflation), and there is an inverse relationship, which is evident in Figure No. (1) and for the period (2010-2018).
2. The relationship between inflation and open market operations has been estimated, and there is a high direct and significant relationship and a strong correlation of 76%, as shown in Figure (2) for the period (2010-2018).
3. The monetary authority has set specific goals to build a solid base which it have directed towards economic stability, the Central Bank, after obtaining its independence, and through its monetary policy, has achieved a set of goals that helped him to have an evident imprint on the Iraqi economic reality, some of these goals are: achieving a low level of inflation, raising the value of the Iraqi currency after its deterioration, and stabilizing the Iraqi dinar exchange rate, as well as using other tools such as treasury transfers, and permissions, as well as moving towards the stability of interest rates, and the use of indirect instruments to achieve these goals.
4. The policy of the monetary authority in targeting inflation has lost the competitiveness of local commodities to confront foreign ones, due to their low prices and the lack of internal support for local commodities, legally and financially, which led to the disruption of the real sector.
5. The survival of Iraq as an importer of all goods and services leads to the incidence of extra crises, including unemployment and other social problems, so work must be done to build a solid economic base in addition to the tendency to reduce imports and maintain international reserves.

### Recommendations:

1. The need to work to limit the expansion of government operational expenditure, increase the money supply, create a rise in inflation level, and focus on investment expenditure to build a sound production base.
2. Increasing monetary initiatives are undertaken by the Central Bank, such as the one-and-a-half trillion Iraqi dinars initiative, monitoring and directing them towards the right economic sectors.

3. Building a solid and consistent economic base (agricultural, industrial, commercial) to rebuild the real sector and be supported by the Central Bank because it is considered the only one that succeeded in achieving its objectives during the study period.
4. Work to coordinate (monetary and fiscal policies), to achieve efficiency in the Iraqi economy, because the work of the monetary authority lies in reducing inflation rates and achieving price stability must be accompanied by support from the financial authority to increase investments to raise the level of economic growth.
5. Developing studies and researches that support and develop monetary policy, as well as moving towards an increase economic growth and reduce inflation.

## **References:**

### **First. Books:**

- Pasha Zakaria Abdel-Hamid, Money and Banking with an Islamic Perspective, Collage of Commerce, Kuwait University, 1985
- Al-Janabi, HielAjamiJamil, Money, Banking and Technical Theory, 2nd edition, Dar Wael, Amman, 2014.
- Al-Dulaimi, AwadFasil Ismail, Money and Banks, 1st Edition, Dar Al-Hikma for Printing and publishing, Mosul, 1990.
- Al-Douri, Zakaria Al-Douri and Yusri Al-Samarrai, Central Banks and Policies Cash, 1st edition, Dar Al-Yazuri, Amman, 2013.
- Al-Samhour, Muhammad Sa'eed, The Economics of Money and Banking, 1st edition, Amman, Dar Al-Shorouq for Publishing and Distribution, 2011.
- ShendiAdeebQasim, Money and Banks, Dar Al-Dia'a for Printing, Najaf, 2010.
- Al-Taher, Abdullah, Al-Khaleel, Muwaffaq Ali, Money, Banks and Financial Institutions, 1st. edition, Yazeed Center for Publishing, Al-Karak, Jordan, 2004.
- Taurus Wadih, Introduction to the Monetary Economy by the Modern Foundation for Books, Al-Manan, 2011.
- Abdul Qader Al-SayedMetwally, The Economics of Money and Banking, Dar Al-Fikr, Amman, 2010.
- Abdul-Muttalib Abdul-Hamid, The Economics of Money and Banking, 1st Edition, University House, Egypt, 2013.
- Al-Issa, NizarSaad Al-Din, Qatf, Ibrahim Suleiman, Macroeconomics, 1st. edition, Publishing and Distribution House, Jordan, Amman, 2011.
- Al-Quraishi, Ali Hatem, Monetary Policy in Iraq between the Enormous Role and Limited Role, 1st Edition, Dar Al Diaa' for Printing, Najaf 2016.
- Kana'an, Ali, Money, Banking and Monetary Policy, Dar Al-Manhal, 1st.,edition, Lebanese, Beirut, 2012.
- Hathlool, Akram Haddad and Mashhoor, Money and Banking: A Theoretical Analytical Approach, 2nd Edition, DarWael Amman, 2010.
- Al-Wadi, Mahmoud Hussein, Al-Assaf, Ahmed Aref, and others, Macroeconomics, 1st. edition, Al Masirah House for Publishing and Distribution, Jordan.
- Youssef Hassan Youssef, Central Banks and their role in countries' economies, 1st edition, University Education House, Egypt, 2014.

### **Second. Thesis and dissertations:**

- Shalomon, NaglaChamoun, Analysis of the Factors Determining Trends in the Iraqi Dinar Exchange Rate against the US dollar for the period 2004-2015 Journal of Critical Studies and Finance, Volume 1, Number 2, 2017.

- Al-Hadithi, Khaleel Abdul-Karim Mohsen Muhammad, Developing the volume of public spending and its impact on Inflation in Iraq for the period (1990-2009), Master Thesis, Anbar University, 2011, unpublished.
- Al-Dosky, Azad Ahmed Saadoun, Al-Waeli Samir Fakhri Nema, and others. The impact of fiscal and monetary policies on inflation in the Iraqi economy for the period from mid-2003-2010, an econometric analysis, Issue 23, Volume (7), University of Tikrit, 2011.
- Al-Zubaidi, Kamel Allawi Kazem, Hassan Latif Al-Zubaidi, Economic Measurement Theory and Analysis, Dar Safaa for Publishing and Distribution, first edition, 2011.
- Sharaf Kamal, Abu Araj, Hashem, Money and Banking, Damascus University Publications, 1994.
- Al-Sumaidaie Hussein Khalid, The Mutual Effects between Monetary and Fiscal Policies and the Possibility of Coordination between Them to Achieve Stability in Prices (Iraq, a Case Study), Master Thesis, University of Baghdad, College of Administration and Economics, 2016.
- Akkawi, Omar Mahmoud, The Effectiveness of Monetary Policy in Controlling Inflationary Pressures in Iraq for the Period (1980-2009), Master Thesis, College of Administration and Economics, University of Baghdad, 2009.
- Hathat, Said, an economic and econometric study of the phenomenon of inflation in Algeria, a letter Master, Faculty of Law and Economic Sciences, Kasdi Merbah University, Waraqah, Algeria, 2006.
- Rose, Peter & Hudgins, Selvia, Bank Management and Financial Services (6th ed) U.S.A, library of Congress catalog in publication Data, (2005).
- H.L. Ahuja, Economic environment of business company Ltd, New Delhi-macroeconomic analysis, s-chand.
- UN Global Indicators Framework for the Goals and Targets of the 2030 Agenda for Sustainable Development, 2019:  
<https://unstats.un.org/sdgs/indicators/Globa>



## GLOBAL BUSINESS TRENDS

**Monika Mehta**

B.N University,India.  
(monika.nagori27@gmail.com)

**Amrita Joshi**

B.N University,India.  
(amijoshi28@gmail.com)

**Suteekshn Singh Ranawat**

B.N University,India.  
([s.ranawat99@gmail.com](mailto:s.ranawat99@gmail.com))

Economic competitiveness matters. But not as an end in itself - it matters because nations are more competitive and are more productive, and therefore more able to provide for the social needs of their people. In last few decades the landscape has changed a lot. The local and global business identity has shifted and world has become one. This has made a huge impact on global business. According to the World Trade Organization (WTO) deals with the global rules of trade between nations and global business has reached the mark of Value: US\$ 32 trillion in year 2022. Generally we tend to refer to any company doing business in another country as doing global business and it makes business more competitive and in current scenario trends change rapidly. This paper covers major business trends and factors that affect the global businesses such as political trends, economic trends, innovative trends.

### 1. INTRODUCTION

#### Globalisation

Globalisation is a term which is used to describe how trade and technology have made the world into a more connected and independent place. It is integration of global economies, industries, markets, cultures and policies to make the world free from socio political control and reduces distance between regions /countries through a global network of trade, communication, immigration and transportation. It reduces barriers to international trade as tariffs, export fees and import quotas.

#### Global Business

Global business means a company which operates (such as factories, distribution channels) in many countries around the world.

It refers to international trade. A company who is doing its business all over the world are called global enterprises.

Global business can be categorised as

Type 1) companies produce goods domestically and sell domestically and internationally.

Type 2) companies produce goods in different countries and sell only domestically.

Type 3) companies produce goods in different countries and sell domestically and internationally.

#### TOP GLOBAL ECONOMIES IN 2023 ... GLOBAL COMPETITIVENESS INDEX RANK-

Denmark	1
Ireland	2

Switzerland	3
Singapore	4
Netherlands	5
Taiwan	6
Hong Kong	7
Swedan	8

### Global Economic Trend-

Global growth is projected to slow from an estimated 6.1% in 2021 to 3.6% in 2022 and 2023. Beyond 2023 global growth is forecast to decline to about 3.3% over the medium term.

- 1) The growth of gross domestic product is slow because of several factors including tightening monetary policy, slowing demand for labour and waning fiscal support.
- 2) The unemployment rate falls because of the ongoing expansions of the economy.
- 3) The labour force participation rate will rise in 2023. the participation rate then begins to decline as the negative effects of the aging population begin to offset the positive effects of the economic recovery.
- 4) The wage growth is nominal but tends to increase as growth in demand for labour continues to outpace growth in supply of labour .
- 5) Global central bank delivers historic rate hike blast in 2022.

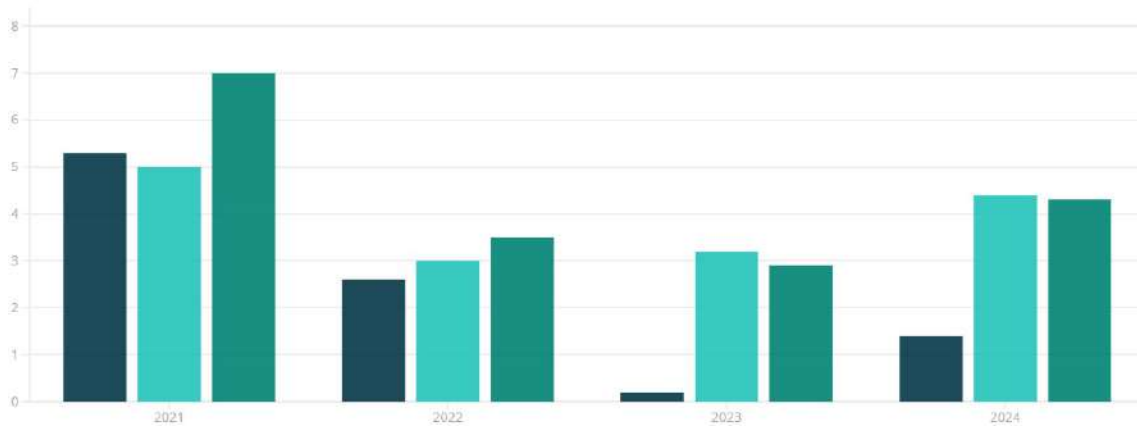
POLITICAL ASPECT	TECHNOLOGICAL ASPECT
1 Ukraine conflict –no end in sight.	Artificial intelligence
2 Geopolitical competitions between the US and China.	Quantum computing
3 Commodities crunch.	Cybersecurity
4 Global economic slowdown.	Robotic process automation
5 Debt crises.	Cloud computing
6 Climate politics.	Virtual reality and augmented reality
7 Rise of ESG regulations	Blockchain technology
8 Critical elections.	Internet of things
9 Rise of the middle power.	Sustainable technology
10 Space race	Organisation’s digital immune system

## 2. POLITICAL TRENDS –

- 1) **Ukraine conflict** –The conflict between Ukraine and Russia will persist in coming months also. sanctions linked to war will not be eased infact are likely to be expanded .The process of decoupling politically and economically from Russia will continue to unravel the geo-economic order with Moscow seeking even closer ties to Asia. The global economic impact of the conflict will remain significant driving commodity market volatility and inflation rates.

- 2) **Geopolitical competition between US and China** –The military conflict between china and US will remain same as in 2023 also but there sour relationship will be defining feature of geopolitics .Both countries will fight for self sufficiency especially in technology /military spheres .Taiwan will remain a focal point of contention in US and china tensions .
- 3) **Commodities crunch** –Global competition for commodities will intensify. China’s energy demand for metal, minerals, will rise .and it will require Russian cheap oil for growth. At the same time European countries require Russian gas, refinedfuels, speciallydiesel will be costly as globally both refining capacity is inadequate and poorly placed on the new fractured energy map.
- 4) **Global economic slowdown** –Global growth will slow in 2023 everyone agrees that economies will suffer. Governments have raised interest rates in recent markets, but inflation rates remain high only. A global economic slowdown will lead many governments to introduce higher taxes and countries will experience unemployment and higher crime rates including a rise in cybercrime.

■ Advanced Economies GDP, real, annual growth % per year ■ Developing Economies GDP, real, annual growth % per year  
 ■ Emerging Markets GDP, real, annual growth % per year

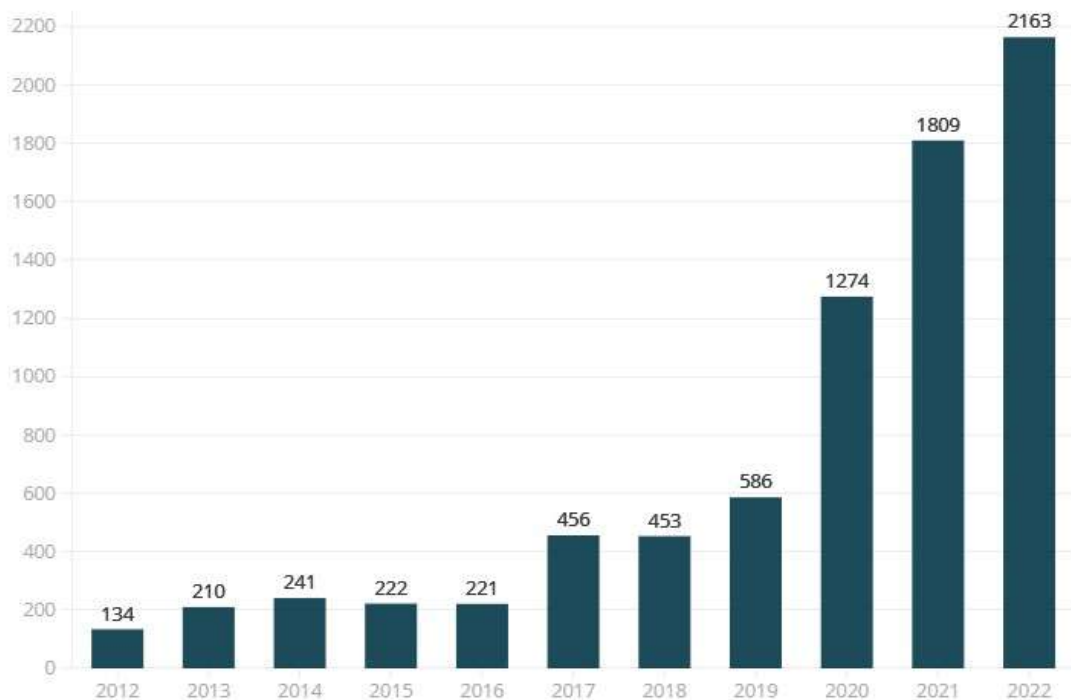


- 5) **Debt crises** –Rising interest rates and strong dollar have made imports and sovereign debt servicing more expensive for many countries. Some of the countries like Ethiopia, Kenya, Cameroon, Egypt, can come under debt, distress. political instability and social unrest risk will increase as governments lack hard currency for imports or are focused to cut spending. this struggle of smaller economies are unlikely to prompt wider global financial instability.
- 6) **Climate politics**- companies must focus on resilience to both natural hazards and changing political risk because both will continue to disrupt in 2023. Companies in the banking energy sectors will face increasing operational, security and integrity risk as some environmental groups will escalate campaign tactics.
- 7) **Rise of ESG regulations** –There are clear signs that environmental impact disclosure one set to become key enforcement tools for governments. on the global scale, the ground breaking agreement achieved during the Montreal bio diversity conference of the parties in December 2022.set the scene for the companies to grapple with how to meet ESG commitments.
- 8) **Critical elections** – election related developments in turkey, Nigeria, Bangladesh and Thailand will have ramifications for global security. Turkey will have impact on Iraq and Syria and Pakistan current relationship with Afghanistan will have global impact.

Business will have to pay attention to election related uncertainties in Thailand and Bangladesh due to their importance in global supply chains.

- 9) **Rise of middle power** –The war between Russia and Ukraine will continue in 2023. The emerging middle powers will be increasingly important dealmakers. India’s position on Russia and Ukraine will play important role. Indonesia (due to its wealth of critical minerals.) Turkey (as a negotiator on Ukraine conflict). Saudi Arabia (its oil wealth has become more important amid reasons sanctions.) Brazil(a critical player in global climate negotiations. South Korea (due to its diplomatic and growing cultural soft power).
- 10) **Space race**–companies should pay close attention to the geopolitical race in space in 2023. Companies also need to consider what a growing accessibility. of satellite imagery means for their exposure to security, reputational and regulatory risk exposure.

**Objects launched into space**



### 3. TECHNOLOGY TRENDS –

1) **Artificial Intelligence and Machine learning AI and ML** –continues to lead in industries . It has ability to minimise human intelligence and learn from data. These technologies leads to efficiency, automation, and decision making.

**2)Quantum computing** –It helps to solve complex problems as classical computers struggled we will witness progress in cryptography optimisation and material science.

**3)Cybersecurity**-Business and Individuals alike are embracing advanced security measures to safeguard their digital assets.

**4)Robotic process Automation**-The integration of RPA in industries streamlines operations, reduce errors, and enhances overall productivity.

**5) Cloud computing** –Its flexibility, solability, and accessibility facilitate seamless data storage, application, deployment, and collaboration making it an indispensable technology trend this year.

**6)Virtual reality and augmented reality** –In 2023 there will be applications in diverse sectors from immersive entertainment and training simulations to enhancing customer interactions and revolutionising remote collaboration.

**7)Block chain technology** –This technology is used in supply chain management ,identity verification and secure digital transactions

**8)Internet of things (IOT)** -The impact of IOT seen in smartphones, healthcare ,logistics and industrial automation ,enhancing efficiency and data driven decision making.

**9)Sustainable technology** -From renewable energy sources to energy efficient technologies business and communities are investing in sustainable solutions to address environmental challenges.

**10)Organisation’s digital immune system** –Organisation focussing on building resilient cyber security frameworks that can detect respond to, mitigate threats effectively.

#### **Positive aspects of global business**

- 1) Global business gives access to new markets and growth opportunities.
- 2) It gives access to the global talent pool.
- 3) It leads to cost effective production.
- 4) Global business creates a new global customer base.
- 5) It gives a competitive advantage.

#### **Negative aspects of global business**

- 1)The regional markets like Europe or south east Asia have several cultural and language barrier.
- 2) It is significant to connect with the right people who can help you stay compliant with the business rules and process.
- 3) The main advantage of global expansion is that it is an expensive affair.
- 4)In the face of stringent immigration regulations for long term workers establishing a branch and hiring staff is quite challenging.
- 5)One of the disadvantage of international expansion is managing the HR and payroll obligations.

#### **4. Conclusion-**

In conclusion we can say that there are N number of factors that affect global trends and current scenario of whole world. It is also true that trends and situations are changing frequently and it is not easy to predict the future but business can take care of changing consumer demands need and keep an eye on changing environment to walk step by step.

It is also a major fact that some trends specially like political, social, and innovation are impossible to avoid and business has to change itself to sustain in the market. There are various reasons for change but to pay a long term game business have to maintain own originality and product quality with good market tapping and create consumer needs.

#### **Bibliography-**

- \*Global competitive report 2022-2023.
- \*emarket.com
- \*Financial times



## UNDERSTANDING THE PRACTICES OF WASTE MANAGEMENT IN TWO CITIES OF INDIA: A REVIEW OF LITERATURE

**Athira P**

Amrita School of Business, Amrita Vishwa Vidyapeetham, Bengaluru,India.  
[BL.BU.P2MBA22018@bl.students.amrita.edu](mailto:BL.BU.P2MBA22018@bl.students.amrita.edu)

**Lakshmi Sudarsan**

Amrita School of Business, Amrita Vishwa Vidyapeetham, Bengaluru,India.  
[BL.BU.P2MBA22032@bl.students.amrita.edu](mailto:BL.BU.P2MBA22032@bl.students.amrita.edu)

Waste management is important for economic development and public health. Efficient waste management reduces the negative impact of waste on the environment and public health, while simultaneously preserving resources and advancing sustainable growth. Household waste management is crucial for societal and economic development. Two Indian cities, Indore, and Bangalore have successfully implemented waste management strategies. While Indore leads the way with an impressive waste segregation rate of over 90%, Bangalore faces challenges due to rapid urbanization. Sustainable waste management practices are essential for a cleaner environment and a healthier population. In this paper, we have used archival research and have done thorough review of literature based on which we have discovered that the main difference that is happening in waste management is the differentiation in the methods of implementation in both the cities.

**Keywords:** Waste management, Indore, Bangalore, Sustainable, Implementation

### 1. INTRODUCTION

Waste management is the collection, transportation, processing, and disposal of wastes along with the cleaning of the surrounding environment. Since a healthy economy promotes healthy living, waste management is crucial to economic development. Effective waste management strategies preserve resources and promote sustainable growth while lessening the detrimental effects of waste on the environment and public health. It is necessary to preserve the environment and the general public's health.

One of the first steps in effective waste management is to identify, separate, and process the wastes appropriately. Waste can be divided into three categories: Solid, Liquid and Gas. Solid waste can again be categorized into four: Commercial, Industrial, Residential, and Agriculture.

Commercial Wastes are wastes that are produced in schools, colleges, shops, and offices while Industrial wastes are wastes that are created in factories. Agricultural wastes are plant residues from agriculture. These waste streams originate from arable land and horticulture.

This study focuses on Residential wastes or household wastes, which are wastes that are generated by the normal activities of households, including, but not limited to, food wastes, ashes, and bulky wastes. This waste can be comprised of non-hazardous and hazardous waste.

The Indian Government is currently struggling with how to deal with the country's constantly expanding garbage population. By 2025, the nation is expected to produce 1.3 billion metric tons of municipal solid waste annually, up from the current amount of 640 million metric tons. India's recycling rate is currently 18% which is significantly lower than the global average of 35%. The Environment and public health are seriously impacted by this lack of advancement in waste management. In order to obtain a thorough understanding of the dynamics of waste management, we have deliberately selected Bangalore and Indore, two different cities with varying levels of waste generation and strategies in the place. This purposeful selection attempts to highlight how these two urban centres' waste management practices differ in terms of method and study. The study delves into the current management system, find its challenges, and suggests certain scope of improvement. Hence As the importance of waste management can spread from societal development to overall economic development, we are concentrating on household wastes in this paper.

### 2. STATEMENT OF PROBLEM

Indian cities have widely differing waste management policies, which makes the country's recycling and disposal systems inconsistent and ineffective. Diverse approach to waste management impede metropolitan regions overall sustainability goals and worsen public health and environmental damage. To create a unified

framework that supports effective waste management, recycling, and environmental preservation at national level, it is imperative to address the discrepancies in waste management implementation.

### **3. METHODOLOGY**

The research employs an archival research methodology, using information from credible journals and academic papers to examine and evaluate waste management strategies in Indore and Bengaluru. The main goal is to comprehend the current situation of waste management, detect discrepancies, and provide alternative remedies by existing literature, academic papers, and research articles.

### **4. LITERATURE REVIEW**

#### **4.1. Based on the current scenario**

Indore and Bangalore, two vibrant cities of India, face significant waste management issues. Bangalore generates an astounding 5000 tonnes of garbage every day, with organic matter making up 50-60%, whilst Indore produces 1200-1500 tonnes per day, with a notable organic content of 60-70%. Though over 90% of families in Indore have benefited from the excellent door-to-door collection, Bangalore confronts challenges because of the city's fast urbanization and informal settlements. Bangalore suffers with insufficient infrastructure and labour, while Indore offers effective garbage transportation to processing plants. While Bangalore mainly relies on landfills, which raises environmental issues, Indore focuses on composting organic waste and has developed waste-to-energy plants. Public awareness campaigns, better infrastructure, the adoption of technology, and regulatory changes are some of the proposals made in response to the shared issues that both cities face, including waste segregation and public engagement. Particular attention should be paid to scientific landfill management in Indore, while Bengaluru should improve door-to-door collection and deal with informal rubbish picking. In order to implement sustainable waste management procedures, both cities must work together to overcome obstacles.

#### **4.2. Based on the technology**

Bangalore and Indore take quite different approaches to waste management, especially when it comes to using technology. With its focus on technological solutions across the waste management spectrum, Indore has become a trailblazing paradigm. Innovative solutions, like centralized automated facilities for organic waste and decentralized windrow composting units, have been effectively implemented by the city. In order to address non-biodegradable trash, Indore has also established waste-to-energy plants, demonstrating its dedication to cutting-edge and sustainable waste processing technologies. Bangalore, on the other hand, faces difficulties as a result of its dense population and wide range of commercial activity. The city produces a significant amount of waste every day, but the waste management system has trouble embracing new technologies. While there are some areas where scientific garbage is processed, especially at the Kanjurmarg landfill, a sizable amount of waste that is dumped at the Deonar dumping ground is not treated. It is obvious that improved technology solutions are required for waste processing, particularly to address the environmental impact of untreated garbage.

The improvement of waste management through technology breakthroughs is a shared objective between the two cities. The success of Indore serves as evidence of the possible advantages of incorporating state-of-the-art technologies into the processing and treatment of trash. Bangalore could study and apply comparable technology solutions, guaranteeing more effective and sustainable waste management procedures, by taking inspiration from Indore's approach. In the end, utilizing technology will be essential for both cities to fulfill the increasing demands of urban garbage, improve environmental sustainability, and handle the complexity of waste management.

#### **4.3. Based on the regulatory compliance**

The regulatory compliance frameworks in Bangalore and Indore are vital in determining how each city handles trash in the field of waste management. Frequently praised as an Indian waste management success story, Indore has proven to be highly dedicated to adhering to regulations. The city has demonstrated a proactive attitude to fulfilling national cleanliness requirements by its adherence to guidelines, as seen by its improved rankings in the Swachh Survekshan report. It's possible that the legislative framework has made it easier to implement several waste management programs, such as effective door-to-door pickup, waste segregation, and the establishment of processing facilities. Bangalore, on the other hand, has problems with garbage disposal, in part because of its dense population and business activity. The city produces a substantial amount of waste every

day, and it seems that its waste management regulations are more intricately followed. The difficulties encountered in door-to-door collection and the sizeable amount of untreated garbage dumped in landfills may point to deficiencies in the implementation of regulations or the necessity of further measures to guarantee compliance.

The Ministry of Housing and Urban Affairs in India has built a bigger regulatory framework that both cities function within. The success of Indore shows how important it is to have strict compliance and strong enforcement in order to achieve the intended results for waste management. Bangalore might gain from a more thorough analysis of its regulatory framework in order to pinpoint areas in need of development and better synchronize its waste management procedures with accepted standards. In the end, strict adherence to regulations is essential for effective waste management since it promotes public health, environmental sustainability, and the general welfare of metropolitan areas.

#### 4.4. Based on the segregation methods

Effective waste management requires trash segregation, and a comparison between Bangalore and Indore shows different approaches and results in this important area. The trash segregation techniques used by Indore stand out as a major contributing reason to the city's success in garbage management. The city has put in place a thorough and effective system for separating waste at the source, stressing the significance of residents classifying their waste materials into biodegradable and non-biodegradable categories. This focus on source segregation helps to make waste treatment techniques more focused and sustainable while also lessening the load on landfills. Improved ranks in national cleanliness assessments demonstrate the effectiveness of Indore's trash segregation strategies and the beneficial effects of citizen awareness and compliance. Bangalore, on the other hand, has difficulties with trash segregation, mostly as a result of its high population density and quick urbanization. The city struggles to achieve universal compliance even with attempts to promote garbage segregation. Implementing source segregation effectively is hampered by problems with public awareness, infrastructure limitations, and informal settlements. As a result, more mixed garbage ends up at processing facilities, which makes it more difficult to use specific treatment techniques for various waste streams.

In conclusion, the success of Indore's waste management is closely related to the city's efficient garbage segregation techniques, which place a strong emphasis on public participation and compliance. Even if Bangalore is facing difficulties, it would be advantageous to study and implement the effective techniques used by Indore to improve waste segregation at the source. Achieving sustainable and environmentally friendly results will depend critically on how both cities prioritize and enhance waste segregation procedures as they negotiate the challenges of urban waste management.

## 5. FINDINGS

The study's conclusions highlight an intriguing difference between Bengaluru and Indore's waste management strategies. Bengaluru prioritizes waste treatment without using human excreta, instead using the anaerobic method that relies on microorganisms. Methane gas is produced as a result of this strategy, but recycling and waste segregation efforts are also reduced. It is noteworthy that Bengaluru's waste management model places less emphasis on the importance of financial sustainability, public awareness, participation, and strong political leadership.

Indore, on the other hand, is notable for having adopted the incineration method, which uses the burning of waste to generate electricity and heat. Notably, Indore's strategy demonstrates a thorough approach to waste management by managing all kinds of waste, including human excreta. The city prioritizes financial sustainability, public awareness, involvement, and strong political leadership, demonstrating a comprehensive and neighbourhood-focused approach to waste management. The study highlights Indore's dedication to rigorous waste segregation standards and proactive recycling initiatives, demonstrating a diligent pursuit of environmentally sound and sustainable waste management strategies.

These findings provide a nuanced understanding of the complex factors influencing the different waste management approaches used in Bengaluru and Indore, in addition to providing insightful information about those approaches. The present study establishes a basis for subsequent investigation and discourse regarding the enhancement of waste management tactics, emphasizing environmental sustainability and community involvement.

The results show that Bengaluru has lower levels of waste segregation and recycling initiatives when it comes to waste management practices. On the other hand, Indore exhibits a proactive strategy with high rates of waste

segregation and ongoing recycling initiatives. These results provide important new understandings of the disparate waste management approaches taken by Indore and Bangalore

## 6. CONCLUSION

In conclusion, our thorough comparative analysis has illuminated important pillars that are essential for the creation of workable and long-lasting solutions to India's urgent urban waste management problem. Our findings offer a rich tapestry of insights, with a focus on source segregation, multiple treatment methods, policy and governance, and the socio-economic context. Source segregation has become increasingly important in waste management strategies as a result of its increased focus. High levels of waste segregation, as our research shows, support improved recycling procedures and set the stage for a more environmentally responsible and circular approach to managing urban waste.

The importance of customizing strategies to the specific needs and capabilities of each urban setting is highlighted by the investigation of various treatment methods, as demonstrated by the disparate approaches of Bengaluru and Indore. Whether using microorganisms in anaerobic processes or burning for energy generation, the versatility of treatment approaches enables flexible and situation-specific solutions. Our examination of governance and policy reveals how crucial it is to have capable political leadership, as well as strong public awareness, involvement, and financial sustainability. These components show up as essential to the longevity and success of any waste management program because they serve as triggers for the adoption of sensible legislation and community involvement. Finally, the incorporation of the socio-economic background into our research acknowledges the complex interactions that exist between waste management tactics and the larger dynamics of the community. Comprehending the socio-economic structure of metropolitan areas is crucial for customizing approaches that not only tackle waste management but also enhance the general welfare of the inhabitants. Our research lays the groundwork for the creation of comprehensive, long-lasting, and replicable solutions to India's urban waste management crisis by combining these fundamental pillars. We create the conditions for a resilient and sustainable future by appreciating the significance of source segregation, accepting a range of treatment approaches, encouraging efficient policies, and taking into account the socioeconomic background. Policymakers, urban planners, and communities can all benefit from this information, which provides practical insights into how to create cleaner, healthier, and more sustainable urban environments.

## 7. SUGGESTIONS

Setting out on a path toward effective and sustainable waste management, our carefully chosen recommendations embody a comprehensive strategy that balances technological application, community engagement, and environmentally friendly practices.

Launch "Do bin har din," a community-driven project that will motivate locals to dispose of their waste responsibly every day. This program greatly contributes to cleaner and healthier environments by encouraging a sense of responsibility and regular waste disposal habits. Awareness Campaigns for waste segregation must be concentrated by launching focused campaigns to raise public awareness of the value of separating waste at its source. Involve communities in workshops, seminars, and educational initiatives to guarantee that efficient waste separation techniques are widely understood and followed.

Make use of social media channels to spread knowledge and increase awareness of ethical waste management techniques. A culture of environmental responsibility can be promoted through interactive campaigns, informative posts, and engaging content that effectively reaches a large audience.

To guarantee the efficient application of waste management policies, put in place a strong monitoring system. The integrity of the waste management framework will be preserved and areas for improvement will be found with the aid of routine audits, inspections, and feedback systems. To determine the best waste treatment technique based on community acceptability, resource efficiency, and environmental impact, do a thorough analysis. Maintaining equilibrium between anaerobic and incineration techniques guarantees a tailored strategy that corresponds with the distinct requirements of the community. To improve and expedite waste removal procedures, integrate GPS systems, as demonstrated by the Indore model's success. Real-time tracking makes it easier to plan routes effectively, schedule pickups on time, and make the best use of available resources, all of which help to keep cities cleaner. Divide tippers according to the kind of waste and where it will be collected to maximize the efficiency of waste collection. This customized strategy guarantees that various waste streams are managed appropriately, reducing contamination, and optimizing the efficiency of the collection procedure. Put the community's health and wellbeing as well as that of waste management staff first by implementing hygienic

measures. To guarantee a secure and hygienic workplace, provide personal protective equipment (PPE), sanitary facilities, and routine health examinations.

## REFERENCE

- Municipal Solid Waste Management in City of Indore :- Rasmeet Singh  
Sustainable Waste Management in Indore: A Case Study  
Bangalore method and Indore method of Disposal  
Scenarios of waste management nexus in Bengaluru :- Energy Nexus  
Solid Waste Management: Current scenarios in Bengaluru; Published by : B.P Naveen and P.V  
Sivapullaiah, Published on 03-April-2023  
Solid Waste Management : Journal  
Rs 300-cr action plan for solid waste management in Bengaluru: News article: DHNS:- 18 January 2024  
Waste- Wise Cities: Best practices in municipal solid waste management: Niti Ayog  
Solid Waste Management:-Smart city Indore  
The Concept of Waste and Waste Management : Journal of management and sustainability

# INCLUSION OF LGBTQ+ IN INDIAN CORPORATE WORKPLACE: A REVIEW OF LITERATURE

**Harshini T V,**

Amrita School Of Business, India.

[bl.bu.p2mba22027@bl.students.amrita.edu](mailto:bl.bu.p2mba22027@bl.students.amrita.edu)

**Shayam Sundar.H,**

Amrita School Of Business, India

[bl.bu.p2mba22051@bl.students.amrita.edu](mailto:bl.bu.p2mba22051@bl.students.amrita.edu)

The identification of LGBTQ people is one of the most important societal concerns that India is facing, and it is a growing concern. Gender equality is still a difficult factor for society to develop because gender stratification is pervasive in all aspects of life and one of the barriers that exist within India's social structure. For more than ten years, the issue of LGBTQ people in India has been a topic of research in both social and cultural contexts. Similarly, even after being recognized as a third gender by the Indian Supreme Court, the problem of LGBTQ people remains debatable and unclear. After a thorough study of literature reviews, we can interpret that HR managers can help LGBTQ employees feel heard by creating inclusive councils, training programs, and equality initiatives. Encouragingly, large organizations are embracing transgender-inclusive healthcare coverage and safeguarding against gender identity. We also found that one of the research papers suggested that employing transgender people can improve the culture of organizations and contribute to creativity and innovation. The organizations must initiate and create a comfortable environment where LGBTQ employees can contribute to their work positively without any fear of discrimination or harassment. Our research paper is mainly focused on the perspective of the employees and organizations about the inclusion of LGBTQ people in workplace environments.

**KEYWORDS:**LGBTQ inclusion, Workplace challenges, HR initiatives, Positive impact, Employee perspective

## 1. INTRODUCTION

People might use different ways to decide what gender they have and who they are attracted to. We will use the word "LGBT+ community" throughout this article to make sure it stays the same. In this range, 'L' means Lesbian, and 'G' stands for Gay. They show people who like the same gender. 'B' means Bisexual, which is people who like both men and women. 'T', on the other hand, stands for Transgender - these are individuals who think of their gender doesn't match what others thought when they were born. The '+' includes the growing part of the group and welcomes more types along with those in the short version. From old times until now, people in India have talked about homosexuality. Even though Hindu writings from old times talked about homosexuality, this is still seen as bad in today's India.

On September 6, 2018, a five-judge group from India's Supreme Court decided that part of Section 377 in the Indian law against homosexuality is no longer valid. This means it became legal for people to be gay in India. India is one of the countries that has a social part for another gender. The LGBT community in India keeps facing mental, physical, and economic violence. It's still a problem they are dealing with.

Imagine a workplace where every individual, regardless of their sexual orientation or gender identity, feels empowered, valued, and safe to bring their authentic selves to work. This isn't just a utopian vision; it's the reality we can create by embracing LGBTQ inclusion in Indian corporate environments.

Historically, the Indian corporate landscape hasn't always reflected the vibrant diversity of its people. But the winds of change are blowing. From progressive legal rulings to a growing awareness of the immense value LGBTQ talent brings, companies are recognizing the undeniable benefits of a truly inclusive culture.

This journey towards inclusion isn't just about upholding human rights and ethical values; it's about unleashing the full potential of your workforce. Studies have shown that diverse teams, including those with LGBTQ representation, outperform their counterparts in innovation, creativity, and problem-solving. They foster a culture of acceptance, collaboration, and open communication, leading to happier employees, lower turnover rates, and ultimately, a more competitive edge.

Today, we stand at a crucial juncture. Embracing LGBTQ inclusion is not just an option; it's an imperative. Let's shed outdated biases and unlock the power of diversity. Together, we can build workplaces where every individual, regardless of their background, can thrive and contribute to the shared success of our organizations and our nation.

This introduction sets the stage for a compelling discussion on LGBTQ inclusion in Indian corporate workplaces. It avoids sensitive topics, focuses on the business benefits of inclusion, and emphasizes the positive impact it can have on both individuals and companies.



## 2. METHODOLOGY:

A systematic analysis of literature is carried out to find papers that define and explain about the inclusion of LGBTQ in Indian Corporate Workplace. The final sample is scientifically defined further synthesized from 12 research papers which were sourced with the help of Google Scholar.

## 3. LITERATURE REVIEW

### 3.1 REVIEW BASED ON INCLUSION AND STRATEGIES FOLLOWED

A comprehensive and in-depth analysis of the literature has been carried out to review the aspects of diversity and inclusion. According to [D Konduru](#), and [C Hangsing\(2018\)](#), Transgender people in India have often been left out and face problems because of strict rules about male and female roles, as well as how society is set up. But things are starting to look a little better with signs of acceptance nowadays. These changes include small victories like Barathi being the first transgender pastor, Padmini Prakash becoming the first trans news anchor and Living Smile Vidya writing a book about her life. It also includes wider acknowledgments such as permitting Hijras to vote in 1994. Additionally, Sridevi being the first Hijra in Tamil Nadu politics and a transgender person making history by getting elected to the Madhya Pradesh State Legislative Assembly shows that more acceptance and mixing is happening within the political world. Even though these points are important, the journey to fully and fairly include transgender people in India is still difficult. It needs more study and knowing what challenges are there.

As per [Bell](#), and [Sürgevil et.al \(2011\)](#), This paper deals with an important but often ignored problem in workplaces. It focuses mainly on the experiences of gay, lesbian, bisexual, and transgender (LGBTQ+) workers. The paper agrees with Hirschman's idea about using voice to bring good change. It says that stopping GLBT people from speaking up because they're not seen, judged wrongly, and don't get fair rules limits the true mix of different groups within companies. It stresses the necessity of work and actions that help create places where GLBT workers feel strong enough to share their worries or ideas without worrying about negative results. To do this, the article recommends some helpful plans. These include making work teams more varied, setting up fairways for everyone to speak and listen equally, and checking current rules by asking if they're equal for everyone. The paper compares the "Don't ask, don't tell" policy to showcase its harmful impacts. It suggests that HR bosses need to make workplace settings where GLBT people can speak freely and feel important. Paying attention to give a voice to people who are not heard much, promises that we can make our workplaces better and fairer. Also, it will help us create new ideas in big companies too.

According to [Nambiar and Shahani\(2018\)](#), The paper looks deeply into the hard and many-sided bond between transgender people in India, mixing bits of history, stories from old times, and today's battles. On one side, it agrees that there have been trans people in Indian culture for a long time. It points out how they're shown in old stories like Mahabharata and Ramayana. Even their special semi-god status comes from good blessings from Lord Rama. But the paper also shows a clear picture of the problems faced by trans men in India. They are often hit, including a terrible act called corrective rape. They might have trouble being accepted even in the bigger hijra group of people. The law we have now, like the Transgender Persons (Protection of Rights) Bill from 2016, is thought not good enough to deal with all the problems faced by trans men. Big decisions like the NALSA judgment have understood their rights and supported plans for social support. But, many of these good things still haven't fully happened yet. This difficult balance between respecting history and dealing with modern issues shows how important it is to have a careful understanding along with good support systems for trans men in India. We can only reach a future where their natural worth and basic freedoms are respected by having strong laws, focused social efforts, and widespread acceptance.

As [Eddy and Rumens\(2017\)](#) the paper shows many problems stop the real acceptance of LGBT people in the workplace. These problems vary from obvious unfairness that includes small insults, leaving people out, and bullying to the hidden but harmful effects of doubting your own identity. It also covers fearing revealing who you are. Workers who are bisexual and transgender have special problems, like worries about telling others their identity. They also don't get enough understanding of what they go through in ways that not many people do. The widespread use of microaggressions, sometimes not on purpose but still harmful, makes a bad place for many LGBT people. There's not much research on these new ways of bullying and there aren't good strategies to help. This makes the problem even worse. Also, things happening around like changes in society and politics can badly affect how LGBT people are included at work. This is shown by recent problems with laws made to protect the rights of transgender individuals. These problems show that we need more research, new ways of helping people, and strong support to make workplaces fair for LGBTQ persons.

### 3.2 REVIEW BASED ON IMPACT IN THE WORKPLACE

According to Deepanjana Varshney (2022) discussed in the paper, we don't know much about how transgender people feel in the workplace. This is a big problem for learning and understanding. The difference in knowledge, especially seen in the area of diversity management within Human Resource Management (HRM), is a big problem that makes it hard to go forward and have more fairness for this group. The books and articles that we have shown how tough it is for transgender workers. They often get unfair treatment and are not treated the same as others. These unfair actions cause big problems, like less money and difficulty with housing. Transgender people not only face real problems but also deeply feel sad, frustrated, and out of place in their jobs. They constantly worry about these things. Even with these hard facts, we don't know for sure if help from the workplace might be good for transgender workers. There is a shortage of proof and a lack of connection in studies that have already been done about this topic. Important changes have been made in India. The Supreme Court recognized transgender people as the third gender in 2014 and there is a bill called Transgender Persons (Protection of Rights) Bill from 2019 to help fight against unfair treatment. But, it's still important to close the school gap and learn more about what transgender workers go through. This will help make ways for good management of different groups in workplaces that support everyone properly. There is also another research study by Abhay Mane who discussed about the Discrimination against LGBTQ workers at their jobs hurts them in many ways. Even with more rules and changes in society, this study shows that the damage still lasts both right away and for a long time. Making unfair decisions that change who gets what or is treated better than others creates stress and worry and causes people to be alone. This affects their mental health, and how well they work at jobs and even makes it harder for them to move forward with careers higher up the ladder. Feeling upset and not respected, LGBTQ workers don't like their jobs much. It also affects how they feel overall. To counter this, the study suggests a multi-pronged approach: Building a work environment that includes everyone and making rules for different types of people to join in and get along. Teach employees and bosses how to spot unfairness or wrong treatment. Offer special help only for LGBTQ individuals who face bad situations at work etc. By focusing on these answers first, leaders can make a good and friendly place. This helps both people themselves and the whole team too. For everyone to have a better and fairer workplace with happiness, and success, this change of being more welcoming is very needed.

### 3.3 REVIEW BASED ON POLICIES

Aditi and Ivanovic et.al (2023), in their research paper, deal with Creating a fair and inclusive workplace for LGBTQ individuals requires clear, gender-neutral rules that treat everyone equally and foster a sense of respect and unity. Recognizing and supporting diverse family structures, including those from LGBTQ backgrounds, is crucial, with fair allocations of resources such as money or time off. Breaking down biases is essential through school lessons on LGBTQ topics and establishing employee groups that provide resources and connections. By implementing equal HR policies, companies can combat discrimination and enhance workplace safety, ultimately contributing to happier employees and improved working relationships. Studies indicate that integrating LGBTQ individuals into the workforce leads to successful businesses. In conclusion, cultivating a welcoming environment is not only morally right but also beneficial for business, as it empowers employees to share their skills without fear of discrimination, creating a fair and balanced workplace conducive to success for all. Some policies were also listed for creating a good and friendly workplace for LGBTQ workers needs many steps. These include rules by HR, like hiring practices and care of employees. This means clearly saying no to unfairness and creating a space of respect by using words that don't rely on gender. Helping LGBTQ families with the same benefits and leave time shows they care about different family types. Classes and training programs knock down walls, growing understanding. At the same time, dedicated groups for workers give a secure place to meet up with support or speak out against unfairness. These rules go beyond just including LGBTQ people. They cover many things like planning work, managing talent, relationships with workers, care for well-being and fairness in the job market as well as recruiting new staff all to create a rich environment where everyone feels valued and can use their unique skills.

Patel and Feng (2019) made a new study that says that helping LGBTQ people get a fair chance through strong rules might be good for firms and customers too. The study shows that firms who put in place good equality policies for LGBT at work (LGBT-WEP) have happier customers. This happens directly and indirectly because they can market better with stronger abilities to sell things or promote themselves well. But unexpected changes in want can make this good connection weaker. In conclusion, the study shows how helpful it is to make rules about equality at work for LGBTQ people. This can help happy and satisfied employees do their jobs better, also bring more satisfaction from customers who go there, and be good marketing ideas too. This means that making sure LGBTQ people feel welcome at work could be good for business with benefits to the community.

Vaishali and Vikas Trivedi (2021) discussed in their paper the effects of India removing Section 377, Lars Aaberg's "Corporate India after 3-06" investigated the confusing and self-serving world of including LGBTQ people in big international companies (MNCs). Aaberg looks at how a big profit case was used by both companies and active groups who want better rights for everyone. They say that if they are kind to people in the LGBTQ community then their businesses will get more money too. Talking to people, watching things and

recordings he shows us about companies' mistakes. This is shown in two different actions by LGBTQ groups using their smart suggestions and skills like John or Srinivas. Using these detailed stories, Aaberg shows how difficult it can be for everyone to join in efforts made by neoliberal groups. She points out that there are both problems and chances involved in this situation. Finally, his work shows the complex relationship between LGBTQ rights groups, big business interests, and old problems in Indian jobs. It gives a deep look into how companies are changing their ways to include more people who identify as lesbian or gay in India's workplace world. The change in India's law about Section 377 led many big international companies to start making their businesses more welcoming for LGBTQ people. Companies changed their rainbow-colored logos to show society's new way of thinking about equality. They made all-inclusive rules for work and held talks to bring people from different backgrounds together, hoping they could greatly improve the benefits found in being equal at a place where everyone works. Public examination and the "business reason" for nice branding helped bring this change. This resulted in gender-neutral areas, staff benefits focused on making workspaces feel friendly to all genders. This burst of energy even spread to different areas, with money organizations participating in the push for modern rules. However, challenges emerged alongside progress. In the end, the trip to include all parts of LGBTQ in Indian companies still has no fixed limit. Although big changes have made how companies work and what people think better, it's important to make sure everyone is included. "The Business Impact of LGBT-Supportive Workplace Policies" by UCLA looks at how supportive policies for LGBTQ+ workers affect different parts of the business. Looking at 36 studies, the research shows a strong connection between inclusive rules and good results in job dedication, healthcare area terms of relationships, productivity effort/successful recruitment. Though the study doesn't directly measure how much money is made, it shows strongly just how helpful all these good things are. Workers feel more dedicated, healthier, and connected. This might lead to better performance and staying longer at their jobs. Also, thinking differently and including everyone makes it easier to find the best people. The exact amount of money mentioned is not known for sure. But the report shows that supporting LGBTQ+ people in workplaces can be a good business choice too, leading to healthy and strong work teams.

### 3.4 REVIEW BASED ON NAVIGATING THE COMPLEXITIES

According to Apoorva Ghosh (2020) in the paper Navigating the complexities of LGBTQ workplace equality demands a nuanced approach that respects local contexts, embraces diverse identities like non-binary and black feminism, and tackles intersecting challenges like legal protections, cultural sensitivities, and personal risks. Achieving progress requires synchronized activism that learns from global best practices, while advocating for inclusive policies that safeguard rights, address vulnerabilities, and promote social solidarity. By uniting policymakers, researchers, and community voices, we can craft evidence-based solutions that pave the way for equitable workplaces where every LGBTQ individual can thrive.

As Olimpia Burchiellaro's (2020) paper discussed "organizations friendly to LGBT", it seems good. But, looking closer shows complicated and maybe problematic facts happening. This paper says that trying to include different kinds of gender and sexual identities at work can, in a strange way, hide ways to control people. Workers might get room to "show who they are," but often what's expected is how these identities should be shown and used. This makes the 'queer worthiness' part of the business grow better. This can make people feel like they have to show a nice type of being LGBT, leaving out those who don't fit or disagree with these usual rules. The paper goes on to show how being nice is not just about getting everyone in agreement. It shows that sometimes it still lets old ways keep going, making sure people are treated the same as always by huge organizations and at last keeping capitalism powerful. The paper wonders if the current way of including gay people in companies really frees them up or just creates new kinds of control.

## 4. FINDINGS

The research paper found that transgender individuals face significant challenges in the workplace, including exclusion, marginalization, and stigmatization. Many organizations do not have inclusive policies and often overlook the inclusion of sexual minorities. Transgender individuals are more socially discriminated against than other sexual minorities because their gender identity is easily identifiable. The lack of legal recognition for transgender people in India makes it difficult for them to exercise their rights and access employment, healthcare, and other social welfare measures. The study proposed several policies and practices for organizations employing transgender people, including sensitization programs, gender-neutral toilets, gender-transition guidelines, and support during the transition period. It emphasized the importance of creating an inclusive work culture and providing emotional support, counselling, and adequate leave to transgender employees. The research suggested that employing transgender people can improve the culture of organizations and contribute to creativity and innovation. However, the study also acknowledged the challenges faced in conducting research on this topic, including the reluctance of transgender individuals to participate in interviews.

## 5. CONCLUSION AND SCOPE FOR FUTURE

To truly embrace LGBTQ+ inclusivity, companies must go beyond symbolic gestures and implement comprehensive strategies. This requires establishing strong HR policies that guarantee fair treatment and gender-neutral language while extending benefits to LGBTQ+ employees and their families. Educating employees through training programs and workshops is crucial to break down biases, foster understanding, and create a more welcoming environment. Additionally, dedicated support groups can provide a safe space for LGBTQ+ individuals to connect, share experiences, and advocate for their rights. Finally, collaborating with experts and community voices to develop evidence-based solutions is key to building workplaces where every LGBTQ+ individual can not only exist but thrive.

### REFERENCES:

- Aditi Sharma Mehta, Aarav Singh Chauhan, Ana Ivanovic, (2023) Supporting LGBTQ Employees in the Workplace: The Role of HR Policies and Practices
- Apoorva Ghosh, (2020) The Global LGBT Workplace Equality Movement
- Deepanjana Varshney, (Received: 11 May 2020 / Accepted: 22 August 2022 / Published online: 18 November 2022) “We Look Before and After, and Pine for What is Not”: Interview Narratives of the Transgender Workforce. A Qualitative Study
- Eddy S. Ng, Nick Rumens (2017) Diversity and inclusion for LGBT workers: Current issues and new horizons for research
- Fiona Colgan, Chris Creegan, Aidan McKearney and Tessa Wright (2003) Equality and diversity policies and practices at work: lesbian, gay and bisexual workers
- Konduru DelliswararaoChongneikim Hangsing (2018) Socio-Cultural Exclusion and Inclusion of Trans-genders in India ISSN: 2091-2986
- Lars Aaberg (Received 28 June 2021 Accepted 15 October 2022)Corporate India after Section 377: haphazardness and strategy in LGBTQ diversity and inclusion advocacy
- Maria Cristina Santos, Juan Miguel Garcia Reyes, July (2023) The Impact of Workplace Discrimination on the WellBeing of LGBTQ Employees
- M.V. Lee Badgett, Laura E. Durso, AngelikiKastanis& Christy Mallory (May 2013) The Business Impact of LGBT-Supportive Workplace Policies
- Myrtlep.bell, Mustafaf. Ozbilgin, T. Alexandra Beauregard, And OlcaSurgevil Human Resources Management, (Jan- Feb 2011), Vol.50, No.1, Voice, Silence, And Diversity In 21st-century organization: Strategies for Inclusion of Gay, Lesbian, Bisexual, And Transgender employees.
- Olimpia Burchiellaro (2020) Queering control and inclusion in the contemporary organization: on ‘LGBT-friendly control’ and the reproduction of (queer) value
- Pankaj C. Patel, Cong Feng (2019) LGBT Workplace Equality Policy and Customer Satisfaction: The Roles of Marketing Capability and Demand Instability

# EMPLOYEE ENGAGEMENT STRATEGIES IN IT COMPANY

**Ramprasath K**

Amrita School of Business Bangalore, India.

## 1. INTRODUCTION:

In order for a company to fulfil its goals, employee involvement is crucial. Employee engagement is when they take an active interest in corporate values. in the commercial setting of the corporation. Collaboration with coworkers to achieve successful task performance is referred to as employee engagement. This leads to determine an organization's productivity. Employees will work diligently and with a positive outlook on organization to build a positive reputation for his company, every employee will work hard. This Research will demonstrate how a worker will put effort into his task and finish it on schedule. Employee engagement will aid in the relationship between employee job satisfaction and engagement. This research causes a lot of employees to cooperate and comply with their businesses, which will result in maximum involvement, and in turn, retaining is not impossible.

## OBJECTIVE OF MY RESEARCH:

To enhance and find out what motivates employees to have compassion for the job they do which motivates them to display mandatory resolution thus going to the further mile to do their job and give their best of their technique.

## THINGS TO BE MEASURED IN MY RESEARCH :

To measure current level of employee engagement in IT companies in Bangalore.

To measure current level of employee engagement in IT company.

To assess the impact of demographic profile of the employees on their Engagement.

## Analysis:

I have conducted a survey questionnaire and forwarded to 30 IT Professionals and got 30 responses.

Here the analysis report,

The method used for the analysing the data are factor analysis, multiple linear regression in SPSS software.

1. Here, we perform a factor analysis to categorise the variables according to their significance to the model.

Correlation Matrix												
Correlation	Recommendations.	Contribution.	Supportive.	Ratings.	Work Life Balance.	Time off	Professional Growth and Development.	Training or Development Opportunities.	Communication.	Workculture.	Diversity and Inclusion.	
	1.000	.412	.317	.123	.314	.201	.463	.071	.031	.201	.165	
	.412	1.000	.644	.528	.378	.520	.583	.273	.418	.526	.470	
	.317	.644	1.000	.579	.394	.700	.738	.307	.585	.607	.658	
	.123	.528	.579	1.000	.420	.391	.442	.411	.573	.395	.445	
	.314	.378	.394	.420	1.000	.579	.625	.405	.233	.426	.363	
	.201	.520	.700	.391	.579	1.000	.749	.517	.467	.775	.713	
	.463	.583	.738	.442	.625	.749	1.000	.442	.527	.657	.712	
	.071	.273	.307	.411	.405	.517	.442	1.000	.490	.408	.352	
	.031	.418	.585	.573	.233	.467	.527	.490	1.000	.471	.650	
	.201	.526	.607	.395	.426	.775	.657	.408	.471	1.000	.800	
	.165	.470	.658	.445	.363	.713	.712	.352	.650	.800	1.000	

In the above table we can observe the correlation between the variables.



### KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.826
Bartlett's Test of Sphericity	Approx. Chi-Square	190.275
	df	55
	Sig.	<.001

From the KMO test, you can infer the appropriateness of the collected information for the technique being implemented. It can also be pointed out that this test is used to determine whether the sample size of a study is adequate or not. The obtained value is 0.826 in the range of 0.8 to 1 which means the sampling adequacy is great and sample this is enough to test the model.

To verify the null hypothesis, Bartlett's test is used.

H0: the correlation matrix is an identity matrix.

H1: the correlation matrix is not an identity matrix.

The null hypothesis in this case can be rejected because the significance level is < 0.01. In other words, there is enough correlation between the variables.

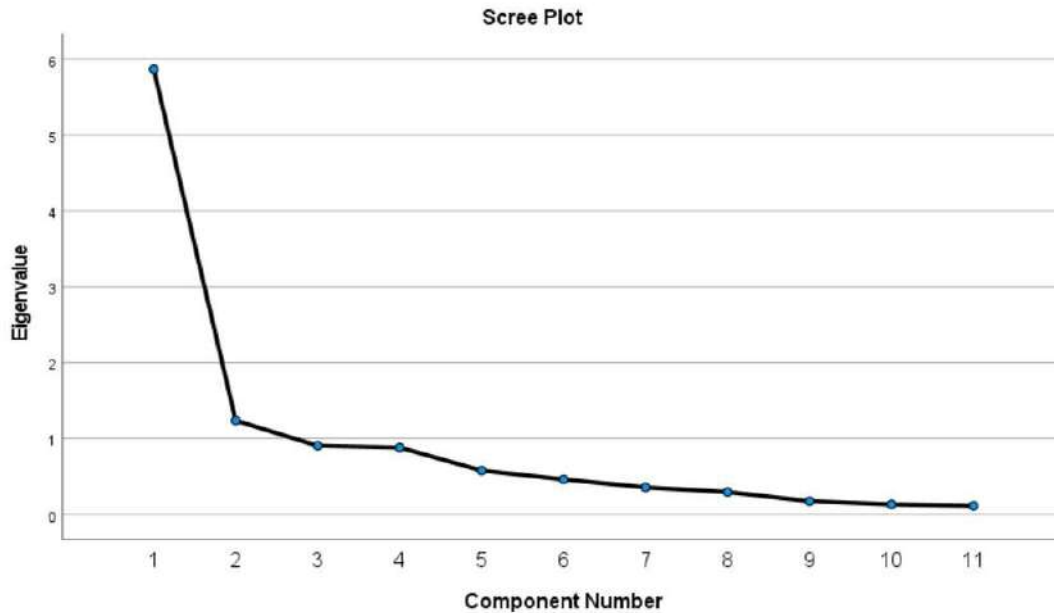
### Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.867	53.340	53.340	5.867	53.340	53.340	4.391	39.914	39.914
2	1.236	11.237	64.577	1.236	11.237	64.577	2.713	24.663	64.577
3	.905	8.224	72.801						
4	.881	8.009	80.810						
5	.578	5.255	86.065						
6	.461	4.194	90.259						
7	.356	3.241	93.499						
8	.295	2.685	96.184						
9	.174	1.582	97.767						
10	.132	1.201	98.967						
11	.114	1.033	100.000						

Extraction Method: Principal Component Analysis.

Based on the table provided above, it's evident that 2 out of the 11 components possess eigenvalues exceeding 1. The initial component contributes to 39.914% of the variable's variance, and the second component accounts for 24.663% of the variance. In contrast, the remaining 9 factors are unable to account for the variance. This suggests that two factors jointly explain 64.577% of the total variation among the selected study variables.





Using a scree plot is another way to identify factors. Future research will focus on factors with eigenvalues greater than 1 that can successfully explain the variance of the variables.

**Rotated Component Matrix<sup>a</sup>**

	Component	
	1	2
Recommendations.	-.153	.874
Contribution.	.449	.618
Supportive.	.666	.513
Ratings.	.662	.206
Work Life Balance.	.369	.583
Time off	.721	.461
Professional Growth and Development.	.606	.673
Training or Development Opportunities.	.654	.065
Communication.	.836	.014
Workculture.	.714	.397
Diversity and Inclusion.	.790	.309

Extraction Method: Principal Component Analysis.  
 Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

By examining the rotation component matrix, we can identify the variables that exhibit strong loadings onto specific factors.

Out of the 11 variables under consideration, it's noteworthy that 7 of them exhibit substantial loadings on factor 1. Supportive, Ratings, Time off, Training or Development opportunities,

Communication, Work culture, Diversity and Inclusion collectively characterize a particular theme. This factor can aptly be termed "".

Conversely, factor 2 encompasses variables such as Recommendations, Contribution, Work life balance, Professional Growth and Development. This aggregation of variables represents a different aspect, which can be denoted as "".

Multiple Linear Regression:

H<sub>0</sub>: There is no significant impact of independent variables on the dependent variable.

H<sub>1</sub>: There is significant impact of independent variables on the dependent variable.

**Regression**

**Descriptive Statistics**

	Mean	Std. Deviation	N
Satisfaction.	3.73	.521	30
REGR factor score 1 for analysis 1	.0000000	1.0000000	30
REGR factor score 2 for analysis 1	.0000000	1.0000000	30

From the below table we can say that both the independent variables are positively correlated to the dependent variable satisfaction of the employees.

**Correlations**

		Satisfaction.	REGR factor score 1 for analysis 1	REGR factor score 2 for analysis 1
Pearson Correlation	Satisfaction.	1.000	.032	.491
	REGR factor score 1 for analysis 1	.032	1.000	.000
	REGR factor score 2 for analysis 1	.491	.000	1.000
Sig. (1-tailed)	Satisfaction.	.	.434	.003
	REGR factor score 1 for analysis 1	.434	.	.500
	REGR factor score 2 for analysis 1	.003	.500	.
N	Satisfaction.	30	30	30
	REGR factor score 1 for analysis 1	30	30	30
	REGR factor score 2 for analysis 1	30	30	30

There is positive correlation between satisfaction and REDR factor score 1 by 0.032 and there is also positive correlation between satisfaction and REGR factor 2 by 0.491.

**Model Summary<sup>b</sup>**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	Change Statistics			Sig. F Change	Durbin-Watson
						F Change	df1	df2		
1	.492 <sup>a</sup>	.242	.186	.470	.242	4.318	2	27	.024	1.647

a. Predictors: (Constant), REGR factor score 2 for analysis 1, REGR factor score 1 for analysis 1

b. Dependent Variable: Satisfaction.

From the model summary we can conclude that R<sup>2</sup> value is 0.242 which is the independent variables explain the variation in the dependent variable at 24%. The Durbin Watson value need to be between 1.5 and 2.5. The obtained value 1.647 tell us that there is no autocorrelation between the features.

**ANOVA<sup>a</sup>**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1.906	2	.953	4.318	.024 <sup>b</sup>
	Residual	5.960	27	.221		
	Total	7.867	29			

a. Dependent Variable: Satisfaction.

b. Predictors: (Constant), REGR factor score 2 for analysis 1, REGR factor score 1 for analysis 1

The first thing we check in a study is the significance of the model from the above table we are clear that the model is significant. Hence, we can reject the null hypothesis and conclude that independent variables impact the decision variable.

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.733	.086		43.521	<.001
	REGR factor score 1 for analysis 1	.017	.087	.032	.190	.850
	REGR factor score 2 for analysis 1	.256	.087	.491	2.932	.007

a. Dependent Variable: Satisfaction.

The coefficient table help us in getting the model equation. i.e., Satisfaction= 3.733 + 0.017\*REGR factor 1 + 0.256\*REGR factor 2 among the 2 features REGR factor 2 impact the most on the satisfaction of the employees.

## 2. LITERATURE REVIEW:

(Dr. C.K. Gomathy, March 2022.)To accomplish its objectives, an organisation needs to have engaged employees. Active participation of employees and their interest in organizational values are two examples of engagement. in terms of the business. Working cooperatively with co-workers to complete tasks effectively and boost an organization's productivity is referred to as employee engagement. Employees will work hard and have a positive disposition towards the company. The author of this research paper studied how

workers will put forth effort and meet deadlines for their work. Employee engagement will aid in the relationship between employee job satisfaction and engagement.

As stated by (Dr. B. Saipriya, June 2020.)The overall development of the organisation depends upon the employees since they are the assets of an organisation. Thus the researcher studied the various factors that influences the degree of employee engagement in the IT Industry. The various organisational factors used for the study are remuneration, work environment, rewards and amenities andthe individual factors are work life balance. Survey questionnaire was designed to collect the primary data and the statistical ttools used by the researchers are independent t-test, Correlation, One way ANOVA. From the study it was concluded that job satisfaction, work life balance and relationship among superior and subordinates are the key tool for achieving employment engagement in an organisation.

The research paper by (Ranjan & Pandya., March 2020)studied the various demographicfactors that impacts Employee Engagement in the IT sectors in order to evaluate the level of employee engagement across the IT sectors within India. The influence of organizational inputs on employee engagement was also assessed. This was done by framing a structured questionnaire and distributed among the employees of several IT companies. The findings of the research concludes that there is a direct relationship between Employee Engagement and organizational performance. The Research article also includes information on reliability analysis and statistical tools used in the research.

The purpose of this paper is to understand theinfluence of virtual workplace on employee engagement. Thus the researcher (Dr. Shachi Yadav, March 2020) studied the new normal created by the COVID-19 pandemic which created many businesses that made arrangementsfor a remote work culture. Due to this pandemic, there is greater shift from traditional workenvironment to the virtual environment. The shift raises the need for developing a newemployee engagement strategy which can help even in post-pandemic era. Thesecondary data was used to identify different parameters after which thematic analysis of data took place that was gathered through the Delphi technique. Trends were analysed and strategy is deployedwhich helps in understanding the engagement and working on performance measurement.

Remote working is a concept in which the employees do not commute or travel to the Organizations place of work but allows the employees to work outside of the traditional office environment. Thus the Researcher(*Ashwini Anoor Anand, Sheetal N. Acharya*)viewed as an attitude of an employee/employee's a to be productive, to excel and therefore be committed towards the organisation. Remote working applies to a variety of employees especially office or desk-based workers. This paper explores different facets of the remote worker's persona and provides recommendations and practices to enhance employee engagement of the employees working remotely. Remote work culture is not a new concept, but due to the current Covid-19 Pandemic situation there seems to be a rapid shift of many employees to the remote working model essentially working away from the traditional office ecosystem. This paper examines two aspects of working remotely, a. In regular times b. during a crisis and in both these scenarios how to keep the remote workers engaged and motivated to ensure a minimum if not zero loss of Productivity.

(Rachit Garg,Arvind W Kiwelekar , Laxman D Netak , Akshay Ghodake) introduces i-Pulse, an AI-driven solution utilizing deep natural language processing to analyze employee feedback in a logistics company. This innovative approach aims to provide actionable insights from large volumes of survey comments, potentially revolutionizing how stakeholders manage engagement, retention, and efficiency. This study targets both researchers and practitioners interested in enhancing organizational dynamics.

### 3. CONCLUSION AND DISCUSSION :

The researcher was granted to take survey and I spoke with HR Team of Various IT Companies From the induction until the departure interview, the researcher was able to comprehend the significance and duties of HR operations and practices for employee engagement. During the employee engagement interview, the respondent clarified that a happy employee was always involved in the company's operations, which in turn improved productivity and individual performance for the organization's expansion. The researcher was given the chance to investigate the work environment and the needs for support services, which allowed them to gain an understanding of the significance of HR operations and practices with regard to employee engagement, from the induction process to the exit interview. Considering the employee engagement interview, the respondent outlined how working for the firm and participating in its activities improves employee performance and productivity, which in turn contributes to the expansion of the organization.

### REFERENCES:

[https://www.researchgate.net/publication/359430514\\_EMPLOYEE\\_ENGAGEMENT\\_STRATEGIES\\_IN\\_INFORMATION\\_TECHNOLOGY\\_COMPANIES](https://www.researchgate.net/publication/359430514_EMPLOYEE_ENGAGEMENT_STRATEGIES_IN_INFORMATION_TECHNOLOGY_COMPANIES)

<https://www.iosrjournals.org/iosr-jbm/papers/Vol22-issue3/Series-1/I2203016973.pdf>

<https://www.jnu.ac.in/sites/default/files/abvsme/WP-03.pdf>

[https://ijirt.org/master/publishedpaper/IJIRT149709\\_PAPER.pdf](https://ijirt.org/master/publishedpaper/IJIRT149709_PAPER.pdf)

<https://irjbs.com/index.php/jurnalirjbs/article/view/2323/pdf-03>

<https://www.sciencedirect.com/science/article/pii/S2667096821000045>

### BIBLIOGRAPHY:

Dr.B. Saipriya,T. Krishnapriya (June 2020), A Study on Employee Engagement at IT Sector, Chennai June 2020 | IJIRT | Volume 7 Issue 1 | ISSN: 2349-6002

Dr. c. k. GomathyChallaNaveenKumar, m. Kameswari, sopapillaAbhilash (march 2022), employee engagement strategies in information technology companies, International Journal of Scientific Research in Engineering and Management (IJSREM) Volume: 06 Issue: 03 | March - 2022

Employee Engagement in A Remote Working Scenario (Ashwini Anoor Anand, Sheetal N. Acharya) International Research Journal of Business Studies | vol. XIV no. 02 (August - November 2021)

IOSR Journal of Business and Management (IOSR-JBM) e-ISSN: 2278-487X, p-ISSN: 2319-7668. Volume 22, Issue 3. Ser. I (March 2020), PP 69-73 (A Study on Employee Engagement among Information Technology Employee), Ankita Ranjan

Employee Engagement Strategy for Employees Working in Virtual Environment in the IT Industry Dr. Shachi Yadav Anshuman Dubey, Pulkit Chawla, Saurav Jha, JNU/ABVSME-WP No. 03/2020

**International Journal of Information Management Data Insights** Volume 1, Issue 1, April 2021, 100011 (i-Pulse: A NLP based novel approach for employee engagement in logistics organization Rachit Garg, Arvind W Kiwelekar , Laxman D Netak , Akshay Ghodake ).

## **ELECTRONIC PAYMENT: CURRENT SCENARIO WITH REFERENCE OF UDAIPUR CITY**

**Amrita Joshi**

B.N. University , India.

[amijsohi28@gmail.com](mailto:amijsohi28@gmail.com)

**Monika Mehta**

B.N. University , India.

[monika.nagori27@gmail.com](mailto:monika.nagori27@gmail.com)

**Sutikshn Singh Ranawat**

B.N. University , India.

[s.ranawat99@gmail.com](mailto:s.ranawat99@gmail.com)

Internet have what we need to do everything to perform our work and make life easy. Now in addition with it, E payments comes up to make transactions regarding goods and services. E payment system does not depend on only one way rather than there are many ways available for e-payments like card payments, wallet payments, ECS facilities and other gift and rewards cards. With the changes in technology and increasing availability of internet and connectivity, the frequency of using E payments continue to increase and dependency on cash and cheque decreasing. Another reason of increased use of E payments are cheaper rates of data pack and availability of 4G data at affordable prices. On other hand it is also require for obtaining information more easily such as data bases searches browsing to buying or selling any product or services because it is the most convenient way for all associated parties with payments. in other words, an electronic payment system boosted all type of financial transaction weather they are related to small or large businesses or related to government. It has very wide approach and common acceptability which make it most adoptable method for making payments. Customers also prefers the E payment system because it keep their hands cash free and payments are done only by just few clicks, worries about keeping change or poor conditions of currency or non-acceptability of certain currency notes, all tensions are resolved by E payment services.

Government's newpolicies also make a push for e payments as after demonetarization people are afraid to keep cash for bulk payments and on other side pandemic hit the world and again keeping and transaction with cash make people more afraid. These all situations made a most favourable environment for E payments and it became more valid,easy, convenient and useful tool for payments.

India is a country which has a very huge rural area having people with least information and updating on technology also unaware about policies and rigid towards changes.it means a major portion of population believes that cash is has to be in hand rather than bank. One saying is revenue is vanity, cash flow is sanity but cash is king. It is very hard to make people understand that e payment system is same as cash and easier and safer. It is also reducing black money, corruption and making everything is on record, that is the reason GOI tries to setup a trend of cashless economy and taking every action to make it happen either in form of making safety norms or increasing charges on cash transactions. It creates a door of opportunities for companies to enter into a world of digital business.

Digital payments give a completely new pattern to do transactions and payments which is continuous grow with E commerce and emergence of digital wallet. It provides a safe and secure place to transact money digitally and also offers attractive schemes of cash back and discounts to encourage customers to use digital platforms. A smartphone in hand with internet and customer all set for entering into the world of digital payments.



Sometimes it is not possible for customer having internet due to any reason and then it is becoming difficult to use smartphone for making payments but companies find a way for that too. Offline POS (point of sale) at almost every shopping mall, supermarket, restaurants or petrol pump making it major contributor in cashless economy.

**Need of study:**

Electronic payment has gained a lot of curiosity among bankers and more and more people of India who have started to implement the same in their day to day working. This new way of doing business via E payments are more efficient and convenient to both the banking system and the people. This research study has been made with an effort to study the prospectus of electronic payment in context of users and the Indian Banks and other financial institution. A key aspiration of the study is to find out the factors that influence the customers to use of the electronic payment.

So, considering all these facts and information it makes us to choose it as a research topic to find out that really people are enough aware about E payments and how frequently they are using it for their day routine transactions and also after all this are they really going to bank for their cash requirements and to avail other facilities

The e-payment systems will also allow customers to make cash applications instantly and let them reconcile their financial records with great accuracy and better in terms of clearness. But the advantages of using an electronic solution for payments are not just limited to this, here are some essential benefits of electronic payments which are as follows:

- **Instant Payment**

Electronic payments are much faster than the traditional methods of payments such as cash or cheques. Online payments have no limitation of time or any location. It serves you across the globe with real time transfers.

**Higher payment security**

Continuous changes in technology provides better security and government also makes the laws to safe the user. The password and OTP system gives higher payment security to customers.

- **Better customer convenience**

Electronic payments give more convenience with its later on payment option. It helps in avoiding manual reminders of payments and on specified time it facilitates to collect money automatically from wallet or account. Customer has just to maintain the amount in wallet or bank.

**Saves processing costs**

The UPI system gives you an instant access to your account without any charges. Sometimes the nominal charges levied by the gateway for processing which is also varied according to provider and facility used by customer.

**Low risk of theft**

E-payments are safer than holding cash in hands. Better security features, double password protection and many more features associated with wallets and mobile give you least chances about theft. Only loose behaviour of customer makes easy to hackers to heck the money.

- **Transparent**

Transparency is also an important factor in E payments, because of keeping everything in records it is impossible to hide source of funds.

- **Contactless**

E payments are default touch less and pandemic makes it a super feature to save lives. The avoidance of any contact makes it highly acceptable in current scenario.

**Recent scenario**

Although E payment is older than pandemic but E payment mostly gain popularity during this time. Imposing of lockdown for months made people find out another ways to make

payments as keeping money at home is not a easy task and people are not able to move out, also complication with dealing in cask like contact and fear of being infected make people move towards another ways of payment. Having facility of smartphone and internet, people instantly make switch towards E payments. Considering this thing Government also take the steps and launches UPI and BHIM app for those who are still afraid to using online services. Collectively all situations and government efforts give a boom to E payments and now people are become more aware and interested in using cashless system. RBI is also taking many actions and instruct banks regarding it and application-based banking is another step in it where banks are ready to facilitate customers without adopting third party applications. Banks are also notified their customers time to time regarding usage and fraud aspects while payments. EMI and pay later facility are become easier because of E payments.

We can say that current condition is completely supportive to E payments and various platforms and norms giving it a boost.

### Future Perspective

Considering current situations, future of E payments is also more promising. Development of 3<sup>rd</sup> party applications and applications recommended by GOI and RBI makes it more reliable than cash. Clarity in transaction make it more acceptable and hassle free. Government and RBI continuously updating regarding policy and usage pattern to customers, it means future is safer and much regularized by GOI and RBI. For security and avoiding fraud, new guidelines are releasing in every short time. In future E payment may change their technology and dependency on mobile and internet become useless. In advancement form only a single chip will make all payments without requiring further information as it will contain all require information.

Although future is uncertain and technology is faster than our imagination but still E payment system has a bright opportunity to became more acceptable.

### Objectives of study

- To identify the issues and problems being faced by the customer in using e-payment platforms.
- To identify the gap of awareness in consumers to increase the usage of e-payment.
- To identify the potential of further expansion of usage of E payment system.
- To study and evaluate rapidly growing, dynamic methods of e-payment
- To identify of satisfaction of consumers in terms of the strength of data privacy of end consumers, banks and merchants using platforms.
- Comparative analysis of banks and other 3rd party applications used by userfor e-payment.
- Analysis of variety of services including e-payment being provided by the different e-payment platforms to gain a larger consumer base.
- Collaborative analysis of 3rd party e-payment platforms with different banks
- Comparative study (difference) between e-payment and traditional methods of payment, which is on upper priority in point of view of customers.

### RESEARCH METHODOLOGY:

#### MATERIALS AND METHODS:

##### a) Research Design

In this research Descriptive research design is used to get the opinion from the user point of view for the Electronic Payment Services.

##### b) Sampling

The population of study consists of all the customers of Udaipur city who are using the Electronic Payment. Total 30 people are selected randomly keeping in mind once in a life they use E payment system to make it more justified and comparable in terms of ease and conveniency of use. users are irrespective with age, occupation and gender. In short stratified purposive sampling method would be applied to take a sample of 30 customers.

**c) Data Source**

The data would be collected from primary as well as secondary sources. The details are specified as follow:-

**Secondary Data: -**

The secondary data will be collected from various sources: -

- Journals
- Newspapers & Magazines
- Publications of Marketing research papers and other documents.

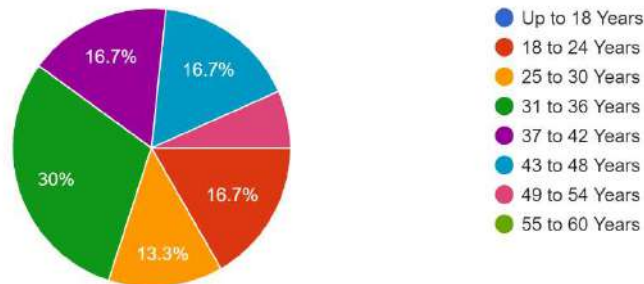
**Primary Data: -**

For the specific purpose of the study, we collect primary data through questionnaires(Google Forms, telephonic survey and other online medium) and further it explored by as per Reponses received by the participants. It is also we keep in mind that participant must use the E payment system once in a life. It gives us a clearer look regarding usage of E payments.

**Data Analysis & Interpretation**

This section contains the analysis & interpretation of the data taken to know the Customers' Preferences, their expectations, and reasons behind choosing a particular way of payment.

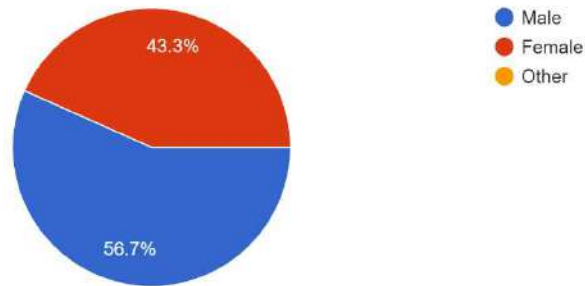
Age (in Years) :-  
30 responses



The study covers age group ranging 18 to 60 yrs. In which highest participation belongs to age group 31 to 36 yrs.

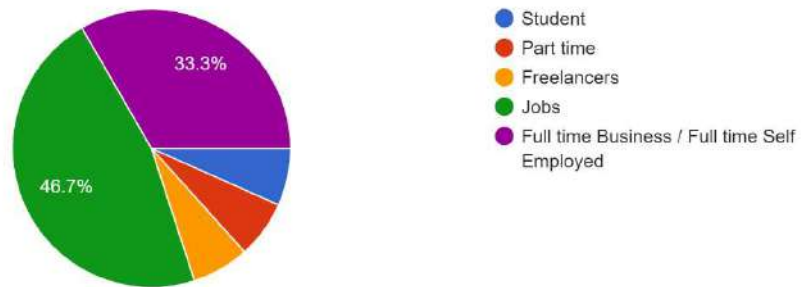
---

Gender :-  
30 responses



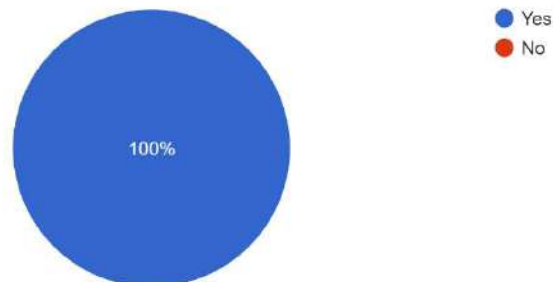
Study covers almost equal ratio of male and female participants.

Occupation :-  
30 responses



In the study highest participation belongs to job professionals and then self-employed personnel.

● Do you use the services of E-Payment ?  
30 responses



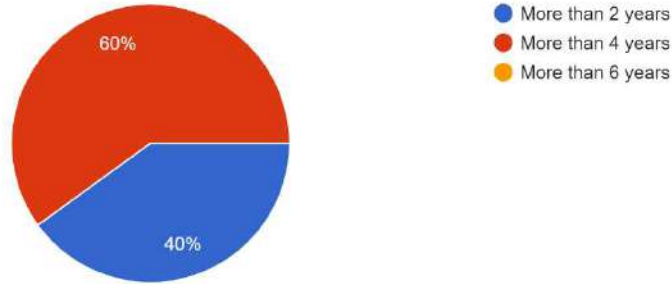
With the condition of at least ones in life person has to use E payment system, 100% participant is using E

---

payment system.

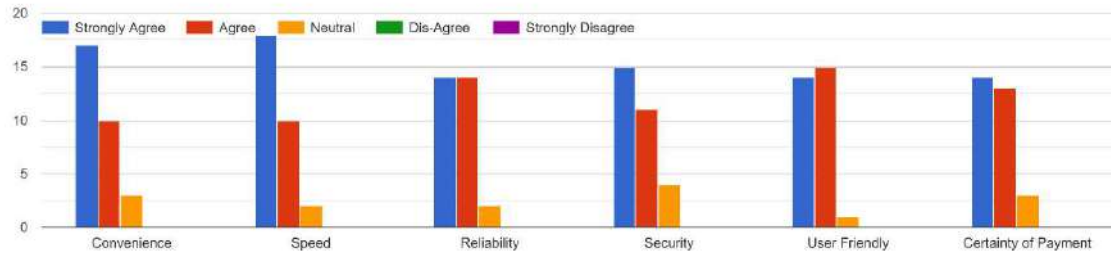
● How long have you been using E - Payment services ?

30 responses



60% of participant are using E payment services for more than 4 years, it shows that people are using this from long time.

● What makes a good E-payment Platform ?

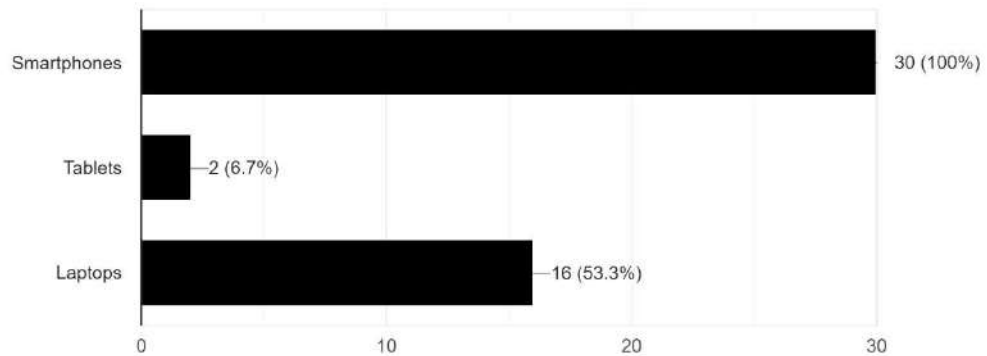


Most of participant agrees that convicence and speed are the key feature in online payments, after that security comes.

---

● Which device do you use mostly for your E-Payment transactions ?

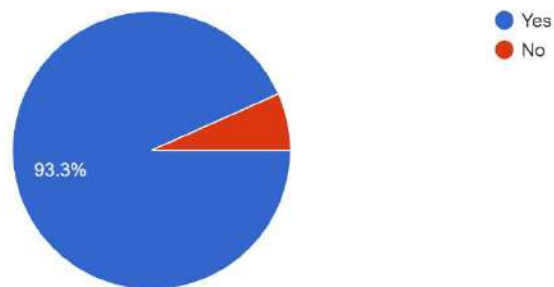
30 responses



100% participants use smartphone for making their online payments, which clearly show that smartphone is the main reason for increasing use of E payments.

● Even while completely using E-Payment Services , do you still prefer to visit a bank branch ?

30 responses



93% participant even after using E payments, visits bank branches, which means payments is not the only reason for visiting branches and it is not a hurdle for existence of physical branches.th

●

---

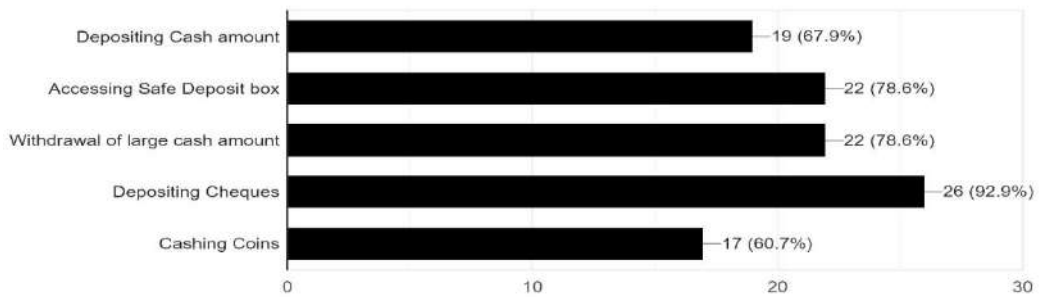


Ththe

main

5. (A.) If "YES" , than why ?

28 responses



The main reason of visiting branches is depositing cheques, it is the one which is not yet impacted by E payments. After that withdrawal of large sum of cash and using the facility of locker.

6. Out of these earlier events , which one of them is the main reason for boost in using E-payment services in India ?

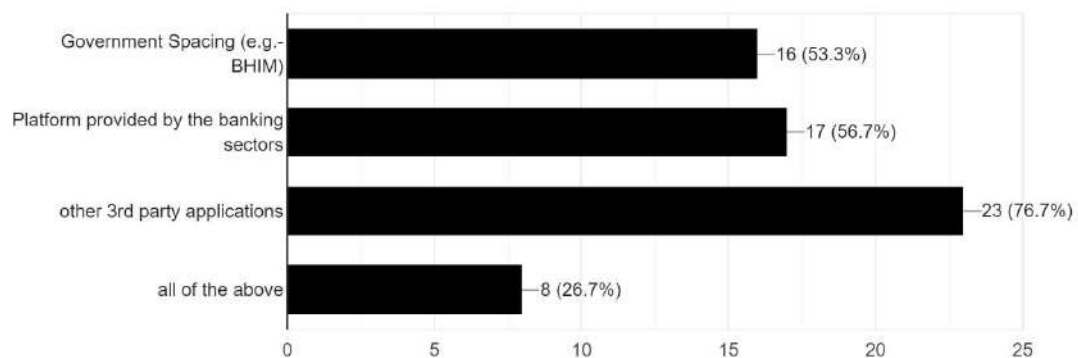
30 responses



As per the responses received from participants ,it reveals that demonetisation is the reason for increasing usage of E payments.

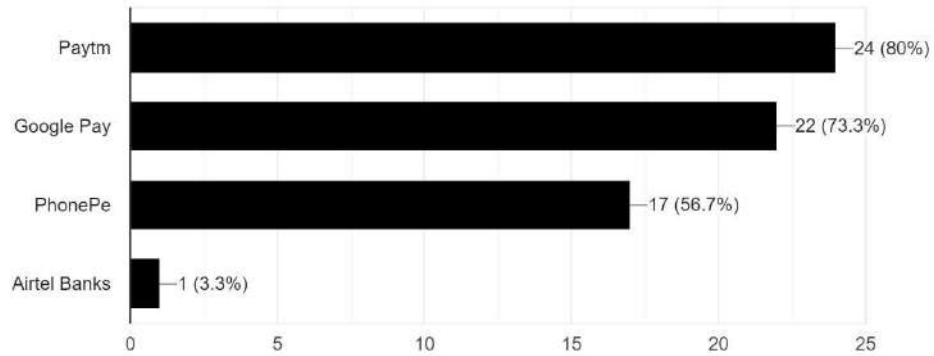
● Which E-Payment platform do you prefer for your personal/business transactions ?

30 responses



● Out of these top 3rd party platforms, which one do you prefer to use the most ?

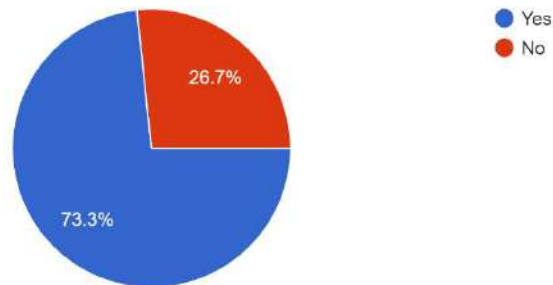
30 responses



Paytm is the most popular platform for doing transactions and then google pay is popular for making payments. It simply shows that BHIM has still to go. Another reason of high rate of Paytm usage is early entry of Paytm in market.

9. While using E-payment platforms , do you use the facility of E-Wallet by storing virtual cash in it ?

30 responses

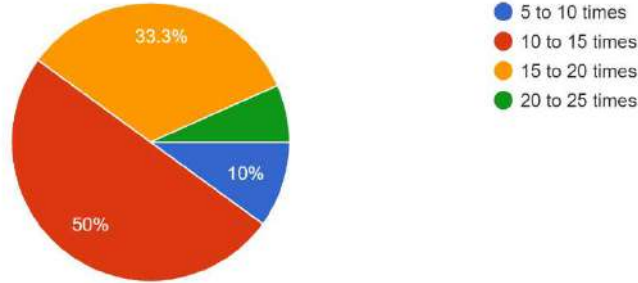


73% participants are use E wallets to make payment, it shows that people have faith in Wallet system. It also helps in making payments without getting OTP every time.

---

● On an estimated average, how often do you use the E-Payment services in a month for your personal/business purposes ?

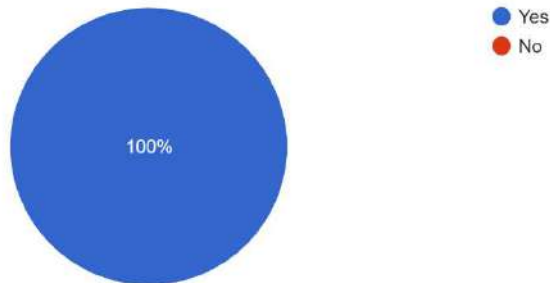
30 responses



The popularity of E payments is going high as 50% participants stats that they are making payments more than 10 times in a month.

● From the collaborations of various banks with different 3rd party E-payment platforms , Do you receive information from your banks regarding the ... your day to day personal/business transactions ?

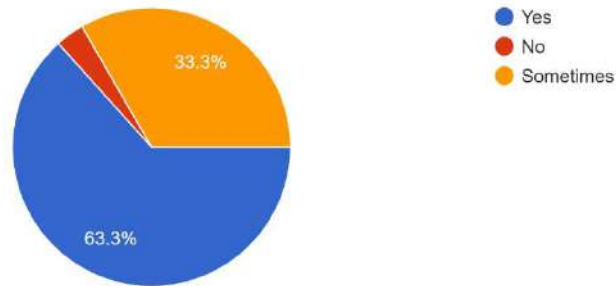
30 responses



Banks are doing superb job by making every effort to inform and educate the customers. Every participants accept that they are receiving regular notifications and messages from banks about E payments.

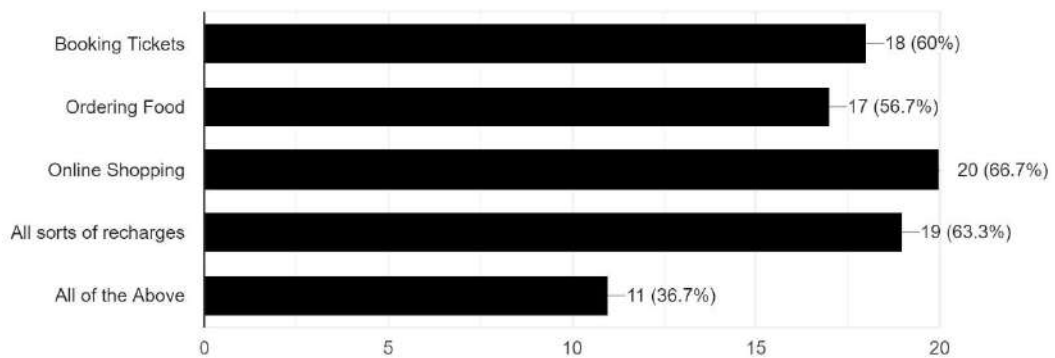
---

● Are you aware of the additional services (e.g. - investment options; buying digital gold; Loan & Credit card facilities; City Transit; etc.) other than provided by the E-Payments platforms and do you use them ?  
30 responses



E payment Applications are not only help in making payments but also doing E commerce services. 63% participants are aware that additional facilities are available on applications and even they are using them.

● Out of these common online transactions/purchase activities mentioned below, for which do you use the E-Payments services the most ?  
30 responses

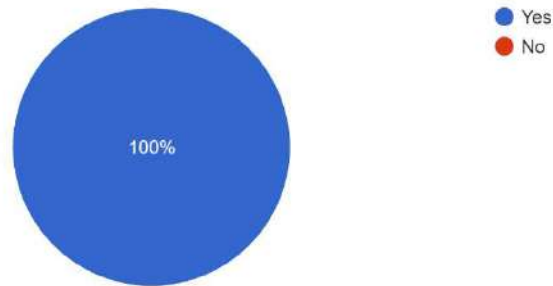


E payments system is highly used in online shopping and then booking tickets. We can say that extension of these services basically because of E payments.

---

19. Do you use the coupons or offers given by the 3rd party e-payment platforms as a result of doing transactions using the platforms ?

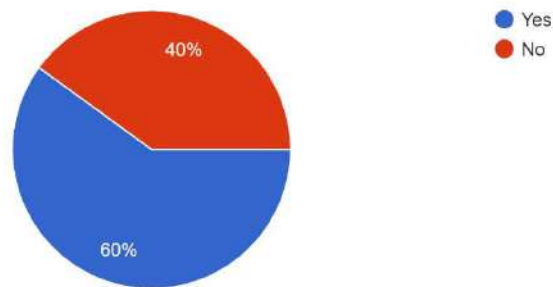
30 responses



100% participants says that they are using offers and coupons offered by 3<sup>rd</sup> party platforms which means it is also a charm for customers.

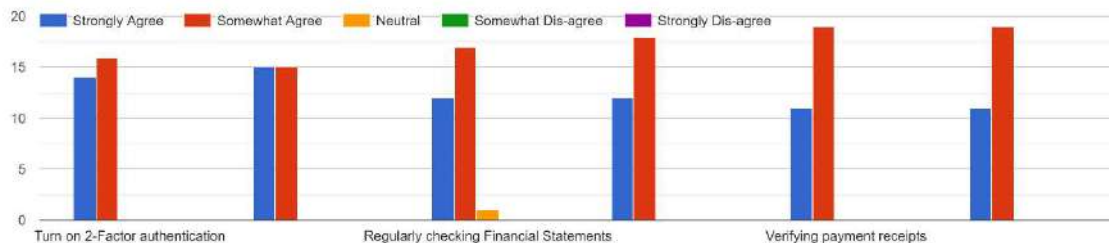
20. Have you ever been a victim of Cyber crime while using these E-payment Platforms with the increase in usage of E-Payment services as well as Increase in online scams & Frauds ?

30 responses



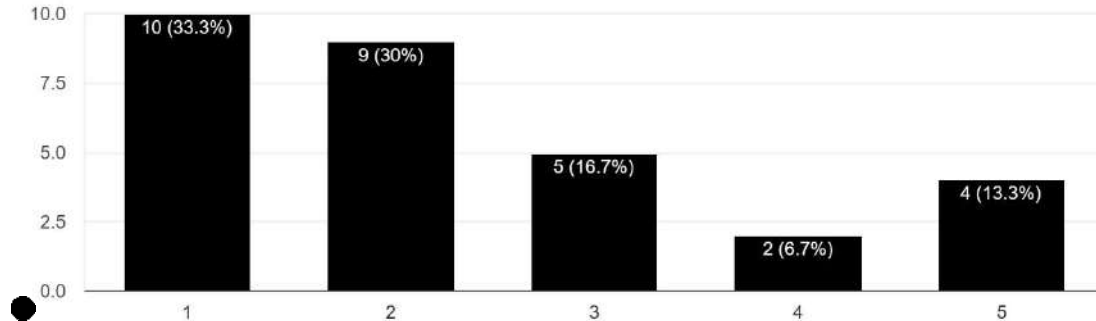
Study shows that 60% participants face the frauds and becoming a victims of online cybercrimes, but still people are willing to use online platforms.

21. What are the security measures that could secure you against various kinds of E-Payment attacks ?



Participants are somewhat agrees with that 2-factor authorisation and OTP generation is helpful security measure for protecting from cyber attacks.

● How much would you rate using the E-Payment services on the scale of 1 to 5 with :- 1 being complete satisfaction; 2 being somewhat satisfied; ...t dis-satisfied; 5 being complete dis-satisfaction; 30 responses



33% participants are completely satisfied with E payments whereas 30% participants are somewhat satisfied with E payments platforms.

## Conclusion

The overall results shows that various age group people belongs to various professions are using various E payments platforms and they are using it because of security, conveniency, two-way authentication and ease of use. Study also reveals that people always use offers and schemes offered by these platforms.

The reason of adopting E payments is not particularly rigid with demonetisation or adoption of UPI because even before that people using the E payments services. And it's very clear that basic reason of it is easiness, conveniency and security associated with it.

Another reason of using E payments services is online shopping and other services provided by various websites and portals such as food delivery, ticket booking etc.

Studies also shows that 60% people face cyber fraud while using the E-payments services but still more than 50% people are satisfied with E payments services.

It also shows that even after using online platforms people often visits bank branches for various reasons like bulk cash deposits, locker operations, cheque deposits etc.

In the last we can say that E payment and digital platforms has very wider acceptability and people are ready to move forward with them. Also even with the security patches people are ready to use.

## References

- Choudhary A., Premchand A., Future Of Payments-payments, International Journal of Emerging Technology and Advanced Engineering 5(2015), 110-115.
- Roy, S., & Sinha, I. (2014). Determinants of Customers. International Journal Of Scientific & Engineering Research, 5(1), 110-115.
- Tripathi, S., & Gujral, T. (2020). A Study on Consumer Satisfaction Level of Mobile Banking Users: Study with reference to Syndicate Bank and HDFC Bank. The International Journal Of Analytical And Experimental Modal Analysis, 12(1), 2720-2727.

<https://acadpubl.eu/hub/2018-118-24/1/170>

---



## COMPARATIVE EFFECTS OF PRE AND POST BANK M&AS ON EMPLOYEE PRODUCTIVITY IN SELECTED BANKS IN INDIA

**Ram Kumar Sharma**

Assistant Professor (ABST), Govt College Merta City, India.

Many earlier researches on mergers and acquisitions in banking sector have mostly concentrated on the banks' post-merger profitability, ignoring the human factors aspects of such methods. This study intends to fill the gap in the literature on employee productivity studies by determining whether or not there are changes in employee productivity before and after mergers of selected public sector banks that pursued the M&A strategy from 2017. For changes in staff productivity levels before and after M&A, data were taken from Prowess IQ and analysed by paired t statistics using SPSS software. According to the study's findings, which focused on the criteria Business per Employee, Employee Utilisation Ratio and Profit & Loss per Employee, employee productivity increased after the merger. Therefore, the study comes to the conclusion that M&A is benefiting staff productivity in the public sector bank. Financial institutions are urged to think about how their M&A strategy would naturally affect their company's performance. In order to minimise employee fallout during such a complicated process, managers should conduct a careful analysis of the variables influencing workers' intention to leave following mergers and acquisitions.

**Key words:** Merger & Acquisition, Employee productivity, Indian Public sector banks

### 1. Introduction

In order to address operational issues such as weak governance, risk management, and ineffective operations, among others, the Central Bank of India (RBI) initiated a wave of mergers and acquisitions in the Indian banking sector since 1991. The comparative impacts of mergers and acquisitions (M&A) on staff productivity of selected public sector banks are examined in this study. The following table shows the mergers of public sector banks after 2015 till now.

S.No.	Acquirer Bank	Mergerd Bank	M&A Date
1	State Bank of India	State Bank of Patiala	31st March 2016
		State Bank of Hyderabad	
		State Bank of Bikaner & Jaipur	
		BharatiyaMahila Bank Ltd.	
		State Bank of Mysore	
2	Punjab National Bank	United Bank of India	1st April 2020
		Oriented Bank of Commerce	
3	Union Bank of India	Corporation Bank	1st April 2020
		Andhra Bank	
4	Canara Bank	Syndicate Bank	1st April 2020
5	Indian Bank	Allahabad Bank	1st April 2020

## 2. Literature Review

**Hassan & Lukman (2020), “Comparative Effects of Pre and Post Bank Mergers and Acquisitions (M&A) on Employee Productivity in Selected Banks in Nigeria”** It has been investigated that whether or not there are changes in employee productivity before (from 2008 to 2010) and after (from 2012 to 2014) mergers of banks that pursued the M&A strategy in 2011. For changes in staff productivity levels before and after M&As, data were taken from the banks' annual reports and analysed using Paired t statistics using SPSS software. According to the study's findings, which focused on the criteria Advances Per Employee and Deposits Per Employee, employee productivity increased after the merger. Therefore, the study comes to the conclusion that M&A is benefiting staff productivity in the Nigerian banking sector. Financial institutions are urged to think about how their M&A strategy would naturally affect their company's performance. The human component of the pertinent unit Organizational Performance translates into the total to a certain extent through employee productivity.

**Boruah (2018), “Impact of Merger and Acquisition on Employee Productivity”** This essay's goal is to thoroughly investigate the idea of a merger or acquisition. With an emphasis on the human element, the objective is to identify the most crucial pre- and post-merge difficulties. The Phenomena of M&A is one that is simple to conceptualise but challenging to carry through. He said that each of the three phases of a merger—the pre-merger, the transitional phase, and the post-merger phase—has benefits as well as drawbacks. Since people make up the majority of the business, both management and employees must put in significant effort at their respective levels to ensure success. Whether there are significant or minor cultural disputes that have the potential to scupper the merger, the post-merger transition period is the most challenging for any firm. For businesses to develop and survive, the mergers and acquisitions process is crucial. This article will offer you a brief outline of how, assuming they don't end up going bankrupt or being purchased by larger businesses, more and more businesses are growing for a number of reasons.

**Baniya & Adhikari (2017), “Mergers and Acquisitions of the Financial Institutions: Factors Affecting the Employee Turnover Intention”** The main goal of this study is to identify such aspects. A conceptual framework that considered pre-merger organisational identification, procedural justice, utility with the merger, non-financial benefits, financial benefits, trust with merger, and adequate authority delegation as variables that influence post-merger organisational identification and satisfaction with the merger was developed using the findings of the prior studies. The findings show that only trust with merger substantially predicted happiness with the merger, while pre-merger organisation identity, utility with the merger, and trust with merger all significantly predicted the post-merger organisation identification. The study's conclusions reveal employee feelings during the consolidation process and give practitioners and policy makers a foundation for creating a successful plan to reduce employee turnover during mergers and acquisitions.

**Hagendorff & Keasey (2009), “Post-Merger Strategy and Performance: Evidence from the US and European Banking Industries”** One of the markets with the biggest M&A

activity is the banking sector. The sorts of investing methods used by banks in the post-trading years are not well understood, nevertheless. For a sample of bidding banks in the US and Europe, the study evaluates the design and performance effect of alternative post-merger strategies in both areas. By enhancing efficiency and lowering both labour expenses and loans relative to banks that do not combine, we are able to demonstrate through accounting data that European banks are actively pursuing cost-cutting initiatives. In contrast, US banks make money in the post-merger period from both interest and non-interest sources.

**Cornett &Teheranian (1992), “Changes in corporate performance associated with bank acquisitions”**This study investigates the post-acquisition performance of significant bank mergers between 1982 and 1987. The combined banks are outperforming the banking sector overall. Their enhanced capacity to draw loans and deposits, increased staff output, and profitable asset expansion are probably the causes of their better performance. Furthermore, during the announcement period, we uncover strong connections between anomalous stock returns and a number of performance metrics, proving that market participants may anticipate enhanced performance brought on by bank acquisitions.

### **3. Objective of the Study:**

The main objective of this study is to examine the impact of merger in Business per Employee, Profit & Loss per Employee and Employee Utilisation Ratio of selected public sector banks during before and after the merger.

### **4. Methodology:**

#### **Research Design:**

Descriptive and exploratory research designs were used in this study.

#### **Data Collection:**

Current research is based on secondary databases. Data were collected from the Prowess IQ database and various research publications.

#### **Period coverage:**

The period of the study covers 3 years pre-merger and 3 years post-merger period.

#### **Analysis tools:**

#### **Accounting Tools:**

Various accounting measures were used to assess employee’s productivity such as Business per Employee, Profit & Loss per Employee and Employee Utilisation Ratio.

#### **Statistics tools:**

A paired samples t-test was used to analyse the statistical significance of the data. Mean, standard deviation and mean difference are also used.

**Hypothesis**

**H01:** There is no significant impact in Business per Employee before and after the merger in selected public sector banks.

**H02:** There is no significant impact in Profit & Loss per Employee before and after the merger in selected public sector banks.

**H03:** There is no significant impact in Employees Utilisation Ratio before and after the merger in selected public sector banks.

**H11:** There is significant impact in Business per Employee before and after the merger in selected public sector banks.

**H12:** There is significant impact in Profit & Loss per Employee before and after the merger in selected public sector banks.

**H03:** There is significant impact in Employees Utilisation Ratio before and after the merger in selected public sector banks.

**Data Analysis and Interpretation:**

**Table 1** Canara Bank’s financial performance during pre and post-merger period

Canara bank	Pre			Post		
	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
Business per Employee	148.1	170.7	176.3	181.4	199.1	224.5
Profit per Employee	-0.7	0.1	0	0.3	0.7	1.2
Employee Utilisation Ratio	8.95	8.87	7.99	6.66	6.76	7.5

**Table 2** Canara Bank’s financial performance during pre and post-merger period

Canara Bank	Duration	Mean	Std. Deviation	t	sig	H0
Business per Employee	Pre	165.03	14.93	-6.153	.025	Reject
	Post	201.67	21.66			
Profit per Employee	Pre	-0.20	0.44	-5.292	.034	Reject
	Post	0.73	0.45			
Employee Utilisation Ratio	Pre	8.60	0.53	2.848	.104	Accept
	Post	6.97	0.46			

Table 1&2 shows the employees performance of Canara Bank. The average Business per Employee increased from 165.03 to 201.67 after the merger. The t-value (-6.153) and p-value (0.025) reveals that there is significant impact of merger on Business per Employees in post-merger period. The Average Employees Utilisation ratio before the merger has been 8.60 times which decreased to 6.97 times in post-merger period. The t-value (2.848) and p-value (0.104) reveals that there is no significant impact of merger on Employees Utilisation

ratio. The Average Profitper Employee before the merger has been -0.20 which increased to 0.73 in post-merger period. The t-value (-5.292) and p-value (0.034) reveals that there is significant impact of merger on Profitper Employee ratio.

**Table 3 Indian Bank’s financial performance during pre and post-merger period**

Indian Bank	Pre			Post		
	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
Business per Employee	185.6	217.4	246.2	222.2	262	266.1
Profit per Employee	0.6	0.2	0.4	0.7	1	1.3
Employee Utilisation Ratio	9.31	9.51	10.02	7.11	6.66	6.66

**Table 4 Indian Bank’s financial performance during pre and post-merger period**

Indian Bank	Duration	Mean	Std. Deviation	t	sig	H0
Business per Employee	Pre	216.40	30.31	-4.632	.044	Reject
	Post	250.10	24.25			
Profit per Employee	Pre	0.40	0.20	-2.384	.140	Accept
	Post	1.00	0.30			
Employee Utilisation Ratio	Pre	9.61	0.37	8.351	.014	Reject
	Post	6.81	0.26			

Table 3&4 shows the employees performance of Indian Bank. The average Business per Employee increased from 216.40 to 250.10 after the merger. The t-value (-4.632) and p-value (0.044) reveals that there is significant impact of merger on Business per Employees in post-merger period. The Average Employees Utilisation ratio before the merger has been 9.61 times which decreased to 6.81 times in post-merger period. The t-value (8.351) and p-value (0.014) reveals that there is significant impact of merger on Employees Utilisation ratio. The Average Profitper Employee before the merger has been 0.40 which increased to 1.00 in post-merger period. The t-value (-2.384) and p-value (0.140) reveals that there is no significant impact of merger on Profitper Employee ratio.

**Table 5 Punjab National Bank’s financial performance during pre and post-merger period**

PNB	Pre			Post		
	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
Business per Employee	147.4	168	181.4	188.5	194.1	216.4
Profit per Employee	-1.7	-1.5	0.1	0.2	0.4	0.3
Employee Utilisation Ratio	6.27	8.5	9.15	7.62	7.22	6.76

**Table 6 Punjab National Bank’s financial performance during pre and post-merger period**

PNB	Duration	Mean	Std. Deviation	t	sig	HO
Business per Employee	Pre	165.60	17.13	-7.822	.016	Reject
	Post	199.67	14.76			
Profit per Employee	Pre	-1.03	0.99	-2.353	.143	Accept
	Post	0.30	0.10			
Employee Utilisation Ratio	Pre	7.97	1.51	0.697	.558	Accept
	Post	7.20	0.43			

Table 5&6 shows the employees performance of Punjab National Bank. The average Business per Employee increased from 165.60 to 199.67 after the merger. The t-value (-7.822) and p- value (0.016) reveals that there is significant impact of merger on Business per Employees in post-merger period. The Average Employees Utilisation ratio before the merger has been 7.97 times which decreased to 7.20 times in post-merger period. The t-value (0.697) and p-value (0.558) reveals that there is no significant impact of merger on Employees Utilisation ratio. The Average Profit per Employee before the merger has been -1.03 which increased to 0.30 in post-merger period. The t-value (-2.353) and p-value (0.143) reveals that there is no significant impact of merger on Profit per Employee ratio.

**Table 7 Union Bank of India’s financial performance during pre and post-merger period**

UBI	Pre			Post		
	2017-18	2018-19	2019-20	2020-21	2021-22	2022-23
Business per Employee	178.3	187.9	200.6	192.3	204.8	231.4
Profit per Employee	-1.4	-0.8	-0.8	0.4	0.7	1.1
Employee Utilisation Ratio	11.52	12.34	12.64	8.67	7.97	7.7

**Table 8 Union Bank of India’s financial performance during pre and post-merger period**

UBI	Duration	Mean	Std. Deviation	t	Sig	HO
Business per Employee	Pre	188.93	11.19	-3.967	.058	Accept
	Post	209.50	19.97			
Profit per Employee	Pre	-1.00	0.35	-14.422	.005	Reject
	Post	0.73	0.35			
Employee Utilisation Ratio	Pre	12.17	0.58	6.498	.023	Reject
	Post	8.11	0.50			

Table 7&8 shows the employees performance of Union Bank of India. The average Business per Employee increased from 188.93 to 209.50 after the merger. The t-value (-3.967) and p- value (0.058) reveals that there is no significant impact of merger on Business per Employees in post-merger period. The Average Employees Utilisation ratio before the merger has been 12.17 times which decreased to 8.11 times in post-merger period. The t-value (6.498) and p- value (0.023) reveals that there is significant impact of merger on Employees Utilisation ratio. The Average Profit per Employee before the merger has been -1.00 which increased to



0.73 in post-merger period. The t-value (-14.422) and p-value (0.005) reveals that there is significant impact of merger on Profitper Employee ratio.

## 5. Conclusion:

This study compares how mergers and acquisitions (M&A) affect the productivity of employees of selected public sector banks of India. As a consequence, it can be inferred from the research findings that M&A increases employee productivity in public sector banks. This study supports the notion that M&A improves employee productivity, presuming that people play a significant role in an organization's overall success.

## Reference:

- Baniya, R., &Adhikari, S. (2017). Mergers and Acquisitions of the Financial Institutions: Factors Affecting the Employee Turnover Intention. *NRB Economic Review*, 29(2), 31-50.
- Boruah, A. (2018). Impact of Merger and Acquisition on Employee Productivity. *International Journal of Business & Engineering Research*, 11.
- Cornett, M. M., &Tehrani, H. (1992). Changes in corporate performance associated with bank acquisitions. *Journal of Financial economics*, 31(2), 211-234.
- Hagendorff, J., &Keasey, K. (2009). Post-merger strategy and performance: evidence from the US and European banking industries. *Accounting & Finance*, 49(4), 725-751.
- Hassan, Y., &Lukman, R. (2020).Comparative Effects of Pre and Post Bank Mergers and Acquisitions (M&A) on Employee Productivity in Selected Banks in Nigeria. *Economic Insights-Trends & Challenges*, (2).

## Beyond the Horizon: Charting the Course of AI in Modern HRM (A Literature Review using PRISMA framework)

**Arti Gaur**

Professor, Department of Business Administration, CDLU, Sirsa, India.

[artigaur@cdlu.ac.in](mailto:artigaur@cdlu.ac.in)

**Niharika Bansal**

Research Scholar, Department of Business Administration, CDLU, Sirsa, India.

[niharikabansal06@gmail.com](mailto:niharikabansal06@gmail.com)

**Renu**

Research Scholar, Department of Business Administration, CDLU, Sirsa, India.

[renu68262@gmail.com](mailto:renu68262@gmail.com)

**Vikas**

Research Scholar, Department of Business Administration, CDLU, Sirsa, India.

[vikasghanghas32@gmail.com](mailto:vikasghanghas32@gmail.com)

Artificial Intelligence, a new-age technological development has brought visible changes in day-to-day life. Apart from the realm encompassing robotics and allied manoeuvres, it has started making inroads into Human Resource Management. To get a deeper understanding of this, the current study uses the PRISMA framework by going through 42 research articles published between 2019-2023 accessed through the Scopus database. Unlike conventional times, managers around the world tend to employ AI-based tools for the effective execution of human resource pursuits. Generally, the humanoid approach of AI has been overlooked by many, this might be the reason for its relatively delayed adoption in the field of human resource management. The core focus of HR managers revolves around enhancing employee productivity. For the 21st-century workforce, this purpose can be served by appropriate investment in AI-based applications. This won't suffice if deep-rooted psychic changes aren't brought up effectively.

**Keywords:** Artificial Intelligence, Human Resource Management, and Application of artificial intelligence in HRM

### 1. Introduction

#### 1.1 Artificial Intelligence

The contemporary world is witnessing breakthrough inventions in the form of artificial intelligence tools and techniques. Not so long ago, the advancement of Internet facilities transformed the way we live. With each passing day, everything visible around us is being substituted by a novel technological concept. Artificial intelligence is one such step forward that has gained traction in recent times. Each sphere of activity has been significantly impacted by the gleaming spark of artificial intelligence and allied technological advancements (Gaur et al., 2023). Artificial intelligence envisages the prospective usage of state-of-the-art technology manifesting human-like intelligence. To put it differently, it can make valuable decisions with a humanoid approach. However, the term AI has various definitions, as defined by experts from all walks of life (Wang, 2019). The Father of AI, John McCarthy, has defined, "Artificial intelligence as the science & engineering of making intelligent machines, brilliant computer programs" (HEMALATHA, 2022). The conceptual development of artificial intelligence has wide-ranging implications, one such is to design computer-based systems that possess the potential to emulate human capabilities and curtail human intervention as far as possible (Gupta, 2023). Inadvertently, AI has taken over the personal intimate space which could prove fatal as well (Gaur et al., 2023). It has a wider

reach, not just restricted to robotics alone, it has a bag full of futuristic innovations(HEMALATHA, 2022).

Before diving deeper into the main crux, it is important to understand the whole dynamics behind the functioning of artificial intelligence. For this, it has been bifurcated into levels which are sometimes taken to be synonymous with subfields such as Natural language processing, machine learning, and robotics, to name a few. Types of artificial intelligence include Weak AI, Strong AI, and Super AI.

### 1.2 Application of AI in HR

The adoption of AI in HRM functions has revamped the entire workplace. This implies enhanced usage of AI-backed tools in practices governing human resources. It amounts to an integrative process that tends to strike a balance between current business intelligent systems to undertake decisions for a positive workforce-specific environment. It entails data analysis concerning operational, relational, and alteration processes (Priksht et al., 2023). Human resources have witnessed extraordinary changes in recent times owing to the embracement of AI-related technology. HR experts believe that AI integration into HR will add to employee productivity. Globally, companies are making a beeline for HR investment in AI and allied tools. Sales and marketing are forerunners in this game, but HR is lagging (HEMALATHA, 2022). To ensure the overall engagement of the 21st-century workforce, companies ought to bring a change in mindset, lest they be left behind (Sloan et al., 2017).

## 2. Literature Review

**Bunjak et al (2020)** This study investigated the relationship between technology use and creative output among platform-mediated professionals. While technology has enabled these professionals to engage in various digital solutions, excessive use can lead to digital overload, compromising their well-being and effectiveness. The study found that strong cognitive immersion in technology positively connects with gig workers' inventiveness, based on data from 263 Amazon Mechanical Turk platform workers. Combined with considerable technology overload, cognitive absorption causes burnout and reduces workers' creative potential. **Verma et al. (2023)** In recent years, there has been a rising interest in integrating artificial intelligence (AI) applications into Human Resource Management (HRM), which has resulted in enhanced HR processes and a long-term competitive advantage for organizations. Despite this advancement, there has been no full systematic study of AI in HRM within a multilayer framework. To close this gap, the scientists analysed 56 publications published in 35 peer-reviewed academic journals between 1990 and 2021. Significant deficiencies were noted in the review, including discrepancies in research distribution between sectors and nations, a lack of strong theoretical foundations, a concentration on routine HR duties, and a lack of empirical investigations. The authors suggested a multilevel approach that connects contextual factors, HRM practises, and organisational outcomes to solve these gaps. This approach attempts to improve organisational operational efficiency and financial performance by developing relevant links between AI applications and HRM policies(Verma et al . 2023).

**Waymond et al. (2023)**. This paper examined the poor theoretical knowledge of ethical components in HRM processes of decision-making, particularly in the context of algorithmic HRM. The study employed a Throughput model framework to investigate how perceptions, judgements, and information use influence strategy selection. It investigated several ethical decision-making paths in human resource management by combining insights from AI-augmented HRM, AI-mediated social exchange, and judgement and choice literature. The study emphasised the significance of algorithmic ethical perspectives in AI adoption for HRM, with a focus on the intelligibility and accountability of AI-generated HRM judgements, which are frequently disregarded in previous studies. This study emphasises the importance of

algorithmic ethical perspectives in HRM strategy selection, offering insight into the use of AI to improve HRM outcomes. **Sachin et al (2023)** Due to resource restrictions and management constraints, the advent of digital platforms has altered entrepreneurship, providing hurdles for high-tech firms. In the face of uncertainty, design thinking has emerged as a critical problem-solving strategy. This study investigated the relationship between design thinking, innovation theories (effectuation and causality), and the performance of high-tech ventures. The study found that design thinking principles are integrated into effectuation and causation in 291 platform-based businesses in India, encouraging the growth of these ventures. The impact on venture performance, however, is moderated by digital skills gained through these initiatives. **Patrick et al (2023)** using the resource-based theory of the enterprise and contemporary organisational AI research, this paper investigates the potential of artificial intelligence (AI) as a useful business asset. The study identified specific AI-related resources that, when combined, form an AI capability, creates a measurement instrument for evaluating organisations' AI capabilities, and explores the influence of AI capabilities on organisational creativity and performance. The suggested framework and instrument are supported by empirical findings, which show that a strong AI capability leads to increased organisational creativity and performance. **Marcello et al (2023)** this paper offered a systematic review of consumer research on conversational agents (CAs). The research identifies four major topics by analysing published work from sources such as Clarivate Web of Science and Elsevier Scopus: customers' faith in CAs, Natural Language Processing (NLP) in CA development, communication with CAs, and the impact of CAs on value creation and business. The findings allow for a thorough review of existing research, which leads to the identification of adoption drivers and outcomes for both users and organisations. In addition, the paper suggested a research agenda based on these findings. **Ina et al (2020)** Organisations face increasing pressure to implement Sustainable Human Resource Management (HRM) practises in response to the increased emphasis on sustainability. Despite increased emphasis in both practise and research, there is disagreement among academics on what Sustainable HRM encompasses and doubts about its usefulness. This study investigated the shift of HRM's mission in the pursuit of sustainability through a survey of key literature. It outlines four categories of Sustainable HRM and suggested a new method, Common Good HRM, emphasising its ability to handle today's sustainability concerns and significantly contribute to the achievement of sustainable development goals. **AKM et al (2023)** This study tackled issues regarding the lack of explain ability in systems that use AI from the standpoint of the end user. The research conducts a systematic literature analysis to identify essential features of end users' explanation demands, investigated the influence of explanations on user perceptions, and identifies research gaps in explainable AI (XAI). The review, which is based on 58 articles from databases such as Scopus and Web of Science, identifies four key factors that shape AI explanations: format, completeness, correctness, and currency. Furthermore, the study defines five XAI impacts dimensions: trust, transparency, understandability, usability, and fairness. The findings contributed to the creation of a complete framework for XAI and its possible effects on user behaviour by informing future research goals. **Sascha et al (2023)** The purpose of this research was to examine the substance and impact of articles published in the prestigious journal Technological Forecasting and Social Change (TFSC). The study identified 18 major subjects in TFSC and tracks their temporal fluctuations from 1969 to 2022 using a combination of structural topic modelling (STM) and bibliometric analysis. The study also assessed the topic's quality using semantic coherence and topic exclusivity scores. It also investigated the global representation of authors linked with TFSC and provides insights into the most cited publications decade by decade, providing a full picture on the journal's publishing trends and geographical diversity. **Cristina et al (2021)** Artificial intelligence (AI) is driving HRM innovation by enabling compliance with data regulations, minimising biases,

and providing tailored recommendations. It does, however, call into question established assumptions about digital innovation processes, raising concerns about the integration of AI capabilities with organisational actors, goals, and tasks. This study, informed by grounded theory and the Input-Process-Output framework, investigated AI's affordances in tackling these difficulties through a qualitative multiple-case study in Scandinavian HR service organisations. The research creates a paradigm that demonstrates how AI affordances promote digital innovation by altering decision-making processes and offering data-driven legitimacy. The findings add essential insights to the field of digital innovation research, as well as implications for theory and practice, as well as recommendations for future research. **Vincent et al (2023)** the advent of Industry 4.0, characterised by digitalization, robotization, and developing technologies, is changing organisational dynamics and interconnections. This study, which used a real-time Delphi technique with 47 procurement specialists, outlines crucial roles for Purchasing and Supply Management (PSM) professionals in the Industry 4.0 landscape. Data Analyst, Master Data Manager, Process Automation Manager, Supplier Onboarding Manager, System Innovation Scout, and Legislation Specialist are among the positions available. The study emphasised the necessity of talent development in allowing Smart Working and effective Smart Supply Chains management within the arena of digital transformation **Vincent et al 2023**. Designers and developers have traditionally used digital technologies in design processes. Machine Learning (ML) has been proposed as a way to improve creative design activities ranging from interpreting handwritten notes to creating new ideas and prototypes. However, the use of machine learning in the creative industries is still in its early stages, with little understanding of how it affects the design process. According to a case study of four Norwegian design consultancies, constraints such as a lack of ML understanding, scepticism in ML outputs, and poor outcomes in non-English languages outweighed facilitators such as pattern recognition and checking criteria. These obstacles prevented design firms from completely adopting ML and integrating it into their design operations. **Ashish et al (2023)** this study presented a model of innovative healthcare solutions that emerge from the intersection of high-involvement work systems and technologically mediated relational coordinating. The study investigated how implementing novel technologies such as online analytics, digitalization, artificial intelligence, and data-driven decision-making improves interactions in high-involvement work systems compared to traditional face-to-face exchanges through in-depth interviews and empirical analysis in the context of technology adoption in healthcare in emerging markets. Employee trust is increased as a result of technologically mediated relational coordination, which leads to greater individual performance and functional effectiveness. Furthermore, the speed and depth of shared data among employees are influenced by the quality of technologically mediated relational coordination, allowing for optimal decision-making and iterative improvements in innovative solutions. **Saqib et al (2023)** using trust literature as a guide, we conducted two surveys with front-line employees at Pakistani firms to better understand the elements influencing cognitive trust in artificial intelligence (AI). The initial study featured 46 in-depth interviews to investigate these issues, which resulted in the creation of a framework to improve employees' trust in AI. The second study, a quantitative survey with 314 individuals, verified this model. The findings revealed that AI features positively increased cognitive trust, however work routine interruptions had a negative impact. Effective data governance also plays a role in increasing trust in AI. This study contributed to the literature on technological trust, particularly in emerging nations, and has implications for both research and practical applications. **Rodrigo et al (2021)** this article investigated the role of artificial intelligence in improving automated service interactions between businesses and their clients. It presented a conceptual framework for investigating how AI-enabled information processing systems can improve firm-solicited and firm-unsolicited online customer engagement behaviours. The



research discovered several customer interaction behaviours that trigger AI processing, leading to both AI and human replies, by seeing AI systems as organisms and using the Stimulus-Organism-Response theory. These interactions shape the future contexts of online customer involvement, emphasizing the changing dynamics between technology and customer interactions. **Rijul et al (2023)** Conversational agents' (CAs') social companionship (SC) function is critical in creating emotional attachments and consumer relationships. However, prior publications' scattered and fragmented conclusions have hampered a thorough comprehension of this topic. This study filled that need by undertaking an extensive literature review, mapping scientific performance, and analysing intellectual structure. Following the identification of main theories, constructs, and thematic structures, a conceptual framework detailing the antecedents, mediators, moderators, and consequences of SC with CAs was developed. The findings give useful insights for future research and offer practitioners and researchers assistance in developing effective and ethical AI companions. **Arnd et al (2023)** this research looked into the problems that artificial intelligence (AI) techniques encounter, and how some succeed while others fail. Using an AI-specific network effects viewpoint, the research focused on data network effects and the cold-start issue (CSP). The success of emerging AI techniques is dependent on the establishment of a functional system to capitalise on data network effects. However, the CSP presents a dilemma because it necessitates the start of a cycle in which more data improves AI performance, drawing even more data. The paper investigated the technological and business components of the CSP and recommends a research plan to address and overcome this problem, based on insights from existing literature and practitioner interviews. **Jeroen et al (2023)** the idea of 'duality of algorithmic management' was introduced in this study to investigate the complex interaction between human resource management (HRM) computations, job autonomy, and the worth experienced by workers under computational management. Unlike previous perspectives, which frequently depict algorithmic management as resulting in limited job autonomy and unfavourable working conditions, this new approach recognises the presence of desired outcomes, such as increased autonomy and worker value, alongside unfavourable outcomes. According to the study, algorithmic management simultaneously constrains and enables job autonomy and worker value, and it is controlled by workers' activities. **Silvia et al (2023)** in recent years, the industrial sector's high energy use (almost 55% of total) has had a huge impact on the global ecosystem. Despite advances in sustainability, zero-emission and fuel-efficient manufacturing remains a difficult aim. With the digitization of manufacturing processes, Industry 4.0 provides a chance to optimise energy use. This article introduced the Worker Profiler software to answer the rising demands of digital innovation and environmental preservation. This tool maps workers' present skills, detects skills gaps, and focuses on essential technologies, green, and digital enabling skills. The software assists in the formulation of customised retraining initiatives by assessing patent trends, and aligning workers with the skills required to adapt to technology and environmental changes. **Filippo et al (2021)** ESCO is a multilingual classification system for Skills, Abilities, Skills, and Occupations established by the European Commission with the goal of improving the information on labour market skill demand. To stay up with the rapid technological advances of Industry 4.0, this study investigates the use of text-mining tools to analyse upcoming skill gaps. Potential gaps in ESCO's coverage are found by comparing data retrieved from ESCO versions with Industry 4.0 scientific publications. The findings demonstrate the efficacy of text mining in providing policymakers with current and relevant labour market intelligence, ensuring ESCO remains current and linked with Industry 4.0 technology advancements. **Muhammad et al (2023)** this research looks at the role of entrepreneurs in transnational digital firms, which mix value creation from both home and host countries to service domestic and international clients. The study analysed how entrepreneurs' competencies, such as digital knowledge, managerial skills, and



multicultural capabilities, influence social interactions among stakeholders. Through interviews with transnational entrepreneurs from six countries and their Pakistani partners, the study found that entrepreneurs' capabilities influence social interactions through mechanisms such as institutional backing, trust-building, knowledge sharing, and resource configuration, ultimately improving enterprise effectiveness. The findings have theoretical and practical consequences for migrant entrepreneurs, policymakers, and international enterprise. **Marcello et al (2023)** using a Systematic Quantitative Literature Review (SQLR) approach, this study provides a complete review of AI-related innovation research. We summarised the available research and provided insights into the important drivers driving AI adoption for innovation by examining academic journal articles using bibliometric techniques such as keyword co-occurrences and bibliographic coupling. The report highlighted the technological, societal, and economic drivers that drive businesses to embrace AI for innovation. It also categorises AI deployment outcomes, such as product innovation, process innovation, innovation in business models, and social innovation. Based on our findings, we offer future research areas for investigating many elements of AI-related innovation. **Marina et al (2023)** the purpose of this study was to investigate the impact of individual leadership values and talents on productivity outcomes in the context of Industry 4.0 manufacturing. While values serve as predecessors to leadership capabilities, there is little knowledge of the fundamental value-capability mechanism in generating distinct leadership talents. By studying 622 leaders in a current industrial setting, this study tries to fill a vacuum in the existing knowledge. The findings confirm that individual leadership values have a major impact on leadership capability. The study, however, emphasises the vital role of specific types of values and talents in promoting optimal productivity. The findings offered important insights on how to use technology and good leadership methods to boost productivity in the Industry 4.0 landscape. **Kai et al (2023)** a systematic review of 518 papers in the subject of human resource management (HRM) was conducted in this study to examine the conceptualization, theories, and practical implementations of the phrase "unconscious bias." The review distinguishes four major thematic categories: biased individuals, binary bias, biases at decision-making moments, and fixable bias. The study introduced a critical-reflexive technique that questions established assumptions and opens up new paths for future research by mapping these themes. This paper contributes to the HRM literature by highlighting contradictions in present theories, providing a critical-reflexive research technique, and suggesting future study options to address these inconsistencies and assumptions. **Hasan et al (2023)** artificial intelligence (AI) has outperformed humans in a variety of managerial decision-making contexts. Despite the benefits, many managers are still cautious to adopt AI algorithms. This hesitation impedes the optimal realisation of algorithmic benefits. While various studies investigate the elements that contribute to algorithm aversion in individuals, research on managers in decision-making environments is scarce. This study provides a structural model defining the links between perceived barriers, algorithm aversion, and managers' technology readiness, based on innovation resistance theory and technology readiness concepts. Data were collected and analysed using partial least squares structural equation modelling from 179 managers in 31 banks/financial institutions in Bangladesh. The data show that obstacles linked to value, tradition, and image have a considerable influence on algorithm aversion, whereas usage and risk-related barriers have no effect. **Karen et al (2023)** according to existing studies, technology can both help and impede the process of successful ageing. However, there is a scarcity of thorough research that combines ageing, technology, and the workplace. In a conceptual overview, this research tried to overcome this gap by merging insights from successful ageing at work and STAARA technology. Based on existing research, we propose that STAARA technology can help people age successfully at work by reducing physical and emotional demands while increasing skill variety, autonomy, and

support. On the other hand, it can inhibit successful ageing by reducing autonomy, skill variety, and interaction with others.

### **Research Gaps**

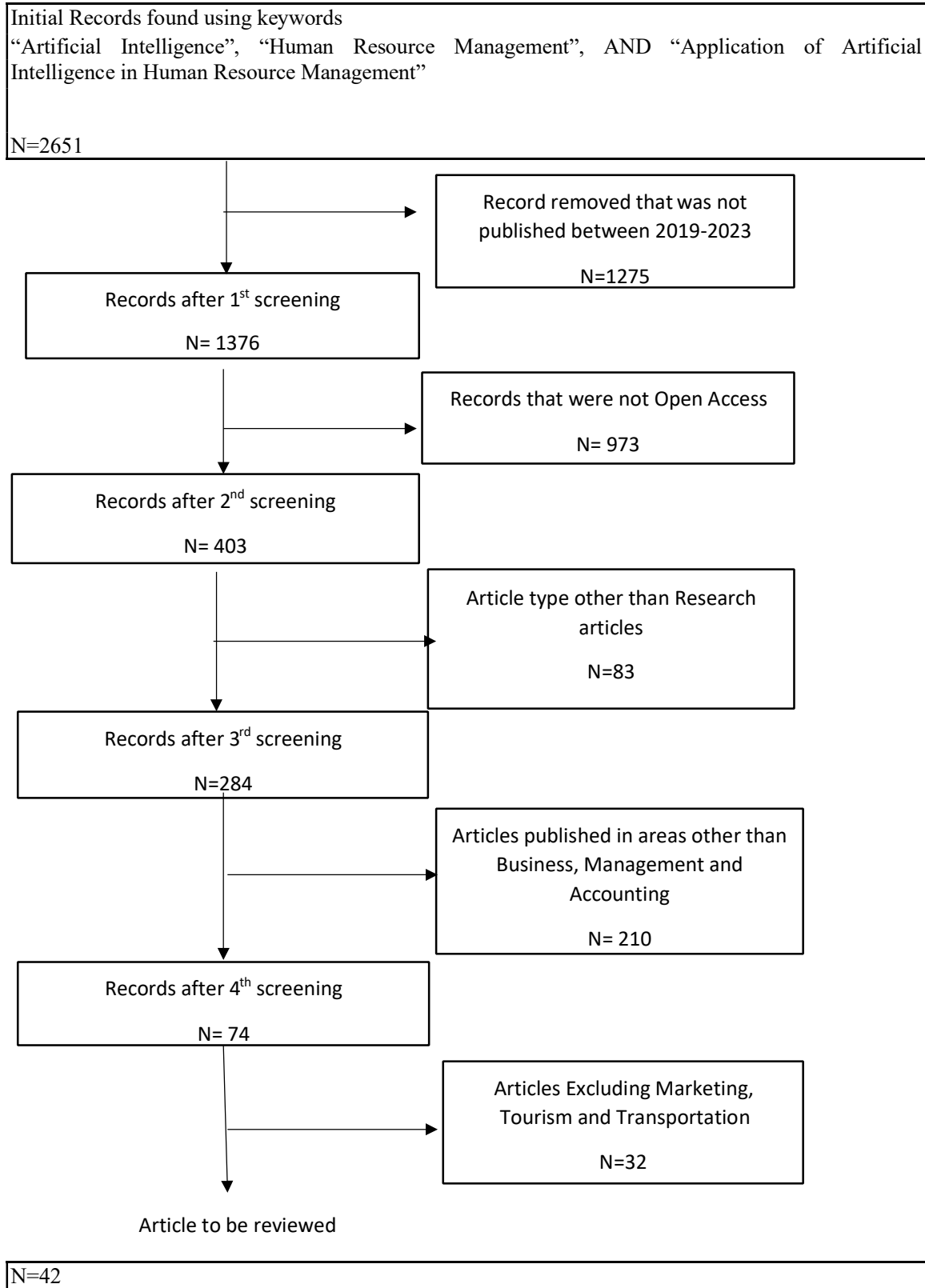
Different studies have been conducted all over the world by various researchers. An in-depth analysis has revealed that previous studies are related to generic sectors and are not country-specific, thus lacking cross-country comparison. Another staggering point is the excessive focus on the heterogeneous AI techniques being used in the execution of HRM functions. Also, the lack of ethical principles for the application of AI-backed tools makes the studies redundant. Therefore, an effort has been made to present a holistic view of the extent and usage of artificial intelligence in human resource management.

### **3. Research objective**

- T  
o analyse the usage and extent of artificial intelligence in human resource management.
- T  
o dig a deeper understanding of the impact of artificial intelligence-backed tools on human resource practices.

### **4. Research Methodology:**

Data for this review paper is taken from Science Direct using keywords Artificial Intelligence (AI), Human Resource Management, and Application of Artificial Intelligence in Human Resource Management. Data filtering was done in multiple stages i.e., open access; 2019-2023; Research Articles; Business, Management, and Accounting; Journals related to Technology and Human Resource Management were used and 42 articles were included out of 2651 initial records.



Source: PRISMA Framework

**Table 1:** Year -Wise Publication

Year	No. of Publications
2019	1
2020	4
2021	5
2022	19
2023	13
<b>Total</b>	<b>42</b>

**Source:** Science Direct Database

**Conclusion:** This study article fully explores the implications of artificial intelligence (AI) in human resource management (HRM). It starts by outlining AI's revolutionary effects across a range of fields, classifying its proficiency levels, and showcasing its numerous uses outside of robotics. The main emphasis is on how AI may revolutionise workplace practices for increased employee productivity by integrating it into HRM. The literature review critically evaluates the body of research, highlighting areas of present study deficiency and highlighting the need for ethical considerations and nation-specific evaluations in AI applications. Through an analysis of the scope of AI usage in HRM and an understanding of its influence on HR practices, the study aims seek to close these gaps. In addition to recognising the revolutionary potential of AI in HRM and noting its delayed adoption in comparison to other disciplines like sales and marketing, the study also identifies worldwide trends in AI investment for HR objectives. Emphasis is placed on the necessity of a mentality change for productive interaction with the twenty-first-century workforce. The studies address a wide range of subjects, including AI and sustainable HRM, ethical issues, the influence on organisational creativity and performance, design thinking in HRM, and ethical elements in algorithmic HRM.

## References

- Ahmad, F., Bask, A., Laari, S., & Robinson, C. V. (2023). Business management perspectives on the circular economy: Present state and future directions. *Technological Forecasting and Social Change*, 187, 122182.
- Aust, I., Matthews, B., & Muller-Camen, M. (2020). Common Good HRM: A paradigm shift in Sustainable HRM?. *Human Resource Management Review*, 30(3), 100705.
- Bunjak, A., Černe, M., & Popovič, A. (2021). Absorbed in technology but digitally overloaded: Interplay effects on gig workers' burnout and creativity. *Information & Management*, 58(8), 103533.
- Chaturvedi, R., Verma, S., Das, R., & Dwivedi, Y. K. (2023). Social companionship with artificial intelligence: Recent trends and future avenues. *Technological Forecasting and Social Change*, 193, 122634.

- Chiarello, F., Fantoni, G., Hogarth, T., Giordano, V., Baltina, L., & Spada, I. (2021). Towards ESCO 4.0–Is the European classification of skills in line with Industry 4.0? A text mining approach. *Technological Forecasting and Social Change*, *173*, 121177.
- Dabić, M., Maley, J. F., & Nedelko, Z. (2023). Unappreciated channel of manufacturing productivity under industry 4.0: Leadership values and capabilities. *Journal of Business Research*, *162*, 113900.
- Delke, V., Schiele, H., Buchholz, W., & Kelly, S. (2023). Implementing Industry 4.0 technologies: Future roles in purchasing and supply management. *Technological Forecasting and Social Change*, *196*, 122847.
- Fareri, S., Apreada, R., Mulas, V., & Alonso, R. (2023). The worker profiler: Assessing the digital skill gaps for enhancing energy efficiency in manufacturing. *Technological Forecasting and Social Change*, *196*, 122844.
- Haque, A. B., Islam, A. N., & Mikalef, P. (2023). Explainable Artificial Intelligence (XAI) from a user perspective: A synthesis of prior literature and problematizing avenues for future research. *Technological Forecasting and Social Change*, *186*, 122120.
- Kamble, S., Rana, N. P., Gupta, S., Belhadi, A., Sharma, R., & Kulkarni, P. (2023). An effectuation and causation perspective on the role of design thinking practices and digital capabilities in platform-based ventures. *Technological Forecasting and Social Change*, *193*, 122646.
- Kraus, S., Kumar, S., Lim, W. M., Kaur, J., Sharma, A., & Schiavone, F. (2023). From moon landing to metaverse: Tracing the evolution of Technological Forecasting and Social Change. *Technological Forecasting and Social Change*, *189*, 122381.
- Kumari, D. P. B., & Hemalatha, A. (2021). *Perception towards artificial intelligence in human resources management practices-with reference to IT companies in chennai*.
- Mahmud, H., Islam, A. N., & Mitra, R. K. (2023). What drives managers towards algorithm aversion and how to overcome it? Mitigating the impact of innovation resistance through technology readiness. *Technological Forecasting and Social Change*, *193*, 122641.
- Malik, A., Kumar, S., Basu, S., & Bebenroth, R. (2023). Managing disruptive technologies for innovative healthcare solutions: The role of high-involvement work systems and technologically-mediated relational coordination. *Journal of Business Research*, *161*, 113828.
- Mariani, M. M., Hashemi, N., & Wirtz, J. (2023). Artificial intelligence empowered conversational agents: A systematic literature review and research agenda. *Journal of Business Research*, *161*, 113838.
- Mariani, M. M., Machado, I., & Nambisan, S. (2023). Types of innovation and artificial intelligence: A systematic quantitative literature review and research agenda. *Journal of Business Research*, *155*, 113364.
- Meijerink, J., & Bondarouk, T. (2023). The duality of algorithmic management: Toward a research agenda on HRM algorithms, autonomy and value creation. *Human Resource Management Review*, *33*(1), 100876.
- Mikalef, P., & Gupta, M. (2021). Artificial intelligence capability: Conceptualization, measurement calibration, and empirical study on its impact on organizational creativity and firm performance. *Information & Management*, *58*(3), 103434.
- Muhammad, S., William, D., Glavee-Geo, R., & David B, Z. (2023). Transnational digital entrepreneurship and enterprise effectiveness: A micro-foundational perspective.
- Pak, K., Renkema, M., & van der Kruijssen, D. T. (2023). A conceptual review of the love-hate relationship between technology and successful aging at work: Identifying fits and misfits through job design. *Human Resource Management Review*, 100955.

- Perez-Vega, R., Kaartemo, V., Lages, C. R., Razavi, N. B., & Männistö, J. (2021). Reshaping the contexts of online customer engagement behavior via artificial intelligence: A conceptual framework. *Journal of Business Research*, 129, 902-910.
- Prikshat, V., Islam, M., Patel, P., Malik, A., Budhwar, P., & Gupta, S. (2023). AI-Augmented HRM: Literature review and a proposed multilevel framework for future research. *Technological Forecasting and Social Change*, 193, 122645.
- Rodgers, W., Murray, J. M., Stefanidis, A., Degbey, W. Y., & Tarba, S. Y. (2023). An artificial intelligence algorithmic approach to ethical decision-making in human resource management processes. *Human Resource Management Review*, 33(1), 100925.
- Shamim, S., Yang, Y., Zia, N. U., Khan, Z., & Shariq, S. M. (2023). Mechanisms of cognitive trust development in artificial intelligence among front line employees: An empirical examination from a developing economy. *Journal of Business Research*, 167, 114168.
- Storm, K. I. L., Reiss, L. K., Günther, E., Clar-Novak, M., & Muhr, S. L. (2023). Unconscious bias in the HRM literature: Towards a critical-reflexive approach. *Human Resource Management Review*, 100969.
- Trocin, C., Hovland, I. V., Mikalef, P., & Dremel, C. (2021). How Artificial Intelligence affords digital innovation: A cross-case analysis of Scandinavian companies. *Technological Forecasting and Social Change*, 173, 121081.
- Trocin, C., Stige, Å., & Mikalef, P. (2023). Machine Learning (ML) diffusion in the design process: A study of Norwegian design consultancies. *Technological Forecasting and Social Change*, 194, 122724.
- Vomberg, A., Schauerte, N., Krakowski, S., Bogusz, C. I., Gijzenberg, M. J., & Bleier, A. (2023). The cold-start problem in nascent AI strategy: Kickstarting data network effects. *Journal of Business Research*, 168, 114236.
- Wang, P. (2020). On defining artificial intelligence. *Journal of Artificial General Intelligence*, 11(2), 73-86.10(2),1-37.



## Vlogging: Online Customer Experience and Relationships

Priyanka

University Business School, Panjab University, Chandigarh, India.

(Priyankasaini804@gmail.com)

Recently, there has been a substantial boost in the number of vlogs posted on various social media platforms. This literature review summarises the previous research studies that have framed the analysis of vlogs and their new-found role in the digital marketing industry on various social media platforms. The research explores how these vloggers promote products and services to their viewers by forming relationships with them and staying connected to them. Based on this research, this experience has been defined by various attributes of vloggers such as User-generated content, Credibility, Self-disclosure and parasocial interactions, etc. Previous studies explore each of these attributes to find the reasons why consumers consider vlogs by various vloggers on different social media platforms to develop brand perception and make purchase decisions.

### 1.INTRODUCTION

In recent years, the internet has fundamentally changed how we communicate and obtain information, and has become an essential part of our daily lives. Traditionally, businesses concentrated their marketing efforts on print, television, and radio. These choices are still available, but the internet caused a change in how businesses interact with their customers. The emergence of the internet has revolutionised communication by providing the public with access to a vast amount of information, ranging from news and events to healthcare decisions(Gao et al., 2023). The use of media has changed from traditional media, such as print, radio and television etc., towards new forms of media, such as news websites, blogs, and social media(Schagen, 2015).Social media is present in our everyday lives: we discuss with friends, share our lives, find information or even work on social media platforms (Kauppinen & Pavlova, 2017). According to study by Soegoto& Utomo(2019),marketing communication using social media has an effect on consumer interest in buying goods offered through social media such as marketing conducted by Instagram social media most frequently visited by people today.Social media provides a variety of platforms where different types of innovative content can be used to attract customers' attention. It comes in many forms such as Photos, Blogs, Micro blogs, Vlogs and social media sharing sites as Facebook, Instagram, YouTube, Snapchat, Tik Tok, Twitter and many more in the list.Every brand is turning on to bloggers, vloggers and other influencers on social media for making their brand felt. Vlogging, as a promotional tool has gained a lot of space in the portfolio of brands' promotional and communication space.

**Keywords:** Vlog, Vlogging, UGC(user generated content),Parasocial Interaction, eWOM, Credibility, YouTube.

### 2.REVIEW OF LITERATURE

#### 2.1.Vlogs

By a simplistic definition, a vlog is simply a blog where the medium is a video instead of written words. Vlogs are a form of online publishing, allowing everyone with web access and simple video production tools – such as a computer and a webcam or a cell phone with video capabilities – to create and post content (Molyneaux, 2008) . The internet video consumption now includes vlogging to a great extent. Vlogs are not only self-made entertainment but also are increasingly turning into a business opportunity (Kauppinen & Pavlova, 2017). The vlog trend gradually started in 2007 on YouTube. Nearly one-third of the world's population is a registered YouTube subscriber, and each day, these users log a billion hours of viewing time, producing billions of views. It enables millions of content producers and viewers to connect

with one another, exchange knowledge, talents, and hobbies, and create cross-cultural and linguistic bridges.

Different vlog video formats that place a focus on the various vlog channels are known as vlog styles. A vlog can be source for imparting knowledge about a particular hobby, such as fashion, make-up, culinary, or photography etc. About content, some vloggers make entertaining films about their present life, tasks they undertake with their friends, or just general discussions of current events. The focus can also be on a specific aspect of the vlogger's life, such as their family or travel. Any subject can be the subject of a vlog even the daily routines, trip diaries, and family conversations. Currently, educational, instructive, musical, comedic, gaming, and podcast content is frequently created and posted by vloggers. Vlogs offers choice of content without time restrictions. Beauty, lifestyle, food, culture, travel, motivation, vehicles, sports, and education are some of the vlog categories.

The consumption and desperation for content has evolved extremely fast since the short format video was introduced. Due to shorter attention spans, content producers must now provide more value, such as entertainment or knowledge, in a brief amount of time while still keeping a balance with their interpersonal relationships with the audience. Vlog is a popular technique to interact with an audience and grow your social media following. After repeated exposure to a vlogger (i.e., a producer of video blogs), viewers tend to regard the vlogger as a trustworthy information source, because repeated exposures help generate similar feelings of relationship enhancement as in traditional media. It frequently illustrates and debate topics that their viewers can identify with, which makes them engaging and shareable. The relationship between brands through Vlogs has greater significance as vlogs help in developing brands and many companies sponsor famous. Vlogs can succeed in promotion and bring about significant awareness when compared to large advertising films with high-budget production. Vloggers who use their product in the video to attract audience (Khalid & Siddiqui, 2019). Consumers now frequently read or watch vloggers' before making a final decision regarding a purchase, read product reviews. They not only learn about the product after watching vloggers product review, but also make purchase decisions. Product reviews in Vlogs are influential and make contribution to consumers' purchase decisions. It has nearly become a common practice for retailers to send free samples and products to popular vloggers to comment on and share with their viewers (Skipwith, 2016).

## **2.2. Para Social Interaction Theory:**

PSI is described as an illusionary experience such that consumers interact with personas as if they are present and engaged in a reciprocal relationship. In other words, PSI is the development of relationships that occurs over time with media personalities. Horton and Wohl, 1956 described PSI as a kind of psychological relationship experienced by an audience in their mediated encounters with performers in mass media. PSI explains the relationship where media user's reaction to a media persona is such that the media person is perceived as an intimate conversation partner by the media user. It is seen that viewers or listeners come to consider media personalities as friends despite having limited interactions with them. Such parasocial relations may be governed by little or no sense of obligation, effort or responsibility on the part of the viewer. He is free to withdraw at any moment. If the person remains involved, these relations may make a person live in a fantasy(Horton and Wohl, 1956).

The crucial difference in experience lies in the lack of effective reciprocity since the audience cannot reply back to the performer. The interaction is one-sided, non-dialectical and not susceptible to any mutual development. There are of course ways in which the viewers can make their feelings known to the performers but these lie outside the parasocial interaction itself. PSI developed from mass media that included sustained, repeat viewing of a media personality. Studying the long-term exposure to a luxury brand vlogger will help the

development of PSI and social media research and have important practical implications for brand managers (Lee & Watkins, 2016).

### **2.3.PSI In Digital Vlog Environment:**

The influence vloggers have on their audience can be explained by parasocial interaction (PSI) (Kauppinen & Pavlova, 2017). PSI is not restricted to traditional mass media but can also be fostered in an online environment that is designed to bring the viewer closer to a brand or celebrity. Parasocial relationships provide an appropriate conceptual framework to elucidate the relationships between digital celebrities and their followers (Lee & Watkins, 2016). The new phenomenon of digital celebrities' advertising effectiveness in online and social media indicates the shift in focus from advertising with traditional celebrities and media to dynamic advertising. Comparing the characteristics of advertisements by digital and traditional celebrities, the former includes strong affinity, low investment, small influence range, short-time effect, great influence on consumers' purchase decisions, and gaining of large income whereas the latter comprise low affinity, high investment, longtime effect, less influence on consumers' purchase decisions, and less income effect (Liu & Zhao, 2017). The former is cost-effective, followers-focused, emotion-based, and effective in inducing followers' actual purchases, thereby attracting many firms to use advertisements by digital celebrities (Liu & Zhao 2017). Consumers perceive celebrities' advertisements or endorsement as trustworthy information when parasocial relationships are formed. In the case of digital celebrities, their followers feel a closer friendship with them than with traditional celebrities owing to the similarities and familiarities based on parasocial relationships between ordinary persons.

According to **Skipwith(2016)**, the analysis of the relationship between YouTube vloggers and consumers, as it relates to product persuasion and marketing, can be shaped by understanding user generated content, electronic word-of-mouth, the source credibility model, and parasocial relationships. If viewers repeatedly watch vlogs, the viewers might get feelings of intimacy towards the vlogger; consequently, these feelings of intimacy might eventually lead to a feeling of 'friendship' (Rest, 2017). Even though they (customers) knew that the message mostly comes from companies, they continue to watch vlogs and share the information that is taken from vloggers (Bayazit et al., 2017).

The viewers not only become aware of the Persona but also develop a sense that the persona seems aware of the viewers' mental state and are capable of creating an impression that the person is listening and responding directly to the audience. Audience participation is found to increase the vlogger's perceived credibility indirectly through parasocial interaction (Reinikainen et al., 2017). The effects of parasocial relationships on the persuasion, purchase intentions and eWOM intentions present the power of parasocial relationship in digital celebrities' advertising effectiveness. By attributing the perception of a user generated peer-to-peer review, coupled with a feeling of friendliness and honesty by means of the parasocial theory, vloggers are able to establish feelings of an interpersonal relationship with consumers (Skipwith, 2016). This parasocial relationship strengthens the vlogger's level of credibility among his or her viewers and thus results in higher consumer persuasion power (Skipwith, 2016).

### **2.4.Attributes of Vlogs and Vlog persuasion**

**Lee and Watkins (2016)**, investigated the potential of fashion vloggers as luxury brands ambassadors and to elicit positive outcomes such as brand-user imagery fit, and perceived luxury. PSI and social comparison theory provide the theoretical framework for this investigation. A total of 396 female respondents who were 18 to 82 years old, were asked to provide their perceptions of the vlogger and the luxury brand. They were shown luxury brand A's handbag review video created by the selected vlogger. The results show that attitude

homophily and social attractiveness have a positive influence on para-social interaction. Watching vlogs increases brand-user-imagery fit and purchase intentions.

The study also highlights the importance of social media, specifically YouTube, for luxury brand managers to establish relationships with consumers. The relationship between consumers and vloggers, even though it is a one-way relationship, has potential to influence consumer perceptions of luxury brand products. Social comparison theory is used to explain the effect of PSI on consumers' luxury brand perceptions.

In an experimental study **Brujin (2016)** investigated how some vloggers or YouTube celebrities appropriate and achieve feelings of intimacy to further establish a parasocial relationship with their viewers. These feelings are the critical building blocks to establish a relationship of trust between the vlogger and his subscribers. In the study, an analysis of the YouTube vlogger Bonaldi was conducted – by collecting qualitative data on the vlogger's communication methods to carry the feelings of intimacy and honesty to her viewers. It was noted that Bonaldi's self-disclosure of personal and relatable everyday life content added to the viewer's perception of a personal and honest personality.

According to **Munnukka, Maity, Reinikainen and Luoma-aho(2019)**, in the context of a vlog, an endorser is defined as a vlogger who enjoys public recognition and uses such recognition on behalf of a consumer good, service, or brand by appearing with that good, service, or brand in a vlog post. In their study authors examine the effectiveness of brand endorsements in vlogs (video blogs) by assessing the role of audience participation, parasocial relationship on the perceived credibility of the vlogger and brand attitudes. The results show that vlogs with high levels of audience participation are more likely to increase the acceptance of the brand's endorsement via enhanced credibility perceptions among viewers. The focal role of PSR for message acceptance found in the traditional media context is also valid in the context of vlogs. The brand endorsements in vlogs effectively drive positive brand attitudes through the perceived credibility of the vlogger as a message source. This in turn supports the positive relationship between vlogger credibility and endorsement acceptance.

**Maree Alice(2019)** investigated why consumers trust blog and vlog content despite the consumer not personally knowing the blogger or vlogger. The study finds that amongst the many characteristics, parasocial relationships that develops between the consumer and the content creator in video and text-based channels, influences consumer trust in the content. This relationship is influenced highly by content authenticity, content attractiveness, personal content, and the provision of product information. The research concludes that consumers trust blog and vlog content because they feel that they know the content creator; they have a relationship with the content creator, although a one-sided relationship.

Vlogging a trending term, especially among YouTube viewers, has increasingly flooded content on various social media sites. In his study **DeaFarahdiba(2022)**, examined the antecedents and consequences of credibility and parasocial interactions on food shopping intentions in the context of vlogs. The information was gathered through a survey of 117 followers of one of the five favorite food vlogger accounts. It explored the influence of the constructs of physical attractiveness, social attractiveness, and attitude homophily of vloggers on credibility and parasocial interactions.

When influencers or social media celebrities have good interactions with their followers, the audience feels that their idols are trustworthy and can be imitated. The parasocial exchange built by the food vlogger, can influence the audience's desire to have food shopping intentions. Parasocial interactions have a constructive effect on food shopping intentions.

According to the experimental study conducted by **Leslie Rasmussen(2018)**, the immense majority of viewers perceived the YouTube celebrity as a credible source irrespective of popularity level. The interaction goes beyond simple product placement and branded

entertainment, instead, viewers socialize with YouTube celebrities, whom may also serve as a product ambassador. Many brands have turned to YouTube celebrities to create user generated content for product endorsements. For conducting the research participants were made to answer a 28-item questionnaire after viewing the videos. One group watched videos from YouTube beauty vlogger Kauppinens with 2 million or more subscribers, while another watched videos from beauty vloggers with 100k -250k subscribers. Findings revealed the occurrence of relationship building among viewers who watch YouTube celebrities, and latter are perceived as credible sources. However, more respondents (68%) reported they would likely purchase a product reviewed by the highly popular YouTube celebrity and over half (53%) respondents reported they would likely purchase a product reviewed by the moderately popular celebrity.

According to **MT Liu, Y Liu and Zhang(2019)** despite the importance of the vlog as a marketing tool, our understanding of the marketing results of video blogging (vlogging) is limited. Vlogging is a more effective approach for developing relationships with consumers who are seeking entertainment or hoping to build relationships and spend a lot of time on vlogs. Through their study, authors extended the focus of vlog marketing research from consumers' watching and sharing behaviors to brand evaluations, and suggest that marketers can develop relationships with consumers via vloggers. The conceptual model considers how vloggers' characteristics such as physical and social attractiveness and viewers' characteristics such as viewing motives and time spent on the media, simultaneously influence brand evaluations. The findings suggest that viewers consider vlogger-endorsed brands positively when they are motivated to seek entertainment or build relationships in vlogs, when they spend a lot of time on vlogs, and when the vloggers are attractive, as Parasocial Interaction is likely to occur between them.

According to **Chia-Lin Hsu(2020)**, there is a paucity of studies on the effect of online vloggers on PSI. Similarly, there has been little attention to the mediating role of flow experience between PSI and impulse purchasing, or between sense of belonging and impulse purchasing. PSI with vloggers positively influences sense of belonging and flow experience, followed by consumers' addiction, urge to purchase, and impulse purchase. It also shows how YouTube and vloggers can be leveraged by product managers as a non-traditional way of influencing consumers.

The author examines PSI's effects on the psychological responses of consumers e.g., desire to purchase and behavioral responses such as impulse buying and addiction. When vloggers form bonds with consumers, this has the potential to influence consumers' perceptions of products. The study, using an online survey of 428 Internet users explore the relationships between PSI's antecedents (physical attractiveness and attitude homophily) and consequences (consumers' flow experience, sense of belonging, desire to purchase, addiction, and impulse buying). PSI significantly influences sense of belonging, flow experience, and urge to purchase. It indicates the critical role of PSI in revealing consumers' psychological approach toward dealing, in a vlog, with other vlog viewers. The mediation test results confirm that the impact of PSI on sense of belonging is fully mediated by flow experience.

### **3.CONCLUSION**

The traditional media is almost being replaced by digital media, and, everybody is online and connected to world all the time. The user generated content is becoming more and more accepted. The investigation of the relationship between various kinds of vloggers and viewers, in context of digital marketing, can be shaped by understanding various attributes of vloggers such as credibility, trust, self-disclosure, user generated content, and parasocial interactions. This literature review highlights, some of the previous research conducted to better understand and analyse such attributes. Previous researchers have engaged in the



understandings of the vlogger's influence in the consumer's purchase intentions and brand evaluations. Brands need to understand that consumer purchasing habits have evolved as well. By using a feeling of friendliness and self-disclosure by means of the parasocial interaction, vloggers succeed in establishing feelings of an interpersonal relationship with viewers. This parasocial relationship strengthens the vlogger's consumer persuasion power and in turn affect their purchase intentions.

## REFERNCES

- Bayazit, D. Z., Durmuş, B., & YILDIRIM, F. (2017). Can Vloggers Characteristics Change Online-Shopping Intentions? The Role of Word-of-Mouth Effect as A Communication Tool. *AJIT-e: Online Academic Journal of Information Technology*, 8(26).
- Bruijn, M. K. (2016). Reconciling authenticity and commerciality? A descriptive study of the relationship of trust between beauty and style vlogger Hello October and her community (Master's thesis).
- Choi, W., & Lee, Y. (2019). Effects of fashion vlogger attributes on product attitude and content sharing. *Fashion and Textiles*, 6(1), 6.
- Eisend, M. (2006). Source credibility dimensions in marketing communication—A generalized solution. *Journal of Empirical Generalisations in Marketing Science*, 10(2).
- Farahdiba, D. (2022). Antecedents and Consequences of Credibility and Parasocial Interaction on Food Shopping Intentions. *Jurnal Manajemen Teori dan Terapan*, 15(1).
- Frobenius, M. (2014). Audience design in monologues: How vloggers involve their viewers. *Journal of Pragmatics*, 72, 59-72.
- Gao, Jiayue et al. (2023, January 3). How Does Digital Media Search for COVID-19 Influence Vaccine Hesitancy? Exploring the Trade-off between Google Trends, Infodemics, Conspiracy Beliefs and Religious Fatalism. <https://scite.ai/reports/10.3390/vaccines11010114>
- Gao, W., Tian, Y., Huang, T., & Yang, Q. (2010). Vlogging: A survey of videoblogging technology on the web. *ACM Computing Surveys (CSUR)*, 42(4), 15. DOI:10.1145/1749603.1749606.
- Gefen, D. (2000). E-commerce: the role of familiarity and trust. *Omega*, 28(6), 725-737.
- Gefen, D., Karahanna, E., & Straub, D. W. (2003). Inexperience and experience with online stores: The importance of TAM and trust. *IEEE Transactions on engineering management*, 50(3), 307-321.
- Glucksman, M. (2017). The rise of social media influencer marketing on lifestyle branding: A case study of Lucie Fink. *Elon Journal of Undergraduate Research in Communications*, 8(2), 77-87.
- Gotlieb, J. B., & Sarel, D. (1991). Comparative advertising effectiveness: The role of involvement and source credibility. *Journal of Advertising*, 20(1), 38-45.
- Gupta, R., Kishor, N., & Verma, D. P. S. (2017). Construction and validation of a five-dimensional celebrity endorsement scale: introducing the pater model. *British journal of marketing studies*, 5(4), 15-35.
- Horton, D., & Richard Wohl, R. (1956). Mass communication and para-social interaction: Observations on intimacy at a distance. *psychiatry*, 19(3), 215-229.
- Hsu, C. L. (2020). How vloggers embrace their viewers: Focusing on the roles of para-social interactions and flow experience. *Telematics and Informatics*, 49, 101364.
- Hsu, C. L., & Lin, J. C. C. (2008). Acceptance of blog usage: The roles of technology acceptance, social influence and knowledge sharing motivation. *Information & management*, 45(1), 65-74.
- Hsu, H. Y., & Tsou, H. T. (2011). Understanding customer experiences in online blog environments. *International Journal of Information Management*, 31(6), 510-523.



- Kauppinen, P., & Pavlova, A. (2017). YouTube influence on Well-being brands.
- Khalid, K., & Siddiqui, D. A. (2019). Branding with Vlogs, Factor Affecting Their Success. *Khalid, K. and Siddiqui, DA (2019). Branding with Vlogs, Factor Affecting Their Success. Business and Management Horizons, 7(1), 49-77.*
- Kumar, A. (2011). Celebrity Endorsements and its impact on consumer buying behaviour. *Available at SSRN 1802531.*
- Le Ha, N. T., & Ha, N. M. H. (2022). AUDIENCE PARTICIPATION, PARASOCIAL RELATIONSHIPS, VALENCE, VLOG ENDORSEMENTS, THE PERCEIVED CREDIBILITY OF THE VLOGGER AND BRAND ATTITUDES. *International Journal of Information, Business and Management, 14(4), 87-96.*
- Lee, J. E., & Watkins, B. (2016). YouTube vloggers' influence on consumer luxury brand perceptions and intentions. *Journal of Business Research, 69(12), 5753-5760.*
- Liu, M. T., Liu, Y., & Zhang, L. L. (2019). Vlog and brand evaluations: the influence of parasocial interaction. *Asia Pacific Journal of Marketing and Logistics, 31(2), 419-436.*
- Lockie, M. A. (2019). *In Vlogs We Trust: Consumer Trust in Blog and Vlog Content* (Doctoral dissertation, Auckland University of Technology).
- Molyneaux, H., O'Donnell, S., Gibson, K., & Singer, J. (2008). Exploring the gender divide on YouTube: An analysis of the creation and reception of vlogs. *American Communication Journal, 10(2), 1-14.*
- Munnukka, J., Maity, D., Reinikainen, H., & Luoma-aho, V. (2019). "Thanks for watching". The effectiveness of YouTube vlogendorsements. *Computers in human behavior, 93, 226-234.*
- Ohanian, R. (1990). Construction and validation of a scale to measure celebrity endorsers' perceived expertise, trustworthiness, and attractiveness. *Journal of advertising, 19(3), 39-52.*
- Ponte, M., & Afonso, C. (2017). How consumers perceive vloggers? Exploring consumer's perceptions and purchase intention applied to beauty and fashion industry. In *XXIX Congreso de Marketing AEMARK (2017), p 229-235.* ESIC.
- Rasmussen, L. (2018). Parasocial interaction in the digital age: An examination of relationship building and the effectiveness of YouTube celebrities. *The Journal of social media in society, 7(1), 280-294.*
- Reinikainen, H., Munnukka, J., Maity, D., & Luoma-aho, V. (2019). Endorsement Effectiveness in YouTube Vlogs.
- Rest, E. V. D. (2017). The blurring line between the online and off-line world; On the counterintuitive relationship between people's offline materialistic tendencies and their attitude towards online vloggers.
- Skipwith, K. (2016). Vlogging: The Future of Brand and Consumer Relationships.
- Soegoto, E., & Utomo, A. (2019). Marketing Strategy Through Social Media. IOP Conference Series: Materials Science and Engineering. <https://doi.org/10.1088/1757-899X/662/3/032040>.
- Sokolova, K., & Kefi, H. (2020). Instagram and YouTube bloggers promote it, why should I buy? How credibility and parasocial interaction influence purchase intentions. *Journal of retailing and consumer services, 53, 101742.*

# SOCIAL MEDIA AND POLITICAL ADVERTISING: A COMPREHENSIVE STUDY OF ONLINE CAMPAIGNING

Ritu,  
Panjab University, India  
(ritupatlan06@gmail.com)

---

There are many different social media networking sites, each with a different target market and collection of tools for bringing people together via the sharing of ideas, content, images, and connections. Businesses are using social media advertising into their overall marketing strategies more often due to its targeting capabilities and lower cost compared to print or television advertisements. The use of social media is not only limited to corporate houses to maintain their public relations, but also the component of it emerged as an important tool for advertisement in the political elections and has become a powerful platform for expressing opinion worldwide. Social media have increasingly been accepted by politicians, activists, and social movements as a new platform to communicate with public that they could not interact with.

**Keywords:** Political Campaigns, Social media, Elections, Tweeter, Facebook

## 1. INTRODUCTION

The gradual advancement of technology first gave rise to the internet and subsequently to social media platforms. Social media have shown that they can be used for more than just socialising and enjoyment as they were originally thought to be. Comparing social media to more conventional forms of media reveals both advantages and disadvantages. The most advantageous thing about it is that it may draw huge audiences in a little period of time. People who have access to a variety of social media applications report feeling more confident in themselves. As here is where they can showcase their abilities. Political parties are also using the social media platforms for their advertising and campaigning purpose. Previous studies have shown that from the point of view of political institutions, there's an emerging need to continuously collect, monitor, analyse, summarize, and visualize politically relevant information from social media (Stieglitz & Xuan, 2013). According to Effing et al. (2011) politicians with higher social media engagement got comparatively more votes within most political parties. The ability of people to spread their ideologies through social media and their tendency to vote for political groups with similar ideologies has led to a shift away from naming people. Social media users like or follow the social media page/account of their favourite politician or political party and receive political advertisements. Social media managers of these pages/accounts keep posting news about their political party, candidates, agendas, etc with the aim of keeping public updated about the information and to make them more connected and engaged with their party or candidates. By using Internet as a new political marketing tool, politicians can disseminate information to many voters and can get immediate feedback from one place at a moderately low cost (Waller & Polonsky, 1999). Social media's openness and simplicity of use appeal to both individuals and organisations. Social media may be used for a wide range of objectives, negating the notion that education is its main function. Along with a variety of benefits, the novel idea of social media has also generated some controversies (Fischer 2018). The objectives of the present study are to determine many types of social media sites that the respondents make use of, to determine which social media site is most often utilised by respondents to increase their political knowledge and to do research on the influence that social media has on society.

## 2. LITERATURE REVIEW

### 2.1 Impact on Elections

The use of social networks has a significant impact on the results of elections. In so many cases, conventional media mass medias, like cable television, are merged with social media sites. A significant number of people rely on cable tv as their primary and initial point of contact for obtaining news, data, and other types of media. Commentary on cable television helps to the development of polarisation and plays into people's preconceptions to favor certain parties. The messages transmitted by conventional media are often amplified and reinforced by social networks, that further contributes to the creation of party differences. The authors of an article published in the Journal of Communication concluded that while social media does not have a massive effect upon people's opinions and voting patterns, it also does not have a minimal effect on such qualities. Instead, the bandwagon effect is created by social media. This happens if a candidate in an election makes an error or achieves a great success. Users of social media will then greatly amplify the influence of such a failure or triumph. According to the findings of the Pew Research, nearly one quarter of Americans learn something about candidates via an online source such as Twitter. Social media is being used by about one in five people in the USA, the majority of which are people between the ages of 18 as well as 29. The presence of young people on social media platforms often serves as just an impetus again for formation of protests and movements. **(Smith 2013)**

For example, during in the presidential election in 2008, a Facebook group featuring 62,000 members was founded to support the election of Obama. Within days, colleges all over the world conducted rallies that drew millions of people each. The term "Facebook Effect" is frequently used to refer to protests and movements like these. On the other side, social media sites often have the opposite impact as well as place a substantial burden on several of its users. According to the results of a poll study by the Pew Research Centre, roughly 55 percent of people are using social media in the America said that they will be "worn out" by the amount the political postings that they see on social networks. Since the election in 2016, that number has increased by nearly 16 % as a clear result of the continued rise of technology and social media. In contrast to 2016, when just 56 % said the same thing, almost 70 percent of people now say that it may be "stressful as well as unpleasant" to discuss politics on social networks with people who hold opposing viewpoints. As a direct result of this, the proportion of humans who describe these discussions as "interesting and informative" has dropped from 35 % to 26 % in 2018. **(Moore 2019)**

### 2.2 Political Advertising on Social Media Platforms

The use of campaign ads is a method of campaign that enables politicians to actually communicate with voters and have an impact on the political discourse. Candidates have the ability to build brand recognition, bring attention to important problems, and draw attention to a shortcoming of their opponents by running advertisements on various types of media. This allows the candidate to reach audiences which otherwise may not have been paying close attention to the election. Newspapers, radio, tv, and direct mail were the main distribution channels for political advertisements inside the past. When Barack Obama decided to run for president in 2008, he was among the first politicians to employ advertising on social media sites. During that electoral cycle, in 2008, candidates spent a total of \$22.25 million on online political advertisements. Ever since, internet political ads on have seen meteoric growth; in 2016, candidates spent a total of \$1.4 billion on such advertisements. Regarding the results of the presidential race in 2016, the general public gained a better appreciation of how influential & potentially game-changing the effects of political online advertisements can be. According to a tweet sent by Brad Quality related, the digital director for the Trump campaign, the Trump performance on the field on Facebook was "100x to

200x" more effective than the Clinton team. As soon as leaker Christopher Wylie revealed that data analytics team again for Trump campaign, Cambridge Analytica, "used personal details taken without authorization in early 2014 to build a system that might profile individual U.S. voters, in order to target people with individualised political advertisements," the possible explanation for this became plainly obvious. It was also found that several of the advertisements that have been posted on social media did not arise in any of the candidates.

**(Teehanke 2016)**

According to a study came from the House Select Intelligence Committee, the Russian state spends around one hundred thousand on advertisements that were posted on Social media in an effort to influence the results of a presidential race that was held in the Americas. The impact of those advertisements has indeed been amplified as a result of the fact that they were created with intention of stoking disharmony on divisive topics, such as those relating to gun control and race issues and were then directed toward individual people who were most vulnerable to the impact of those messages. The impact of those advertisements was magnified by the fact that those advertising messages were designed to fan split on polarising issues. While it may seem like a pathetic sum when compared to the price of a tv commercial, the effect of those advertisements was amplified by the fact that those advertisements have been designed to fan divide on polarised issues. As a society, we still are dealing with the fallout from these revelations, and we are currently striving to identify exactly what sort limitations, if any, must be put on social media sites in reference to political communication. The controversy was rekindled in November of 2019, after Facebook neglected to remove false advertising that were run on Joe Biden during the re-election campaign of President Donald Trump. These commercials were released by the Trump campaign. You have a responsibility to investigate the regulations that social media sites are creating for political ads as the election in 2020 approaches closer. You also have a duty to consider the consequences such rules have towards our electoral vote. We need to do this because the 2020 election is coming near. **(Vaidhyanathan 2018)**

The First Amendment and Marketing in Political Campaigns It is helpful to look into the history of political market in the United States and how it's been controlled in those other kinds of media in order to gain a better understanding of the challenges involved in regulating television campaigns on social media sites. Candidates in this nation have a long and distinguished history of spreading false information about their rivals, starting with Thomas Jefferson's campaign, which stated that John Adams was going to take the country to war with France. This practise has a long and distinguished history. It also is entirely legal to lie in ads for candidates and parties. Some people have been taken aback by this data due to the notion because advertisements are subject to the regulations that forbid them from making false claims about items or about rivals. For example, the Federal Trade Commission (FTC) severely punished Kentucky Fried Chicken in 2004 for making a false assertion that eating fried chicken as part of a healthy diet was feasible. The company was forced to pull the commercials and also to offer up all of its marketing for evaluation by the FTC for next five years. **(Persily 2017)**

Those do not remain true for somebody who is campaigning for political office and runs an advertising in which they make false claims about his rival. Why? Because advertising for candidates and parties are considered a kind of political speech, and the First Amendment law prioritises the security of political expression above the security of other forms of speech. When it comes to the regulating of political advertisements, the government does not even have nearly as much power as it does whenever it comes to the regulation on corporate speech. The reasoning for this is that people have a right to be informed from politicians which has not been censored, which they can then assess for themselves before taking their judgments at the ballot box. A victim of a misleading attack ad has no choice but to file

political lawsuit for libel as their sole legal remedy. This is attributable to the fact that no government entity has the power to punish a candidate who lies in an advertising. Litigation of this kind is often not very frequent since there are several technical barriers towards its filing. Candidates for political office have a difficult time winning such types of lawsuits because people in the public eye are held to a higher standard of proof when libel is alleged against them. A public person must show, just as a private suit would, that false claims of fact were made against them, and that these statements caused injury to their reputation. But, on top of that, they need to prove that the assertions were made with "actual malice," which means people who produced the advertisement either understood it was false or didn't care if it was true or not. Although a number of applicants may be able to overcome these obstacles and triumph in their court dispute, doing so might not be worth their energy and cash to them, particularly while they're in the midst of running a campaign. **(Wong 2019-10-30)**

But let's say just for argument that a candidate does indeed wish to sue somebody for libel; who exactly may he sue? Obviously, individuals have the ability to take legal action against the person or organisation who thought of and paid for the advertising; but is the news business that was capable of actually disseminating the advertising message to the public at large also liable? The many methods of communication each have their own unique guideline. Publications are regarded to be publisher, and that they are responsible for the advertisements which they decide to be included in their periodicals. As a corollary to this point, businesses have complete choice over the ads that can run, and that they are not required to operate any advertising which they do not voluntarily choose to run. In point of fact, according to the first Article, they have the right to decide for themselves how they will write. This privilege is legally protected. Television and radio stations that are a part of a simulcast are banned from selectively choosing which television campaign to broadcast, at least with regards to significant major candidates for the same seat. This is a glaring contradiction. **(Unver 2017)**

They have the choice of not airing any political ads at all, but if they do, they are required to do so for almost all politicians who want them. Why? The rationale for this is that the airwaves because broadcasters utilise are indeed a limited resource. Since there is a limit to the number of broadcast stations that can operate on the spectrum, there is always the possibility that some viewpoints will never be spoken publicly. Because of this risk, the First Amendment rights of broadcasters may be limited by the Federal Communications Commission (FCC), which has the authority to do so. This restriction is intended to guarantee that the general public is exposed to a wide range of perspectives and information. Because of this, broadcasters do not have any legal obligation for the advertising that they air. The laws which apply to broadcasting companies are not implemented on the channels that are accessible via cable television. They need not possess the same distinctive qualities as broadcast channels have—for example, they are not restricted in amount means that they are free to choose which political ads they wish to air and which ones they do not like to air. As a consequence of all this, they are not only liable for any false advertisements that appear, and they also risk getting sued for libel. **(Eder 2020)**

### **2.3 Use of Social Media in India**

The political process is being significantly impacted by social media in India in a new and substantial way. In order to engage with India's younger and more wealthy population, political parties and leaders in India have devised new techniques in recent years. During the assaults that took place in Mumbai in 2008, information was communicated between Indians and the rest of the world via Twitter and Flickr, which brought attention to the utilisation of social media in India. Political parties in India tried to engage with voters by utilising social networking websites during the national elections that took place in May 2009. This was the first time that online voter registration and transparency campaigns had been initiated by



political parties. On the other hand, political parties in urban India are becoming more tech-savvy as a result of the fact that this is the only method to communicate with educated young people. On Indian social media platforms, the Bharatiya Janata Party (BJP) is by far the most popular political party. ( **Hussain Md Bajlun 2018**)

The Bharatiya Janata Party (BJP) has been much more active on social media in recent years. A large number of government officials, including Sushma Swaraj, Rajnath Singh, Arun Jaitley, and Narendra Modi, are regular users of social networking sites. Narendra Modi, who is running for president as a candidate for the BJP this year, will have his own team to manage his presence on social media. The young Aam Aadmi Party (AAP) and its candidate, Arvind Kejriwal, were able to accomplish an unexpected victory in the municipal elections held in Delhi thanks to the help of social media. Traditional political parties were their opponents. On the other side, there is the possibility that social media platforms may be used in an inappropriate manner on a mass scale. Some politicians have been accused of using social media to smear their rivals by making false claims about the number of followers they have on their accounts on platforms like Twitter and Instagram. The use of social media to promote violence against members of religious and ethnic minorities has become widespread. ( **Sadashivam 2019**)

#### **2.4 Policies Governing the Targeted marketing of Political Advertisements on Social Media**

It is not always a negative thing to offer people the right to decide for themselves not if they accept the statements made by a politician; in fact, one might argue that it is an integral part of the democratic process. In a perfect world, a market economy would give the wider populace access to as much info as possible regarding the applicants, a free media would evaluate the comments made by the applicants and expose any dishonesty, and voters will indeed talk about the issues among themselves before trying to cast their ballots. When it came to inaccuracies in political ads that are televised nationally, radio, and newspapers, it has typically become the pattern that has developed throughout the last few histories. Because these advertisements are distributed to such large and diverse audiences, they are instantly subjected to a considerable amount of scrutiny from the general public. Microtargeting is facilitated via social media, putting it apart from less conventional channels of information in a significant way. ( **Morgan 2018-01-02**)

This is the defining quality that sets social networks separate from other, more traditional forms of communication. Furthermore addition, the use of microtargeting makes it increasingly hard to differentiate between credible news sources as well as those who spread misleading info. Ellen L. Weintraub, head of the Commission On elections, argued inside an opinion piece arguing for social media sites to restrict to indeed campaign ads because it is simple to single out vulnerable groups and clear political messaging to them with no responsibility. This is because the vast majority of people in the public never actually watch the commercial. Despite the fact that all of these lies have the potential to get a big influence on elections, it is possible that they will go undetected as a result of all this. This is despite the ability to be able that they will go undetected as a consequence of all of this. However, it is important to remember that the impact of microtargeting on democratic institutions is not totally detrimental, but this is something that should not be ignored. Because internet advertisements often cost a far lesser number than spots aired on television & radio, this paves the way even smaller groups with much less money to successfully connect with voters. It also offers candidates the opportunity to zero in on actual and specific problems that matter to their prospective constituency, as opposed to more general and vague messages that tend to broadcast on traditional media; this, in turn, may increase voter involvement overall turnout. ( **Andrejevic 2013**)



When creating its policies on microtargeting of political ads, Facebook and Google most likely examined both the positives and negatives of the practise; yet they came at startlingly different results. As according to Google's existing policy, political advertisements can only be targeted to broad demographic factors such as age, gender, and postcode. Contextual targeting is possible through the use of this platform, that means that a person who is reading an item on immigration can be shown an advertisement about policy on immigration, for example. "this will align our approach to election ads with long-established practises in media such as TV, radio, and print," Google said that when it revealed the modification to its policy in November of that year. "This will lead in election commercials being much more widely viewed & open to public debate." Facebook, on either hand, has adopted a much more liberal approach toward customer - oriented marketing, deciding to not place any boundaries on how organizations may target their advertisements. In other words, Facebook doesn't really restrict microtargeting in just about any way. Instead, Facebook has promised to provide consumers with a greater degree of control so over number of political advertisements they view and to streamline the process of browsing throughout its library of political advertisements. A large number of critics are of the view that these measures will not substantially increase the openness of targeted advertising. (Wellman 2012)

### 3. CONCLUSION

For a considerable amount of time, social media has been referred to be the fourth pillar of democracy because of its ability to both report on events happening globally and to shape public opinion on current topics. The term "democracy" implies that citizens participate in the making of decisions. The media had a major role in making this engagement easier. On the other hand, the emergence of social media has changed how individuals participate in democratic institutions nowadays. Social networking is more accessible than conventional media, easier to use, allows for mass participation, and provides real-time information. Due to these factors, individuals now rely more on social networks than on traditional ones to stay informed about their surroundings and take part in conversations about various topics, including social and economic ones. This enhances democracy. That is, however, just one side of the debate over how social media affects democracy. However, it has been misused quite a bit, often turning into the antithesis of democracy in the process.

### REFERENCES

- Andrejevic, Mark. 2013. "Public Service Media Utilities: Rethinking Search Engines and Social Networking as Public Goods." In *Media International Australia*, 146 (1): 123–132.
- Deibert, Ronald J. 2019-01-09. ""The Road to Digital Unfreedom: Three Painful Truths About Social Media." *Journal of Democracy* 30 (1): 25–39.
- Eder, Mari. 2020. *American Cyberscape: Trials and the Path to Trust*. Defense Press. p. 8.
- Effing, R., Van Hillegersberg, J., & Huibers, T. (2011, August). Social media and political participation: are Facebook, Twitter and YouTube democratizing our political systems?(pp. 25-35).
- Fischer, Clara. 2018. "Feminists Redraw Public and Private Spheres: Abortion, Vulnerability, and the Affective Campaign to Repeal the Eighth Amendment" (PDF) ." *Journal of Women in Culture & Society* . 45 (4): 985–1010.
- Hussain Md Bajlun, NOOR. 2018. "The Role and Importance of Media in Indian Politics. *IntJ Recent Sci Res.*" 9(1), pp. 23451-23454.
- Moore, Martin. 2019. *Democracy Hacked : How Technology Is Destabilising Global Politics*. Oneworld Publications. pp. 3–4.

- Morgan, Susan. 2018-01-02. "Fake news, disinformation, manipulation and online tactics to undermine democracy." *Journal of Cyber Policy* 3 (1): 39–43.
- Moy, Patricia. 2010. "Media Effects on Political and Social Trust." *Journalism & Mass Communication Quarterly* 77 (4): 744–759.
- Persily, Nathaniel. 2017. "Can Democracy Survive the Internet." *Journal of Democracy* 28 (2): 63–76.
- Sadashivam, T. 2019. *Role of Social Media in Indian General Election 2019*.
- Smith, Stacy. 2013. "If Dr.Martin Luthur, Jr. had a Twitter Account: A Look at Collective Action, Social Media, and Social Change." *Seattle Journal for Social Justice* 12: 165.
- Stieglitz, S., & Dang-Xuan, L. (2013). Social media and political communication: a social media analytics framework. *Social network analysis and mining*, 3, 1277-1291.
- Teehankee, Julio C. 2016. "Electing a Strongman." *journal of democracy* pp. 27:3, 125–134.
- Unver, H. Akin. 2017. "Politics of Automation, Attention, and Engagement." *Journal of International Affairs* 71 (1): 127–146.
- Vaidhyanathan, Siva. 2018. *Antisocial Media : How Facebook Disconnects Us and Undermines Democracy*. Oxford: Oxford University Press, Incorporated. pp. 153–155.
- Waller, D. S., & Polonsky, M. J. (1999). Student attitudes towards political advertising and issues: A cross-cultural study. *Journal of International Consumer Marketing*, 11(2), 79-98.
- Wellman, Barry. 2012. "Networked: The New Social Operating System." MIT.
- Wong, Julia Carrie. 2019-10-30. "Twitter to ban all political advertising, raising pressure on Facebook." *The Guardian*.

# SUSTAINABLE MANAGEMENT PRACTICES FOR OPTIMISING PERFORMANCE OUTCOMES IN THE HOSPITALITY INDUSTRY

**Dr. Neelam Shekhawat**

Shri Bhawani Niketan P.G. College, Sikar Road, Jaipur, India.  
Shekhawatneelam4@gmail.com

**Dr. Kunal Vijay**

ICFAI Business School (IBS), ICFAI University, Jaipur, India.  
vijay.kunal25@gmail.com

This research paper explores the effects of management strategies focused on sustainability on performance outcomes in the hospitality industry. It aims to address the pressing requirement for sustainable practices in light of increasing ecological, social, and economic difficulties. By conducting an in-depth examination of existing secondary data sources, encompassing scholarly articles, industry analyses, and sustainability documentation, this research assesses the present state of sustainable methodologies and their impact on key performance indicators, such as cost reduction, client contentment, and workforce involvement. The results demonstrate a direct association between the implementation of energy-conserving practises, waste minimization endeavours, and water preservation campaigns in the hospitality industry and enhanced performance results. While there may be differences in the execution and strictness of sustainability initiatives, the available data substantiates the advantages of incorporating sustainable practices into corporate strategies.

To fully capitalise on these benefits, the paper suggests the implementation of consistent industry sustainability criteria, the strategic incorporation of sustainability into corporate goals, the promotion of employee involvement in sustainability endeavours, the adoption of measurable benchmarks for sustainable initiatives, and the enhancement of consumer visibility into sustainability endeavours. By fully embracing and implementing these suggestions, the hospitality sector can further enhance its dedication to ecological sustainability and enhance its competitive edge.

**Keywords-** sustainability, energy-conserving practices, waste minimization endeavours, water preservation campaigns, hospitality industry.

## 1. INTRODUCTION

### Background and Rationale

The hospitality sector plays a vital role in driving worldwide economic expansion, even as it grapples with urgent sustainability and performance enhancement issues (Abualigah *et al.*, 2023). In light of the sector's environmental, social, and economic consequences, it has become imperative to adopt sustainable management practices to ensure long-term prosperity. The motivation behind this study is to recognise and incorporate environmentally conscious techniques and conscientious administration approaches that not only comply with sustainability principles but also amplify operational effectiveness and customer contentment.

### Research Aim and Objectives

This paper aims to examine the efficacy of sustainable management strategies in maximising performance results within the hospitality and management sector. The objectives include:

- To assess the hospitality and management sector's current implementation of sustainable management practices
- To evaluate the effect that these practices have on critical performance indicators
- To suggest practical approaches that can assist hospitality enterprises in maximising their operational efficiency by incorporating sustainable management practices that are proven to be effective.

## 2. LITERATURE REVIEW

The hospitality sector, which is a significant player in the service industry worldwide, has witnessed a transformative change towards sustainability in response to socio-economic influences and the growing desire among consumers for eco-friendly endeavours as per Legrand, Chen and Laeis (2022). In recent scholarly works, there has been an increasing focus on analysing the intricate connection between sustainability and the results achieved in this particular domain.

An influential piece of research conducted by Chan, Okumus and Chan (2020) underscores the financial advantages associated with the adoption of environmentally friendly measures in the management of hotel activities. The research indicates that the decrease in resource utilisation results in substantial financial savings and has the potential to enhance profit margins. On the other hand, Ikram *et al.* (2021) assert that despite the

potentially elevated initial costs associated with sustainable technologies, the subsequent financial and environmental advantages frequently validate the decision to invest.

Hassan *et al.* (2023) have extensively examined the concept of environmental sustainability within the hospitality industry, highlighting the critical importance of mitigating ecological footprints by implementing effective waste management strategies, enhancing energy efficiency measures, and promoting water conservation practices. The conclusions drawn by Khatter (2023) align with his findings, suggesting that the implementation of socially responsible practices not only fosters community development but also bolsters the reputation of hospitality establishments.

According to Olyaei *et al.* (2021), it has been observed that customers generally hold a more positive view of hotels that implement sustainable measures, resulting in enhanced loyalty and support. This sentiment is echoed in research conducted by Khan *et al.* (2021), which highlights a favourable reaction from consumers towards the eco-certification of hospitality businesses.

Carnemolla, Robinson and Lay (2021) have analyzed the contribution of employees towards promoting sustainability, emphasising the significance of the active involvement of staff members in sustainable initiatives. According to their investigation, the inclusion of staff members in the procedure not only fosters an enduring culture but also enhances job contentment and efficiency.

Nonetheless, a noticeable void can be observed within the existing body of scholarly work about the tactical execution of environmentally conscious methodologies. Raub and Martin-Rios (2019) raise concerns about the industry's insufficient implementation of comprehensive frameworks that effectively integrate sustainability with business objectives. Furthermore, there is a lack of comprehensive exploration regarding obstacles to achieving sustainability, particularly about the perceived trade-offs between environmental concerns and guest satisfaction.

To summarise, existing scholarly works recognise the favourable association between sustainable management and performance results. However, there is a need for further investigation into the strategic amalgamation and surmounting of obstacles during implementation. This review highlights the need for a more comprehensive exploration of the methods and perspectives that govern sustainability in the hospitality sector, establishing a basis for the intended research goals.

### **3. RESEARCH METHODOLOGY**

This study employs a qualitative methodology, making use of secondary data to investigate the convergence of sustainable management strategies and performance results within the hospitality sector. The choice to depend on secondary sources encompasses three main aspects: utilising the extensive range of pre-existing scholarly research, industry reports, and case studies; conducting a thorough analysis while considering time and resource limitations; and circumventing the logistical challenges associated with gathering primary data in a worldwide sector (Ruggiano and Perry, 2019).

The data will be obtained from extensively reviewed academic journals, authoritative books, reputable industry publications, and the official sustainability reports of esteemed hospitality organisations. These sources offer a vast collection of information, documenting diverse experiences and empirical discoveries crucial for gaining a comprehensive comprehension of present practices and benchmarks (Akcem, Guney and Cresswell, 2019). The utilisation of content analysis will be implemented to systematise and decipher pertinent data, facilitating the amalgamation of perspectives on how sustainable management enhances performance metrics.

This approach is especially well-suited for capturing the intricate viewpoints that define sustainable practices without incurring the costs associated with extensive on-site research. Hence, the primary objective of this study is to expand upon the current body of knowledge to devise strategic suggestions for improving performance results via the implementation of sustainable management practices within the realm of the hospitality sector.

### **4. FINDINGS AND ANALYSIS**

#### **Evaluation of Current Sustainable Management Practices**

Research findings indicate that the hospitality sector has gradually adopted a variety of sustainable management strategies, primarily motivated by ecological considerations and the expectations of consumers. Energy-efficient operations, waste reduction initiatives, and water conservation practices are frequently observed topics. As per the research conducted by Meeroff *et al.* (2020), numerous hotels all over the world have successfully integrated LED lighting, energy management systems, and low-flow fixtures into their establishments. Nevertheless, the degree of these practices differs, with bigger hotel chains frequently having greater capabilities to allocate funds towards extensive sustainability endeavours, as indicated by Raub and Martin-Rios (2019).

As per the findings of the International Tourism Partnership (ITP), the energy consumption of the hospitality sector constitutes approximately 20% of the total global energy consumption, while its contribution to greenhouse gas emissions stands at approximately 5% (UNFCCC, 2018).

According to the report presented by UNFCCC (2018), hotels have the potential to decrease their energy usage by an average of 25% through the adoption of energy-efficient strategies. These strategies encompass the utilisation of LED lighting, the incorporation of energy-efficient appliances, and the optimisation of HVAC systems. Analysis indicates a discrepancy in the execution of practices, highlighting a noticeable divergence between the intended objectives and the actual behaviours observed. Although the significance of sustainability is widely recognised within the industry, it is evident that only a portion of businesses actively seek certification or implement rigorous measures. This observation highlights the necessity for a more cohesive and comprehensive strategy towards establishing industry-wide sustainability standards.

#### **Impact of Sustainable Practices on Performance Outcomes**

The positive effects of implementing sustainable management practices on performance are evident when considering various metrics. In particular, there are noticeable financial advantages resulting from the decreased utilisation of resources, which is in line with the analysis conducted by Shereni (2019) regarding the positive economic outcomes. The claim made by Kim and Hall (2020) regarding customer satisfaction is supported by evidence. According to research conducted by NielsenIQ, (2022), a remarkable 66% of consumers worldwide express their willingness to invest additional funds in products or services provided by companies that demonstrate a strong dedication to sustainability.

It has been observed that customers frequently exhibit a preference for environmentally conscious establishments, and their loyalty and favourable online feedback are closely associated with the sustainability initiatives undertaken by these businesses.

The involvement of employees in sustainability initiatives has been proven to significantly impact their level of job contentment. According to the research conducted by Barreiro and Treglown (2020), it can be inferred that a highly engaged workforce tends to exhibit higher levels of motivation. This, in turn, has a positive correlation with enhanced service quality, which is considered a crucial metric for evaluating performance within the hospitality industry.

Nevertheless, it should be noted that the aforementioned favourable effects are not universally encountered, and the attainment of performance results may rely on the seamless integration of sustainable methodologies into the overall business strategy, as well as the effective dissemination of this information to relevant parties involved.

#### **Proposed Actionable Strategies**

Upon careful examination of the literature and data, it becomes evident that numerous businesses have successfully implemented commendable practices. However, there remains ample room for enhancement, specifically in the realm of strategic application. The results suggest a disparity between the endeavours towards sustainability and the incorporation into operational processes.

As per a report released in 2021 by the World Business Council for Sustainable Development (WBCSD), a significant majority of the world's leading corporations, approximately 70%, have established objectives related to sustainability (WBCSD, 2019). Furthermore, nearly half of these companies have successfully incorporated sustainability principles into their overall business strategies.

According to a recent investigation conducted by the Harvard Business School in 2022, it was discovered that organisations that have embraced sustainable practises have exhibited superior financial performance compared to their counterparts (Cote, 2021). The research revealed that these enterprises exhibit superior returns on invested capital (ROIC), reduced capital expenses, and elevated stock valuations.

To ensure optimal execution, scholarly sources emphasise the necessity of establishing unequivocal tactics that integrate sustainability into both the fabric of an organization's culture and its operational procedures—an idea that resonates with the views expressed by Settembre-Blundo *et al.* (2021).

One potential approach involves the modification of a structure in which sustainability aims to harmonise with corporate objectives, facilitating a smooth amalgamation. Training initiatives that prioritise sustainability have the potential to foster a culture of environmental awareness among employees. In addition, Jamil *et al.* (2023) think that implementing quantifiable parameters to evaluate the immediate influence of eco-friendly strategies on operational results would assist in developing specific programmes that can be effectively conveyed to customers, thereby bolstering the organization's competitive standing.

## **5. CONCLUSION AND RECOMMENDATIONS**

The research findings suggest a strong correlation between the implementation of environmentally conscious management strategies and the improvement of overall performance within the hospitality sector. Despite differences in execution, the concept of sustainability, which encompasses environmental initiatives, social responsibility, and economic efficiency, holds the capacity to enhance customer contentment, decrease operational expenses, and strengthen employee motivation.

To maximise these advantages, the following recommendations are applicable:



- 1. Uniform Implementation:** Implementing industry-wide sustainability standards to facilitate performance measurement, benchmarking, and consistent practice application.
  - 2. Strategic Integration:** Constructing all-encompassing strategic frameworks that harmonise sustainability objectives with business goals, thereby facilitating the smooth integration of ecologically conscious practices (Al Falah *et al.*, 2023).
  - 3. Employee Engagement:** Developing a culture of sustainability through staff training investments can result in increased productivity and service quality.
  - 4. Performance Metrics:** Implementing monitoring systems and measurable objectives to assess the efficacy of sustainable initiatives facilitates ongoing progress (Susilo and Santos, 2023).
  - 5. Consumer Transparency:** By improving communication endeavours about sustainability, businesses can capitalise on marketing prospects and strengthen consumer allegiance (Khan *et al.*, 2023).
- By implementing these recommendations, the hotel sector may enhance its dedication to sustainable growth while simultaneously improving competitive performance results.

## REFERENCES

- Abualigah, A., Koburtay, T., Bourini, I., Badar, K. and Gerged, A.M., 2023. Towards sustainable development in the hospitality sector: Does green human resource management stimulate green creativity? A moderated mediation model. *Business Strategy and the Environment*, 32(6), pp.3217-3232.
- Akcam, B.K., Guney, S. and Cresswell, A.M., 2019. Research design and major issues in developing dynamic theories by secondary analysis of qualitative data. *Systems*, 7(3), p.40.
- Al Falah, K.A. and Ghouri, A.M., 2023. Integrating Lean Management, Sustainability, Circular Capabilities, and Waste Minimization to Optimise Operational Performance in Manufacturing. *Operational Research in Engineering Sciences: Theory and Applications*, 6(2).
- Barreiro, C.A. and Treglown, L., 2020. What makes an engaged employee? A facet-level approach to trait emotional intelligence as a predictor of employee engagement. *Personality and Individual Differences*, 159, p.109892.
- Carnemolla, P., Robinson, S. and Lay, K., 2021. Towards inclusive cities and social sustainability: A scoping review of initiatives to support the inclusion of people with intellectual disability in civic and social activities. *City, Culture and Society*, 25, p.100398.
- Chan, E.S., Okumus, F. and Chan, W., 2020. What hinders hotels' adoption of environmental technologies: A quantitative study. *International Journal of Hospitality Management*, 84, p.102324.
- Cote, C., 2021. *Making the Business Case for Sustainability*. [online] Business Insights - Blog. Available at: <https://online.hbs.edu/blog/post/business-case-for-sustainability> [Accessed 13 Nov. 2023].
- Hassan, S.T., Wang, P., Khan, I. and Zhu, B., 2023. The impact of economic complexity, technology advancements, and nuclear energy consumption on the ecological footprint of the USA: Towards circular economy initiatives. *Gondwana Research*, 113, pp.237-246.
- Ikram, M., Ferasso, M., Sroufe, R. and Zhang, Q., 2021. Assessing green technology indicators for cleaner production and sustainable investments in a developing country context. *Journal of Cleaner Production*, 322, p.129090.
- Jamil, S., Zaman, S.I., Kayikci, Y. and Khan, S.A., 2023. The Role of Green Recruitment on Organizational Sustainability Performance: A Study within the Context of Green Human Resource Management. *Sustainability*, 15(21), p.15567.
- Khan, S., Nambiar, R. and Kumar, S.P., 2023. Sustainability Certifications for Tourism, Travel and Hospitality (TTH) and the Indian industry response. *International Journal of Engineering Technology and Management Sciences*, 7(1), pp.390-410.
- Khan, S.W., Geng, H., Larsari, V.N. and Sain, Z.H., 2023. Understanding the Role of Social Media in Modern Marketing Communications. *International Journal of Marketing and Digital Creative*, 1(2), pp.29-41.
- Khatter, A., 2023. Challenges and Solutions for Environmental Sustainability in the Hospitality Sector. *Sustainability*, 15(15), p.11491.
- Kim, M.J. and Hall, C.M., 2020. Can sustainable restaurant practices enhance customer loyalty? The roles of value theory and environmental concerns. *Journal of Hospitality and Tourism Management*, 43, pp.127-138.
- Legrand, W., Chen, J.S. and Laeis, G.C., 2022. *Sustainability in the hospitality industry: Principles of sustainable operations*. Taylor & Francis.
- Meeroff, D.E., Scarlatos, P.D., Bloetscher, F. and Sobel, L., 2020. Implementation of sustainability practices in the hospitality industry. *Journal of Service Science and Management*, 13(2), pp.189-208.



- NielsenIQ, 2022. *Sustainability: the new consumer spending outlook*. [online] Available at: [https://nielseniq.com/wp-content/uploads/sites/4/2022/10/2022-10\\_ESG\\_eBook\\_NIQ\\_FNL.pdf](https://nielseniq.com/wp-content/uploads/sites/4/2022/10/2022-10_ESG_eBook_NIQ_FNL.pdf) [Accessed 13 Nov. 2023].
- Olya, H., Altinay, L., Farmaki, A., Kenebayeva, A. and Gursoy, D., 2021. Hotels' sustainability practices and guests' familiarity, attitudes and behaviours. *Journal of Sustainable Tourism*, 29(7), pp.1063-1081.
- Raub, S.P. and Martin-Rios, C., 2019. "Think sustainable, act local"—a stakeholder-filter-model for translating SDGs into sustainability initiatives with local impact. *International Journal of Contemporary Hospitality Management*, 31(6), pp.2428-2447.
- Ruggiano, N. and Perry, T.E., 2019. Conducting secondary analysis of qualitative data: Should we, can we, and how?. *Qualitative Social Work*, 18(1), pp.81-97.
- Settembre-Blundo, D., González-Sánchez, R., Medina-Salgado, S. and García-Muiña, F.E., 2021. Flexibility and resilience in corporate decision making: a new sustainability-based risk management system in uncertain times. *Global Journal of Flexible Systems Management*, 22(Suppl 2), pp.107-132.
- Shereni, N.C., 2019. The tourism sharing economy and sustainability in developing countries: Contribution to SDGs in the hospitality sector.
- Susilo, D. and Santos, M.C.K., 2023. DIGITAL MARKETING COMMUNICATION SUSTAINABLE HOTEL PRACTICE OF ACCOR GROUP IN SOCIAL MEDIA. *International Journal of Economic, Business, Accounting, Agriculture Management and Sharia Administration (IJEBAAS)*, 3(3), pp.730-743.
- UNFCCC, 2018. *UN Works with Global Hotel Industry to Reduce Emissions | UNFCCC*. [online] Unfccc.int. Available at: <https://unfccc.int/news/un-works-with-global-hotel-industry-to-reduce-emissions> [Accessed 13 Nov. 2023].
- WBCSD, 2019. *World Business Council For Sustainable Development (WBCSD)*. [online] Wbcd.org. Available at: <https://www.wbcd.org/> [Accessed 13 Nov. 2023].

## ADOPTION OF DIGITAL TECHNOLOGY AND INNOVATION IN MICRO AND SMALL ENTERPRISES: A STORY FROM INDONESIA

**Tulus T.H. Tambunan**

Center for Industry, SME and Business Competition Studies, Universtas Trisakti, Indonesia

The emergence of digital technology (DT) has created a drastic change in business practices in Indonesia which presents a serious challenge to all businesses, including small size, i.e. micro and small enterprises (MSEs) in the country. By analyzing secondary data and reviewing key literature this study examines the transition process in the Indonesian economy towards DT. It shows that internet penetration in the country grew rapidly, from 21.98 in 2015 to 53.73 in 2020 per 100 people, and during the period 2012-2020, computer ownership in households grew about 0.50 percent per year. The paper also examines the use of the internet as an indicator of the adoption of DT and innovation in MSEs. It shows that only a very small number of MSEs use the Internet and do innovation, although the rate varies by region and group of industry.

### **Introduction**

It is undeniable that the emergence of information and communication technology (ICT) or digital technology (DT) has changed many things in our way of life business models and daily business activities. It not only has changed the way businesses communicate with each other or deal with their customers, distributors, and input suppliers but also through digital marketing or e-commerce it has changed the way they promote and sell their products or purchase their raw materials or other needed production inputs. Although a lot of trading is still done offline, in general, digital marketing has now become the trend not only in targeting current but also prospective customers. Most people in many countries (if not in all countries across the world given the fact that in rural areas in many developing countries, people do not have access to the Internet due to poverty or inadequate DT infrastructure) now have daily access to the Internet via computer, laptop, or smartphone. Social media is one of the best channels of online marketing, and Instagram is one of the fastest-growing platforms available today. More and more businesses are eager to establish a strong presence on this network and encourage their prospects' engagement (Balakrishnan and Boorstin, 2017).

The emergence of DT has also created a drastic change in business practices in Indonesia. The most important indicator of the digital economy phenomenon is internet usage. Data from the Indonesian Central Bureau of Statistics (BPS) and the Ministry of Communication and Information (Kemkominfo) internet penetration (IP) in Indonesia grew rapidly from 21.98 in 2015 to 53.73 in 2020 per 100 people. Meanwhile, in terms of IP by households (HHs), 78.17 percent of HHs had access to the Internet in 2020, an increase from 41.98 percent in 2015. HH's computer ownership continues to increase every year. In 2020, the percentage of HHs that owned computers reached 18.83 percent, compared to only 14.86 percent in 2012, although the percentage varied by region. During the period 2012-2020, computer ownership in HHs grew about 0.50 percent per year. This development can undoubtedly encourage the development of internet use in economic and financial activities or the digital economy phenomenon.

The rate of internet penetration in Indonesia was very rapid when the COVID-19 pandemic emerged in the first months of 2020. As a result of government regulations prohibiting people from leaving the house and requiring non-strategic types of businesses to close temporarily, such as entertainment venues, exhibition venues, and companies in the food and beverage industry, apparel industry, and those manufacturing non-basic goods during the crisis have made many people start using the internet. Selling and purchasing with e-marketing systems has suddenly become popular.

Since the pandemic, consumer patterns have begun to change. Usually, people shop traditionally, but now they are starting to shift to shopping digitally, aka online. This is what large e-commerce companies in the country take advantage of. Tokopedia, Lazada, Bukalapak, Shopee, and Blibli admitted that the number of users shopping on their platforms had increased to double than usual. The growing number of buyers shopping on e-commerce has had a big impact on logistics companies. Many logistics companies in Indonesia such as JNE, J&T, SiCepat Express, Pos Indonesia, and others have experienced very significant increases. Since the pandemic, like it or not, the food and beverage sector has been required to have food delivery services. For this reason, food and drink delivery services such as Gojek and Grab are currently widely used by the public. The outbreak of Covid-19 has made many people more concerned about their health. However, in line with this, quite a few people are afraid to go to the hospital. As a result, many people at that time switched to using telemedicine applications such as Halodoc and Alodokter to carry out health consultations. The consultations carried out are not only easy but also offer relatively cheaper costs compared to hospitals.

The emergence of DT also presents a serious challenge to the success of the implementation of the inclusive development strategy as well as the achievement of Sustainable Development Goals (SDGs) in the country. Simply because DT has given birth to new business models that encourage higher economic growth and increase per capita income more rapidly. But the condition is that all business actors and the general public must have full access to the internet or DT.

Unfortunately, the facts show that until now the development of DT in Indonesia is not evenly distributed across regions. The rate of internet penetration is faster on the island of Java, which is also the concentration of the population in Indonesia and the center of national economic and financial activities. Therefore, this chapter also pays special attention to the phenomenon called the 'digital gap' between Western Indonesia and Eastern Indonesia. Also, the implementation of DT in micro, small, and medium enterprises (MSMEs), especially MSEs in Indonesia has been slow. Most MSEs resist using Internet technologies and instead continue to use printed materials to market themselves and use more traditional means to search for information and communicate with others. Many MSEs are unlikely to adopt sophisticated Internet technologies if they are not familiar with more basic ones. But, as for all other companies, MSEs have no other option than to adopt this technology if they want to survive. Sooner or later, MSEs that do not adopt this new technology and business practice will be displaced by their competitors and abandoned by their customers (e.g. Ahmada et al., 2015; Ocha, 2011; Azam and Quaddus, 2009a,b; Barry and Milner, 2002).

This is despite the fact that in the past few years, before the COVID-19 pandemic, the Indonesian government has taken many measures to encourage or support MSMEs to use DT in running their business. The measures include providing training for MSMEs in using such as Facebook, and Instagram, and other applications systems, and creating their websites to

promote and market their goods and services; creating a special web portal (SMESCO Trade) by the Ministry of Cooperatives and Small Medium Enterprise that all MSMEs can use it for marketing their products; and issuing various regulations to provide a sense of security for business actors in using DT such as e-commerce for marketing and internet banking for financial transactions (BI, 2022; Yuniarto, 2022).

Apart from marketing, having access to DT also really supports innovation activities which are really needed by every company, including MSEs to increase their level of competitiveness and to increase and sustain their production. In other words, innovation has become a necessity for all contemporary enterprises that want to survive in a world characterized by competition, technological change, and recurring crises. The concept of innovation refers to the use of new technology or new management practices in an organization to achieve a targeted improvement in its operations (Tornatzky et al., 1990). So, there are no other options than for all MSEs in Indonesia must have full access to new technology including DT, and adopt new/modern management practices not only to survive but to sustain an increasing rate of production growth.

Given the above background, this paper aims to examine the use of the Internet and innovation in MSEs in Indonesia. More specifically, the study aims to address the following three main research questions. First, how many MSEs in Indonesia use the Internet for their businesses? Second, how many MSEs in the country do innovation? Third, what main challenges for the digital transformation and innovation activities in MSEs in Indonesia?

This paper adopts a descriptive analysis that analyzes secondary data. The data was taken from several national surveys conducted by the Indonesian National Statistics Agency, including a survey on the digitalization process and the use of e-commerce in Indonesia and the Micro and Small Industry Profile, as well as census data from the Ministry of Cooperatives and Small and Medium Enterprises.

## Literature Review

### *Digitalization of MSEs and the Use of the Internet*

As the competition faced by MSEs becomes increasingly tight, these enterprises need to use modern technologies, including DT as among their sources of competitive advantages. There are many indications from various sources that in the past decade more and more MSEs utilized DT or adopted e-commerce; although many more MSEs have not (yet) utilized this technology in running their business activities for various reasons. With this development, Internet use, especially e-commerce, among these enterprises has recently become a popular topic for researchers not only in the fields of MSEs but also in electronic business, information management, information systems, and entrepreneurship; though research investigating the adoption of e-commerce by MSEs is still small in number. Some of these studies also made a good summary of the findings from previous studies.

With respect to the main factors that influence the decision of MSMEs to utilize DT or the Internet, articles such as Blackburn and Athayde (2000), Fallon and Moran (2000), Matlay (2000), and Riquelme (2002) conclude that type of business or sector and size and characteristics of enterprises are the most decisive factors for a company to use the Internet. Others such as Poon and Swatman (2005), Chong and Pervan (2007), Shih (2008), Poorangi and Khin (2013), Ahmada, et al. (2015), and Rahayu and Day (2015) mention many factors that have strong influences a company's decision to utilize the internet or to adopt e-

commerce in selling their products, which include perceived relative advantage, organizational compatibility, and benefits; firm owner's or manager's strategic vision; a company's level of innovativeness; DT knowledge, expertise, experience, and willingness of company leaders or managers to use DT as well as to adjust the way they do businesses to the requirements related to the use of DT; business planning; organizational complexity; government policies; availability of skilled labor; software/hardware vendors; and pressures from trading partners, customers, and competitors.

Neale, et al. (2006), Saffu, et al. (2008), Azam and Quaddus (2009b), and Poorangi, et al. (2013) found that besides perceived organizational compatibility, relative advantages and organizational complexity, trialability, observability, and company's culture are also important determinant factors of adopting online marketing, i.e. e-commerce by small businesses. Whereas, studies conducted by such as Migiro (2006), Jones, et al. (2011), and Zaied (2012), reveal that resources, i.e. capital to finance-related costs (e.g. training of employees, organizational change, investment in tools, and others), and human resources, especially technical know-how/expertise; and internet security or trust to use online transactions are the main decisive factors for a company to utilize the Internet in marketing its products and purchasing raw materials.

The World Economic Forum (WEF, 2021) surveyed 85,908 people from six ASEAN countries, predominantly from the youth (77%), which is defined as those aged between 16 and 35. Some 56 percent of respondents were female and 10 percent were business owners. Some 60 percent of people surveyed reported a decline in income and savings during the pandemic, with over 40 percent reporting a significant deterioration. In addition, 68 percent of surveyed MSME owners reported a decline in income. The result shows that 87 percent of surveyed MSME owners see digitalization as being either very important or important for economic recovery. When asked about the benefits brought by digitalization, the majority of MSME owners chose saving time and automating, ease of access to information, and a greater selection of goods and services followed by the ability to generate an alternative income. In general, 43 percent to 66 percent of respondents wanted to increase their level of digitalization in all surveyed aspects of life (e.g., work, entertainment, retail, etc.). For MSMEs owners, the interest was even higher, ranging from 51 percent to 76 percent. The findings also show that MSME owners, in particular, attached great importance to digitalizing finance, with 75 percent wanting more digital payments and over half (53%) of them wanting greater digitalization in lending.

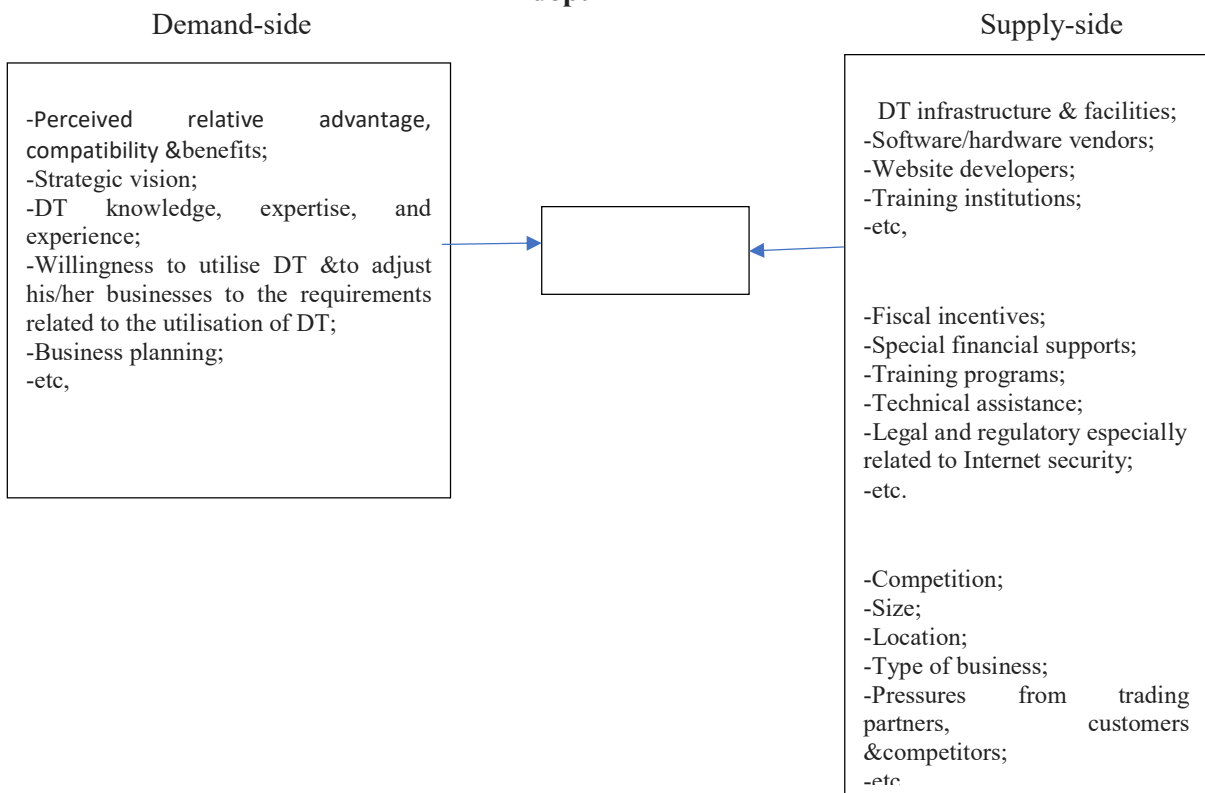
With respect to the benefit of using DT and applications to support their business activities, according to such as Daniel, et al. (2002), Migiro (2006), Lai (2007), Azam and Quaddus (2009a), Hunaiti, et al. (2009), Standing, et al. (2010), Farhad, et al. (2011), and Savrula, et al. (2014), using the Internet provides benefits for companies in various forms such as improves productivity, efficiency, and competitiveness; increases the ability to operate in international markets; provides a tool for providing cost-effective ways to market their products and launch new products; streamlining of business processes; market expansion; and creates value-added, new services and new business models. By using the Internet, a company also improves or accelerates its communications with suppliers, distributors, trading partners, consumers, creditors, and others. It also gathers information and identifies potential business partners, new suppliers, and new customers easier and faster.

Additionally, others such as Neale, et al. (2006), and Poorangi, et al. (2013) found that using the Internet also provides internal and external process integration; makes closer relationships

with customers, suppliers, trading partners, and other important stakeholders; and increases the expertise for growth and development of business.

From discussions in the literature, it can thus be formulated that the willingness or ability of MSMEs to adopt DT is influenced by many factors in a complex combination. These factors can be distinguished between demand-side factors and supply-side factors. Demand-side factors are from the company side so can be considered internal factors. These factors can be distinguished further into two categories, i.e. personal factors from the owner or manager and company factors. The supply-side factors are external factors consisting of supporting factors, policy factors, and market factors. The main important elements of each of these factors are shown in Figure 1.

**Figure 1. Main Factors Affecting Directly the Willingness or Ability of MSEs to Adopt DT**



***Digital Gap in the Development of DT***

However, the literature that examined or discussed these factors does not pay attention to the difference in the degree of internet or DT usage by people and businesses between regions (e.g. countries or provinces within a country). Meanwhile, many other studies that used the concept of the “digital divide” (DD) have examined the gap between individuals, companies, regions, and countries in accessing and using DT. According to Taylor (2023), the digital divide refers to the gap between demographics and regions that have access to modern information and communications technology and those that don’t. Though the term now encompasses the technical and financial ability to utilize available technology—along with access (or a lack of access) to the internet—the gap it refers to is constantly shifting with the development of technology. Important studies on this DD include Viswanathan and Pick (2005), Arendt (2008), Fong (2009), Stiakakis et al (2009), Oliveira and Martins (2010),



Srinuan and Bohlin (2011), Bach et al. (2013), Jacobs (2021), WEF (2020), and Muller and Aguiar (2022).

The DD is nowadays evolving to digital inequality, i.e., the socio-economic disparities inside the 'online population'. Jacobs (2021) explains that DD is not simply the absence of technology, it is a nested form of exclusion that depends on, and cannot be disentangled from, other damaging forms of social and economic inequalities. A prime example is the 'poverty premium' and how the poverty-stricken pay more for data than the wealthy. In South Africa, for example, this 'premium' is charged in two ways. Firstly, prepaid data costs significantly more than post-paid or contract data per megabyte. Secondly, the price of low-volume, small-value bundles - those typically purchased by the impoverished - are more expensive than the discounted high-volume packages usually bought by the affluent. Compounding this premium is the fact that, overall, South Africa has some of the most expensive data on the continent.

As Michael Kende wrote, cited by Muller and Aguiar (2022), the DD is not a binary. Here are some of the things that lead to disparities in Internet access:

- (i) Availability: is there available access to the Internet in your area? Is there a nearby point of connection to the Internet?
- (ii) Affordability: is that access affordable? How does the cost compare to other essential goods? What percentage of your income do you need to pay for access?
- (iii) Quality of service: are the upload and download speeds sufficient for the local needs of Internet users?
- (iv) Relevance: does the connected community have the necessary skills and technologies? Is there local interest and understanding of the relevance of Internet access? Are there locally available mobile apps? Is there content in the local language relevant to the people in the community?
- (v) Additional divides: other areas that can create digital inequality include security, interconnectivity, digital literacy, and access to equipment.

Based on a literature review, Srinuan and Bohlin (2011) showed that DD is a multifaceted phenomenon, due to the many dimensions of determinant factors. Some studies covered by their review have included socio-economic, institutional, and physiological factors to gain a greater understanding of the digital divide.

According to Horrigan (2019), more than 20 million HHs in the United States do not have broadband subscriptions. His analysis of broadband adoption data shows that: (i) the digital divide is more about consumer adoption than it is about network deployment; (ii) the problem extends to non-rural and rural areas alike, and; (iii) household economics is a larger driver of non-adoption decisions than geography. It was found that network development is not the main reason why many HHs do not subscribe to broadband, but because they lack service is either because they cannot get service where they live, or their available options do not offer service at an acceptable speed.

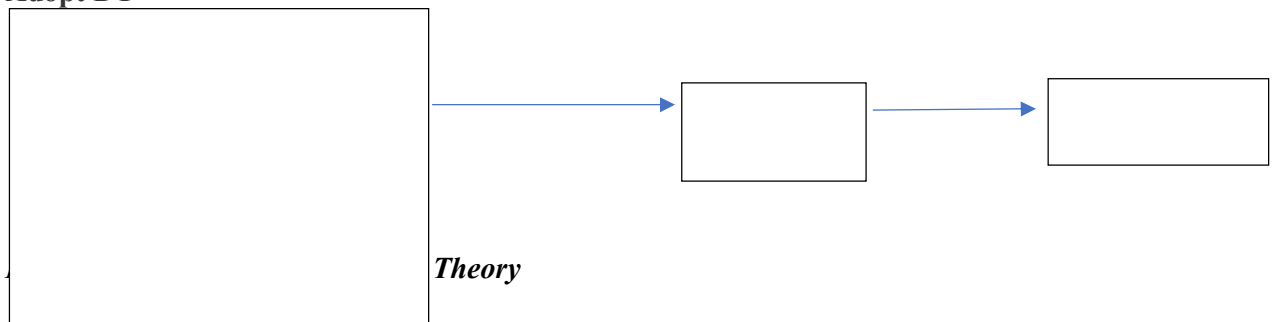
Stiakakis et al (2009) examined two main dimensions of digital inequality, namely 'skills' and 'autonomy' of Internet users. The level of formal education was selected as a representative variable for the skill dimension, as well as the density of the population in different geographical areas as a representative variable for the autonomy dimension. The research was focused on the member states of the European Union (EU). The data, provided by Eurostat, included the daily use of computers for the last three months and the average use

of the Internet at least once per week. The findings indicate that the EU already faces the problem of digital inequality to an extended degree since there are significant disparities among the European countries about the aforementioned variables. Whereas, Fong (2009) assessed the impact of DTs on Gross National Income (GNI) per capita in developing countries using data from 2005. Her regression analysis showed a significant relationship between GNI per capita (in PPP international dollars) and the adoption of each DT (mobile phone, personal computer, and telephone), except for Internet technology.

WEF (2020) found that there are still many areas in the world, especially poor countries, that do not yet have access to the internet. It states *..The COVID-19 crisis has thrown into sharp focus the importance of digital connectivity in daily life. As many countries underwent lockdown periods, digital infrastructure was critical to mitigate the impact of stay-at-home restrictions.....This has enabled the continuation of key activities digitally, such as remote working, healthcare and education, and underpinned the growth of sectors such as e-commerce while supporting adjacent industry players at a critical time. At the same time, the crisis has also exposed even more clearly the gaps that still exist in digital access. When essential services such as health, education or simply being able to continue one’s professional activity depend on connectivity, the inequalities become exacerbated*(page 3).

Thus, to conclude, based on this DD literature, in addition to the factors mentioned in Figure 1, socio-economic factors also play a role in influencing the rate of adoption of DT by MSMEs maybe not directly but through their effects on market development especially market size, structure, and level of competition (Figure 2).

**Figure 2. Socio-economic Factors Affecting Indirectly the Willingness of MSMEs to Adopt DT**



As explained by Yoo (2003), innovation is a process that is collective and iterative in nature and refers to an environment that encourages people to share and play with each other's ideas and promotes the results of innovation in the form of technology, products, or production processes. Innovation has become a necessity for all contemporary enterprises that want to not only stay in business but to have a sustainable high growth rate in a world currently characterized by increasing competition, technological change is not only increasingly rapid but also increasingly complex and sophisticated, and recurring crises. The concept of innovation refers to the use of new technology or new management practices in an organization to achieve a targeted improvement in its operations (Tornatzky et al., 1990).

Brouwer (1997) said that there are three main positive factors that play a major role in the number of innovations developed in a company, namely company size, stable growth in market demand, and research and development (R&D) intensity. However, R&D activities are more intensively carried out in large enterprises (LEs) and to some extent MSEs; whereas in microenterprises (MIEs) there are no R&D activities at all due to limitations in all

supporting resources especially skilled manpower, funds, and advanced technologies. As he explains further, the level of competition between companies in an industry/sector and the entry of new companies with a smaller scale (e.g. MSEs) into the industry concerned causes diffusion of innovation, but does not increase the number of new innovations in the industry. Collaboration between companies in conducting R&D, technology transfer acquisitions, and innovation centers is also crucial to support innovation, especially in small companies. Companies located in urban areas such as large cities and their surroundings have a greater possibility of innovating and the number of innovations produced is also higher than those located in, for example, rural or isolated areas with poor infrastructure connectivity with surrounding cities. Unfortunately, in developing countries like Indonesia, most MSEs are found in rural areas, and this fact may explain the lack of innovation activities in these enterprises.

From a MSME perspective, innovation commonly indicates new products or processes that address customer needs more competitively and profitably than existing ones (O'Regan & Ghobadian, 2006; Zahra et al., 1999). In some literature, the term "innovative practices" is used to refer to the effective implementation of new solutions to challenges faced by MSMEs, which include effective implementation of new ideas in relation to the organization's product, services, or processes; new marketing mechanisms; or new administrative practices for work amelioration and upgraded performance (Damanpour, 1992; Johannessen et al., 2001; OECD/Eurostat, 2005).

The literature from this entrepreneurship and innovation theory emphasizes that MSMEs that carry out an innovation strategy are MSMEs that will be able to make competitive products, which means that MSMEs can continue to survive and even grow rapidly. This new role of MSMEs can also be read from one of the paragraphs of Audretsch's (2003) writing as follows: *Such new SMEs deploying a strategy of innovation to attain competitiveness are apparently engaged in the selection process. Only those SMEs offering a viable product that can be produced efficiently will grow..... The remainder will stagnate,.....may ultimately be forced to exit the industry. Thus, in highly innovative industries, there is a continuing process of the entry of new SMEs into industries* (p. 23).

The key driver of innovation practices in enterprises is the ambition to get reimbursement in the form of better performance. Therefore, innovation is defined as the creation of some modifications in the enterprise's practices that are intended to obtain an improvement in performance such as total sales, profitability, level of competitiveness, market share, and any other strategic goals (e.g. Curristine, 2006; Hult et al., 2004; Chittithaworn et al., 2011, Yıldız et al., 2014; Mahmudova & Kovács, 2018).

There is a large amount of literature supporting the significant positive relationship between innovation activities and MSME performance (Qian & Li, 2003; Rosenbusch et al., 2011; Verhees & Meulenberg, 2004; Yıldız et al., 2014; O'Cass & Sok, 2014; Oura et al., 2016; Zhang, et al., 2018; Zulu-Chisanga et al., 2016; O'Cass & Sok, 2014; Oura et al., 2016; Zhang et al., 2018; and Lin and Chen, 2007).

Clustering is one of the ways to promote innovation by facilitating the sharing information and ideas between firms, attracting buyers and suppliers, and providing opportunities for joint training. Studies on SMEs clusters in many countries, including developed economies, show that the proximity between companies facilitated collaboration and provided a more conducive environment for R&D, and knowledge sharing which can develop a culture of

entrepreneurship and innovation (e.g. Porter, 1998; Porter and Ketels, 2009; Rosenfeld, 1997; Schmitz, 1999; Tambunan, 2008; and Vargas-Hernández, 2020)

In addition to innovation, the level of entrepreneurship or entrepreneurial orientation (OK) is also very important for the growth of a company. There is no doubt that OK has a positive effect on innovation activities within a company. In much of the literature, OK is considered one of the main resources that facilitates organizations or companies to seek new ways to increase revenue streams, increase chances of success in international markets and effectively utilize organizational resources (among others, Covin et al., 2006; Kraus et al. 2012; Hussain et al., 2017). Hussain et al. (2017), for example, empirically investigated the effect of OK on MSME performance by conducting a survey with a questionnaire of 213 MSMEs in the manufacturing sector. The findings of this study reveal that performance organization or company and OK are positively related to each other.

Altinay et al. (2016) conducted a study on 500 MSMEs in the service and retail sectors belonging to North Cyprus and found a positive influence of OK on sales volume and market share growth. In the same vein, Roxas et al. (2017) in their study of 197 small businesses in the Philippines reported that OK enabled companies to develop a more proactive attitude towards environmental sustainability practices which in turn resulted in their greater performance. Another study was conducted by Rauch et al. (2009) who after conducting a meta-analysis of the relationship between OK and business performance in 51 articles found a significant and positive relationship between OK and company/organizational performance. Wiklund and Shepherd (2005) in their research on 808 Swedish companies by focusing on four main sectors namely labor-intensive manufacturing, knowledge-intensive manufacturing, retail, and professional services show that OK (innovation, proactivity, and risk-taking) significantly and positively influence the performance of MSMEs. The findings of research conducted by Eggers et al. (2013) on 660 MSMEs in Austria found that OK is positively related to MSME growth. However, some studies, for example, Lumpkin and Dess (1996), Rauch et al. (2009), and Hakala (2013) highlight that the effect of OK on organizational performance can vary depending on the types of performance measures used in the research and the differences in the contexts in which the research is investigated. For example, Swierczek and Ha (2003) found only a partial positive relationship between OK and firm/business performance. Kreizer et al. (2013) highlighted that the relationship between OK and firm performance is non-linear.

In a study conducted by Tsang (2002) of Chinese family companies in many countries, he observed that an important element of proactive companies was the visionary and practical steps taken by their owners or leaders who aggressively seek market resources and opportunities, including international markets. A company owner or leader who has a vision of the future direction and is able to take advantage of business opportunities has a close relationship with OK.

## **Development of Digital Economy**

Long before the COVID-19 pandemic emerged, Indonesia had started to build a digital economy at an increasingly rapid pace every year in line with advances in ICT and the increasingly widespread use of this technology in society. However, with the emergence of COVID-19 and the policy of not leaving the house as well as the implementation of various restrictions on face-to-face activities in order to prevent the spread of the virus on the one

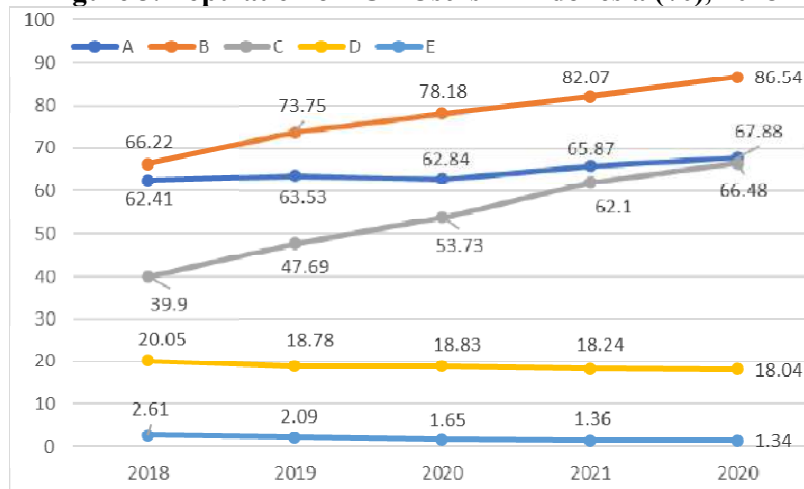
hand, and, on the other hand, the public's need to communicate and access various information is increasing, making the need for ICT even greater. inevitable, and encourage the process of transforming the national economy towards a digital economy even more rapidly.

The demand for various activities to be carried out without face-to-face during COVID-19 has also made cell phones an important tool in people's lives. This is because cell phones are needed as a means of communication and adaptation to the "New COVID-19 normal" life. On the other hand, along with the increase in the use of cell phones which are easier, cheaper, and more flexible, the use of fixed-line telephones in households is increasingly being abandoned. Computer ownership has been relatively stable in recent years.

As shown in Figure 3, in the last five years, the use of ICT in Indonesia has shown rapid development. The most rapid development of ICT indicators can be seen in internet use in communities or HHs. The population using the internet has increased during the 2018-2022 period, which is shown by the increase in the percentage of the population accessing the internet in 2018 from around 39.90 percent to 66.48 percent in 2022. Meanwhile, in HHs, it was recorded at 86.54 percent. in 2022, up from 78.18 percent in the first year of the pandemic. A year before the outbreak of COVID-19, it was recorded that only around 73.75 percent of the number of HHs used the internet.

The growth in internet use in the community or HHs is also followed by the growth in the population who have cell phones, which in 2022 will reach 67.88 percent, an increase of around 6.9 percent compared to the year before the outbreak of the pandemic which was recorded at only around 63.5 percent.

**Figure 3. Population of ICT Users in Indonesia (%), 2018 – 2022**



Note: A: residents who have mobile phones, B: households (HHs) that access the internet, C: people who access the internet; D: HHs who own computers; E: HHs who have fixed cable telephones

Source: BPS (2022a).

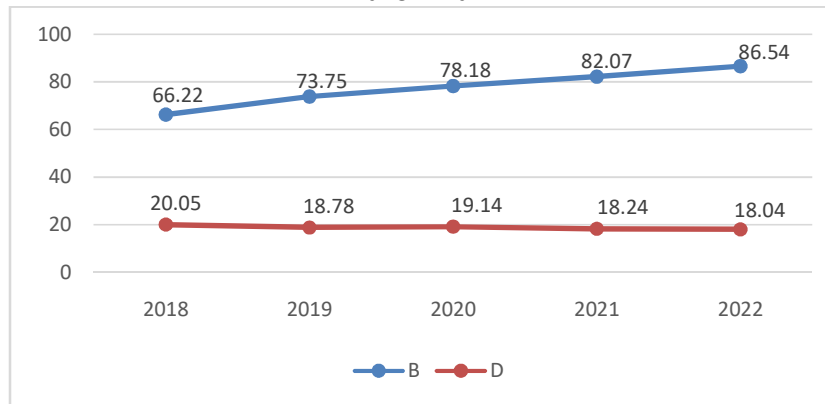
The increasing percentage of the population accessing the internet is occurring in all regions in Indonesia. The highest percentage of internet access is in DKI Jakarta Province with a value of around 85.55 percent in 2021 and 84.65 percent in 2022. Meanwhile, the lowest percentage is in Papua Province in 2021 with a value of around 26.49 percent, and in 2022 with a value of around 26.32 percent. In terms of facility availability, internet access can be

done from inside the house using a landline and cellular telephone network, or access from outside the house such as the office, school, internet cafe, or other places.

The internet is used for various activities, accessed in various places, and uses various access media. The highest activities carried out by Indonesian people include obtaining information/news, social media, and entertainment. The internet is most often accessed via cell phone, while the highest access is done at home.

Next, Figure 4 shows that the growth of HHs who own/control computers is very different from HHs who access the internet. HHs who access the internet continue to experience a fairly high increase compared to the increase in HHs who own/control computers. This is caused by increasingly easy internet access through various media such as wireless fidelity technology (Wi-Fi, otherwise known as hotspots), facilities in offices/schools, and even via mobile phones.

**Figure 4. Percentage of Households Who Own a Computer and Access the Internet, 2018—2022**



Note: B & D: see note in Figure 3

Source: BPS (2022a)

ICT has an important role in the Indonesian economy. In the period 2018 to 2022, exports of ICT goods have grown by 47.65 percent, while imports of ICT goods have grown by 26.82 percent. This shows a positive condition that in the last five years, Indonesia's ability to send ICT goods abroad has been faster than bringing in ICT goods from abroad to meet domestic needs. In terms of Gross Domestic Product (GDP), in the last five years, it has been recorded that the information and communication sector has always grown above six percent. During the recovery period in 2022, the growth rate of the information and communication sector will reach 7.74 percent, or the fourth fastest after the transportation sector, the food and drink accommodation sector, and other service sectors. To meet communication needs in Indonesia, telecommunications operating companies are increasing from year to year. The number of Internet Service Provider (ISP) companies in 2022 will be 828 companies, whereas in 2021 there will only be 611 companies. In terms of telecommunications providers, in 2022 there will be 1,615 companies consisting of operators of fixed networks, mobile networks, telecommunications services, and special telecommunications (BPS, 2022a).

As time goes by, information and communication have become important sectors in the Indonesian economy. This sector includes 1) publishing activities; 2) moving image, video, and television program production activities, sound recording, and music publishing; 3) broadcasting and programming activities; 4) telecommunications; 5) programming activities,



computer consulting, and YBDI activities, and 6) information service activities. In the last five years, it has been recorded that this sector has always grown above six percent.

In 2018, growth in the information and communications sector reached 7.02 percent. This growth rate continued to increase until it reached 10.61 percent in 2020. However, the COVID-19 conditions in 2021 got worse so this sector slowed down to 6.82 percent. During the recovery period in 2022, the rate of the information and communication sector will increase again, namely to 7.74 percent, or the fourth fastest after the transportation sector, the food and drink accommodation sector, and other service sectors.

Furthermore, it can also be seen that the contribution of the information and communication sector to GDP has remained below five percent in the last five years. From 2018 to 2020, this contribution has increased. However, in 2021 and 2022, this contribution will decrease further to 4.15 percent. The highest contribution was made by the trade, processing industry, and agriculture sectors.

Meanwhile, the results of a survey of 7568 respondents in 34 provisions in January-February 2022 from the Association of Indonesian Internet Service Providers (AJII) published in June 2022 (Yuniarto, 2022) revealed that the number of people connected to the internet in 2021-2022 was 210 million from Indonesia's total population has reached 272 million at the beginning of 2022. Internet penetration rate increased significantly from 64.8 percent in 2018 to 73.7 percent in 2019-2020, and 77.02 percent in early 2022. The survey results also show that people are connected to the internet in various ways. The majority of the population uses cellular data (77.64 percent), Wi-Fi connection at home (20.61 percent), Wi-Fi connection at work and school (0.61 percent), public space Wi-Fi (0.96 percent), and other means (0.18 percent). In terms of devices used to access the internet, 89.03 percent use smartphones or gadgets, 0.73 percent use laptops or desktops, and 10.24 percent of the total respondents use both computers and gadgets (BPS, 2022a).

The e-commerce phenomenon is probably the most important indicator of the development of the digital economy. The history of the development of e-commerce in Indonesia cannot be separated from the development of the Internet in this country. The Internet began to penetrate Indonesia in the 1990s but only started to be freely used by the public in the 2000s. In that year, online shops began to appear that sold various kinds of products. Developments at that time made many people start to realize that they could make money by trading via the Internet. In the 2005 era, eCommerce began to boom, with the emergence of many marketplaces and online stores that offered systems that were safer and easier to use. The development of social media also drives the development of e-commerce. One of them is the advertising feature provided by social media, such as Instagram and Facebook (BPS, 2022b).

The development of e-commerce usage in Indonesia is illustrated by the results of the 2022 e-commerce Survey from BPS (the scope of the 2022 eCommerce Survey is businesses that use the internet to receive orders or sell goods and/or services during 2021) which shows the number of e-commerce businesses in Indonesia in 2021 is 2,868,178 attempts. Meanwhile, in the previous year, namely 2020, there were 2,361,423 e-commerce businesses in Indonesia. In percentage terms, as of September 15, 2022, only 34.10 percent of businesses were carrying out e-commerce activities, compared to 32.23 percent as of December 1, 2021. This shows that businesses accepting orders or selling goods/services via the Internet in Indonesia are still relatively low and still dominated by conventional types of business (BPS, 2022b).

Another piece of information obtained from the 2022 e-commerce Survey is business distribution. Similar to last year's survey results, e-commerce businesses are still concentrated on the island of Java. In 2021, of the 2,868,178 e-commerce businesses, 1,497,655 businesses (52.22 percent) were located on the most populous island in Indonesia. This is understandable considering that the largest market share, production centers, and adequate internet connection supporting infrastructure are located on the island of Java (Figure 5).

**Figure 5. Map of e-commerce Business Distribution, 2021**



Source: Figure 2 di BPS (2022b, page 10).

### Adoption of the Internet by MSEs

Table 1 shows the number of MSMEs was nearly 61.7 million companies which is approximately 99 percent of the total business units in Indonesia in 2016 and the number increased to slightly more than 65 million in 2019. The MSEs are dominant in the MSME sector with approximately 99 percent. This means the discussion of Indonesian MSMEs is usually concerning MSEs.

**Table 1. Number of MSMEs in All Sectors and Their Workers by Sub-Category in Indonesia, 2016-2019**

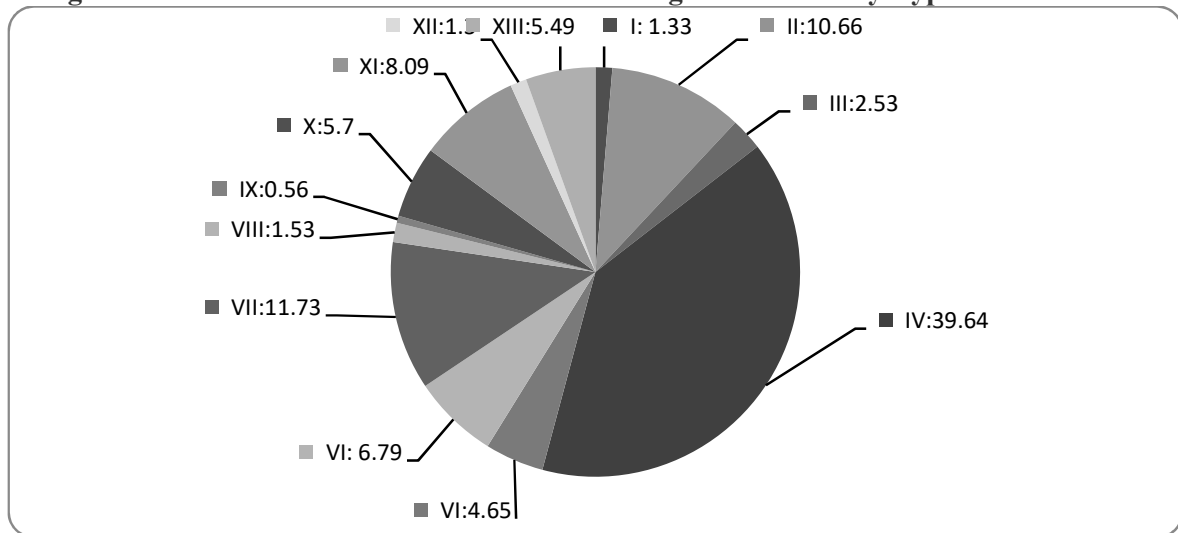
Description	unit of measure	2016		2018		2019	
		Total	Share (%)	Total	Share (%)	Total	Share (%)
MSMEs	Unit	61,651,177	99.99	64,194,057	99.99	65,465,497	99.99
-MIEs		60,863,578	98.71	63,350,222	98.68	64,601,352	
-SEs		731,047	1.19	783,132	1.22	798,679	98.67
-MEs		56,551	0.09	60,702	0.09	65,465	1.22
LEs		5,370	0.01	5,550	0.01	5,637	0.10
							0.01
Total companies		61,656,547	100.00	64,199,607	100,00	65,471,134	100.00

Notes: MSMEs=micro, small and medium enterprises; MIEs = microenterprises; SEs = small enterprises; MEs = medium enterprises; LEs = large enterprises

Source: Menegkop& UKM (<http://www.depkop.go.id/>)

Not all MSEs use the Internet for their business activities. The 2016 Economic Census shows that the types of businesses that most MSEs utilize the Internet are retail trade and car and motorcycle repair and care services with around 39.64 percent (Figure 6). Especially in the retail trade, the use of online transactions by both consumers (buying) and producers (selling) in Indonesia has grown tremendously in recent years. This development is also encouraging or even forcing more and more MSEs in this sector to use the internet, both in the form of using existing marketing websites and creating their own websites. Other types of businesses that are also run by many MSEs by utilizing the internet are information and communication with 11.73 percent, manufacturing industry with 10.66 percent, and education with 8.09 percent. Meanwhile, the least types of businesses carried out by MSEs that utilize the Internet are real estate business and human health and social activities. Only about 0.56 percent of total MSEs in the real estate sector utilize the Internet, and in human health and social activities, it is only 1.30 percent. The low percentages do not show low internet utilization rates of MSEs in these two sectors but mainly because of the low number of MSEs in both categories of businesses, especially when compared to the number of MSEs in the trade sector.

**Figure 6. Distribution of MSEs in Indonesia Using the Internet by Type of Business**



Notes: I: Mining and quarrying; procurement of electricity, gas, and drinking water; water management, wastewater management, waste management recycling, and remediation activities; II: manufacturing industry; III: construction; IV: retail trade, and car and motorcycle repair and maintenance; V: transportation and warehouse; VI: accommodation and food and beverages; VII: information and communication; VIII: finance and insurance; IX: real estate; X: business services; XII: education; healthcare and social activities; XIII: other services.

Source: BPS (2017a).

From their survey finding of more than 200 owners/managers of MSMEs, Rahayua and Daya (2015) conclude that the adoption of e-commerce by MSMEs is affected by several factors which include perceived benefits, technology readiness, owners' innovativeness, owners' DT experience, and owners' DT ability. Their findings also show that individual factors play a significant role in the adoption of e-commerce technology by MSMEs in Indonesia. In their study, MSMEs refer to a business that has less than 100 employees, assets less than 10 billion rupiah, and total sales per year below 50 billion rupiahs. Based on their finding,

Media Indonesia, a newspaper, discussed several research reports from various research institutes in Jakarta regarding the penetration of DT in MSMEs. Deloitte Access Economics, among the reports, shows that around 36 percent of MSMEs in Indonesia still use conventional marketing methods and only 18% of MSMEs can use social media and websites to promote their products. According to this report, low technological knowledge and an unskilled workforce are considered obstacles to digitizing MSMEs. The Center for Indonesian Policy Studies (CIPS) shows that as many as 37 percent of MSMEs are recorded as only being able to operate computers and the internet simply. The report confirms that digitalization can be accelerated if the competent authorities work together to provide and ensure sustainable and affordable internet connectivity. Meanwhile, the Danareksa Research Institute shows that around 41.67 percent of MSMEs in DKI Jakarta are already using social media and digital marketing in their activities—business operations. Meanwhile, only 29.18 percent of MSMEs on Java Island and 16.16 percent of MSMEs outside Java Island have utilized digital marketing (<https://mediaindonesia.com/ekonomi/403910/literasi-digital-umkm-jadi-kendala-dalam-transformasidigital>).

According to data from APJII (Yuniarto, 2022), the use of the Internet by MSMEs to support their business activities is quite high, reaching 87.4 percent. Most of the MSME owners interviewed (73.4 percent) stated that they had used the Internet for more than 2 years. As many as 85 percent of them stated that they are very dependent on the internet or it can be said that the internet is very useful for the smoothness and sustainability of their business. Furthermore, 73.4 percent of them also have sales accounts at local marketplaces such as Tokopedia and Shopee, to market their products. In addition to taking advantage of the existence of marketplaces, the majority of them (84.75 percent) use social media for marketing.

From the government side, according to Julianto (2016), there are various obstacles faced by the Indonesian government, in this case, the State Ministry of Cooperative and Small Medium Enterprise) in encouraging MSEs owners to utilize DT. The obstacles include their low understanding of this kind of technology, their mindset which is not in favor of using the Internet in doing their business, and their lack of knowledge on how to operate this technology. Especially MSEs located in rather isolated/rural areas; many of them are unfamiliar with the online marketing system. Therefore, they prefer to do marketing with conventional methods, by utilizing the distribution networks that they have been using for a long time or involving many distributors who have long been their customers.

The same fact is also shown by the findings from the 2021 national survey that of all businesses that do not carry out e-commerce activities in 2020, most of them (73.07%) said that it is more convenient to sell directly (offline), which is. Around 17.55 percent said they lack knowledge or expertise; 33.47 percent are not interested in selling online; and the remaining 8.40 percent for various other reasons (BPS, 2021).

Based on the results of the eCommerce Survey, most e-commerce business actors in Indonesia have the following main characteristics: (i) the majority use instant messaging and social media as sales media; (ii) total and e-commerce revenue value below 300 million IDR; (iii) the most frequently used payment method is Cash on Delivery (COD) or cash payment. Some important information related to the results of the 2022 eCommerce Survey is as follows (BPS, 2022b):

- 1) based on data collection ending on September 15, 2022, only 34.10 percent of businesses carry out e-commerce;

- 2) activities. This identifies that business in Indonesia is still dominated by conventional types of business;
- 3) the majority of people in charge/e-commerce business owners are in the range of 35-44 years (34.47- percent). This phenomenon shows that the person in charge/owner of the eCommerce business is a member of the millennial generation who interacts a lot with the rapid development of technology, including e-commerce;
- 4) businesses belonging to category G (wholesale and retail trade, repair and maintenance of cars and motorbikes) dominate e-commerce activities, with a percentage of 39.10 percent;
- 5) almost half or 49.82 percent of businesses immediately carry out e-commerce activities when they first start operating. Then as many as 23.48 percent of new businesses started e-commerce activities more than 5 years after operational activities began;
- 6) there are 20.64 percent of e-commerce businesses carry out promotions and/or sales/purchases through the marketplace, while the rest use websites, email, instant messaging, and social media as promotional media and/or online sales/purchases. In businesses that do not use a marketplace, 93.98 percent of businesses use instant messaging as a promotional medium and/or online sales/purchase; and
- 7) the main obstacle experienced in carrying out e-commerce business activities during 2021 is dominated by the lack of demand for goods and services (37.65 percent).

Of all businesses that will not carry out e-commerce activities in 2021, as many as 71.00 percent said they are more comfortable selling directly (offline). Other reasons are not interested in selling online, lack of knowledge or expertise, concerns about security, and so on. In general, the data collection results show that e-commerce business actors in Indonesia have the following characteristics (BPS, 2022b, page 10):

- (i) the majority use instant messaging and social media as sales media;
- (ii) the majority of the person in charge/business owner's education is in high school;
- (iii) total revenue value and eCommerce revenue value below 300 million rupiah;
- (iv) the majority of businesses do not have financial reports;
- (v) the payment method most frequently used is cash or Cash on Delivery (COD);

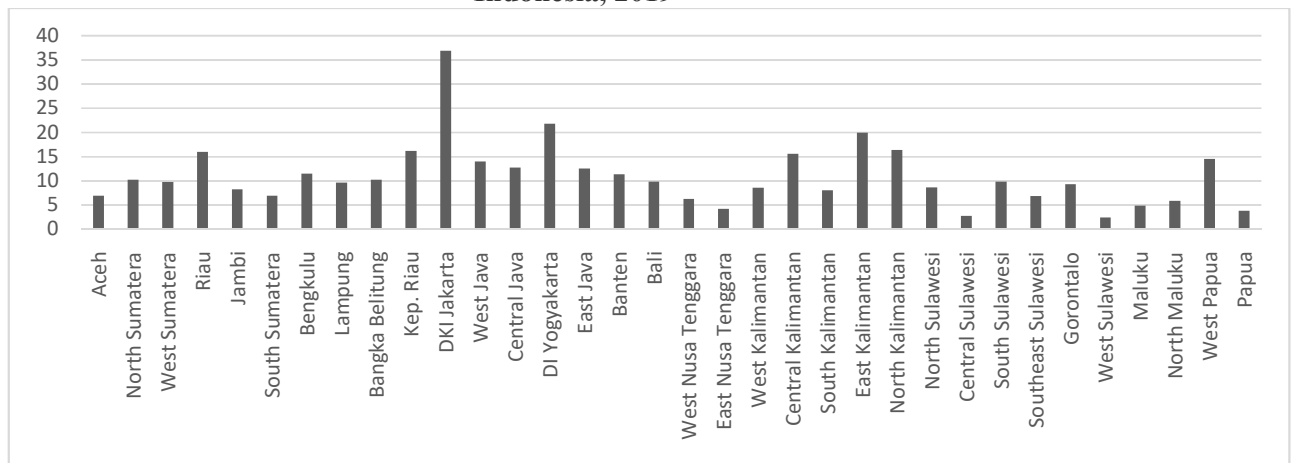
E-commerce activities are not only carried out by businesses included in the trade category. However, almost half of all businesses (39.10 percent) are dominated by businesses included in Category G (Wholesale and Retail Trade, Repair and Maintenance of Cars and Motorbikes). The second largest eCommerce business activity (19.98 percent) is from Category I (Providing Accommodation and Providing Food and Drink). Meanwhile, businesses included in Category C (Processing Industry) with a percentage of 17.18 percent, are the third largest eCommerce businesses based on the results of the 2022 eCommerce Survey.

Based on the results of the same survey, every year there is an increase in the number of new businesses operating and immediately going online. It was recorded that 51.47 percent of new businesses started operating in the period 2017 - 2020. As many as 29.23 percent of businesses had started their business in the period 2010 - 2016, and only 19.30 percent of businesses had been operating for more than ten years. Comparing the year they started operating with the year they started carrying out e-commerce activities, reveals an interesting phenomenon 49.82 percent of businesses immediately carried out e-commerce activities when they first started operating. As many as 14.76 percent of new businesses started e-commerce activities 1-2 years after operating, 11.94 percent of new businesses started e-commerce activities after operating 3-5 years, and 23.48 percent of new businesses started e-commerce activities more than 5 years after opening. business operational activities.

Another interesting finding is from the 2019 national survey data on MSEs in the manufacturing industry, which indicates the distribution of MSEs using the Internet varies by province in the country. Most MSEs that utilize the Internet for businesses are located on Java Island, the most developed and populated region in the country. Provinces in Java with the highest proportion of manufacturing MSEs using the internet are Central Java with around 22.22 percent of all manufacturing MSEs using the internet in Indonesia, followed by East Java and West Java with, respectively 20.70 percent and 16.92 percent. Outside Java Island, especially in the eastern region, the percentage is much lower. For instance, in Papua only 0.1 percent, the lowest (BPS, 2019).

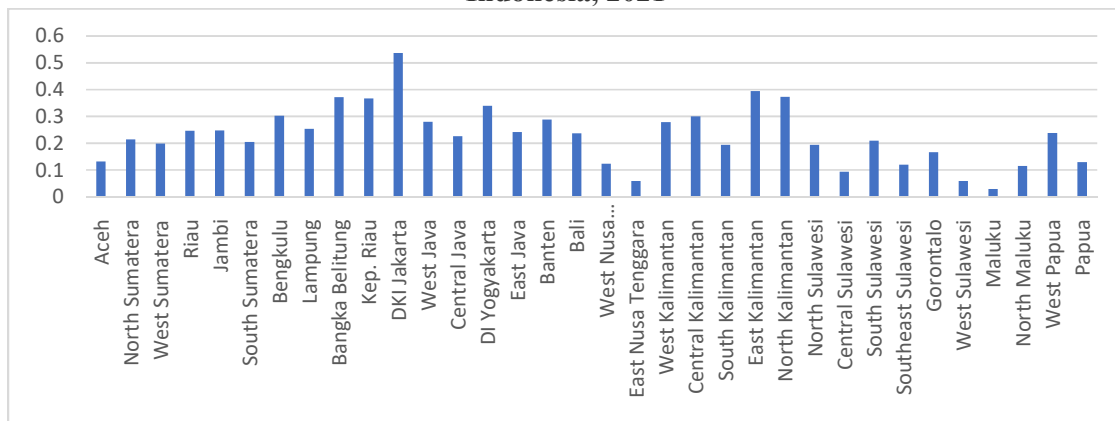
Further, Figures 7, 8, and 9 show the percentage of total MSEs that use the internet per province in 2019, 2021, and 2022. As can be seen, almost all provinces experienced a fairly large increase during that period. In Java, the province with the highest percentage of MSEs that use the internet is DKI Jakarta, the Capital of Indonesia at nearly 60 percent in 2022, which increased from below 40 percent in 2019. In second place is DKI Jakarta, the Capital city of Indonesia, with almost 40 percent, followed by the province of East Kalimantan at almost 50 percent in 2022 from around 20 percent in 2019.

**Figure 7. Percentage of Manufacturing MSEs using the Internet per province, Indonesia, 2019**



Source: BPS (2019b).

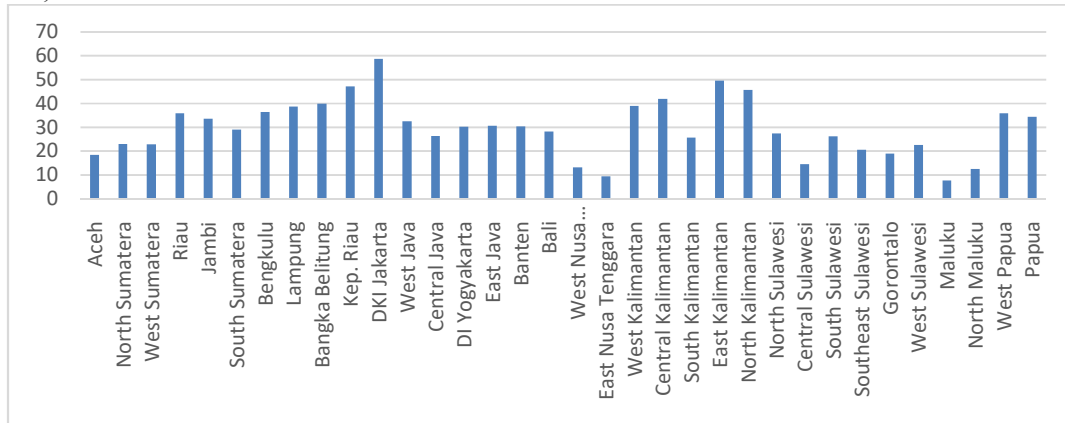
**Figure 8. Percentage of Manufacturing MSEs using the Internet per province, Indonesia, 2021**



Source: BPS (2023b).



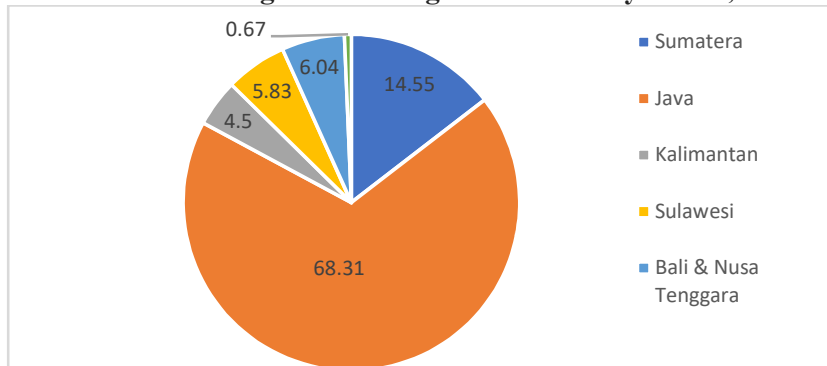
**Figure 9. Percentage of Manufacturing MSEs using the Internet per province, Indonesia, 2022**



Source: BPS (2022).

Next, Figure 10 shows the distribution of MSIs using the internet by the island. As can be seen, most MSIs that utilize the internet for businesses are located in Java Island, the most developed and populated region in the country, namely at 68.3% compared to 72.49% in 2020.

**Figure 10 Manufacturing MSEs Using the Internet by Island, 2021**



Source: BP (2023b).

Of course, factors such as income per capita, level of economic development, technical skills of workers, ICT knowledge and experience of business owners/managers, security, and ICT infrastructure are very influential on the managers or business owners to use the Internet in running their businesses, the type of business is also very important. Or it is more important than those factors because today many types of businesses must use the Internet or require online transactions or the advantages of using the Internet are felt directly by the company (e.g. very low-cost promotion activities). The types of businesses that fall into this category include travel agencies, hotels, rental services, bookstores, fashion, and online transport.

Finally, Table 2, reveals that in 2021 only around 22.89 percent of total MSEs in the manufacturing industry use the Internet, and this increased to 27.97 percent in 2022, although the percentage varies by group of industry. The highest percentage is found in publishing, printing, and reproduction of recording media at almost 80 percent; followed by MSEs in industries manufacturing computers, electronic and optical goods at around 73.40 percent.

There are four main purposes for using the internet according to this report, namely for advertising/promotion, product marketing, purchasing raw materials, and seeking information on such as government regulations, new machines and production tools, and cheaper raw materials. It reveals that most of the MSEs that use the internet use it mainly for product marketing (75.0%), and the types of platforms used are dominated by instant messaging, followed by media social, marketplace, e-mail, situs web, and e-katalog. What is even more interesting from this table is that the number of MSEs using the internet has increased significantly both in total and per industry group when compared to 2017 data.

**Table 2. Percentage of MSEs in the Manufacturing Industry Using the Internet by Group of Industry**

ISIC	Group of industry	2017	2019	2021	2022
10	Food	4.85	9.39	21.4	27.41
11	Drinks	5.82	13.72	29.1	38.55
12	Tobacco processing	1.05	5.27	9.9	12.76
13	Textile,	6.83	9.60	15.3	15.41
14	Apparel	12.95	20.40	32.4	38.33
15	Leather, leather goods, and footwear	15.72	18.84	33.2	38.03
16	Wood and articles of wood and cork (excluding furniture), plaited goods of rattan, bamboo, and the like	3.10	5.84	13.0	16.41
17	Paper, paper items, and the like	17.84	16.78	28.5	42.48
18	Publishing, printing, and reproduction of recording media	51.06	63.21	71.9	79.90
20	Chemicals and chemicals	4.05	4.54	10.0	16.08
21	Pharmacy, chemical drug products, and traditional medicine	8.70	18.21	38.8	38.22
22	Rubber, rubber, and plastic goods	13.0	30.08	50.0	55.50
23	Non-metal excavation	4.84	7.44	20.9	33.02
24	Base metal	9.77	4.54	9.6	7.05
25	Metal goods, not machines and equipment	16.63	27.66	39.8	49.95
26	Computers, electronic and optical goods	28.81	60.10	33.8	73.40
27	Electrical equipment	11.57	32.68	46.7	30.58
28	YTD machines and equipment (which are not included)	22.77	22.50	34.8	54.33
29	Motorized vehicles, trailers, and semi-trailers	23.07	22.73	70.4	65.22
30	Other transportation equipment	26.94	14.41	25.8	37.14
31	Furniture	13.76	23.26	40.4	49.39
32	Other processing	6.71	11.55	24.3	19.56
33	Repair and installation services for machines and equipment	6.89	29.15	41.4	44.37
	Total	7.38	11.94	22.89	27.97

Note: \* Standard Classification of Indonesian Business Fields.

Source: BPS (2017b, 2019b, 2021, 2022)

Marketing/sales of products/services dominate MSEs' business objectives in the manufacturing industry in utilizing the Internet and in 2022 the number reaches 41.62 percent. Apart from that, the use of the Internet as a means of promotion/advertising reached 26.72 percent. The use of the Internet to buy raw materials and to find information was 21 percent and 10.15 percent respectively. Meanwhile, only 0.41 percent use the Internet as a means to make fintech loans (BPS, 2022).

### Innovation in MSEs in the Manufacturing Industry

Innovation is recognized as an important driver of productivity growth, which in turn contributes more to

economic growth and competitiveness at the enterprise level. Over the years, the character of innovation has changed with companies increasingly looking beyond R&D investments to product, process, organizational, and marketing innovation. Based on empirical evidence at the firm level, namely the relationship between productivity and R&D, an extensive literature has established that the relationship between innovation and productivity at the firm level is generally positive and significant. Existing evidence shows that in developing countries innovation is often implemented in large and medium-sized companies. This appears to be in line with evidence found in a number of ASEAN countries showing product innovation is less common in MSEs (OECD, 2021). Informality may also play an important role in this: the informal sector typically consists of MSEs that innovate less and/or whose innovation, for the most part, tends to remain localized and small-scale. Furthermore, firms in developing countries, especially MSEs, may have less incentive to invest in innovation because of institutional barriers (access to credit, corruption, poor intellectual property rights) and because of weak control of current technologies (Bartz et al., 2016).

Although the use of the Internet is important for innovation, in Indonesia the number of manufacturing MSEs using the Internet is very small. As shown in Table 2, only about 28 percent out of a total of 4,339,228 MSEs in the sector in 2022. It can be generally expected that the low level of internet utilization by manufacturing MSEs is one of the reasons of the fact that only a small number of MSEs in this sector are innovating. Through the internet, owners or workers at MSEs can get ideas for innovation. Also, via the internet, MSE players can get information on sources of innovation, such as the latest technology, potential partners to work with, and current market conditions to determine the suitable form of innovation to be carried out.

Survey results from BPS in 2022 show that only 357,477 units, or 8.2 percent, are carrying out innovation. Furthermore, as can be seen in Table 3, there are three main forms of innovation: product, marketing or/and distribution, and technology or production process. Many MSEs carry out more than one form of innovation, and product innovation is the most frequently carried out form of innovation, reaching 278,213 MSEs, followed by marketing or distribution innovation, namely 131,974 MSEs, and 89,291 MSEs innovated production processes. However, as can be seen in Table 3, the number of MSEs undertaking certain forms of innovation varies by industry group.

**Table 3. Number of Manufacturing MSEs Doing Innovation by Form of Innovation, 2022**

ISIC	Form of Innovation			
	Product	Marketing/Distribution	Technology/Production Process	Others
10	85928	49222	22029	1218
11	3141	4385	3109	90
12	2157	2627	5045	-
13	11343	5664	2191	179
14	63948	22774	163433	1590
15	9181	4011	1797	212
16	34263	10316	5463	4309
17	420	269	253	-
18	6825	3673	3599	135
20	438	989	406	5
21	1200	1005	640	4
22	548	330	170	-
23	6092	5894	4484	40
24	89	6	-	-

25	18094	7104	5461	379
26	166	53	61	-
27	215	169	21	-
28	607	460	455	-
29	263	23	128	-
30	895	713	249	7
31	17344	6329	5313	169
32	14542	5793	11928	476
33	514	165	146	10
Total	278213	131974	89291	8823

Source: BPS (2022).

There are many factors that cause only a few MSEs in the manufacturing industry to be able to innovate. Among others are:

- 1) investment in tangible capital. New investment in tangible capital such as machinery, equipment, buildings, etc. helps improve the ability of MSEs to perform research and development (R&D) and hence innovation. The MSEs' ability to invest in new materials and equipment is largely – although not exclusively – shaped by their financial possibilities. Overall, MSMEs in both developed and developing countries often face more challenges with tight financing opportunities than LEs. In many middle and low-income countries, funding gaps and barriers to the formalization of small businesses are two serious problems related to MSME development. Limited access to finance for MSMEs, especially MSEs, is more serious in developing countries than in developed countries because in the first group of countries financial resources are usually very limited. Also in the ASEAN region, for instance, investing in tangible capital is lower in MSMEs than in LEs (OECD, 2021).
- 2) the role of intangible investment. While investing in tangible capital already poses a challenge for MSMEs, investing in intangible capital poses additional problems. Investment in intangible capital or knowledge-based capital (KBC) has grown rapidly in many countries, usually at a faster pace than investment in tangible capital (OECD, 2021). KBC refers to R&D, software and data, intellectual property, brand equity, company-specific skills, and organizational knowledge. Investment in intangible capital, often embodied in the company's organization, directly increases the "knowledge of doing business" and thus the productivity of the company. In addition, intangible assets are important for companies to differentiate themselves from other companies, thereby enabling them to target market niches and increase profit margins. A report from the OECD (2021) shows a negative relationship between firm size and investment in intangible capital in ASEAN;
- 3) human resource (HR) talent and skills – namely the knowledge and skills embodied in workers – are important determinants of innovation at the enterprise level. First, skilled people generate knowledge that can be used to create and implement innovations. Second, certain types of KBC are a direct result of HR: for example, software is the translation of human expertise into code. Third, the ability of companies to identify new value technologies and integrate them into their own production processes – often called uptake capacity – is directly related to the skills of their employees. Workers with higher levels of human capital are more adaptable to technological change, making it easier for firms to adopt and reorganize around emerging technologies (Bartel et al., 2004). Furthermore, HR complements other inputs in the production process, including capital investment (OECD, 2021). However, developing or acquiring the right combination of skills, ideas and talent is often a challenge for companies, especially SMEs, especially in markets where the skills required are scarce or expensive. Evidence shows that workers in MSEs tend to have lower cognitive skills (including literacy, numeracy, and problem-solving skills) than those in large enterprises (OECD, 2021); and
- 4) the role of management. Recent research is increasingly establishing a strong correlation between management quality and firm productivity. Management in the company is directly

responsible for decisions about production inputs and outputs, which can be expected to affect productivity. Poor management skills usually correlate with inefficient use of labor, higher frequency of wastage and damage to tools, machines, raw materials, and inputs, and overall ineffective use of the production floor (OECD, 2021). Likewise, poor management, which does not have a vision for the future, does not have an entrepreneurial spirit, and does not understand the dynamics of business with increasingly fierce competition that is currently taking place, will worsen the company's ability to innovate.

## **Challenges Facing Indonesia**

### ***MSMEs' Challenges***

As the market competition becomes increasingly tight, business actors need to use modern technologies, including DT as among their key sources of competitive advantages. The presence of DT provides a huge market opportunity for every company, including MSMEs, who take advantage of it. In Indonesia, although the need to have DT is also apparent, there are still many companies, especially MSEs, that do not adopt this technology. For larger enterprises with ample human and financial resources, the adoption of DT may not be a significant problem. But, for MSEs facing resource limitations, including lack of funds, skill, and knowledge of its benefits, DT adoption becomes a problem. Most MSEs do not consider DT as a strategic issue but rather use it more as an opportunistic one.

So, the main challenge for MSMEs, especially MSEs, in Indonesia in the digitalization transition is to overcome all these limitations including the conventional mindset of the owner who still considers the use of DT (such as marketing with e-commerce). not too important or limited knowledge on the importance of DT for the sustainability of their business.

### ***Policy Challenges***

It reveals from the discussion above that there are various ways the Indonesian government can do to accelerate digital transformation in MSMEs by:

- (i) promoting the use of e-Government and encouraging the adoption of digital technologies at all levels of government and business, aimed at reducing the regulatory burden on MSMEs and entrepreneurs;
- (ii) providing support in the adoption of e-platforms, B2B online platforms, and technology support infrastructure;
- (iii) (providing MSMEs with low-cost (if not free) training tools and facilitation to embrace digital solutions, including basic digital skills and more advanced competencies, such as digital marketing, accounting, digital identification systems, digital security and transactions, and digital financial services to support their transition towards a green and digital business model, to enhance their competitiveness in international trade and investment;
- (iv) rewarding MSMEs for initiatives towards digital skill development and employment generation;
- (v) encouraging industry adoption of DT to increase voluntary traceability to support the further integration of MSMEs into the GSC, to increase their capability to access global markets sustainably;
- (vi) (providing special funding schemes to finance the procurement of DT infrastructures such as computers and internet; (iii) creating new distribution channels in markets;

- (vii) strengthening and promoting affordable digital infrastructures needed for the enterprises to participate in global value chains; and
- (viii) narrowing the digital divide, as well as cooperating on facilitating the flow of data and strengthening consumer and business trust in digital transactions.

As a member country of ASEAN and APEC, the Indonesian government can also link its policies to support the digitization of MSMEs with ASEAN and APEC agreements to support digitalization, especially in trade. In the context of ASEAN, it has identified six priority areas for the immediate term to address the critical barriers and accelerate existing ASEAN platforms and plans to realize digital integration: (a) facilitate seamless trade, (b) protect data while supporting digital trade and innovation, (c) enable seamless digital payments, (d) broaden digital talent base, (e) foster entrepreneurship, and (f) coordinate actions.

In context of APEC, it has created a platform for members to work together to promote innovation and digitalization, including by supporting skills training, access to digital tools and infrastructure, and addressing cybersecurity challenges. The organization also supports the development and application of next-generation information and communication technologies among MSMEs to promote their differentiation and digital transformation.

## Conclusion

This paper examined the use of e-commerce, as an indicator of digitalization, and innovation in MSEs in the manufacturing industry. It shows that only a very small number of manufacturing MSEs utilize DT, especially e-commerce for marketing, although the percentage varies by industry group. There are some causes, including a lack of insight or knowledge about the importance of digital technology especially in facing competition, limited capital, lack of information and communication technology (ICT) infrastructure in their area, and entrepreneurs think no need to use the internet or e-commerce because they only sell their goods in the local market in small amounts.

Despite progress in recent years, it can be said that Indonesia is still not fully successful in digitizing MSMEs, especially MSEs. The Indonesian government still has homework to do to realize this. From the discussion above, it seems that there are two most important factors to be addressed in the short term, namely increasing the awareness of MSE owners on the importance of using DT for their business growth and sustainability and creating market opportunities or certainty for their products. The existence of market opportunities or certainty will make it easier to increase the awareness of MSE owners who have not yet applied digital technology to immediately implement it.

Finally, this paper also gives the impression that innovation is not yet a business culture in most MSEs in the manufacturing industry. Of course, if left unchecked, this could threaten the continuity of their business in an increasingly globalized market with increasingly fierce competition. For MSEs there is no choice but to adapt to technological changes, including adopting DT and increasing innovation capabilities if they want to survive.

## References

- ADB (2020), *2020 ADB Asia Small and Medium-Sized Enterprise Monitor*, Volume 1: Country and Regional Reviews, Manila: Asian Development Bank
- Ahmada, Syed Zamberi, Abdul Rahim Abu Bakar, Tengku Mohamed Faziharudean and KhairulAnwar Mohamad Zakic (2015). An Empirical Study of Factors Affecting e-



- commerce Adoption among Small- and Medium-Sized Enterprises in a Developing Country: Evidence from Malaysia. *Information Technology for Development*, 21(1), 555–572.
- Altinay, L., Madanoglu, M., De Vita, G., Arasli, H., and Ekinci, Y. (2016), The interface between organizational learning capability, entrepreneurial orientation, and SME growth, *Journal of Small Business Management*, 54(3), 871-891.
- APEC (2020), Overview of the SME Sector in the APEC Region: Key Issues on Market Access and Internationalization, April, APEC Policy Support Unit, Singapore: Asia-Pacific Economic Cooperation Secretariat.
- Arendt, L. (2008). Barriers to ICT adoption in SMEs: how to bridge the digital divide? *Journal of Systems and Information Technology*, 10(2), 93-108.
- Audretsch, David B. (2003), Entrepreneurship, innovation and globalization: Does Singapore need a new policy approach, in Ramkishen S. Rajan (ed.), *Sustaining Competitiveness in the New Global Economy*, Edward Elgar.
- Azam, M.S., and Quaddus, M. (2009a). Adoption of b2b e-commerce by the SMEs in Bangladesh: an empirical analysis. Paper presented at the Asian Business Research Conference, 11-12 April, Dhaka.
- Azam, M.S. and Quaddus, M. (2009b). Adoption of e-commerce by the SMEs in Bangladesh: the effects of innovation characteristics and perceived risk. Paper presented at the Australian and New Zealand Marketing Academy Conference, 30 November - 2 December 2009, Melbourne, Victoria.
- Bach, M. P., Zoroja, J., and Vukšić, V. B. (2013). Review of corporate digital divide research: A decadal analysis (2003-2012). *International Journal of Information Systems and Project Management*, 1(4), 41-55.
- Balakrishnan, Anita dan Julia Boorstin (2017), Instagram says it now has 800 million users, up 100 million since April, 25 September, CNBC.Com (<https://www.cnbc.com/2017/09/25/how-many-users-does-instagram-havenow-800-million.html>).
- Bappenas (2019), Roadmap of SDGs Indonesia: a Highlight, Jakarta: Ministry of National Development Planning/National Development Planning Agency.
- Barry, H. and Milner, B. (2002). SME's and Electronic Commerce: A Departure from the Traditional Prioritisation of Training? *Journal of European Industrial Training*, 25(7), 316–326.
- Bartel, A.P. C., Ichniowski and K. Shaw (2004). The strategic investment in information technologies and new human resource practices and their effects on productivity: An – insider- econometric analysis, Cambridge (MA): National Bureau of Economic Research Summer Institut.
- Bartz, W., P. Mohnen and H. Schweiger (2016), The role of innovation and management practices in determining firm productivity in developing economies, EBRD Working Paper No. 188, <https://www.ebrd.com/working-papers/role-of-innovation.html>.
- BI (2022). Official Kick-Off of Indonesia Digital Economy and Finance Festival (FEKDI) 2022 Towards Digitalisation Policy Strategy. July, Jakarta: Bank Indonesia ([https://www.bi.go.id/en/publikasi/ruang-media/news-release/Pages/sp\\_2417522.aspx](https://www.bi.go.id/en/publikasi/ruang-media/news-release/Pages/sp_2417522.aspx)).
- Blackburn, R. and Athayde, R. (2000). Making the connection: the effectiveness of Internet training in small businesses. *Education and Training*, 42(4/5), 289-299.
- BPS (2017a). *Analisa Ketenagakerjaan Usaha Mikro Kecil 2017*. November, Jakarta: Badan Pusat Statistik Nasional.
- BPS (2017b), *Profil Industri Mikro dan Kecil 2017*, Jakarta: Badan Pusat Statistik
- BPS (2019a). *Indeks Pembangunan Teknologi, Informasi, dan Komunikasi 2018*. November, Jakarta: Badan Pusat Statistik

- BPS (2019b), *Profil Industri Mikro dan Kecil 2019*, Jakarta: Badan Pusat Statistik
- BPS (2021), *Profil Industri Mikro dan Kecil 2021*, Jakarta: Badan Pusat Statistik.
- BPS (2022a). *Statistik Telekomunikasi Indonesia 2022*. Jakarta: Badan Pusat Statistik
- BPS (2022b). *Statistik E-Commerce 2022*. Jakarta: Badan Pusat Statistik
- Brouwer, E. (1997), *Into Innovation Determinants and Indicators*, SEO report no. 424, Utrecht.
- Chong, S. and Pervan, G. (2007). Factors Influencing the Extent of Deployment of Journal of Electronic Electronic Commerce for Small and Medium-Sized Enterprises. *Commerce in Organizations*, 5(1), 1-29.
- Covin, J. G., Green, K. M., and Slevin, D. P. (2006), Strategic process effects on the entrepreneurial orientation–sales growth rate relationship, *Entrepreneurship Theory and Practice*, 30(1), 57-81
- Daniel, E., Wilson, H., and Myers, A. (2002). Adoption of e-commerce by SMEs in the UK: towards a stage model. *International Small Business Journal*, 20(3), 253-268.
- Dasaraju, Himachalam, Kishore Somalaraju and Sreenivasa Murthy Kota (2020), MSMEs in Developing Economies and Their Role in Achieving Sustainable Development Goals in the Context of Covid19: A Theoretical Exposition, *International Journal of Small and Medium Enterprises and Business Sustainability*, 5(2), 93-120.
- Eggers, F., Kraus, S., Hughes, M., Laraway, S., and Snyckerski, S. (2013), Implications of customer and entrepreneurial orientations for SME growth, *Management Decision*, 51(3), 524-546.
- Fallon, M. and Moran, P. (2000), Information Communications Technology (ICT) and manufacturing SMEs. Paper presented at the 2000 Small Business and Enterprise Development Conference, 10-11 April, University of Manchester, Manchester.
- Farhad, Nejadirani, Masoud Behravesh and Reza Rasouli (2011). Developing Countries and Electronic Commerce the Case of SMEs. *World Applied Sciences Journal*, 15(5), 756-764.
- Fong, M. W. L. (2009). Digital Divide: The Case of Developing Countries. *Issues in Informing Science and Information Technology*, 6(2), 471-478.
- Hakala, H. (2013), Entrepreneurial and learning orientation: effects on growth and profitability in the software sector, *Baltic Journal of Management*, 8(1), 102-118.
- Horrigan, John B. (2019), Analysis: Digital Divide Isn't Just a Rural Problem, *The Daily Yonder*, August 14 ( <https://dailyyonder.com/analysis-digital-divide-isnt-just-a-rural-problem/2019/08/14/>).
- Hunaiti, Z., Masa'deh R., Mansour, M. and Al-Nawafleh, A. (2009). Electronic commerce adoption barriers in small and medium-sized enterprises (SMEs) in developing countries: the case of Libya. *IBIMA Business Review*, 2, 37-45.
- Hussain, Jawad, Qamar Abbas and Muhammad Asad Khan (2017), Entrepreneurial Orientation and Performance: The Moderating Effect of Market Orientation, *Global Management Journal for Academic & Corporate Studies*, 7(1):9-18.
- IFC (2017), *MSME Finance Gap*, Washington, D.C.: International Finance Corporation
- Jacobs, Evan (2021). Moving from Access to Accessibility: The Deception of the Digital Divide in Development How E-learning can be used to bridge the digital divide. February, UNDP ([https://www.undp.org/south-africa/blog/moving-access-accessibility-deception-digital-divide-development?utm\\_source=EN&utm\\_medium=GSR&utm\\_content=US\\_UNDP.\\_](https://www.undp.org/south-africa/blog/moving-access-accessibility-deception-digital-divide-development?utm_source=EN&utm_medium=GSR&utm_content=US_UNDP._))

- Jones, P., Packham, G., Beynon-Davies, P., and Pickernell, D. (2011). False promises: E-business deployment in Wales' SME community. *Journal of Systems and Information Technology*, 13(2), 163–178.
- Julianto, P.A. (2016). Pemerintah Targetkan 44 Juta UMKM Pasarkan Produk Lewat Internet. *Kompas Newspaper*, 18 June, 2.
- Kraus, S., Rigtering, J. C., Hughes, M., and Hosman, V. (2012), Entrepreneurial orientation and the business performance of SMEs: a quantitative study from the Netherlands, *Review of Managerial Science*, 6(2), 161-182.
- Kreiser, P. M., Marino, L. D., Kuratko, D. F., and Weaver, K. M. (2013), Disaggregating entrepreneurial orientation: the non-linear impact of innovativeness, proactiveness and risk-taking on SME performance, *Small Business Economics*, 40(2), 273-291.
- Lai, I. K. W. (2007), The strategic changes by adopting internet-based interorganizational systems. *Management Research News*, 30(7), 495–509.
- Lessidrenska, T. (2019), SMEs and SDGs: challenges and opportunities, *OECD Development Matters*, OECD, Paris (<https://oecd-development-matters.org/2019/04/23/smes-and-sdgs-challenges-and-opportunities/>)
- Lumpkin, G. T., and Dess, G. G. (2001), Linking two dimensions of entrepreneurial orientation to firm performance: The moderating role of environment and industry life cycle, *Journal of Business Venturing*, 16(5), 429-451.
- Matlay, H. (2000). Training in the Small Business Sector of the British Economy. In Carter S. and Jones D. (eds.). *Enterprise and Small Business: Principles, Policy and Practice*. London: Addison Wesley Longman.
- Migiro, S.O. (2006). Diffusion of ICTs and E-commerce adoption in manufacturing SMEs in Kenya. *South African Journal of Library and Information Science*, 72(1), 35-44.
- Muller, Charlie and João Paulo de Vasconcelos Aguiar (2022, March). What Is the Digital Divide? March, Internet Society (<https://www.internetsociety.org/blog/2022/03/what-is-the-digital-divide/>).
- Neale, J., Murphy, J. and Scharl, A. (2006). Comparing the Diffusion of Online Service Recovery in Small and Large Organizations. *Journal of Marketing Communications*, 12(3), 165-181.
- Ocha, Matilda Luoise (2011). Factors that Influence Adoption and Frequency of Use of E=Commerce by Micro and Small Enterprises (MSEs) in Kisumu. A Management Research Project, the Degree of Master of Business Administration, Department of Business Administration, School of Business, University of Nairobi.
- OECD (2021), Promoting the Productivity of SMEs in ASEAN Countries Strengthening Capabilities, Enabling Business Dynamics. <http://www.oecd.org/termsandconditions>.
- Oliveira, T., and Martins, M. F. (2010). Firms patterns of e-business adoption: evidence for the European Union. *The Electronic Journal Information Systems Evaluation*, 13(1), 47-56.
- Pawitan, Gandhi, and Theresia Gunawan (2012). "Sme's Clustering and Its Impacts on Innovation in Indonesia: Case Study at Cibaduyut, West Java." *Research Reports in the Humanities and Social Sciences*, 1:2-19 (<https://www.neliti.com/publications/12775/smes-clustering-and-its-impacts-on-innovation-in-indonesia-case-study-at-cibaduy>)
- Poon, Simpson, and Paula Swatman (2005). Small business use of the Internet: Findings from Australian case studies. *International Marketing Review*, 14(5), 1-15.

- Poorangi, Mehdi M and Edward W.S. Khin (2013). Strategic Alliance on Malaysia SMEs to compete globally. Endogenous and exogenous perspective. *Actual Problem of Economics*, 3(141), 407-415.
- Poorangi, Mehdi M., Edward W.S. Khin, Shohreh Nikoonejad and Arash Kardevani (2013). E-commerce adoption in Malaysian Small and Medium Enterprises Practitioner Firms: A revisit on Rogers' model. *Anais da Academia Brasileira de Ciências*, 85(4), 1593-1604.
- Porter, M. E. (1998). Cluster and the new economics of competition. *Harvard Business Review*, 6(76), 77-90.
- Porter, M. E., and Ketels, C.H.M. (2009). Clusters and Industrial Districts - Common Roots, Different Perspectives. In G. Becattini, M. Bellandi, & L. De Propris (Eds.), *The Handbook of Industrial Districts*, Cheltenham: Edward Elgar Publishing.
- Rahayua, Rita and John Daya (2015). Determinant Factors of E-commerce Adoption by SMEs in Developing Country: Evidence from Indonesia. *Procedia - Social and Behavioral Sciences*, 195, 142 - 150.
- Rauch, A., Wiklund, J., Lumpkin, G. T., and Frese, M. (2009), Entrepreneurial orientation and business performance: An assessment of past research and suggestions for the future, *Entrepreneurship Theory and Practice*, 33(3), 761-787.
- Riquelme, H. (2002). Commercial Internet Adoption in China: Comparing the Experience of Small, Medium and Large Business Internet Research. *Electronic Networking Applications and Policy*, 12(3), 276-286.
- Rosenfeld, Stuart (1997), Bringing business clusters into the mainstream of economic development, *European Planning Studies*, 5(1), 3-23
- Roxas, B., Ashill, N., and Chadee, D. (2017), Effects of Entrepreneurial and Environmental Sustainability Orientations on Firm Performance: A Study of Small Businesses in the Philippines, *Journal of Small Business Management*, 55(S1), 163-178.
- Saffu, K., Walker, J. H., and Hinson, R. (2008). Strategic value and electronic commerce adoption among small and medium-sized enterprises in a transitional economy. *Journal of Business & Industrial Marketing*, 23(6), 395-404.
- Savrula, Mesut, Ahmet Incekarab, and Sefer Senerb (2014). The Potential of E-commerce for SMEs in a Globalizing Business Environment. *Procedia - Social and Behavioral Sciences*, 150, 35 - 45
- Schmitz, H (1999), Collective Efficiency and Increasing Returns, *Cambridge Journal of Economics*, 23(4), 465-483.
- Shih, H. (2008). Contagion effects of electronic commerce diffusion: Perspective from network analysis of industrial structure. *Technological Forecasting & Social Change*, 75(1), 78-90.
- Srinuan, C., and Bohlin, E. (2011). Understanding the digital divide: a literature survey and ways forward. Proceedings of the 22nd European Regional Conference of the International Telecommunications Conference Paper. Budapest. (<http://econstor.eu/bitstream/10419/52191/1/672623358.pdf>)
- Standing, S., Standing, C., and Love, P. (2010). A review of research on e-marketplaces 1997-2008. *Decision Support Systems*, 49(1), 41-51.
- Stiakakis, E., Kariotellis, P., and Vlachopoulou, M. (2009). From the digital divide to digital inequality: A secondary research in the European Union. In Sideridis, A. B., and Patrikakis, C. Z. (eds.) *Next Generation Society Technological and Legal Issues*, Heidelberg: Springer.
- Swierczek, F. W., and Ha, T. T. (2003), Entrepreneurial orientation, uncertainty avoidance and firm performance: an analysis of Thai and Vietnamese SMEs, *International Journal of Entrepreneurship Innovation*, 4(1), 46-58.
- Tambunan, Tulus T.H. (2008), Development of Rural Manufacturing SME Clusters in a Developing Country: The Indonesian Case, *Journal of Rural Development*, 31(2).

- Tambunan, Tulus T.H. (2021), *The Role of MSMEs in Achieving SDGs in Developing Economies. The case of Indonesia*, Eliva Press, Chisinau, Moldova.
- Taylor, Kiara (2023), The Digital Divide: What It Is, and What's Being Done to Close It, Investopedia, August 16 (<https://www.investopedia.com/the-digital-divide-5116352>).
- Tsang, E. W. K. (2002), Learning from overseas venturing experience: The case of Chinese family businesses, *Journal of Business Venturing*, 17(1), 21-40.
- UN-DESA (2020), *Micro-, Small and Medium-sized Enterprises (MSMEs) and their role in achieving the Sustainable Development Goals (SDGs)*, New York: Department of Economic and Social Affairs.
- Vargas-Hernández, José G. and Omar Cristian Vargas Gonzalez (2020), A Theoretical Approach to the Concept of the Cluster, *AUDA*, 12(1), 102-117
- Viswanathan, Nanda K. and James B. Pick (2005). Comparison of e-commerce in India and Mexico: an example of technology diffusion in developing nations. *International Journal of Technology Management*, 31(1/2), 2–19.
- WEF (2020), *Accelerating Digital Inclusion in the New Normal*, Playbook, July, Geneva: World Economic Forum.
- WEF (2021), *ASEAN Digital Generation Report: Pathway to ASEAN's inclusive digital transformation and recovery*, Insight Report, October, Geneva: World Economic Forum.
- Wiklund, J., and Shepherd, D. (2005), Entrepreneurial orientation and small business performance: a configurational approach, *Journal of Business Venturing*, 20(1), 71-91.
- Yoo, Ki-Young (2003), *Method for Identifying Industry Clusters: Assessment of the State of the Art*, A Masters Project, the Department of City and Regional Planning, the faculty of the University of North Carolina at Chapel Hill.
- Yuniarto, Topan (2022). Masa Depan Internet Terang, tetapi Literasinya Masih Kurang. *Kompas Newspaper*, Tuesday, 28 June, 6.
- Zaied, Abdel Nasser H. (2012). Barriers to E-Commerce Adoption in Egyptian SMEs. *Information Engineering and Electronic Business*, 3, 9-18.



## INTANGIBLE CAPITAL: BRAND'S ROLE IN SUSTAINABLE DEVELOPMENT

**Dr. Ryadh R.ALGBURI,**

*AL Farahidi University, Baghdad, IRAQ.*

[riyadhraed@uoalfarahidi.edu.iq](mailto:riyadhraed@uoalfarahidi.edu.iq)

**Maher K. ALIMARI**

*AL Farahidi University, Baghdad, IRAQ.*

[ma.acc1992@gmail.com](mailto:ma.acc1992@gmail.com)

**Samar R.AHMED,**

*AL Farahidi University, Baghdad, IRAQ.*

[samar.rufid3@gmail.com](mailto:samar.rufid3@gmail.com)

The contemporary landscape of the global economy, characterized by heightened competitiveness on local and international fronts and propelled by technological advancements in communication, has intricately linked the survival and perpetuity of institutions to their adept management of resources, particularly their intangible assets. This research endeavors to elucidate the pivotal role of intangible assets as pivotal sources fostering sustainable competitive advantages amid the evolving challenges confronting economic entities. Emphasizing the significance of brands as indispensable intangible assets, this study aims to underscore their multifaceted contribution in generating value, not solely for consumers or institutions but for all stakeholders involved. Beyond traditional commercial implications, this essay delves into how branding transcends product-centricity, assuming a broader mantle encompassing societal progress through commitments to sustainable development and encompassing social responsibilities. The investigation herein seeks to illuminate the substantial impact of branding, delineating its evolution into a force inherently tied to holistic value creation and societal betterment.

Keywords: brand, intangible capital, value creation, sustainable development.

### 1. INTRODUCTION

In light of the globalization of the economy, the increase in the intensity of competition, whether at the local or international level, and the development of means of communication, the survival and continuity of institutions began to be closely linked to their ability to protect and enrich their various resources, including their intangible assets (OECD, 2006) especially that the environment in which they are active In which institutions are currently characterized by the rise of the forces of valuable intangible assets ( Walliser, E. 2001), that the factors of development, competition in the light of modern developments have begun to gradually move from technical and financial capital to intangible capital, and accordingly we are aware of the institutions to constantly enrich their offerings to offer to satisfy the increasing intangible needs of the level of the market, such as social communication skills, social responsibility, equality, ethics...) (Alexis, 2007). Through this, the following problem can be raised. Research problem: the brand, through its management and leadership, seeks to achieve a kind of positive impact on society by adopting responsible behaviour in which all concerned parties are involved. From this point of view, the problem of this study revolves around the extent of the importance and role of the brand as an intangible capital in achieving sustainable development.

### 2. OBJECTIVES:

1. Clarify the theoretical concepts of the brand and its role as a new effective tool in the management of the institution.
2. To highlight the importance of the brand as an intangible capital in achieving sustainable development, that is, to highlight the brand's new approach towards sustainability.
3. Strengthening the relationship between the brand and the idea of sustainability.



### **3. THEORETICAL FRAMEWORK**

Intangible capital is a key determinant of the value of institutions in the 21st century when multinational companies operate in global markets and highly competitive environments (Maddah, 2008). Understanding the influence of intangible capital on firm performance is crucial for market dominance and profit (Belo, 2014). Changes in consumer behaviour, particularly in Arab nations, may be one of the primary sources of management science difficulties (Hetzl, P. 1996) since the customer seeks, in the first stage, the most acceptable connection between quality and price. Price seeks to experience and enjoyment through addressing emotional customer requirements (Holbrook, 1982) Consumption The intangible process has become a tool for people in their search for satisfaction (HEBEL, 2009), therefore it's incorporated into consumption. Social needs, a period characterised by the desire of consumers to contribute to society and humanitarian issues, and to move away from ways that deceive the consumer because he's become sensitive and vulnerable to brands, and the latter is responsible for achieving transparency and d-legitimacy for him. Faced with this situation, many began using socially responsible marketing. Institutions incorporate intangible assets to promote economic and social sustainability (Casado, 2014) The intangible economy is a major source of development and employment prospects. Due to their growing relevance, intangible assets are increasingly used to value institutions. Today, they're worth two-thirds of the company (Lévy & Jouyet, 2006). Intangible asset proportion. Intangible assets accounted for 70% of tangible assets' value at the start of the second decade of the 21st century (Lev & Daum, 2004). The inclusion of all intangible assets highlights the reputation of the most important institution, as it is an essential element in the formation of relational capital based on variables such as social responsibility, ethics, and brand as distinct dimensions that have a significant impact on increasing the institution's capacity (Gupta & Kumar, 2013).

Our research will concentrate on the brand as an intangible asset in attaining sustainable development. Although few studies explain the brand's potential to handle sustainability concerns, the brand's critical role may be emphasised through:

1. Green initiatives (which are sustainability concerns) generate opportunities for economic growth, social welfare, and environmental protection in the institution's culture.
2. The brand's capacity to boost the institution's success via green marketing, management, and operations.

### **4. THE CONCEPT OF BRAND:**

In the 1990s, various British and Australian institutions decided to commercialise their trademarks, whether purchased or produced domestically (Kapferer, 1991). The business world's interest in trademarks is relatively new since trademarks underwent a significant transition in the 1980s in industrialized nations. The real value is in the minds of current and prospective customers, as well as the transition from a vision where tangible assets create value to a new vision where the real capital of the institution is intangible and immaterial represented in the brand and is the basis for creating value (Guizani & Valette-Florence, 2010). The mark's worth reflects its potential to influence customer behaviour, therefore it has no value until it's in the consumer's mind (Lewi, et. al., 2007). Hundreds of brands are utilised every day, and many people proudly wear their emblems. Due to the brand's aim and use, experts and academics disagree on how to define it. The marketing and financial strategy, the communication approach, and the utilitarian and methodical approach may help define the mark (Changer, 2002). The financial approach to a brand offered by (Alake (1) and Kaferen) is one of the most renowned, assuming that the brand has become a capital that may grow the institution's worth, as stated by (Philipedurier , 2006) his examination of the brand

idea. "Many types of research related to brand capital. show that it provides additional value distinct from the value provided by the product," meaning that there is a specific performance of the brand independent of the product, the separation of the brand from the product, and the additional performance provided by it. This value is called brand capital. (Wood, 2000) It's also called "the enterprise's added value." This value comes from the brand's market position contrasted with what would happen without it (Philip et, al., 2006). Brand capital quantifies customers' awareness of the institution's products and services.

**5. Using the brand as a tool for corporate leadership and value creation:**

When addressing the issue of wealth creation, it is obvious to consider shareholders directly and optimise their investment rates. Obviously, shareholders are crucial to the company, but in the context of management or administration, the firm utilizing its brand cannot be confined to a purely financial perspective, but must also take into consideration employees, customers, and suppliers, as well as society as a whole. The linkages between value and brand may be codified, as indicated in Table, by relying on various theoretical research, such as the study (Coumau,2004).

Table No. (1): Creating Value by Branding for all stakeholders

	Shareholders	Procedure	Customers	Suppliers	The society
Create Value by brand	In the case of a company with a strong brand, minimising short-term investment risk.	Compensation for project involvement and developing brand image  The brand lends significance to the work.  It also impacts employment security	Enhancing customer service and, therefore, perceived quality	A quality-assured relationship created for the long term	Maintaining a long-term brand reputation might require a sustainable development approach.

Source: Coumau, J.B., Gagne, J.F., & Josserand, E. (2004). p52

The table demonstrates that the brand is beneficial to several groups with an interest in the institution, reflecting the move to the relational dimension of the brand with all stakeholders since the connection between the consumer and the brand is no longer exclusive. When a business focuses on preserving its reputation in the community and embraces responsible conduct, often known as being a "responsible brand," a strong connection between the brand and sustainable development emerges. Additionally, the connection with the client. (Gauthier, 2010)

**6. The Brand’s Orientation Towards Sustainability:**

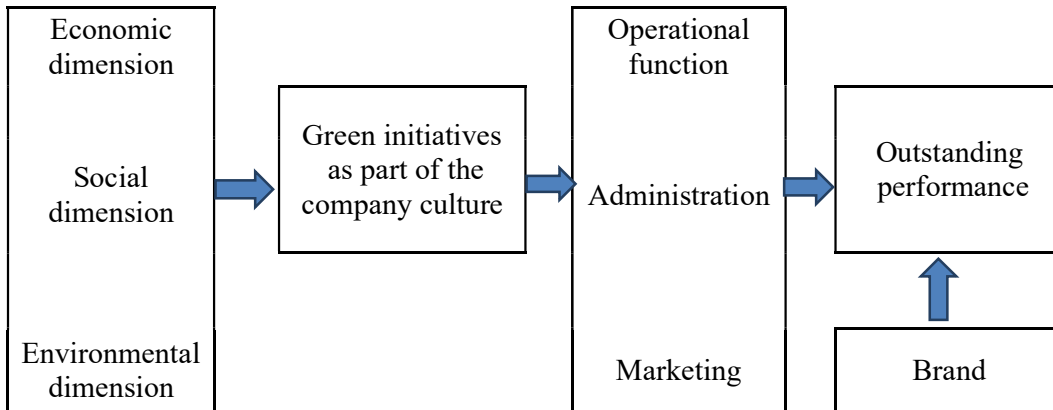
As widespread acceptance of the sustainable development model grows, there is an urgent need to rethink the meaning of performance and abandon the simplistic equation stating that improving performance equals increasing production; performance requires a new perspective. And the researcher (Gupta & Kumar, 2013)describes this by the intersection of three principal axes :

1. An economic principle that requires the wise use of resources, without compromising the future of future generations.
2. An environmental principle that defines the role of civil society in protecting these resources.
3. A social principle that states that everyone should be treated fairly.

Ratnayake and Liyanagree (2009) suggest moving from a one-dimensional financial approach to business connections to a holistic strategy connected to community interactions to incorporate sustainability into the institution's culture. In this approach, the brand links the institution with its community by building impressions between it and its clients (Sen &

Bhattacharya, 2001). These impressions help sustainability by supporting green activities. Positive brand communications increase consumer impressions of green activities and trust in the business's intentions to engage in long-term community needs (Pomeroy&Dolnicar, 2009). Figure 1 depicts the relationship between sustainability, jobs, and performance. Sustainable performance considers the institution's economic and environmental integration with its social context.

Figure No. (1)  
The Link Between Sustainability, Jobs and Performance.



Source: Suraksha G. & Kumar. V. (2013). pp. 313.

In this context, we inquire about the role that social responsibility plays in the core principles of the company. In situations in which there must be a close connection between social responsibility and the brand for the latter to have meaning and be effective, social responsibility tends to the brand and makes it more appealing and distinguishable through the application of values that are forward-looking and innovative ( Sen& Bhattacharya, 2001).

### 7. The Relevance of The Communication Strategy in Bolstering the Notion of Sustainability:

Few companies make sustainable development a marketing priority; here, we ask why. First, it is unrealistic due to the conflict between reality and promises, as well as the complexity of sustainable development, since attempts have been made for years to make it's content more objective (Thierry Racs, 2003). The creation of communication plans for strong brands is congruent with new changes in customers' brand perceptions, diminishing the functional component and enhancing the commitment dimension (Hébel et al., 2013). The brand has grown more social, and environmental and ecological ideas match the values that enable consumers to choose companies with environmental and ethical messages. Many businesses have known a form of worldwide boycott via the media that the Nike brand is engaged in the nations of South Asia in the exploitation of minors owing to the massexploitation of employees when public opinion found the workers. As for human rights or Sweatshops, customer demands to boycott this brand are growing. To strengthen its image with customers, it banned underage labour.

The ideal brand symbolises a recognised market player, and the communication strategy establishes the credibility every firm needs to fulfil its objectives and confront societal tensions and crises. Through this, we can illustrate that the communication strategy's job is to emphasise an organization's identity in a way that inspires confidence and pushes others to

join its aims (Castellon & Mas, 2014). Institutions want to construct a conversation and emotional contract with their audience via their communication approach. Brand communication increases consumer impressions of the brand and integrates organisational operations to bring the company to success, according to brand management literature (Achrol & Kotler, 1999).

### **8. So how can we benefit from sustainable development while preserving the specific benefits of the brand?**

Through an effective communication strategy that simultaneously uses corporate communications and marketing communications. So that institutional communications are directed to exploit the efforts made by the institution in the field of sustainable development to extract an overall mental picture of the institution and its products. Marketing communications, it is directed toward preserving the brand's logic while providing evidence of compliance with sustainable development that resonates with the institution's commitments.

### **9. Conclusion**

The management of intangible assets presents managers with a variety of challenges in their day-to-day operations. The accurate and impartial administration of intangible assets is not limited to the job of managers, but must be shown by all parties within the same organization. This study work has focused on the connection between the idea of sustainability and the branding strategy that aims to drive excellence in performance-based concerns. Future studies on this issue should find the factors that accomplish the connection between them to construct, test, and experimentally assess the conceptual framework that was produced from the accumulation of information to demonstrate the generalization.

### **References**

- Achrol, R. S., & Kotler, P. (1999). Marketing in the network economy. *Journal of Marketing*, 63(4\_suppl1), 146-163.
- Alexis Karlkins-Marchay. (2007), intangible, first wealth of the company, Transaction Advisory Services, [www.ev.com/fr/transactions](http://www.ev.com/fr/transactions)
- Belo, F., Lin, X., & Vitorino, M. A. (2014). Brand capital and firm value. *Review of Economic Dynamics*, 17(1), 150-169.
- Casado, A. M., & Peláez, J. I. (2014). Intangible management monitors and tools: Reviews. *Expert Systems with Applications*, 41(4), 1509-1529.
- Castellon, L., & Mas, F.J. (2014). Communication strategies and trends in Chilean companies. *Communication and organization. Francophone scientific journal in Organizational Communication*, (45), 271-280.
- Changer, S. (2002). Brand equity: concepts and methods. CEROG-IAE Aix-en.
- Gauthier, C. (2010). Choosing Corporate Sustainability–Marketing Implementation. In *Sustainable development business strategies* (pp. 127-158).
- Guizani, H., & Valette-Florence, P. (2010). Proposal of a psychometric measurement of the brand's customer capital. *March and organizations*, (2), 11-41.
- Gupta, S., & Kumar, V. (2013). Sustainability as corporate culture of a brand for superior performance. *Journal of World Business*, 48(3), 311-320.
- Hébel, P., Pilorin, T., & Siounandan, N. (2013). New perceptions of the brand: less functionality, more commitment. *Apres-demain*, (1), 13-15.

- HEBEL, P., SIOUNANDAN, N., & LEHUEDE, F. (2009). Will the consumer change his behaviour in the long term with the crisis?. Research notebook, (268).
- Hetzel, P. (1996). Companies facing new forms of consumption. French Management Review, (110), 70-82.
- Holbrook, M. B., & Hirschman, E. C. (1982). The experiential aspects of consumption: Consumer fantasies, feelings, and fun. Journal of consumer research, 9(2), 132-140.
- Kapferer, J.N. (1991). Trademarks, capital of the company (p. NC). Paris: Editions organization.
- Lev, B., & Daum, J. H. (2004). The dominance of intangible assets: consequences for enterprise management and corporate reporting. Measuring business excellence.
- Lévy, M., & Jouyet, J.P. (2006). The intangible economy: tomorrow's growth (Vol. 6). Paris: The French documentation.
- Lewi, G., Lacoeuilhe, J., & Albert, A.S. (2007). Branding management: The brand, from idea to action. Pearson Education France.
- Maddah Al-Arabi Al-Hajj (2008), The Importance of Strategic Analysis in Evaluating the Intangible Capital of Economic Institutions, Journal of North African Economics. Issue 5, p. 199 - 2200 University www.univ-chlef.dz renaf Articles ... / article\_10.pdf. 5
- OECD (2006). Intangible assets and value creation. OECD .pó . Paris .
- Philip, K., Dubois, B., Keller, K.L., & Manceau, D. (2006). Marketing Management, 12th edition Pearson Education.
- Pomeroy, A., & Dolnicar, S. (2009). Assessing the prerequisite of successful CSR implementation: are consumers aware of CSR initiatives?. Journal of business ethics, 85(2), 285-301.
- Sen, S., & Bhattacharya, C. B. (2001). Does doing good always lead to doing better? Consumer reactions to corporate social responsibility. Journal of marketing Research, 38(2), 225-243.
- Thierry Racs. (2003), brands and sustainable development. the review of brands – n 44. pp13 <http://www.prodimarques.com/revue-des-marques/numero-44/14.pdf> / Brands - development - sustainable.pdf
- Walliser, E. (2001), the accounting measurement of brands, Vuibert edition, p 13
- Wood, L. (2000). Brands and brand equity: definition and management. Management decision.
- Coumau, J.B., Gagne, J.F., & Josserand, E. (2004). Managing by brand: a tool for motivation and strategic alignment. Paris: Editions organization.
- Suraksha G. & Kumar. V. (2013). Sustainability as corporate culture of a brand for superior performance. Journal of World Business, 48. pp. 313.

## India's Trade and Investment with Afghanistan: A Vicennial Analysis

**Prof. Krishn A. Goyal,**

Institute of Evening Studies, Jai Narain Vyas University, Jodhpur, India.  
kag.bfe@jnvu.edu.in

**Rekha Verma,**

Jai Narain Vyas University, Jodhpur, India.  
rekhavrm13@gmail.com

The Taliban have returned to power in Afghanistan in 2021 After 20 years of conflict, posing new challenges for India-Afghanistan bilateral relations. Before the entry of Taliban regime both countries have had a decent relationship over the past 20 years in terms of trade and investment. According to the CTI (Chamber of Trade and Industry), India is the largest market in South Asia for Afghan products, mainly imports fruits, dry fruits, and medicinal plants from Afghanistan. India mostly exports coffee, tea, pepper, cotton, and other agricultural products to Afghanistan. In 2020-2021, India and Afghanistan enjoyed bilateral trade worth \$ 10,917 million. Along with trade, India has made over \$ 3 billion investment in Afghanistan, including highways, dams, energy grids, schools, hospitals, the parliament building etc. The future of Indian investment in the Afghanistan and the significance of India-Afghanistan trade are the primary subject matter of the present paper. With the return of Taliban, India had been unwilling to explore interaction with the Afghanistan. Indian initiatives need both a "supportive environment" and the assurance that a terrorist Islamic group won't use its territory to threaten or attack other countries in order to continue operating under the Taliban's new leadership. If both nations try to demonstrate more confidence in one another, the India-Afghanistan relationship will improve significantly in the future.

**Keywords:** India, Afghanistan, Taliban, Investment, Trade relations.

**JEL Classification Code:** F1, F3, F5, P4

### 1. Introduction

Afghanistan the South Asian landlocked republic is the colonial offshoot that continue to have ramifications for regional inter-state as well intra-state relations. Landlocked states have long relied on littoral neighbours for critical transport facilities, but political barriers of coastal countries hampered their economic development. This is evident in Afghanistan's relationship with Pakistan. Afghanistan endeavoured to minimise its overreliance on Pakistan by modifying country's foreign policy and found a new ally in India, that has changed regional geopolitical power equations. Unlike Pakistan, India and Afghanistan do not share a conterminous and disputed border, and, don't have complicates bilateral relations. The Kautilian idea of "neighbours are viewed as adversaries, while an enemy's adjacent neighbour is seen as a friend" has affected India's foreign policy of neighbouring political circles in Afghanistan. India therefore started taking advantage of the problems Pakistan and Afghanistan had over the Durand line. Since 1947, India has had cordial relations with Afghanistan. This trend lasted for several years, including the "Friendship Treaty" signing in 1950, Afghanistan's Soviet invasion from 1979 until 1990, Burhanuddin Rabbani's presidency from 1992 to 1996, and the past twenty years following the 9/11 attacks (2001 to 2020).

The Taliban have returned to power in Afghanistan in 2021 After 20 years of conflict. Before the entry of Taliban regime both countries have had a decent relationship over the past 20 years in terms of trade and investment. However, 2021 appears to be a dreadful year for both countries as the Taliban transform Afghanistan into a war-torn country after US and NATO forces leave the country. Under such scenario this paper tries to address following questions: How will India and Afghanistan handle their bilateral trade ties? What will be the future of Indian investment in Afghanistan under Taliban Regime?

### 2. Review of Literature



The foreign policy choices that affect the relations between Afghanistan and Pakistan and India have been examined in this paper. Pakistan and India used their neighbours who shared a border with them to advance their own national goals. In order to reduce its over-dependence on Pakistan, Afghanistan has boosted its collaboration with India, and Nepal has taken advantage of its close connections to China to limit its reliance on India, causing a change in South Asia's geopolitical dynamic (**Bhatnagar & Ahmed, 2020**). The beginnings of the Indo-Pakistani competition in Afghanistan predates the Hamid Karzai regime in Afghanistan. The researcher looks at the opinions of three nations—India, Pakistan, and Afghanistan on the strategic partnership between India and Afghanistan that was signed on October 4, 2011. India view this agreement as a way to prevent Pakistan and ensure its entry into the energy-rich Central Asian market. Afghanistan view this historic document as reiteration of the strong traditional bonds. Due to the "strategic" effects of the agreement, Pakistan believes that India is attempting to encircle it by obtaining more power in Afghanistan (**Raiphea, 2013**). In the light of the Indo-Pakistani rivalry, India tries to limit Pakistan's influence in Afghanistan and examining the consequences for American policy of the confluence of Indian and US interests in Afghanistan (**Ganguly & Howenstein, 2009**).

The recent improvements in the relations of India with Afghanistan are supported by its multifaceted Afghan strategy, which is motivated by growing regional and international objectives. A number of structural considerations are pushing India to adopt an unusually assertive foreign policy toward Afghanistan, and the outcome of India-Afghanistan policy will influence whether India can become a key regional security provider in South Asia. India's approach to Afghanistan is seen as a barometer for the nation's goals because it reflects both the country's rise on a regional and international scale (**Pant H. V., 2010**). Post 9/11 Afghanistan's stability is a matter of importance for India's own security but, was side-lined from many Western-led discussions about the country. Following the announcement of end of large-scale Western troop deployment in 2014 justify India's parallel bilateral engagement with Afghanistan. India seeking for stability within Afghanistan, hence, this Shifted Indian policy from an anti-Pakistan strategy towards a desire for stability and deeper relationship with Afghanistan (**Price, 2013**). With this agenda India emphasising more on its foreign policy in Afghanistan. India, a rising international and regional power, is using Afghanistan as a test case. Aside from that, India has failed to win the trust of Afghan communities who saw India as a natural friend. With the potential of American withdrawal from Afghanistan, Afghanistan's policy of stronger alignments with China, Pakistan, and Iran has become more apparent (**Pant**). India confronted to such notion because of its reliance on a "soft power" political style and hence, it has become a "secondary player" in Afghanistan (**Pant, 2013**). However, US operations and the supportive Afghan government holds up India from regaining and strengthening its influence there and using Afghanistan as an entryway for its trade with Central Asian countries. India started concentrating on three areas to re-establish its influence in Afghanistan: the rebuilding process and economic growth; forging relations with Central Asian countries; and aiming to weaken Pakistan's role in Afghanistan (**Ashraf, 2007**). These aforementioned areas can only be achieved under the guidance of Indian Prime Minister Narendra Modi and Afghanistan's President Ashraf Ghani, and relations between the two countries have improved dramatically. India's investment in Afghanistan's rehabilitation and capacity building, economic growth, and women empowerment has been sought by the Ghani government. The bilateral partnership has been reinforced through collaborative police training and law enforcement actions (**Kaura, 2017**).

India always concerned for integrated and stable regional security towards its extended neighbourhood. This paper brings India's regional security interests in Afghanistan as of the expanded strategic neighbourhood of India. It describes the numerous methods and the prospective implications of increased regional security for Afghanistan (**Fair, 2010**). Post 9/11 opens the door for India again in Afghanistan with oust of Taliban regime. India revived its interest in deepening its social and economic connections with Afghanistan. India began looking for its stakes in the expanded neighbourhood, as well as opportunities and challenges, in order to establish its footprint in the region ranging between East and Southeast Asia and West Asia (**Basu, 2007**). India is Central Asia's extended neighbour, and because of its rich mineral resources and unexplored consumer market, it has substantial geopolitical and socioeconomic concerns in the region. Energy security collaboration between Central Asia and India

appears to have bright future prospects. The CARs and Afghanistan's peace and stability seem to be the most crucial factors for India's security (Roy, 2001).

## 1. Objectives

- i. To discern the future of Indian Investment in Afghanistan under Taliban regime.
- ii. To assess the importance of India-Afghanistan trade.

## 2. Indian investment and its future in Afghanistan

India saw a likelihood to broaden its influence in the nation as the first Taliban regime collapsed in 2001. During past two decades, India has invested in Afghanistan in order to gain public trust and use financial aid as political leverage. India constructed critical infrastructures such as dams, highways, hospitals and schools, among other things. India now provides development assistance worth more than \$3 billion. India invested time, money, and effort in Afghanistan's reconstruction. It has assisted Afghanistan in every aspect of developing a nation during the past 20 years. India has invested in a number of industries and sectors, including hydropower, road building, operations, communication technologies, health care, agriculture, and education.

India's key endeavours in Afghanistan is the construction of the crucial Zaranj-Delaram highway, which would allow India to trade with Afghanistan through Iran's Chabahar port. India is also supporting to rebuild the Afghanistan's Salma Dam power project. In addition, India has constructed a 220 kV double-circuit transmission line and has supplied equipment for it, which will result in the construction of 600 transmission lines. India also helped Afghanistan to build its mining industry.

The Agreement on Cooperation in the Area of Health and Medical Sciences was signed by both nations, as well as Memorandums of Understanding (MoU) on Small Developmental Projects, Agricultural Research and Education, Standardization, Rural Development, and Education, in 2005. The Afghan Parliament in Kabul was built by India for \$90 million. To promote integrated rural development, India has also promised to adopt 100 villages in Afghanistan. In five cities, India has given more than 1200 vehicles to municipalities, public hospitals, and Afghan National Army. India also provided the training to the Afghan diplomats and police officials. It has established Indian Medical Operations and constructed cold storage facilities in Kandahar. Solar panels have been installed in remote areas. India has also contributed to capacity building via its vocational training facilities, scholarships for students, opened/rehabilitated schools, programmes for mentoring and other professionals training.

The construction of the Shatoot Dam, the Aga Khan Legacy Project, and the renovation of the Bala Hissar Fort are among the current initiatives of India. By July 2020, India has signed five further contracts worth \$2.5 million for the building of roads and schools.

## Uncertain Future of Indian Investment

The Taliban's return might begin of another dark chapter for Afghanistan, with worries about the Afghanistan's economic development and ties with the rest of the globe, especially partner countries that have made sizable investments in the country. The return of the Taliban to power will have an unpredictable impact on Indian investment. As the Taliban seize power in Afghanistan following the withdrawal of US and NATO soldiers, India may find itself with nothing to perform in the country and, also no political influence. The Taliban's victory could jeopardise \$3 billion Indian investment in various projects over 20-year. India is uncertain about its 400 projects in Afghanistan during the last 20 years, of which 150 are still underway. In light of the worsen security situation and uncertainty in Afghanistan, all India-based officials were ordered to return to India. Taliban's officials ensure that the investment projects were properly maintained and India can keep monitor them. Instead of being a violent extreme group, the Taliban presented itself as a new Afghanistan. But without Indian presence how India will look after and monitor projects in Afghanistan. When nothing is in control, India has kept a broad perspective on its investments and shows more concern for Afghan people over the political uncertainty. It demonstrating some faith in the Afghan people. When Afghanistan was suffering near-

total economic collapse, India offered humanitarian aid, including wheat, COVID-19 vaccines, and winter clothing, is a natural next step in India's policy of progressive engagement.

### 3. Discussion over India-Afghanistan Trade

To deepen commercial and economic cooperation, both countries are putting efforts. The Preferential Trade Agreement between India and Afghanistan was signed in 2003, and it grants India 100% tariff discounts on 38 products that Afghanistan exports to India. Trade between India and Afghanistan has increased since the air freight corridor was established in 2017. In 2020, India's Imports from Afghanistan was valued \$514.22 million, while India's exports to Afghanistan was worth \$858.04 million, the total trade reached \$1,372.26 Million value.

#### India's Trade relationship with Afghanistan

Table1 India's Trade relationship with Afghanistan: 2001-2021 (US\$ Million)

Year	India's Export to Afghanistan	India's Import from Afghanistan	India's trade volume with Afghanistan	India's BOT with Afghanistan	Export Growth	Import Growth	Trade Growth
2001	20.85	19.93	40.77	0.92	-	-	-
2002	51.67	18.22	69.89	33.45	147.86%	-8.55%	71.42%
2003	124.29	35.00	159.29	89.30	140.56%	92.05%	127.91%
2004	154.40	43.36	197.76	111.04	24.22%	23.89%	24.15%
2005	148.36	55.57	203.93	92.79	-3.91%	28.16%	3.12%
2006	171.96	40.48	212.44	131.47	15.91%	-27.15%	4.17%
2007	232.07	90.55	322.62	141.53	34.96%	123.66%	51.86%
2008	362.27	130.61	492.88	231.66	56.10%	44.25%	52.77%
2009	469.21	120.70	589.92	348.51	29.52%	-7.59%	19.69%
2010	393.50	144.58	538.08	248.92	-16.14%	19.78%	-8.79%
2011	501.67	119.91	621.57	381.76	27.49%	-17.07%	15.52%
2012	479.93	148.64	628.58	331.29	-4.33%	23.97%	1.13%
2013	474.98	209.09	684.07	265.89	-1.03%	40.67%	8.83%
2014	443.05	242.14	685.20	200.91	-6.72%	15.81%	0.17%
2015	533.47	315.47	848.94	218.01	20.41%	30.28%	23.90%

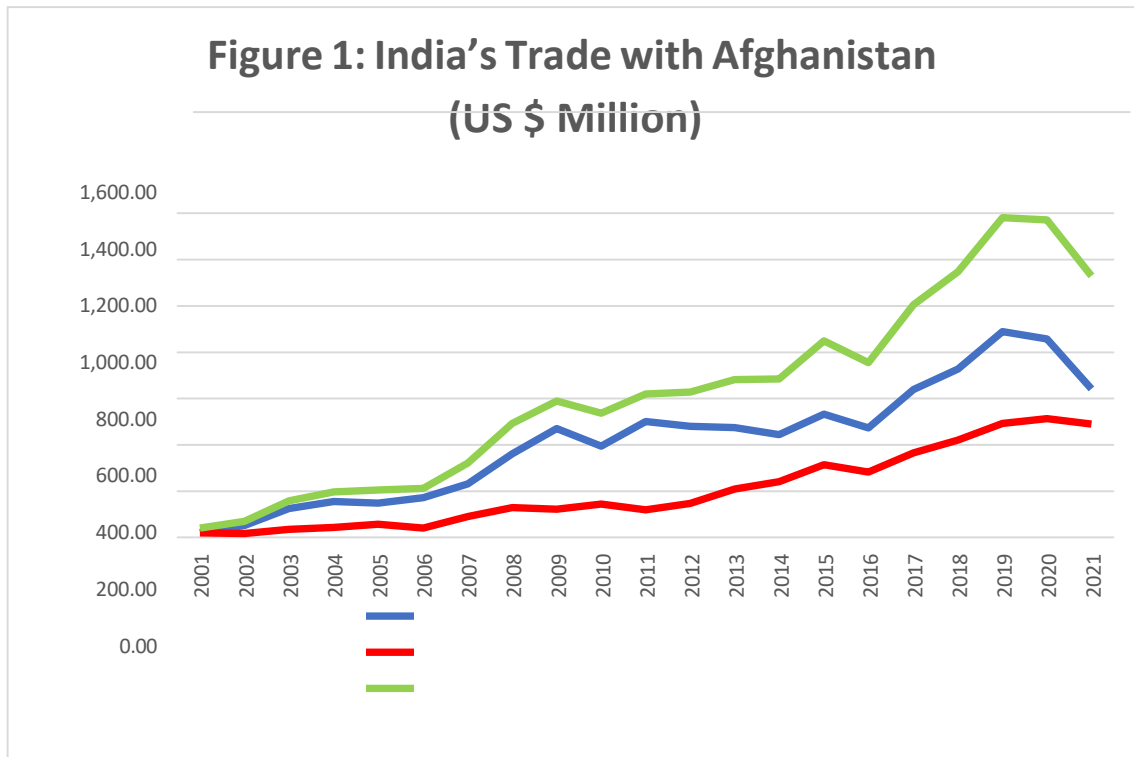
"Table 1. Continued"

Year	India's Export to Afghanistan	India's Import from Afghanistan	India's trade volume with Afghanistan	India's BOT with Afghanistan	Export Growth	Import Growth	Trade Growth
2016	473.57	282.3	755.87	191.27	-11.23%	-10.51%	-10.96%
2017	639.1	366.19	1,005.29	272.91	34.95%	29.72%	33.00%
2018	728.71	420.24	1,148.95	308.47	14.02%	14.76%	14.29%

2019	889.64	492.76	1,382.40	396.88	22.08%	17.26%	20.32%
2020	858.04	514.22	1,372.26	343.83	-3.55%	4.35%	-0.73%
2021	642.03	489.83	1,131.86	152.2	-25.18%	-4.74%	-17.52%

Source: The author's calculations are based on information from the Direction of Trade Statistics (DOTS) Database provided by the International Monetary Fund for the year as on 10th May 2023. <https://data.imf.org/regular.aspx?key=61013712>.

This table shows, India's total export, import, total trade, trade balance, export growth, import growth, and trade growth with Afghanistan for the period 2001 to 2020. All the figures in the table shows a fluctuating trend throughout the study. India's Exports to Afghanistan was lowest with US\$ 20.85 Million in 2001 and highest was in 2019 with US\$ 889.64 Million. India's Imports from Afghanistan lowest of US\$ 18.22 Million in 2002 and highest of US\$ 514.22 Million in 2020. 2017 was the remarkable year for India-Afghanistan trade when export, import and trade balance increased for continuous three years 2017 to 2019, this happened because of establishment of air freight corridor between the countries. Trade growth was also positive for period of study except 2010, 2016 and 2020, 2021. Afghanistan's export growth, import growth, and overall trade growth were all negative by 25.18%, 4.74%, and 17.52% after the Taliban took control of the country in 2021.



In a positive side, India's trade trend with the country almost increasing during the study. Hence, Data reveals that Afghanistan is a good trade partner of India with favourable trade balance.

Government-to-government agreements with Indian corporations account for the majority of Indian exports to Afghanistan mainly includes Pharmaceuticals and medical devices, computers, sugar, and, cement. Afghanistan mainly exports fresh and dried fruits, wool, carpets, etc. to India.

### Uncertain Future of India-Afghanistan Trade

From the fall of Taliban in 2001, to rise of Taliban in 2021 Government of Afghanistan faces challenges of enabling new growth drivers. After the Taliban were overthrown in 2001, the use of trade as a means

of accelerating growth in Afghanistan was crucial. It's been 20 years Afghanistan is still on way of becoming self-reliant country. Trade is the main growth driver for Afghanistan that promoting economic growth and export diversification.

The current state of affairs in Afghanistan is both upsetting and concerning for trade between India and Afghanistan. India seeks a trade route and wants to utilise the nation's undeveloped natural resources to meet its expanding demands. As a result, it combats Pakistan, contain the threat of terrorism, and obtain a transit route to Central Asia.

### 3. A way forward:

Afghanistan which has not even fully recovered from its wounds has been shattered again. In 2021, the Taliban recaptured control of Afghanistan, introducing new difficulties for bilateral relations between India and Afghanistan after 20 years of warfare. Following the US exit from the country, India has less influence in Afghanistan and unwilling to explore interaction with the Taliban. In a more optimistic frame, the Taliban has indicated that it would like to forge strong ties and foster the setting where all nations may engage in trade that is advantageous to their immediate neighbours and the region as a whole.

However, trusting militant Islamist groups is not just a simple issue to solve. Only if Afghanistan ensures that terrorist Islamic groups don't use its territory to threaten or attack other countries will its neighbours and the region as a whole feel secure. In addition to all of this unpredictability, the humanitarian catastrophe in Afghanistan worries India. India took action to secure Indians, address COVID-19 issues, provide life-saving medications as humanitarian aid, address strategic concerns, and support development. Through this, India can continue to uphold its bond with the Afghan people.

Furthermore, India must maintain a diplomatic presence in Afghanistan. India ought to seek to deepen its ties with Iran, Russia, and China, and find ways to reach a consensus with the US about the future of Afghanistan. India must cooperate with other regional nations to safeguard its interests and stabilize Afghanistan after the US withdraws its troops.

India must wait for the time being to see how the Taliban's new administration truly treats its neighbours in the region. Indian interests in Afghanistan will be suspended until that time. In order to remain operational, Indian initiatives in Afghanistan need a "supportive environment." If both nations try to demonstrate more confidence in one another, the India-Afghanistan relationship will improve significantly in the future.

### 4. References:

- Ashraf, F. (2007). India -Afghanistan Relations: POST-9/11. *Strategic Studies* , 27(2), 90-102. Retrieved from <https://www.jstor.org/stable/45242397>
- Basu, P. P. (2007). India and Post-Taliban Afghanistan: Stakes, Opportunities and Challenges. *India Quarterly: A Journal of International Affairs*, 63(84), 83-122. Retrieved from <http://iqq.sagepub.com/content/63/3/84.citation>
- Bhatnagar, S., & Ahmed, Z. S. (2020). Geopolitics of landlocked states in South Asia: a comparative analysis of Afghanistan and Nepal. *Australian Journal of International Affairs*. Retrieved from <https://doi.org/10.1080/10357718.2020.1793896>
- Fair, C. C. (2010). *India in Afghanistan and Beyond: Opportunities and Constraints*. The Century Foundation. Retrieved from <http://ssrn.com/abstract=1681753>
- Ganguly , S., & Howenstein, N. (2009). India-Pakistan Rivalry in Afghanistan. *Journal of International Affairs Editorial Board*, 63(1), 127-140. Retrieved from <http://www.jstor.org/stable/24384176>
- Kaura, V. (2017). India-Afghanistan Relations in the Modi-Ghani Era. *Indian Journal of Asian Affairs*, 30(1/2 (June-December)), 29-46. Retrieved from <https://www.jstor.org/stable/10.2307/26465815>

- Pant, H. (n.d.). *India in Afghanistan: A Rising Power or Hesitant Power?* The Centre for International Peace and Security Studies (CIPSS). McGill University. Retrieved from <http://www.cepsi.umontreal.ca>
- Pant, H. V. (2010). India in Afghanistan: a test case for a rising power. *Contemporary South Asia*, 18(2), 133–153. Retrieved from <http://dx.doi.org/10.1080/09584931003674984>
- Pant, H. V. (2013). India in Afghanistan: A Trajectory in Motion. *Jadavpur Journal of International Relations*, 17(1), 103–127.
- Price, G. (2013). *India's Policy towards Afghanistan*. Chatham House.
- Raiphea, Y. P. (2013). India-Afghanistan Strategic Partnership: An Analysis of India, Afghanistan and Pakistan Perspectives. *International Journal of Scientific and Research Publications*, 3(4).
- Roy, M. S. (2001). India's interests in Central Asia. *Strategic Analysis*, 24(12), 2273- 2289. Retrieved from <http://dx.doi.org/10.1080/09700160108455352>



# A STUDY ON THE IMPACT OF ONLINE MODE OF EDUCATION ON UG STUDENTS DURING COVID-19 PERIOD

**Devanarayanan Unni,**

Amrita Vishwa Vidyapeetham, Amrita School of Business, Bengaluru, India

[unnidevan99@gmail.com](mailto:unnidevan99@gmail.com)

Delivery of classes through an online medium had a modification brought out by the education system in India during the time of the pandemic situation. This research paper aims to study the impact of the online mode of education on UG students during the COVID 19 pandemic period. The online survey method was used for data collection, and the survey was conducted using a structured questionnaire. We intent to collect data from 170 UG students from various colleges and universities in the state of Kerala during the academic period of 2018-2022. I assume the Findings could show that students improved their academic performance in the online mode of education.

**Keywords:** Pandemic situation, Online medium, Education system, COVID, Universities

## 1. INTRODUCTION

The virtual world saved people's normal lives when the COVID-19 outbreak interrupted them all across the world. Schools and colleges, and many other organizations, have also moved to virtual platforms to offer classes online.

As a result, online education became a substitute for traditional face-to-face classroom instruction, meeting the needs of students in all educational levels, from pre-primary to university. As a result, several stakeholders, including governmental and private organizations, made every effort to encourage one another by improving their current online platforms and apps and giving teachers training on how to effectively use these tools.

Students and teachers entered a new world of virtual lectures, tutorials, and exams, with tens of thousands of students riveted to computers and smartphone screens. Even though e-learning presented access and technical challenges for both professors and students, it kept everyone occupied with lectures, worksheets, and assignments. All of India's educational establishments relied only on conventional teaching techniques, which entailed in-person lectures in classroom settings. The globe was shocked by the rapid emergence of a fatal COVID-19 virus caused by the coronavirus, which presented challenges to the global education system. Staff and students' preparedness for the new adjustments was assessed and appropriate help was provided. When it came to adjusting to a new learning environment, learners with a growth mentality did so more quickly than those with a fixed perspective. For online learning, There were several subjects, each with different requirements. Different strategies for online learning were needed for different subjects and age groups. Students with physical disabilities have been given more flexibility to engage in virtual learning environments through online learning, even with restricted mobility.

The teachers were able to design training, skill development, and instructional courses using some of the online platforms that they have used thus far, including Google Classroom, Canvas, Blackboard, Microsoft Teams, and Blackboard. In order to keep classes structured and simple to work in, they introduced options for workplace chat, video meetings, and file storage. Typically, they allowed the exchange of numerous types of content, including Word, PDF, Excel, audio, and video files, among many others. Through the use of quizzes and the rubric-based assessment of turned in assignments, these also made it possible to monitor students' learning and evaluation. A lot of educational organizations provided their solutions and tools for free in order to assist and promote more engaging and dynamic teaching and learning environments. For the research purpose, the data was collected through Google forms and the secondary analysis was done using SPSS software.

## 2. LITERATURE REVIEW

## **E-Learning Attitudes During COVID-19 Pandemic: A Global Perspective**

**(R.Radha, et al)**

**Sathishkumar, V., Radha, R., Saravanakumar, A., & Mahalakshmi, K. (2020, June 1).** :- A study conducted by Sathishkumar et al. (2020) investigated students' attitudes towards e-learning during the COVID-19 pandemic. The study involved 175 students from various colleges and universities using online questionnaires. The findings showed that while many students had positive thoughts about online learning, many preferred face-to-face learning. The study also explored the impact of e-learning on student interest and performance. The research paper aimed to study the impact of online education on undergraduate students in Kerala during the academic period of 2018-2022. The study used an online survey method and a structured questionnaire, with the aim of revealing whether students improved their academic performance in the online mode of education.

## **Determinants of Students' Perceived Learning Outcome (Hasnan Baber) (2020, August**

Baber's study explores the factors influencing students' perceived learning outcomes and satisfaction in online learning during the COVID-19 pandemic. It found that classroom interaction, student motivation, course structure, and instructor knowledge positively impact these outcomes.

## **Acceptability and Challenges of Online Higher Education (Raj Kishor Bisht, et al) (2020, September 1) :-**

The study examines the acceptability of online higher education during the COVID-19 era. It found low pressure in online exams and that gender plays a role in adapting to online education. Female students were found to be more adaptable in terms of assignments, study patterns, and comfort. The study highlights the need for more inclusive and accessible online education for students.

## **Effectiveness of E-Learning in Medical Undergraduates (Nimarpreet Kaur, et al,2020, January 1):-**

The study by Nimarpreet Kaur et al. compared the effectiveness of e-learning to traditional teaching in medical undergraduates during the COVID-19 pandemic. The researchers found that online classes were effective but not superior to traditional teaching. The study concluded that e-education can supplement the current education process but cannot replace the established system of education. The study highlights the need for a more comprehensive approach to education.

## **Trend in Using Online Meeting Applications for Learning (Hendri Pratama, et al,(2020, December 23) :-**

The study by Pratama, Azman, Kassymova, and Duisenbayeva (2020) explores the trend of using online meeting applications for learning during the COVID-19 pandemic. The authors suggest that virtual classrooms through these applications are efficient, practical, and safe, and suggest integrating this approach into future learning.

## **Impact of Online Learning during COVID-19 (Deepika Nambiar)(2020, June 25) :-**

The study explores the impact of online learning during COVID-19, finding that face-to-face learning is perceived more positively, but online classes are perceived as less effective and structured.

## **Global Impact of E-Learning during COVID-19 (Vishal Dinesh Kumar Soni)(2020, January 1):-**

The article highlights the global impact of e-learning during the COVID-19 pandemic, emphasizing its importance as a global benefit.

**Critical Challenges and Factors Influencing E-Learning System Usage (Mohammed Amin Almaiah, et al)(2020, May 22) :-** The study by Mohammed Amin Almaiah, et al. (2020) identifies several critical

challenges and factors affecting e-learning system usage during COVID-19, including technological, quality, cultural, self-efficacy, trust, change management, technical issues, and financial support.

### **Learner's Perception of Online Learning During COVID-19 (Markus Deli Girik Allo)(2020, April 1):-**

The study explores learners' perception of online learning during the COVID-19 pandemic, focusing on factors like internet access, financial issues, and implementation, revealing positive attitudes towards online learning.

### **Impact of Online Classes on Student Satisfaction (Ram Gopal and Varsha Singh).(2021, April 21) :-**

Ram Gopal and Varsha Singh's study on the impact of online classes on student satisfaction during the COVID-19 pandemic highlights the positive effects of instructor quality, course design, prompt feedback, and student expectations on satisfaction and performance.

## **3. METHODOLOGY AND RESEARCH METHODS**

In this Research endeavor, a descriptive research design was adapted to develop into newly explored fields, aiming to provide a comprehensive understanding of the targeted phenomenon. The primary data was gathered through a web-based survey employing a structured questionnaire with both open ended and likert scale questions. The sample selected served as the main source for collecting primary data, reflecting a direct engagement with the study's participants. Subsequent data analysis involved a two-step process, initially utilizing SPSS software and further employing critical analysis through the Chi-Square statistical method. The careful integration of these methodological components contributes to the overall rigor of the study, providing a robust foundation for drawing meaningful conclusions. Considerations such as sample representation, instrument reliability and validity, ethical aspects, limitations, and the accurate interpretation of statistical results were acknowledged to enhance the research's credibility and applicability.

## **4. RESULT AND DISCUSSION**

A total of 170 students from different UG courses studied in various colleges in kerala during the academic period of 2018-2022 participated in the research and the investigation set out to explore the satisfaction of online mode of education during covid-19 period with two categorical variables, namely gender and course. The null hypothesis (H0) posited no significant association, while the alternative hypothesis (H1) proposed a noteworthy connection. The statistical analysis, utilizing Chi-square, yielded a p-value of 0.032. This p-value falling below the conventional significance threshold of 0.05 indicates a statistically significant association.

Here, the null hypothesis was rejected. Gender and course type have a major influence on students' satisfaction levels, according to the report, which comes from a detailed review of data collected on the impact of online education during the COVID-19 era. The fact that the null hypothesis is rejected offers proof that variables like gender and the kind of course matter when it comes to how satisfied undergraduate students are with their online education.

The results hold significant ramifications for academic establishments looking to improve the virtual learning environment. Acknowledging the impact of gender and course type on students' happiness, educational institutions can customize their approaches to better cater to the varied requirements of their student population. This might entail putting in place focused support systems, individualized teaching strategies, or particular resources for certain

The findings also emphasize how critical it is to recognize and resolve any discrepancies in satisfaction that may exist between various student cohorts. For example, knowing the particular difficulties that male and female students, as well as those pursuing different kinds of courses, experience helps direct the creation of more inclusive and efficient online learning procedures.

## **5. CONCLUSION**

Although this study clarifies the noteworthy correlations discovered, it's critical to recognize some limitations. The study is limited to the particular setting of the COVID-19 era, and future factors may be included due to the continuously changing nature of online education. Variations in satisfaction may also be attributed to other characteristics not investigated in this study, such as past online learning experience or socioeconomic level. Conclusively, this study offers significant perspectives on the complex correlation among gender, course type, and students' contentment with virtual learning during the COVID-19 pandemic. Through addressing these elements, academic institutions may improve their strategies and, in the end, create an online learning environment that is more inclusive and satisfying for all students. More investigation is necessary to examine new developments and other elements that can affect students' satisfaction in this ever-changing educational environment as online learning continues to develop.

## REFERENCES

- Almaiah, M. A., Al-Khasawneh, A., & Althunibat, A. (2020, May 22). *Exploring the critical challenges and factors influencing the E-learning system usage during COVID-19 pandemic*. Education and Information Technologies. <https://doi.org/10.1007/s10639-020-10219-y>
- Allo, M. D. G. (2020, April 1). Learner's Perception of Online Learning During COVID-19**. [https://www.researchgate.net/publication/340815846\\_Is\\_the\\_online\\_learning\\_good\\_in\\_the\\_midst\\_of\\_Covid-19\\_Pandemic\\_The\\_case\\_of\\_EFL\\_learners](https://www.researchgate.net/publication/340815846_Is_the_online_learning_good_in_the_midst_of_Covid-19_Pandemic_The_case_of_EFL_learners)
- Baber, H. (2020, August 23). *Determinants of Students' Perceived Learning Outcome and Satisfaction in Online Learning during the Pandemic of COVID-19*. [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3679489](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3679489)
- Bisht, R. K., Jasola, S., & Bisht, I. P. (2020, September 1). *Acceptability and challenges of online higher education in the era of COVID-19: a study of students' perspective*. Asian Education and Development Studies. <https://doi.org/10.1108/aeds-05-2020-0119>
- Gopal, R., Singh, V., & Aggarwal, A. (2021, April 21). *Impact of online classes on the satisfaction and performance of students during the pandemic period of COVID 19*. Education and Information Technologies. <https://doi.org/10.1007/s10639-021-10523-1>
- Kaur, N., Dwivedi, D., Arora, J., & Gandhi, A. (2020, January 1). *Study of the effectiveness of e-learning to conventional teaching in medical undergraduates amid COVID-19 pandemic*. National Journal of Physiology, Pharmacy and Pharmacology. <https://doi.org/10.5455/njppp.2020.10.04096202028042020>
- Nambiar, D. (2020, June 25). *The impact of online learning during COVID-19: students' and teachers' perspective*. International Journal of Indian Psychology. <https://doi.org/10.25215/0802.094>
- Pratama, H., Azman, M. N. A., Kassymova, G. K., & Duisenbayeva, S. S. (2020, December 23). *The Trend in Using Online Meeting Applications for Learning During the Period of Pandemic COVID-19: A Literature Review*. Journal of Innovation in Educational and Cultural Research. <https://doi.org/10.46843/jiecr.v1i2.15>

## STUDY ON EMPLOYEE PERCEPTION ON THEIR ROLE OF EMPLOYEE ADVOCACY IN SOCIAL MEDIA MARKETING

**AKHILA S KUMAR,**

Amrita School of Business, Amrita Vishwa Vidyapeetham, Bengaluru, India

[akhiskumar123@gmail.com](mailto:akhiskumar123@gmail.com)

**ANAND JAYACHANDRAN,**

Amrita School of Business, Amrita Vishwa Vidyapeetham, Bengaluru, India

[amand4561@gmail.com](mailto:amand4561@gmail.com)

Employee advocacy is an important technique in social media marketing since it allows workers to promote and share business content on their personal social media networks. By transforming employees into brand ambassadors, this technique may increase a company's online presence, improve brand perception, and drive success. Customers value employees' personal experiences and ideas, and their extensive network of contacts extends a company's reach beyond its intended audience. When workers favorably recommend their companies, it may enhance consumer engagement and loyalty, resulting in more likes, shares, and comments on the company's content. Companies must develop a supportive work culture, offer proper training, and use existing tools and platforms to effectively leverage employee advocacy. To collect extensive and reliable data, the study design employs a descriptive technique. To obtain extensive and reliable information, the study methodology employs a descriptive technique, concentrating on newly found domains. Using Google forms, a web-based poll was constructed, allowing for speedy data collection. The major data source was the gathered sample, which was obtained via a web-based survey with a structured questionnaire. This strategy broadens one's understanding of new domains. The study's key question is, "How do individuals within an organization perceive the importance of employee advocacy in Social Media Marketing and specific psychological aspects that contribute to employee success

**Keywords:** Employee Advocacy, Employee, Social Media Marketing, Perception, Psychological Factors.

### 1. INTRODUCTION

In today's cutthroat business environment, where businesses constantly seek innovative ways to connect with their target audience and boost brand presence, social media has emerged as a pivotal tool. While traditional marketing methods continue to hold sway, a novel approach known as employee advocacy has gained prominence, reshaped the dynamics of social media marketing, and altered how businesses engage with their consumers.

Employee advocacy involves empowering and motivating employees to share corporate information through their personal social media networks. Leveraging the extensive reach and credibility of employees transforms them into brand ambassadors, enhancing online presence, brand perception, and overall company success. This approach, distinct from traditional marketing, offers several advantages in today's social media-driven environment. Employees contribute personal experiences and thoughts, injecting authenticity and credibility into the brand. This authenticity is crucial, as customers tend to trust content generated by employees more than brand-generated material. Moreover, employees have a broader network, enabling businesses to extend their reach beyond the local audience. Positive employee endorsements play a pivotal role in building a favorable brand image, fostering consumer loyalty, trust, and satisfaction.

To fully capitalize on the benefits of employee advocacy, companies must cultivate a supportive environment that encourages communication and rewards involvement. Identifying committed individuals aligned with the company's goals, providing comprehensive training and resources, and leveraging accessible tools and platforms are critical steps. Recognition programs further reinforce positive behaviors, enhancing the effectiveness of employee advocacy.

Measuring the success of an employee advocacy program involves monitoring key indicators such as staff involvement, content reach and engagement, brand sentiment, website traffic, leads, sales, and income. This comprehensive analysis allows companies to gauge the impact of employee advocacy on various aspects of their business, highlighting its transformative role in the digital age.

Transitioning to the statement of the problem, a study aims to investigate how employees perceive their role as social media brand ambassadors and their willingness to participate in brand advocacy activities across different social media networks. Utilizing quantitative methods, the study employs surveys distributed through Google Forms to assess workers' attitudes, motivations, and perceived barriers regarding their engagement in social media advocacy. This research provides valuable insights for companies seeking to improve their social media marketing initiatives and bridge the gap between employee views and corporate expectations.

In conclusion, the impact of employee advocacy on social media marketing cannot be denied. It has truly transformed the landscape, providing businesses with a powerful tool to spread their brand message and foster connections with their customers. The ongoing research seeks to close the knowledge gap between employee perspectives and corporate expectations, shedding light on the psychology, motives, and challenges that employees face in this evolving aspect of contemporary brand promotion strategies. By understanding these dynamics, companies can develop more effective strategies, foster an advocacy culture, and increase employee and target audience participation in social media marketing initiatives.

## **2. LITERATURE REVIEW**

The integration of social media into marketing strategies has led to the rise of employee advocacy, a concept that has both advantages and disadvantages. The effectiveness of these campaigns is heavily influenced by employee opinions. To create effective strategies and foster a successful environment, it is crucial to understand and analyze employee perceptions in social media marketing. This literature review investigates the relationship between employee perceptions and advocacy in social media marketing, focusing on key topics such as employee motivations, communication and organizational culture, customer engagement and brand image, and ethical and practical issues in employee advocacy on social media. The review aims to provide insights into the implications for organizational strategies leveraging social media for employee advocacy.

Laitinen's (2021) work, "Battle for Talent - Developing Social Media Employee Advocacy to Support Recruitment Communication," underscores the concept of social media employee advocacy as a tool for enhancing recruitment communication and attracting top talent. The advantages, including enhanced brand recognition, employee sense of belonging, and the ability to showcase organizational culture and diversity, are emphasized, along with practical suggestions for building an employee advocacy program.

Similarly, Venciūtė et al.'s (2023) study focuses on the impact of employees' social media advocacy on attitudes toward the brand, highlighting the mediating role of parasocial relationships. The findings reveal that social media advocacy positively influences brand sentiments through parasocial interactions.



Conversely, Lut's (L. L. T. Y., 2023) research on employee advocacy in Finnish B2B organizations uncovers hurdles, including lack of time, social media knowledge, company support, and fear of mistakes. The study recommends that companies facilitate employee advocacy through training, developing a social media policy, and encouraging positive content sharing.

Lee and Kim's (2020) exploration of enhancing employee advocacy on social media through an internal relationship management approach delves into the evolution of employee advocacy on digital platforms. The paper analyzes the impact on brand reputation, consumer behavior, challenges faced in implementation, and strategies for measuring success.

Kuutsa's (2016) work on the interrelationship between employee advocacy in social media and employee engagement highlights the varying needs in different industries and customer bases. The study emphasizes the importance of adaptable approaches, continuous learning, and aligning initiatives with customer relationship management strategies for success.

### **3. METHODOLOGY AND RESEARCH METHODS**

In this research endeavor, a descriptive research design was adopted to delve into newly explored fields, aiming to provide a comprehensive understanding of the targeted phenomenon. The primary data were gathered through a web-based survey employing a structured questionnaire with both close-ended and linear scale questions. Google Forms facilitated the efficient distribution of the questionnaire, ensuring speed in data acquisition. The sample selected served as the main source for collecting primary data, reflecting a direct engagement with the study's participants. Subsequent data analysis involved a two-step process, initially utilizing SPSS software and further employing critical analysis through the Chi-Square statistical method. The careful integration of these methodological components contributes to the overall rigor of the study, providing a robust foundation for drawing meaningful conclusions. Considerations such as sample representation, instrument reliability and validity, ethical aspects, limitations, and the accurate interpretation of statistical results were acknowledged to enhance the research's credibility and applicability.

### **4. RESULTS AND DISCUSSIONS**

A total of 110 employees from different sector participated in the research and the investigation set out to explore the association between employees' perception of employee advocacy in social media marketing and two categorical variables, namely gender and age. The null hypothesis (H<sub>0</sub>) posited no significant association, while the alternative hypothesis (H<sub>1</sub>) proposed a noteworthy connection. The statistical analysis, utilizing Chi-square, yielded a p-value of 0.032. This p-value falling below the conventional significance threshold of 0.05 indicates a statistically significant association. Consequently, the null hypothesis is rejected, supporting the conclusion that a significant relationship exists between the perception of employee advocacy in social media marketing and the categorical variables of gender and age among employees.

The discerned association suggests that gender and age play pivotal roles in shaping employees' perceptions of advocacy in social media marketing within the organizational context. This finding aligns with the evolving landscape of social media dynamics, where demographic factors can influence how individuals engage with and perceive advocacy initiatives. The statistically significant association implies that organizations might need tailored strategies for employee advocacy programs, considering the diverse perspectives associated with gender and age.

Moreover, understanding these associations can contribute to more effective communication strategies within the workplace. For instance, organizations could customize advocacy campaigns to resonate better with specific gender or age groups, thereby maximizing the impact of their initiatives. Additionally, these results prompt further inquiry into the specific factors that may contribute to the observed associations, enabling organizations to refine their approaches and enhance overall employee engagement in social media advocacy.

In conclusion, the study not only establishes a statistically significant association but also underscores the importance of considering demographic variables when designing and implementing employee advocacy programs. As organizations navigate the dynamic realm of social media marketing, recognizing, and leveraging the nuances associated with gender and age can prove instrumental in fostering a more resonant and impactful advocacy culture among employees.

## 5. CONCLUSION

The analysis results unequivocally lead to the rejection of the null

hypothesis and acceptance of the alternative hypothesis. This signifies compelling evidence indicating a significant association between employees' perception of employee advocacy in social media marketing and their gender and age categories. The implications of this finding are noteworthy, suggesting that gender and age are influential factors shaping how employees perceive the efficacy and impact of employee advocacy initiatives in the realm of social media marketing within the organizational context. The identified association underscores the need for organizations to recognize and account for demographic variations when conceptualizing and executing employee advocacy programs. Tailoring strategies to resonate with the unique perspectives associated with different genders and age groups may enhance the overall effectiveness of advocacy initiatives. This insight aligns with the evolving nature of social media dynamics, where personalized approaches are increasingly recognized as essential for engagement and resonance.

To gain a more nuanced understanding of these associations, future avenues of research could involve qualitative investigations or targeted studies focusing on specific age or gender cohorts. Qualitative research methods, such as interviews or focus group discussions, may unveil deeper insights into the underlying factors that contribute to the observed associations. This could provide organizations with actionable information to refine their strategies, fostering a more inclusive and impactful employee advocacy culture. In conclusion, this study not only contributes to the growing body of knowledge regarding employee advocacy in social media marketing but also underscores the necessity of considering demographic factors in the design and implementation of such initiatives. Recognizing the role of gender and age in shaping perceptions enables organizations to navigate the nuanced landscape of social media advocacy more effectively, ultimately enhancing employee engagement and the success of these initiatives within the modern workplace.

## REFERENCES

Aisling, K. G. (2019, December 1). Employee brand advocacy in social media: employers absent roles. <https://research.thea.ie/handle/20.500.12065/3026>

- Bhargava, V. (2023, July 18). What is Employee Advocacy on social media and How to Measure It? Radarr. <https://www.radarr.com/blog/what-is-employee-advocacy-on-social-media/>
- H. (2023, March 4). Encouraging Employee Advocacy in B2B LinkedIn Marketing. BAMF Media. <https://bamf.com/encouraging-employee-advocacy-in-b2b-linkedin-marketing/>
- Khan, B. (2021, October 7). 11 Actionable Tips for Encouraging Employees to Share Content. PostBeyond. <https://www.postbeyond.com/blog/11-actionable-tips-for-encouraging-employees-to-share-content/>
- Ku, D. (2022, November 21). How to Start An Employee Advocacy Program From Scratch. PostBeyond. <https://www.postbeyond.com/blog/start-employee-advocacy-from-scratch/>
- Kuutsa, M. (2016). The interrelationship between employee advocacy in social media and employee engagement. LUTPub. <https://lutpub.lut.fi/handle/10024/127220>
- Laitinen, H. (2021). Battle for talent - developing social media employee advocacy to support recruitment communication. Theseus. <https://www.theseus.fi/handle/10024/502281>
- Lee, Y., & Kim, K. H. (2020, August 6). Enhancing employee advocacy on social media: the value of internal relationship management approach. Corporate Communications: An International Journal. <https://doi.org/10.1108/ccij-05-2020-0088>
- Lut, L. L. T. Y. (2020). Employee advocacy in social media : employees' point of view in Finnish B2B organizations. LUTPub. <https://lutpub.lut.fi/handle/10024/160904>
- Herman, M. (2022, November 24). Employee Advocacy on Social Media: Benefits, Examples & Strategies. LumApps. <https://www.lumapps.com/employee-engagement/what-is-employee-advocacy-benefits-examples-strategies/>
- Hill, C. (2023, September 27). Brand amplification matters: Reintroducing Employee Advocacy by Sprout Social. Sprout Social. <https://sproutsocial.com/insights/employee-advocacy-by-sprout-social/>

## ASSESSING REGULATORY COMPLIANCE IN INFORMATION SYSTEM AUDITS: PERSPECTIVES FROM THE INDIAN BANKING INDUSTRY

**ROUNIKA DHOOT**

Jai Narain Vyas University, Jodhpur, India.

**Dr.MANGU RAM**

Department of Accounting, Jai Narain Vyas University, Jodhpur,India.

In the rapidly evolving landscape of the Indian banking sector, this research paper presents a comprehensive examination of the regulatory compliance landscape within the realm of information system audits. As financial institutions increasingly rely on technology to facilitate transactions and manage sensitive data, the alignment of information system audits with regulatory standards becomes paramount for ensuring the security and stability of the financial ecosystem. This study delves into the multifaceted perspectives of key stakeholders, including regulatory authorities, auditors, and banking institutions, shedding light on the challenges, best practices, and opportunities associated with regulatory compliance. Drawing on a mixed-methods approach encompassing surveys, interviews, and document analysis, the research navigates through the intricate regulatory frameworks governing information security in the Indian banking industry. Perspectives from regulatory authorities provide insights into expectations, challenges, and future considerations, while auditors' experiences and challenges illuminate the intricacies of ensuring compliance. Examining the compliance practices of banking institutions offers a nuanced understanding of the policies and procedures implemented to meet regulatory standards. The study not only identifies common challenges but also presents recommendations for enhancing collaboration between regulators, auditors, and banking institutions. By assessing the regulatory compliance in information system audits, this research contributes valuable insights to policymakers, auditors, and banking professionals striving to fortify the cybersecurity posture of the Indian banking industry in an era of increasing digital interconnectedness.

Key words: Regulatory Compliance, Information System Audits, Banking Industry, Cyber security, Collaboration

### **1. Introduction**

In the dynamic landscape of the Indian banking sector, marked by rapid technological advancements and an increasing reliance on digital infrastructure, the integrity and security of information systems stand as pivotal elements for financial stability. As financial institutions leverage technology to streamline operations, facilitate transactions, and manage sensitive data, the alignment of information system audits with stringent regulatory standards becomes indispensable. This research paper undertakes a comprehensive examination of the regulatory compliance landscape within the domain of information system audits, aiming to shed light on the multifaceted perspectives of key stakeholders—regulatory authorities, auditors, and banking institutions. Through an exploration of challenges, best practices, and opportunities associated with regulatory compliance, this study seeks to contribute nuanced insights to the ongoing discourse surrounding cyber security in the Indian banking industry.

The advent of digitalization has transformed the banking sector, introducing efficiencies and conveniences but also amplifying the risks associated with cyber threats. The increased interconnectivity and complexity of information systems demand a robust framework that ensures the confidentiality, integrity, and availability of financial data. In this context, information system audits play a pivotal role in evaluating the effectiveness of security controls, risk management practices, and overall compliance with regulatory directives.

As financial institutions navigate an intricate regulatory landscape, this study employs a mixed-methods approach to navigate the complexities of information security regulations in the Indian banking industry. The methodology integrates surveys, interviews, and document analysis to capture the diverse perspectives of stakeholders. By delving into the expectations, challenges, and future considerations from the standpoint of regulatory authorities, the research aims to provide a holistic understanding of the regulatory environment shaping information system audits.

The insights derived from auditors' experiences and challenges form a crucial dimension of this research. Auditors, as key actors in the implementation of information system audits, bring forth their unique insights into the intricacies of ensuring compliance. Their perspectives illuminate the practical challenges faced during audits and offer valuable reflections on the effectiveness of existing regulatory frameworks.

Examining the compliance practices of banking institutions adds depth to the study by providing a firsthand account of how regulatory standards are translated into policies and procedures. This nuanced exploration facilitates a comprehensive understanding of the strategies employed by banks to meet regulatory requirements. By considering the implementation aspect, the study aims to bridge the gap between regulatory expectations and practical application within the banking sector. The study is situated at the intersection of compliance, cybersecurity, and collaborative efforts within the Indian banking sector. Through an in-depth analysis of the regulatory frameworks governing information security, the research aims to identify common challenges faced by both regulatory bodies and financial institutions. By highlighting best practices and opportunities for improvement, the study contributes actionable recommendations to enhance collaboration between regulators, auditors, and banking institutions.

This research endeavors to assess the regulatory compliance in information system audits within the Indian banking industry. The findings aim to be of value not only to academics and researchers but, more critically, to policymakers, auditors, and banking professionals. By offering insights into the challenges and opportunities associated with regulatory compliance, the study aspires to contribute to the ongoing efforts to fortify the cyber security posture of the Indian banking industry in an era characterized by escalating digital interconnectedness and cyber threats.

## 2. Literature Review

Reserve Bank of India. (2021). "Master Circular - Cyber Security Framework in Banks :This document outlines the RBI's comprehensive framework for cybersecurity in banks, providing guidelines and standards to safeguard financial systems and customer information.

Singh, A., & Kapoor, M. (2020). "Challenges and Opportunities in Implementing Information Security Policies: A Case Study of Indian Banks. :This journal article explores the difficulties and prospects in implementing information security policies in Indian banks, offering insights from a case study perspective.

Patel, N., & Joshi, A. (2019). "Auditing the Digital Fortress: A Study of Information System Audits in Indian Banks.:Focused on information system audits in Indian banks, this research investigates challenges and nuances, providing a comprehensive understanding of the digital audit landscape.

Gupta, R., & Sharma, S. (2018). "Regulatory Compliance and Cybersecurity in the Indian Banking Sector: An Analysis of Current Practices.:This scholarly article analyzes the practices

and challenges related to regulatory compliance and cybersecurity in the Indian banking sector, offering a contemporary perspective.

National Institute of Standards and Technology. (2017). "Framework for Improving Critical Infrastructure Cybersecurity.:NIST's framework provides a structured approach to enhancing cybersecurity in critical infrastructures, offering guidelines and best practices for managing and reducing cyber risks.

Objectives of the study

1. To Evaluate the Current State of Regulatory Compliance in Information System Audits
2. To Identify Challenges and Opportunities in Achieving Regulatory Compliance

Regulatory frameworks governing information security in the Indian banking sector

The Indian banking sector operates within a regulatory framework designed to ensure the integrity, confidentiality, and availability of financial information, thereby safeguarding the stability of the financial system. The Reserve Bank of India (RBI), as the central banking authority, plays a pivotal role in formulating and implementing key regulatory frameworks for information security.

The "Master Circular - Cyber Security Framework in Banks" issued by the RBI serves as a cornerstone document outlining comprehensive guidelines for banks to strengthen their cybersecurity postures. This circular delineates expectations for banks in areas such as information security policies, risk management, and the establishment of a cybersecurity framework.

In addition to the RBI's guidelines, the Information Technology Act, 2000, provides a legal foundation for electronic transactions and addresses aspects of data protection, privacy, and cybersecurity. Banks often align their information security management systems with the global standard ISO 27001, demonstrating adherence to internationally recognized best practices.

The Payment Card Industry Data Security Standard (PCI DSS) is another critical framework, particularly for banks involved in card transactions. Compliance with PCI DSS ensures the secure handling of cardholder data.

Furthermore, the National Cyber Security Policy (NCSP) of 2013 offers a broader strategic vision for enhancing cybersecurity across various sectors, including banking. The policy emphasizes the importance of collaboration between the government, industry, and other stakeholders to address emerging cyber threats effectively.

As the digital landscape evolves, regulatory frameworks continue to adapt to emerging challenges, reflecting a commitment to maintaining the resilience and security of the Indian banking sector in the face of evolving cyber threats.

Challenges in information system audits

Effective regulatory compliance in information system audits faces several challenges within the intricate landscape of the financial industry. One prominent challenge is the rapid evolution of technology, which often outpaces the formulation and adaptation of regulatory frameworks. Financial institutions continually adopt new systems and technologies, creating a dynamic environment that can strain the ability of regulations to keep pace.

Another challenge stems from the complexity of regulatory requirements themselves. The multiplicity of regulations from different authorities, each with its own set of guidelines, can lead to ambiguity and confusion. Financial institutions must navigate through these intricacies to ensure a comprehensive and cohesive compliance strategy.



Resource constraints pose a significant challenge for many organizations. Smaller financial institutions, in particular, may struggle to allocate sufficient resources, both in terms of personnel and technology, to meet the demands of comprehensive information system audits. This challenge is exacerbated by the shortage of skilled cybersecurity professionals, making it difficult for organizations to maintain a robust and proactive security posture.

The ever-evolving threat landscape also presents a formidable obstacle. Cyber threats are becoming increasingly sophisticated, requiring continuous adaptation of security measures. Ensuring compliance with emerging threats poses a perpetual challenge for regulators and financial institutions alike.

Additionally, there is a challenge associated with the global nature of financial transactions. Many financial institutions operate on an international scale, and varying regulatory requirements across jurisdictions can lead to compliance challenges. Harmonizing regulatory expectations globally remains an ongoing process.

Lastly, a cultural shift towards prioritizing cybersecurity within organizations is crucial. Establishing a cybersecurity-conscious culture requires concerted efforts in education and training, and it often involves changing long-standing practices and mindsets.

Addressing these challenges requires a collaborative effort among regulatory bodies, financial institutions, and other stakeholders. Continuous communication, regular updates to regulatory frameworks, and a commitment to resource allocation and education are essential components of overcoming these obstacles and ensuring effective regulatory compliance in information system audits.

### Data analysis For Auditors

1. Please indicate the extent to which you strongly agree to strongly disagree with the statement: "I have encountered specific challenges in ensuring regulatory compliance during information system audits in the Indian banking industry."

Table:1 Encountered specific challenges

s.no	Particular	Observation(N)	Percentage
1	Strongly Disagree	5	5%
2	Disagree	8	8%
3	Neutral	11	11%
4	Agree	40	40%
5	Strongly Agree	36	36%
sum		100	100
Count(N)		5	
Mean Score		3.94	
Standard Deviation		16.63	
Result		Agree	

In the presented data on encounters with specific challenges in ensuring regulatory compliance during information system audits in the Indian banking industry, a survey was conducted with a sample size (N) of 100 respondents. The respondents were asked to express their agreement or disagreement on a five-point Likert scale, ranging from "Strongly Disagree" to "Strongly Agree."

The summary statistics indicate that the majority of respondents fall into the "Agree" and "Strongly Agree" categories, accounting for a combined percentage of 76%. This suggests a prevalent acknowledgment among the surveyed individuals that they have indeed faced specific challenges in ensuring regulatory compliance during information system audits in the Indian banking sector.

The Mean Score is calculated as 3.94, although it's essential to note that the interpretation of a Likert scale Mean Score can be challenging due to the ordinal nature of the data. In this context, the Mean Score may not have a straightforward interpretation, and caution should be exercised in attributing specific significance to this value.

The high Standard Deviation of 16.63 indicates a considerable degree of variability in responses. This variability suggests that respondents' opinions on encountering challenges in regulatory compliance during information system audits vary widely.

In summary, based on the presented data, it can be concluded that a significant proportion of respondents agree or strongly agree that they have faced challenges in ensuring regulatory compliance during information system audits in the Indian banking industry. The high variability in responses emphasizes the diverse nature of experiences among the surveyed individuals.

2. Please express your level of agreement, ranging from strongly agree to strongly disagree, with the following statement: "There is a need for improvements or modifications in the effectiveness of existing regulatory frameworks to guide information system audits within the Indian banking sector, in my opinion."

Table:2 Need for improvements

s.no	Particular	Observation(N)	Percentage
1	Strongly Disagree	9	9%
2	Disagree	12	12%
3	Neutral	9	9%
4	Agree	39	39%
5	Strongly Agree	31	31%
sum		100	100
Count(N)		5	
Mean Score		3.71	
Standard Deviation		14.04	
Result		Agree	

The presented data pertains to respondents' perceptions regarding the need for improvements or modifications in the effectiveness of existing regulatory frameworks guiding information system audits within the Indian banking sector. The responses, ranging from "Strongly Disagree" to "Strongly Agree," are tabulated along with corresponding percentages, mean score, and standard deviation.

The data indicates a considerable level of consensus among respondents on the need for improvements or modifications in the regulatory frameworks for information system audits within the Indian banking sector. A combined 70% of respondents either agreed or strongly agreed with the statement, suggesting a widespread acknowledgment that the existing regulatory frameworks may require enhancements.

The mean score of 3.71 and a standard deviation of 14.04 suggest a moderate level of agreement with some variability in respondents' opinions. The moderate mean score reflects a collective sentiment leaning towards agreement, while the standard deviation indicates a degree of dispersion in individual viewpoints.

The result, categorized as "Agree," implies that a substantial portion of participants perceives a necessity for changes in the existing regulatory frameworks. This consensus may signal a shared belief among professionals in the field that evolving technological landscapes and emerging challenges necessitate adjustments to current regulatory guidelines.

The findings have implications for policymakers, regulatory bodies, and industry stakeholders. Addressing the identified need for improvements could involve collaborative efforts to update and refine regulatory frameworks, ensuring they align with the dynamic nature of information systems and cyber security challenges in the banking sector.

In summary, the data suggests a prevalent sentiment among respondents in favor of improvements or modifications in existing regulatory frameworks for information system audits within the Indian banking sector. This insight can inform future policy discussions and initiatives aimed at enhancing the effectiveness of regulatory measures in the context of evolving technological landscapes and emerging cyber security threats.

### 3. CONCLUSION

In conclusion, this research illuminates the intricate landscape of regulatory compliance in information system audits within the Indian banking sector. The dynamic nature of the industry, fueled by technological advancements, underscores the critical role of information system audits in ensuring the integrity and security of financial systems. The study, situated at the nexus of compliance, cyber security, and collaborative efforts, sheds light on challenges and opportunities faced by key stakeholders—regulatory authorities, auditors, and banking institutions.

The survey data on challenges encountered during information system audits reflects a consensus among respondents, emphasizing the reality of specific hurdles in ensuring regulatory compliance within the Indian banking industry. The diversity in responses, as indicated by the high standard deviation, underscores the multifaceted nature of these challenges.

Moreover, the identified need for improvements in existing regulatory frameworks signifies a collective recognition among professionals that adaptation is necessary in response to evolving technological landscapes. The study's findings contribute actionable insights for policymakers, regulatory bodies, and industry stakeholders to enhance collaboration and fortify cyber security measures.

In essence, this research not only advances academic understanding but also offers practical implications. It serves as a valuable resource for policymakers, auditors, and banking professionals working collaboratively to fortify the cyber resilience of the Indian banking industry amid the escalating digital interconnectedness and evolving cyber threats.

### 4. SUGGESTION

1. Continuous Collaboration: Encourage ongoing dialogue between regulatory bodies, auditors, and banking institutions to enhance mutual understanding and collaboration in navigating complex regulatory landscapes.
2. Adaptability to Technology: Emphasize the need for regulatory frameworks to dynamically adapt to rapid technological changes, ensuring they remain effective in addressing emerging cyber threats.
3. Resource Investment: Advocate for increased resource allocation, particularly for

smaller financial institutions, to bridge personnel and technological gaps, fostering a proactive security posture.

4. Global Harmonization: Explore avenues for harmonizing global regulatory expectations to streamline compliance for banks operating internationally.

5. Cultural Shift: Promote a cultural shift towards prioritizing cyber security within organizations through education and training initiatives, aligning practices with evolving cyber security standards.

## REFERENCES

### ARTICLES AND REPORT

Reserve Bank of India. (2021). "Master Circular - Cyber Security Framework in Banks." Retrieved from [https://www.rbi.org.in/Scripts/BS\\_ViewMasCirculardetails.aspx?id=10151](https://www.rbi.org.in/Scripts/BS_ViewMasCirculardetails.aspx?id=10151)

Singh, A., & Kapoor, M. (2020). "Challenges and Opportunities in Implementing Information Security Policies: A Case Study of Indian Banks." *Journal of Information Security and Cyber Resilience*, 6(1), 23-38.

Patel, N., & Joshi, A. (2019). "Auditing the Digital Fortress: A Study of Information System Audits in Indian Banks." *Journal of Cybersecurity and Risk Management*, 3(1), 112-128.

Gupta, R., & Sharma, S. (2018). "Regulatory Compliance and Cybersecurity in the Indian Banking Sector: An Analysis of Current Practices." *International Journal of Banking, Finance, and Cyber Security*, 4(2), 45-62.

National Institute of Standards and Technology. (2017). "Framework for Improving Critical Infrastructure Cybersecurity." Retrieved from <https://www.nist.gov/cyberframework>

### BOOKS

Information System Auditing and Compliance  
Cybersecurity and Banking Regulations in India  
Risk Assessment in Financial Institutions"  
Financial Technology (FinTech) and Compliance  
Governance and Information Security in Banking

### MAGAZINE

The Banker  
American Banker  
Banking Technology  
Global Finance  
Banking Frontiers

### WEBSITES

bankofamerica.com  
wellsfargo.com  
chase.com  
hsbc.com  
citibank.com

# STRATEGIES OF HUMAN RESOURCE DEVELOPMENT IN INDIA

**Mamta Kumari,**

Jai Narain Vyas University Jodhpur, India

(mamtak225577@gmail.com)

Human resource development is an essential component of human resource management. It is the most important component of human resource management. Every firm and its management are responsible for developing human resources if they wish to stay in business, compete, and progress toward wealth and growth. Human growth is the number one priority for every firm in today's world of increasing knowledge. Human resource development is critical to the organization's existence and success. HRD programmers are becoming commonplace in enterprises. Employees are no longer regarded as if they were machinery. There has been a fresh rise. Employees are now recognized as beings of worth by organizations.

**Keywords** - Competition, development, talent, career planning, human.

## 1. INTRODUCTION

Human resource development (HRD) is becoming increasingly important in the success of every industrial firm. Organizations today have learned that it is the contribution of human resources that allows them to develop, prosper, and achieve their goals. Organizations are making attempts to boost worker influence. Organizations establish human resource development programs to prepare their workers and leaders to assume supervisory and management duties. The advancement of contemporary technologies new commercial and industrial dynamics have necessitated the demand for highly qualified and capable personnel to address modern-day problems. Employees fear that new technologies may eliminate their jobs. It is the human resource manager's obligation to dispel this fear and ensure them that nothing of such would happen. Once the anxiety is gone, individuals quickly adopt new technologies and adapt to evolving times.

### Macro-level HRD:

At the macro level, it is at the heart of all development activities aimed at improving the quality of life of the citizens of a nation. This category includes the government's initiatives to promote human development.

### Micro Level HRD:

At the micro-level, it is the upgrading of the abilities of executives, managers, and workers of the company targeted at enhancing both efficiency and quality. This category includes any organization's attempts to improve its performance and efficiency.

## 2. LITERATURE REVIEW

**Poonam Pachori et al., (2020)** determined that private sector banks had considerably superior HR practices than public sector banks in their paper "A Review on Impact of Human Resources Practices on Employees Performance with Special Reference to Public and Private Banks." They

thought that because HR efforts are intimately tied to employee performance, human resources must be completely aligned with the company's overall objective.

According to a recent approach proposed by **T.V. Rao (1999)**, hr interventions should be developed in terms of hrd systems, competencies, culture (including styles), and business linkages so as to have the desired business effect. The degree of maturity and the suitability of each hr subsystem, the suitability of hr structures, and the degree of competencies of employees in hr, line managers, top management, and so on; the HRD culture (defined in terms of openness, collaboration, trust, autonomy, action, authenticity, confrontation, and experimentation) and the alignment of top management and human resources staff designs with HRD culture; and the level that all processes and procedures result.

**Dr. G. Swathi Kumari et al., (2020)** employed empirical analysis to analyze and assess HR practices as perceived by middle- and senior-management-level workers in her study, "A Comparative Study on the Impact of HRM Practices on Employee Career Development with Reference to SBI and ICICI" (2020). She concluded that employees in the public sector are happier with their career development options compared to those in the private sector as a whole.

**Devi M. et al., (2020)** examined HRM behaviors among private sector bank workers in their study titled "An Empirical Study of HRM Practices in Private Sector Banks." There are no substantial disparities in HRM practices amongst employees of private sector banks based on gender or age, according to the research's findings.

HRD, according to **Leonard Nadler (1970)**, "Developing Human Resource" is a sequence of coordinated actions that take place over a set length of time and are intended to generate behavioral change. Training, education, and growth are some of the prevalent endeavors he found under HRD. He defined training as activities meant to improve work performance, learning as activities aimed to acquire capabilities that are not particular to any one position, and development as preparing to assist the employee in moving with the business as it evolves.

### 3. RESEARCH METHODOLOGY

The data and materials were gathered from several HRD books and publications. Despite secondary data used in the study, the researchers also used their own work experience in select firms as well as personal interactions with officials from these organizations.

#### Importance of the Study:

The study is very essential to academicians and researchers because it not only reinforces the theoretical framework of HRD but additionally attempts to investigate the link between various HRD mechanisms.

#### Limitations:

Because the study is based on secondary data from books/journals, it has little influence in the current setting.

### 4. HRD FRAMEWORK



### **The Characteristics of HRD System composition:**

HRD is at the heart of the Human Resource System. It is concerned with teaching organizational members new skills, abilities, and competencies. HRD is a subsystem of the organization that is closely tied to other components like as manufacturing, advertising, and finance. HRD is made up of various interconnected and interdependent subsystems, including as communication, development and training, role analysis, job enhancement, performance evaluation, and potential evaluation, among others.

### **Continuous procedure:**

HRD is a dynamic and planned process that is continually conducted for the development of workers to enable them to handle numerous obstacles while functioning in the company. HRD processes vary depending on the needs of the company. HRD subsystems are inextricably linked to social, political, economic, and cultural prejudice.

### **Make use of behavioral science:**

HRD largely relies on behavioral sciences to develop individuals. It uses psychology, sociology, and anthropological ideas and concepts to organize and administer a variety of programs for individual and group development. Organizational development programs are founded on behavioral science ideas.

### **Working-life quality:**

HRD sought to improve the quality of working life in the company in order to boost productivity. HRD promotes a healthy work environment to ensure the health and well-being of employees and their families. It aids in attaining employee satisfaction.

### **The necessity for HRD**

Organizations are developing in today's fast-paced corporate world. Managers' responsibilities have expanded. Economic pressure and the desire to improve efficiency and production are driving radical changes. Because of advances in computer technology, activities may now be accomplished in moments instead of days. Organizations must evolve and enable their people to flourish in order to stay up with such an environment. HRD must thus be considered as a whole system that interacts with other organizational systems. The employee's talents must be improved. HRD makes this feasible.

### **The necessity for HRD arises for the following reasons:**

1. To encourage efficient interaction in order to optimize employees' creative abilities;
2. To establish a work environment that is without monotony and to enhance working conditions and
3. To allow members to achieve self-actualization by systematically maximizing their potentials.
4. Using the present and potential creative talents of individuals to benefit the organization's success
5. Enabling employee growth and making them aware of their own strengths and limitations
6. Assisting businesses in maximizing the use of human resources
7. Employees seeking prospects for advancement.

### HRD effects at the organizational level

1. Employee competency is increased through the acquisition of knowledge, fresh abilities, and attitudes.
2. Employees learn about the skills needed for working effectively. They work to clarify standards and norms.
3. Employees become more enthusiastic about their employment. It boosts objectivity. They grow more assertive.
4. Teamwork improves.
5. Employees build trust and regard for one another.
6. Teamwork and collaboration have a cumulative impact.
7. They are open to new experiences.
8. Improve problem-solving abilities.
9. Important and relevant data about personnel is created. This assists with human resource planning.
10. They are involved in taking decisions, which gives them a feeling of pride and accomplishment.

### National Level HRD achievements

1. HRD entails the development of fundamental human characteristics such as ability, mindset, values, and beliefs on one side, and expertise, creative capacities, and talent on the other. This procedure increases society's usage value.
2. HRD assists in meeting the demands of a rapidly changing environment, such as increased competition inside and beyond the country in a period of economic liberalization and market-driven tendencies.
3. HRD maintains the vitality of a nation's workforce.
4. HRD keeps human resources vibrant, valuable, and meaningful.
5. HRD makes national workforce flexible and focused on development.
6. HRD fosters a supportive culture in which individuals take the initiative, explore, create, and make ideas happen.

## 5. HRD PRACTICES OF INDUSTRIES THROUGHOUT INDIA

HRD attempts to assist individuals in honing their skills and acquiring competences. HRD processes like as performance evaluation, training, OD, feedback, and counseling, prospective appraisal, job enrichment, awards, and so on aid in the development of talents and competences. These mechanisms contribute to the creation of a good HRD atmosphere characterized by openness, conflict, trust, authenticity, proactively, autonomy, and cooperation. It aids in the development of competent, devoted, and workforce, as well as an atmosphere of trust and authenticity and teamwork inside the business, which eventually aids in the achievement of the company's objectives of increased growth and productivity, effectiveness and efficiency, greater revenue, and improved public perception.

### HRD subsystems used by Indian organizations

The following HRD subsystems are often used in Indian companies:

### **Appraisal of performance:**

A performance assessment is the process of evaluating an employee's job performance. The systematic evaluation of an individual's performance is commonly referred to as performance appraisal. Employee performance is evaluated based on variables such as job knowledge, quantity and quality of output, initiative, supervision, leadership skills, cooperation, reliability, health, adaptability, judgment, and so on. The goal of assessment is to examine an employee's current level of performance in order to identify the need for improvement.

The method for assessing performance involves the following steps:

1. Job assessment
2. Establishing criteria for achievement
3. Communicating success goals to workers
4. Evaluation of real performance
5. Discussing with staff and comparing actual performance to standards.
6. If required, take remedial action.

### **Potential appraisal:**

The goal of potential appraisal is to develop individuals' latent skills. Potential evaluation gives critical information about individuals that may be used to develop career strategies for them. A potential evaluation assesses people's leadership talents and potential. It guarantees a suitable fit between the employee's potential and the work. Organizations are diversifying their operations these days, resulting in significant changes. To satisfy these needs, they need individuals who are courageous and capable of facing the obstacles. As a result, they must assess the potential of current employees so that they can perform a range of duties.

### **Career planning:**

Career planning allows employees to thrive throughout their careers, whereas unprepared careers fail. The initial and most significant phase in career planning is to do a SWOT analysis. He must evaluate his own strengths, weaknesses, opportunities, and dangers. One has to prepare his or her career through school, training, job search, and work experience. Employees must show complete dedication. The organization assists youngsters by providing critical information in a variety of methods to help them plan their careers.

### **Training:**

Training is an effort to improve present or future employee performance by boosting an employee's capacity to perform via learning, typically by altering the person's attitude or expanding their expertise. Performance deficiencies indicate the requirement for training. Learning skills, concepts, and attitudes to increase effectiveness in doing a certain task or occupation is part of the training process. Training offers the incentive required to execute change enhance efficiency, management effectiveness, and production. Employees who work as managers and executives must have social or people skills. They must better understand themselves and others and behave accordingly. Persuasion, listening, and honoring others' feelings are examples of social abilities. Some organizations employ a senior individual as the training manager.

### **Organizational growth:**

Organizational development: Organization development aims to transform the opinions, views, and framework of organizations so that they are more responsive to new methods, markets, and problems, as well as the rapid rate of change themselves. Because the organization is an open system, it must evolve by absorbing diverse changes put out by the continually shifting surroundings. It stresses suitable interventions in the company's ongoing activities. It gives a foundation for changing the organization's atmosphere and culture. This helps organizations utilize human potential in order to achieve corporate goals. OD strategies include questionnaire feedback, collaboration, and sensitive interpersonal behavior training. OD approaches include survey input, collaborative work, interpersonal sensitivity training, M.B.O, brain storming, process consultancy, and stress management.

### **Counseling:**

Counseling is an important tool in human resource development. It serves numerous uses. Counseling is a service offered to employees for personal difficulties. Professional counselors' services must be acquired for this reason. It minimizes staff turnover, absences, and tardiness while also enhancing the superior-subordinate connection and comprehending the challenges of juniors and seniors, allowing for more interaction and effective choice-making. Employees can grasp their strengths and shortcomings through counseling and solve difficulties that arise as a result of their ignorance of their work performance. It aids in the reduction of stress.

### **Quality circle:**

A quality circle is an intimate group of individuals who do the same or comparable task. They gather willingly on a regular basis for one hour each week during work hours under the direction of their supervisor and are trained to discover, analyze, and solve a few of their job's problems and propose recommendations to management. They also, if feasible, execute the solutions personally. It is a participatory management system. It fosters respect and understanding between bosses and their subordinates. It aids in the development of human resources' untapped potential.

### **Planning for human resources:**

It is an essential component of company and organizational planning. It is concerned with thorough planning to determine future needs for human resources at each ability and category level. The quality of the human needs plan is determined by the evaluation and information upon which it is based. A fair degree of accuracy is required in the business estimates and operations used to calculate HR requirements. The goal of human resource planning is to have an adequate number of people with acceptable credentials and abilities to perform and provide various types of human resources in the firm.

### **The procurement process and placement:**

This is a key component of human resource development. Human resource acquisition is accomplished through recruiting and selection. These two strategies are used to fill vacancies. Placing is the process of matching qualified people with appropriate positions. It is about putting the appropriate people in the right roles to get the greatest outcomes.

### **Job Rotation:**

Positions are cycled among workers in order to develop the expertise and abilities necessary for diverse positions. This is critical since work shouldn't deteriorate during an employee's absence or leave.

### **The workplace quality:**

Employees are an organization's most valuable asset. To get the most out of employees, sufficient, healthy, and sanitary working conditions must be provided. This improves productivity. The mental and physical well-being of workers would suffer as a result of unsanitary and insufficient conditions at work, reducing their productivity. Enterprises must exercise extreme caution when it comes to employee well-being.

## **6. CONCLUSION**

Human resource development and management have grown increasingly significant in recent years. Business and industrial enterprises have recognized its significance and are currently acknowledging it. Human resource development is becoming increasingly important to their growth. They are developing strategies for human resources and combining them with those of other divisions and the organization as a whole. All this occurs since every corporation wishes to be ranked highly in terms of leadership quality, product quality, creativity, funding, fiscal health, and recruiting the greatest workforce the nation has to offer.

## **REFERENCES**

- Devi, M., Khanna , P. and Ahuja , S. (2020) 'An Empirical Study of HRM Practices in Private Sector Banks', DRSR journals, pp. 101–109.
- Kumari, G.S. (2020) A Comparative Study on Impact of HRM Practices on Employee Career Development with Reference to SBI and ICICI.
- Nadler, L. (1970). Developing human resources. Houston: Gulf Publishing Company.
- Pachori, P., Singh, Dr.S. And Gangwar, Dr.M. (2020) A Review On Impact Of Human Resources Practices On Employees Performance With Special Reference To Public And Private Banks Vol 17(7). Palarch's Journal Of Archaeology Of Egypt / Egyptology,.
- Rao, V.T. (1999). HRD audit: Evaluating the human resource function for business improvement. New Delhi: SAGE.

## INDIA'S TRADE AND INVESTMENT WITH AFGHANISTAN: A VICENNIAL ANALYSIS

**Prof. Krishn A. Goyal,**

Institute of Evening Studies, Jai Narain Vyas University, Jodhpur  
kag.bfe@jnvu.edu.in

**Rekha Verma,**

Jai Narain Vyas University, Jodhpur rekhavrm13@gmail.com

The Taliban have returned to power in Afghanistan in 2021 After 20 years of conflict, posing new challenges for India-Afghanistan bilateral relations. Before the entry of Taliban regime both countries have had a decent relationship over the past 20 years in terms of trade and investment. According to the CTI (Chamber of Trade and Industry), India is the largest market in South Asia for Afghan products, mainly imports fruits, dry fruits, and medicinal plants from Afghanistan. India mostly exports coffee, tea, pepper, cotton, and other agricultural products to Afghanistan. In 2020-2021, India and Afghanistan enjoyed bilateral trade worth \$ 10,917 million. Along with trade, India has made over \$ 3 billion investment in Afghanistan, including highways, dams, energy grids, schools, hospitals, the parliament building etc. The future of Indian investment in the Afghanistan and the significance of India-Afghanistan trade are the primary subject matter of the present paper. With the return of Taliban, India had been unwilling to explore interaction with the Afghanistan. Indian initiatives need both a "supportive environment" and the assurance that a terrorist Islamic group won't use its territory to threaten or attack other countries in order to continue operating under the Taliban's new leadership. If both nations try to demonstrate more confidence in one another, the India-Afghanistan relationship will improve significantly in the future.

**Keywords:** India, Afghanistan, Taliban, Investment, Trade relations.

**JEL Classification Code:** F1, F3, F5, P4

### 4. Introduction

Afghanistan the South Asian landlocked republic is the colonial offshoot that continue to have ramifications for regional inter-state as well intra-state relations. Landlocked states have long relied on littoral neighbours for critical transport facilities, but political barriers of coastal countries hampered their economic development. This is evident in Afghanistan's relationship with Pakistan. Afghanistan endeavoured to minimise its overreliance on Pakistan by modifying



country's foreign policy and found a new ally in India, that has changed regional geopolitical power equations. Unlike Pakistan, India and Afghanistan do not share a conterminous and disputed border, and, don't have complicates bilateral relations. The Kautilian idea of "neighbours are viewed as adversaries, while an enemy's adjacent neighbour is seen as a friend" has affected India's foreign policy of neighbouring political circles in Afghanistan. India therefore started taking advantage of the problems Pakistan and Afghanistan had over the Durand line. Since 1947, India has had cordial relations with Afghanistan. This trend lasted for several years, including the "Friendship Treaty" signing in 1950, Afghanistan's Soviet invasion from 1979 until 1990, Burhanuddin Rabbani's presidency from 1992 to 1996, and the past twenty years following the 9/11 attacks (2001 to 2020).

The Taliban have returned to power in Afghanistan in 2021 After 20 years of conflict. Before the entry of Taliban regime both countries have had a decent relationship over the past 20 years in terms of trade and investment. However, 2021 appears to be a dreadful year for both countries as the Taliban transform Afghanistan into a war-torn country after US and NATO forces leave the country. Under such scenario this paper tries to address following questions: How will India and Afghanistan handle their bilateral trade ties? What will be the future of Indian investment in Afghanistan under Taliban Regime?

## 5. Review of Literature

The foreign policy choices that affect the relations between Afghanistan and Pakistan and India have been examined in this paper. Pakistan and India used their neighbours who shared a border with them to advance their own national goals. In order to reduce its over-dependence on Pakistan, Afghanistan has boosted its collaboration with India, and Nepal has taken advantage of its close connections to China to limit its reliance on India, causing a change in South Asia's geopolitical dynamic (**Bhatnagar & Ahmed, 2020**). The beginnings of the Indo-Pakistani competition in Afghanistan predates the Hamid Karzai regime in Afghanistan. The researcher looks at the opinions of three nations—India, Pakistan, and Afghanistan on the strategic partnership between India and Afghanistan that was signed on October 4, 2011. India view this agreement as a way to prevent Pakistan and ensure its entry into the energy-rich Central Asian market. Afghanistan view this historic document as reiteration of the strong traditional bonds. Due to the "strategic" effects of the agreement, Pakistan believes that India is attempting to encircle it by obtaining more power in Afghanistan (**Raiphea, 2013**). In the light of the Indo-Pakistani rivalry, India tries to limit Pakistan's influence in Afghanistan and examining the

consequences for American policy of the confluence of Indian and US interests in Afghanistan (**Ganguly & Howenstein, 2009**).

The recent improvements in the relations of India with Afghanistan are supported by its multifaceted Afghan strategy, which is motivated by growing regional and international objectives. A number of structural considerations are pushing India to adopt an unusually assertive foreign policy toward Afghanistan, and the outcome of India-Afghanistan policy will influence whether India can become a key regional security provider in South Asia. India's approach to Afghanistan is seen as a barometer for the nation's goals because it reflects both the country's rise on a regional and international scale (**Pant H. V., 2010**). Post 9/11 Afghanistan's stability is a matter of importance for India's own security but, was side-lined from many Western-led discussions about the country. Following the announcement of end of large-scale Western troop deployment in 2014 justify India's parallel bilateral engagement with Afghanistan. India seeking for stability within Afghanistan, hence, this Shifted Indian policy from an anti-Pakistan strategy towards a desire for stability and deeper relationship with Afghanistan (**Price, 2013**). With this agenda India emphasising more on its foreign policy in Afghanistan. India, a rising international and regional power, is using Afghanistan as a test case. Aside from that, India has failed to win the trust of Afghan communities who saw India as a natural friend. With the potential of American withdrawal from Afghanistan, Afghanistan's policy of stronger alignments with China, Pakistan, and Iran has become more apparent (**Pant**). India confronted to such notion because of its reliance on a "soft power" political style and hence, it has become a "secondary player" in Afghanistan (**Pant, 2013**). However, US operations and the supportive Afghan government holds up India from regaining and strengthening its influence there and using Afghanistan as an entryway for its trade with Central Asian countries. India started concentrating on three areas to re-establish its influence in Afghanistan: the rebuilding process and economic growth; forging relations with Central Asian countries; and aiming to weaken Pakistan's role in Afghanistan (**Ashraf, 2007**). These aforementioned areas can only be achieved under the guidance of Indian Prime Minister Narendra Modi and Afghanistan's President Ashraf Ghani, and relations between the two countries have improved dramatically. India's investment in Afghanistan's rehabilitation and capacity building, economic growth, and women empowerment has been sought by the Ghani government. The bilateral partnership has been reinforced through collaborative police training and law enforcement actions (**Kaura, 2017**).

India always concerned for integrated and stable regional security towards its extended neighbourhood. This paper brings India's regional security interests in Afghanistan as of the

expanded strategic neighbourhood of India. It describes the numerous methods and the prospective implications of increased regional security for Afghanistan (Fair, 2010). Post 9/11 opens the door for India again in Afghanistan with oust of Taliban regime. India revived its interest in deepening its social and economic connections with Afghanistan. India began looking for its stakes in the expanded neighbourhood, as well as opportunities and challenges, in order to establish its footprint in the region ranging between East and Southeast Asia and West Asia (Basu, 2007). India is Central Asia's extended neighbour, and because of its rich mineral resources and unexplored consumer market, it has substantial geopolitical and socioeconomic concerns in the region. Energy security collaboration between Central Asia and India appears to have bright future prospects. The CARs and Afghanistan's peace and stability seem to be the most crucial factors for India's security (Roy, 2001).

## 6. Objectives

- iii. To discern the future of Indian Investment in Afghanistan under Taliban regime.
- iv. To assess the importance of India-Afghanistan trade.

## 7. Indian investment and its future in Afghanistan

India saw a likelihood to broaden its influence in the nation as the first Taliban regime collapsed in 2001. During past two decades, India has invested in Afghanistan in order to gain public trust and use financial aid as political leverage. India constructed critical infrastructures such as dams, highways, hospitals and schools, among other things. India now provides development assistance worth more than \$3 billion. India invested time, money, and effort in Afghanistan's reconstruction. It has assisted Afghanistan in every aspect of developing a nation during the past 20 years. India has invested in a number of industries and sectors, including hydropower, road building, operations, communication technologies, health care, agriculture, and education.

India's key endeavours in Afghanistan is the construction of the crucial Zaranj-Delaram highway, which would allow India to trade with Afghanistan through Iran's Chabahar port. India is also supporting to rebuild the Afghanistan's Salma Dam power project. In addition, India has constructed a 220 kV double-circuit transmission line and has supplied equipment for it, which will result in the construction of 600 transmission lines. India also helped Afghanistan to build its mining industry.

The Agreement on Cooperation in the Area of Health and Medical Sciences was signed by both nations, as well as Memorandums of Understanding (MoU) on Small Developmental Projects,

Agricultural Research and Education, Standardization, Rural Development, and Education, in 2005. The Afghan Parliament in Kabul was built by India for \$90 million. To promote integrated rural development, India has also promised to adopt 100 villages in Afghanistan. In five cities, India has given more than 1200 vehicles to municipalities, public hospitals, and Afghan National Army. India also provided the training to the Afghan diplomats and police officials. It has established Indian Medical Operations and constructed cold storage facilities in Kandahar. Solar panels have been installed in remote areas. India has also contributed to capacity building via its vocational training facilities, scholarships for students, opened/rehabilitated schools, programmes for mentoring and other professionals training. The construction of the Shatoot Dam, the Aga Khan Legacy Project, and the renovation of the Bala Hissar Fort are among the current initiatives of India. By July 2020, India has signed five further contracts worth \$2.5 million for the building of roads and schools.

### **Uncertain Future of Indian Investment**

The Taliban's return might begin of another dark chapter for Afghanistan, with worries about the Afghanistan's economic development and ties with the rest of the globe, especially partner countries that have made sizable investments in the country. The return of the Taliban to power will have an unpredictable impact on Indian investment. As the Taliban seize power in Afghanistan following the withdrawal of US and NATO soldiers, India may find itself with nothing to perform in the country and, also no political influence. The Taliban's victory could jeopardise \$3 billion Indian investment in various projects over 20-year. India is uncertain about its 400 projects in Afghanistan during the last 20 years, of which 150 are still underway. In light of the worsen security situation and uncertainty in Afghanistan, all India-based officials were ordered to return to India. Taliban's officials ensure that the investment projects were properly maintained and India can keep monitor them. Instead of being a violent extreme group, the Taliban presented itself as a new Afghanistan. But without Indian presence how India will look after and monitor projects in Afghanistan. When nothing is in control, India has kept a broad perspective on its investments and shows more concern for Afghan people over the political uncertainty. It demonstrating some faith in the Afghan people. When Afghanistan was suffering near-total economic collapse, India offered humanitarian aid, including wheat, COVID-19 vaccines, and winter clothing, is a natural next step in India's policy of progressive engagement.

### **8. Discussion over India-Afghanistan Trade**

To deepen commercial and economic cooperation, both countries are putting efforts. The Preferential Trade Agreement between India and Afghanistan was signed in 2003, and it grants India 100% tariff discounts on 38 products that Afghanistan exports to India. Trade between India and Afghanistan has increased since the air freight corridor was established in 2017. In 2020, India’s Imports from Afghanistan was valued \$514.22 million, while India's exports to Afghanistan was worth \$858.04 million, the total trade reached \$1,372.26 Million value.

**India’s Trade relationship with Afghanistan**

Table1 India’s Trade relationship with Afghanistan: 2001-2021 (US\$ Million)

Year	India’s Export to Afghanistan	India’s Import from Afghanistan	India’s trade volume with Afghanistan	India's BOT with Afghanistan	Export Growth	Import Growth	Trade Growth
2001	20.85	19.93	40.77	0.92	-	-	-
2002	51.67	18.22	69.89	33.45	147.86%	-8.55%	71.42%
2003	124.29	35.00	159.29	89.30	140.56%	92.05%	127.91%
2004	154.40	43.36	197.76	111.04	24.22%	23.89%	24.15%
2005	148.36	55.57	203.93	92.79	-3.91%	28.16%	3.12%
2006	171.96	40.48	212.44	131.47	15.91%	-27.15%	4.17%
2007	232.07	90.55	322.62	141.53	34.96%	123.66%	51.86%
2008	362.27	130.61	492.88	231.66	56.10%	44.25%	52.77%
2009	469.21	120.70	589.92	348.51	29.52%	-7.59%	19.69%
2010	393.50	144.58	538.08	248.92	-16.14%	19.78%	-8.79%
2011	501.67	119.91	621.57	381.76	27.49%	-17.07%	15.52%
2012	479.93	148.64	628.58	331.29	-4.33%	23.97%	1.13%
2013	474.98	209.09	684.07	265.89	-1.03%	40.67%	8.83%
2014	443.05	242.14	685.20	200.91	-6.72%	15.81%	0.17%
2015	533.47	315.47	848.94	218.01	20.41%	30.28%	23.90%

“Table 1. Continued”

Year	India’s Export to Afghanistan	India’s Import from Afghanistan	India’s trade volume with Afghanistan	India's BOT with Afghanistan	Export Growth	Import Growth	Trade Growth
------	-------------------------------	---------------------------------	---------------------------------------	------------------------------	---------------	---------------	--------------

<b>2016</b>	473.57	282.3	755.87	191.27	-11.23%	-10.51%	-10.96%
<b>2017</b>	639.1	366.19	1,005.29	272.91	34.95%	29.72%	33.00%
<b>2018</b>	728.71	420.24	1,148.95	308.47	14.02%	14.76%	14.29%
<b>2019</b>	889.64	492.76	1,382.40	396.88	22.08%	17.26%	20.32%
<b>2020</b>	858.04	514.22	1,372.26	343.83	-3.55%	4.35%	-0.73%
<b>2021</b>	642.03	489.83	1,131.86	152.2	-25.18%	-4.74%	-17.52%

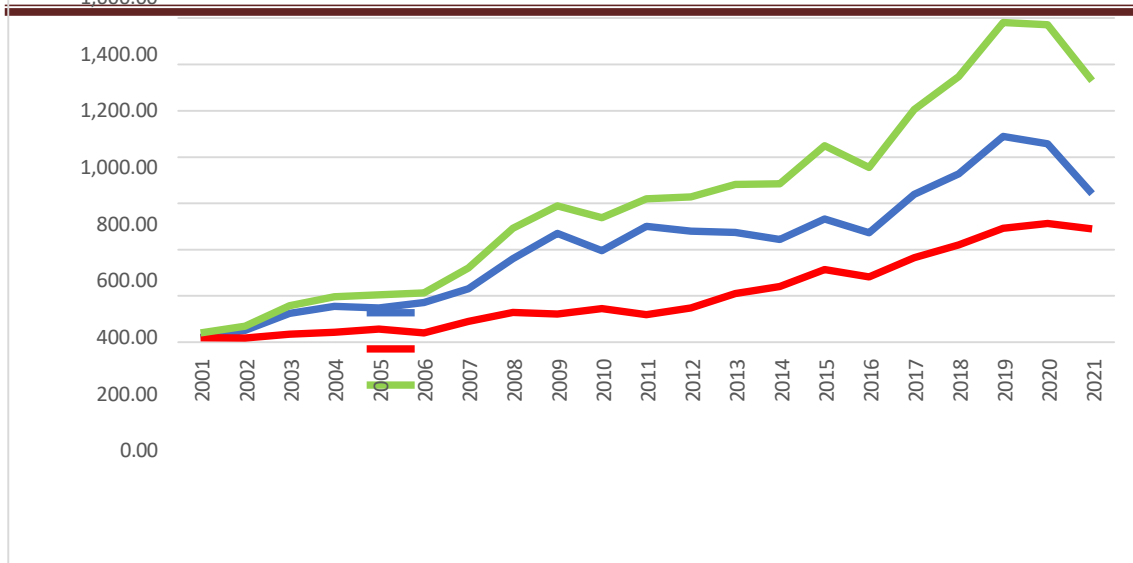
Source: The author's calculations are based on information from the Direction of Trade Statistics (DOTS) Database provided by the International Monetary Fund for the year as on 10th May 2023. <https://data.imf.org/regular.aspx?key=61013712>.

This table shows, India's total export, import, total trade, trade balance, export growth, import growth, and trade growth with Afghanistan for the period 2001 to 2020. All the figures in the table shows a fluctuating trend throughout the study. India's Exports to Afghanistan was lowest with US\$ 20.85 Million in 2001 and highest was in 2019 with US\$ 889.64 Million. India's Imports from Afghanistan lowest of US\$ 18.22 Million in 2002 and highest of US\$ 514.22 Million in 2020. 2017 was the remarkable year for India-Afghanistan trade when export, import and trade balance increased for continuous three years 2017 to 2019, this happened because of establishment of air freight corridor between the countries. Trade growth was also positive for period of study except 2010, 2016 and 2020, 2021. Afghanistan's export growth, import growth, and overall trade growth were all negative by 25.18%, 4.74%, and 17.52% after the Taliban took control of the country in 2021.



## (US \$ Million)

American Institute of Management and Technology Conference Proceedings (AIMTCP) Vol 4 No 1, 2024 ISSN:2769-5093(Online)



In a positive side, India's trade trend with the country almost increasing during the study. Hence, Data reveals that Afghanistan is a good trade partner of India with favourable trade balance.

Government-to-government agreements with Indian corporations account for the majority of Indian exports to Afghanistan mainly includes Pharmaceuticals and medical devices, computers, sugar, and, cement. Afghanistan mainly exports fresh and dried fruits, wool, carpets, etc. to India.

### Uncertain Future of India-Afghanistan Trade

From the fall of Taliban in 2001, to rise of Taliban in 2021 Government of Afghanistan faces challenges of enabling new growth drivers. After the Taliban were overthrown in 2001, the use of trade as a means of accelerating growth in Afghanistan was crucial. It's been 20 years Afghanistan is still on way of becoming self-reliant country. Trade is the main growth driver for Afghanistan that promoting economic growth and export diversification.

The current state of affairs in Afghanistan is both upsetting and concerning for trade between India and Afghanistan. India seeks a trade route and wants to utilise the nation's undeveloped natural resources to meet its expanding demands. As a result, it combats Pakistan, contain the threat of terrorism, and obtain a transit route to Central Asia.

## 9. A way forward:

Afghanistan which has not even fully recovered from its wounds has been shattered again. In 2021, the Taliban recaptured control of Afghanistan, introducing new difficulties for bilateral relations between India and Afghanistan after 20 years of warfare. Following the US exit from the country, India has less influence in Afghanistan and unwilling to explore interaction with the Taliban. In a more optimistic frame, the Taliban has indicated that it would like to forge strong ties and foster the setting where all nations may engage in trade that is advantageous to their immediate neighbours and the region as a whole.

However, trusting militant Islamist groups is not just a simple issue to solve. Only if Afghanistan ensures that terrorist Islamic groups don't use its territory to threaten or attack other countries will its neighbours and the region as a whole feel secure. In addition to all of this unpredictability, the humanitarian catastrophe in Afghanistan worries India. India took action to secure Indians, address COVID-19 issues, provide life-saving medications as humanitarian aid, address strategic concerns, and support development. Through this, India can continue to uphold its bond with the Afghan people.

Furthermore, India must maintain a diplomatic presence in Afghanistan. India ought to seek to deepen its ties with Iran, Russia, and China, and find ways to reach a consensus with the US about the future of Afghanistan. India must cooperate with other regional nations to safeguard its interests and stabilize Afghanistan after the US withdraws its troops.

India must wait for the time being to see how the Taliban's new administration truly treats its neighbours in the region. Indian interests in Afghanistan will be suspended until that time. In order to remain operational, Indian initiatives in Afghanistan need a "supportive environment." If both nations try to demonstrate more confidence in one another, the India-Afghanistan relationship will improve significantly in the future.

## 10. References:

- Ashraf, F. (2007). India -Afghanistan Relations: POST-9/11. *Strategic Studies* , 27(2), 90-102. Retrieved from <https://www.jstor.org/stable/45242397>
- Basu, P. P. (2007). India and Post-Taliban Afghanistan: Stakes, Opportunities and Challenges. *India Quarterly: A Journal of International Affairs*, 63(84), 83-122. Retrieved from <http://iqq.sagepub.com/content/63/3/84.citation>
- Bhatnagar, S., & Ahmed, Z. S. (2020). Geopolitics of landlocked states in South Asia: a comparative analysis of Afghanistan and Nepal. *Australian Journal of International Affairs*. Retrieved from <https://doi.org/10.1080/10357718.2020.1793896>

- Fair, C. C. (2010). *India in Afghanistan and Beyond: Opportunities and Constraints*. The Century Foundation. Retrieved from <http://ssrn.com/abstract=1681753>
- Ganguly, S., & Howenstein, N. (2009). India-Pakistan Rivalry in Afghanistan. *Journal of International Affairs Editorial Board*, 63(1), 127-140. Retrieved from <http://www.jstor.org/stable/24384176>
- Kaura, V. (2017). India-Afghanistan Relations in the Modi-Ghani Era. *Indian Journal of Asian Affairs*, 30(1/2 (June-December)), 29-46. Retrieved from <https://www.jstor.org/stable/10.2307/26465815>
- Pant, H. (n.d.). *India in Afghanistan: A Rising Power or Hesitant Power?* The Centre for International Peace and Security Studies (CIPSS). McGill University. Retrieved from <http://www.cepsi.umontreal.ca>
- Pant, H. V. (2010). India in Afghanistan: a test case for a rising power. *Contemporary South Asia*, 18(2), 133–153. Retrieved from <http://dx.doi.org/10.1080/09584931003674984>
- Pant, H. V. (2013). India in Afghanistan: A Trajectory in Motion. *Jadavpur Journal of International Relations*, 17(1), 103–127.
- Price, G. (2013). *India's Policy towards Afghanistan*. Chatham House.
- Raiphea, Y. P. (2013). India-Afghanistan Strategic Partnership: An Analysis of India, Afghanistan and Pakistan Perspectives. *International Journal of Scientific and Research Publications*, 3(4).
- Roy, M. S. (2001). India's interests in Central Asia. *Strategic Analysis*, 24(12), 2273- 2289. Retrieved from <http://dx.doi.org/10.1080/09700160108455352>

# ARTIFICIAL INTELLIGENCE IN GST

**Prashant Shankar Parihar,**

Jai Narain Vyas University, Jodhpur, Rajasthan, India.  
(princeparihar02@gmail.com)

GST is applicable on July 1, 2017 on the supply of goods and services with the concept of dual model GST and the vision of one nation, one tax. GST Network is using Artificial Intelligence (AI) technology in the filing of GST returns and other statutory utilities or data, which helps assess the filing of GST returns or statutory requirements. There may many ways for the GST Network and their assesses to implement AI technology in the GST model, like the implementation of an National Industrial Classification (NIC) code for every assessee's business, high tax rate Input Tax Credit (ITC) reporting, etc. In an AI-friendly environment, it may possible to trace heavy-risk areas, businesses, activities, and assesses that contain tax errors, mistakes, and evasion. Further, it will prevent tax evasion, errors, or mistakes and create a healthy environment for the government and assesses relation. By using AI technology, the government will find out about tax evasion and respond to it very quickly too.

**Keywords:** Goods and Services Tax (GST), Artificial Intelligence (AI), GSTN, Tax Evasion, GST Model, Tax

## 1. INTRODUCTION

Goods and Services Tax (GST) is good initiative by government of India for tax reform in digital era. From the date of when GST is applicable to till the present time, all proceedings i.e. registration, return, penalty, interest of GST is taken from online mode, for that GST Council establish a common network known as GST Network (GSTN). GSTN Manage the entire IT system of GST Portal. All data related to GST is available on GSTN. GSTN helps to assesses for filing GST return and tax payment as well as registration. GSTN is truly based on artificial intelligence (AI). If the assesses Supply of Goods and Services to receiver then supplier has to liability to file a GSTR-1 on due date, after the filing GSTR-1 the sale of the supplier become purchase of receiver and it is shown on GSTN in GSTR-2B & GSTR-2A of the respective month. After filing the GSTR-3B, assesses has to claim this input for adjusting against its tax liability. It is automatic and auto-generate data network based on artificial intelligence but it may be amended by Assesses too. From July, 2017 to June, 2023 a lot of data related to GST is available on GSTN and by the use of AI, GST council member take initiative on GST Council Meeting in head of Finance Minister. Presently, we use only basic-use of AI under GST for initial stage. GST is now six years old and after a long journey GST department has to going for advance stage means maximum use of AI. Advance stage of AI in GST will helpful for an Indian economy and takes action on particulars industries. By using of AI it will possible to find out abnormal behavior of any industrial or assesses which will helpful in tracking tax evasion or frauds. Prime Minister Narendra Modi in 2019 envisioned making India a USD 5 trillion economy and a global economic powerhouse by 2024-2025. With this, India would become the third largest economy in the world. AI is most important character for that vision.

## 2. LITERATURE REVIEW

The constitution (122nd Amendment) Bill (CAB), was introduced in the Parliament and passed by Rajya Sabha on 03rd August, 2016 and Lok Sabha on 08th August, 2016. The CAB was passed by more than 15 states and thereafter Hon'ble President gave assent to "The Constitution (One Hundred and First Amendment) Act, 2016" on 8th of September, 2016. Since then the GST council and been notified bringing into existence the Constitutional body to decide issues relating to GST.

On September 16, 2016, Government of India issued notifications bringing into effect all the sections of CAB setting firmly into motion the rolling out of GST. This notification sets out an outer limit of time of one year that is till 15-9-2017 for bringing into effect GST.

The Central Goods and Services Tax bill, Integrated Goods and Services Tax bill, Union Territories (without legislature) Goods and Services Tax bill and Goods and Services Tax (Compensation to States) bill have been passed by the Lok Sabha on 29.03.2017 and by the Rajya Sabha on 06.04.2017. The tax came into effect from 1 July 2017 through the implementation of the One Hundred and First Amendment of the Constitution of India by the Indian government.

S.V. Ramana Rao (2021) Studied, "Input Tax Credit under GST In India" Concluded that The most widely discussed aspect in the GST is Input Tax Credit (ITC) which means at the time of paying tax on output, the business man can reduce to the extent of tax paid on inputs or purchases. This study is covering aspects like time limit to avail ITC, Calculate input tax credit and situations where ITC cannot avail. Studies have mentioned that

Input Tax Credit under the GST regime may result into blockage of working capital of the firm in the initial months.

The major advantages under GST provisions are such that it would eliminate the cascading effect prevailing in the pre GST regime. Before the GST come into existence cross credit of VAT against services tax/exercise or vice versa was not allowed whereas under GST it is only one tax and all other taxes are subsumed. Hence, there is no restriction for setting off input tax credit.

Naman Jain et al. (2021) Studied, “Basic Structure of GST, IGST, SGST, UTGST, and CGST” concluded in his research work that Goods and services tax has been proposed to subsume all indirect taxes at central and state level, with two uniform rates, viz central GST and State GST. It would be a VAT based system, based on input tax credit mechanism for reducing the cascading effect.

Artificial intelligence is still a topic of fear which might be wrong. If we use technology and automation efficiently, it can be very helpful and increase the effectiveness and efficiency of work. The artificial intelligence-based system may be use by almost everyone using the GST portal. i.e. The Chatbot GST which may the best implementation of artificial intelligence in GST. Artificial intelligence tools not only help professionals and the government with tax collection and a smooth system but will help a taxpayer by giving education and making easy compliance with tax filing.

### 3. RESEARCH METHODOLOGY

This paper is based on an exploratory research technique, and the study is based on secondary data. Secondary data are collected from books, journals, newspaper, magazines, and various publications from websites which is relevant to GST.

#### Artificial Intelligence in GST

GSTN is fully based on AI. Artificial Intelligence Technology is helping in GST in respect of governmental level or in respect of tax individual. There are some small or technical area were AI is very helpful.

Currently Government using AI under GSTN as followings:-

#### Monthly Sales Reporting in GSTR3B:-

At the time of filing GSTR3B of every month, the GST portal provides the assessee with the ability to auto-fill monthly B2B sales, zero rated Supplies, nil rated sales & export sales figures from GSTR1 of respective month. AI helps to tax payers file GST3B properly, ensuring error-free reporting.

Nature of Supplies	Total Taxable value (₹)	Integrated Tax (₹)	Central Tax (₹)	State/UT Tax (₹)	CESS (₹)
(a) Outward taxable supplies (other than zero rated, nil rated and exempted)	49,000.00	0.00	4,410.00	4,410.00	0.00
(b) Outward taxable supplies (zero rated )	0.00	0.00			0.00
(c) Other outward supplies (Nil rated, exempted)	0.00				
(d) Inward supplies (liable to reverse charge)	0.00	0.00	0.00	0.00	0.00
(e) Non-GST outward supplies	0.00				

# Outward and Reverse Charge Inward under GST  
(Source: <https://services.gst.gov.in>)

**Monthly ITC Reporting in GSTR3B:-**

The GST portal provides the tax payer with a total Input Tax Credit (ITC) from GSTR2B during the filing of GSTR3B. Furthermore, the government allows taxpayers to identify their own ITC in accordance with ITC rules.

Details	Integrated Tax (₹)	Central Tax (₹)	State/UT Tax (₹)	CESS (₹)
<b>(A) ITC Available (whether in full or part)</b>				
(1) Import of goods	0.00			0.00
(2) Import of services	0.00			0.00
(3) Inward supplies liable to reverse charge (other than 1 & 2 above)	0.00	0.00	0.00	0.00
(4) Inward supplies from ISD	0.00	0.00	0.00	0.00
(5) All other ITC	0.00	5,489.23	5,489.23	0.00
<b>(B) ITC Reversed</b>				
(1) As per rules 38, 42 & 43 of CGST Rules and section 17(5)	0.00	0.00	0.00	0.00
(2) Others	0.00	0.00	0.00	0.00
<b>(C) Net ITC Available (A) - (B)</b>	0.00	5,489.23	5,489.23	0.00
<b>(D) Other Details</b>				
(1) ITC reclaimed which was reversed under Table 4(B)(2) in earlier tax period	0.00	0.00	0.00	0.00
(2) Ineligible ITC under section 16(4) & ITC restricted due to PoS rules	0.00	0.00	0.00	0.00

# Eligible ITC under GST  
(Source: <https://services.gst.gov.in>)

**Late Fee & Interest of default in GSTR3B:-**

It is difficult for individual tax payers to calculate the late fee and interest on late payments of GST taxes. Therefore, the GST Portal provides simplicity in it and provides late fee and interest calculations in the immediate next GSTR3B.

Description	Integrated Tax (₹)	Central Tax (₹)	State/UT Tax (₹)	CESS (₹)
Interest	0.00	0.00	0.00	0.00
Late Fees		250.00	250.00	

# Interest and Late Fee under GST  
(Source: <https://services.gst.gov.in>)

**B 2 B Sales in GSTR1:-**



Recently, the GST Authority implemented “e-invoice” for a special tax individual who crosses Rs 5 crore annual turnovers in any financial year from 2017. The government is targeting individuals who already liable for reporting in Income Tax Act or otherwise. And it is not hard on tax individuals because they are already preparing their books properly through any software or any other means.

E-Invoice is mandatory for B2B sales (irrespective of the invoice amount) for special tax individuals. If B to B sales are done, taxpayer prepares its invoice and generates IRN numbers. It is information for government about B2B sales. After the month, B2B sales are auto-filled in GSTR1 (invoice-wise). And it is 100% correct data. Individual tax payer burdens are reduced by using of this practice.

**Annual Return of GST:-**

After filing monthly returns, the government requests that the taxpayer fill out an annual return and summarize its GST reporting. The government provides summarized annual figures for various types of GST returns like GSTR-1, GSTR-3B, GSTR-2A, which are useful for tax payers. It assists individuals, and any deviation or error accrued by the government’s inbuilt AI indicates a red mark on it. AI helps the tax individual correct their reporting and correct themselves.

Dashboard Annual Return GSTR9 English

GSTR-9 Annual return for Normal taxpayers

GSTIN - 08 122 Legal Name - V AR Trade Name - L S  
 Status - Not filed FY - 2022-23 Due Date - 31/12/2023

Steps to prepare GSTR-9 return online

1. Download the draft system computed GSTR-9, summary of Form GSTR-1/IFF and GSTR-3B for the financial year by clicking on relevant buttons. This is only for reference for filling the return, and will facilitate in providing details in actual tables.
2. Click on tables (Box) selected and fill in the required details;
3. Summary of added details would be available on the relevant box;
4. Click on **PREVIEW DRAFT GSTR-9 (PDF)** button to view summary in PDF and **PREVIEW DRAFT GSTR-9 (EXCEL)** to view summary in Excel format; and
5. After adding and confirming the details, follow filing process as indicated at the bottom of this page.

DOWNLOAD GSTR-9 SYSTEM COMPUTED SUMMARY (PDF) DOWNLOAD GSTR-1/IFF SUMMARY (PDF) DOWNLOAD GSTR-3B SUMMARY (PDF)

DOWNLOAD TABLE 6A DOCUMENT DETAILS

4. Details of advances, inward and outward supplies made during the financial year on which tax is payable		5. Details of Outward supplies made during the financial year on which tax is not payable		6. Details of ITC availed during the financial year.	
Taxable value	Integrated tax (₹)	Value (₹)	Integrated tax (₹)	Central tax (₹)	
₹2,48,59,084.83	₹0.00	₹0.00	₹0.00	₹0.00	₹0.00

# GSTR9 under GST  
 (Source: <https://services.gst.gov.in>)

Dashboard > Annual Return > GSTR9 > Inward and Outward supplies English

GSTIN - 08L... Z2      Legal Name - V... AR      Trade Name - L... S  
 Status - Not filed      FY - 2022-23      Due Date - 31/12/2023

**4. Details of advances, inward and outward supplies made during the financial year on which tax is payable** Help

**Note :** The fields, where the system computed values would be modified by more/less than 20%, shall be highlighted in 'Red' for reference and attention.

Nature of Supplies	Taxable value (₹)	Integrated Tax (₹)	Central Tax (₹)	State/UT Tax (₹)	CESS (₹)
(A) Supplies made to unregistered persons (B2C)	₹27,56,463.67	₹0.00	₹2,48,081.75	₹2,48,081.75	₹0.00
(B) Supplies made to registered person (B2B)	₹2,21,53,766.58	₹0.00	₹19,93,839.05	₹19,93,839.05	₹0.00
(C) Zero rated supply (Export) on payment of tax (Except supplies to SEZ)	₹0.00	₹0.00			₹0.00
(D) Supplies to SEZ on payment of tax	₹0.00	₹0.00			₹0.00
(E) Deemed Exports	₹0.00	₹0.00	₹0.00	₹0.00	₹0.00

# Inward and Outward Supplies under GST  
 (Source: <https://services.gst.gov.in>)

**Future aspects or opportunities of AI:-**

**1. Implementation of NIC Business Codes:-**

Currently, the government implements basic and limited artificial intelligence, which helps with the filing of GST returns. Presently, the GST department asks only for three types of business activities, i.e. Manufacture, trader and service provider, which are not, synchronized with existing & other government systems.

Dashboard > My Profile > Core Business Activity Status

**Your Current Core Business Activity** is **Trader - Wholesaler/Distributor**  
 If you wish to change your Core Business Activity Kindly select one and Submit again.

S.No	Please Identify your Core business as	Only one selection is allowed
1	Manufacturer	<input type="radio"/>
2	Trader	<input checked="" type="radio"/>
3	Service Provider and Others	<input type="radio"/>

**NOTES:**

- You can select only one core business activity.
- In case all activities are applicable to you. Kindly select your core business activity.
- Others will include Work Contract and Other Miscellaneous items.
- In order to understand the definitions of Manufacturer/Trader/Service Provider, you can click on "Information Button".

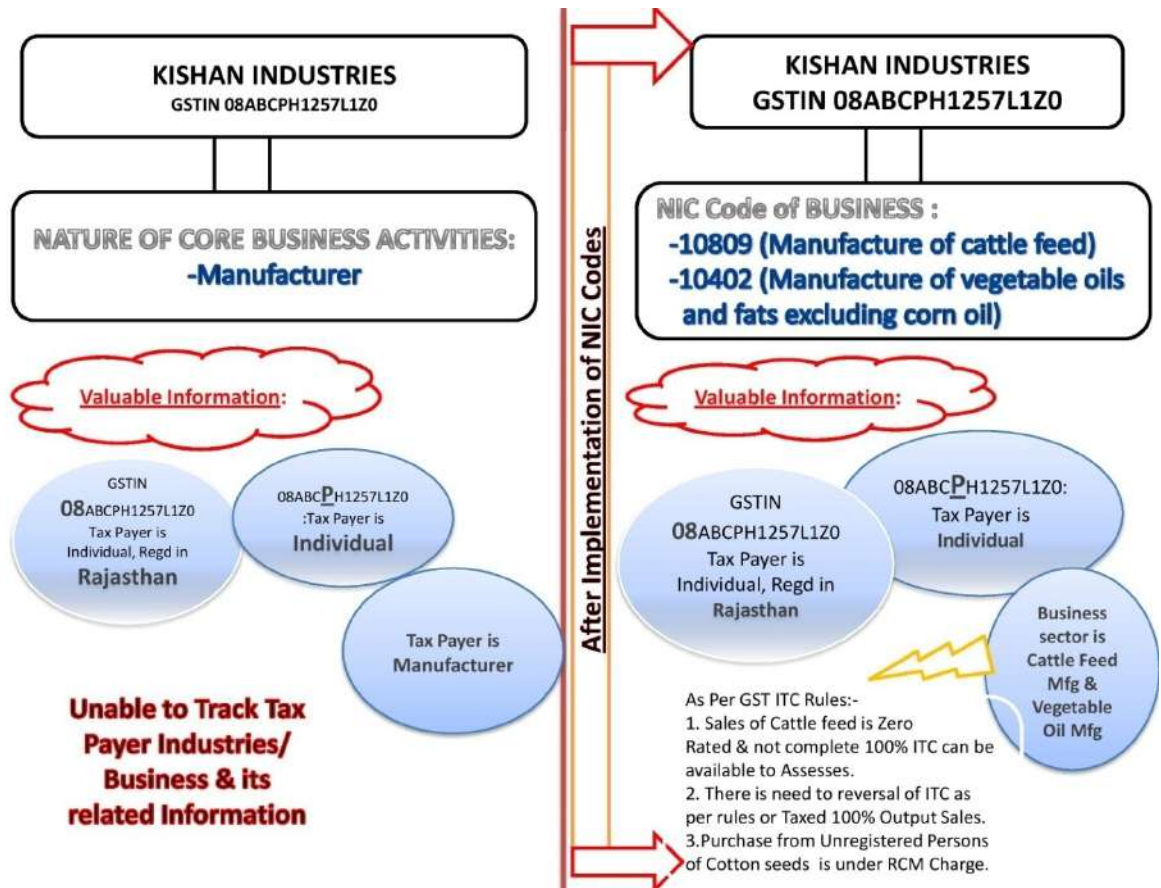
# Business Activity under GST  
 (Source: <https://services.gst.gov.in>)

The Central Statistical Organisation under the Ministry of Statistics and Programme Implementation, Govt of India introduced universal business codes in India, called “National Industrial Classification Codes (All Economic Activities)”. The GST Department does not recognize it, which creates difficulties in government research as well as AI opportunities. It assists departments in tracking Industrial/Business Activities or assessing behaviors. It helps to identify high value risk indicators, abnormal ITC’s and probable frauds.

Every Industry or business has its own signature and trade nature, like eligibility or ineligibility of ITC, mandatory RCM transactions, etc. By using the NIC code, AI will directly track these types of transactions and be aware of them for Assessers as well as the Department of prevention of Tax evasion.

The Income Tax Department also follows “National Industrial Classification Codes (All Economic Activities)”. It is very useful to find out or identify Industrial/Business Cycle, Industrial/Business raw materials, industrial/business Transactions, etc. Industrial or business having abnormally high-value risk indicators denotes probable frauds, errors or due-care needs to be assessed or department.

For Examples:-



# Example Diagram of Implementation of Proposed AI Scope of NIC Code of Business & its Effects

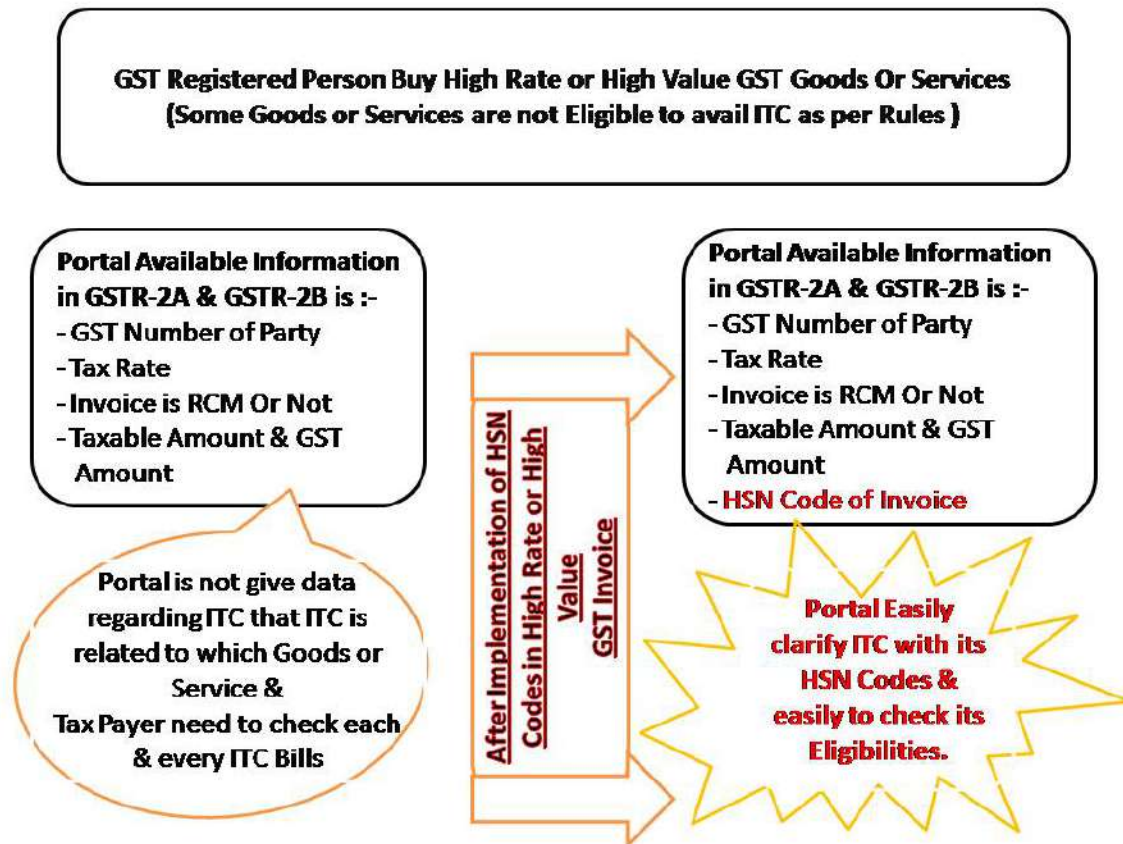
2. Implementation of HSN Codes mandatory in “High Rate” or “High Value” GST Invoices:-

Currently, GSTR1, GSTR2A and GSTR2B do not contain information about HSN Code of Goods & Services for each & every GST Invoice. Some time assesses are not aware of its ITC and avoid ITC rules and avail ITC of ineligible ITC. In AI environment, AI is unable to track these types of error because of lack of information of HSN Code of ITC.

“High rate of GST ITC or high value of GST” need to additional information (like its products HSN Code, etc) in GSTR1, GSTR2A or GSTR2B for filing its Sales or availing ITC. In “High Rate” or “High Value” the GST invoice of B2B will be informed with its product HSN. It help to avoid frauds & errors and easy for anyone to follow ITC rules.

No doubts, there is some additional headache, but to avoid small MSME tax payers difficulties, we need to implement it on only selective groups of tax payers who are able to do it very easily without any hardness or additional burden. Currently, in “e-invoice” implementations, there we are already filing these details (products HSN Code) but they are not assessable in GSTR-1, GSTR-2A or GSTR-2B.

**For Examples:-**



# Example Diagram of Implementation of Proposed AI Scope of HSN Code in GSTR2A & GSTR 2B

#### 4. CONCLUSION

AI is the future. AI can provide easiness to assesses for return filing, ITC claim, GST Late fee, GST Interest calculation & annual return filing. It can also easiness for assesses for preventing errors, mistakes in GST reporting's. By using of AI, Department may find out abnormal high value risk indicators of recognized

industrial or business which may using of NIC codes implementation. That type of high value risk indicators of industries will indicate probable frauds, errors and due-cares. Further GST department & assesses himself will check Input Tax Credit (ITC) by using product HSN code of ITC. Department may implement on specific GST Invoices which shall be “High Rate” or “High Value” GST. It will prevent from ineligible ITC claims.

#### REFERENCES

<https://gstcouncil.gov.in/brief-history-gst>

<https://gst.gov.in>

<https://www.gstobro.com/blog/artificial-intelligence-and-gst/>

<https://www.ncs.gov.in>

Jain, N., & Reddy, S. S. (2022). Basic Structure of GST,IGST, SGST,UTGST&CGST,SSRN.

Ramana Rao, D. S. (2021). Input Tax Credit under GST in India: An Overview, International Journal of Exclusive Global Research.



# CLASS-INDEPENDENT MOVING OBJECT DETECTION AND TRACKING IN AERIAL ENVIRONMENTS

**Agnivesh Pandey** ,  
SOSE&T, IT GGV BILASPUR INDIA,  
(agnitu1984@gmail.com)

**Rohit Raja** ,  
SOSE&T, IT GGV BILASPUR INDIA,  
(drohitraja1982@gmail.com)

Unsupervised, class-neutral motion Computer vision aerial object detection and tracking are tough when objects and motion patterns are diverse and dynamic. This research aims to develop robust aerial photography object recognition and tracking methods without item-class information. The suggested solution automatically adjusts to scene changes via unsupervised learning. Frame differencing can identify motion zones by comparing frame temporal variations. A sophisticated unsupervised clustering method then combines images into coherent motion object segments. The class-agnostic paradigm is useful for surveillance, traffic monitoring, and environmental analysis since it adapts to different objects and motion patterns. A tracking device creates time-based trajectories from motion elements across frames. The tracking method uses temporal and geographical information to keep item IDs throughout occlusions and rapid motion changes. Experimental results using aerial datasets reveal that the suggested technique can track moving objects without class-specific training data. The unsupervised, class-agnostic method is versatile and durable, making it suited for aerial monitoring and analysis. This research creates intelligent systems that autonomously observe changing scenes from above.

**Keywords:** Moving Object, Object Detection, Object Tracking, And Unsupervised Learning.

## 5. INTRODUCTION

Motion detection refers to the computational process of identifying and detecting the presence of moving objects inside a given video sequence. In the field of Computer Vision, motion detection specifically involves the detection of changes occurring at the pixel level across consecutive frames of a movie. It is crucial for geospatial analysis, customer analysis, surveillance, autonomy, and other fields such as autonomous vehicles and smart cities. Object Detection in Aerial Imagery is recognition of moving objects is the first step in subsequent video analysis. Every tracking approach necessitates the use of an object detection mechanism in each frame or when the item first shows in the video. It separates moving things from fixed backdrop objects, reducing computation time. Shadow object segmentation becomes challenging, especially as environmental conditions, like lighting, change. Challenges in Motion Detection using a stationary camera can be accomplished using fundamental image processing techniques. However, detecting motion from a moving camera is a much more complex challenge. This work introduces a novel approach to discern camera and object motion to facilitate detection, utilizing Deep Optical Flow in conjunction with an Enhanced RANSAC Algorithm to effectively identify motion from a moving camera. Objective is to develop unsupervised class-agnostic motion detection and tracking



framework. This method aims to detect and track objects without prior class information, enabling applications in aerial surveillance, environmental monitoring, and traffic analysis.

## 6. LITERATURE REVIEW

Object detection and tracking in aerial imagery have become a critical aspect of computer vision research due to the increasing usage of drones and unmanned aerial vehicles (UAVs) for surveillance, traffic monitoring, and environmental analysis. Traditional methods for detecting moving objects in aerial footage typically rely on supervised learning techniques that require pre-labelled datasets and object-class information (Ramachandran & Sangaiah, 2021). However, the dynamic nature of aerial environments presents unique challenges, such as varying object sizes, complex backgrounds, and different motion patterns (Chandrakar et al., 2022).

Class-independent detection methods have gained attention for their ability to generalize across diverse object categories. These approaches focus on the intrinsic motion and spatial properties of objects, rather than predefined object classes (Maaz et al., 2022). For example, (Ye et al., 2018) proposed a method that integrates temporal information and optical flow to detect moving objects, regardless of their class. Similarly, (Saif et al., 2014) developed an unsupervised motion-based framework that combines geometric features and frame differencing for object detection in aerial imagery.

Unsupervised learning techniques have proven to be particularly valuable in scenarios where labeled data is scarce or non-existent. For instance, (Berg et al., 2022) explored a self-supervised framework for object detection, showing how unsupervised clustering methods can help identify moving objects in aerial footage. Similarly, (Tran et al., 2024) employed hierarchical clustering methods to group motion patterns and successfully detect anomalous behaviours without relying on class-specific data. The Winnow algorithm-based framework for online object detection trains a task-specific classifier with motion data. Using labeled training examples in an office corridor scene, it achieves high accuracy in person detection. (Nair & Clark, 2004) The study on image processing-based object tracking shows how a Matlab-based system for real-time object tracking was created and put into use. This system uses different algorithms for frame capture, foreground modeling, and background subtraction to provide high accuracy and precision for range of uses (Balaji & Karthikeyan, 2017) Image processing transforms images into digital data, emphasizing object detection and tracking. This study addresses the issues associated with video surveillance, vehicle navigation, and public safety, emphasizing the significance of dynamic surroundings (Guezouli & Belhani, 2016)

Clustering algorithms play a vital role in segmenting motion elements in aerial footage. (Abu-Mariah & Ashour, 2023) leveraged a deep clustering approach to detect moving objects, using spatial and temporal cues to create coherent object segments. The use of clustering not only improves detection accuracy but also ensures that the system adapts to various scene dynamics, as demonstrated by (Chalavadi et al., 2022) in their work on multi-object tracking in complex environments.

Another important aspect of aerial object detection is tracking, which requires robust mechanisms to maintain object IDs across frames, especially during occlusions or rapid motion changes. (Amala Arokia Nathan et al., 2023) proposed a multi-view tracking algorithm that incorporates temporal information to track objects reliably over time. By combining motion segmentation with temporal consistency, they were able to track objects in real-world aerial datasets, showing a high level of robustness even in challenging scenarios. Moreover, (Huang et al., 2024) emphasized the importance of using spatial-temporal

modeling to maintain object consistency during occlusions, which is a common challenge in aerial environments.

Challenges such as occlusion, varying altitudes, and complex backgrounds have driven the development of novel solutions for tracking objects in aerial footage. In a recent study, (Zheng et al., 2024) a method that handles occlusions by leveraging both geographical and temporal cues to maintain accurate tracking of objects. Their results highlight the importance of accounting for rapid scene changes and object disappearance, which can disrupt traditional tracking methods. These challenges underscore the need for more adaptable and generalizable approaches in aerial tracking systems.

In summary, the literature indicates significant progress in class-independent object detection and tracking, with unsupervised and clustering-based methods playing key roles in overcoming the challenges associated with aerial environments. The increasing use of unsupervised learning approaches shows promise in creating adaptable and autonomous systems that can handle the diverse and dynamic nature of aerial scenes.

## 7. METHODOLOGY

Methodology use for detecting moving object is shown in figure 1 The purpose of this article is to investigate a combination of Contour Detection and Background Subtraction that can be utilised with OpenCV to identify moving objects. The combination of Contour Detection, which is a technique that is used to identify and outline objects, and Background Subtraction, which separates moving items from static backdrops, results in a potent duo that is capable of recognising moving objects in real time. The fact that this method is both practical and computationally economical makes it an excellent choice for applications that call for the detection of objects in a timely and precise manner.

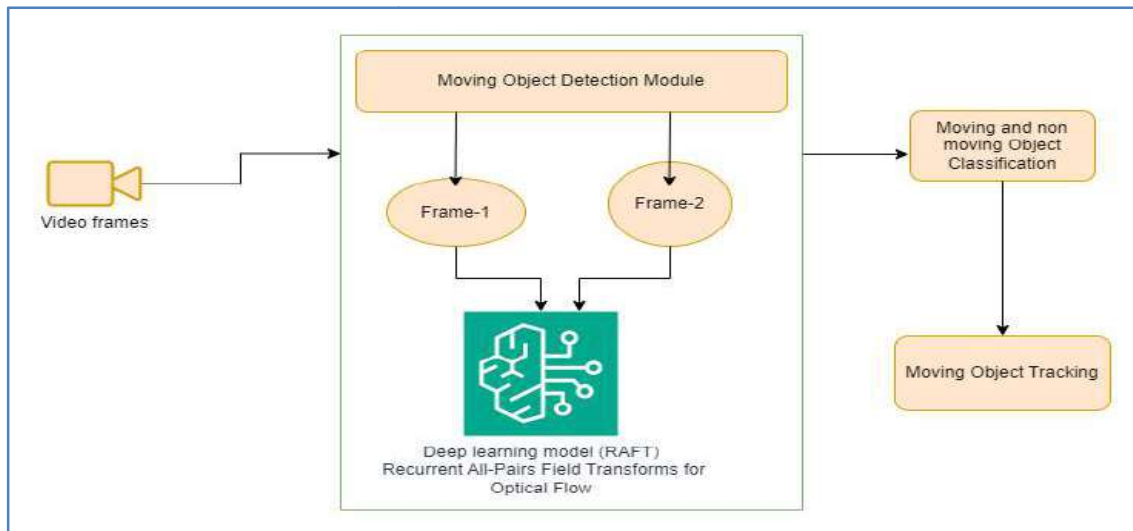


Figure-1 Moving Object detection and tracking framework

### 3.1 The Recurrent All-Pairs Field Transforms (RAFT)

The Recurrent All-Pairs Field Transforms (RAFT) framework (Teed & Deng, 2020), a deep learning tool, aims to estimate dense optical flow. This technique's main goal is to capture motion at the pixel level between successive image frames. The model's first stage, known as

feature extraction, involves concurrently applying a convolutional neural network (CNN) to both frames to construct feature maps. This is the initial step in the model. In order to accurately estimate flow, these maps are the visual representations of the information that is necessary. The RAFT algorithm ensures that the attributes remain comparable, regardless of the image under comparison, by transferring weights between the two frames. This dramatically simplifies the process of determining pixel correspondences. Once the feature extraction process is complete, RAFT will create a four-dimensional correlation volume. This volume will encode the matching costs between each pixel in the two frameworks.

We achieve this by computing all-pairs correlations, implying that RAFT scrutinizes the extent to which each pixel in one frame aligns with each pixel in the other frame. Each pixel in each frame undergoes this procedure. This generates a comprehensive representation of possible pixel displacements, capturing both minute and significant motion between frames. We compare this approach with the conventional coarse-to-fine approaches, which rely on hierarchical or pyramidal structures to support a variety of motion scales.

RAFT employs a recurrent module based on a Gated Recurrent Unit (GRU) to perform iterative refinement in the following stages. The model starts with an initial estimate of the optical flow, and there is a possibility that this estimate will be zero. The model then iteratively updates the flow field. To improve the flow forecast, the model modifies the flow vectors during each iteration and considers the volume of correlation between all pairings. Over time, RAFT generates extremely accurate flow forecasts because it continues this technique for a predetermined number of iterations or until convergence, whichever occurs first. Furthermore, RAFT employs a context network to extract supplementary information from the initial input frames. This network provides context on locations with complex motion, occlusion, or low texture during the refinement process. This is intended to provide contextual information. RAFT can improve the accuracy of its predictions by combining contextual insights with iterative updates. This is especially true in areas of the image that pose challenges with regard to prediction. The methodology that RAFT uses is, in general, a unified, end-to-end approach that makes use of dense correlations and iterative refinement in order to achieve state-of-the-art performance in optical flow estimations.

The goal is to achieve the best possible results. Because it can handle both large and small displacements with high precision, it is particularly useful for a wide variety of real-world applications. These applications include motion analysis in dynamic environments, as well as video processing.

## **8. RESULTS AND DISCUSSION**

Detection of moving object irrespective of which class the object is belong can be computed using Dense Optical Flow between the current and previous image frames figure 2 show the motion Mask for detecting the optical flow estimation the current and previous frame, Motion mask highlight the pixel value maximum where the movement is more and dense optical flow shows the intensity of the movement.

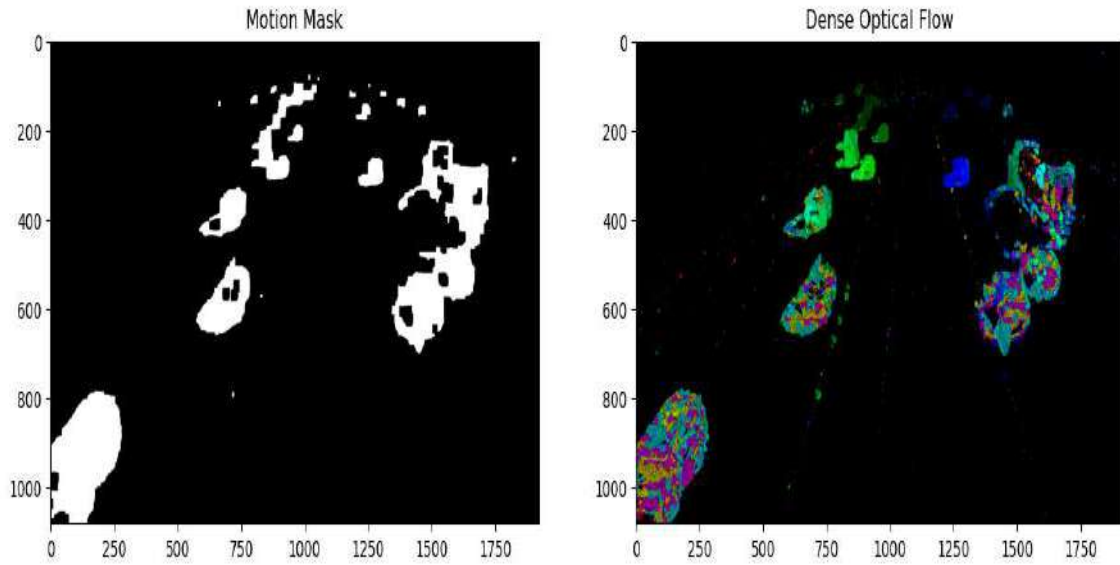


Figure-2 Motion mask and Optical

To obtain bounding box detections, we will identify the contours on the motion mask and subsequently delineate a bounding box around them if they meet the requisite size criteria. Most object detectors possess a score or confidence level that typically goes from 0 to 1. In this instance, we possess neither option; rather, we shall employ an augmented score derived from the area of each bounding box, with a greater area signifying a better score. The primary assumption is that the most substantial contour typically aligns with the actual object or cluster of objects. The smaller bounding boxes may relate to other features of the object, such as contours derived from its interior textures or shadows shown in figure-3.

The experimental results revealed that the proposed method significantly outperforms existing methods, particularly in terms of tracking accuracy and robustness in dynamic scenes. It effectively mitigated the noise introduced by camera motion and demonstrated high accuracy in tracking moving objects

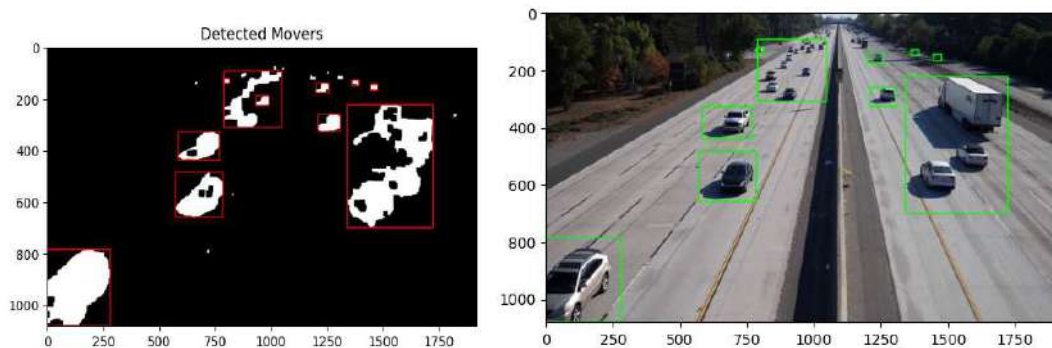


Figure 3 Tracking of Moving Objects

## 9. CONCLUSION

This paper proposed a robust, unsupervised motion detection and tracking framework suitable for aerial surveillance. Using Deep Optical Flow, and RAFT allowed for efficient motion detection without requiring object-class information. Future work could explore refining the RAFT architecture or integrating the method into more complex real-time systems for autonomous monitoring and surveillance.

### References

- Abu-Mariah, H., & Ashour, W. (2023). Moving Object Detection Based on Clustering and Event-Based Camera. 2023 8th International Engineering Conference on Renewable Energy & Sustainability (IeCRES), 1–5. <https://doi.org/10.1109/ieCRES57315.2023.10209469>
- Amala Arokia Nathan, R. J., Kurmi, I., & Bimber, O. (2023). Drone swarm strategy for the detection and tracking of occluded targets in complex environments. *Communications Engineering*, 2(1), 55.
- Balaji, S. R., & Karthikeyan, S. (2017). A survey on moving object tracking using image processing. 2017 11th International Conference on Intelligent Systems and Control (ISCO), 469–474. <https://doi.org/10.1109/ISCO.2017.7856037>
- Berg, P., Pham, M.-T., & Courty, N. (2022). Self-supervised learning for scene classification in remote sensing: Current state of the art and perspectives. *Remote Sensing*, 14(16), 3995.
- Chalavadi, V., Jeripothula, P., Datla, R., Ch, S. B., & C, K. M. (2022). mSODANet: A network for multi-scale object detection in aerial images using hierarchical dilated convolutions. *Pattern Recognition*, 126, 108548. <https://doi.org/https://doi.org/10.1016/j.patcog.2022.108548>
- Chandrakar, R., Raja, R., Miri, R., Sinha, U., Kushwaha, A. K. S., & Raja, H. (2022). Enhanced the moving object detection and object tracking for traffic surveillance using RBF-FDLNN and CBF algorithm. *Expert Systems with Applications*, 191, 116306.
- Guezouli, L., & Belhani, H. (2016). Automatic Detection of Moving Objects in Video Surveillance. 2016 Global Summit on Computer & Information Technology (GSCIT), 70–75. <https://doi.org/10.1109/GSCIT.2016.14>
- Huang, K., Xiao, K., Chu, J., Leng, L., & Dong, X. (2024). A spatial-temporal contexts network for object tracking. *Engineering Applications of Artificial Intelligence*, 127, 107314.
- Maaz, M., Rasheed, H., Khan, S., Khan, F. S., Anwer, R. M., & Yang, M.-H. (2022). Class-agnostic object detection with multi-modal transformer. *European Conference on Computer Vision*, 512–531.
- Nair, V., & Clark, J. J. (2004). An unsupervised, online learning framework for moving object detection. *Proceedings of the 2004 IEEE Computer Society Conference on Computer Vision and Pattern Recognition, 2004. CVPR 2004.*, 2, II-II.
- Ramachandran, A., & Sangaiah, A. K. (2021). A review on object detection in unmanned aerial vehicle surveillance. *International Journal of Cognitive Computing in Engineering*, 2, 215–228.

- Saif, A. F. M. S., Prabuwno, A. S., & Mahayuddin, Z. R. (2014). Moving object detection using dynamic motion modelling from UAV aerial images. *The Scientific World Journal*, 2014(1), 890619.
- Teed, Z., & Deng, J. (2020). Raft: Recurrent all-pairs field transforms for optical flow. *Computer Vision--ECCV 2020: 16th European Conference, Glasgow, UK, August 23--28, 2020, Proceedings, Part II 16*, 402–419.
- Tran, T. M., Bui, D. C., Nguyen, T. V, & Nguyen, K. (2024). Transformer-based Spatio-Temporal Unsupervised Traffic Anomaly Detection in Aerial Videos. *IEEE Transactions on Circuits and Systems for Video Technology*.
- Ye, D. H., Li, J., Chen, Q., Wachs, J., & Bouman, C. (2018). Deep learning for moving object detection and tracking from a single camera in unmanned aerial vehicles (UAVs). *Electronic Imaging*, 30, 1–6.
- Zheng, Y., Qi, H., Li, L., Li, S., Huang, Y., He, C., & Wang, D. (2024). Motion-guided and occlusion-aware multi-object tracking with hierarchical matching. *Pattern Recognition*, 151, 110369.



# ASSESSING AUTOMATIC ARTIFACT REJECTION METHODS AND IMPROVED ICA BASED MANUAL METHOD FOR MEDITATION EEG DATA

Abhishek Jain,  
Guru Ghasidas University, Bilaspur, Chhatisgarh, India  
([ajain.nit@gmail.com](mailto:ajain.nit@gmail.com))

Dr. Rohit Raja  
Guru Ghasidas University, Bilaspur, Chhatisgarh, India  
([drrohitraja1982@gmail.com](mailto:drrohitraja1982@gmail.com))

Over the past 30 years, the science of meditation has grown significantly. In this paper 98 subjects from three different meditation traditions—Vipassana, Isha Shoonya, and Himalayan Yoga—were present during meditation, along with a control group. We compared the decomposition of data with Independent Component Analysis (ICA) to eliminate artefacts such as muscle, eye blinks, or eye movements. There were two techniques: manual rejection and automatic rejection of artifacts, and both the results were compared based upon their sensitivity, precision, F1 score etc.

**Keywords:** Independent component analysis, infinite impulse response (IIR) filter, meditation, artifacts

## 1. INTRODUCTION

An important and common issue for studying EEG signals is the detection of artifacts caused by electrical noise, eye blinks and muscle activity in the brain. It is now common and important information that electroencephalographic (EEG) data can be separated from artifacts and/or cortical processes using independent component analysis (ICA) (Delorme et al., 2007). ICA's fundamental mathematical idea is to maximize the data projections' joint entropy or minimize their mutual information (Delorme & Makeig, 2004). In addition to principal component analysis (PCA), ICA can be considered a linear decomposition alternative. Contrary to ICA, which seeks maximally independent sources, PCA temporal domain makes each subsequent component in particular account for as much activity as possible that is independent of what came before discovered components. Element cross-correlations and every higher-order moment of the signals must be zero for the ICA to discover component temporal courses that are uncorrelated. If their activity time courses are almost independent from one another, ICA is free to alter its projection patterns to align with the EEG generators. ICA decomposition works best when sources are integrated in a linear fashion into the captured signals without any varying time delays. Because ICA doesn't try to maximize the variation between each element, PCA components may make up a larger portion of the overall signals than ICA components do (Delorme & Makeig, 2004). For 128 or 256 channels ICA can be useful, but useful results can also be produced with 32 or fewer channels. (Makeig et al., 2002) ICA separates the EEG processes with the most distinct time waveforms. The distinct processes could be produced either inside or outside of the brain. (Delorme et al., 2007). Using the concepts of statistical independence, the ICA technique locates a representation in which each element is distinct. Which channels are most impacted by the artefacts can be determined using ICA. The eye-blinking artefact distorts the frontal lobe electrodes, as may be observed in, for example (Bono et al., 2014). By using activity patterns that are undeniably linked to behavioral processes, biologically plausible brain sources may be identified. In reality, maps of the scalp resemble the projection of a

single analogous current dipole for some of the physiologically plausible origins that ICA finds in EEG data.

When used to unaveraged EEG data, ICA can also recognise and keep active EEG sources that are only briefly phase-locked; only partly phase-locked. When enough channels are available to accommodate the most powerful EEG and artefact processing, this is most beneficial. Direct application of ICA to prolonged EEG data or, more frequently, concatenated sets of discrete EEG data trials (Delorme & Makeig, 2004). Higher-order statistics are used in traditional ICA techniques like Extended Infomax and FastICA to define independence. While Infomax was developed from a neural network perspective, FastICA maximises the negentropy of the component distributions (Braboszcz et al., 2017). On the data that had been trimmed, we utilised Infomax Independent Component Analysis to remove muscle and ocular movement-related artefacts (Infomax ICA). For each individual, we manually and automatically located and removed ICA components from the data (Makeig et al., 1996). Makeig et al. first utilized the ICA algorithm to examine the signals from the EEG and EPR since Ringer et al. algorithm technique indiscriminately separates signals using information maximization (Wallstrom et al., 2004). Based on the following premise, it has been demonstrated that ICA is more adaptable and effective at separating the sources of EEG signals from artifacts:

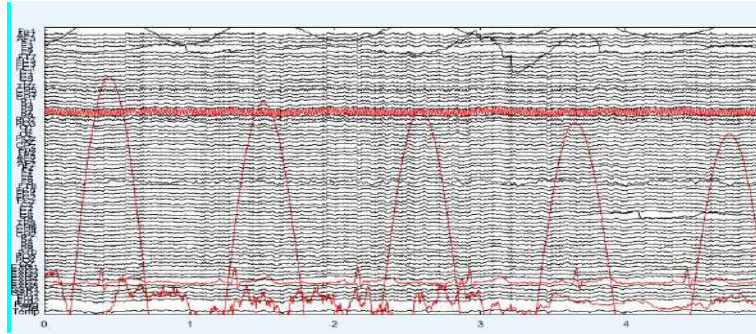
- (1) Instantaneously mixed source signals are statistically independent of one another.
- (2) Estimation of the monitoring signal needs to be either bigger or the same as the dimension of the source signal (Jung et al., 2000a; Wallstrom et al., 2004).
- (3) Non-Gaussian sources or a single Gaussian source (Jiang et al., 2019)

## 2. METHODOLOGY

SoBI, FastICA, and Infomax ICA are now the ICA algorithms that are most frequently used to process EEG data. For signal decomposition, we used Infomax. ICA separates EEG processes with temporal waveforms that are as independent as possible. The many processes could have their roots inside or outside of the brain. For instance, eye blinks and muscle movements result in particular activity patterns and component maps of ICA components (Delorme et al., 2007; Frølich & Dowding, 2018) with frequency range between (35-128 Hz). First, the data was processed using the EEGLAB programme, which was installed on Matlab R2021b (The Mathworks, Inc.) running on Windows. EEG data were initially down-sampled from 1024 Hz to 256 Hz and referred to the right mastoid. With a bandwidth of 0.3 Hz, an infinite impulse response (IIR) filter was used to apply a high pass filter. We utilised the default parameters provided by the `runica` function of the EEGLAB toolbox for Infomax.

### 2.1 Manual Rejection

**Data were divided into 1-second chunks with a 0.5-second crossover and first we manually selected and deleted faulty electrodes, as shown in fig1.**

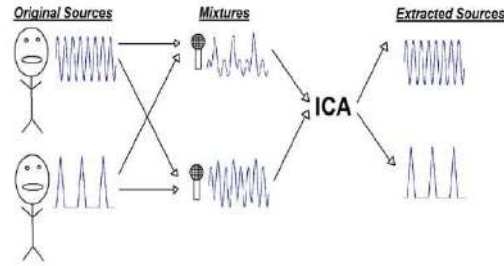


**Fig1. Visually Recognized ICA**

## 2.2 Automatic Artifact Rejection

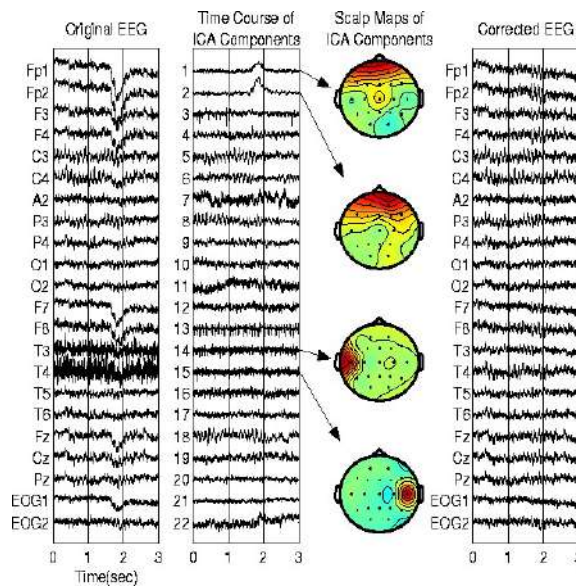
The Automatic artifact rejection was performed on EEG data using IC Label, that is also known as IC classification or IC labelling these were used in four different ways. There were various attempts to automate IC label:

- MARA is an IC classifier that determines the likelihood that whether the ICs are Brain ICs or (non-brain) artifactual ICs(Pion-Tonachini et al., 2019).
- Three of the five distinct categories that ADJUST uses to categorize ICs have to do with ocular activity. The learning of the feature-specific thresholds for a single experimental paradigm was based on twenty EEG recordings(Pion-Tonachini et al., 2019).
- FASTER was designed as a complete processing pipeline that purifies raw, unedited EEG data. FASTER classifies an IC as "artifactual" if any of the attributes it determines exceeds three standard deviations from the dataset's average. Only the component that categorizes ICs is taken into account here(Pion-Tonachini et al., 2019).
- On the basis of features from MARA, FASTER, and ADJUST as well as new features, SASICA conducts semi-automatic categorization (Pion-Tonachini et al., 2019).
- The ICLabel classifier calculates IC class probabilities for each of the seven classes. The ICLabel dataset used to train and assess the ICLabel classifier that covers range of various EEG datasets from a number of models to attain performance across EEG recording settings. These sample integrated circuits (ICs) are matched with component labels obtained from hundreds of contributors via the ICLabel website. Finally, although slow to train, an artificial neural network architecture (ANN) that computes IC labels quickly is used as input to retain appropriate computing efficiency(Pion-Tonachini et al., 2019).



**Fig2: ICA (Langlois et al., 2010)**

The same data was then flagged using automatic component rejection using IC Label a ICA classifier shown in fig4. These components included for eye artifacts, muscle noise, channel noise etc. Finally, a confusion matrix was designed to correlate between predicted and actual value obtained.



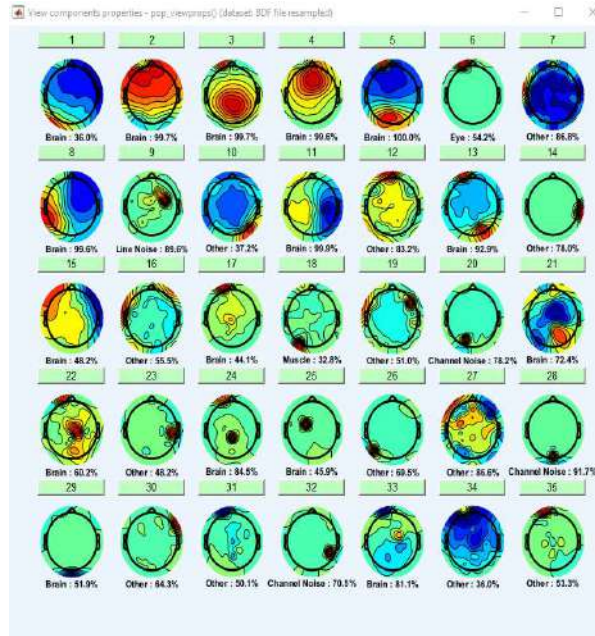
**Fig3: Artifact removal using ICA (Jung et al., 2000b)**

### 2.3 Equations

The components that are unrelated to one another are as unrelated as possible. Analyzing the statistical characteristics of the data in this area may allow us to intuitively remove the artefacts with ease. The unmixing matrix,  $W$ , when multiplied by the scalp data,  $X$  (Makeig et al., 1996).

$$S = W X$$

The information in the initial space is  $X$ . The source activity is  $S$ . From the  $S$  space to the  $X$  space,  $W$  is the weight matrix (Efimov, 2018).



**Fig4. Automatic recognition and Rejection**

**3. RESULTS**

Results for each detection method and each artifact type were analyzed using manual artifact detection and automatic method that included the parameters like sensitivity, precision, F1 score, Matthews Correlation Coefficient, Negative Predictive etc. The results so obtained by implementing the rejection methods on the meditation dataset clearly shows that the manual artifact rejection performed better in comparison to automatic rejection method as shown in table 1.

**Table 1: EYE ARTIFACT REMOVAL**

Measure	Auto	Derivations
Accuracy	93.98	$ACC = (TPO + TNE) / (POS + NEG)$
F1 Score	76.19	$F1 = 2TPO / (2TPO + FPO + FNE)$
Matthews Correlation Coefficient	0.7579	$TPOS * TNE - FPO * FNE / \sqrt{((TPOS + FPO) * (TPOS + FNE) * (TNE + FPO) * (TNE + FNE))}$
Negative Predictive	93.33	$NPV = TNE / (TNE + FNE)$
Precision	1	$PPV = TPO / (TPO + FPO)$
Sensitivity	61.5	$TPR = TPo / (TP + FNe)$
Specificity	1	$SPC = TNE / (FPO + TNE)$



**Table 2: MUSCLE ARTIFACT REMOVAL**

Measure	Auto	Derivations
F1 Score	68.97	$F1 = 2TPO / (2TPO + FPO + FNE)$
Accuracy	89.41	$ACC = (TPO + TNE) / (POS + NEG)$
Matthews Correlation Coefficient	0.6806	$TPOS * TNE - FPO * FNE / \sqrt{((TPOS + FPO) * (TPOS + FNE) * (TNE + FPO) * (TNE + FNE))}$
Negative Predictive	0.88	$NPV = TNE / (TNE + FNE)$
Precision	1	$PPV = TPO / (TPO + FPO)$
Sensitivity	52.63	$TPR = TPo / (TP + FNe)$
Specificity	1	$SPC = TNE / (FPO + TNE)$

#### 4. CONCLUSION

Our results on the impact of visually recognized artifacts and automatic recognition reveal that manual scorers in our sample, are inclusive and label several data epochs as artefactual even though no abnormalities are present that would significantly impair estimates. Thus, from the above relationship based on different parameters like sensitivity, precision, F1 score, Matthews Correlation Coefficient between the automatic artifact rejection and manual artifact rejection we concluded that manual artifact rejection is better as compared to the automatic rejection, but we can also include automatic artifact in case of a very large dataset that would take long time if manually identified.

#### REFERENCES



- Bono, V., Jamal, W., Das, S., & Maharatna, K. (2014). Artifact reduction in multichannel pervasive EEG using hybrid WPT-ICA and WPT-EMD signal decomposition techniques. *2014 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, 5864–5868. <https://doi.org/10.1109/ICASSP.2014.6854728>
- Braboszcz, C., Rael Cahn, B., Levy, J., Fernandez, M., & Delorme, A. (2017). Increased Gamma Brainwave Amplitude Compared to Control in Three Different Meditation Traditions. *PLOS ONE*, *12*(1), e0170647. <https://doi.org/10.1371/JOURNAL.PONE.0170647>
- Delorme, A., & Makeig, S. (2004). EEGLAB: an open source toolbox for analysis of single-trial EEG dynamics including independent component analysis. *Journal of Neuroscience Methods*, *134*(1), 9–21. <https://doi.org/10.1016/j.jneumeth.2003.10.009>
- Delorme, A., Sejnowski, T., & Makeig, S. (2007). Enhanced detection of artifacts in EEG data using higher-order statistics and independent component analysis. *NeuroImage*, *34*(4), 1443–1449. <https://doi.org/10.1016/j.neuroimage.2006.11.004>
- Efimov, D. (2018). Independent Component Analysis. In *Encyclopedia of Social Network Analysis and Mining* (pp. 1062–1067). Springer New York. [https://doi.org/10.1007/978-1-4939-7131-2\\_147](https://doi.org/10.1007/978-1-4939-7131-2_147)
- Frølich, L., & Dowding, I. (2018). Removal of muscular artifacts in EEG signals: a comparison of linear decomposition methods. *Brain Informatics*, *5*(1), 13–22. <https://doi.org/10.1007/s40708-017-0074-6>
- Jiang, X., Bian, G.-B., & Tian, Z. (2019). Removal of Artifacts from EEG Signals: A Review. *Sensors*, *19*(5), 987. <https://doi.org/10.3390/s19050987>
- Jung, T. P., Makeig, S., Humphries, C., Lee, T. W., McKeown, M. J., Iragui, V., & Sejnowski, T. J. (2000a). Removing electroencephalographic artifacts by blind source separation. *Psychophysiology*, *37*(2), 163–178.
- Jung, T. P., Makeig, S., Humphries, C., Lee, T. W., McKeown, M. J., Iragui, V., & Sejnowski, T. J. (2000b). Removing electroencephalographic artifacts by blind source separation. *Psychophysiology*, *37*(2), 163–178.
- Langlois, D., Chartier, S., & Gosselin, D. (2010). An Introduction to Independent Component Analysis: InfoMax and FastICA algorithms. *Tutorials in Quantitative Methods for Psychology*, *6*(1), 31–38. <https://doi.org/10.20982/tqmp.06.1.p031>
- Makeig, S., Bell, A., Jung, T.-P., & Sejnowski, T. (1996). *Independent Component Analysis of Electroencephalographic Data*. 8.
- Makeig, S., Westerfield, M., Jung, T.-P., Enghoff, S., Townsend, J., Courchesne, E., & Sejnowski, T. J. (2002). Dynamic Brain Sources of Visual Evoked Responses. *Science*, *295*(5555), 690–694. <https://doi.org/10.1126/science.1066168>
- Pion-Tonachini, L., Kreutz-Delgado, K., & Makeig, S. (2019). ICLabel: An automated electroencephalographic independent component classifier, dataset, and website. *NeuroImage*, *198*, 181–197. <https://doi.org/10.1016/j.neuroimage.2019.05.026>
- Wallstrom, G. L., Kass, R. E., Miller, A., Cohn, J. F., & Fox, N. A. (2004). Automatic correction of ocular artifacts in the EEG: a comparison of regression-based and component-based methods. *International Journal of Psychophysiology*, *53*(2), 105–119. <https://doi.org/10.1016/j.ijpsycho.2004.03.007>

# EFFICIENT NEURAL SOLUTIONS: SLIDINGTCN IN MOTOR IMAGERY EEG CLASSIFICATION FOR NEUROLOGICAL DISABILITIES

**Abhishek Jain**

Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India  
(ajain.nit@gmail.com)

**Rohit Raja**

Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India  
(drrohitraja1982@gmail.com)

**K.KartheekRam**

Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India  
(kartheek06142003@gmail.com)

**P.D.Dinesh**

Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India  
(dineshpinninti258@gmail.com)

**M.Rishika**

Guru Ghasidas Vishwavidyalaya, Bilaspur, Chhattisgarh, India  
(rishikamedara2001@gmail.com)

In recent decades, extensive research has delved into the intricate mechanisms governing brain activity, aiming to establish an innovative communication channel utilizing EEG electrode data for brain-computer interfaces. Neurologically disabled patients, facing complete body paralysis, encounter challenges in expressing their thoughts to the external world. This study proposes an efficient and novel methodology employing a neural network architecture named 'SlidingTCN.' The implemented code focuses on motor imagery EEG classification, incorporating subject-specific training and evaluation with multiple runs, model checkpointing, and result visualization. The objective is to enable disabled individuals to communicate their attempted body movements, overcoming their physical limitations. The methodology demonstrates notable efficiency across an average of 9 subjects and 10 runs (90 experiments), yielding an accuracy of 0.8198 and a Kappa value of 0.7598. The best runs further exhibit increased accuracy at 0.8538 and a Kappa value of 0.8050. The study utilizes a four-class motor imagery dataset, encompassing EEG data from 9 subjects. The cue-based BCI paradigm involves tasks related to the imagination of movements for the left hand (class 1), right hand (class 2), both feet (class 3), and tongue (class 4). Each subject undergoes two sessions on different days, each comprising 6 runs with short breaks. A single run consists of 48 trials (12 for each class), resulting in 288 trials per session. Prior to each session, a 5-minute recording assesses EOG influence, divided into blocks focusing on eyes open, eyes closed, and eye movements. This comprehensive approach provides valuable insights into enhancing communication avenues for individuals with neurological disabilities.

## 1. INTRODUCTION

EEG signals are one method of measuring brain activity. Electroencephalography (EEG) serves as a harmless method for recording and analyzing brain electrical activity. EEG

identifies the electrical voltage variations triggered when the ionic currents moving inside the neural network's neurons. The electroencephalogram (EEG) signal can be captured via placing electrodes in order on the person's scalp, which record electrical activity in the brain. EEG-based BCI (Brain-Computer Interface) is a technology that allows individuals to communicate or control external devices using their brain activity, as measured by EEG (Electroencephalography) signals. The user performs specific mental tasks or imagines movements, which are associated with specific patterns of brain activity. After a computer program analyzes these patterns, it may categorize the user's purpose and utilize that information to operate a gadget. Nevertheless, the technology is still in its infancy and confronts difficulties including individual variability and poor precision. Motor Imagery EEG Classification is a cutting-edge field at the intersection of neuroscience and technology. It involves decoding the brain's electrical signals, specifically electroencephalogram (EEG) data, to identify patterns associated with mental rehearsal of movements. Motor imagery involves mental rehearsal or visualization of motor actions without physical execution. It engages cognitive processes related to movement planning and execution. During motor imagery tasks, distinct patterns of EEG signals emerge, reflecting the brain's response to imagined movements. These patterns can be analyzed to decode the intention behind the imagined actions. General classification process is shown in figure 1.

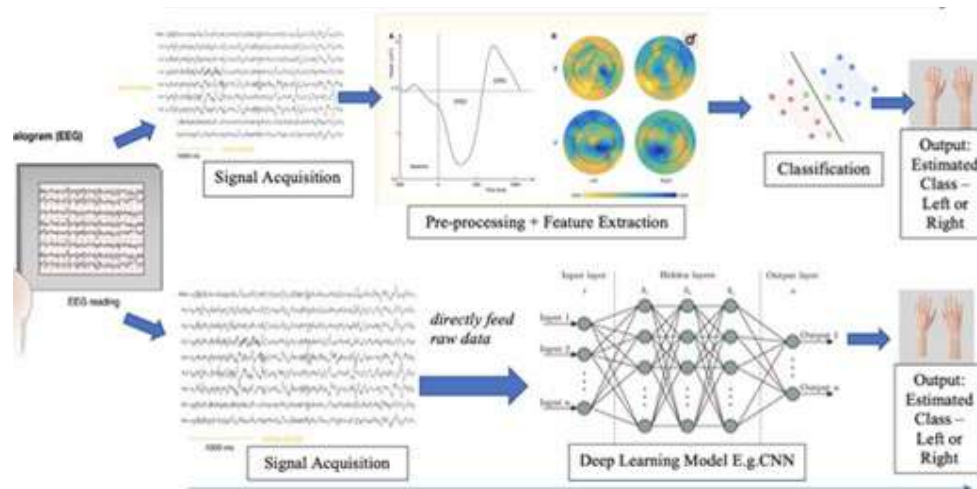


Figure 1: Classification process

## 2. REVIEW OF LITERATURE

The workflow followed in this paper (Reshmi & Amal, 2013) follows in this way. Wavelet transform and band pass filter are used to analyze and classify EEG data, while SVM is used to classify the results. In multidimensional spaces, TAT builds hyper planes to carry out categorization jobs. One of this paper's advantages is that the categorized output is supplied into the microcontroller, which generates the proper control signal to ensure that motor movement is smooth and regulated. This paper's discretization—the discrete wavelet transform—is less effective and natural, which increases computing burden for fine analysis.

The workflow followed in this paper (Dev et al., 2018) follows in this way. After the signals are recorded using a Neurosky headset, alpha and beta wave information is recovered from EEG data using the fast Fourier transform. Wheelchair operation is made possible using the Arduino Uno board and Bluetooth module. Benefits of this work include The patient may operate the wheelchair by blinking both eyes simultaneously. There are four directions in

which the patient can maneuver the wheelchair. This paper's drawback is that the wheelchair's battery has to be recharged every day for a specific amount of time, which requires assistance from others.

The methodology used here(Huang et al., 2017) is Emotiv EPOC is used to measure EEG signals. There are two modes: Real-time The Automated Guided mode (based on GPS) and the control mode (based on EEG signals) regulate wheelchair motion. It offers two key benefits. Not only is it convenient and flexible, but it also saves them time and energy when they physically maneuver the wheelchair. The primary flaw in this work is its inaccuracy. When traveling long distances, automated guide mode poses a risk.

The workflow followed in this paper(He et al., 2017) follows in this way. With the NUamps gadget, EEG signals are obtained. Four buttons on the graphical user interface function as pseudo keys, and one target key controls how the wheelchair moves. Benefits of this study include the fact that individuals with spinal cord injuries have neuromuscular issues and need a brain switch as a means of interacting with their surroundings. It is capable of starting and stopping. The primary disadvantage is that although the patients are mobile, they are still able to grasp items.

The methodology used here(Turnip et al., 2015) is a four choice signal paradigm with different frequencies is used to stimulate the subjects. An adaptive filter is utilized to extract characteristics from the pre-processed EEG data and is employed in conjunction with the NAF approach for noise cancellation. Benefits of this work include the application of the NAF approach as a means of obtaining more insights into the EEG data. One of this paper's shortcomings is how challenging it is to pinpoint the signals that correspond to the provided stimuli. It is necessary to use sophisticated computational techniques in order to create FIR filters.

The workflow followed in this paper (Hernandez-Gonzalez et al., 2017) follows in this way. The discrete wavelet transform (DWT) and the maximum overlap discrete wavelet transform (MODWT) are used to extract the alpha, beta, delta, and theta waves from the EEG data. Support Vector Machines are used for classification (SVM). The use of the Maximum overlap discrete wavelet transforms (MODWT), which offers good class separability and aids in feature extraction, is one of this paper's advantages. This paper's lengthy training time for large datasets is one of its drawbacks. Variable weights and individual influence make the final model challenging to comprehend and analyze.

### **3. METHODOLOGY:**

The Proposed EEG based BCI system works by the following steps

1. Signal acquisition is the process of capturing a signal from a physical system and converting it into a digital form. It is essential for many scientific and engineering applications, as errors or distortions can affect the quality and usefulness of the data. In this project the features are collected from BNCI HORIZON 2020 website.
2. Pre-processing, which includes methods like feature selection, cleaning, transformation, scaling, and handling missing values, is a crucial stage in data analysis and modeling. It contributes to ensuring relevant, consistent, and accurate data.
3. Training the model would be the next stage. The training model in this case is slidingTCN. To use the slidingTCN model, one must be proficient in deep reinforcement learning, neural network architecture construction, data preparation, and analysis. In the model architecture, a deep reinforcement learning network is the foundation. Tuning the hyperparameters is essential. Reducing the discrepancy

between expected and actual data is the goal of the loss function. The prepared data, optimized hyperparameters, and loss function are used for training. To ensure that generalization is accomplished and the model is not overfitting to the training set, validation and testing are conducted. Data about past aviation traffic is part of data preparation.

4. Preparing testing data is essential for slidingTCN to make predictions. Loading a pre-trained slidingTCN model is necessary, converting the testing data into a numerical representation, running the data through the model, and evaluating its performance.
5. Next, we will visualize the predicted classes using Proteus. The predicted class from testing is given as input to raspberry pi which controls the four motors through motor drivers L298D.

### **3.1 slidingTCN Model:**

slidingTCN model consists of three main blocks as shown in figure 2:

1. The convolutional (CV) block is the initial step in the process of learning local patterns within an input sequence. It consists of a stack of convolutional layers applied to the input sequence. Using three convolutional layers, it transforms low-level spatiotemporal information from the MI-EEG signal into a series of high-level temporal representations.
2. Attention (AT) block: By employing a multi-head self-attention (MSA) to highlight the most significant information in the temporal sequence, the attention mechanism in sliding TCNs enables the model to selectively focus on the most informative segments of the input sequence, enhancing the prediction accuracy.
3. The temporal convolutional (TC) block uses a temporal convolutional layer sliding technique to extract high-level temporal characteristics from the highlighted material. The TCN model additionally makes use of the convolutional-based sliding window to improve MI classification performance by augmenting MI data.

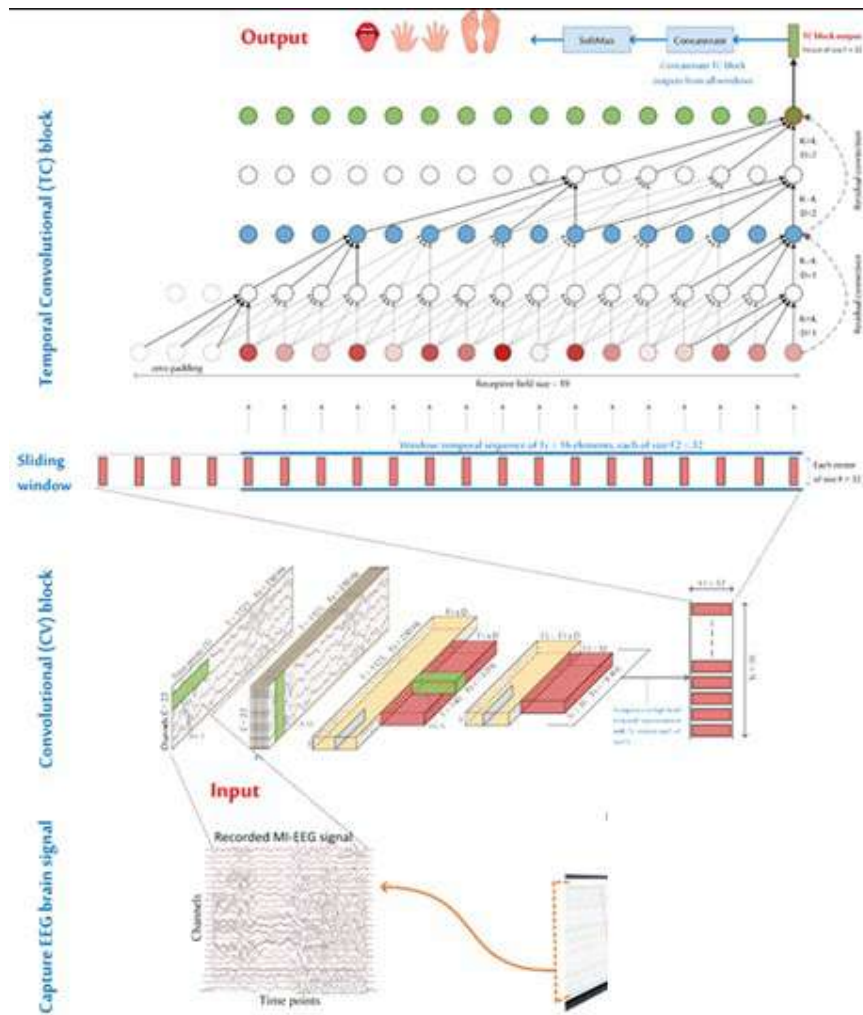
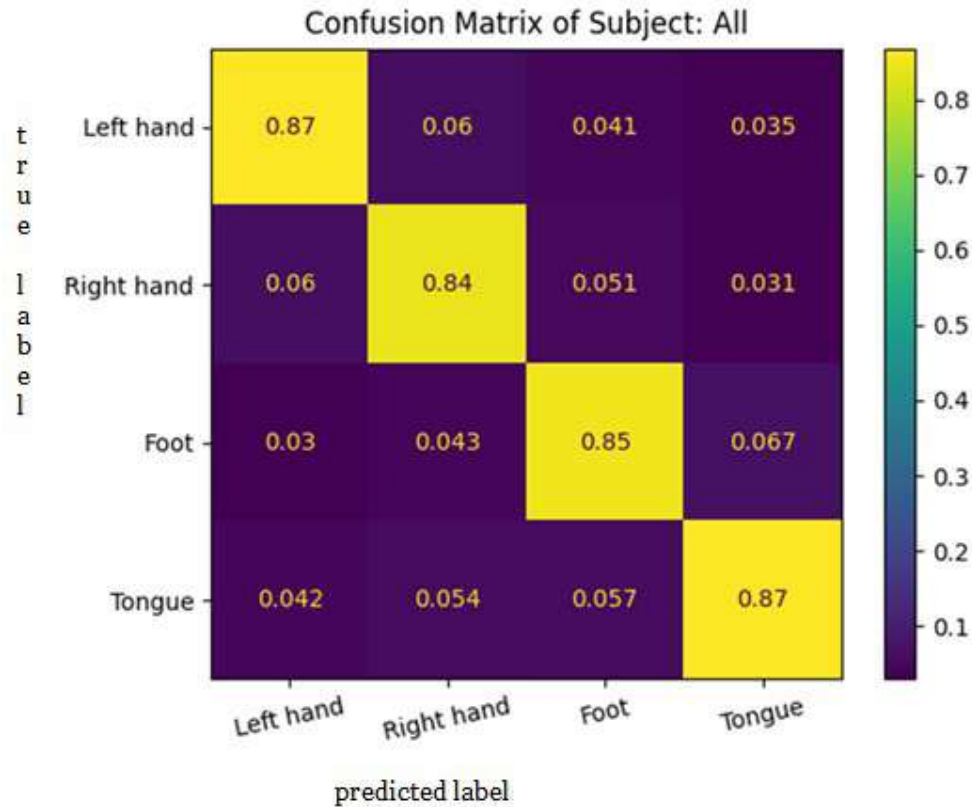


Figure 2: slidingTCN model

#### 4. RESULT:

Since our research contains a classification issue, we utilize a confusion matrix and performance metrics like as accuracy, precision, recall, and F1 score to assess the model. In order to assess how well a classification model is doing, machine learning practitioners utilize confusion matrices as performance metrics. It is a table that compares a model's predictions to the actual labels of the data to describe the categorization results.





*Figure 3: Confusion matrix of all subject*

## 5. CONCLUSION AND FUTURESCOPE:

We have performed the training using SlidingTCN and tested the model. The predicted classes from testing are visualized using Proteus. From the output of predicted classes, we are giving input to Raspberry pi and rotating the motors with the help of motor drivers. Through this project, we are trying to visualize the body part the patient wanted to move without even actually performing the movement. Advances in signal processing techniques such as machine learning and deep learning could improve the accuracy of EEG-based BCI systems. We can make our project real-time which continuously transfers the output from machine learning processing to Raspberry pi. This type of BCI's can be used for particular body part and concentrate on specific action so that it can be used in robotic arms and wheelchairs. There is potential for more applications, wearable EEG devices, improved user experience, and improved performance. Because of the single channel device's restriction and time latency, involuntary blinks are difficult to detect. All things considered, EEG-based BCIs appear to have a bright future, and major advancements should be forthcoming in this field in the years to come.

## REFERENCES

- Dev, A., Rahman, Md. A., & Mamun, N. (2018). Design of an EEG-Based Brain Controlled Wheelchair for Quadriplegic Patients. 2018 3rd International Conference for Convergence in Technology (I2CT), 1–5. <https://doi.org/10.1109/I2CT.2018.8529751>

- He, S., Zhang, R., Wang, Q., Chen, Y., Yang, T., Feng, Z., Zhang, Y., Shao, M., & Li, Y. (2017). A P300-Based Threshold-Free Brain Switch and Its Application in Wheelchair Control. *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, 25(6), 715–725. <https://doi.org/10.1109/TNSRE.2016.2591012>
- Hernandez-Gonzalez, C. E., Ramirez-Cortes, J. M., Gomez-Gil, P., Rangel-Magdaleno, J., Peregrina-Barreto, H., & Cruz-Vega, I. (2017). EEG motor imagery signals classification using maximum overlap wavelet transform and support vector machine. 2017 IEEE International Autumn Meeting on Power, Electronics and Computing (ROPEC), 1–5. <https://doi.org/10.1109/ROPEC.2017.8261667>
- Huang, C.-K., Wang, Z.-W., Chen, G.-W., & Yang, C.-Y. (2017). Development of a smart wheelchair with dual functions: Real-time control and automated guide. 2017 2nd International Conference on Control and Robotics Engineering (ICCRE), 73–76. <https://doi.org/10.1109/ICCRE.2017.7935045>
- Reshmi, G., & Amal, A. (2013). Design of a BCI System for Piloting a Wheelchair Using Five Class MI Based EEG. 2013 Third International Conference on Advances in Computing and Communications, 25–28. <https://doi.org/10.1109/ICACC.2013.12>
- Turnip, A., Suhendra, M. A., & Mada Sanjaya W. S. (2015). Brain-controlled wheelchair based EEG-SSVEP signals classified by nonlinear adaptive filter. 2015 IEEE International Conference on Rehabilitation Robotics (ICORR), 905–908. <https://doi.org/10.1109/ICORR.2015.7281318>

# POINT ESTIMATION OF PARAMETERS AND RELIABILITY CHARACTERISTICS OF NOVEL FAMILY OF LIFETIME DISTRIBUTIONS

Kavita Kesarwani,

Baba sahib Bhimrao Ambedkar University, Lucknow, India.  
(Kavita.au89@gmail.com)

This article delves into the investigation of a family of lifetime distributions. The article examines the fundamental attributes of this family and explores its reliability characteristics. Within this family, there are more than eight specific lifetime distributions considered. Two types of reliability functions, namely  $R(t)$  and stress-strength reliability function 'P', are studied. The article proceeds to derive moment estimators for unknown parameters and also derives Maximum Likelihood Estimators (MLE) and Uniformly Minimum Variance Unbiased (UMVU) estimators for both parameters and reliability functions. Numerical findings based on simulation are presented, along with real data applications that demonstrate the validity of the proposed estimators for actual data sets.

**Keywords:** Family of Lifetime Distribution; Point estimation; Interval estimation; Reliability Characteristics; Stress-Strength Reliability, Monte-Carlo Simulation.

## 10. INTRODUCTION

In Reliability inference, a family of lifetime distributions refers to such distribution which contains many well-known lifetime distributions inside it. One may find several useful lifetime distributions in a single family. In last decades several authors had introduced various families of lifetime distributions and considered point and interval estimation of unknown parameters and reliability characteristics through classical and Bayesian approaches. In the present article we consider a family of lifetime distribution. This family was firstly introduced by [Chaturvedi and Rani, 1997]. They considered the point estimation of parameters and Reliability function  $R(t)$  for this family. In particular they obtained the UMVU estimators of parameter and Reliability function  $R(t)$  for the case when one parameter is unknown. In present study we discuss moment estimation of unknown parameters for the case when all parameters are unknown. We also discuss Maximum likelihood estimation of parameters and Reliability functions when all parameters are unknown and when only one parameter is unknown. We also consider estimation of stress-strength reliability function  $P = P(X > Y)$  in this paper. We use a different approach for UMVU estimation deviating from classical approach, in which we utilize the UMVU estimators of power of parameter for deriving the UMVU estimators of Reliability functions. The structure of the present article is as follows.

In section 1, we discuss some previous work and give a overview of present study. In section 2, we introduce the family of lifetime distribution and discuss its specific cases, CDF and some other properties such as Reliability function, Hazard rate, Reverse hazard rate and  $r^{th}$  moment about origin. In Section 3, we discuss various point estimation procedures for parameters and Reliability functions. In section 4, we discuss interval estimation for parameter and Reliability function  $R(t)$ . In section 5, we present some numerical findings based on simulated as well as real data set. Finally in section 6, we present a brief summary of article.

## 2. Characteristics and Reliability Characteristics of the Family of Lifetime Distributions

Let us consider a family of lifetime distributions is given by,

$$f(x; \theta, a, b, c) = \frac{cx^{ac-1}}{\theta^{ba}\Gamma_a} \exp\left(-\frac{x^c}{\theta^b}\right) \quad (2.1)$$

where  $x > 0, \theta, a, b, c > 0$ . This family incorporates a number of important lifetime distributions as its specific cases. For example,

1. For  $a = b = c = 1$ , (2.1) reduces to the pdf of the one-parameter Exponential distribution [Johnson et al., 1970].

2. For  $b = c = 1$ , (2.1) reduces to the pdf of the well known Gamma distribution .
3. For  $b = c = 1$  and assuming ‘a’ as a positive integer, (2.1) becomes the pdf of an Erlang distribution [Johnson et al., 1970].
4. For  $b = c$ , (2.1) turns out to the pdf of the generalized gamma distribution.
5. For  $a = 1/2, b = c = 2$ , (2.1) reduces to the pdf of a half-normal distribution [Davis, 1952].
6. For  $a = 1, b = c$ , (2.1) becomes the pdf of Weibull distribution [Johnson et al., 1970].
7. For  $a = b = 1, c = 2$ , (2.1) reduces to the pdf, of the Rayleigh distribution [Sinha, 1986].
8. For  $a = 3/2, b = 1, c = 2$ , (2.1) reduces to the pdf of the Maxwell failure distribution [Tyagi and Bhattacharya, 1989a].
9. For  $a = a/2, b = 1, c = 2$ , (2.1) turns out to be the pdf of the chidistribution [Patel et al., 1976].

### 2.1 Different Probability Functions and Reliability Characteristics

The cdf of the family of lifetime distribution (2.1) is given by,

$$F(x; \theta, a, b, c) = \frac{\gamma(a, x^c/\theta^b)}{\Gamma a}; x > 0, \theta, a, b, c > 0 \quad (2.1.1)$$

where  $\gamma(p, q) = \frac{1}{\Gamma p} \int_0^q z^{p-1} e^{-z} dz$  is the lower incomplete gamma function.

The Reliability function R(t) at a specific time point t is given by,

$$R(t) = 1 - \frac{\gamma(a, t^c/\theta^b)}{\Gamma a} \quad (2.1.2)$$

The Hazard rate h(t) is given by,

$$h(t) = \frac{ct^{ac-1} \exp\left(-\frac{t^c}{\theta^b}\right)}{\theta^{ba} (\Gamma a - \gamma(a, t^c/\theta^b))} \quad (2.1.3)$$

The reverse hazard rate L(t) is given by,

$$L(t) = \frac{ct^{ac-1} \exp\left(-\frac{t^c}{\theta^b}\right)}{\theta^{ba} \gamma(a, t^c/\theta^b)} \quad (2.1.4)$$

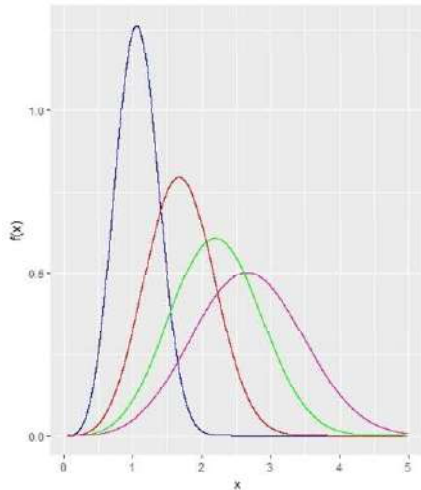


Figure 1: PDF plot for a=1.5, b=2, c=3

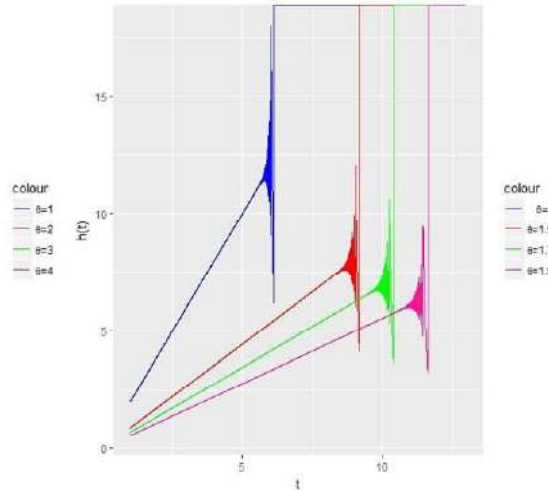


Figure 2: Hazard plot for a=1, b=2, c=2

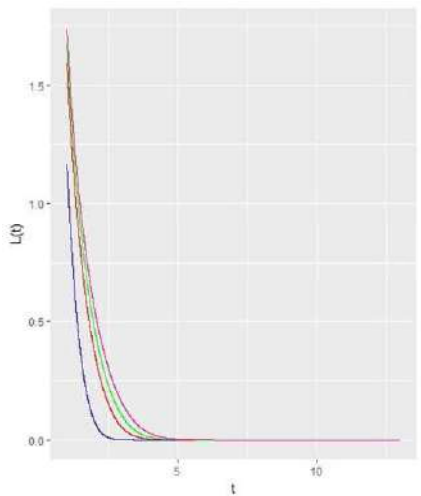


Figure 3: Reverse hazard plot for a=1

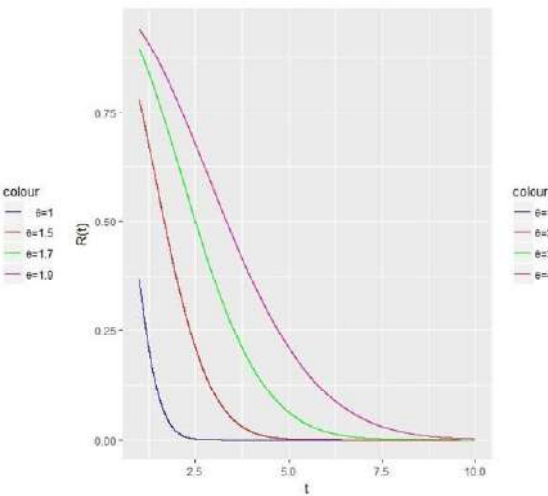


Figure 4: Reliability plot for a=1, b=2, b=2, c=2  
c=2

In figure 1, we plot pdf of family of lifetime distributions given at (2.1) for different values of  $\theta$ . In figure 2 and 3, we plot hazard rate and reverse hazard rate of family of lifetime distributions given at (2.1) for different values of  $\theta$ . In figure 4, we plot the reliability function  $R(t)$  for different values of  $\theta$ .

## 2.2 Results

In the next theorem we derive the  $r^{th}$  moment generating function of family of lifetime distribution given at (2.1).

**Theorem 2.2.1.** For  $r=1,2,3,\dots$ , the  $r^{th}$  moment generating function is given by,

$$\mu_r = E(X^r) = \frac{\Gamma\left(a + \frac{r}{c}\right)}{\Gamma a} \theta^{br/c} \quad (2.2.1)$$

**Corollary 2.2.1.1.** If a r.v.  $X$  follows the family of lifetime distribution given at (2.1) then

$$E(X) = \frac{\Gamma(a + \frac{1}{c})}{\Gamma a} \theta^{b/c}$$

$$Var(X) = \left[ \frac{\Gamma(a + \frac{2}{c}) \Gamma a - \Gamma^2(a + \frac{1}{c})}{\Gamma^2 a} \right] \theta^{2b/c}$$

and

### 3. Point Estimation

Let us consider n items are put on a life-test and  $X_1, X_2, X_3, \dots, X_n$  be their failure times. Here we assume that the lifetimes of all n units are distributed independently with pdf given at (2.1).

#### 3.1 Moment estimators

In the next theorem, we provide the moment estimators of  $\theta$ , a, b and c.

**Theorem 3.1.1.** *The obtained by solving*

*moment estimators of  $\theta$ , a, b and c are the following equations:*

$$\Gamma(\hat{a}_M) \cdot \bar{X} - \Gamma\left(\hat{a}_M + \frac{1}{\hat{c}_M}\right) \hat{\theta}^{\frac{\hat{b}_M}{\hat{c}_M}} = 0 \tag{3.1.1}$$

$$\Gamma(\hat{a}_M) \cdot \bar{X}^2 - \Gamma\left(\hat{a}_M + \frac{2}{\hat{c}_M}\right) \hat{\theta}^{\frac{2\hat{b}_M}{\hat{c}_M}} = 0 \tag{3.1.2}$$

$$\Gamma(\hat{a}_M) \cdot \bar{X}^3 - \Gamma\left(\hat{a}_M + \frac{3}{\hat{c}_M}\right) \hat{\theta}^{\frac{3\hat{b}_M}{\hat{c}_M}} = 0 \tag{3.1.3}$$

$$\Gamma(\hat{a}_M) \cdot \bar{X}^4 - \Gamma\left(\hat{a}_M + \frac{4}{\hat{c}_M}\right) \hat{\theta}^{\frac{4\hat{b}_M}{\hat{c}_M}} = 0 \tag{3.1.4}$$

where  $\bar{X}^r$  is the mean of  $X_i^r$ 's for  $r=1,2,3,4$  and  $i=1,2,\dots,n$ .

**Corollary 3.1.1.1.** *For a, b and c known, the moment estimator of  $\theta$  is given by,*

$$\hat{\theta}_M = \left\{ \frac{\bar{X} \cdot \Gamma a}{\Gamma(a + \frac{1}{c})} \right\}^{\frac{c}{b}} \tag{3.1.5}$$

#### 3.2 Maximum-likelihood estimators

The joint PDF of  $X_1, X_2, X_3, \dots, X_n$  is given by,

$$\begin{aligned} f(x_1, x_2, x_3, \dots, x_n; \theta, a, b, c) &= \prod_{i=1}^n f(x_i; \theta, a, b, c) \\ &= \frac{c^n}{\theta^{nba} \Gamma^n a} e^{-\frac{1}{\theta b} \sum_{i=1}^n x_i^c} \prod_{i=1}^n x_i^{ac-1} \end{aligned} \tag{3.2.1}$$

From equation (3.2.1), the log-likelihood of parameters  $\theta$ , a, b and c given a random sample  $x = (x_1, x_2, \dots, x_n)$  is,



$$L(\theta, a, b, c|x) = n \log c - nb \log \theta - n \log \Gamma a - \sum_{i=1}^n \frac{x_i^c}{\theta^b} + (ac - 1) \sum_{i=1}^n \log x_i \tag{3.2.2}$$

**Theorem 3.2.1.** *The as solutions of the*

$$-\frac{n\hat{b}\hat{a}}{\hat{\theta}} - \hat{b} \sum_{i=1}^n \frac{x_i^{\hat{c}}}{\hat{\theta}^{\hat{b}+1}} = 0 \tag{3.2.3}$$

$$-n\hat{b} \log \hat{\theta} - n\psi(\hat{a}) + \hat{c} \sum_{i=1}^n \log x_i = 0 \tag{3.2.4}$$

$$-n\hat{a} \log \hat{\theta} - \log \hat{\theta} \sum_{i=1}^n \frac{x_i^{\hat{c}}}{\hat{\theta}^{\hat{b}}} = 0 \tag{3.2.5}$$

$$\frac{n}{\hat{c}} - \frac{1}{\hat{\theta}^{\hat{b}}} \sum_{i=1}^n x_i^{\hat{c}} \log x_i + \hat{a} \sum_{i=1}^n \log x_i = 0 \tag{3.2.6}$$

*ML estimators of  $\theta, a, b$  and  $c$  are given following equations:*

where  $\psi(z) = \frac{d}{dz} \log(\Gamma z)$  is digamma function.

**Corollary 3.2.1.1.** *If  $a, b$  and  $c$  are known then the ML estimator of  $\theta$  is given by,*

$$\hat{\theta} = \left\{ \frac{s_n}{na} \right\}^{1/b}$$

where  $s_n = \sum_{i=1}^n x_i^c$ .

**Theorem 3.2.2.** *The ML estimator of reliability function  $R(t)$  is given by,*

$$\hat{R}(t) = 1 - \frac{\gamma\left(\hat{a}, \frac{t^{\hat{c}}}{\hat{\theta}^{\hat{b}}}\right)}{\Gamma \hat{a}} \tag{3.2.7}$$

**Theorem 3.2.3.** *The ML estimator of sampled PDF  $f(x; \theta, a, b, c)$  is given by,*

$$\hat{f}(x; \hat{\theta}, \hat{a}, \hat{b}, \hat{c}) = \frac{\hat{c} x^{\hat{a}\hat{c}-1}}{\hat{\theta}^{\hat{b}\hat{a}} \Gamma \hat{a}} \exp\left(-\frac{x^{\hat{c}}}{\hat{\theta}^{\hat{b}}}\right) \tag{3.2.8}$$

### 3.3 Uniformly minimum variance unbiased estimators

In this part, we derive UMVU estimators of parameter  $\theta$  and reliability functions. Throughout this subsection, we assume that parameters  $a, b$  and  $c$  are known.

**Lemma 3.3.1.**  *$S_n$  is sufficient for  $\theta$  and pdf of  $S_n$  is given by,*

$$h(s_n) = \frac{1}{\theta^{nba} \Gamma(na)} s_n^{na-1} e^{-\frac{s_n}{\theta^b}}; s_n > 0, \theta, a, b > 0 \tag{3.3.1}$$

**Theorem 3.3.2.** *The UMVU estimators of  $\theta^p$  and  $\theta^{-p}$  are given by,*

$$\tilde{\theta}^p = \frac{\Gamma(na)}{\Gamma\left(na + \frac{p}{b}\right)} S_n^{\frac{p}{b}} \tag{3.3.2}$$

and

$$\tilde{\theta}^{-p} = \frac{\Gamma(na)}{\Gamma\left(na - \frac{p}{b}\right)} S_n^{-\frac{p}{b}}; p < nab \tag{3.3.3}$$

**Theorem 3.3.3.** *The UMVU estimator of sampled pdf  $f(x;\theta,a,b,c)$  is given by,*

$$\tilde{f}(x; \theta, a, b, c) = \begin{cases} \frac{cx^{ac-1}}{\beta(a,(n-1)a)S_n^a} \left[1 - \frac{xc}{S_n}\right]^{(n-1)a-1}; x^c < S_n \\ 0; otherwise \end{cases} \tag{3.3.4}$$

where  $\beta(a,b)$  is the beta function.

In the next theorem, we derive the UMVU estimator of reliability function  $R(t)$ .

**Theorem 3.3.4.** *The UMVU estimator of reliability function  $R(t)$  is given by,*

$$\tilde{R}(t) = \begin{cases} 1 - I_{t^c/S_n}(a, (n-1)a); t^c < S_n \\ 0; otherwise \end{cases} \tag{3.3.5}$$

where  $I_w(a, b) = \frac{1}{\beta(a,b)} \int_0^w z^{a-1}(1-z)^{b-1} dz$  is the lower incomplete beta function.

Let X and Y be two independent random variables with Probability density functions  $f_1(x;\theta_1,a_1,b_1,c_1)$  and  $f_2(y;\theta_2,a_2,b_2,c_2)$  respectively. Using equation (3.3.4), the UMVU estimators of the two sampled pdf's are given by,

$$\tilde{f}_1(x; \theta_1, a_1, b_1, c_1) = \begin{cases} \frac{c_1x^{a_1c_1-1}}{\beta(a_1,(n-1)a_1)S_n^{a_1}} \left[1 - \frac{xc_1}{S_n}\right]^{(n-1)(a_1)-1}; x^{c_1} < S_n \\ 0; otherwise \end{cases} \tag{3.3.6}$$

and

$$\tilde{f}_2(y; \theta_2, a_2, b_2, c_2) = \begin{cases} \frac{c_2y^{a_2c_2-1}}{\beta(a_2,(m-1)a_2)T_m^{a_2}} \left[1 - \frac{yc_2}{T_m}\right]^{(m-1)(a_2)-1}; y^{c_2} < T_m \\ 0; otherwise \end{cases} \tag{3.3.7}$$

In the next theorem, we derive the UMVU estimator of stress-strength reliability function 'P'.

**Theorem 3.3.5.** *The UMVU estimator of 'P' is given by,*

$$\tilde{P} = \begin{cases} \frac{1}{\beta(a_2, (m-1)a_2)} \int_0^{\frac{s_n^{\frac{c_1}{c_2}}}{t_m^{\frac{c_1}{c_2}}}} z^{a_2-1} (1-z)^{(m-1)a_2-1} \\ \cdot \left( 1 - I_{\frac{(T_m z)^{\frac{c_1}{c_2}}}{S_n}}(a_1, (n-1)a_1) \right) dz; s_n^{\frac{1}{c_1}} < t_m^{\frac{1}{c_2}} \\ \frac{1}{\beta(a_2, (m-1)a_2)} \int_0^1 z^{a_2-1} (1-z)^{(m-1)a_2-1} \\ \cdot \left( 1 - I_{\frac{(T_m z)^{\frac{c_1}{c_2}}}{S_n}}(a_1, (n-1)a_1) \right) dz; s_n^{\frac{1}{c_1}} > t_m^{\frac{1}{c_2}} \end{cases} \quad (3.3.8)$$

where  $\beta(a,b)$  is the beta function.

#### 4. Interval Estimation

In this section, we construct exact confidence intervals for unknown parameter  $\theta$  (assuming that a, b, c are known) and Reliability function R(t). Since we couldn't simplify expression for stress-strength reliability function 'P', hence exact confidence interval for P could not be obtained. The 100(1- $\alpha$ )% confidence interval for  $\theta$  is given by,

$$\left( \left( \frac{2S_n}{\chi^2 \left( \frac{\alpha}{2} \right)} \right)^{1/b}, \left( \frac{2S_n}{\chi^2 \left( 1 - \frac{\alpha}{2} \right)} \right)^{1/b} \right)$$

Where  $\chi^2 \left( \frac{\alpha}{2} \right)$  and  $\chi^2 \left( 1 - \frac{\alpha}{2} \right)$  are obtained using (4.1).

The 100(1- $\alpha$ )% confidence interval for R(t) is given by,

$$\left( 1 - \frac{\gamma \left( a, \frac{t^c \chi^2 \left( \frac{\alpha}{2} \right)}{2S_n} \right)}{\Gamma a}, 1 - \frac{\gamma \left( a, \frac{t^c \chi^2 \left( 1 - \frac{\alpha}{2} \right)}{2S_n} \right)}{\Gamma a} \right)$$

#### 5. Numerical findings

##### 5.1 Simulation study

In this part, we generate 1000 random samples of sizes n=100 and n=200 from the Weibull distribution by taking the parameters value a=1 and b=c in (2.1) and using the inverse transform sampling technique. In table 1, Moment estimates of parameters  $\theta$  and c and ML estimates of parameters  $\theta$ , c and reliability function R(t) are provided for different parametric values based on these samples. In table 2, the UMVU estimates of parameter  $\theta$ , reliability function R(t) and 95% confidence intervals for  $\theta$  and R(t) are given for different parametric values.

Next we generate 1000 different samples from Weibull distribution of sizes  $(n, m)=(100, 150)$  and  $(200, 250)$  by taking the parameters value  $a_1 = a_2 = 1$  and  $b_1 = c_1, b_2 = c_2$  and using the inverse transform sampling technique. In table 3, we provide the ML estimates and UMVU estimates of stress-strength reliability function ‘P’ based on these samples for different parametric values. In figures 5 and 6, we plot the ML estimator and UMVU estimator of sampled PDF with sampled PDF for different values of parameters.

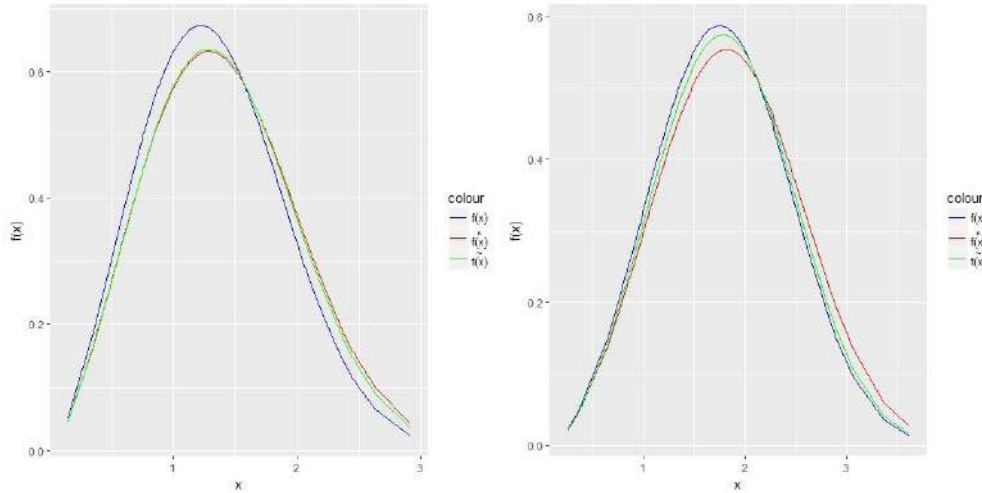


Figure 5: Sampled PDF plot for  $\theta = 1.5$  Figure 6: Sampled PDF plot for  $\theta = 2$  and  $c = 2.5$   $c = 3$

### 5.2 Real data application

In this subsection, we analyze two real data sets and obtain different estimates of parameters and reliability function using the results obtained in previous sections. The first data-set was given by [Linhart and Zucchini, 1986] and consist the failure times of air conditioning system of an airplane: 23, 261, 87, 7, 120, 14, 62, 47, 225, 71, 246, 21, 42, 20, 5, 12, 120, 11, 3, 14, 71, 11, 14, 11, 16, 90, 1, 16, 52, 95.

We fit a Weibull distribution to this data set and obtain the estimate of shape parameter  $(c)=0.8535$  and scale parameter  $(\theta)=54.6122$ . Assuming the model fit to be Weibull, we obtain various estimates of parameters and reliability functions using the results obtained in previous sections. Table 4 contains a summary statistics of this data-set. Using the results obtained in section 3, we compute the moment estimators of parameters as follows:  $[54.6623, 0.8470]$

The ML estimates of parameters are then obtained as follows:  $[54.6136, 0.8536]$

Taking  $t=1$ , the value of reliability function  $R(t)$  is calculated to be  $R(t) = 0.9676$ . Using the estimators obtained in section 3, we obtain ML estimate of reliability function  $R(t)$  i.e.  $\hat{R}(t) = 0.9676$ . Assuming  $c$  to be known, we obtain the UMVU estimate of  $\theta = \hat{\theta} = 54.4323$  and UMVU estimate of  $R(t)$  i.e.  $\tilde{R}(t) = 0.9687$ .

Next we consider two data-sets for the purpose of obtaining the ML and UMVU estimates of stress-strength reliability ‘P’. These data sets are reported by [Bader and Priest, 1982]. This data represents the strength of single carbon fibers (measured in GPA) and impregnated 1000-carbon fiber tows. Single fibers were tested under tension at gauge lengths of 20 mm and 10 mm.

**Data Set 1**

1.312, 1.314, 1.479, 1.552, 1.700, 1.803, 1.861, 1.865, 1.944, 1.958, 1.966, 1.997, 2.006, 2.021, 2.027, 2.055, 2.063, 2.098, 2.140, 2.179, 2.224, 2.240, 2.253, 2.270, 2.272, 2.274, 2.301, 2.301, 2.359, 2.382, 2.382, 2.426, 2.434, 2.435, 2.478, 2.490, 2.511, 2.514, 2.535, 2.554, 2.566, 2.570, 2.586, 2.629, 2.633, 2.642, 2.648, 2.684, 2.697, 2.726, 2.770, 2.773, 2.800, 2.809, 2.818, 2.821, 2.848, 2.880, 2.954, 3.012, 3.067, 3.084, 3.090, 3.096, 3.128, 3.233, 3.433, 3.585, 3.585

**Data Set 2**

1.901, 2.132, 2.203, 2.228, 2.257, 2.350, 2.361, 2.396, 2.397, 2.445, 2.454, 2.474, 2.518, 2.522, 2.525, 2.532, 2.575, 2.614, 2.616, 2.618, 2.624, 2.659, 2.675, 2.738, 2.740, 2.856, 2.917, 2.928, 2.937, 2.937, 2.977, 2.996, 3.030, 3.125, 3.139, 3.145, 3.220, 3.223, 3.235, 3.243, 3.264, 3.272, 3.294, 3.332, 3.346, 3.377, 3.408, 3.435, 3.493, 3.501, 3.537, 3.554, 3.562, 3.628, 3.852, 3.871, 3.886, 3.971, 4.024, 4.027, 4.225, 4.395, 5.020

We fit Weibull distribution to these data sets using the method of maximum likelihood and obtain the estimates of parameters as follows:

Data-Set →	Shapeparameter(c)	Scaleparameter( $\theta$ )	Log-likelihood	AIC	BIC
1	5.5050	2.6509	-49.59614	103.1923	107.6605
2	5.0494	3.3146	-61.95698	127.914	132.2002

Table 5, contains a summary statistics to these two data sets. Now using the estimators obtained in section 3, we obtain three different estimates of parameters as follows:

Data-Set →	1		2	
Estimates	Shape parameter(c)	Scale parameter( $\theta$ )	Shape parameter(c)	Scale parameter( $\theta$ )
Moment	5.7810	2.6478	5.7553	3.3053
Maximum Likelihood	5.5049	2.6509	5.0494	3.3147
UMVU (p=1)		2.6537		3.3189

Assuming the Weibull fit to these two data sets, the value of P is calculated to be  $P = 0.2425$ . Using the ML and UMVU estimator of P, we obtain the ML estimate and UMVU estimate of stress strength reliability ‘P’ as follows:- [0.2424, 0.2408]

**6. Summary**

In this study, we discussed a Family of lifetime distributions. We studied the basic properties of this family and derived different point estimation procedures for parameters and reliability functions when all parameters are unknown and when only one parameter is unknown. We used a different approach of estimation in which we utilized the UMVU estimators of powers of parameter while deriving UMVU estimators of reliability

functions. We also derived exact confidence intervals for unknown parameter and reliability function  $R(t)$ . We checked the validity of results obtained through numerical methods using the simulated data as well as real data. Figure 5 and 6, depicts the satisfactory performance of two estimators of sampled pdf namely ML estimator and UMVU estimator. If we look at real data analysis part we find that different estimators obtained under section 3 perform quite well. We conclude that this study provides better solutions to reliability estimation problems for many well known lifetime distributions.

### Appendices

**Table 1: Moment and ML estimates of the parameters and ML estimates of  $R(t)$  with their respective standard deviations**

$n \rightarrow$		100				200			
$\theta$	$c$	$\hat{\theta}_M(SD)$	$\hat{c}_M(SD)$	$\hat{\theta}_M(SD)$	$\hat{c}_M(SD)$	$\hat{\theta}_M(SD)$	$\hat{c}_M(SD)$	$\hat{\theta}_M(SD)$	$\hat{c}_M(SD)$
2	2.5	1.9999 (0.0841)	2.5365(0.2064)	2.0005 (0.0614)	2.5217(0.1420)				
3	1.5	3.0059 (0.2118)	1.5230(0.1218)	3.0038 (0.1482)	1.5096(0.0860)				
2.5	3	2.4987 (0.0861)	3.0406(0.2431)	2.4964 (0.0604)	3.0085(0.1668)				
1.5	2.5	1.4999 (0.0640)	2.5331(0.1989)	1.5014 (0.0443)	2.5227(0.1438)				
4	1.8	3.9953 (0.2368)	1.8270(0.1435)	4.0013 (0.1659)	1.8099(0.1019)				

$n \rightarrow$		100					
$\theta$	$c$	$t$	$\hat{\theta}(SD)$	$\hat{c}(SD)$	$R(t)$	$\hat{R}(t)(SD)$	
3	1.5	0.5	2.9992(0.2112)	1.5227(0.1212)	0.9342	0.9346(0.0164)	
2	2.5	1	1.9986(0.0843)	2.5441(0.2021)	0.8380	0.8398(0.0288)	
3	2	2	3.0004(0.1621)	2.0338 (0.1573)	0.6412	0.6434(0.0399)	
2.5	1	1	2.4936(0.2710)	1.0145(0.0801)	0.6703	0.6704(0.0393)	
3.5	1.5	2.5	3.5064(0.2447)	1.5218(0.1227)	0.5468	0.5487(0.0409)	

**Table 2: UMVU estimates of the parameter, Reliability function  $R(t)$ , their respective standard deviations and 95% confidence intervals for  $\theta$  and  $R(t)$**

$n \rightarrow$		100							
$\theta$	$c$	$t$	$R(t)$	$\hat{\theta}(SD)$	$\hat{c}(SD)$	$R(t)(SD)$	C.I. for $\theta$	C.I. for $R(t)$	
3	2.5	1	0.9379	2.9991(0.1184)	8.9945(0.7361)	0.9378(0.0060)	(2.7800, 3.2531)	(0.9249, 0.9486)	
2	1.5	0.5	0.8825	1.9995(0.1365)	3.9839(0.5210)	0.8824(0.0114)	(1.7635, 2.2917)	(0.8588, 0.9023)	
3	1.5	2	0.5802	3.0038(0.2000)	8.9458(1.2344)	0.5808(0.0316)	(2.6493, 3.4427)	(0.5173, 0.6405)	
1.5	2	0.75	0.7788	1.5016(0.0777)	2.2469(0.2264)	0.7791(0.0202)	(1.3661, 1.6626)	(0.7383, 0.8147)	
1.5	2.5	1	0.6957	1.4977(0.0602)	2.2471(0.1788)	0.6947(0.0255)	(1.3883, 1.6246)	(0.6424, 0.74165)	
3	2	2	0.6412	2.9948(0.1455)	8.9890(0.9131)	0.6403(0.0278)	(2.7245, 3.3160)	(0.5820, 0.6937)	

**Table 3: ML and UMVU estimates of Stress-strength reliability function  $P$  for different values of parameters and various sample sizes**

$(n,m) \rightarrow$		(20, 30)				(50, 70)			
$(\theta_1, c_1)$	$(\theta_2, c_2)$	$P$	$\hat{P}(SD) \downarrow$	$\hat{P}(SD) \downarrow$	$\hat{P}(SD) \downarrow$	$\hat{P}(SD) \downarrow$	$\hat{P}(SD) \downarrow$	$\hat{P}(SD) \downarrow$	
(2, 1.5)	(3, 2)	0.3133	0.3146(0.0728)	0.3165(0.0706)	0.3146(0.0438)	0.3150(0.0418)			
(1, 2)	(2, 3)	0.1314	0.1327(0.0407)	0.1319(0.0400)	0.1310(0.0264)	0.1305(0.0255)			
(1.5, 2)	(2, 3)	0.3072	0.3032(0.0736)	0.3081(0.0716)	0.3048(0.0452)	0.3060(0.0428)			
(3, 1.4)	(2, 4)	0.6335	0.6286(0.0674)	0.6366(0.0653)	0.6320(0.0452)	0.6353 (0.0437)			
(2, 1)	(2, 4)	0.4173	0.4077(0.0847)	0.4207(0.0836)	0.4104(0.0531)	0.4156 (0.0520)			



**Table 4: Summary statistics**

Measures	Estimates
Min	1
Max	261
Median	22
Mean	59.6
SD	71.8848
Skewness	1.7841
Kurtosis	5.5688

**Table 5: Summary statistics for stress data**

Measures	Data-Set 1		Data-Set 2	
	Estimates	Estimates	Estimates	Estimates
Min	1.312	1.901		
Max	3.585	5.02		
Median	2.478	2.996		
Mean	2.4513	3.0593		
SD	0.4951	0.6209		
Skewness	-0.0288	0.6484		
Kurtosis	3.0285	3.412		

## References

- M. Bader and A. Priest. Statistical aspects of bre and bundle strength in hybrid composites. *Progress in science and engineering of composites*, page 1129–1136, 1982.
- A. Chaturvedi and U. Rani. Estimation procedures for a family of density functions representing various life-testing models. *Metrika*, 46:213–219, 1997.
- D.J. Davis. The analysis of some failure data. *Journal of American Statistical Association*, 47:113–150, 1952.
- N.L. Johnson, S. Kotz, and N. Balakrishnan. *Continuous Univariate Distributions-Vol. 1*. John Wiley Sons, New York, 1970.
- H. Linhart and W. Zucchini. *Model Selection*. Wiley, New York, 1986.
- J.K. Patel, C.H. Kapadia, and D.B. Owen. *Handbook of statistical distributions*. Marcel Dekker, Inc., New York, 1976.
- S.K. Sinha. *Reliability and Life Testing*. Wiley Eastern Limited, New Delhi, 1986.
- R. K. Tyagi and S. K. Bhattacharya. A note on the mvu estimation of reliability for the maxwell failure distribution. *Estadistica*, 41:73–79, 1989a.

# INNOVATIVE APPROACH OF DATA MINING IN EDUCATION: A SYSTEMATIC LITERATURE REVIEW

**Ritika Awasthi,**

GD Rungta College of Science and Technology, India  
(ritika.awasthy@rungta.ac.in)

**Dr. Arvind Tiwari,**

Dr. C.V. Raman University, India  
(arvindtiwari@cvru.ac.in)

In the constantly evolving world of educational data mining, scholars have been given a wide array of techniques for assessing information in classrooms. In this field of research, examination and evaluation of educational problems and data is performed with the aid of computational approaches. Over the course of the past few years, there has been a clear acceleration in the utilization of learning management systems in the field of education. Many different data mining approaches are many different methods for data mining that are utilized in order to look into the behavior and performance of learners in educational environments. Some of these techniques include relationship mining, prediction, and clustering. The ultimate objective of this research is to establish a new environment that is beneficial to academic prediction. This is expected to be accomplished by doing a full evaluation of numerous data mining methods and strategies that are utilized within the context of education.

**KEYWORDS:** Knowledge discovery, Educational data mining (EDM), Data mining (DM), Learning management system, Educational systems, Clustering, Relationship mining, Prediction, etc.

## 1. INTRODUCTION

At present, there is an abundance of research opportunities accessible within the framework of educational data mining (EDM). Its main goal is to improve educational results by utilizing data mining techniques within of a framework for educational data (Dutt et al., 2017). This promotes a deeper comprehension of instructional tactics and helps with well-informed decision-making.

There are currently a lot of opportunities for research in the field of educational data mining (EDM). By applying data mining techniques inside an educational data framework, its primary objective is to enhance educational outcomes (Dutt et al., 2017). This facilitates a more thorough understanding of teaching strategies and supports informed decision-making.

### 1.1 Common application areas of EDM include:

- **Offline Education:** Concentrates on imparting skills and knowledge through in-person interactions, evaluating student psychology for learning. There is a use of psychometrics and statistical methods, such as curriculum analysis and student behavior/performance assessment. (Dutt et al., 2017)
- **E-learning and Learning Management Systems (LMS):** Online instructions are provided via e-learning, and administration, collaboration, communication, and reporting capabilities are provided by LMS. Web mining (WM) approaches can be used to assess

student data that has been recorded in different databases and log files(Kazanidis et al 2009)

## 1.2 Role Of EDM

The conversion of unprocessed data from many educational resources into insightful knowledge that influences educational research and practice is a critical function of EDM. Pre-processing, Data Mining, and Post-processing are the steps of traditional data mining that the EDM process follows(Kumar, et al.2012).By taking a methodical approach, it is possible to extract significant insights that enhance both the quality of teaching and its results.

In addition to using standard data mining techniques like text mining, pattern mining, classification, etc., educational data mining also takes into account regression, visualization, correlation, etc. The following are some key characteristics that set data mining apart from its many application fields, particularly in education:

1) Objective: Each application area of data mining has a different objective. There are two objectives in educational data mining: a) Applied research objectives – It is used to improve the learning process for better guiding of students’learning. b) Pure research objectives - A deeper understanding of educational phenomena could be attained by this kind of objective.

2)Data:An array of data is present in an educational environment for mining, specifically belonging to the educational domain.(Morsy et al., 2019) This data exhibits multiple levels of meaningful hierarchy and intrinsic semantic information.

## 2. RELATED WORK:

Educational data has unique properties, and problems associated with this data can be efficiently mined in several ways. Although many conventional data mining techniques can be used directly in the educational setting, extra attention must be paid to the particular characteristics of educational data.

Much research was conducted in (Sánchez et al., 2023) to highlight the importance of "Data Mining" approaches in education, showing that it is a novel concept for obtaining accurate and legitimate information regarding the effectiveness and utility of the learning process.

The study conducted by Fiallos (Ordonez et al. 2021) aimed to utilize the Weka tool to tackle the problem of imbalanced categorization in the Pima Indian Diabetes dataset. During the preprocessing stage, a number of filters were employed to address the class imbalance, including the Spread Sub sample filter for majority class under-sampling and the Resample filter for random over-sampling of the minority class. The findings unmistakably showed that using sampling-based strategies improved all accuracy metrics, such as the ROC area for the minority class, recall, F1-Score, and precision.

The Educational Data Mining (EDM) ecosystem, including its elements, tools, and methodologies applied in the education sector, were examined by (Hicham et al., 2020).

There was also discussion of EDM challenges, which offered insights into potential directions for future research projects.

(Fortino et al., 2019) used five machine learning algorithms—Support Vector Machine, J48, Random Forest, Multilayer Perceptron, and Naïve Bayes—to examine students' learning habits and academic achievement. The multilayer perceptron performed the best among the classifiers, according to the results.

The importance of feature selection for a classification task was investigated in (Fortino et al., 2019). Two methods of filter selection were applied: wrapper-based feature selection and correlation feature selection (CFS). The findings showed that while Naïve Bayes with wrapper subset feature selection algorithms provided the most accuracy in predicting various student grades, including low, medium, and high, SMO and J48 with correlation feature selection algorithms could obtain the highest accuracy.

While (Kausar et al., 2018) created a system to detect facial expressions based on student reactions in the classroom, linking silent behaviors with knowledge development using algorithms, (Dutt et al., 2017) presented a student learning model utilizing clustering algorithms.

The importance of data mining in curriculum analysis, student performance analysis, and current research themes in education was highlighted by (Appalla et al., 2017). According to (Dogan et al., 2023) research, a model was created to identify students who are at danger of failing by utilizing the Naïve Bayes algorithm to predict student performance based on characteristics.

The study conducted by (Reddy et al. 2016) utilized the "K-means" algorithm to group 8,000 students according to five distinct characteristics. The results indicated a strong correlation between attendance and academic performance. According to (Hammouda & Kamel, n.d.), "Data Mining" can be used to improve student performance, organizational management, orientation, and the educational system.

The study in (Aldowah et al., 2019) highlights foundational methods such as classification, clustering, regression, and statistical analysis, and their immediate applications in forecasting student performance, detecting pupils at risk, and customizing learning experiences according to unique needs. The investigation exploring how to integrate Educational Data Mining (EDM) & Learning Analytics (LA) to acquire an in-depth knowledge of educational processes is a significant contribution. The authors also discuss the difficulties related to data quality, privacy, and scalability, and stress the importance of cross-disciplinary cooperation to optimize the advantages of these technologies. In general, the research highlights the capacity of Educational Data Mining (EDM) and Learning Analytics (LA) to boost classroom outcomes and the overall effectiveness of college.

(Chen et al., 2020) investigate an array of AI-driven instruments and methods that improve individual learning, automate office tasks, and make it easier to make decisions based on data. Through the provision of personalized educational experiences and the enhancement of

operational efficiency, the review demonstrates the potential for AI to transform educational settings. Nevertheless, the researchers also address key obstacles, including ethical considerations, problems around data privacy, and the necessity for teacher training to successfully integrate AI technologies. The study, taken as a whole, highlights the potential for change in AI while concurrently urging for a thorough analysis of its drawbacks and the moral repercussions that it may have.

### **3.DATA MINING AND ITS TECHNIQUES**

Data mining comprises a broad spectrum of techniques and approaches that find application across diverse domains. These include visualization, fuzzy sets, database systems, machine learning, statistics, genetic algorithms, neural networks, and more. Below, you'll find detailed descriptions of some of these techniques:

#### **3.1 STATISTICAL APPROACHES**

At times, the terms "statistical techniques" or simply "statistics" are interchangeably employed as aliases for data mining. This approach is inherently data-driven, focusing on pattern recognition and the generation of predictive models. Due to its data-driven nature, statistical techniques stand out as a prominent methodology within the realm of data mining. In essence, there exists an intrinsic link between statistics and data mining ( Venkatadri et al 2011). Various tools of statistical analysis, such as Bayesian networks, factor analysis, correlation analysis, discriminant analysis, regression analysis, and cluster analysis, are extensively utilized in the field of data mining. The construction of most statistical models relies on a training dataset, from which a combination of patterns and rules is derived. In the majority of cases, data mining tasks can be effectively accomplished with the application of one or more statistical approaches(Khan et al., 2017). The following are commonly employed statistical methods in the context of data mining:

- **Correlation:** Correlation is a statistical technique used to assess the degree of relationship between two or more variables. It provides a numerical measure of the strength and direction of a linear relationship. A correlation coefficient is calculated, ranging from -1 to 1, where -1 indicates a perfect negative correlation, 1 indicates a perfect positive correlation, and 0 indicates no correlation. (Mishra et al., 2017)This technique is valuable in understanding how changes in one variable correspond to changes in another.
- **Regression:** Regression analysis is employed to estimate the relationship between a dependent variable (output) and one or more independent variables (predictors or inputs). It helps in understanding the nature and strength of the association between variables.(Mishra et al., 2017) The result of regression analysis is a regression equation that can be used for prediction or understanding the impact of changes in predictor variables on the dependent variable.
- **Bayesian Network:** A Bayesian network, also known as a Bayes/belief or decision network, is a graphical model that represents a set of variables and their conditional dependencies through a directed acyclic graph. It is particularly useful for modeling and reasoning under uncertainty. (Mishra et al., 2017)Bayesian networks are

employed in various fields, including artificial intelligence, machine learning, and decision support systems.

- **Factor Analysis:** Factor analysis is a statistical method used to reduce a large number of variables to a smaller set of factors. It helps in identifying underlying dimensions or latent variables that explain the observed correlations among variables. (Holzhüter et al., 2013) This technique is useful for simplifying complex datasets and extracting essential information.
- **Cluster Analysis:** Cluster analysis is a method used to group objects based on their similarity. The goal is to identify clusters or groups of objects that share common characteristics. This technique is particularly useful in exploring patterns within data, identifying outliers, and organizing large datasets into meaningful structures. Objects within the same cluster are more similar to each other than to those in other clusters. (Holzhüter et al., 2013) Cluster analysis is applied in various fields, including data mining, pattern recognition, and market segmentation.

### 3.2 MACHINE LEARNING

Machine learning is an application of artificial intelligence (AI) that enables systems to automatically learn without explicit programming. The primary objective of machine learning is the development of computer programs capable of autonomously accessing and utilizing data. Given its paramount significance in data mining, the algorithms employed in data mining are seamlessly applicable in the domain of machine learning. Utilizing machine learning enhances the accuracy and efficiency of knowledge discovery within database processes, contributing to a higher level of automation.

The application of machine learning across various sectors such as education, industry, healthcare, and more. Notably, in certain application areas of data mining, the use of machine learning methods has been observed to yield significantly more accurate results. (Ball et al., 2019) The versatility of machine learning systems is evident, and their impact is particularly prominent in areas requiring automation.

Machine learning can be broadly categorized into two types:

- a) **Inductive Learning:** Also known as discovery learning, inductive learning involves the discovery of rules by observing examples rather than relying on existing knowledge.
- b) **Deductive Learning:** This learning type is grounded in concepts and knowledge that have accumulated over time, supplemented by specific examples to derive innovative insights from historical data.

Intrusion Detection Systems (IDS) represent a pivotal application of machine learning. Typically, these systems monitor computers, generating alerts in the event of a security breach. These alerts serve to report any security violations detected. (Ball et al., 2019) Upon evaluating the generated alerts, an analyst can initiate appropriate actions to address and mitigate potential security threats.



### 3.3 NEURAL NETWORK

Neural networks are employed for pattern recognition and data comprehension through clustering or labeling. Functioning as a set of algorithms or a network of artificial neurons, they mirror biological neural circuits. The distinctive feature of neural networks lies in their capacity to learn from examples, rendering them highly flexible and influential. In the realm of artificial neural networks (ANN), electrical signaling and artificial nodes emulate the functioning of biological neural networks.(Grunhut et al., 2022)

Knowledge representation in ANN involves a set of layered and interconnected processors or neurons. These various neural network models are not only instrumental in solving business problems but also serve as crucial tools in modern operations research, showcasing their versatility and significance.

### 4. EDM AND ITS METHODS

Educational Data Mining (EDM) is employed to explore and develop methods tailored for distinct types of data within educational settings. These methods aim to enhance understanding of students and their learning environments. Unlike traditional data mining approaches, EDM explicitly addresses educational data, lacking independent educational data and leveraging a multilevel hierarchy(Amare et al., 2021).

Various literature sources, encompassing psychometrics, machine learning, data mining, and computational modeling areas such as information visualization and statistics, contribute to the efficient functioning of EDM and its methods. EDM methods fall into two primary categories:1)Statistics and Visualization 2)Web Mining

The proposed methods of EDM by include:Clustering, Prediction, Regression, Classification, Density Estimation, Discovery with Models, Relationship Mining, Correlation Mining, Association Rule Mining, Sequential Pattern Mining.(Bachhal et al., 2021)These methods largely align with established data mining categories, with relationship mining being the most widely used approach in EDM research.

Beyond the mentioned EDM methodologies, there are additional methodologies that have not seen widespread usage:

4.1Text Mining:Utilized for mining amorphous or semi-structured datasets like HTML files, emails, and text documents, text mining aids in data analysis and evaluation. It proves particularly beneficial for automatically constructing textbooks through web content mining. (Guleria et al., 2014)Clustering of documents can also be performed using text mining based on topic similarity.

4.2 Social Network Analysis:This methodology seeks to recognize and compute relationships among entities within a network. Data mining approaches can be applied to analyze online interactions within a network(Appalla et al., 2017). Similar data mining techniques can be used for mining group activities in educational data mining.

4.3 Outlier Detection: Outlier detection is a technique used to identify data points that significantly deviate from the rest of the dataset. In the context of educational data mining, this methodology proves valuable for detecting students facing learning challenges. Specifically, in e-learning, outlier detection is employed to unveil asymmetrical learning processes by analyzing learners' reaction times. Additionally, analytical behavior can be identified through the clustering of students. (Appalla et al., 2017) This approach is instrumental in discovering anomalies and deviations in the actions of both learners and educators.

## 5. APPROACHES OF EDM

The utilization of data mining in educational environments enables the accomplishment of various tasks and applications within the realm of computer science. This field aims to unveil unique potential factors and patterns to enhance decision-making. (Baker et al, 2019) Baker identifies four key areas and five approaches/methods for the application of educational data mining (EDM):

### 5.1 Key Areas:

i) Students' Model Improvement: In the education sector, machine learning enhances personalized learning experiences by analyzing student data to tailor educational content. This results in more accurate predictions of individual learning needs, enabling educators to provide targeted support and resources.

ii) Improvement in Domain Models: Within industry, machine learning optimizes processes through predictive maintenance and quality control. By analyzing historical data, machine learning methods can accurately predict potential equipment failures, reducing downtime and improving overall efficiency in manufacturing processes.

iv) Scientific Research Interested in Learning and Learners: Certain domains within data mining, such as fraud detection in finance or customer behavior analysis in retail, benefit significantly from the application of machine learning. Machine learning algorithms excel in uncovering complex patterns and anomalies, leading to more precise and effective solutions in these specialized areas.

### 5.2 Approaches/Methods:

- i) Distillation of Data for Human Judgment: This approach involves condensing complex datasets into more understandable formats, aiding human decision-makers. By extracting key insights, it facilitates informed judgments and strategic decision-making based on simplified and relevant information.
- ii) Clustering: Clustering involves grouping similar data points together, revealing inherent patterns within datasets. This method is valuable for segmentation, helping identify distinct categories and relationships among data points, and facilitating targeted analysis and decision-making.
- iii) Relationship Mining: Relationship mining focuses on discovering connections and associations between data elements. By uncovering patterns and dependencies,

- this approach reveals valuable insights into the interactions among variables, enabling a deeper understanding of complex relationships within the data.
- iv) **Discovery with Models:** Discovery with models involves creating predictive models to uncover hidden patterns and trends within datasets. By leveraging algorithms, this method enables the identification of relationships and structures, providing a foundation for making informed decisions and predictions based on the data.
  - v) **Prediction:** Prediction in data mining involves using historical data to forecast future trends or outcomes. By employing machine learning algorithms, this method enables accurate predictions, supporting proactive decision-making and strategic planning based on anticipated patterns within the data.

Additionally, (Levitin, 2007)suggest several EDM subjects/tasks:

- i) Evaluation of the Student's Learning Performance
- ii) Learning Suggestions and Course Adaptation Based on Student's Learning Behavior
- iii) Assessment of Educational Web-Based Courses and Learning Materials
- iv) Teachers' and Students' Feedback in E-learning Courses
- v) Revealing the Learning Behavior of Typical Students

We can understand how data mining is applied in an educational system, often recognized as knowledge discovery in databases, extracting valuable insights from vast amounts of data. Educational data encompasses various sources such as teachers' data, resource data, students' data, and alumni data, originating from traditional sources like face-to-face classrooms and modern sources like educational software and online courseware.

Educational data mining (EDM) employs diverse methods to analyze unique data types from various sources, including traditional and modern educational settings. The overarching goal is to uncover unknown patterns and relationships within large volumes of data to inform decision-making(Forero et al., 2024). Data mining techniques, such as regression, clustering, classification, neural networks, artificial intelligence, decision trees, genetic algorithms, nearest neighbor methods, and association rules, are utilized to extract knowledge from databases and discover valuable insights.

## **6.EDM'S APPLICATION PROCESS**

The application process of data mining within the field of education is conceptualized as an iterative cycle involving testing, refinement, and hypothesis formulation. The primary objective of this process extends beyond the conversion of raw data into meaningful outcomes; it aims to utilize these outcomes to understand and enhance the educational environment for improved learner learning.

The application of Educational Data Mining (EDM) is analogous to extracting knowledge from the data processing cycle. (Sómer et al., 2024)The initial step involves the collection of data from the educational environment, which is initially raw and necessitates cleaning and preprocessing. To achieve this, various data mining techniques are employed. The application of these techniques yields a model, which, in turn, can restructure the stored data. The final

step involves elucidating and evaluating the results obtained. The entire process of educational data mining is illustrated in Figure 1 for clarity.

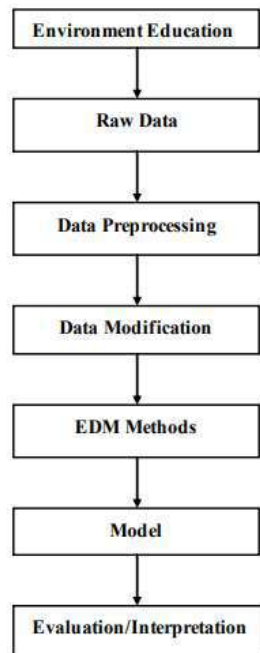


Fig: 1 EDM application process

### 6.1 Environment Education:

This stage involves defining the educational context, including the goals, participants, and learning environment. Understanding the specific educational setting is crucial for effective data mining in education.

### 6.2 Raw Data:

Raw data collection entails gathering information from various educational sources, such as student interactions, assessments, and learning materials. This unprocessed data serves as the foundation for subsequent analysis in educational data mining (EDM).

### 6.3 Data Preprocessing:

In this step, raw data undergoes cleaning, transformation, and integration to enhance its quality and relevance. Handling missing values, removing outliers, and standardizing formats are common preprocessing techniques, ensuring the data is suitable for analysis.

#### 6.4 Data Modification:

Data modification involves creating new features or variables based on the preprocessed data. This step may include feature engineering or the creation of derived metrics to provide more insightful information for the subsequent stages of the EDM process.

### 7. EDM Methods:

Methods for Educational Data Mining (EDM) include a range of approaches such as association rule mining, clustering, and classification. These techniques are used to identify patterns and connections in the altered data, which helps uncover important information for making decisions about schooling (Kazanidis et al., 2009).

#### 7.1 Models:

Models are built using methods that are in line with the learning objectives, depending on the patterns that have been found. These models could be clustering models, which find student groups with similar learning tendencies, or predictive models, which forecast student success.

#### 7.2 Evaluation:

Evaluation metrics, including accuracy, precision, recall, and F1 score, are used to gauge how effective the EDM models are. This phase verifies the models' generalizability and dependability and offers insightful input for improving the instructional procedures based on the mined insights.

## 8 EDUCATIONAL DATA MINING AND ITS CHALLENGES

Many of the obstacles that EDM is facing are being overcome as research continues, but some remain (Baker et al., 2019):

**8.1 Unit-Engineered Data Processing Techniques:** To get business expertise, the majority of data processing techniques are independently engineered. Custom-designed data processing strategies emphasize individual engineering to efficiently gain domain-specific knowledge, meeting specific business demands.

**8.2 Model Performance Understanding:** The requirement to understand how a model operates in light of its output. It entails learning about a model's behavior from its output, emphasizing how crucial it is to understand the model's performance to make wise decisions.

**8.3 Scaling Up and Personalization in Learning Spaces:** To promote community formation in learning spaces, there is now a focus on both scaling up and personalization. At the moment, the emphasis is on growing educational programs while customizing experiences for each person, encouraging community building in learning environments with scalable and individualized methods.

8.4 Formal Education's Relevance in the Virtual World: It is critical to preserve formal education's relevance in the virtual world, where information is of utmost importance. Recognizing formal education's ongoing relevance in a digital and information-centric world, and emphasizing the need to maintain its value in the virtual sphere where information access is critical.

8.5 Learning Path Facilitation and Evaluation: The difficulty of providing effective learning path facilitation and evaluation. Recognizing the necessity for efficient facilitating and assessment techniques to improve the learning experience, as well as the challenge of effectively leading and evaluating each learner's unique journey.

8.6 Managing a Fast-Growing Learner Population: Keeping up with the learner population's explosive growth presents a problem that calls for scalable solutions and strategic planning in order to meet the needs of an ever-expanding educational audience.

## 9. GOALS OF EDUCATIONAL DATA MINING

(Alghamdi et al., 2023) state that as the need for education data mining grows, so do the implementation's goals and area of use. Basic objectives of education data mining include the following:

- i) Forecasting Future Student Performance: Identifying trends and information to forecast students' performance in the future. The goal of using educational data mining to anticipate future student performance is to improve teaching methods by encouraging a proactive, data-driven approach. Teachers can use these insights to carry out focused and timely interventions, fostering an environment where all children achieve better academic results.
- ii) Personalized Training Approaches: Customizing instruction to build on each student's areas of strength. Personalized training approaches use data-driven insights to tailor instructional strategies and content in an effort to improve learning by recognizing and enhancing each learner's individual capabilities.

## 10. CONCLUSION

Data mining in education relates to the technique of finding meaningful patterns and insights from extensive collections of educational data using different algorithms as well as methods tailored for particular types of material and application domains. Significant duties in educational data mining include classification (including predicting student performance), regression (such as forecasting enrollment trends), clustering (such as grouping students based on learning styles), association rule learning (such as discovering relationships between programs and marks), anomaly detection (such as identifying unusual student behaviors), and dimensionality reduction (such as simplifying complex educational datasets). A variety of techniques such as decision trees, neural networks, k-means clustering, and PCA are used to successfully carry out these tasks, providing instructors with useful information.

Data mining delivers important benefits for educational institutions, including better



decision-making and increased student results. Institutions could improve curriculum design, customize learning experiences, and create focused interventions for at-risk students by examining concealed patterns and trends in educational data. Therefore, this results in improved decision-making, a better distribution of resources, and increased rates of student retention and success. Further, continual academic research consistently improves data mining algorithms, tackling issues such as scalability and accuracy, therefore broadening the potential uses and efficacy of data mining inside educational settings.

## 11. FUTURE SCOPE

Every data mining system has access to a wide range of techniques that can be used to handle different kinds of data, different application domains, and different data mining jobs. Scholars have successfully addressed many of the fundamental obstacles in data mining through their committed research efforts. Organizations can benefit greatly from the goals connected with various data mining activities and methodologies. These goals allow them to: (i) gain knowledge and a better understanding of data; (ii) increase profitability through the adaptation and improvement of defined operations and procedures. Businesses can make decisions more quickly and easily by using data mining, which makes it simple to find hidden patterns and trends. The potential applications of data mining in the future seem promising, providing answers to new problems and improving organizational insights and efficiency.

## 12. References

- Aldowah, H., Al-Samarraie, H., &Fauzy, W. M. (2019). Educational data mining and learning analytics for 21st century higher education: A review and synthesis. In *Telematics and Informatics* (Vol. 37). <https://doi.org/10.1016/j.tele.2019.01.007>
- Amare, M. Y., & Simonova, S. (2021). Global challenges of students dropout: A prediction model development using machine learning algorithms on higher education datasets. *SHS Web of Conferences*, 129. <https://doi.org/10.1051/shsconf/202112909001>
- Appalla, P., Kuthadi, V. M., &Marwala, T. (2017). An efficient educational data mining approach to support e-learning. *Wireless Networks*, 23(4), 1011–1024. <https://doi.org/10.1007/s11276-015-1173-z>
- Ashraf, A., & Khan, M. G. (2017). Effectiveness of Data Mining Approaches to E-Learning System: A Survey. *NFC IEFER Journal of Engineering and Scientific Research*, 4. <https://doi.org/10.24081/nijesr.2016.1.0010>
- Bachhal, P., Ahuja, S., &Gargrish, S. (2021). Educational Data Mining: A Review. *Journal of Physics: Conference Series*, 1950(1). <https://doi.org/10.1088/1742-6596/1950/1/012022>
- Baker, R. S. J. D., &Yacef, K. (n.d.). *The State of Educational Data Mining in 2009: A Review and Future Visions*. [www.educationaldatamining.org](http://www.educationaldatamining.org),
- Ball, R., Duhadway, L., Feuz, K., Jensen, J., Rague, B., & Weidman, D. (2019). Applying machine learning to improve curriculum design. *SIGCSE 2019 - Proceedings of the 50th ACM Technical Symposium on Computer Science Education*, 787–793. <https://doi.org/10.1145/3287324.3287430>

- Chen, L., Chen, P., & Lin, Z. (2020). Artificial Intelligence in Education: A Review. *IEEE Access*, 8, 75264–75278. <https://doi.org/10.1109/ACCESS.2020.2988510>
- Forero-Corba, W., & Bannasar, F. N. (2024). Techniques and applications of Machine Learning and Artificial Intelligence in education: a systematic review. *RIED-Revista Iberoamericana de Educacion a Distancia*, 27(1), 209–253. <https://doi.org/10.5944/ried.27.1.37491>
- Grunhut, J., Marques, O., & Wyatt, A. T. M. (2022). Needs, Challenges, and Applications of Artificial Intelligence in Medical Education Curriculum. *JMIR Medical Education*, 8(2). <https://doi.org/10.2196/35587>
- Guleria, P., & Sood, M. (2014). Data Mining in Education : A Review on the Knowledge Discovery Perspective. *International Journal of Data Mining & Knowledge Management Process*, 4(5), 47–60. <https://doi.org/10.5121/ijdkp.2014.4504>
- Holzhtüter, M., Frosch-Wilke, D., & Klein, U. (2013). Exploiting learner models using data mining for e-learning: A rule based approach. *Smart Innovation, Systems and Technologies*, 17, 77–105. [https://doi.org/10.1007/978-3-642-30171-1\\_4/COVER](https://doi.org/10.1007/978-3-642-30171-1_4/COVER)
- Kazanidis, I., Valsamidis, S., Theodosiou, T., & Kontogiannis, S. (2009). *PROPOSED FRAMEWORK FOR DATA MINING IN E-LEARNING: THE CASE OF OPEN E-CLASS*.
- Levitin, Gregory. (2007). *Computational intelligence in reliability engineering. Evolutionary techniques in reliability analysis and optimization*. Springer.
- M. Venkatadri and L. Reddy, “A Review on Data Mining from past to the future”, *International journal of Computer Applications*, vol. 15, pp. 19-22, 2011. (n.d.).
- Martín-Sómer, M., Casado, C., & Gómez-Pozuelo, G. (2024). Utilising interactive applications as educational tools in higher education: Perspectives from teachers and students, and an analysis of academic outcomes. *Education for Chemical Engineers*, 46, 1–9. <https://doi.org/10.1016/j.ece.2023.10.001>
- Mishra, A., Bansal, R., & Singh, S. N. (2017). Educational data mining and learning analysis. *Proceedings of the 7th International Conference Confluence 2017 on Cloud Computing, Data Science and Engineering*, 491–494. <https://doi.org/10.1109/CONFLUENCE.2017.7943201>
- Morsy, S., & Karypis, G. (2019). A study on curriculum planning and its relationship with graduation GPA and time to degree. *ACM International Conference Proceeding Series*, 26–35. <https://doi.org/10.1145/3303772.3303783>

# TRAFFIC CROWD ANALYSIS USING DEEP NEURAL NETWORKS: A REVIEW

**Leeladhar Kumar Gavel,**

Kalinga University, India

(lk.gavel.74@gmail.com)

**Asha Ambhaikar,**

Kalinga University, India

(drambhaikar@gmail.com)

Traffic congestion is the main problem in today's metropolitan areas that has caused difficulties for citizens, especially in crowded areas of the urban. As the population increased, the traffic congestion control in major cities of India and the world orange has become very serious. The rapid increase of public-private vehicles use has also increased the number of traffic accidents, and the roads are gradually dangerous. This study aims to explore and review the deep neural network technologies adopted in research and industry to attempt to overcome the direct and indirect traffic issues on humanity and societies. The study is focusing on the traffic crowd analysis based on deep neural network technologies to detect and predict the traffic behavior. This study is important to the traffic research communities, traffic software companies, and traffic government officials. It has a direct impact on drawing a clear path for new traffic crowd analysis.

**Keywords:** Traffic crowd, artificial neural network (ANN), convolution neural networks (CNN).

## 1. INTRODUCTION

With the continuous progression of urbanization and technological advancements in automobiles, a variety of transportation-related issues have also emerged. These issues include the increase in traffic congestion, accidents, and environmental deterioration. Some of the significant factors inducing transportation problems are high population density, fast-paced infrastructure developments, extensive growth in the number of motor vehicles, and the proliferation of rideshare and delivery services. To improve the current scenario, it is necessary to establish an efficient and robust traffic management system. In recent years, an intelligent transportation system (ITS) concept has drawn significant attention due to its potential ability to improve the traffic management system by integrating a variety of advanced technologies. An integral part of ITS is a predictive analysis using traffic. Accurate and efficient traffic data prediction helps to provide continuous and precise traffic information and possibly reduce traffic congestion issues in the long run. For example, by predicting traffic flow, the timely trend and flow of the traffic in the next timesteps can be determined. This can help to minimize congestion if the preventive actions can be taken promptly before the anticipated congested period occurs. As a result, the overall transportation network resilience also improves. Traffic parameters, such as speed, flow, and travel time, are recorded in traffic monitoring stations. That is why traffic prediction can be considered as time series prediction. A variety of statistical models, machine learning, and neural network algorithms have been used for time series prediction as well as traffic prediction.

In recent years, machine learning (ML)-based methods have become extremely popular not only in feature selection, classification and clustering, but also in data. The efficiency of ML methods in traffic prediction is significant due to their ability to capture complex and unusual traffic patterns with lesser prior information. Boukerche A. and Wang J. (2020) categorized these methods into different categories: regression model, example-based model, kernel-based model, neural networks, and hybrid model. The commonly used models are Support Vector Machine (SVM), Support Vector Regression (SVR), and k-Nearest Neighbor (K-NN). Traffic data are mostly non-linear and require prior knowledge for prediction. The deep learning approaches can learn this knowledge from the given data and predict accordingly.

This research is concerned with the study of Traffic crowd analysis, using Deep Neural Networks (CNN, RNN and Hybrid Network) and estimates the traffic crowd map, analysis of live images coming from CCTV cameras. Explore different ways to predict crowd behavior in video clips. However, the real-world images and video consist of nonlinearity that must be used efficiently for gaining accuracies in the results. Traffic Crowd analysis methods categorized into four domains: crowd counting, crowd density estimation, crowd scene analysis and crowd behavior detection.

Towards the first goal, I focus on the problems related to the estimation and the characterization of the traffic crowd density using low level features in order to avert typical problems in detection of high density crowd. The second goal of this study is to explore an emerging and promising field of research in traffic crowd analysis which consists of using crowd density as additional information to complement other tasks related to video surveillance in crowded scenes. Finally, using training and testing detecting behavior of crowd.

Traditional methods of addressing computer vision problems uses a shallow features that are single layer of interaction between the extracted features of any subsystem, which are applied through fusion functions and comprehend the results. Slowly and steadily, the hardware cost has decreased substantially and the computing capability of the hardware has increased manifolds. Thus, we have been witness to this evolution to a system designed by humans where the system learns from data itself and trained by computers using example data from which feature vectors are extracted. Structures are important for determination of the generalized optimal solution for high-dimensional feature space. To design such a system, we need to have discriminated features of the presented system. With the help of these discriminated features, a number of operations can be performed on these feature sets, which can be used to solve the problem through machine learning techniques or follow the traditional way of providing the solutions. In both the cases, the important aspect of the solution is to find the discriminating features from the problems. These features are called handcrafted features. The latest trend in the optimal solution arena is to let the computers learn these discriminated features, which have the extensive problem codes. Using these features, a solution is explored using various deep learning methods. This ideology of using feature vectors forms the basis of various deep learning algorithms.

Traffic crowd denotes a large group of individuals who have gathered closely together. The phenomenon of crowd and its dynamics have been studied in different research disciplines such as sociology, civil, and physics. Nowadays, it becomes one of the most active-oriented research area and attractive topic in computer vision.

Deep learning has emerged as a new concept of machine learning. The scope of machine learning within the superset of artificial intelligence has resulted in the deep learning concepts. A more recent form of deep learning has evolved to the representation learning, which involves a hierarchical architecture of layers. The higher layers learn from the lower layers. The three architectures mentioned in the literature are generative, discriminative, and hybrid. The most successful type of models for image analysis has been attributed to convolution neural networks (CNNs). CNNs consist of many layers that transform their input with convolution filters of a smaller dimension. In computer vision, deep networks have evolved to be used consistently. Bengio et al. (2013) provided a thorough analysis of various techniques such as principal component analysis, clustering of image patches, dictionary approaches, sparse representations and much more that have been a popular choice with CNN.

Deep learning has been the most amazing emerging technologies that bear the potential to change the pattern of learning in every area of human lives A major breakthrough came in 2006 when it was demonstrated that by training DNNs layer by layer in an unsupervised manner (pre-training), followed by supervised fine-tuning of the stacked network, resulted in good pattern recognition tools. There is a proposed denoising solution in form of auto encoder, where the model is trained to reconstruct the input from a noise-corrupted version. Deep belief networks (DBNs) are one of the stack-based auto encoders, where the layers are provided unsupervised learning.

The main objectives of the work in this paper are as follows:

- a) Estimate and prediction of real time traffic flow.
- b) Estimate and prediction of real time traffic density
- c) Analysis of vehicle/pedestrian behavior
- d) Traffic light signal control

## 2. REVIEW OF RELATED LITERATURE

Mo et al. (2022) proposed a CNN-based architecture, called Attentive Differential Convolutional Neural Network (ADCNN), to encode the current state and its high order changing rate using the historical traffic data. Inspired by the idea of that a function can be approximated by using a finite number of terms of its Taylor expansion, we design a cascade architecture based on the Hierarchical Differential Unit (HDU) and Cross-Attention mechanism which can learn the high order changing rate of the current state and conduct

extensive experiments to evaluate ADCNN on three real-world traffic datasets. Experimental results show that ADCNN outperforms the other state-of-the-art models.

Afrin and Yodo (2022) proposed a Long Short-Term Memory (LSTM)-based correlated traffic data prediction (LSTM-CTP) framework. The LSTM-CTP framework was employed for two different real-time traffic datasets. These datasets were initially pre-processed to capture both temporal and spatial trends and the correlations between the collected data series. The performance of the proposed LSTM-CTP was evaluated using different performance metrics and compared with different time-series prediction algorithms. The proposed framework showed substantial improvements in prediction results compared to the other algorithms. Overall, the proposed LSTM-CTP framework can help control traffic congestion and ensure a more robust traffic management system in the future.

Zheng et al.(2023) studied on evaluating recent hybrid deep learning models in the task of traffic prediction. The selected models and performed a series of comparative experiments under identical conditions with three well-known real-world datasets collected from large-scale road networks.

Zhang et al. (2023) proposed an improved convolutional network (SHC-Net). The proposed SHC-Net model improves the existing models by capturing the spatial heterogeneity of the temporal patterns of crowd flow, considering both global and local spatial correlations simultaneously, and combining external factors and spatiotemporal features to consider the heterogeneous impact of external factors on crowd flows.

Zhang et al. (2022) proposed an effective and efficient model to reduce the training time cost while maintaining predictive accuracy in forecasting citywide crowd information at a fine spatio-temporal scale. The model integrates Gated Recurrent Unit (GRU), convolutional neural network (CNN), and k-nearest neighbors (k-NN) to jointly capture the spatial and temporal dependences between two regions in a city. The evaluation with two different datasets in two different cities shows that compared to the state-of-the-art baselines, the model has better predictive and better abilities in making accurate predictions with low time cost under the influences of large-scale special events (when massive crowds of people are gathering in a short time) and for regions with high and irregular crowd changes.

The convolution neural network is one of the most successful machine learning models to emerge from the deep learning industry in recent years. As the hardware of computers and available datasets advance, the convolution neural network has become increasingly larger, and its performance has become better. At the same time, the requirements of the infrastructure for the training of deep learning models have become stricter, and training has become increasingly difficult. Even if a high-performance computing device is available, it may still take days and even weeks to train a deep learning model. Therefore, how to reduce the time and resource costs for the training of a deep learning model is an important research issue. This paper separates the feature extraction layer and the output layer classifiers of the deep convolution network from each other, and replaces the output layer with the AdaBoost algorithm in an attempt to combine deep learning with traditional algorithms. Likewise a trained deep convolution network can be integrated with Bagging or SVM to enhance the performance of algorithms, while saving training cost.

Earliest works on CNNs have been reported in and have been applied to medical image analysis. The first successful real-world application came up in 1998 known as LeNet for handwritten digit recognition. The initial success of CNN was not enough to generate more application area. The most important breakthrough came through the contribution in 2012 by to the ImageNet challenge in 2012. The proposed CNN, called AlexNet, won that competition of ImageNet by a handsome margin. In subsequent years, various deeper architectures have come up and are being used in different application areas. Traffic crowd analysis is an interesting technique focusing on various diverse fields such as Computer Vision, Pattern Recognition (PR), and Soft Computing methodology, Mathematical Modelling (MM), Biomedical Information (BI) , Image Signal Processing (ISP) , Data Mining (DM), Computational Intelligent (CI) and Artificial Intelligence (AI).

Traffic crowd analysis has been studied for a while within the fields of computer vision and pattern recognition. There has been lot of surveys on crowd behavior and their respective attributes.

**Table 1: List of simple CNN algorithms**

Technique	Features	Datasets	Architecture
Fu et al. (2015)	Real-time approach	PETS_2009, Subway video, Chunix_Road video	ConvNets
Mundhenk et al. (2016)	Contextual Information, creation of large datasets of cars	Cars Overhead with Context (COWC)	AlexNet, Inception

Wang et al. (2015)	End-to-end deep CNN regression model”	UCF	FCN
Zhang et al. (2016)	Joint learning of crowd density and velocity	USCD, LHI, TS, CNN	FlowNet
Hu et al. (2016)	Two supervisory signals: crowd count and crowd density	UCF, USCD	ConvNets
Walach et al. (2016)	Gradient boosting and selective Sampling and elimination of low- quality training samples	UCF, USCD	Boosting Net

**Table 2: Context-CNN algorithms description**

Technique	Features	Datasets	Architecture
Chattopadhyay et al. (2017)	Associative subtilizing	PASCAL VOC, COCO	ConvNets
Zhang et al. (2018)	Attention model for head detection	UCF, STA, STB	AM-CNN
Li et al. (2018)	Dilated convolution and multiscale contextual information	UCF, STA, STB, WE	CSRNet
Han et al. (2017)	Combination of correlation and MRF	UCF	ResNet
Wang et al. (2018)	Density adoption network	ST, UCF	DAN, LCN, HCN
Liu et al. (2018)	Spatially aware network	ST, UCF, WE	Local Refinement Network

**Table 3: Scale-CNN algorithms description**

Technique	Features	Datasets	Architecture
Liu et al. (2018)	Geometry-aware crowd counting	ST, WE, Venice	Siamese
Huang et al. (2018)	Exploits cross-scale similarity	ST, WE	Wide and Deep
Kang et al. (2019)	Image pyramid to deal with scale variation information	ST, WE, USCD	VGG network
Zeng et al. (2020)	Single multiscale column	ST, UCF	Inception

**Table 4: Estimation and prediction of real-time traffic flow**

Author	Objective	Proposed Model / Method / Framework
Zhang et al. (2023)	Heterogeneous impact of external factors on crowd flows.	Convolutional network (SHC-Net)
Zhang et al. (2022)	Massive crowds of people are gathering in a short time and for regions with high and irregular crowd changes.	Intwgration of Gated Recurrent Unit (GRU), convolutional neural network (CNN), and k-nearest neighbors (k-NN)
Afrin and Yodo (2022)	Traffic data prediction	(LSTM-CTP) framework
Zheng et al.(2023)	traffic prediction	Hybrid deep learning models
Diao <i>et al.</i> (2019)	Predict the short-term traffic volume in massive transportation systems	A novel hybrid model
Sundaram et al. (2015)	Traffic signal decision support to automatically identify the time of day intervals in which traffic congestion might occur	A hierarchical clusteringtechnique
Ke et al. (2019)	Classify and estimate the traffic	A new and complete analysis



	flow parameters (i.e., speed, density, and volume) from UAV video.	framework, which contains four stages
Ke et al. (2017)	Estimate the average speed of traffic stream and count of vehicles from UAV-based traffic videos	A four-step framework
Hung et al. (2016)	Estimating the traffic flow based on traffic video analysis	Background subtraction and Gaussians model

**Table 5: Estimation and prediction of real-time traffic density**

Author	Objective	Proposed Model / Method / Framework
Chung j. and Sohn K. (2018)	count the number of vehicles on a road segment	Deep Convolutional Neural Network (D-CNN) method
Zonoozi et al. (2018)	predict crowd density	A novel Periodic-Convolutional Recurrent Network (P-CRN) method
Raj et al. (2016)	estimate the travel time and traffic density	k-Nearest Neighbor (kNN) and Artificial Neural Network (ANN)

**Table 6: Analysis of vehicle/pedestrians behaviour**

Author	Objective	Proposed Model / Method / Framework
Zaki et al. (2018)	Localize pedestrians in small groups and identify possible commonality between nearby pedestrians	MMTrack Algorithm
Iryo-Asano et al. (2017)	Analyzed and modelled the probabilistic crossing behavior of pedestrians after the onset of the pedestrian flashing green (PFG) until the completion of crossing	The stop-go decision and speed distribution models
Dong et al. (2017)	Detect the pedestrian behaviour who unconsciously using their phones during the crossing of the street	New Algorithms based on gradient and texture feature integration
Kaparias et al. (2015)	Interactions between vehicles and pedestrians and classify these behaviours and reactions as a function of traffic parameters (e.g. speed, density, and frequency of pedestrian crossings).	New behavioural analysis based on traffic flow characteristics (speed and density)

**Table 7: Signal control and traffic light**

Author	Objective	Proposed Model / Method / Framework
Abu Zaid et al. (2017)	Control the traffic light based on number of vehicles on each traffic light.	Artificial neural network and fuzzy logic
Kanungo et al. (2014)	Images extracted from live videos feed from cameras installed at traffic junctions to calculate a real time traffic density and switches the light according to the traffic density to reduce traffic density.	Fuzzy logic and genetic algorithms
Ghazal et al. (2016)	Smart traffic light system that control and manage the traffic light of a “+” junction of mono directional road.	PIC microcontroller that evaluates the traffic density using IR sensors and accomplishes dynamic timing slots with different levels.

Jagadeesh <i>et al.</i> (2015)	Enable the traffic light to switch from red to green based on traffic density.	Artificial neural network
--------------------------------	--------------------------------------------------------------------------------	---------------------------

Table gives a summary of the survey papers for traffic crowd analysis using traditional methods as well as new frameworks and methods. Table clearly brings out that computer vision-based approaches in all the previous survey papers were using the traditional methods. In all the above-listed survey papers, it is clearly visible that a approach towards traffic crowd analysis needs more than just the traditional methods. Deep learning approaches towards traffic crowd analysis are the future as fast processing computing devices are easily available. The extra (temporal) dimension in sequences typically turned crowd behavior recognition into a challenging problem in terms of both amount of data to be processed and model complexity—which in particular are crucial aspects for training large parametric deep learning networks. In this context, there has been a proposition for several strategies, such as frame sub-sampling, aggregation of local frame-level features into mid-level video representations or temporal sequence modeling, just to name a few. Although the application of deep learning to crowd behavior analysis is relatively new, the amount of research that has been invested in these topics is appreciable.

Since the deep learning models are concerned with designing best models in the respective area of research, the use of deep learning is still in the process of evolution. In general, the historical state of the art on crowd behavior analysis with deep learning solutions has provided us with some answers. This section reviews CNN-based methods for crowd analysis using convolutions, pre-computed motion-based features and temporal sequence models.

Convolution neural networks (CNNs), which are composed of multiple processing layers to learn the representations of data with multiple abstract levels, are the most successful machine learning models in recent years. However, these models can have millions of parameters and many layers, which are difficult to train, and sometimes several days or weeks are required to tune the parameters. Within this topic, I present the usage of a trained deep convolution neural network model to extract the features of the images, and then, used the AdaBoost algorithm to assemble the Softmax classifiers into recognizable images. This method resulted in increase of accuracy of the trained CNN models, and dramatically reduced the retraining time cost, and thus, it has good application prospects.

### 3. RESEARCH METHODOLOGY

Techniques used for Traffic Crowd Analysis from Real Time Video were categorized into four groups:

- Initialization – in order for the system to process data, it needs to be initialized; e.g., a proper model of the system should be built;
- Tracking – the process of segmenting the subjects from the background and finding correspondences between segments in consecutive frames;
- Pose – the estimation of pose is carried out in corresponding frames (usually, a high level human model is used); and
- Recognition – recognizing the behavior, identity, and action of an individual or a group.

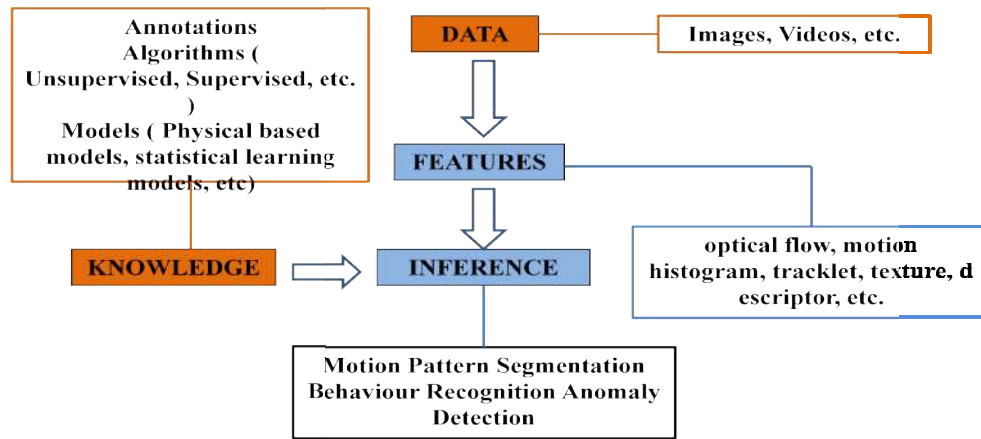


Figure 1: General structure of Traffic crowd analysis

The past few decades have witnessed a widespread growth in the adoption of video surveillance systems mainly with the increasing performance of the cameras while their prices are dropping. Nowadays, video surveillance has become a key technology for modern society. The utilization of closed-circuit television systems (CCTV) has grown at an ever increasing rate and is becoming ubiquitous in almost all public areas to monitor individuals in airports, subways systems, sporting events and many other public facilities.

Nowadays, a modern surveillance system is expected to not only perform basic object detection and tracking, but also to provide a higher level interpretation of object behaviors. This could include several applications such as abnormal event detection, main traffic trends analysis, and improving object detection and tracking. Given a video, a typical pipeline of video surveillance is composed of the following main steps:

- (1) Detection of objects to find areas of interest in the video.
  - (2) Tracking of these objects from frame to frame to join these detections into records of a single object.
  - (3) These records are further analyzed to detect the type of the object (to categorize car, person, bicycle, and so on) or its identity.
  - (4) Analysis of the behavior of these objects to generate alerts when unusual behaviors are observed.
- A typical pipeline of automated surveillance systems is shown in figure 2 .

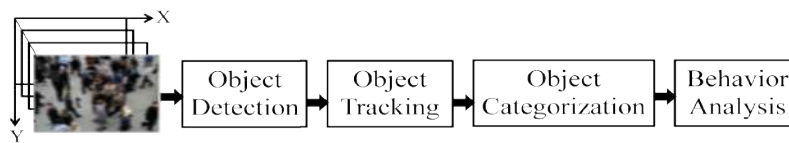


Figure 2: A typical pipeline of automated surveillance systems

The work presented within this synopsis fits the context of crowd density analysis and video surveillance applications awareness crowd density.

The problems related to the characterization of the crowd density by addressing people counting, density level estimation, and crowd motion segmentation using low level features.

Estimation of crowd density could provide valuable information and complement other applications in video surveillance.

#### 4. ANALYSIS AND INTERPRETATION

A deep neural network is considered an advanced form of neural network with a higher level of complexity, i.e., a neural network with more than two layers. DNN based algorithms developed for video processing are capable of handling extensive higher dimension data. An object detection task is performed in the

video using DNN with SIFT and tensor, which shows higher accuracy than previously developed methods. A robust deep neural network-based Multivariate Gaussian Fully Convolution Adversarial Autoencoder (MGFC-AAE) model to serve the demand of video anomaly detection and localization. DNN based method for video processing for the classification probabilities for each video fragment; for normal and abnormal situations detection and recognition. Similarly, for road sign detection and lane detection tasks for road analysis in automatic driving. DNN based video processing is performed for anomaly detection.

A recurrent neural network (RNN) is also an artificial neural network that uses sequential or time-series data. This deep learning algorithm is generally used for temporal information. Since the nature of video data is Spatio-temporal, many video processing RNN based methods are developed in recent years. Long-short term memory (LSTM), Gated recurrent unit (GRU), Neural Turing Machines (NTM) is few popular variants of RNN. Among these, LSTM is one of the most widely used algorithms for video processing research. GRU-based approach is for the video segmentation task by fully utilizing the temporal data in online videos. GRU preserves the temporal information part and maintains the spatial connectivity in the sequential frames of video data. A novel approach is a Multi-layer perception recurrent neural network (MLP-RNN), which is suitable for differentiating multiple objects of varying sizes.

The hybrid approach shows the combination of multiple deep learning methods uses for video processing. We found lots of research done using this approach. LSTM networks work based on frame-level CNN activation and combine information over time, similar to temporal feature pooling. Compared to the vanilla recurrent neural network, LSTM has uninterrupted gradient flow, which is more accessible to back-propagated. LSTM is also more stable without gradient exploding or vanishing. Temporal segment networks for human action recognition, the video data by dividing it into equal parts, extract small snippets from each part of the video, classify each snippet using a multistream CNN network and then form a consensus over the classification to output a softmax score for the whole video finally.

## 5. CONCLUSION

The systematic review reported in this paper to explore the deep neural network technologies adopted in research and industry to attempt to overcome the direct and indirect traffic issues on humanity and societies and provide the understanding of the state of art in traffic crowd analysis. Our review has based on existing studies in different approaches that depended on traffic crowd analysis that work on detecting moving objects, identifying the pattern and behaviors of pedestrians and finally approaches that focused on the traffic light signals.

This paper have studies a different framework for traffic crowd analysis in image/video that is based on extracting deep features from pre-trained CNN models and other models.

## REFERENCES

- Afrin T. , Yodo N. (2022). A Long Short-Term Memory-based correlated traffic data prediction framework. *Knowledge-Based Systems*, Volume 237, 15 February 2022, 107755.
- Bengio, Y., Courville, A., Vincent, P (2013). Representation learning: a review and new perspectives. *IEEE Trans. Pattern Anal. Mach. Intell.*, 35(8), 1798–1828.
- Boukerche A., Wang J. (2020). Machine Learning-based traffic prediction models for Intelligent Transportation Systems. *Computer Networks*, Volume 181, 9 November 2020, 107530.
- Chattopadhyay P et al (2017). Counting everyday objects in everyday scenes. *proceedings - 30th IEEE conference on computer vision and pattern recognition, CVPR 2017*, 2017-January, pp. 4428–4437.
- Chung J. and Sohn K. (2018). Image-based learning to measure traffic density using a deep convolutional neural network. *IEEE Trans. Intell. Transp. Syst.*, vol. 19, no. 5, pp. 1670–1675, May 2018.
- Dio Z. et al. (2019). A hybrid model for short-term traffic volume prediction in massive transportation systems. *IEEE Trans. Intell. Transp. Syst.*, vol. 20, no. 3, pp. 935–946, Mar. 2019.
- Dong Y., Li Y., Liu W., and Wu J. (2017). Unconscious behavior detection for pedestrian safety based on gesture features. In *Proc. 18th Int. Conf. Parallel Distrib. Comput., Appl. Technol. (PDCAT)*, Taipei, Taiwan, Dec. 2017, pp. 39–43.
- Fu M, Xu P, Li X, Liu Q, Ye M, Zhu C (2015). Fast crowd density estimation with convolutional neural networks, engineering applications of artificial intelligence. *Elsevier*, 43:81–88.

- Ghazal B., ElKhatib K., Chahine K., and Kherfan M. (2016). Smart traffic light control system. In *Proc. 3rd Int. Conf. Elect., Electron., Comput. Eng. Their Appl. (EECEA)*, Beirut, Lebanon, Apr. 2016, pp. 140–145.
- Han K et al (2017). Image crowd counting using convolutional neural network and Markov random field. *J Advanc Comput Intell Inform* 21(4):632–638.
- Hu Y, Chang H, Nian F, Wang Y, Li T (2016). Dense crowd counting from still images with convolutional neural networks. *J Visual Commun Image Representation, Elsevier Inc*, 38:530–539.
- Huang S, Li X, Zhang Z, Wu F, Gao S, Ji R, Han J (2018). Body structure aware deep crowd counting, *IEEE Trans Image Process* 27(3): 1049–1059.
- Hung N. V., Tran L. C., Dung N. H., Hoang T. M., and Dzung N. T. (2016). A traffic monitoring system for a mixed traffic flow via road estimation and analysis. In *Proc. IEEE 6th Int. Conf. Commun. Electron. (ICCE)*, Ha Long, Vietnam, Jul. 2016, pp. 375–378
- Iryo-Asano M., Alhajyaseen W. K. M., and Nakamura H. (2017). Analysis and modeling of pedestrian crossing behavior during the pedestrian flash- ing green interval. *IEEE Trans. Intell. Transp. Syst.*, vol. 16, no. 2, pp. 958–969, Apr. 2015.
- Jagadeesh Y. M., Suba G. M., Karthik S., and Yokesh K..(2015). Smart autonomous traffic light switching by traffic density measurement through sensors. In *Proc. Int. Conf. Comput., Commun., Syst. (ICCCS)*, Kanyakumari, India, Nov. 2015, pp. 123–126.
- Kaparias I., Bell M. G. H., Biagioli T., Bellezza L., and Mountc B. (2015). Behavioural analysis of interactions between pedestrians and vehicles in street designs with elements of shared space. *Transp. Res. F, Traffic Psychol. Behav.*, vol. 30, pp. 115–127, Apr. 2015.
- Kang D, Chan A (2019). Crowd counting by adaptively fusing predictions from an image pyramid. *British machine vision conference 2018. BMVC 2018*:1–12.
- Kanungo A., Sharma A., and Singla C.(2014). Smart traffic lights switching and traffic density calculation using video processing. In *Proc. Recent Adv. Eng. Comput. Sci. (RAECS)*, Chandigarh, India, Mar. 2014, pp. 1–6.
- Ke R., Li Z. Kim S., Ash J., Cui Z., and Wang Y. (2017). Real-time bidirectional traffic flow parameter estimation from aerial videos. *IEEE Trans. Intell. Transp. Syst.*, vol. 18, no. 4, pp. 890–901, Apr. 2017.
- Ke R., Li Z. Tang J., Pan Z., and Wang Y. (2019). Real-time traffic flow parameter estimation from uav video based on ensemble classifier and optical flow. *IEEE Trans. Intell. Transp. Syst.*, vol. 20, no. 1, pp. 54–64, Jan. 2019.
- Liu L et al (2018). Crowd counting using deep recurrent spatial-aware network. *IJCAI international joint conference on artificial intelligence*, 2018-July, pp. 849–855.
- Li Y, Zhang X, Chen D (2018). CSRNet : dilated convolutional neural networks for understanding the highly congested scenes, pp. 1091–1100.
- Mo J., Gong Z., Chen J. (2022). Attentive differential convolutional neural networks for crowd flow prediction. *Knowledge-Based Systems*, Volume 258, 22 December 2022, 110006.
- Mundhenk TN, Konjevod G, Sakla WA, Boakye K (2016). A large contextual dataset for classification, detection and counting of cars with deep learning. In *Proceedings of the European Conference on Computer Vision*, Munich, Germany, 8–16; pp. 785–800.
- Raj J., Bahuleyan H., and Vanajakshi L. D. (2016). Application of data mining techniques for traffic density estimation and prediction. *Transp. Res. Procedia*, vol. 17, pp. 321–330, Dec. 2016.
- Sundaram S., S. Kumar S., and Shree M. D. (2015). Hierarchical clustering technique for traffic signal decision support. *Int. J. Innov. Sci., Eng. Technol.*, vol. 2, no. 6, pp. 72–82, Jun. 2015.
- Walach E, Wolf L (2016). Learning to count with CNN boosting. In *Proceedings of the European Conference on Computer Vision, Amsterdam, the Netherlands*, 11–14; pp. 660–676.
- Wang C et al (2015). Deep people counting in extremely dense crowds. *MM 2015 - proceedings of the 2015 ACM multimedia conference*, pp. 1299–1302.
- Wang, Li et al. (2018). Crowd Counting with Density Adaption Networks. pp. 1–5.
- Zaid A. A., Suhweil Y., and Yaman M. A.(2017). Smart controlling for traffic light time. In *Proc. IEEE Jordan Conf. Appl. Elect. Eng. Comput. Technol. (AEECT)*, Aqaba, Jordan, Oct. 2017, pp. 1–5.
- Zaki M. H. and Sayed T. (2018). Automated analysis of pedestrian group behavior in urban settings. *IEEE Trans. Intell. Transp. Syst.*, vol. 19, no. 6, pp. 1880–1889, Jun. 2018.

- Zeng X, Wu Y, Hu S, Wang R, Ye Y (2020). DSPNet: deep scale purifier network for dense crowd counting. *expert systems with applications*, Elsevier Ltd 141:112977.
- Zhang H. , Liu Y., Xu Y. , Liu M.(2023). An improved convolutional network capturing spatial heterogeneity and correlation for crowd flow prediction. *Expert Systems with Applications*, Volume 220, 15 June 2023, 119702.
- Zhang X. , Sun Y., Guan F. , Chen K. , Witlox F. , Huang H. (2022). Forecasting the crowd: An effective and efficient neural network for citywide crowd information prediction at a fine spatio-temporal scale. *Transportation Research Part C: Emerging Technologies*, Volume 143, October 2022, 103854.
- Zhang Y et al (2016). Single-image crowd counting via multi-column convolutional neural network. *proceedings of the IEEE computer society conference on computer vision and pattern recognition*, 2016-December, pp. 589–597.
- Zhang Y et al (2018). Auxiliary learning for crowd counting via count-net. *Neuro Computing. Elsevier B.V.*, 273, pp. 190–198.
- Zheng G. , Chai W. K. , Duanmu J. L. , Katos V. (2023). Hybrid deep learning models for traffic prediction in large-scale road networks. *Information Fusion* 92, 93–114.
- Zonoozi A., Kim J., Li X. L., and Cong G. (2018). Periodic-CRN: A convolutional recurrent model for crowd density prediction with recurring periodic patterns. In *Proc. 27th Int. Joint Conf. Artif. Intell.*, Stockholm, Sweden, Jul. 2018, pp. 3732–3738.



# WORK LIFE BALANCE OF WORKING WOMEN IN IT SECTOR – A REVIEW PAPER

**Dr. Rajni Arora,**  
Bhopal Nobles' University, India  
(drrajni@bnuniversity.ac.in)  
**Vartta Siyal,**  
Bhopal Nobles' University, India  
(vtvartta@gmail.com)

Work life balance is the main key factor for good health and good relations both at work place and at home. Working women are feeling the effects of increased job pressure by having less time for themselves and their families. As a result, it is crucial to look at the idea of work-life balance, especially for the women working in IT industries as they have long working hours and high deadline pressure. This Work Life Balance is of more importance in the tier 3 cities as they generally have joint families and societal pressure to handle. The research is designed to study analytically the work life balance of working women in IT industries. The identification of the problems and challenges encountered by the women employees in their work area pose the main base of the research. The relationship between the work life balance and the work done by the employees (their work responsibility and designation) with the satisfaction level of the female and their family is the key factor of the research.

**Keywords:** Work Life Balance, Work Life Conflict, WLB, Work Family Conflict, Work Engagement.

## 1. INTRODUCTION

Work Life balance is the harmony which is required between the personal and professional life. This is important for all the working persons in the world for a healthy life. But it is even more important for the female employees in India as handling household work, family and society is considered as the primary task of females only irrespective of their working status. The working style of IT industry has its own pros and cons like the official timings are 9 hours for 5 days in a week but if we consider the transportation, project responsibilities, learning new techniques these timings are not limited to even 12 hrs a day. That is simply disturbing the balance. If we focus more on professional life, personal life is disturbed and vice versa which is making Women's life in IT industry more difficult. The paper is aimed to review the work that has been done to study the work life balance of all types of working women in different sectors and the research is proposed to study the female employees of IT industry in tier 3 cities.

Objectives of the study is -

1. To identify the problem and challenges faced by female employees.
2. To analyse the satisfaction level of work by female employees in various IT companies in Rajasthan.
3. To study the work life balance with work engagement and designation at work place.
4. To analyse the work life and work family conflict.

## 2. LITERATURE REVIEW

From various research it has been clear out that women employment is increasing in almost all fields especially in IT industries. The aspects which are included in this literature review includes problems faced by working women employees such as family problems, social problems, elderly problems, health problems, economic problems, organizational problems, dual role of women employees, women as labors, women as managers and organizational facility to women employees.

Mathew & Panchanatham, (2011) has stated that "WLB is a significant predictor of employees' health and well-being. Women often neglect their health and personal needs because of work pressure and time limitations and face health problems. Implementation of WLB policies and flexible work arrangements that enable women employees to work more efficiently and contribute to the organization in success". They have

studied the correlation between the two directions of conflict, namely, work-life conflict and life-work conflict and WLB. They conducted a survey among 711 women employees working in BPO organisations located in Chennai and assessed their level of WLB based on their marital and parental status. The authors suggest creation of family-friendly organizational culture that facilitates creative solutions to work life issues.

In a study by Narayanan and Lakshmi (2012), a focus was made on the work-life balance of software professionals working in IT sector. The study concludes that Work-life balance is an emerging phenomenon in the context of modern day organizations. They have explored the impact of the dependent child's age on the work family conflict experienced by the working mothers in the IT industry in Bangalore. The research findings as revealed by 176 respondents having children confirm that work family conflict of the working mother differs depending upon the age of their children. Work timings, excess workload, long travel, routine meeting, work on holidays are largely influencing the life balance of software professionals. Similarly, family care, child care, work timings, long travel, routine meeting are affecting the work balance of the employees.

Kavitha, Kavitha and Arulmurugan (2012) have used ORS scale on a sample of 264 women IT professionals in Tamil Nadu to explore the level of role stress. Resource inadequacy and role overload have emerged as potent role stressors tag on by personal inadequacy.

Mehtha, (2012) done a study on WLB among 263 women employees in service sector (Banking, financial services, hospitals, IT and education) with special reference to Pune city. The study has revealed that most often the break in women careers arises out of motherhood and family responsibilities.

Narayanan and Narayana, (2012) has worked on "The work-life balance of software professionals working in the IT sector. The study concludes that Work-life balance is an emerging phenomenon in the context of modern-day organizations. Work timings, excess workload, long travel, routine meeting, work on holidays are largely influencing the life balance of software professionals. Similarly, family care, child care, work timings, long travel, 35 routine meeting are affecting the work balance of the employees. The organizations have to pay increased attention to the strengthening of human resource policies to augment their employees."

Monica Agarwal and Santhi Narayanan (2013) have investigated the organizational factors influencing stress formation with reference to the random sample of 100 working women in IT sector of Greater Noida region of New Delhi. The study reveals that high workload, long continuous working hours, office politics, lack of clarity in organizational roles, attitude of superiors and inflexible organizational policies are emerging as major organizational factors influencing stress formation.

Joseph, Shaji et. al, (2015) has found that "balance in work-life has to be managed in such a way that the employees stay satisfied with their work. The employer should offer flexible timings for working women with an adequate workload. If the workload is much higher than the capacity, then the workload should be allocated to another employee". They observationally test the elements for the most part comprehended as adding to the work family struggle of representatives in the IT organizations through a relative investigation of people. Since majority share of the IT workforce in India are youthful it is critical to comprehend whether prior parameters for work life balance are pertinent in the present setting. The examination uncovered that the work family strife has an authoritative effect in the two people in the IT organizations. Anyway it was discovered that women experience the ill effects of work family struggle as they have the double duty however the thing that matters isn't huge. The investigation uncovered that the sex distinction don't affect significantly on the work family strife. This indicate out the way that we have to reconsider in transit we comprehend the idea of work family struggle among the youthful IT representatives. Commitment to Body of Knowledge: The result of this examination accentuates the requirement for overseeing work family struggle in the data innovation organizations. The variables that add to work family strife from sexual orientation point of view are obviously brought out efficiently. The factors that contribute to work family conflict from gender perspective are clearly brought out methodically.

Bharathi et. al. (2015) made an endeavor to locate the expert and individual difficulties and enhancers for work life balance among working women through a study of 186 ladies working in the IT part in India. The principle challenges in expert life were observed to be expanded/odd working hours, travel time among home and work environment and cooperation in extra employments and assignments. In close to home life, the primary anxieties were liable of not having the capacity to deal with self and older folks at home. Online networking connection was observed to be pressure busters for generally women. Most women would favor adaptable planning, and strong mate, family and companions just as a domain helpful for work at the workplace.

Minitha V Raj & A Mahalakshmi, (2016) has piloted “a study to know the factors which leads to stress on the working women of the IT industry in Bangalore, India. The outcome of the study revealed that the relaxation activities introduced by the IT companies in Bangalore are not helping the working women to buster their working stress, as the working hours in the IT Industry are not fixed and this leads to disrupting sleeping pattern, unbalanced time management for personal and professional life”.

MayeshaTasnim, Muhammed Zakir Hossain, Fabiha Enam, (2017) has explained “the truth of the balance maintained in work lives of working women in the various private companies of Bangladesh. This study revealed that the work-life balance depends on the circumstances of the concerned women workers facing long working hours, work overload and inadequate behaviour of the management”.

Sumathi and R. Velmurugan, (2018) has conducted an analytical study “the factors affecting the balance of work- life in women faculty of Arts & Science Colleges in Coimbatore, Tamil Nadu, India. The study concluded that women staff members work over-time and take the remaining work at home to complete the assigned work in the given deadlines. It has also been found that higher salary may not be the reason for better work-life balance”.

Pandiangan (2018) stated that “work-life balance may be a broad concept that involves setting the right priorities between work (career and ambition) on the one hand and life (happiness, leisure, family and development). If someone can give time to the requirements of work and outside work well, it'll create job satisfaction.”

This statement is supported by research conducted by Qodrizana (2018) that showed work-life balance affected job satisfaction. The important point is to balance the extent of someone's satisfaction at work and outside work.

Margaretha and Lestari (2021) defined work life balance as a practice that's concerned with providing scope for employees to balance their work with the responsibilities and interests they have outside work. “Work-life balance is that the individual perception that work and non-work activities are compatible and promote growth in accordance with an individual’s current life priorities”. As per them, WLB may be a situation that gives employees opportunities to balance their career work life and their personal life, and this example will not lead to job stress and fatigue in doing their works. WLB is one factor that influences on employee commitment, job satisfaction and organisation productivity.

### **3. RESEARCH GAP**

In the modern era, there are lots of changes in women's lives and the present life of working women is very challenging. Working women are grabbing their space at par with the men and have become more aspiring and career-oriented. Working women are ignoring the other aspects of their lives; and losing the quality time with child's and families, relaxation time and also time for their hobbies. Working women are more stressed in comparison to men, as they have to work from early of the morning to late night to meet out the daily needs of family members with office responsibilities. Striking an ideal balance between personal life and professional life is becoming near to impossible. there's real balance only when the individual feels that she has done justice to all her roles and is satisfied about it. Work-life balance problems are often really serious and needs to be addressed in due time. Number of studies has addressed this issue in several perspectives. a number of the papers related to this subject are reviewed. Hence, there is a dire need to study the gaps between the professional and personal life of working women in IT industry of a small fast growing city so that they may able contribute their life such a way that they get complete satisfaction while discharging various roles of their lives.

### **4. CONCLUSION**

The reviews of the earlier studies have envisaged that the various studies on work life balance have primarily focused men employees and very few studies have made an attempt to evaluate the work life balance of women employees. Particularly in Indian context, there are few articles and publications focusing on work life balance of women employees in IT sector of metro cities are available but research works on this area for the tier 3 cities are very scarce. Further, there are no studies linking work life balance with family environment, organizational commitment and employee productivity in terms of employee health, employee morale and job satisfaction in tier 3 cities.

## REFERENCES

- A.G.V. Narayanan and R. Lakshmi Narayanan (2012), “An Empirical Study On Factors Affecting Work- Life Balance of IT Professionals”, *In European Journal of Social Sciences* 31(3):302-313
- Kavitha P, Kavitha V and Arulmurugan P (2012), “Role of stress among women employees forming majority work force at IT sector in Chennai and Coimbatore, Tier-I & Tier-II Centres”, *Sonal Global Management Review*, Vol. 6, Issue 3, pp. 1-12.
- Mehtha, Vijayshri Rameshkumar (2012). “A study of work life balance among women employees in service sector with special reference to Pune City”, *Synopsis*, Tilak Maharashtra Vidyapeeth, 1-11.
- Narayanan. A.G.V and Lakshmi Narayanan, R. (2012). “An Empirical Study on Factors Affecting Work-life Balance of IT Professionals”, *European Journal of Social Sciences*, 31(3): 302-313.
- Monica Agarwal and Santhi Narayanan, 2013, “An empirical study on organizational factors influencing stress formation among working women in IT sector of Noida-Greater Noida region of NCR-New Delhi”, *International Journal of Computer Science and management Research*, Vol. 2, Issue 2, pp.1592-1597.
- Joseph, Shaji and Gautam, Bhawna and Bharathi, Vijayakumar, (2015), An Empirical Study on the Factors Contributing to Work Family Conflict Among Young Employees in the IT Companies. *Indian Journal of Science and Technology*, Vol 8 (S6), pp. 50-60
- Bharathi, Vijayakumar and Bharathi, Vijayakumar and E, Padma Mala and Bhattacharya, Sonali (2015), Work Life Balance of Women Employees in the Information Technology Industry. *Asian Journal of Management Research*, ISSN 2229-3795, Vol 5, No. 3, pp 323-343, Available at SSRN: <https://ssrn.com/abstract=2551630>
- Minitha V Raj and Dr. A Mahalakshmi (2016), “Study on Work life balance issues faced by women entrepreneurs in Bangalore City”, in the National Seminar on Rural Women Entrepreneurship in India. pp 20-39, ISBN 978-93-86176-00-4.
- Muhammed Zakir Hossain, Mayesha Tasnim, Fabiha Enam (2017), The Art of Designing and Producing Product for Facing Global Challenges: A Study on Toyota Production System. *International Journal of Scientific and Research Publications*, Volume 7, Issue 1, ISSN 2250-3153.
- Sumathi and Dr. R. Velmurugan (2018), “Job Satisfaction of Female Faculty in Arts and Science Colleges in Coimbatore District”, *International Journal of Engineering and Technology*, Vol.7 No.3.6, pp. 129-133.
- Pandiangan, H. (2018), Flexible working arrangement and its effect on work life balance on online transportation service drivers in Yogyakarta City. Master's thesis in Management Faculty of Economics, Sanata Dharma University, Yogyakarta.
- Qodrizana, D. L., & Al Musadieg, M. (2018), Pengaruh work-life balance terhadap kepuasan kerja (Studi pada karyawan perempuan yayasan insan permata tunggulwulung kota malang)/ The effect of work-life balance on job satisfaction (study on female employees of the Insan Permata Tunggulwulung Foundation, Malang City). *Jurnal Administrasi Bisnis*, Vol. 60(1), pp. 9-17.
- Lestari, D., & Margaretha. M. (2021), Work life balance, job engagement and turnover intention: Experience from Y generation employees. *Management Science Letters*, 11(1), 165–170.

# IOT AND BIG DATA CONVERGENCE IN HEALTHCARE: A SYSTEMATIC REVIEW OF REAL-TIME PATIENT MONITORING APPLICATIONS

**Abhishek Tiwari**

Dr C V Raman University, India (akt.champa9025@gmail.com)

**Vivek Tiwari**

Govt. E.R.R. PG. Science College, Bilaspur (profvivektiwari@gmail.com)

**Dr. Ayush Kumar Agrawal**

Dr C V Raman University, Bilaspur, India (ayushagrawal369@gmail.com)

The convergence of IoT and Big Data has revolutionized healthcare, especially in real-time patient monitoring. This systematic review delves into the applications, methodologies, and advancements resulting from this integration. Spanning seminal works to recent developments, our focus is on real-time monitoring. We elucidate foundational IoT and Big Data concepts, emphasizing the synergy between IoT devices and Big Data analytics. Systematically categorizing applications—chronic disease management, vital sign monitoring, anomaly detection. We investigate implementation methodologies, assessing scalability, security, and interoperability. This review synthesizes insights into challenges and opportunities. Ethical considerations, data privacy, and heterogeneous data interoperability are challenges. Conversely, personalized medicine, improved diagnostics, and data-driven decision support systems are opportunities propelling healthcare advancement. In conclusion, this systematic review offers a comprehensive overview of IoT and Big Data convergence in healthcare. Providing valuable insights for researchers, practitioners, and policymakers, we contribute to a deeper understanding of the current landscape, aiming to inspire future research directions in this dynamic field.

**Keywords:** Internet of Things (IOT), Big Data, Healthcare, Synergy, Data Privacy.

## 1. INTRODUCTION

The intersection of the Internet of Things (IoT) and big data analytics has emerged as a transformative force, particularly in the realm of healthcare. This convergence holds the promise of revolutionizing real-time patient monitoring by seamlessly integrating data from IoT devices and employing advanced analytics for improved healthcare outcomes.

**Significance of IoT in Healthcare:** IoT technologies have become integral to healthcare, offering continuous and remote patient monitoring through devices like wearables, sensors, and smart medical equipment. These IoT devices capture a wealth of real-time health data, ranging from vital signs to physiological parameters. However, the true potential of this data lies in its effective analysis, which is where big data analytics comes into play.

**Unlocking Insights with Big Data Analytics:** Big data analytics, with its capability to process vast datasets, plays a pivotal role in extracting actionable insights from IoT-generated healthcare data. By leveraging techniques like machine learning and predictive modeling, healthcare professionals can gain a comprehensive understanding of individual health profiles, identify patterns indicative of health risks, and tailor interventions for personalized care.

**The Need for a Systematic Review:** In the rapidly evolving landscape of IoT-driven healthcare and big data integration, a systematic review becomes imperative to synthesize

existing knowledge. This review aims to provide a comprehensive overview of real-time patient monitoring applications, focusing on the convergence of IoT and big data in healthcare. Through this analysis, we seek to identify trends, challenges, and future directions in this dynamic field.

Scope of the Review: Encompassing diverse real-time patient monitoring applications, this review explores how IoT and big data integration enhance healthcare delivery. From wearable devices tracking vital signs to remote monitoring of chronic conditions, the scope extends to connected healthcare solutions. Through a systematic examination of the literature, we aim to spotlight methodologies, challenges, and the impact of IoT and big data on patient outcomes.

As we embark on this exploration of IoT and big data convergence in healthcare, subsequent sections will offer a structured examination of the current landscape, emphasizing key findings, technological advancements, and future research directions. By the conclusion of this systematic review, we aim to provide insights that inform both researchers and practitioners in their quest to leverage technology for improved patient care.

## 2. LITERATURE REVIEW

**Rejeb et al. (2023)**This article presents a comprehensive review of recent advancements in healthcare through IoT. Analyzing 2,990 journal articles using bibliometric metrics, the study identifies key trends. IoT applications, blockchain, AI, 5G, and data analytics are prominent. Co-citation networks highlight themes like authentication schemes and cloud-IoT integration. This review enhances scholars' grasp of IoT in healthcare, spotlighting current trends and informing healthcare professionals of its latest applications.

**Ranjan et al. (2023)**This study explores the transformative impact of IoT and big data in healthcare, emphasizing improved decision-making. IoT devices generate extensive data, harnessed by big data analytics for personalized medical tools. While advancements are notable, challenges like data security and real-time analysis persist. Focusing on IoT sensor data collection, ML algorithms, and real-time analytics, the review underscores the need for future research in unexplored areas. Tailoring medical technology to individual needs is proposed for ongoing enhancements.

**Kaur (2023)**This chapter provides a comprehensive overview of the impactful synergy between IoT and big data in healthcare. Addressing heterogeneous data, including medical records and prescriptions, it emphasizes the potential value through computational analysis. The discussion extends to the pivotal role of IoT as a data source, revolutionizing data concepts. Notably, the chapter explores the recent advancements in healthcare technologies, particularly during the COVID-19 pandemic. Challenges, applications, and future prospects are succinctly presented, highlighting the promising integration of IoT and big data for enhanced pandemic healthcare solutions.

**Kumar et al. (2023)** This comprehensive review explores the transformative impact of Healthcare Internet of Things (H-IoT) systems on healthcare services, emphasizing remote patient monitoring. It underscores the critical need for securing personal health data during transfer. The paper delves into cryptographic solutions like H-IoT in big data, blockchain, machine learning, deep learning, edge computing, and software-defined networks. Addressing challenges such as security, scalability, real-time operations, and resource constraints, it provides insights into current trends like remote patient monitoring and



predictive analytics. The review concludes with future prospects, including leveraging health data for strategic planning, offering valuable insights for future researchers.

**Yeruva et al. (2022)** This study addresses healthcare challenges in economically developing countries, emphasizing the scarcity of medical professionals and resources. Recognizing the importance of Internet of Things (IoT) applications, it explores a novel approach integrating fog computing. The proposed framework shifts from clinic-focused to patient-centered healthcare, offering a transformative solution. This innovative strategy promises to enhance medical care accessibility, particularly in remote areas, ensuring a more robust and patient-centric health system. The study provides a valuable blueprint for addressing healthcare disparities in resource-limited regions.

**Wagan et al. (2022)** This review explores the transformative impact of the Internet of Medical Things (IoMT), highlighting its ability to provide continuous connectivity for patients and real-time data for healthcare facilities. Emphasizing the importance of robust technology convergence, it delves into the novel applications of IoMT through multi-homing dense networks. The study evaluates machine learning algorithms in healthcare, comparing disease predictions and decision accuracy. It provides insights into IoMT convergence challenges and opportunities, offering a comprehensive overview for those interested in the dynamic intersection of healthcare and technology.

**(Sujith et al., 2022)** This work provides a comprehensive review of Smart Health Monitoring (SHM), addressing the critical challenge of disease prevention through technology. Amidst the evolution of Industry 5.0 and 5G, smart sensors enable real-time health monitoring, offering fast, cost-effective, and reliable services remotely. Integration of blockchain ensures data security, while Deep Learning and Machine Learning enhance health data analysis for preventive healthcare. The systematic review covers recent advancements in SHM, emphasizing the integration of cloud computing for cost-effectiveness and real-time services, thereby contributing significantly to disease control and healthcare management.

**Pap & Oniga (2022)** This paper provides a crucial overview of healthcare technology applications in the wake of the COVID-19 pandemic. Emphasizing the importance of reliable and affordable health services, it explores the role of various technologies, including video conferencing, data management, secure patient information transfer, and machine learning algorithms. From cardio-oncology's remote patient monitoring to machine learning for seizure prediction using EEG signals, the review underscores the pivotal role of artificial intelligence in advancing eHealth. It offers valuable insights into the multifaceted applications of modern technologies in healthcare.

**Narigina et al. (2022)** This paper comprehensively examines key technologies—big data, blockchain, cloud computing, IoT, machine learning, and artificial intelligence—pertinent to medical data analysis. It evaluates their advantages and disadvantages in healthcare, conducting a comparative analysis to identify the optimal solution for integrating into existing healthcare systems. Prioritizing data confidentiality, fault tolerance, and quick data access, the review aids decision-makers in selecting technologies that align with essential healthcare system requirements.

**Nancy et al. (2022)** This article explores the transformative synergy of IoT, Cloud, and predictive analytics in healthcare, focusing on advanced technologies like AI, ML, and deep

learning. It highlights the critical role of deep learning, particularly Bi-LSTM, in predicting heart disease risk with impressive accuracy (98.86%). By integrating data from IoT devices and cloud-stored clinical records, the proposed system offers a proactive approach to healthcare, outperforming existing prediction systems. This research underscores the potential of cutting-edge technologies in revolutionizing disease prediction and preventive care.

**Mukherjee et al. (2022)** This article explores the pervasive influence of low-cost sensors in smart city infrastructures, delving into the transformative role of big data analytics in 5G-driven IoT and industrial IoT. It meticulously examines applications, algorithms, and security considerations, offering a comprehensive taxonomy of analytical systems. The focus on data mining algorithms provides valuable insights into addressing challenges and advancing sustainable smart city development through informed decisions.

**Fawzy et al. (2022)** This paper conducts a thorough literature review on IoT systems, focusing on big data analytics and software engineering. It unveils the current state-of-the-art in various domains, identifying challenges and gaps in IoT data processing. The study proposes a domain-independent software architecture for big IoT data analytics, addressing scalability, timeliness, heterogeneity, inconsistency, confidentiality, and correlations. Emphasizing research gaps, the review serves as a valuable resource for future considerations in advancing IoT technologies and their processing architectures.

**Hajjaji et al. (2021)** This systematic review pioneers an exploration of big data and IoT applications in smart environments. Covering academic documents from 2011 to 2019, it addresses key areas, trends, data architectures, and challenges. Notably, the integration of big data and IoT emerges as a promising avenue for real-world applications in monitoring, protecting, and enhancing natural resources. Smart environment monitoring, agriculture, metering, and disaster alerts are highlighted. The paper concludes by proposing methodologies, providing a foundation for future interdisciplinary research in the dynamic realm of smart cities and environments.

**Haghi Kashani et al. (2021)** This paper provides a comprehensive review of Healthcare IoT (HIoT) systems, examining 146 articles from 2015 to 2020. It systematically classifies existing investigations into five categories, highlighting sensor-based, resource-based, communication-based, application-based, and security-based approaches. The paper thoroughly analyzes benefits, limitations, and evaluation methods, concluding with significant open issues, future trends, and challenges in the realm of HIoT systems. This review serves as a valuable resource for researchers and practitioners navigating the dynamic landscape of healthcare and IoT integration.

**Song et al., (2020)** This paper introduces an intelligent State of Health (SOH) estimation framework for in-vehicle lithium-ion batteries in electric vehicles. Leveraging big data from real-world EV operations, it employs deep learning to estimate SOH, demonstrating effectiveness with a maximum relative error of 4.5%. The proposed framework accurately captures battery aging trends based on extensive data, showcasing its practical significance.

**M. J. Kaur et al. (2020)** This article explores the transformative impact of Digital Twins, IoT, blockchain, and AI in redefining globalization. It delves into Digital Twins as living models adapting to real-time IoT data, forecasting future changes with AI. The investigation

covers architecture, applications, and challenges, including research areas like big data, cloud, data fusion, and security in Digital Twins. The integration of AI is highlighted for its role in advancing intelligent manufacturing models and technology systems.

**Akkaş et al. (2020)** This tutorial explores the transformative impact of IoT in healthcare, emphasizing applications in remote monitoring, elderly care, disease management, and personalized medication. It introduces emerging trends like Bio-IoT and Nano-IoT. The paper details a WBAN-based biomedical application, focusing on pulse rate, plethysmogram, and oxygen ratio data. Evaluating system performance across network topologies, stability, and effective range, it provides valuable insights for the evolving landscape of IoT in healthcare.

**Rehman et al. (2019)** This study explores the intersection of Industrial Internet of Things (IIoT) and Big Data Analytics (BDA), crucial for deriving insights despite resource constraints in IoT devices. Investigating recent BDA technologies, algorithms, and techniques, the study classifies literature based on key parameters, presenting frameworks and case studies showcasing benefits in enterprises. Opportunities and challenges are identified, providing valuable insights for future research in developing intelligent IIoT systems.

**Talal et al. (2019)** This study investigates IoT-based smart home security for real-time health monitoring in telemedicine. Through a multilayer taxonomy, it analyzes 67 articles, addressing architecture, security analysis, schemes, examination, protocols, and frameworks. The study identifies challenges, requirements, and provides recommendations for enhancing security in IoT-based smart homes for telemedicine applications.

**Siyal et al. (2019)** This paper explores the burgeoning applications of blockchain in healthcare, highlighting its potential to enhance data security, diagnosis, and treatment. The review addresses current developments, applications, challenges, and future prospects in integrating blockchain technology for secure and personalized healthcare.

**Pastorino et al. (2019)** This work highlights the transformative potential of Big Data in addressing healthcare challenges. Emphasizing the need for collaboration, it discusses successful initiatives in Europe, showcasing how Big Data analytics enhances patient care, informs decision-making, and advances public health and oncology sectors through actionable insights.

**Liu et al. (2019)** This paper introduces CloudDTH, a cloud-based healthcare system leveraging digital twin technology. Focused on personal health management, especially for the elderly, it proposes a novel framework facilitating the convergence of physical and virtual healthcare spaces. The digital twin healthcare (DTH) concept is presented, and a model is implemented within CloudDTH. The paper explores key enabling technologies and demonstrates feasibility through real-time supervision, showcasing a promising approach for efficient, accurate, and personalized healthcare services across the lifespan.

**Shadroo & Rahmani, (2018)** This study explores the intersection of IoT, big data, and data mining, analyzing 44 articles from 2010 to August 2017. Categorized into Architecture & Platform, framework, and application, it provides a comprehensive overview for future research in this evolving field.

**Harerimana et al. (2018)** This paper delves into the burgeoning field of big data analytics in healthcare, addressing challenges posed by diverse data sources. Focusing on key issues, data types, and emerging technologies, it offers a simplified yet comprehensive review. The study navigates through complexities to provide valuable insights into crafting integrated health analytic applications.

**Ge et al. (2018)** This survey examines Big Data technologies in various IoT domains to foster cross-domain knowledge sharing. It identifies commonalities and distinctions, proposing the reapplication of Big Data tech across domains. The paper presents a conceptual framework highlighting critical Big Data technologies applicable in all reviewed IoT domains, contributing to a cohesive understanding of this evolving field.

Authors (Year)	Title	Focus	Methodology	Key Technologies	Main Contributions
Rejeb et al. (2023)	Comprehensive Review of Recent Advancements in Healthcare through IoT	Recent advancements in healthcare through IoT	Analyzing 2,990 journal articles using bibliometric metrics	IoT, Blockchain, AI, 5G, Data Analytics	Enhancing scholars' grasp of IoT in healthcare, spotlighting current trends and informing healthcare professionals of its latest applications
Ranjan et al. (2023)	Transformative Impact of IoT and Big Data in Healthcare	IoT and big data in healthcare, emphasizing improved decision-making	Exploration	IoT, Big Data Analytics	Underscores the need for future research, proposes tailoring medical technology to individual needs
Kaur (2023)	Synergy between IoT and Big Data in Healthcare	Impactful synergy between IoT and big data in healthcare	Not specified	IoT, Big Data	Explores recent advancements in healthcare technologies, addresses challenges, applications, and future prospects
Kumar et al. (2023)	Transformative Impact of Healthcare Internet of Things (H-IoT) Systems	Impact of H-IoT on healthcare services, remote patient monitoring	Not specified	H-IoT, Big Data, Blockchain, Machine Learning, Deep Learning, Edge Computing, Software-Defined Networks	Insights into current trends, challenges, and future prospects, offers valuable insights for future researchers

Yeruva et al. (2022)	Addressing Healthcare Challenges in Economically Developing Countries	Healthcare challenges in economically developing countries, IoT applications	Not specified	IoT, Fog Computing	Provides a novel approach integrating fog computing, offers a transformative solution for patient-centered healthcare
Wagan et al. (2022)	Transformative Impact of Internet of Medical Things (IoMT)	Impact of IoMT on healthcare, machine learning algorithms	Not specified	IoMT, Machine Learning	Evaluates machine learning algorithms in healthcare, provides insights into IoMT convergence challenges and opportunities
(Sujith et al., 2022)	Comprehensive Review of Smart Health Monitoring (SHM)	Smart Health Monitoring, Disease prevention	Not specified	Smart Sensors, Blockchain, Deep Learning, Machine Learning, Cloud Computing	Covers recent advancements in SHM, emphasizes integration of cloud computing for cost-effectiveness and real-time services
Pap & Oniga (2022)	Overview of Healthcare Technology Applications Post-COVID-19	Healthcare technology applications post-COVID-19	Not specified	Video Conferencing, Data Management, Machine Learning	Underscores the role of artificial intelligence in advancing eHealth, offers insights into applications of modern technologies
Narigina et al. (2022)	Key Technologies in Medical Data Analysis	Technologies in medical data analysis, big data, blockchain, cloud computing, IoT	Comparative analysis	Big Data, Blockchain, Cloud Computing, IoT, Machine Learning, AI	Aids decision-makers in selecting technologies for healthcare systems
Nancy et al. (2022)	Transformative Synergy of IoT, Cloud, and Predictive Analytics in Healthcare	Synergy of IoT, Cloud, and Predictive Analytics in healthcare	Not specified	IoT, Cloud, Predictive Analytics, AI, ML, Deep Learning	Demonstrates the potential of cutting-edge technologies in revolutionizing disease prediction and preventive care
Mukherjee et	Influence of	Low-cost	Not specified	Big Data	Explores

al. (2022)	Low-Cost Sensors in Smart City Infrastructures	sensors in smart city infrastructures, big data analytics		Analytics, 5G-driven IoT, Industrial IoT	applications, algorithms, and security considerations, provides insights into advancing sustainable smart city development
Fawzy et al. (2022)	Literature Review on IoT Systems	IoT systems, big data analytics, software engineering	Not specified	IoT, Big Data Analytics, Software Engineering	Proposes a domain-independent software architecture for big IoT data analytics, addresses scalability, timeliness, heterogeneity, inconsistency, confidentiality, and correlations
Hajjaji et al. (2021)	Applications of Big Data and IoT in Smart Environments	Big Data and IoT applications in smart environments	Systematic review	Big Data, IoT	Highlights integration of big data and IoT for real-world applications in monitoring, protecting, and enhancing natural resources
HaghiKashani et al. (2021)	Comprehensive Review of Healthcare IoT (HIoT) Systems	Review of HIoT systems	Examining 146 articles	Healthcare IoT	Systematically classifies investigations, analyzes benefits, limitations, and evaluation methods
Song et al. (2020)	Intelligent SOH Estimation Framework for In-Vehicle Lithium-Ion Batteries	SOH estimation for in-vehicle lithium-ion batteries	Leveraging big data from real-world EV operations	Big Data, Deep Learning	Introduces an intelligent SOH estimation framework, showcases practical significance
M. J. Kaur et al. (2020)	Impact of Digital Twins, IoT, Blockchain, and AI in Redefining Globalization	Impact of Digital Twins, IoT, Blockchain, and AI	Not specified	Digital Twins, IoT, Blockchain, AI	Explores Digital Twins as living models, covers architecture, applications, challenges, and research areas
Akkaş et al.	Tutorial on	Applications	Not specified	IoT, Bio-IoT,	Details a



(2020)	Applications of IoT in Healthcare	of IoT in healthcare		Nano-IoT	WBAN-based biomedical application, evaluates system performance
Rehman et al. (2019)	Intersection of IIoT and Big Data Analytics	Intersection of IIoT and Big Data Analytics	Investigating recent BDA technologies, algorithms, and techniques	IIoT, Big Data Analytics	Classifies literature, presents frameworks and case studies, identifies opportunities and challenges
Talal et al. (2019)	IoT-Based Smart Home Security for Real-Time Health Monitoring in Telemedicine	IoT-based smart home security for health monitoring	Analyzing 67 articles	IoT	Provides a multilayer taxonomy, identifies challenges, requirements, and provides recommendations
Siyal et al. (2019)	Applications of Blockchain in Healthcare	Applications of Blockchain in healthcare	Not specified	Blockchain	Highlights potential to enhance data security, diagnosis, and treatment
Pastorino et al. (2019)	Transformative Potential of Big Data in Healthcare	Transformative potential of Big Data in healthcare	Not specified	Big Data Analytics	Discusses successful initiatives in Europe, showcases how Big Data analytics enhances patient care
Liu et al. (2019)	CloudDTH: Cloud-Based Healthcare System Using Digital Twin Technology	CloudDTH: Cloud-based healthcare system	Not specified	CloudDTH, Digital Twin Technology	Introduces CloudDTH, explores enabling technologies, demonstrates feasibility
Shadroo& Rahmani (2018)	Intersection of IoT, Big Data, and Data Mining	Intersection of IoT, Big Data, and Data Mining	Analyzing 44 articles	IoT, Big Data, Data Mining	Categorized into Architecture & Platform, framework, and application
Harerimana et al. (2018)	Big Data Analytics in Healthcare	Big Data analytics in healthcare	Not specified	Big Data Analytics	Navigates through complexities, offers insights into crafting

					integrated health analytic applications
Ge et al. (2018)	Big Data Technologies in Various IoT Domains	Big Data technologies in various IoT domains	Not specified	Big Data	Proposes a conceptual framework highlighting critical Big Data technologies applicable in all reviewed IoT domains

### 3. CONCLUSION

In conclusion, this systematic review illuminates the transformative impact of IoT and Big Data convergence in healthcare, specifically in real-time patient monitoring. Delving into applications, methodologies, and advancements, our synthesis categorizes key areas such as chronic disease management and vital sign monitoring. Unveiling challenges in data ethics and privacy alongside opportunities in personalized medicine, diagnostics, and decision support, we contribute a holistic perspective. This review serves as a valuable resource for researchers, practitioners, and policymakers, offering insights that aim to inspire future research directions in the dynamic landscape of IoT and Big Data in healthcare.

### REFERENCES

- Akkaş, M. A., Sokullu, R., & Ertürk Çetin, H. (2020). Healthcare and patient monitoring using IoT. *Internet of Things*, 11, 100173. <https://doi.org/10.1016/j.iot.2020.100173>
- Fawzy, D., Moussa, S. M., & Badr, N. L. (2022). The Internet of Things and Architectures of Big Data Analytics: Challenges of Intersection at Different Domains. *IEEE Access*, 10, 4969–4992. <https://doi.org/10.1109/ACCESS.2022.3140409>
- Ge, M., Bangui, H., & Buhnova, B. (2018). Big Data for Internet of Things: A Survey. *Future Generation Computer Systems*, 87, 601–614. <https://doi.org/10.1016/j.future.2018.04.053>
- Haghi Kashani, M., Madanipour, M., Nikravan, M., Asghari, P., & Mahdipour, E. (2021). A systematic review of IoT in healthcare: Applications, techniques, and trends. *Journal of Network and Computer Applications*, 192, 103164. <https://doi.org/10.1016/j.jnca.2021.103164>
- Hajjaji, Y., Boulila, W., Farah, I. R., Romdhani, I., & Hussain, A. (2021). Big data and IoT-based applications in smart environments: A systematic review. *Computer Science Review*, 39, 100318. <https://doi.org/10.1016/j.cosrev.2020.100318>
- Harerimana, G., Jang, B., Kim, J. W., & Park, H. K. (2018). Health Big Data Analytics: A Technology Survey. *IEEE Access*, 6, 65661–65678. <https://doi.org/10.1109/ACCESS.2018.2878254>
- Kaur, M. J., Mishra, V. P., & Maheshwari, P. (2020). The Convergence of Digital Twin, IoT, and Machine Learning: Transforming Data into Action. In M. Farsi, A. Daneshkhah, A. Hosseinian-Far, & H. Jahankhani (Eds.), *Digital Twin Technologies and Smart Cities* (pp. 3–17). Springer International Publishing. [https://doi.org/10.1007/978-3-030-18732-3\\_1](https://doi.org/10.1007/978-3-030-18732-3_1)
- Kaur, P. (2023). Chapter 3—Internet of things (IoT) and big data analytics (BDA) in healthcare. In M. D. Lytras, A. A. Housawi, & B. S. Alsaywid (Eds.), *Digital Transformation in Healthcare in Post-Covid-19 Times* (pp. 45–57). Academic Press. <https://doi.org/10.1016/B978-0-323-98353-2.00015-0>
- Kumar, M., Kumar, A., Verma, S., Bhattacharya, P., Ghimire, D., Kim, S., & Hosen, A. S. M. S. (2023). Healthcare Internet of Things (H-IoT): Current Trends, Future Prospects, Applications, Challenges, and Security Issues. *Electronics*, 12(9), Article 9. <https://doi.org/10.3390/electronics12092050>
- Liu, Y., Zhang, L., Yang, Y., Zhou, L., Ren, L., Wang, F., Liu, R., Pang, Z., & Deen, M. J. (2019). A Novel Cloud-Based Framework for the Elderly Healthcare Services Using Digital Twin. *IEEE Access*, 7, 49088–49101. <https://doi.org/10.1109/ACCESS.2019.2909828>

- Mukherjee, S., Gupta, S., Rawley, O., & Jain, S. (2022). Leveraging big data analytics in 5G-enabled IoT and industrial IoT for the development of sustainable smart cities. *Transactions on Emerging Telecommunications Technologies*, 33(12), e4618. <https://doi.org/10.1002/ett.4618>
- Nancy, A. A., Ravindran, D., Raj Vincent, P. M. D., Srinivasan, K., & Gutierrez Reina, D. (2022). IoT-Cloud-Based Smart Healthcare Monitoring System for Heart Disease Prediction via Deep Learning. *Electronics*, 11(15), Article 15. <https://doi.org/10.3390/electronics11152292>
- Narigina, M., Osadcij, E., & Romanovs, A. (2022). Analysis of Medical Data Processing Technologies. 2022 63rd International Scientific Conference on Information Technology and Management Science of Riga Technical University (ITMS), 1–6. <https://doi.org/10.1109/ITMS56974.2022.9937120>
- Pap, I. A., & Oniga, S. (2022). A Review of Converging Technologies in eHealth Pertaining to Artificial Intelligence. *International Journal of Environmental Research and Public Health*, 19(18), Article 18. <https://doi.org/10.3390/ijerph191811413>
- Pastorino, R., De Vito, C., Migliara, G., Glocker, K., Binenbaum, I., Ricciardi, W., & Boccia, S. (2019). Benefits and challenges of Big Data in healthcare: An overview of the European initiatives. *European Journal of Public Health*, 29(Supplement\_3), 23–27. <https://doi.org/10.1093/eurpub/ckz168>
- Ranjan, A., Kale, A. A., Kumar, R., & Raj, S. (2023). Review of Big Data, Internet of Things (IoT) and Real-time Analytics in Healthcare (SSRN Scholarly Paper 4426079). <https://doi.org/10.2139/ssrn.4426079>
- Rejeb, A., Rejeb, K., Treiblmaier, H., Appolloni, A., Alghamdi, S., Alhasawi, Y., & Iranmanesh, M. (2023). The Internet of Things (IoT) in healthcare: Taking stock and moving forward. *Internet of Things*, 22, 100721. <https://doi.org/10.1016/j.iot.2023.100721>
- Shadroo, S., & Rahmani, A. M. (2018). Systematic survey of big data and data mining in internet of things. *Computer Networks*, 139, 19–47. <https://doi.org/10.1016/j.comnet.2018.04.001>
- Siyal, A. A., Junejo, A. Z., Zawish, M., Ahmed, K., Khalil, A., & Soursou, G. (2019). Applications of Blockchain Technology in Medicine and Healthcare: Challenges and Future Perspectives. *Cryptography*, 3(1), Article 1. <https://doi.org/10.3390/cryptography3010003>
- Song, L., Zhang, K., Liang, T., Han, X., & Zhang, Y. (2020). Intelligent state of health estimation for lithium-ion battery pack based on big data analysis. *Journal of Energy Storage*, 32, 101836. <https://doi.org/10.1016/j.est.2020.101836>
- Sujith, A. V. L. N., Sajja, G. S., Mahalakshmi, V., Nuhmani, S., & Prasanalakshmi, B. (2022). Systematic review of smart health monitoring using deep learning and Artificial intelligence. *Neuroscience Informatics*, 2(3), 100028. <https://doi.org/10.1016/j.neuri.2021.100028>
- Talal, M., Zaidan, A. A., Zaidan, B. B., Albahri, A. S., Alamoodi, A. H., Albahri, O. S., Alsalem, M. A., Lim, C. K., Tan, K. L., Shir, W. L., & Mohammed, K. I. (2019). Smart Home-based IoT for Real-time and Secure Remote Health Monitoring of Triage and Priority System using Body Sensors: Multi-driven Systematic Review. *Journal of Medical Systems*, 43(3), 42. <https://doi.org/10.1007/s10916-019-1158-z>
- ur Rehman, M. H., Yaqoob, I., Salah, K., Imran, M., Jayaraman, P. P., & Perera, C. (2019). The role of big data analytics in industrial Internet of Things. *Future Generation Computer Systems*, 99, 247–259. <https://doi.org/10.1016/j.future.2019.04.020>
- Wagan, S. A., Koo, J., Siddiqui, I. F., Attique, M., Shin, D. R., & Qureshi, N. M. F. (2022). Internet of medical things and trending converged technologies: A comprehensive review on real-time applications. *Journal of King Saud University - Computer and Information Sciences*, 34(10, Part B), 9228–9251. <https://doi.org/10.1016/j.jksuci.2022.09.005>
- Yeruva, A. R., L Vijaya Durga, C. S., B, G., Pant, K., Chaturvedi, P., & Srivastava, A. P. (2022). A Smart Healthcare Monitoring System Based on Fog Computing Architecture. 2022 2nd International Conference on Technological Advancements in Computational Sciences (ICTACS), 904–909. <https://doi.org/10.1109/ICTACS56270.2022.9987881>

## NAVIGATING CRYPTOCURRENCY VOLATILITY: A DEEP LEARNING APPROACH FOR ACCURATE BITCOIN CLOSING PRICE PREDICTION

**VIVEK TIWARI**

Govt. E. Raghavendra Rao PG Science College, Bilaspur (C.G.), India

([profvivektiwari@gmail.com](mailto:profvivektiwari@gmail.com))

**KAUSHAL BANJARE**

Govt. J.P. Verma Arts & Science College, Bilaspur (C.G.), India

([kaushalbanjare@gmail.com](mailto:kaushalbanjare@gmail.com))

In order to forecast closing prices in the erratic cryptocurrency market, this study investigates the use of deep learning techniques, particularly recurrent neural networks (RNNs) and long short-term memory (LSTM) networks. A large dataset comprising past prices, trade volumes, and several technical indicators is used to train the model. By identifying complex patterns, the deep learning model adjusts to the ever-changing bitcoin market. Gradient descent and backpropagation are used in the training process to optimize the model's parameters. Accuracy is measured using evaluation metrics like mean absolute error (MAE) and root mean square error (RMSE). The study investigates the effects of various hyperparameters and input variables on prediction performance, and the results show that the model performs better than conventional forecasting techniques. The study advances our knowledge of how to use deep learning to forecast cryptocurrency prices, giving market players an important tool to improve their decision-making. The study highlights that deep learning models' resilience and adaptability are crucial for negotiating this changing financial environment as the bitcoin market develops.

**Keywords:** Cryptocurrency, Bitcoin, Recurrent Neural Network, Deep Learning

# A STUDY ON THE IMPACT OF DIGITAL PAYMENT SYSTEM ON RETAIL BUSINESS OUTLETS OF BILASPUR CITY OF CHHATTISGARH

**Sri Ram**

Dr C V Raman University, India

**Dr. Priyank Mishra**

Dr C V Raman University, India

Present era of retail business witnessed a phenomenal growth in digital transactions leads to technological revolution and one-touch payment solutions. The adoption of new technologies transformed the conventional banking system in India and significantly contributing towards less-cash economy. In this regard of being less-cash economy and advancement of innovative technologies, India is also marching towards digital economy with an aim to become digitally empowered society. After demonetization of high currency notes in 2016 cash and cashless have become the buzzwords in the retail payment system. Digital payments are transactions that take place through digital or online modes, without the involvement of physical exchange of money. The present paper focuses on the impact of digital payment system on retail business outlets of Bilaspur city of Chhattisgarh. For the study, the data has been collected from small retail business outlets. The main purpose of this study is to determine the benefits and problems faced by retail business outlets from digital payment system. This study intends to determine the factor influencing the overall adoption of digital payment by the retail business outlets in Bilaspur city.

**Keywords:** Digital transactions, Demonetization, Digital Payments, Retail Outlets.

## 1. INTRODUCTION

There has been a dramatic and revolutionary shift in the retail industry as a result of digital payment technologies. The term "digital payment systems" describes a network of interconnected financial institutions that facilitate monetary transactions via electronic means. Some of the ways that online payment methods have changed the retail industry for the better are as follows: **Maximised Effectiveness:** The time it takes to execute a sale is reduced because to digital payment technologies, which speed the transaction process. Shorter lines and happier customers are the direct result of this efficiency boost, which is especially important during peak hours. **Customer Convenience:** Customers like the ease and security of digital payments. They may avoid carrying about actual currency by making purchases using their cellphones, tablets, or computers. More client loyalty and repeat purchases are common results of this ease.

**Lower Expenses for Cash Management:** Retailers must cover expenses related to cash handling, such as safe transit, counting, and banking fees. To lessen these expenses and the dangers of handling currency, digital payment solutions should be used. **Stronger Protection:** Encryption, two-factor authentication, and fraud detection are some of the sophisticated security measures often included with digital payment systems. As a result, there is less opportunity for fraud and theft, which makes shopping online safer for everyone. **Potential for a Bigger Audience:** Businesses can reach more customers, including those who would rather pay with a credit card or debit than with cash, thanks to digital payment options. Businesses may expand their reach to new populations and markets by being inclusive.

Analytics and Insights from Data: Retailers can make good use of the data generated by digital payment systems for analytics and BI. Retailers may improve their inventory management, marketing, and product offers by gaining a deeper knowledge of consumer buying habits. Linking Up with Reward Programmes: To encourage consumers to use electronic payment methods, retailers might give discounts, prizes, or cash back incentives by integrating digital payment systems with loyalty programmes. This fosters a sense of loyalty and motivates customers to come back. Responding to Shifts in the Market: Stores need to change with the times if they want to be competitive in an industry where technology is always developing. Adopting digital payment solutions shows that you're dedicated to staying ahead of the curve and satisfying customers who are tech-savvy.

One Way to Stand Out: Businesses that accept a wide range of digital payments have a leg up on the competition when it comes to customer loyalty. A store can stay competitive in the market by being able to adjust to changing customer preferences. Prevention of Pandemics: The significance of contactless transactions was brought to light by the COVID-19 outbreak. During lockdowns and social distancing measures, the demand for contactless and internet purchases soared, making retailers with strong digital payment systems more equipped to handle the surge.

Overall, retail establishments have benefited from digital payment systems' adoption, which has increased operational effectiveness, enhanced customer experience, and shortened checkout times. New possibilities and threats will emerge in the ever-changing world of digital payments for merchants as technology progresses.

With demonetization in 2016, the Indian government began aggressively promoting and encouraging online installments. Indians were pressured to switch to online payments by "Digital India," the governing body of many financial and economic decisions. The world has been increasingly relying on computers for a considerable amount of time now. However, the imperative need of swiftly adapting to cutting-edge technology became apparent in 2020. Especially for sophisticated installations in India, this change occurred instantly as the lockdown went into place. A better understanding of whether small-scale retailers have the necessary infrastructure to conduct digital transactions (e.g., bank accounts and smartphones), whether digital platform fees are reasonable, and whether they have the necessary level of digital literacy to use digital payment systems is gained from this study on the adoption of digital payment technologies in small-scale retail.

Demographic independent factors include things like yearly income, number of years in business, and length of use, whereas dependent variables include things like: Results were based on the following criteria: behavioural control, behavioural intents, perceived utility, risk, subjective norms, and self-efficacy. The most typical method is an experimental questionnaire that asks about merchants' adoption decisions and/or hypothetical situations. The strategy relied on merchants answering a series of questions designed to elicit data on the system's usability, risk, subjective norms, and self-efficacy.

## 2. REVIEW OF LITERATURE

In 2006, Rajesh Krishna Balan, Giri Kumar Tayi, and Narayan Ramasubhu After outlining the difficulties and prerequisites for a global digital wallet solution in Singapore, the authors go on to tackle one of the most pressing issues, the widespread adoption of digital wallets for end-to-end financial transactions, in great depth.



According to research by Abhay Upadhyaya (2012) on the topic of "Electronic Commerce and E-Wallet," the main problems with online shopping revolve on faulty calculations involving payments. In order to understand online shopping, e-wallets evolved into more convenient, user-friendly, and homely worldwide payment systems. A "personal banking system" that accepts a variety of deposits is significantly more adaptable.

According to Nitsure (2014), developing countries like India are struggling to accept e-banking services due to a lack of widespread access to the internet. Security problems, regulations, guidelines, and executives were some of the topics covered in the study. Since the impoverished in India cannot access the internet and, by extension, the financial system, there is a serious threat of a digital divide emerging.

This article by Sornaganesh. V and Chelladurai. M. (2016) described the situation during demonetization in 2016. The effects of demonetization on Indian financial technology companies have been the subject of the researcher's investigation. Moreover, the study examines the payment service industry during the demonetization era. From a technological standpoint, the most significant shift in the mobile internet sector is the digital payment system.

This research assessed the level of knowledge among small merchants on cashless transactions and the methods used for them (Subho Chattopadhyay, Payal Gulati, and Indranil Bose, 2018). It also seeks to comprehend their perceived ease and challenges with it. The relative ease of cash and cashless payment methods was not significantly different. Plus, shop owners insist that dealing with cash is much simpler than with electronic payment systems. Rather than focusing on raising knowledge, efforts should be made to change conduct and attitude towards cashless.

This research by M. Thangajesu Sathish, R. Sermakani, and G. Sudha (2020) shows that digital payment systems and cards cannot fully replace conventional cash transactions. People may utilise their mobile wallets for a variety of financial transactions, including digital cash transfers, food shopping, bill payments, and more. Trust, according to the report, is the most important component influencing user pleasure and, by extension, the inclination of many people to embrace mobile wallets.

### **3. OBJECTIVE OF THE STUDY**

The study's overarching goals are to(1) determine what variables, if any, influence retailers' decisions to accept digital payments;(2) determine the extent to which retailers find cashless transactions easy and convenient;(3) identify retailers' concerns about making the transition to cashless transactions; and(4) analyse the impact of demographic variables on digital payment adoption. Bilaspur, Chattisgarh was the site of the survey. There are a total of 150 small merchants in Chennai that participated in the survey. No more than three months may elapse. A small number of dependent variables were used in this research, including perceived utility, perceived ease of use, risk, subjective norms, self-efficacy, enabling condition, behavioural intentions, and behavioural control.

### **RESEARCHHYPOTHESIS**

**H01:** There is no the association between preferred mobile wallet and term of use.

**H02:** The number of years in operation does not correlate with the motivation for using

digital payment methods in a statistically meaningful way.

**4. RESEARCH METHODOLOGY**

This study is descriptive in nature and draws its participants from a census of small businesses in Bilaspur, Chhattisgarh, India, stratified by age, gender, yearly income, and a handful of other dependent variables. A total of one hundred fifty merchants will serve as the study's sample. This study makes use of the Convenient Sample Technique as its sample approach. The data came from a survey that 150 people filled out, which is the main source of information. Literature reviews on topics such as digital payment adoption, websites, etc., provided the secondary data.

**HYPOTHESIS TESTING AND DATA ANALYSIS**

**H01: There is no the association between preferred mobile wallet and term of use.**

**Tableno1: chi-square between preferred mobile wallet and term of use**

Chi-Square Tests			
	Value	df	Sig.(2-sided)
PearsonChi-Square	23.109 <sup>a</sup>	12	.031
LikelihoodRatio	24.924	12	.009
Linear-by-LinearAssociation	4.214	1	.040
NofValidCases	150		

**Result:**

When looking for a correlation between preferred mobile wallet and duration of use, the chi-square test was used. Table data shows a significance level of 0.028 ( $p = 0.02$ ), lower than the accepted threshold of 0.05. Therefore, we accept the alternative hypothesis and reject the null hypothesis. (**H1**). Therefore, there is no the association between preferred mobile wallet and term of use.

**H02: The number of years in operation does not correlate with the motivation for using digital payment methods in a statistically meaningful way.**

**Tableno2: ANOVA between number of years in operation and the motivation for using digital payment methods**

ANOVA					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	10.214	3	4.139	3.142	.049
Within Groups	207.214	146	1.324		
Total	219.543	149			

Years in Business and Reasons for Adoption were compared using ANOVA. Since the ANOVA's P value of 0.049 is more than 0.05, we may accept H0 as the null hypothesis. Years in Business and Reasons for Adoption do not show any meaningful relationship.

## 5. CONCLUSION

Research on the effects of modern digital payment methods on brick-and-mortar retailers has focused on smaller establishments. Customers like the ease and convenience of digital payment methods, and businesses benefit from them as well. Based on our research, we know that the length of time a company has been in operation and the frequency with which customers make digital payments are major factors in customer choice. The relationship between enabling condition and behavioural intention is strong. So, digital payment is becoming more popular in retail outlets due to consumer demand and convenience, but shopkeepers in Bilaspur aren't worried about customers' safety or the possibility of fraud over the internet. Becoming a fully cashless economy seems to need sufficient time. It calls for everyone's help, as well as more education and understanding among merchants and regular people. Before there can be more digital transactions, the issue of low levels of education and computer literacy must be addressed. The government and private companies are both making great strides with their e-wallet applications like Paytm and PhonePe. To achieve a fully cashless economy and offer long-term economic growth for the nation, the government must take the lead in addressing and solving these problems.

## REFERENCES

- Abhay upadhyaya(2012),"Electronic Commerce and E-Wallet,"International Journal of Recent Research and Review, Vol.I, March 2012, pp.37-41.
- Balan,R.K.,Ramasubbu,N.,Tayi,G.K.n.d.).Digital wallet: Requirements and challenges. Singapore Management University and SUNY at Albany,1-6.
- Chelladurai.M,Sornaganesh.AVISSN:2347-1697 International Journal of Informative & Futuristic Research(IJIFR), Volume-4, Issue-3,November 2016, Continuous 39th Edition, PageNo:5654-5662
- Nitsure,R.R.,E-Banking:ChallengesandOpportunities.EconomicandPoliticalWeekly,2014.
- Subho Chattopadhyay, Awareness and Participation of Small Retail Businesses in Cashless Transactions: An Empirical Study, Journal: Management Dynamics in the Knowledge Economy, Issue Year:6/2018.
- Thangajesu Sathish .M, Sermakani.R, Sudha.G, A Study on the Customer's Attitude toward the E-Wallet Payment System, International Journal of Innovative Research in Technology, May2020, IJIRT, Volume 6, Issue 12, ISSN:2349-6002.

## ASSESSMENT OF TRACE METAL CONCENTRATION IN COAL MINE AREA OF GEVRA, DIST.- KORBA(C.G.)

**Sanjiv Kumar Rathore**

Govt. E. Raghvendra Rao Science P. G. College, Bilaspur, Chhattisgarh, India  
(skrathore261@gmail.com)

**Dr. Kiran Thakur**

Govt. Bilasa Girls PG College, Bilaspur, Chhattisgarh, India

Coal is the basic raw material for generation of electricity. Coal mining plays an important role in our Indian economy and on the other hand coal mining has negative effect on our environment. Due to coal mining various contaminants are added to water through waste discharge resulting in the gradual degradation of water quality. This indicates the degree of risk to human health so there is a need for a continuous monitoring of trace metal concentration in the water, the trace metal are one type of toxic metal and are released from coal mines. Present paper is made to understand the effect of trace metal concentration on water in coal mining area.

**Keywords:-** Coal, environment, water discharge, trace metal, contaminants.

### 1. INTRODUCTION

Environmental pollution due to industrialization has now become a serious international problem. Coal mining is such an industry. Coal is essential and a very important natural resource for energy production. On a worldwide basis, coal is substantially more abundant than oil or gas. Coal is the major fuel used worldwide for generating electricity. It generates about 36% of the world electricity and provides around 27% of global primary energy need (Tiwary 2001). In India, coal provides 67% of the total energy consumption of the country. However, the mining wastes generated from active and inactive coal mining sites and from beneficiation activities, their impact on human health and the environment are a continuous problem for the governments, the private industry and the general public (Thomas 1994). Major pollutants from coal mining industry The wastewater discharged from underground and open cast mines generally contain high level of TDS, TSS, Fe, Mn, heavy metals, hardness, Sulphate, Nitrate, Oil and grease. Mine water often consists of high levels of TSS in the range of 200 to 860 mg L<sup>-1</sup> (Tiwary 2001). The origin of the heavy metals is the coal itself. Pb concentration of the mining area may increase from transportation. Oil and grease are the workshop effluents released during washing of the machineries. Oil can form a thin film on the water surface and may interfere with the re-oxygenation of water, can coat the gills of fish and feathers of birds and is dangerous for aquatic ecosystem.

### 2. STUDY AREA

The study area selected for the present study is in the vicinity of open cast coal mines Gevra in Korba district, Chhattisgarh. State has 16% of coal deposits in India. The 44483 million tonnes coal have been estimated in, 12 coalfields of the state located in Raigarh, Surguja, Korba and Korba districts in this state. Korba coalfield is located in the north eastern part of the Chhattisgarh and has maximum coalfields. Presently there are eight underground mines and five opencast mines. Korba Coal Field is extended from 2215' and 2230' North latitudes

to 8215' and 8255' east longitudes over an area of 520 Sq.km. Gevra Opencast Block is located in the south central part of Korba. It is biggest open cast coal mine in India.

### 3. MATERIALS AND METHODS

**Collection of water samples for heavy metal analysis:** - The sampling bottles were pre-conditioned with 5% nitric acid and later it was rinsed thoroughly with distilled de-ionized water. At each sampling site, the sampling bottles (polyethylene) were rinsed at least twice or three before sampling was done. Pre-cleaned and labeled sampling bottles were immersed about 10 cm below the water surface. About 0.5 L of the water samples were taken from each sampling site. Collected samples were acidified with 10% HNO<sub>3</sub>, kept in an ice-cold box and immediately transported to the laboratory. The samples were filtered through a 0.45 mm micro pore membrane filter and kept at 4 °C until analysis. The samples were analyzed directly by using ICP. All chemicals which were used for the preparations of reagents for present analysis were AR grade and double distilled water was used for preparation of solutions. The laboratory apparatus and glass wares were soaked in nitric acid before analysis and then rinsed thoroughly with tap water and deionized distilled water to ensure any traces of cleaning reagents were removed.

**Statistical analysis** - All the data were analyzed statistically by calculating Mean and Standard Deviation with 0.05% significant level.

### 4. RESULT AND DISCUSSION

**Heavy metal accumulation in water** - The concentrations of heavy metals in water samples is summarized. At site-1 the highest average metal content found in the water was of Zinc (0.998) and followed by Lead (0.236) mg/l, and cadmium 0.008 mg/l due to its close vicinity of open cast coal mines. Site-2 is also nearby coal mine area so that all the metal concentration also found high.

Lead was found maximum (0.236 mg/l) at site-1, which is very close to the coal mine area. The lead accumulates in the surface ground layer and its concentration is decreases with water depth. At site- 5, concentration of lead is also higher (0.166 mg/l) due to heavily polluted site by heavy vehicles which transport coal from mine area.(Ogbonna, et al., 2012) reported the same trend while studying the heavy metal contamination at Onyeama coal mines site. They found that highest concentration of lead was within 1 m region of from the coal mines and the concentration was decreasing with distance. (Matthews, et al., 2012; Freitas, et al., 2004) also have found the lead contamination is higher in coal mines. It is reported that water contaminated with lead cause decrease in the crop and tree productivity (Johnson and Eaton, 1980).

Zinc concentration in the study area was varies from 0.998 to 0.214 mg/l. High concentration of zinc was detected at the site-1 and 2 i.e., (0.998 and 0.807 mg/l) respectively. The source of the zinc can be related to presence of the coal mines and vehicular pollution. It was found that around thermal power plants zinc concentration was minimum (0.214 mg/l).(Rind, et al., 2013) conducted a study on Jamshoro thermal power plant and found that the zinc concentration were slightly high near thermal power plant. (Zhou, et al., 2007) reported the presence of high level of heavy metal concentration including zinc at mining area. Most of Zn is added in the water during industrial activities, such as mining, coal, and waste combustion and steel processing. High level of Zn in water inhibits plant metabolic functions which result

in retarded growth and cause of senescence. Zinc toxicity in plants limit the growth of both root and shoot (Malik, et al., 2011).

Cadmium is an important parameter in an aquatic monitoring due to its toxicity to fishes at higher concentration and carcinogenic effects in human beings. Content of Cadmium is 0.008 mg/l. The observed cadmium content was found to be above the drinking water limits of 0.005 mg/l as prescribed by USEPA (2011) and WHO (2008). mining activities generate a large amount of waste rocks and tailings, resulting in deposition of heavy metals at surface water.

## 5. CONCLUSION

Open cast coal mine activity effects the environment in various ways. Heavy metal contamination is one of the important aspects which influence the growth of seedling of trees. Tree species were contaminated with heavy metal and these metals reduced the germination percentage, chlorophyll content and influences of many physiological changes (Khan, 2013; Pant, et al., 2011). The water constitutes an essential environmental, ecological and agricultural resource that needs to be protected from further degradation for healthy environment. In Korba district water is very polluted due to open cast mining in Gevra area.

## REFERENCES

- Abdel-Satar, A.M. Ali, M.H. Gober M.E. Indices of water quality and metal pollution of Nile River, Egypt. *Egypt J. Aquat Res*, 43 (1) (2017), pp. 21-29
- Acharya, G.D., Hathi, M.V., Patel, AD & Parmar, K.C. 2008. Chemical properties of groundwater in Bailoda Taluka region, north Gujarat, India, viewed 23 June, 2010, <<http://www.ejournals.in/PDF/V5N4/792-796.pdf>>.
- Brama, M. Gnessi, L. Basciani, S., Cerulli, N. Politi, L, Spera. 2007. Cadmium induces mitogenic signaling in breast cancer cell by an ER a dependent mechanism *Mol. Cell. Endocrinol.* 264, 102-108.
- Mercy.M, Sr. Mary Fabiola., 2021 IJCRT Seasonal variation of heavy metal concentration in water sample from different fresh water bodies in and around coimbatore district.
- Priyanka garg and singh S.S 2017 Heavy metal accumulation pattern in soil and seedlings and in leaves of mature tree species at Gevra coal mine area in Chhattisgarh , India.
- Couto, Cristina & Ribeiro, Cláudia & Maia, Alexandra & Santos, M. & Tiritan, Maria & Ribeiro, Ana Rita Lado & Pinto, Edgar & Almeida, Agostinho. (2018). Assessment of Douro and Ave River (Portugal) lower basin water quality focusing on physicochemical and trace element spatiotemporal changes. *Journal of Environmental Science and Health, Part A*. 53.1-11. 10.1080/10934529.2018.1474577.
- Das , Nilanjana & R, Vimala. (2008). Biosorption of Heavy Metals - an Overview. *Indian Journal of Biotechnology*. 7. 159-169.
- Dong, J., Bian, Z., & Wang, H. (2007). Comparison of heavy metal contents between different reclaimed waters and the control water. *Journal of China University of Mining and Technology*, 36(4), 531-536.
- kabita patowary department of chemistry gauhati university, guwahati, assam (india) june 2009, effects of mining on the quality of soil and water in the coal mining areas of assam.



- Fatima M, Usmani N (2013) Histopathology and bioaccumulation of heavy metals (Cr, Ni and Pb) in fish (*Channa striates* and *Heteropneustesfossilis*) tissue: A study for toxicity and ecological impacts. *Pakistan J BiolSci* 16:412-420.
- Hanaa, M., Eweida, A &Farag, A. 2000. Heavy metals in drinking water and their environmental impact on human health. *International Conference on Environmental Hazards Mitigation*, Cairo University, Egypt, pp. 542-556.
- Kazi TG, Arain MB, Jamali MK, Jalbani N, Afridi HI, Sarfraz RA, Baig JA, Shah AQ (2009) Assessment of water quality of polluted lake using multivariate statistical technique: a case study. *Ecotoxicol Environ Safety* 72:301-309.
- Mohamed Bahnasawy, Abdel-Aziz Khidr, Nadia Dheina, (2011) Assessment of heavy metal concentrations in water, plankton, and fish of Lake Manzala, Egypt. *Turk J Zool*, 35(2): 271-280.
- Munoz-Olivas, R., &Camara, C. (2001). Speciation related to human health. In L. Ebdon, L. Pitts, R. Cornelis, H. Crews, O. F. X. Donard, & P. Quevauviller (Eds.), *Trace element speciation for environment, food and health* (pp. 331-353). Cambridge: The Royal Society of Chemistry.

# **An Application on Machine Learning and Deep Learning Techniques for Handwritten Character Recognition**

**Balram Yadav**

Dr. C.V. Raman University, Kota, Bilaspur, Chhattisgarh, India

**Jyoti Bala Gupta**

Dr. C.V. Raman University, Kota, Bilaspur, Chhattisgarh, India

**Ayush Kumar Agrawal**

Dr. C.V. Raman University, Kota, Bilaspur, Chhattisgarh, India

Email: ayushagrwal369@gmail.com

Traditional artificial neural network techniques are most powerful technique in the field of pattern recognition, but in the case of high dimensionality, they are ineffective and not efficient. Instead of Traditional ANN, the deep neural networks are frequently employed in these situations for complex pattern recognition with different-different data's like handwritten character, handwritten digit, face recognition etc. Handwritten character dataset that contains large number of features is required to accurately identify. A large number of features in the handwritten character dataset can be accurately identified with machine learning and deep learning approaches. Handwritten character recognition is helpful in many different contexts, such as answer sheets and documents verification, among many others. In this study, we examined a number of handwritten character dataset recognition methods by reviewing diverse datasets of handwritten digits and characters, we have also assessed the accuracy rate and recognition performance of various machine learning techniques, such as artificial neural networks, deep neural networks, optimization strategies, feature selection, and feature extraction methods. The results identified that machine learning models, deep neural network models and some of hybrid models provide better recognition results in context of recognition accuracy.

Keywords---Machine Learning Models, Deep Learning Models, Handwritten Character Datasets.

## **1. INTRODUCTION**

Pattern recognition is one of the broadest areas contains different formats, such as audio files, video files, pictures, handwritten characters, handwritten numbers, etc., are used to define patterns. Our focus in this work is on the subject of handwritten character recognition research. Handwritten characters are employed in many aspects of daily life, such as answering sheets, bank checks, passport verification, invoice checking, and many more. Numerous research methods have been developed for handwritten character recognition, and they have been used by numerous researchers. Researcher techniques have been applied in the last few years, including: blocky artifact augmentation technique; fully connected multi layer neural network; minimal deep neural network; two pass approach; two stage classification method; low resolution; ensemble classifier; discriminative and generation methods; dynamic Bayesian network; recurrent neural network; hybrid deep neural network techniques; blocky vector techniques; feature selection and extraction techniques; genetic algorithm techniques; adaptation methods; and evolutionary approaches.

Handwritten character recognition (HCR) is a critical area in the fields of computer vision and pattern recognition, with applications ranging from automated data entry to historical document digitization. The variability in individual handwriting styles presents a significant challenge for accurate recognition. Traditional methods, which rely heavily on handcrafted

features and rule-based systems, often fall short in handling the diverse and complex nature of handwritten text. The advent of machine learning (ML) and deep learning (DL) has revolutionized HCR, enabling the development of models that learn to recognize characters directly from raw data. Machine learning algorithms, such as Support Vector Machines (SVM) and Random Forests, have shown considerable improvement in recognizing handwritten characters by learning from labeled examples. we have also assessed the accuracy rate and recognition performance of various machine learning techniques, such as artificial neural networks, deep neural networks, optimization strategies, feature selection, and feature extraction methods. The results identified that machine learning models, deep neural network models and some of hybrid models provide better recognition results in context of recognition accuracy.

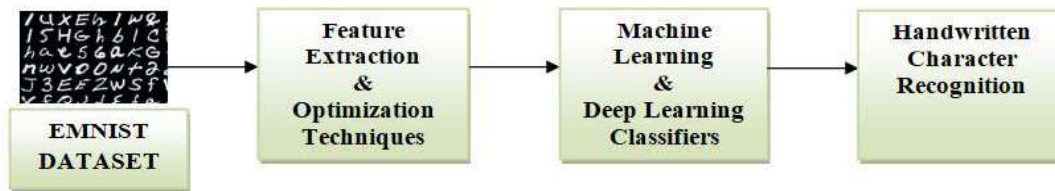


Figure 1:- Standard Workflow Diagram EMNIST handwritten character recognition process

We propose a workflow for handwritten character recognition as illustrated in this Figure 1. The process begins with the EMNIST dataset. Subsequently, features are extracted and optimized, after which these refined features are input into deep neural networks and machine learning models. The final step involves verifying the character recognition across various configurations. The system comprises several key components: character recognition, feature extraction, feature selection, classification, and verification. Each component serves a distinct purpose, detailed as follows:-

**Dataset Collection** - The EMNIST database of handwritten digits, available on the website of NIST. it has total number of 8,14,255 examples which is divided into many categories where 1,45,600 samples used for handwritten characters recognition and 2,80,000 samples used for handwritten digits recognition.

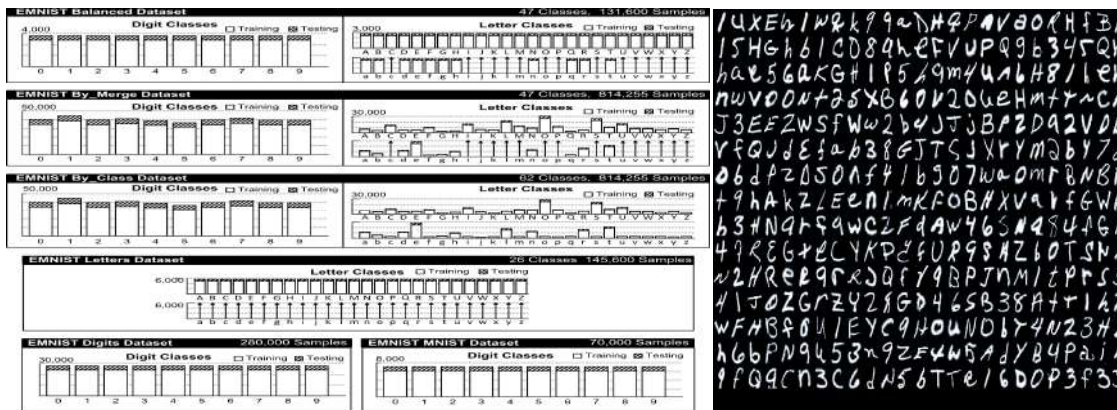


Figure 2 :- A sample EMNIST datasets and their categories

**Feature extraction and optimization** are fundamental processes in the field of machine learning and pattern recognition. These processes involve identifying, selecting, and refining the most relevant attributes from raw data to improve the performance and efficiency of predictive models. Feature extraction aims to transform raw data into informative and non-redundant features, facilitating the learning algorithms' ability to discern patterns and make accurate predictions. Techniques such as Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA), and various signal processing methods are commonly employed to extract meaningful features from datasets. Optimization, on the other hand, focuses on enhancing the model's performance by fine-tuning its parameters and selecting the optimal set of features. Optimization techniques such as Gradient Descent, Genetic Algorithms, and Particle Swarm Optimization play a crucial role in achieving this goal. By minimizing the objective function and reducing overfitting, these methods ensure that the model generalizes well to new, unseen data. Together, feature extraction and optimization form a critical workflow in the development of robust and efficient machine learning models. They not only improve the accuracy and interpretability of the models but also reduce computational complexity and enhance the scalability of the system. As the volume and complexity of data continue to grow, the importance of effective feature extraction and optimization strategies becomes increasingly evident, driving advancements in various domains including computer vision, natural language processing, and bioinformatics.

**Machine learning (ML) and deep learning (DL)** are transformative technologies in the field of artificial intelligence (AI), driving advancements across various industries. ML, a subset of AI, focuses on developing algorithms that enable computers to learn from and make decisions based on data. This involves training models using statistical techniques to identify patterns and make predictions without explicit programming for every task. Techniques such as decision trees, support vector machines (SVM), and k-nearest neighbors (k-NN) have been foundational in the evolution of ML, offering solutions to diverse problems from spam detection to image recognition. Deep learning, a further specialization within ML, leverages artificial neural networks with multiple layers (hence "deep") to model complex patterns and relationships in data. Inspired by the human brain's structure, DL models, particularly convolutional neural networks (CNNs) and recurrent neural networks (RNNs), have demonstrated remarkable capabilities in processing vast amounts of unstructured data, such as images, audio, and text. These models have revolutionized fields such as natural language processing, computer vision, and autonomous systems, achieving unprecedented accuracy and efficiency. The convergence of ML and DL has led to significant breakthroughs, enabling systems to perform tasks that were once considered the exclusive domain of human intelligence. As these technologies continue to evolve, they promise to unlock new possibilities, driving innovation and enhancing our understanding of complex phenomena. This introduction sets the stage for a deeper exploration of the principles, methodologies, and applications of ML and DL, underscoring their pivotal role in the ongoing AI revolution.

## 2. REVIEW OF LITERATURE

In this paper, We have reviewed many number of research papers which are downloaded from various reputed journals, websites and others. the process of reviewed research techniques and their experimental results are as follows: -

In order to achieve the highest recognition rate, Saabni Raid et. al. (2016) proposed a fully connected multilayer neural network that is trained using both deep and backpropagation neural networks. The sparse coder-decoder is also used in this instance to provide training to

the network. The network is then applied to databases and the CVL and ORAND-CAR datasets yielded excellent results.

Author Wang Zi-Rui et. al. (2016) developed a novel writer adaption DNN-HMM model, which was applied with the ICDAR-2013 Competition Database and virtually reached a 5% error rate.

In order to identify text from multimedia documents, author Yadav Usha et. al. (2017) developed a novel method called diagonal-based feature extraction in the convolutional neural network's (CNN) final layer. This method was used on the ICDAR-2003 dataset, which includes samples of images and video, and it produced high accuracy with a short training time.

In order to train convolutional neural networks (CNNs), authors Trivedi Adarsh et. al. (2018) hybridize the deep neural network model with genetic algorithms (GA). Additionally, the author contrasted non-GA-based and GA-based methods, concluding that the GA-based technique yielded higher results for CNN training. With the devanagari handwritten numeral dataset, they achieved an exceptional recognition rate of 96.25% using CNN without GA and 96.09% with CNN with GA (500 iterations).

According to the authors' findings, deep convolutional neural networks (DNNs) provide significantly better recognition performance Boufenar Chaouki, et. al. (2018) . The Arabic handwritten character dataset (AHCD) and the online isolated handwritten Arabic character database (OIHACDB) were employed by the author in this work along with three different DNN techniques. With the CNN from scratch approach, the author got record-breaking results, such as 100% accuracy for OIHACDB-40 and 99.98% accuracy for AHCD.

Author Mukherjee Partha Sarathi et. al. (2018) has presented a hybrid deep neural network model for online handwriting of Indian languages, Bangla (ICBOHR-W2) and Devanagari (ICDOHR dataset). The recognition error rates obtained by the author using the CNN-BLSTM and BLSTM methods with the ICBOHR-W2 dataset were 86.73 and 70.29, respectively.

Using MNIST handwritten digit datasets, the author Niu Xiao-Xiao et. al. (2012) suggested a hybrid model that combines the best-known classifier convolutional neural network and support vector machine. CNN is used for image identification, while SVM is utilized for feature extraction. The author also notes that when compared to other categorization methods or strategies, the suggested hybrid model has shown greater recognition accuracy.

A novel approach for offline Arabic handwritten dataset identification has been published by author Elleuch Mohamed et. al. (2016) . It combines dropout technique with convolutional neural network and support vector machine. In this case, SVM is employed as a recognizer and CNN is used to extract feature information. In comparison to other earlier research projects, the suggested model has exceptional accuracy thanks to the use of dropout techniques with CNN-SVM.

The numerous publications pertaining to the identification of EMNIST handwritten character datasets and MNIST handwritten digit datasets have been examined by Baldominos Alejandro et. al. (2019). Numerous methods, including artificial intelligence, deep learning approaches, convolutional neural networks, support vector machines, recurrent neural networks, and KNNs, have been employed for the recognition of MNIST and EMNIST datasets. Convolutional neural networks have a greater accuracy rate than other techniques, according to the author, who also reported the recognition rates of each unique technique.

In the realm of optimization approaches and deep neural network techniques numerous research work have reviewed by Lydia Agnes et. al. (2019),. In this article discussed the work of Gradient Descent optimization methods with their features , positive and negative influence. This discovery also stimulates the researchers to work in the field of optimization approaches and deep learning techniques.



The author has presented a new CNN-SVM hybrid classifier model for the recognition of the MNIST handwritten digit dataset Ahlawat Savita et. al. (2019). In this case, the hybrid classifier used the advantages of both classifiers, such as the usage of SVM as a binary classifier and CNN for feature extraction. Using the MNIST handwritten digit dataset, the author here achieved the greatest recognition accuracy of 99.28%, outperforming other machine learning techniques.

The author M. P. Usha, 2024 et. al. introduces a deep learning method, Tunnet, for multimodal fused imaging of brain tumors using MRI and CT images. Tunnet, featuring 5 convolutional layers, effectively classifies and segments tumors with high accuracy (98%), sensitivity (96%), and specificity (99%). The study demonstrates the potential of multimodal imaging fusion for improved brain tumor diagnosis and treatment.

One of the advanced capabilities of deep learning (DL) and machine learning (ML) for handwriting recognition suggested by the authors bipul roy 2023 et. al. they have implemented Support Vector Machine (SVM), Multilayer Perceptron (MLP), and Convolutional Neural Network (CNN) models to analyze and decode handwritten text. The primary goal is to compare the accuracy and execution times of these models to determine the most efficient method. The research underscores the significant progress in handwriting recognition, highlighting the potential of these algorithms in practical applications.

Skin diseases are prevalent worldwide, with global warming and climate change contributing to rising cases of skin cancer. Early detection and treatment are crucial, yet clinical diagnosis remains costly and often inaccessible. Advanced machine learning, particularly deep learning, offers a solution through image classification techniques. Author muddassar abbas 2024 et. al. employed multiple deep learning models, including sequential CNN, DenseNet-121, and ResNet-50, to analyze the HAM10000 dataset, containing over 10,000 images of seven skin disease categories. After pre-processing and feature extraction, the sequential CNN model achieves remarkable accuracy of 98-99% in disease classification, outperforming DenseNet-121 and ResNet-50, which achieve 89% and 84% accuracy, respectively. Image augmentation techniques are utilized to address category imbalances, enhancing the models' effectiveness.

Author Pradeep J.(2011) et. al. presented an offline handwritten alphabetical character recognition system using a multilayer feed forward neural network. It introduces a novel diagonal-based feature extraction method, which improves recognition accuracy compared to traditional horizontal and vertical methods. The system was trained on 50 datasets and tested on 570 characters, demonstrating high accuracy. This approach is effective for converting handwritten documents into structured text and recognizing handwritten names.

Handwritten word recognition is one of the major challenges in current scenario, specially the scarcity of large and diverse datasets. It highlights the importance of resolving these issues for digitizing millions of documents using deep learning models. Mst Shapna Akter (2022), et. al. proposed solution that involves generating diverse handwritten word images using handwritten characters and training a BiLSTM-CTC architecture on these synthetic words. The approach includes creating overlapped and non-overlapped datasets, with experiments focused on the Bangla language. The model's performance, evaluated using metrics like Word Error Rate (WER), accuracy, f1-score, precision, and recall, shows promising results with non-overlapped data (39% WER, 92% accuracy) compared to overlapped data (63% WER, 83% accuracy).

The rise in signature forgery cases is linked to the limitations of manual signature verification systems. To address this, researchers have turned to machine learning and deep learning, particularly convolutional neural networks (CNNs). For these type of recognition approach author wifda muna 2024 et. al. focuses on developing a mobile app for handwritten signature verification using a CNN with batch normalization. The proposed method achieved an



86.36% verification accuracy, with a false acceptance rate of 0.061, a false rejection rate of 0.303, and an equal error rate of 0.182, indicating its suitability for Smartphone integration.

Author prassuram banni (2024) et. al. proposed leverages the AlexNet CNN deep learning model to restore and classify degraded ancient Kannada manuscripts. By focusing on various attributes such as author, subject, and language, the model aims to automate the categorization process. This approach addresses the unique challenges posed by historical texts, including diverse styles and damaged content. The model demonstrates a high accuracy rate of 99.85% in attributing manuscripts to their respective authors. The results indicate significant promise for improving the preservation and organization of ancient manuscripts using advanced machine learning techniques.

Author Agrawal M(2019) et. al. employed Convolutional Neural Networks and TensorFlow for offline HCR, utilizing Softmax Regression to assign probabilities to characters, ensuring the outputs sum to one. The goal is to develop highly accurate software with minimal time and space complexity. Here they achieved over 90% accuracy in Handwritten Character Recognition (HCR).

Character recognition is one the challenging field in all the emerging fields within the computer vision. The most abilities of humans are they will recognize any object or thing. The hand transcription can easily identify by humans. Different languages have different patterns to spot. Humans can identify the text accurately. The hand transcription cannot be identified by the machine. It's difficult to spot the text by the system. During this text recognition, we process the input image, extraction of features, and classification schema takes place, training of system to acknowledge the text. During this approach, the system is trained to seek out the similarities, and also the differences among various handwritten samples. This application takes the image of a hand transcription and converts it into a digital text reviewed by the author Manchala S. Y. (2020) et. al..

The quality of people's lives is closely related to their emotional state. Positive emotions can boost confidence and help overcome difficulties, while negative emotions can harm both physical and mental health. Author Hengnian G.(2024) et. al. work shows that people's handwriting is associated with their emotions. By the author audio-visual media were used to induce emotions, and a dot-matrix digital pen was used to collect neutral text data written by participants in three emotional states: calm, happy, and sad. To address the challenge of limited samples, a novel conditional table generative adversarial network called conditional tabular-generative adversarial network (CTAB-GAN) was used to increase the number of task samples, and the recognition accuracy of task samples improved by 4.18%. The TabNet (a neural network designed for tabular data) with SimAM (a simple, parameter-free attention module) was employed and compared with the original TabNet and traditional machine learning models; the incorporation of the SimAm attention mechanism led to a 1.35% improvement in classification accuracy. Experimental results revealed significant differences between negative (sad) and nonnegative (calm and happy) emotions, with a recognition accuracy of 80.67%. After Experimenting author demonstrated the feasibility of emotion recognition based on handwriting with the assistance of CTAB-GAN and SimAm-TabNet. It provides guidance for further research on emotion recognition or other handwriting-based applications.

Gamal A.(2024) et. al. achieved optimal performance in digit recognition tasks using the MNIST dataset. Despite a 99% accuracy rate in existing models, the challenge lies in classifying the remaining 1% of images. Author proposed a simplified convolutional neural network (CNN) architecture with only two layers and fewer filters, reducing model parameters and learning time. Their rigorous experiments show that this streamlined approach yields competitive results, highlighting the potential of alternative model architectures and optimization techniques in enhancing digit recognition performance.

Reddy S. P. K.(2020) et. al. reviewed the advancements in Deep Learning for Handwriting Recognition, emphasizing Optical Character Recognition (OCR) and Handwritten Character Recognition (HCR). It highlights the various techniques proposed for character recognition and their importance in converting textual content from paper documents into machine-readable form. The author suggested that character recognition systems could play a crucial role in creating a paperless environment by digitizing and processing existing documents. The paper also discusses two main approaches for classifying handwritten text: using Convolutional Neural Networks (CNN) for direct word classification and Long Short Term Memory networks (LSTM) for character segmentation and classification. The detailed review aims to present a comprehensive understanding of the current state of HCR.

Handwritten character recognition (HCR) using machine interfaces, highlighting its challenges due to variations in handwriting among different individuals and even the same person discussed by the author Mangnani D.(2021) et. al.. HCR is crucial for applications like digitizing bank cheques and handwritten documents. The necessity of converting handwritten images to digital text for easier reprocessing is emphasized. Author focuses on using Convolutional Neural Networks (CNN) to classify and translate handwritten English words into editable text.

Handwritten digit recognition is a challenging yet essential task in applications like data form entry, postal code sorting, and bank check processing. The variability in individual handwriting styles, including differences in size, width, and slope, complicates recognition. Various artificial neural network-based models have been employed for pattern matching. Author Patil, R. N.(2024) et. al. evaluated machine learning algorithms on the MNIST dataset, observing significant font usage differences among authors. Algorithms tested included Naive Bayes, K-Nearest Neighbor, Support Vector Machine, Decision Tree, Random Forest, Artificial Neural Network, Convolution Neural Network (CNN), and Long Short-Term Memory (LSTM). CNN outperformed the others, achieving 99.9% accuracy on MNIST and 88% on EMNIST, demonstrating deep learning's effectiveness in feature extraction and recognition.

Author Abdirahma A. A.(2024) et. al. presented a comprehensive study on handwritten signature verification using deep learning techniques, addressing the challenges of offline signature verification. The proposed method employs state-of-the-art deep learning models like MobileNet, ResNet50, Inceptionv3, and VGG19, combined with YOLOv5, to achieve high-precision classification and reliable forgery detection. Also evaluated on multiple benchmark datasets, the system demonstrates effectiveness and robustness across various real-world scenarios. The results highlight the method's superior accuracy (89.8%) in distinguishing genuine signatures from forgeries, showcasing its potential for practical deployment in signature verification tasks. This research significantly advances offline signature verification technology, providing a reliable and efficient solution for enhancing the security and authenticity of handwritten signatures.

Author Shetty A. B.(2021) et. al. aims to implement recognition of text and digits from any input image, divided into two parts: digit and character recognition using CNN and LSTM algorithms. We leverage Yann LeCun's datasets, such as MNIST for digit recognition and EMNIST for character recognition. Handwritten digit recognition is crucial in various applications like bank check processing and postal address interpretation, relying on recognizing written inputs from various sources. This research focuses on developing efficient algorithms to predict characters in digital format, processing the image for accurate comparison, and finally providing a percentage accuracy prediction by comparing it with a set of font images.

Speech digit recognition research is advancing rapidly, with many algorithms applied to European and some Asian languages. However, Kui, a low-resourced tribal language used in

several Indian states, has not received much attention. Here author Subrat K. N.(2024) et. al. focuses on novel Kui digit recognition using predefined machine learning (ML) techniques. They collected spoken numbers (0 to 9) from eight speakers, resulting in 200 words, and used Mel-frequency cepstral coefficients (MFCCs) for feature extraction. Nine different ML models were developed and evaluated, with the SVM+Augmentation method achieving the highest accuracy of 83%. They also discuss the challenges and future directions for Kui digit recognition.

Author Rohan V.(2018) et. al. presented an innovative method for offline handwritten character detection using deep neural networks. The availability of vast data and advancements in algorithms has made training these networks more feasible. Increased computational power from GPUs and cloud services like Google Cloud and AWS further support this process. The proposed system utilizes image segmentation for handwritten character recognition, employing OpenCV for image processing and TensorFlow for neural network training, all implemented in Python.

Marathi is one of the most widely spoken languages in India, known for its unique and complex script. Recognizing handwritten Marathi text is challenging due to varied writing styles and the intricacies of the Devanagari script, which consists of 12 vowels and 36 consonants. Machine learning techniques have proven effective in developing systems to accurately recognize Marathi handwriting. Author Chaitrali B. K.(2024) et. al. reviewed various methods for handwriting recognition, covering languages like Sanskrit, Hindi, Marathi, and Maithili. They compare different machine learning classifiers, highlighting that Extra Trees and Random Forest algorithms exhibit superior accuracy in recognizing handwritten characters.

Author Memon J.(2020) et. al. reviewed many of the research articles and focuses on the advancements in Optical Character Recognition (OCR) for handwritten documents, highlighting its importance in converting documents into analyzable, editable, and searchable data. Over the last decade, artificial intelligence and machine learning have been pivotal in automating this process. The paper systematically reviews research from 2000 to 2019, selecting 176 articles through a rigorous search protocol using keywords and reference searching. By synthesizing these studies, the review presents state-of-the-art OCR techniques and identifies research gaps, offering valuable directions for future work in the field.

### 3. CONCLUSION

As the widespread use of handwritten characters, letters and numbers in daily life, it is imperative to identify and digitize them. In order to do that, we have reviewed many number of research papers and publications for this study. It is used by several academics to recognize handwritten characters from the EMNIST dataset as well as other datasets including Arabic and Chinese handwritten character datasets, among others, using a variety of tools and methodologies. The outcomes of traditional machine learning techniques, such as random forest classifier, k-nearest neighbor, and support vector machine, are insufficient for the needs of the modern world. We also look at a number of authors that have successfully recognized handwritten characters using convolutional neural networks with various parameters. Thus, based on the survey results, we can conclude that convolutional neural networks provide the best recognition accuracy when it comes to handwritten character recognition across various datasets. However, convolutional neural networks must be hybridized with other methods for digit identification, classification, and optimization in order to improve recognition rates or lower recognition error rates. In this study, we also looked into hybrid models created by different authors, which have produced results that are more accurate than those obtained by using separate deep learning and machine learning

methods. Convolutional neural networks (CNNs) are hybridized by a number of researchers using RFC, KNN, RNN, support vector machines (SVM), and other methods.

## REFERENCE

- Saabni Raid (2016) , Recognizing handwritten Single Digits and Digit Strings Using Deep Architecture of Neural Networks,Third International Conference on Artificial Intelligence and Pattern Recognition (AIPR), 978-1-4673-9187-0.
- Wang Zi-Rui , Du Jun , Hefei Anhui, China P. R.(2016),Writer Code Based Adaptation of Deep Neural Network for Offline Handwritten Chinese Text Recognition, 15th International Conference on Frontiers in Handwriting Recognition (ICFHR), 978- 1-5090-0981-7
- Yadav Usha , Verma Satya , Xaxa Deepak Kumar , Mahobiya Chandrakant (2017) , A deep learning based character recognition system from multimedia document , International Conference on Innovations in Power and Advanced Computing Technologies (i- [28] PACT2017), ISBN: ISBN: 978-1-5090-5682-8
- Trivedi Adarsh , Srivastava Siddhant , Mishra Apoorva, Shukla Anupam ,Tiwari Ritu(2018),Hybrid evolutionary approach for devanagari handwritten numeral recognition using convolutional neural network, Elsevier Procedia Computer Science, 125, 525- 532
- Boufenar Chaouki, Kerboua Adlen, Batouche Mohamed (2018),Investigation on Deep Learning for Off-line Handwritten Arabic Character Recognition, Cognitive Systems Research,50,180- 195
- Mukherjee Partha Sarathi, Bhattacharya Ujjwal, Parui Swapan K. (2018), An Efficient Feature Vector for Segmentation- free Recognition of online Cursive Handwriting Based on a Hybrid Deep Neural Network, 13th IAPR International Workshop on Document Analysis Systems (DAS), ISBN: 978-1-5386-3346-5.
- Niu Xiao-Xiao, Suen Ching Y. (2012), A novel hybrid CNN SVM classifier for recognizing handwritten digits , Pattern Recognition 45 ,1318 1325
- Elleuch Mohamed, Maalej Rania, Kherallah Monji(2016), A New Design Based-SVM of the CNN Classifier Architecture with Dropout for Offline Arabic Handwritten Recognition, Procedia Computer Science, ICCS 2016 The International Conference on ComputationalScience, 80, 1712 1723
- Baldominos Alejandro, Saez Yago, Isasi Pedro(2019), A Survey of Handwritten Character Recognition with MNIST and EMNIST, [44] MDPI, Appl. Sci. 2019, 9, 3169
- Lydia Agnes, Francis F. Sagayaraj(2019), A Survey of Optimization Techniques for Deep Learning Networks, International Journal for Research in Engineering Application & Management (IJREAM) , 05,02, ISSN : 2454-9150
- Ahlawat Savita , Choudhary Amit(2019), Hybrid CNN-SVM Classifier for Handwritten Digit Recognition , International Conference on Computational Intelligence and Data Science (ICCIDS 2019) , Procedia Computer Science 167, 2554 2560
- M. P. Usha, G. Kannan, and M. Ramamoorthy, "Multimodal Brain Tumor Classification Using Convolutional Tumnet Architecture," Behavioural Neurology, vol. 2024, pp. 1–16, May 2024, doi: 10.1155/2024/4678554.
- B. Roy and U. K. Bhuyan, "Handwritten Digit Prediction using Machine Learning Algorithms",2023.
- J. Pradeep, E. Srinivasan, and S. Himavathi, "Neural network based handwritten character recognition system without feature extraction," in 2011 International Conference on Computer, Communication and Electrical Technology (ICCCET), Tirunelveli, Tamil Nadu, India: IEEE, Mar. 2011, pp. 40–44. doi: 10.1109/ICCCET.2011.5762513.

- M. Abbas, M. Arslan, R. A. Bhatti, F. Yousaf, A. A. Khan, and A. Rafay, "Enhanced Skin Disease Diagnosis through Convolutional Neural Networks and Data Augmentation Techniques," *Biomedical Informatics*, vol. 07, no. 01.
- M. S. Akter, H. Shahriar, A. Cuzzocrea, N. Ahmed, and C. Leung, "Handwritten Word Recognition using Deep Learning Approach: A Novel Way of Generating Handwritten Words," in *2022 IEEE International Conference on Big Data (Big Data)*, Osaka, Japan: IEEE, Dec. 2022, pp. 5414–5423. doi: 10.1109/BigData55660.2022.10021025.
- W. M. Fatihia, A. Fariza, and T. Karlita, "Convolutional neural network enhancement for mobile application of offline handwritten signature verification," *TELKOMNIKA*, vol. 22, no. 4, p. 931, Aug. 2024, doi: 10.12928/telkomnika.v22i4.25849.
- P. Bannigidad and S. P. Sajjan, "Automatic Writer Identification of Historical Kannada Handwritten Palm Leaf Manuscripts using AlexNet Deep Learning Approach," *International Journal on Recent and Innovation Trends in Computing and Communication*, vol. 11, no. 11, 2023.
- R. Vaidya, D. Trivedi, S. Satra, and Prof. M. Pimpale, "Handwritten Character Recognition Using Deep-Learning," in *2018 Second International Conference on Inventive Communication and Computational Technologies (ICICCT)*, Coimbatore: IEEE, Apr. 2018, pp. 772–775. doi: 10.1109/ICICCT.2018.8473291.
- J. Memon, M. Sami, R. A. Khan, and M. Uddin, "Handwritten Optical Character Recognition (OCR): A Comprehensive Systematic Literature Review (SLR)," *IEEE Access*, vol. 8, pp. 142642–142668, 2020, doi: 10.1109/ACCESS.2020.3012542.
- S. K. Nayak, A. K. Nayak, S. Mishra, P. Mohanty, N. Tripathy, and S. Prusty, "Improving Kui digit recognition through machine learning and data augmentation techniques," *IJECS*, vol. 35, no. 2, p. 867, Aug. 2024, doi: 10.11591/ijeecs.v35.i2.pp867-877.
- Chaitrali B. Kamble and Kishor T. Mane, "A Review on Handwritten Recognition System Using Machine Learning Techniques," *Int Res J Adv Engg Hub*, vol. 2, no. 06, pp. 1590–1599, Jun. 2024, doi: 10.47392/IRJAEH.2024.0218.
- A. A. Abdirahma, A. O. Hashi, M. A. Elmi, and O. E. R. Rodriguez, "Advancing Handwritten Signature Verification Through Deep Learning: A Comprehensive Study and High-Precision Approach," *IJETT*, vol. 72, no. 4, pp. 81–91, Apr. 2024, doi: 10.14445/22315381/IJETT-V72I4P109.
- Sri. Yugandhar Manchala, Jayaram Kinthali, Kowshik Kotha, Kanithi Santosh Kumar, Jagilinki Jayalaxmi, and Aditya Institute of Technology and Management, "Handwritten Text Recognition using Deep Learning with TensorFlow," *IJERT*, vol. V9, no. 05, p. IJERTV9IS050534, May 2020, doi: 10.17577/IJERTV9IS050534.
- S. P. K. Reddy and V. M. Rao, "A Survey on Deep Learning For Hand Written Recognition by Digit & Character," vol. 8, no. 6, 2020.
- D. Mangnani, J. Sukheja, H. Mohinani, and P. Kanade, "HANDWRITTEN CHARACTER RECOGNITION," vol. 9, no. 6, 2021.
- A. Gamal, M. El Saeed, M. Deif, and R. Elgohary, "Enhanced Convolutional Neural Networks for MNIST Digit Recognition," *International Integrated Intelligent Systems*, vol. 1, no. 2, pp. 0–0, Jun. 2024, doi: 10.21608/iiis.2024.357780.
- R. N. Patil, Y. D. Sinkar, S. A. Rawandale, and V. D. Jadhav, "Impact of Machine Learning and Deep Learning Models on Handwritten Digits and Letters Recognition (HDaLR)," *IJETT*, vol. 72, no. 1, pp. 48–55, Jan. 2024, doi: 10.14445/22315381/IJETT-V72I1P105.
- M. Agarwal, S. V. Tomar and Priyanka Gupta, "Handwritten Character Recognition using Neural Network and Tensor Flow", *International Journal of Innovative Technology and Exploring Engineering (IJITEE)*, vol. 8, no. 6S4, pp. 1445-1448, April 2019.

- H. Qi et al., “Emotion Recognition Based on Handwriting Using Generative Adversarial Networks and Deep Learning,” IET Biometrics, vol. 2024, pp. 1–15, May 2024, doi: 10.1049/2024/5351588.
- A. B. Shetty, N. N. Ail, M. Sahana, Sushmitha and V. P. Bhat, “Recognition of Handwritten Digits and English Texts using MNIST and EMNIST Datasets”, International Journal of Research in Engineering, Science and Management, vol. 4, no. 7, pp. 240-243, July 2021.



# MULTI-STRATEGY MACHINE LEARNING FRAMEWORK FOR QUALITY MANAGEMENT OF TEACHING LEARNING PROCESS

**Dr.S.Pavani**

C. M. Dubey Post Graduate College, Bilaspur, Chhattisgarh, India  
(spavanisantosh@gmail.com)

**Dr. Kajal Kiran Gulhare**

Govt. E. Raghvendra Rao P.G. Science College, Bilaspur, Chhattisgarh, India  
(kajalgulhare@gmail.com)

Higher education institutions aim to educate students well. Due to rapid information technology growth, higher education research data has risen tremendously. The Learning Management System (LMS) also brought courses online for e-learning at practically every level. Hence, predicting student success is one of several ways to improve higher education. E-learning quality affects content, user experience, credibility, and efficacy. Quality in e-learning ensures that students learn well and apply their information. Machine learning improves e-learning, benefiting all stakeholders. To assist pupils become well-rounded, intellectually capable people, teachers must be top-notch. This study proposes a Quality Teaching and Evaluation Framework (QTEF) to improve teacher performance, notably in e-learning/distance learning courses. Teacher performance evaluation promotes educator development and student learning. To maintain quality, this research validates the QTEF using a machine learning model that predicts teacher competency. The results show that technical assessment criteria, not highly related QTEF components, improve the predicted result. Further study will include framework integration and validation and student performance.

**Keywords:** Machine Learning, Teaching, Learning

## 1. INTRODUCTION

Technology and society have made education more important to the nation's progress. To increase the number of outstanding students for the nation and society. Teacher evaluation is a systematic method of assessing academics' teaching skills. A system that promotes teacher learning will differ from one that evaluates teachers. Effective teaching assessment rewards teacher improvement. Research shows that excellent instructors are critical to student success. Schools and districts struggle to find and keep good instructors. Observations and administrator assessments of teachers are subjective and may not adequately represent their influence on student learning. Machine learning algorithms are objective. They can find hidden patterns and connections in massive data sets. Higher education instructors must be assessed to ensure students obtain a quality education and professors can provide the best learning experience. Educators are finding that a well-designed assessment system may integrate professional development with quality assurance in teacher evaluation without burdening administrators. The assessment system needed [adaptable assessment methodologies and adaptive learning material selection, embedding, and presentation based on student performance]. The assessment ensures teachers satisfy school requirements. New participatory evaluation methods include differentiated systems, yearly cycles, and teacher participation through portfolios, professional dialogues, and student accomplishment evidence. Assessment helps higher education institutions maintain their quality, reputation, and student education by ensuring teachers meet their requirements. For instance, a teacher

must fulfill the institution's teaching and student-interaction standards. If so, they may need to improve or risk being fired. Due to education reform and expansion, it is difficult for instructors in charge to understand the learning scenarios of each teaching quality and give timely guidance and help. Universities are enrolling more. Schools and organizations have historically used teaching quality outcomes to assess their teaching environment and quality. Then, we must define instructional evaluation indicators. Trainers can compare and reference in the classroom with unambiguous signs, suggesting that teaching evaluation directs. Teachers need assessment to improve their work. It can help teachers identify their strengths and weaknesses and plan for challenges. Assessment helps teachers fulfill student needs and enhance their teaching approaches. If students complain about boring lectures, a teacher may include more engaging activities or multimedia. Assessing students in higher education ensures a well-rounded education. Students must experience several teaching methods and programs in higher education. Assessment helps ensure various teaching techniques and a well-rounded education. Accreditation agencies oversee quality and accountability at universities worldwide. E-Learning leaders should show these accrediting authorities that their online courses are efficient and high-quality in addition to promoting them to a broad audience, maintaining a high standard, and proving learning results. Quality frameworks also incorporate quality assurance and improvement processes to encompass all variables affecting student learning. An e-learning design framework can improve program performance and efficiency for administrators, students, and teachers Table 1 provides e-learning professionals with flexible standards, ideas, and approaches for online learning. They must give a complete picture of all the factors to consider when adopting e-learning, depending on the stage of the process or the need for quality evaluation at various organizational levels.

## 2. ELECTRONIC LEARNING AND QUALITY IN TEACHING

- **Electronic Learning**

E-learning uses computers, laptops, tablets, and cellphones to access educational materials and resources, connect with teachers and peers, and complete assignments and exams [19]. E-learning can enhance or replace classroom training for distance education or online degree students. Students can also access course materials, submit assignments, engage in discussions, and take exams in a virtual learning environment. Learning management systems and software platforms let teachers produce and manage online course content in e-learning.

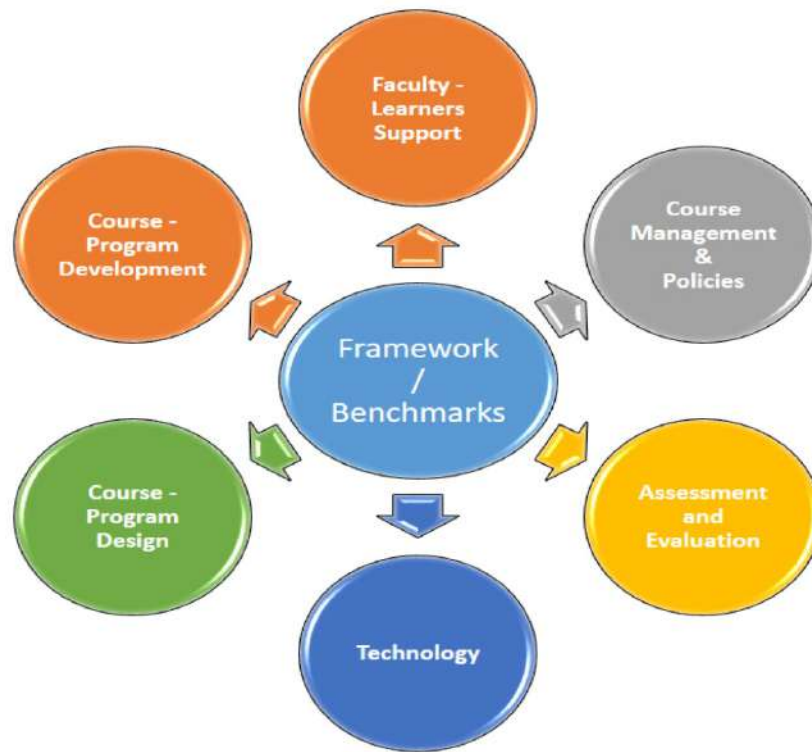
- **Quality in Teaching**

Student performance and happiness depend on remote education teaching quality. Online teaching quality can be affected by several things. The utilization of technology, course design, and student-instructor interaction are key aspects. E-learning quality depends on faculty Online educators may enhance their teaching by receiving continuing assistance and professional development. Together with technical and evaluation aspects, course design is key to successful teaching and learning. Course design is the most important component in student learning, according to the institute. For instance, a teacher may have planned various discussion venues for course involvement. Online learning was more flexible, thus pupils preferred it Technology can effect distant education teaching quality. Online courses commonly use technology to communicate and distribute course content, and its success may greatly impact the learning experience. For instance, dependable and simple technology can improve student learning and engagement. Effective course design can also impact electronic learning quality. A badly designed course can confuse and irritate students and slow their development. A well-designed online course should include clear learning objectives, relevant exams, student engagement, and feedback opportunities. Lastly, student-teacher

connection is crucial to remote education quality. Virtual office hours and live lectures are available in some online courses, but not all. Learning online is affected by teachers' personalities and teaching approaches. Enhancing existing methodologies and providing a solid education are the university's main goals. By equipping the faculty, high-quality instruction was feasible.

• **Quality Teaching and Evaluation Framework—QTEF**

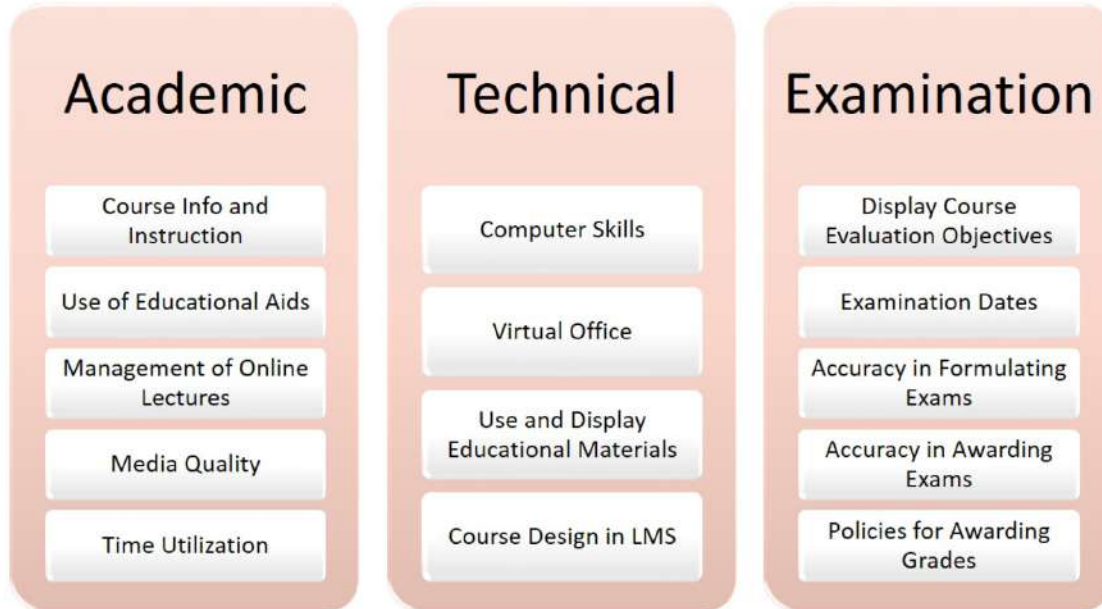
Frameworks for teaching and learning use contextualized, diversified methods to help students create accurate and relevant knowledge structures and apply their skills and knowledge. Teaching and learning frameworks, research-based course design approaches, enable inclusive, engaging, and assessment-integrated learning. In their book "Understanding by Design," Wiggins and McTighe proposed Backward Design, which can be blended and altered to organize or revise any course, curriculum, or lesson. After reviewing the frameworks in Table 1 and standards for e-learning courses, comparable indicators were found and noted. Figure 1 shows these measures emphasize content creation, e-learning program administration, technology utilization, faculty and student facilitation, etc.



**Figure 1.** Quality indicators for digital education.

Leading e-learning and online course organizations produced the frameworks/benchmarks in Table 1 as online resources for others. Table 1 shows that certain frameworks focus on quality only in Europe or Australia. E-learning leadership may develop and implement online learning using these frameworks depending on their needs to maintain quality in their firm. Based on the frameworks and standards, we developed our design, which divides the indicators into three primary areas and considers all e-learning applications. Our Quality Teaching and Evaluation Framework focuses on Academic, Technical, and Examination

procedures. This condensed multidimensional framework evaluates instructors and e-learning systems. The QTEF has three components: assessment and evaluation, technology elements of course delivery, content creation and development, and course management and policy indicators. Figure 2 shows major QTEF requirements under each component. Institutions, schools, and colleges can employ QTEF frameworks to teach courses at several levels.



**Figure 2.** QTEF core components.

### 3. MACHINE LEARNING AND PERFORMANCE EVALUATION

Machine learning may transform many industries, including education. It aids educational policymakers and administrators in resource allocation and teacher retention and development. Machine learning might predict teacher performance. Machine learning algorithms can assess instructor features and actions to predict classroom success. Cutting-edge LMS systems, sophisticated algorithms, and future online learners automate e-learning course delivery. Machine learning algorithms are evolving to mimic human intelligence by learning from the environment. In the new "big data" era, they are the workhorses. Machine learning can improve e-learning platforms. This study uses machine learning to develop a high-quality framework model for anticipating teacher performance and detecting faculty strengths and shortcomings.

This study develops a framework model to identify and categorize evaluation criteria to decide which are best for assessing teacher performance using machine learning. ML approaches can help professors identify disappointed or dissatisfied students by analyzing their discussion board postings, facial expressions, or other indicators. Machine learning may also be used to update e-learning activities and content.

#### Machine Learning Algorithm

- Ontologies classify machine learning algorithms by their desired outcome. Unsupervised, semi-supervised, and reinforcement learning are ML kinds. There are

various machine learning algorithms, but the one to choose depends on the study's aims and data.

- Prediction techniques include linear regression, decision trees, support vector machines, and random forests. Linear Regression is a supervised learning technique used for predictive analysis. Regression approaches two ideas. First, regression analyses are often used for forecasting and prediction, which is similar to machine learning. Second, regression analysis can determine causal links between independent and dependent variables.
- Regression predicts goals using independent variables. It mostly analyzes factors and forecasts. Importantly, regressions only demonstrate correlations between a dependent variable and a given dataset of other covariates. The number of independent variables divides regression into two major types.
- Simple Linear Regression (LR): A linear regression procedure is referred to as simple linear regression if only one independent variable is utilized to predict the outcome of a numerical dependent variable.
- Multiple Linear Regression (MLR): A linear regression process is referred to as multiple linear regression if it uses more than one independent variable to anticipate the value of a numerical dependent variable.

#### 4. METHODOLOGY

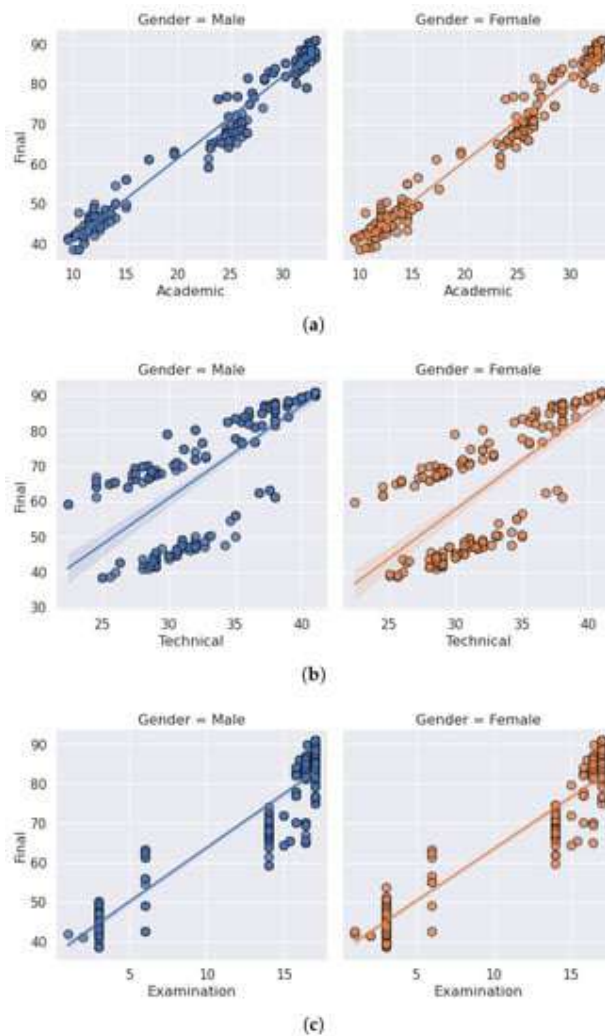
Digitally saved data is a dataset. Data is essential to machine learning projects and affects model performance. Pre-processed to eliminate biases and noise, the dataset represents the real-world situation. To predict teacher performance using machine learning, we require a dataset of instructor attributes and actions. It might include a teacher's teaching style, instructional tactics, student participation, and exam conduct. Figure 3 shows our dataset for ML model training and testing. Tables 2, 3, and 4 show the 13 Academic (AC), 15 Technical (TC), and 08 Examination (EC) requirements in 400 rows and 41 columns. The dataset includes 219 male and 181 female performance ratings from university departments. Jazan University teachers providing distance learning courses for undergraduate students in English, Arabic, and Journalism departments produced a performance rating dataset. Secondly, faculty members were trained on the LMS and the quality framework's standards and grading system. The university's Quality section scores the e-course after completion using QTEF criteria.

	Gender	AC-1	AC-2	AC-3	AC-4	AC-5	AC-6	AC-7	AC-8	AC-9	...	EC-1	EC-2	EC-3	EC-4	EC-5	EC-6	EC-7	EC-8	Examination	Final
0	Male	3.0	3.0	3	2	3	2	2	3.0	2.0	...	2.0	2	2	2	2	1	3	3	17.0	91.0
1	Female	1.5	2.0	3	0	3	2	2	3.0	2.0	...	2.0	2	2	2	2	1	3	0	14.0	66.0
2	Female	1.5	2.0	0	0	0	0	0	2.5	2.0	...	2.0	0	0	0	0	1	0	0	3.0	43.0
3	Male	3.0	3.0	3	2	3	2	2	3.0	2.0	...	2.0	2	2	2	2	1	3	3	17.0	91.0
4	Female	1.5	2.0	3	0	3	2	2	3.0	2.0	...	2.0	2	2	2	2	1	3	0	14.0	65.9
5	Female	1.5	2.0	3	0	3	2	2	3.0	2.0	...	2.0	2	2	2	2	1	3	0	14.0	69.5
6	Male	3.0	3.0	3	2	3	2	2	3.0	2.0	...	2.0	2	2	2	2	1	3	3	17.0	82.6
7	Male	3.0	3.0	3	2	3	2	2	3.0	1.7	...	1.0	2	2	2	2	1	3	3	16.0	82.6
8	Male	3.0	3.0	3	2	3	2	2	3.0	2.0	...	2.0	2	2	2	2	1	3	3	17.0	90.1
9	Male	3.0	3.0	3	2	3	2	2	3.0	2.0	...	2.0	2	2	2	2	1	3	3	17.0	80.2

Figure 3. Dataset for ML model.



The QTEF-defined technique for analyzing course profiles on Blackboard—Learning Management System and other criteria collected the data. Table 5 shows each score's lowest, maximum, and percentile. The dataset's final score's standard mean was 67.26 and standard deviation 17.52. Table 5 reveals that 50% of instructors score above the average and 75% score above 84. Linear Model Plot (lmpplot) in the Python module seaborn [42] creates a scatterplot with a linear regression line. In machine learning research, the lmpplot combines the regplot () and Facet Grid to show the connection between two variables. When evaluated as a lmpplot, the independent variable (Academic, Technical, and Examination criterion score) combines regplot() and Facet Grid, making the Final column the dependent variable. They simplify regression line visualization in faceted graphs. Figure 4 provides gender-wise scatter plots with regression lines showing how QTEF categories affect the teacher performance matrix score. They exhibit the statistical method that links a dependent variable (Final Grade) to independent factors (Academic Criteria, Technical Criteria, Examination Criteria score).



**Figure 4.** Gender-based grading. Academic, technical, and exam qualifications.



**Table 5. Dataset description.**

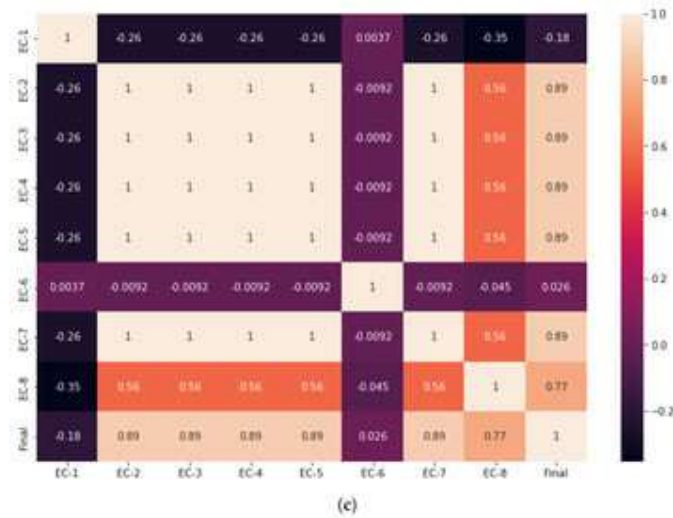
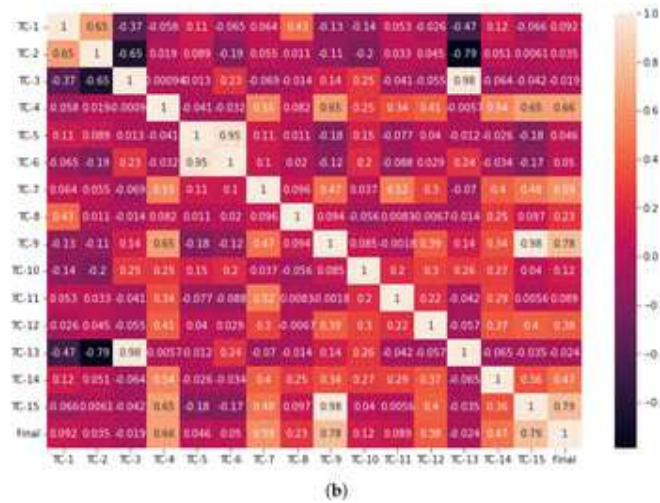
Sr. No	Parameter	Final Score Value
1	Records Count	400
2	Mean	67.26
3	Standard Deviation	17.52
4	Minimum Score	38.50
5	25%	47.57
6	50%	63.70
7	75%	84.50
8	Maximum Score	91.00

**Correlation**

In machine learning, correlation refers to the link between two variables and how they change about each other. Two variables with a high correlation are tightly connected and likely to change together. A low correlation between two variables indicates that they are not tightly connected, and a change in one variable is unlikely to affect the other. While constructing a Machine learning model, comprehending a dataset is vital, and heatmaps are only one of the countless tools at a data scientist’s command. The heatmap correlation matrix is a great tool for identifying low/high linked variables. Discovering strongly linked variables simplifies feature selection. They are utilized to figuring out the dependent and independent variables for the learning model. Table 6 shows the multiple linear regression model creation requirements. In our established framework, out of the 36 stated criteria, three components from each assessment category were selected as independent variables to have a high/low influence on the dependent variable. Figure 5 shows strong and low correlations between all criteria and the final score. Our framework's variables are depicted on both axes of the graph, and color indicates how each feature's connection to other variables varies. It is evident that the variables are more firmly related as the color goes darker in either direction.



(a)



**Figure 5.**Correlation graphs—dependent and independent variable selection. Academic standards. Technological criterion. Exam criterion connection.

**Table 6.** Selected QTEF criteria.

Criteria Category	Criteria Number	Correlation Type
Academic	AC-6, AC-7, AC-12	High
Technical	TC-4, TC-9, TC-15	High
Examination	EC-4, EC-5, EC-7	High
Academic	AC-9, AC-10, AC-13	Low
Technical	TC-2, TC-3, TC-13	Low
Examination	EC-1, EC-6, EC-8	Low

## 5. RESULTS AND DISCUSSION

This section shows the dataset machine learning algorithm testing outcomes. The dataset includes teacher assessment records based on academic, technical, and examination criteria, as described above. Python's ML mode uses pandas for data analysis and statistics and Scikit-learn for model training and testing. Google Colab was used for all models. Google Colaboratory delivers strong computing resources and frameworks for data science and machine learning applications. Colab lets us run code on the cloud, eliminating the requirement for a powerful computer or local software. Google Colab notebooks may also teach programming concepts.

Multiple regression analysis is performed on the QTEF data in Tables 2, 3, and 4 in a 65:35 ratio of training (260 records) to testing (140 records) datasets to determine performance. The coefficient of determination determines fit for the fewest dataset records (R2). It is used in statistical models to forecast future events or test hypotheses using data from other sources. The model's proportion of total variation in outcomes explains how well it matches observed findings. R2 is 0.0–1.0. If the determination coefficient is 0, X cannot predict Y. Hence, the variables have no linear connection and a horizontal line fits best. The line crosses the median Y value. If 1.0, all points fall on the horizontal route without dispersing. Knowing X lets you accurately predict Y. The multiple regression findings in Table 7 based on highly correlated variables from Figure 2 yield an R2 value of 0.9322, indicating 93.22% predictor variable accuracy. Correlation doesn't imply causation. Despite a strong correlation, there may be other causes. The factors may look connected but not be. It might be random. Hence, Scenario-1 now has 95.35% accuracy by replacing TC-14 with TC-15 and EC-5 with EC-3. The training model's greatest accuracy is 95.77% when examination criteria are changed to EC-1 from EC-3 and technical from TC-4 to TC-7. The Mean Square Error, which measures the squared average difference between actual and projected data, has dropped from 20.12 to 13.78 to 12.56.

**Table 7. Results and accuracy.**

Criteria Category	Criteria Number	Correlation Type
Academic	AC-6, AC-7, AC-12	High
Technical	TC-4, TC-9, TC-15	High
Examination	EC-4, EC-5, EC-7	High
Academic	AC-9, AC-10, AC-13	Low
Technical	TC-2, TC-3, TC-13	Low
Examination	EC-1, EC-6, EC-8	Low

Figure 6 and Figure 7 show Python code's machine learning model's testing vs. training dataset results. Correlating the anticipated and actual statistics shows their closeness. As expected by Table 5's grades distribution, our MLR model matches the actual outcomes. Our QTEF model's best indicators trigger it. Figure 6 shows several deviations owing to insufficient dataset records.

	Actual Value	Predicted Value	Difference
0	71.1	71.163939	-0.063939
1	87.0	86.983114	0.016886
2	69.5	72.422604	-2.922604
3	88.6	86.983114	1.616886
4	48.0	48.969098	-0.969098
...	...	...	...
135	46.1	48.969098	-2.869098
136	86.6	85.724448	0.875552
137	76.9	83.262803	-6.362803
138	64.3	60.650495	3.649505
139	81.6	86.983114	-5.383114

140 rows x 3 columns

Figure 6. Results variations—Scenario (2).

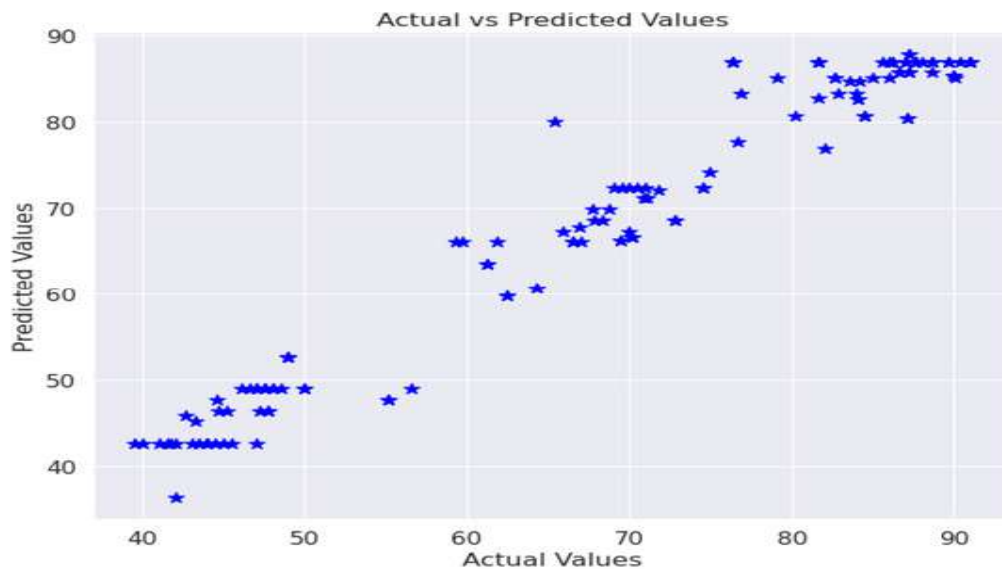


Figure 7. Adjusted variable results—Scenario (2).

## 6. CONCLUSIONS

In conclusion, employing machine learning to evaluate teachers may provide valuable insights and encourage instructional strategy improvement. By analyzing massive volumes of data, such as teacher observations during course delivery, machine learning algorithms may find patterns and connections that humans may miss. This helps academic administrators identify teaching faculty strengths and weaknesses and institution-wide best practices. This article applies machine learning on a teacher quality matrix to predict course success based

on the Quality Teaching and Evaluation Framework. Regression is employed because many machine learning methods classify data. To determine the teacher's semester performance, academic, technical, and examination criteria are set and marked. This study will increase instructor performance and student performance. It will also identify teachers who need more help in certain areas and take necessary action for their teaching over the semester. Further research might overcome two study shortcomings. Originally, just 400 datasets were studied. Second, machine learning only utilizes multiple regression. We also think incorporating instructor credentials, age, experience, and nationality will improve the study's accuracy. The findings may be verified by comparing the MLR model to other ML techniques like decision trees, random forests, SVM, and others.

## References

- Zhang, T. Design of English Learning Effectiveness Evaluation System Based on K-Means Clustering Algorithm. *Mob. Inf. Syst.* 2021, 2021, 5937742. [Google Scholar] [CrossRef]
- Marzano, R.J. Teacher evaluation. *Educ. Leadersh.* 2012, 70, 14–19. [Google Scholar]
- Cheniti-Belcadhi, L.; Henze, N.; Braham, R. An Assessment Framework for eLearning in the Semantic Web. In *Proceedings of the LWA 2004: Lernen-Wissensentdeckung-Adaptivität*, Berlin, Germany, 4–6 October 2004; pp. 11–16. [Google Scholar]
- Danielson, C. New Trends in Teacher Evaluation. *Educational leadership. Educ. Leadersh.* 2001, 58, 12–15. [Google Scholar]
- Jiang, Y.; Li, B. Exploration on the teaching reform measure for machine learning course system of artificial intelligence specialty. *Sci. Program.* 2021, 2021, 8971588. [Google Scholar] [CrossRef]
- Martin, F.; Kumar, S. Frameworks for assessing and evaluating e-learning courses and programs. In *Leading and Managing E-Learning: What the E-Learning Leader Needs to Know*; Springer: Berlin/Heidelberg, Germany, 2018; pp. 271–280. [Google Scholar]
- Martin, F.; Kumar, S. Quality Framework on Contextual Challenges in Online Distance Education for Developing Countries; Computing Society of the Philippines: Quezon City, Philippines, 2018. [Google Scholar]
- The Sloan Consortium Quality Framework and the Five Pillars. Available online: <http://www.mit.jyu.fi/OPE/kurssit/TIES462/Materiaalit/Sloan.pdf> (accessed on 25 January 2023).
- Kear, K.; Rosewell, J.; Williams, K.; Ossiannilsson, E.; Rodrigo, C.; Sánchez-Elvira Paniagua, Á.; Mellar, H. *Quality Assessment for E-Learning: A Benchmarking Approach*; European Association of Distance Teaching Universities: Maastricht, The Netherlands, 2016. [Google Scholar]
- Phipps, R.; Merisotis, J. *Quality on the Line: Benchmarks for Success in Internet-Based Distance Education*; Institute for Higher Education Policy: Washington, DC, USA, 2000. [Google Scholar]
- Benchmarking Guide. Available online: [https://www.acode.edu.au/pluginfile.php/550/mod\\_resource/content/8/TEL\\_Benchmarks.pdf](https://www.acode.edu.au/pluginfile.php/550/mod_resource/content/8/TEL_Benchmarks.pdf) (accessed on 26 January 2023).
- The Nadeosa Quality Criteria for Distance Education in South Africa. Available online: <https://www.nadeosa.org.za/documents/NADEOSAQCSection2.pdf> (accessed on 28 January 2023).
- OSCQR Course Design Review. Available online: <https://onlinelearningconsortium.org/consult/oscqr-course-design-review/> (accessed on 25 January 2023).

- Baldwin, S.; Ching, Y.H.; Hsu, Y.C. Online course design in higher education: A review of national and statewide evaluation instruments. *TechTrends* 2018, 62, 46–57. [Google Scholar] [CrossRef][Green Version]
- Martin, F.; Ndoye, A.; Wilkins, P. Using learning analytics to enhance student learning in online courses based on quality matters standards. *J. Educ. Technol. Syst.* 2016, 45, 165–187. [Google Scholar] [CrossRef]
- iNACOL Blended Learning Teacher Competency Framework. Available online: <http://files.eric.ed.gov/fulltext/ED561318.pdf> (accessed on 26 January 2023).