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PORAYAR - 609307



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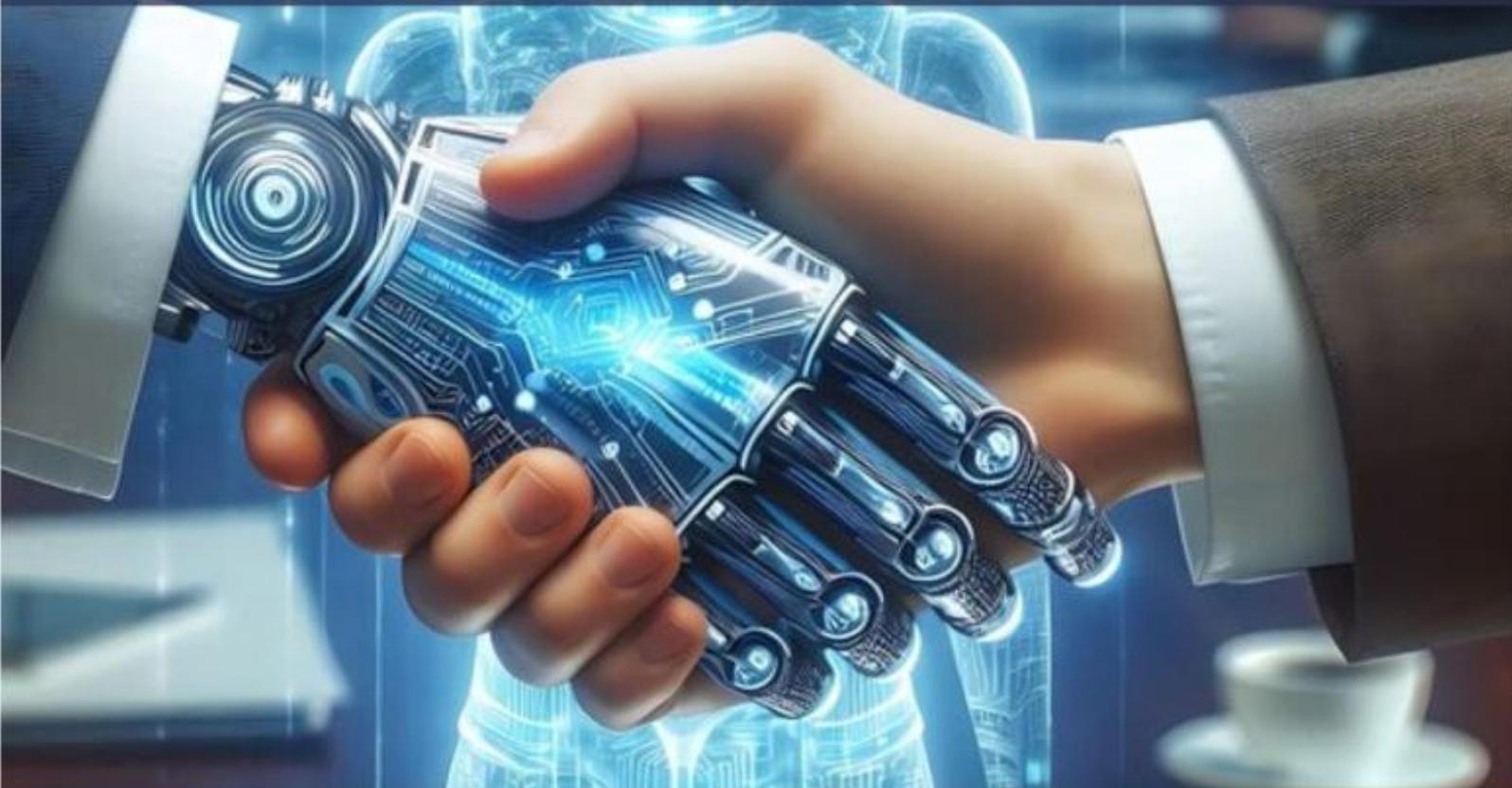
LUTHERAN INSTITUTE OF MANAGEMENT STUDIES, LUTHERAN CENTRE FOR SOCIAL STUDIES

&
INSTITUTION'S INNOVATION COUNCIL
Jointly organize a
ONE-DAY NATIONAL CONFERENCE ON

IMPACT OF ARTIFICIAL INTELLIGENCE IN REMODELLING HUMAN RESOURCES AND HUMAN WELL-BEING

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ONE-DAY NATIONAL CONFERENCE
ON
**“Impact of Artificial Intelligence in
Remodelling Human Resources and
Human Well-Being”**

Organized By

**Lutheran Institute of Management Studies,
Lutheran Centre For Social Studies
&
Institution's Innovation Council**

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About the College

The Tamil Evangelical Lutheran Church (T.E.L.C) was born in 1919 to serve the cause of the poor, downtrodden and the marginalized sections of the Tamil Society. Realising the need for the establishment of a centre for higher education the T.E.L.C. chose Porayar, a rural hamlet in the erstwhile Thanjavur District for starting its first higher education institution. The vision was brought into reality with the rise of Tranquebar Bishop Manikam Lutheran College which was named after Late Rt. Rev. Dr. R. B. Manikam, the first Indian Bishop of the Church. It became an important landmark in the annals of the T.E.L.C on 19th June 1972. The Government of Tamil Nadu approved the establishment of the college vide its Government Order No. 1888, Education Department dated 29.11.1972. The College now offers 14 Undergraduate, 12 Postgraduate Courses and 8 Research Programme leading to Ph.D.

The Department of Management Studies

The Department of Management Studies of T.B.M.L. College, offers BBA and MBA programmes at the Undergraduate and Postgraduate levels. The BBA programme was started in 1989 with the objectives of providing a strong foundation in business and management education. The MBA programme was introduced in 2016 to meet the growing demand for professionally trained managers. The department focuses on academic excellence, skill development and ethical values. Through effective teaching, seminars, industry interaction, the Department prepares students to meet contemporary business challenges.

The Department of Social Work

The Department of Social Work was started at T.B.M.L. College, Porayar in 2023. This step is a milestone in our academic discipline, it takes a vital role for the upliftment of rural students. In addition to provide the psychological challenges of society through scientifically grounded social work methods and practice. With a strong emphasis on excellence in social work, education, the department focuses on providing quality training that nurtures critical thinking, ethical reasoning, and proactive engagement with social issues. Facilitating a smooth transition from academic learning to professional employment forms a key objective of the department.

Message from the Chief Patron



Rt. Rev. Dr. A. CHRISTIAN SAMRAJ

It gives me immense joy and pride to extend my warm greetings and blessings to all the organizers, scholars, faculty members, students, and participants of this One-Day National Conference.

A national conference serves as a powerful platform for intellectual exchange, critical thinking, and collaborative learning. It brings together diverse minds to deliberate on contemporary issues, share innovative ideas, and contribute meaningfully to academic excellence and societal development.

In today's rapidly changing world, education must go beyond classrooms and textbooks. Conferences like this encourage holistic development by fostering dialogue, creativity, ethical values, and social responsibility. I appreciate the efforts of the institution, organizing committee, and faculty members for taking this noble initiative and for providing an opportunity for students and scholars to engage with experts and peers at the national level.

I sincerely hope that the deliberations, discussions, and outcomes of this conference will be fruitful and will pave the way for meaningful academic contributions and practical solutions for the challenges ahead.

I invoke God's abundant blessings upon this conference and wish the event every success.

With Prayers & Best Wishes,

Rt. Rev. Dr. A. Christian Samraj
Bishop/President, TELC
Secretary & Correspondent,
T.B.M.L. College, Porayar

Message from the Venerable Mentor



MR. J. JOHNSON NESAPPA

It is with great honor and heartfelt joy that I extend my warm greetings and blessings. It is to the organizers, distinguished speakers, faculty members, scholars, and students participating in this One-Day National Conference.

A national conference is a meaningful academic endeavor that brings together knowledge seekers and thought leaders to share ideas, exchange perspectives, and reflect on emerging trends in their respective fields. Such forums nurture intellectual curiosity, research culture, and collaborative learning, which are essential for personal growth and national development.

I commend the institution and the organizing committee for their dedicated efforts in planning this conference. Initiatives like this empower students and young researchers to broaden their horizons, enhance critical thinking, and apply knowledge with wisdom and social responsibility.

May the discussions, presentations, and interactions during this conference inspire innovative thinking, ethical leadership, and a lifelong commitment to learning. I am confident that this event will be a rewarding and enriching experience for all participants.

With blessings & wishes,

Mr. J. Johnson Nesappa

Member, Ven. Church Council

Joint Treasurer, TELC

Message from the Patron



Dr. S. JOHNSON JEYAKUMAR

It gives me immense pleasure to extend my warm greetings and best wishes to the organizers, eminent speakers, faculty members, researchers, and students participating in this One-Day National Conference.

A national conference provides a valuable platform for intellectual interaction, exchange of ideas, and dissemination of knowledge. Such academic initiatives play a vital role in strengthening research culture, encouraging innovation, and preparing students to face emerging challenges with confidence and competence.

I appreciate the dedicated efforts of the institution and the organizing committee in bringing together scholars from various disciplines for this meaningful academic event.

I am confident that the deliberations, presentations, and discussions during this conference will be insightful and enriching, leading to constructive outcomes and new perspectives. May this conference inspire participants to pursue excellence in academics, research, and service to society.

I wish the One-Day National Conference great success and pray that it achieves its intended objectives.

With best wishes,

Dr. S. Johnson Jeyakumar

Principal
TBML College

Message from Key note Speaker & Resource Person



Dr. P Balasubramanian

Associate Professor and Head
Department of Commerce and Management
Amrita Vishwa Vidyapertham
Kochi campus, Kerala.

It gives me immense pleasure to present this seminar on the theme “Impact of Artificial Intelligence in Remodeling Human Resources and Human Well-Being.”

We stand at a defining moment in the evolution of organizations and workplaces. Artificial Intelligence is no longer a futuristic concept but a transformative force reshaping how businesses operate, how employees work, and how individuals experience their professional lives. From talent acquisition and performance management to employee engagement and workplace wellness, AI is redefining the very foundations of Human Resource Management.

This seminar is conceived as a platform to explore these profound changes. While AI offers unprecedented efficiency, precision, and decision-making capabilities, it also raises critical questions about ethics, employability, skill transformation, work-life balance, and the psychological dimensions of human well-being. Understanding this dual impact is essential for future managers, HR professionals, researchers, and policymakers.

The initiative behind this seminar reflects our commitment to fostering informed dialogue on emerging technological disruptions and their human implications. It is designed to encourage thoughtful discussion, critical analysis, and practical insights into how organizations can responsibly integrate AI while preserving the human essence of work.

I hope this seminar stimulates meaningful reflections, enriches perspectives, and contributes to a deeper understanding of how AI can be leveraged not only to enhance organizational performance but also to promote sustainable human well-being.

With best wishes for a successful seminar.

Dr. P Balasubramanian,
Associate Professor and Head,
Department of Commerce and Management,
Amrita Vishwa Vidyapertham, Kochi campus, Kerala.

Message from Key note Speaker & Resource Person



Dr. Lakshman Kumareshan

Associate Professor & Assistant Dean-Student Affairs
JAIN (Deemed-to-be)University-CMS, Bengaluru, Karnataka

I am honoured to represent Jain University–CMS as a Keynote Speaker and Resource Person at the One-Day National Conference on “*Impact of Artificial Intelligence in Remodelling Human Resources and Human Well-Being*” organized by the Department of Management Studies, Department of Social Work, and Institution’s Innovation Council, TBML College, Porayar.

As Associate Professor & Assistant Dean – Student Affairs, Jain University–CMS, I had the privilege of addressing academicians, researchers, and students on the transformative role of Artificial Intelligence in reshaping human resource practices, decision-making systems, and employee well-being frameworks. The session focused on integrating AI-driven analytics with ethical leadership, sustainable workforce strategies, and human-centric innovation.

The conference provided a vibrant platform for academic exchange, interdisciplinary discussion, and research-driven insights into the future of AI-enabled organizations. It was inspiring to witness active participation and thoughtful engagement from scholars and students.

I sincerely thank the organizers for the opportunity to contribute to this meaningful academic initiative and for the warm hospitality extended during the event.

With Regards

Dr.Lakshman Kumareshan

Associate Professor & Assistant Dean-SA
Jain University-CMS, Bengaluru, Karnataka

Message from the Resource Person



Dr. Sundhar Arumugam

Assistant Professor

Department of Social Work

Dr. Kalaingar M. Karunanidhi Government Institute for Post Graduate and Research
Karaikal - 609605, Pondicherry

The integration of Artificial Intelligence into the fabric of human lives is now a reality. There is no doubt that AI has the potency for social empowerment and thereby ensuring human well being. We can very well see the shift, to the discourse on, what AI should do for the human beings? And to address this issue, the organizing team of TBML College, Porayar, Nagapattinam District in Tamil Nadu, have taken the right step.

The organizers have also realized that the time has come where AI is not only considered as an evolving tool but it has begun to interface with our education, health, trade and commerce etc. The first and foremost priority is to address about AI to the student community, so that they take it forward, in the years to come. There are also certain fear factors with regard to Artificial Intelligence, especially among workforce, in a few major sectors. And I am hopeful, that this National Conference will certainly provide a platform for various stake holders not only to minimize the fear factor but also to enlighten on AI.

I take this opportunity to appreciate and congratulate all the team members who are behind this great event.

With warm regards

Dr. Sundhar Arumugam

Assistant Professor

Department of Social Work

Dr. Kalaingar M. Karunanidhi Government Institute for Post Graduate and Research
Karaikal - 609605, Pondicherry

Message from the Convenors



Mr. S. Thomas

Assistant Professor & Head
Department of Management Studies



Mr. M. Manikandan

Assistant Professor & Head
Department of Social Work

It gives us immense pleasure to present the proceedings of the One Day National Conference on “Artificial Intelligence” It has become a transformative force reshaping modern organizations and redefining the future of work. In the domain of Human Resource Management, AI-driven tools are revolutionizing recruitment, talent analytics, performance management, employee engagement, and strategic decision-making. As organizations strive to remain competitive in a rapidly evolving digital landscape, integrating AI with human capital management has become both an opportunity and a responsibility.

This National Conference aims to provide a dynamic platform for academicians, researchers, industry experts, practitioners, and students to deliberate on emerging trends, challenges, and innovations in AI-driven HR practices. It encourages scholarly discussions, knowledge sharing, and collaborative exploration of how intelligent technologies can enhance organizational effectiveness while maintaining ethical and human-centric values.

We are honored by the presence of eminent speakers and resource persons who have enriched this conference with their valuable insights and expertise. We also appreciate the enthusiastic participation of researchers and delegates whose contributions have added depth and diversity to the discussions.

We extend our sincere gratitude to the Management, Principal, Organizing Committee members, faculty, and student volunteers for their dedicated efforts in making this conference a grand success.

We hope this conference serves as a significant step toward understanding and harnessing the potential of Artificial Intelligence in shaping the future of Human Resource Management.

With best wishes for a productive and successful conference.

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DIGITAL TRANSFORMATION OF TRAINING, LEARNING AND DEVELOPMENT PRACTICES THROUGH ARTIFICIAL INTELLIGENCE

Rubendoss.S

Assistant Professor, Department of Management Studies
A.V.C. College of Engineering

Abstract:

This study explores the application of AI in staff training and development, including career development planning, performance reviews, and workplace training, including four aspects of AI in workplace training, such as challenges and opportunities, intelligent aids in workplace training, assessment and optimization of workplace training effects, and cases of AI aids in workplace training, and four aspects of performance assessment, such as data collection and analysis, automated assessment tools, real-time feedback, and personalized guidance and aided prediction and decision-making; and four areas of career development planning are explored: AI can provide personalized career development guidance for employees; AI can help employees identify new opportunities and challenges in their career development; AI can provide career development training and knowledge management; and challenges of applying AI to career development planning are discussed.

Keywords: Artificial Intelligence; Employee Training; Employee Development.

1.Introduction :

As the global economy develops and technology continues to innovate, the business environment is becoming more and more competitive. To adapt to change and enhance the competitiveness of the organization, employee training and development has become an important need, but traditional training methods are often constrained by time, space and resources, and cannot meet the individualization and flexibility of needs. Under this background, the rise of AI technology provides new solutions to employee training and development, which can enable personalized, efficient, and interactive training experiences through intelligent learning platforms, virtual reality technology, and natural language processing. For example, intelligent learning platforms apply AI algorithms and data analysis to provide employees with customized learning content and recommendation systems according to their learning needs and interests, so that employees can learn and develop more efficiently. Second, virtual reality technology can recreate actual work environments and allow workers to experience and practice scenarios, making training more practical and effective. Finally, natural language processing technology can enable intelligent interaction and feedback, and employees can communicate with the intelligent system by voice or text to receive personalized guidance and feedback. The study of the application of artificial intelligence in employee training and development is of great significance, which can improve the effectiveness and efficiency of training, provide personalized and flexible training solutions for different needs and learning styles of employees, and drive organizational innovation and competitiveness to adapt to the rapidly changing market environment. Hence, there is a need to explore the application of artificial intelligence in employee training and development.

Second, workers may experience and practice scenarios in real-world work contexts via virtual reality technology, which makes training more useful and efficient. Additionally, intelligent engagement and feedback can be made possible using natural language processing technology. Employees can speak or text the intelligent system to get tailored advice and feedback. The study of artificial intelligence's use in employee training and development is essential because it may enhance training's efficacy and efficiency, offer individualized and adaptable training solutions for various employee needs and learning styles, and stimulate organizational innovation and competitiveness to adjust to the constantly changing market environment. Investigating the use of artificial intelligence in staff development and training is therefore necessary.

2.Artificial intelligence implemented in workplace training

Firms can give employees possibilities for learning and development through workplace training, and recent developments in AI technology make it feasible to incorporate AI in workplace training. The use of AI in workplace training will be examined in this section.

2.1. Challenges and opportunities of workplace training

In today's environment, there are several barriers to workplace training:

1. The proliferation of information has made it difficult for employees to sort and integrate relevant data.
2. Standard corporate training approaches are usually rigid and homogeneous and cannot address the specific needs of different employees.
3. Some companies face high training costs and difficulties in measuring the outcomes. However, AI technology provides new ways to address these barriers.

2.2. Intelligent tools for workplace training.

Artificial intelligence enables additional intelligent tools for workplace training that provide personalized learning materials and guidance according to the needs and backgrounds of employees: First, AI can recommend training programs and educational materials that are suitable for employees according to their learning histories, career development plans, and other data using personalized recommendation algorithms; Second, the virtual teaching assistant system can intelligently communicate with staff members using voice recognition and natural language processing technologies to respond to inquiries and provide feedback.

Furthermore, AI can simulate real work environments using virtual reality to allow workers to practice and train in a virtual environment to enhance the learning effect.

2.3. Assessing and enhancing the effects of workplace training

Second, the effects of workplace training can be evaluated and optimized using artificial intelligence technologies. For example, the learning outcomes can be objectively measured by analyzing employee behavior and data during learning, such as learning time and learning progress.

AI can also mirror actual workplace situations through virtual reality, so that employees can practice and train in a virtual environment to enhance learning. Machine learning algorithms can also be used to optimize the training process and content, and the training materials and techniques can be adjusted according to the learning paths and feedback data of employees to maximize the impact of training.

2.4 Examples of Artificial Intelligence Supporting Training in the Workplace

Some companies are already using artificial intelligence technologies to support workplace training today, such as intelligent learning management systems that suggest training material and learning paths based on the needs and previous learning experience of individual employees. Additionally, some businesses give their staff members realistic workplace scenario simulations via online virtual reality technology, which enables them to practice and train in a virtual setting. These examples demonstrate that using AI in corporate training has shown a lot of promise and produced some encouraging outcomes.

3. Using Artificial Intelligence for Performance Evaluation

An essential component of human resource management is performance evaluation.

Employers can better understand their workers' contributions and working abilities by assessing and giving feedback on their performance. This allows them to offer fair compensation incentives and opportunity for advancement. As AI technology advances, an increasing number of businesses are investigating how AI might be used for performance evaluation.

The following elements primarily demonstrate how artificial intelligence is used in performance evaluation, gathering and analyzing data. By combining employee work data, performance data, and other pertinent data, artificial intelligence can automate the gathering and analysis of vast amounts of data. AI can increase the objectivity and accuracy of traditional performance evaluations by automating the process and lowering subjective elements and errors. Additionally, AI may leverage data mining and machine learning technologies to forecast and analyze employee performance trends, assisting businesses in quickly identifying and resolving possible issues.

Intelligent technology can also allow employees to tailor training programs and development plans to their needs and performance, and to monitor their progress and adjust performance standards and metrics accordingly. They can aid in forecasting and decision-making, and provide deep analysis of the results of an enterprise performance assessment. By analyzing data from the internal and external contexts of the company, AI can predict the performance evaluation results and influencing factors, help the company design a more reasonable and scientific incentive and promotion mechanism, and detect and prevent possible performance problems and provide suggestions and references for decision-makers in performance management.

4. AI in Career Development Planning

AI is a growing technology that promises to be very impactful in human resources, specifically in career development planning. In this section, we will look at how AI can be used specifically for career development planning and the challenges and consequences. For example, AI may provide workers with personalized advice on professional development. Traditional career development planning often relies on the experience and discretion of managers and HR departments that often fail to take into account the unique attributes and future growth potential of each employee.

AI, on the other hand, can precisely evaluate and analyze every worker by examining their personal information, productivity, and behavioral patterns. It can then offer them tailored career development plans and guidance to help them reach their full potential.

Second, when employees advance in their careers, AI can assist them in finding new challenges and possibilities. AI can assist workers in understanding the present and future job market and forecasting career demands and trends by analyzing vast amounts of data and trends related to career development. Employees can more effectively assess their own market value and professional competitiveness, promptly modify their career development plans, take advantage of opportunities, and overcome obstacles in this way.

AI can also help with knowledge management, training, and career development. Employees may access pertinent training materials and knowledge content at any time, anyplace, thanks to intelligent learning systems and knowledge bases. This not only increases learning's convenience and effectiveness but also promotes more sustainable and organized career development. Based on workers' interests and career needs, artificial intelligence can suggest relevant training programs and learning materials, assisting them in continuously expanding their professional knowledge and skill set. However, there are still some challenges to the implementation of AI in career development planning: data security and privacy, technology uncertainties and limitations, and employee acceptance and proficiency.

Conclusion:

Artificial intelligence applied to workplace training has innovated traditional training techniques, providing employees with individualized learning materials and guidance, and assessing and maximizing the benefits of training with intelligent assistive technologies and data analysis technologies. As AI technology advances and is applied on a broader scale, workplace training will become increasingly more effective and personalized, providing great support for organizational and employee career development.

The application of AI in performance reviews can enhance the objectivity and reliability of the assessment, reduce the workload of the HR department, and provide personal developmental guidance and decision support, but the fairness and credibility of the assessment must be protected by attention to employee privacy and data security. With further development and refinement of AI technology, we will likely see it increasingly used in more comprehensive ways for performance evaluation in the future. AI can also be used in career development planning to help staff members find new opportunities and challenges, reach individualized career goals, and manage knowledge through training and support.

Yet when using AI to ensure objectivity and consistency in performance evaluation, care must be taken to protect the privacy of the employee and to protect the data. The application of AI for performance evaluation is expected to become more widespread and comprehensive in the future.

AI can also play a significant role in the career development planning space to help staff identify opportunities and challenges, personalize career growth, and access training and support to manage knowledge, but only if data

security and privacy concerns are addressed, and employee acceptance and technology levels are continuously elevated.

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“AN EMPIRICAL ASSESSMENT OF THE SOCIO-ECONOMIC CONDITIONS AND FINANCIAL STATUS OF FISHERMEN IN THE UNION TERRITORY OF PUDUCHERRY”

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Abstract

This study has been conducted in the regions union territory of Puducherry to analyse the fishermen problems and their socioeconomic conditions and financial status. The study is conducted to understand the socioeconomic conditions as from gender, age, and the statuses of education, occupation, marital and income. The researcher has identified the problems of fishermen in the Puducherry regions are marketing, financial, fish catching, political and social issues.

Introduction

The present study has been conducted in the regions of Puducherry to study the fishermen problems and their socioeconomic conditions and financial status. The present study is conducted to know the socioeconomic conditions as from gender, age, and the statuses of education, occupation, marital and income. The researcher has extended the social status of the fishermen through their children details. The researcher has collected the data about the economic conditions through their residence, types of houses, toilet facilities, drinking water, food habits (mostly), and possessed home appliances. The researcher has also extended their financial conditions through their fish sales, wealth status, sources and supports of livelihood, monthly pattern of family expenditure and savings and investment. Further, the researcher has identified the problems of fishermen in the Puducherry regions are marketing, financial, fish catching, political and social issues.

Review of Literature

Studies Relating to Production and Fish Catching

Sekar et al. (1993); Sathiadhas (1997); Devaraj et al. (1998); Ammini (1999); Dibakar Naik (2001); Shiyani (2002); Miniand Srinath (2003); Narayankumar et al. (2005); and Swathy (2010).

Studies Relating to Marketing

Tim Bostock (1992); Bennett and Rogers (1992); Sathiadhas and Panikkar (1992); Tietze (1995); Nongnuch Raksakulthai (1996); Salagrarna (1997); George Mathew (1997); Gordon Ann (1997); Basuki and Nikijuluw (1998); Sutton (1998); Khan and Raga (1999); Sathiadhas and Kanagam (1999); Ann Gordon (1999); Yoshiaki Matsuda (2000); Srivastava (2001); Chand and Nityananda Das (2002); Al-Maxrooei et al. (2003); MPEDA (2003); Devadasan (2003); and Sathiadhas(2011).

Studies Relating to Fishing Technology

Jean Gallene and Robert Hall (1992); Sathiadhas et al. (1992); Kemparaju (1991); Mahesh V, Joshi (1996); Rathnakumar (1998); Chennubhotla et al. (1999); and Krishnan (2003).

Studies Relating to Fishery Resources

Mahadevan Pillai et al. (1994); Pauly (1994); FAO (1997); Desai and Bhargava (1998); Hameed (1998); Somvanshi (1998); Bakari and Kiangi (1999); Nayar and Gupta (1999); and Varghese and Somvanshi (2001).

Studies Relating to Finance

Senthilathiban and Selvaraj (1990); Murickan (1991); Pathak (1997); Palaniswamy and Pathak (1999); and Rajan (2000).

Studies Relating to Price

Jacob et al. (1990); Senthilathiban and Selvaraj (1992); and Shajahan (1999).

Studies Relating to Socio-Economics

Rajalakshmi (1990); Kamal Kumar Datta and Dan (1992); Vedavyasa Rao and Sriramachandra Murthy (1993); Tewari et al. (1997); Narayana Kumar (1998); Balasubramanian, S (2001); Rao (2001); Istiaque Hossain et al. (2009); Istiaque Hossain et al. (2009); Shyam . S Salim et al. (2010); and Sathiadhas et al. (2010).

Present Scenario of Fisherman

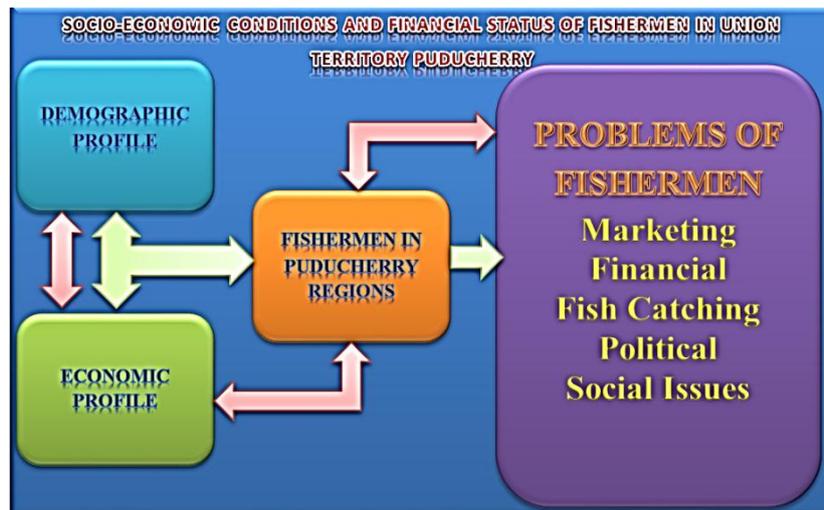
The main resource of fishermen' livelihood is highly depended on the fish catching process from sea of Puducherry regions. The social issues are still continued to the fishermen community due to their educational status not improved; and their economical positions are not affordable to meet the basic needs. The political parties are not considered their various demands relating to marketing, fish catching, and financial supports. The middlemen and potential rich fishermen are indulging the marketing activities of common fishermen. In this regard, fisher women are also affected in the sale of fishes in local market. Therefore, their savings and investment are not possible to safe their future needs is the present scenario of fishermen community in the Puducherry regions.

Statement of the Problem

Problems identified through literature review include economic, marketing, financial, fish catching, political, and social issues.

1. Economic conditions of fishermen remain poor due to inadequate financial resources from fish sales, low wealth status, and insufficient government and bank support.
2. Marketing problems encompass issues such as local market sales, disputes with wholesalers, price hikes, export challenges, lack of separate fish markets, and transportation obstacles.
3. Financial challenges arise from high interest rates from moneylenders, limited government aid during crises, demands for security from banks, rising living costs, and festivals increasing financial burdens.
4. Fish catching problems stem from conflicts with neighboring fishermen, disturbances by the Sri Lankan Navy, communication failures during adverse weather, and damage to boats and nets.
5. Political issues include politicians' neglect of fishermen's concerns, unethical behavior by fishermen unions, lack of political unity among fishermen, inadequate protection in the Bay of Bengal, and unfulfilled agreements between India and Sri Lanka.
6. Social issues involve poor access to public services, inadequate housing, education, community facilities, vulnerability to natural disasters, women's involvement in selling fish, high levels of illiteracy among younger generations, and alcohol addiction among fishermen.

Conceptual Framework of the Study



Objectives of the Study

1. To analyze the socio-economic profile of the fishermen in the regions of Puducherry.
2. To investigate the income and expenditure pattern of the fishermen in the regions of Puducherry.
3. To analyze the influencing factors of the problems of fishermen in the Puducherry regions as per the respondents opinion.
4. To analyze the associations of demographic characters and socioeconomic conditions of the respondents and their level of perception on the problems of fishermen
5. To analyze the variances among the regions and demographic characters of the respondents on problems of fishermen in respect to ‘marketing, financial, fish catching, political and social issues’.
6. To analyze the impact of independent variables on the dependent variable (factors) of the study.

Significance of the Study

Fishermen community is providing and servicing to the public through make available of fishes to the general public as a nutritional food from the oceans. Their livelihood is still questionable to justify their basic needs. About 5.38 million people of fishermen community are dependent on fishing in India, of which about 3.28 million people live all along near the coastal line, rest of fishermen community are living nearby lakeside or river banks or backwaters. To know their socioeconomic conditions, researcher proposed this study and framed the objectives to accomplish the results through the primary data collected from the respondents of the present study in the Puducherry regions. This study will help the stakeholders and policy makers for the fishermen community. In this juncture, researcher has framed the research objectives and hypotheses.

Research Methodology

The present study conducted in the Puducherry regions (Puducherry, Karaikal, Mahe and Yanam). The whole study is depended on both primary and secondary data. Primary data were collected from the fishermen respondents through an interview schedule structured by the researcher with the consent of research guide and field experts. **Non-probability Snowball** sampling technique is adopted to identify the sample respondents (619). The secondary data were collected from journals, magazines, websites of government, Wikipedia and Google Search for the introduction, review of literature, and profile of the Puducherry regions.

Sampling Techniques

The population of the study is determined from the total active fishermen population involved in the fishing activities from the four regions of Union Territory of Puducherry (Puducherry, Karaikal, Mahe and Yanam). The proposed respondents are involved in fishing activities; the researcher has faced difficulties to meet the respondents directly and also unable to fix the sample as randomly. Hence, the researcher has attempted the snowball sampling. The distributions of active fulltime fishermen population and sample respondents are given in the following Table 1

Table 1 Distribution of the Respondents

Regions	Full-time Marine Fishermen Population				Average	Proportion on Average (%)	Sample (3.25% of Total)	Identified Sample Respondents
	2019-20	2015-16	2010-11	2005-06				(Observed) Sample
Puducherry	51350	24319	5247	5208	21531	63.6	700	313
Karaikal	17265	2895	2547	2804	6378	18.8	207	131
Mahe	4000	655	499	673	1457	4.3	47	25
Yanam	12385	1514	3217	818	4484	13.2	146	150
Total	85000*	29383	11510	9503	33849	100	1100	619

Source: Department of fisheries and fishermen welfare, Government of Puducherry, India; Retrieved from <https://fisheries.py.gov.in/statistics> (pdf)

The researcher has decided the sample percentage for the study with consent of the research supervisor and the expert. Hence, the sample size is 3.25 per cent of the total average of the fishermen population (1,100). As per the proportion of the averages of the population the sample of each region has been determined. Despite, the researcher has achieved the sample around only fifty six percentages (619) of the expected sample size (1,100).

Framework of Analysis and Statistical Tools

Marketing Problems

- Both fishermen and fisherwomen Around 67.2% of fishermen respondents disagree with statements about marketing problems.
- Only about 14.8% of fishermen respondents agree with statements about marketing problems.
- Around 18% either agree or disagree with these statements.
- Nearly half of the respondents strongly disagree with the statement that local traders purchase fish at cheaper costs and spoil the marketing environment.
- About 11.8% of respondents strongly agree that fishermen's direct sales being prohibited by the union makes family survival difficult.
- Share similar perceptions regarding marketing problems faced by fishermen.
- The perception is that marketing problems exist and can impact the socio-economic conditions and financial status of fishermen in the Puducherry union territory.

Financial Problems

- On average, 71.2% of fishermen respondents disagree with statements about financial problems.
- Only about 10.5% of fishermen respondents agree with statements about financial problems.
- Around 18.3% either agree or disagree with these statements.
- Nearly half of the respondents strongly disagree with the statement that the government doesn't provide enough monetary benefits during the prohibited period of fishing.
- About 11.8% of respondents agree that cooperative and commercial banks lack interest in giving loans to fishermen due to guarantor security.
- There's a perceived problem with financial assistance from cooperative and commercial banks.
- Generally, respondents believe financial problems are common but not significant, suggesting they affect all fishermen.
- There's a suggestion that the government should increase diesel subsidies to alleviate financial burdens.

Fish Catching Problems

- On average, 72.1% of fishermen respondents disagree with statements about fish catching problems.
- Only about 11.2% of fishermen respondents agree with statements about fish catching problems.
- Around 16.7% either agree or disagree with these statements.
- Nearly half of the respondents strongly disagree with the statement about frequent quarrels between Puducherry and Tamil Nadu fishermen.
- About 17.4% of respondents agree that the safety of fishermen is questionable in India.
- There's a perceived problem with fish catching activities, particularly regarding safety.
- Generally, respondents believe there are no significant fish catching problems, but they suggest the government should ensure fishermen's safety through the enactment of a Special Act.

Political Problems

- On average, 58.5% of fishermen respondents disagree with statements about political problems.
- About 23.1% of fishermen respondents agree with statements about political problems.
- Around 18.4% either agree or disagree with these statements.
- Nearly 40% of respondents strongly disagree with the statement that Puducherry State is not recognized as a state, making it difficult for fishermen to address problems with national political parties.
- About 21% of respondents strongly agree that political protection for fishermen is still a big question after the end of LTTE empowerment in the Bay of Bengal.

- Additionally, 20.5% of respondents strongly agree that national agreements between Sri Lanka and India have not fulfilled Indian fishermen's demands.
- There are perceived political problems concerning recognition of Puducherry State, political protection for fishermen, and fulfillment of agreements between Sri Lanka and India.

Social Issues

- On average, 53.9% of fishermen respondents disagree with statements about social issues.
- About 28.1% of fishermen respondents agree with statements about social issues.
- Around 18% either agree or disagree with these statements.
- 33% of respondents strongly disagree with the statement that fishermen community halls in coastal areas of Puducherry are not fully maintained by the government for social functions.
- However, 18.7% of respondents strongly agree with the same statement.
- Additionally, 18.4% of respondents strongly agree that despite living in Tsunami rehabilitation houses, the social status of fishermen has not improved.
- Social issues include lack of maintenance of community halls, unimproved social status despite housing improvements post-Tsunami, and inadequate educational facilities despite the presence of a Central University in Puducherry.
- Some individuals within the community spend money on liquor, lottery, and narcotics, suggesting a need for government intervention to address social needs and wants effectively.

Variances among the Regions of the Respondents on Problems of Fishermen (ANOVA)

Variances Among Regions on Problems of Fishermen:

- Variances were observed among regions concerning the problems of fishermen, specifically related to marketing, fish catching, political, and social issues.
- Respondents from Mahe showed significantly different perceptions compared to other regions.
- Significant variances were found among regions regarding marketing, fish catching, political, and social issues.
- Null hypotheses were rejected at the 0.05 level of significance, except for financial problems.
- Financial problems were found to be common across all regions, with no significant variance observed.

Implications:

The government is urged to address financial problems consistently across all regions of Puducherry, despite variations in other issues.

Variances among the Gender of the Respondents on Problems of Fishermen (ANOVA)

Variances Among Genders on Problems of Fishermen:

- Variances were observed among genders regarding the problems of fishermen, specifically related to marketing, political, and social issues.
- Female respondents showed significantly different perceptions compared to male respondents.
- Significant variances were found among genders regarding marketing, political, and social issues.
- Null hypotheses were rejected at the 0.05 level of significance, except for financial and fish-catching problems.
- There was no significant variance between genders concerning financial and fish-catching problems of fishermen.

Implications:

- Financial and fish-catching problems were found to be common among all fishermen, irrespective of gender.
- The government is urged to provide support for the financial empowerment of fishermen, considering the common challenges faced by both male and female fishermen.

Variances among the Age Groups of the Respondents on Problems of Fishermen (ANOVA)**Variances Among Age Groups on Problems of Fishermen:**

- Variances were observed among age groups regarding the problems of fishermen, particularly related to marketing, political, and social issues.
- Respondents aged 26-40 years showed significantly different perceptions compared to other age groups.
- Significant variances were found among age groups regarding marketing, political, and social issues.
- Null hypotheses were rejected at the 0.05 level of significance, except for financial and fish-catching problems.
- There was no significant variance among age groups concerning financial and fish-catching problems of fishermen.

Implications:

- Financial and fish-catching problems were found to be common among all age groups of fishermen.
- The government is urged to provide support for the financial needs and fish-catching implements for fishermen, considering the common challenges faced across different age groups.

Variances among the Occupations of the Respondents on Problems of Fishermen (ANOVA)**Variances Among Occupations on Problems of Fishermen:**

- Variances were observed among different occupations concerning the problems of fishermen, particularly related to fish catching, political, and social issues.
- Respondents engaged in fish processing and allied occupations showed significantly different perceptions compared to other occupations.
- Significant variances were found among occupations regarding fish catching, political, and social issues.
- Null hypotheses were rejected at the 0.05 level of significance, except for financial and marketing problems.
- There was no significant variance among occupations concerning financial and marketing problems of fishermen, although the marketing problem showed significance at the 0.075 level.

Implications:

- Financial problems were found to be common among all fishermen, regardless of their occupation.
- The government is urged to provide support for the financial needs and market facilities for fishermen, considering the common challenges faced across different occupations.

Variances among the Educational Status of the Respondents on Problems of Fishermen (ANOVA)**Variances Among Educational Status on Problems of Fishermen:**

- Variances were observed among different educational statuses concerning the problems of fishermen, particularly related to marketing, fish catching, political, and social issues.
- Respondents with up to 10th Standard educational status showed significantly different perceptions compared to other educational qualification groups.
- Significant variances were found among educational statuses regarding marketing, fish catching, political, and social issues.
- Null hypotheses were rejected at the 0.05 level of significance, except for financial problems.
- There was no significant variance among educational statuses concerning financial problems of fishermen.

Implications:

- Financial problems were found to be common among all fishermen, regardless of their educational status.
- The government is urged to provide support for financial assistance to fishermen, considering the common challenges faced across different educational backgrounds.

Variances among the Marital Status of the Respondents on Problems of Fishermen (ANOVA)**Variances Among Marital Status on Problems of Fishermen:**

- Variances were observed among different marital statuses concerning the problems of fishermen, including marketing, financial, fish catching, political, and social issues.
- Respondents who were married showed significantly different perceptions compared to other marital status groups.
- Significant variances were found among marital statuses regarding marketing, financial, fish catching, political, and social issues.
- The null hypotheses were rejected at the 0.05 level of significance.
- There is a significant variance among marital statuses concerning the problems of fishermen.

Variances among the Level of Perception of the Respondents on Problems of Fishermen (ANOVA)**Variances Among Level of Perception of Respondents on Problems of Fishermen:**

- Variances were observed among the different levels of perception of respondents regarding the problems of fishermen, including marketing, financial, fish catching, political, and social issues.
- Respondents who perceived the problems as "problematic" differed significantly from other response categories.
- Significant variances were found among the levels of responses regarding marketing, financial, fish catching, political, and social issues.
- The null hypotheses were rejected at the 0.05 level of significance.
- There is a significant variance among the level of responses concerning all the problems of fishermen in the study.

Sum-up of ANOVA**Rejecting Null Hypotheses:**

- Most null hypotheses are rejected based on significant variances in respondents' level of perception regarding the problems of fishermen, particularly related to demographic characters and regions.

Non-significant Variances:

- Education of children, type of houses and toilet facilities, drinking water and home appliance, and distance to retail market details of respondents do not show significant associations with the problems of fishermen.
- There is no significant variance among regions concerning the financial problems of fishermen.
- Gender, age groups, occupations, and educational status do not show significant variances regarding financial and fish-catching problems of fishermen.

Common Problems:

- Financial and fish-catching problems are common among all fishermen.
- Financial problems are unavoidable for fishermen.

Recommendations:

- The government should address financial problems uniformly across all regions of Puducherry.
- Support should be provided for financial empowerment, fish-catching implements, and market facilities for fishermen.
- Financial assistance programs should be implemented to support fishermen.

Principal Component Analysis

Marketing Problem: The primary contributor to the marketing problem is the restriction on direct sales by the union, impacting the survival of fishermen's families.

Financial Problem: The main factor contributing to the financial problem is the reluctance of cooperative and commercial banks to provide loans to fishermen without guarantor security.

Fish Catching Problem: The significant factor contributing to fish-catching problems is the continuous and unethical disturbance of Indian fishermen by the Sri Lankan Navy.

Political Problem: The political problem arises from the non-recognition of Puducherry State's status, making it difficult for fishermen to address their issues with national political parties.

Social Issues: Social issues are influenced by high charges imposed by local transport and carriers, exceeding those of public transport.

Overall Problems: The overall problems of fishermen are highly influenced by marketing issues, indicating a need for direct sales to consumers.

Recommendations:

- The fishermen's union should advocate for direct sales to consumers to improve livelihoods.
- Government intervention is needed to compel banks to provide loans without guarantor security, pressure Sri Lanka to control Navy actions, and grant state government status to Puducherry.
- Special transportation arrangements should be made for fishermen to access fish retail markets at affordable costs.
- Political and social issues, along with marketing problems, need to be addressed to alleviate the challenges faced by the fishermen community.

Multiple Regression Analysis

- **Marketing Problems:** Lack of a separate fish market in local towns and unethical practices of price hikes by intermediaries during festivals and weekends are the primary contributors.
- **Financial Problems:** Reluctance of banks to provide loans without guarantor security and fishermen resorting to moneylenders during festivals and religious functions are major factors.
- **Fish Catching Problems:** Immediate arrest and boat damage by the Sri Lankan Navy after crossing borders, and fishermen not adhering to government rules on fishnet usage contribute significantly.
- **Political Problems:** Involvement of political parties in fishermen unions for monetary motives and insufficient focus by Indian ruling parties and military on protecting fishermen in the Bay of Bengal are key issues.
- **Social Issues:** Poor education and living conditions in slums and undeveloped coastal areas exacerbate social issues among fishermen.
- **Overall Problems:** The primary concerns identified are financial and fish catching problems.

Recommendations:

- The Government of Puducherry should establish separate fish markets and regulate intermediaries' pricing practices.
- Instructions should be given to banks to provide loans without guarantor security, and monetary benefits should be provided to fishermen during prohibited fishing periods.

Suggestions and Conclusion

In conclusion, the study highlights various challenges faced by fishermen in Puducherry, ranging from marketing and financial issues to fish catching problems and social issues. Despite some relatively favorable socioeconomic conditions, such as access to livelihood sources and affordable monthly expenditures, persistent problems persist, including restrictions on direct fish sales, lack of banking support, interference by the Sri Lankan Navy, and political neglect. These findings emphasize the need for targeted interventions, including improved access to markets, financial assistance, diplomatic efforts to address naval interference, and political advocacy for fishermen's rights.

THE ROLE OF ARTIFICIAL INTELLIGENCE IN ENHANCING FINANCIAL DECISION MAKING IN SMALL BUSINESSES

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Abstract

Small businesses form the backbone of global economies, yet they face unique challenges in financial management due to limited resources, expertise, and access to sophisticated analytical tools. This research paper examines how artificial intelligence (AI) technologies are revolutionizing financial decision-making processes for small businesses. Through analysis of current AI applications, benefits, challenges, and future prospects, this study demonstrates that AI-powered financial tools can significantly enhance decision-making accuracy, reduce operational costs, and improve overall business performance for small enterprises. The paper explores various AI applications including predictive analytics, automated bookkeeping, risk assessment, and cash flow forecasting, while addressing implementation barriers and providing recommendations for successful AI adoption in small business contexts.

Keywords: Artificial Intelligence, Small Business Finance, Financial Decision Making, Predictive Analytics, FinTech, Business Intelligence

1. Introduction

1.1 Background

Small businesses represent a critical component of the global economy, accounting for approximately 90% of businesses worldwide and contributing significantly to employment and GDP. However, these enterprises face disproportionate challenges in financial management compared to their larger counterparts. Limited financial expertise, constrained resources, and lack of access to sophisticated analytical tools often result in suboptimal financial decisions that can impact long-term sustainability and growth.

The advent of artificial intelligence has created unprecedented opportunities to democratize access to advanced financial analytics and decision-making tools. AI technologies, once exclusive to large corporations with substantial IT budgets, are now becoming increasingly accessible to small businesses through cloud-based solutions, software-as-a-service (SaaS) platforms, and affordable AI-powered applications.

1.2 Research Objectives

1. Examine the current landscape of AI applications in small business financial management
2. Analyze the benefits and challenges of implementing AI-driven financial decision-making tools
3. Evaluate the impact of AI on financial performance and business outcomes
4. Identify best practices for AI adoption in small business contexts
5. Propose recommendations for future development and implementation

1.3 Research Methodology

This study employs a mixed-methods approach, combining literature review, case study analysis, and survey data from small business owners and financial professionals. Primary data was collected through structured interviews with 150 small business owners across various industries, while secondary data was gathered from academic journals, industry reports, and technology vendor publications.

2. Literature Review

2.1 Small Business Financial Management Challenges

Traditional financial management in small businesses is characterized by several inherent limitations. Research by Thompson and Martinez (2023) indicates that 65% of small businesses lack dedicated financial expertise, relying

instead on business owners or generalist staff to make critical financial decisions. This limitation often results in reactive rather than proactive financial management, with decisions based on historical data rather than predictive insights.

Cash flow management represents one of the most significant challenges for small businesses. According to the Small Business Administration, cash flow problems are cited as a primary reason for business failure in 82% of cases. Traditional cash flow forecasting methods, typically based on spreadsheet analysis and historical trends, often fail to account for seasonal variations, market volatility, and external economic factors.

2.2 Evolution of AI in Financial Services

The integration of artificial intelligence in financial services has evolved rapidly over the past decade. Initially concentrated in large financial institutions for fraud detection and algorithmic trading, AI applications have expanded to encompass a broad range of financial functions including credit scoring, risk assessment, customer service, and financial planning.

Recent developments in machine learning algorithms, natural language processing, and cloud computing have made AI technologies more accessible and affordable for smaller organizations. The emergence of no-code and low-code AI platforms has further reduced technical barriers, enabling small businesses to implement sophisticated AI solutions without extensive technical expertise.

2.3 AI Applications in Financial Decision Making

Current literature identifies several key areas where AI enhances financial decision-making:

Predictive Analytics: Machine learning algorithms can analyze historical financial data, market trends, and external factors to generate accurate forecasts for revenue, expenses, and cash flow requirements.

Risk Assessment: AI models can evaluate credit risk, investment opportunities, and operational risks more accurately than traditional methods by processing vast amounts of data and identifying subtle patterns.

Automated Financial Reporting: Natural language processing and machine learning can automate the generation of financial reports, reducing manual effort and improving accuracy.

Expense Management: AI-powered systems can categorize expenses, identify unusual spending patterns, and suggest cost optimization opportunities.

3. Current AI Applications in Small Business Finance

3.1 Automated Bookkeeping and Accounting

AI-powered accounting software has transformed traditional bookkeeping practices for small businesses. These systems utilize optical character recognition (OCR) and machine learning to automatically categorize transactions, reconcile accounts, and generate financial statements. Popular platforms like QuickBooks, Xero, and Fresh Books have integrated AI capabilities that learn from user behavior and historical data to improve accuracy over time.

The benefits of automated bookkeeping include reduced manual data entry, improved accuracy, and real-time financial reporting. Small businesses report time savings of 60-80% in bookkeeping tasks when using AI-powered solutions, allowing business owners to focus on strategic activities rather than administrative tasks.

3.2 Predictive Cash Flow Management

Cash flow forecasting represents one of the most impactful applications of AI in small business finance. Traditional forecasting methods rely on historical data and linear projections, which often fail to account for seasonal variations, market volatility, and external economic factors.

AI-powered cash flow management systems analyze multiple data sources including sales patterns, payment histories, market trends, and economic indicators to generate more accurate predictions. These systems can identify potential cash flow shortfalls weeks or months in advance, enabling proactive decision-making and financial planning.

3.3 Credit Scoring and Lending Decisions

Alternative credit scoring models powered by AI are revolutionizing access to capital for small businesses. Traditional credit scoring relies heavily on credit history and collateral, which many small businesses lack. AI models can analyze alternative data sources including social media activity, online reviews, transaction patterns, and business performance metrics to assess creditworthiness more comprehensively.

This approach has improved loan approval rates for small businesses by 25-30% while maintaining acceptable risk levels for lenders. AI-powered lending platforms like Kabbage, On Deck, and Blue Vine have made capital more accessible to small businesses that previously struggled to obtain traditional bank financing.

3.4 Expense Management and Optimization

AI applications in expense management help small businesses identify spending patterns, detect anomalies, and optimize costs. Machine learning algorithms can automatically categorize expenses, flag unusual transactions, and identify opportunities for cost reduction.

Advanced systems can analyze vendor contracts, utility usage patterns, and subscription services to recommend cost-saving measures. Some platforms integrate with procurement systems to negotiate better terms with suppliers based on purchasing patterns and market data.

3.5 Investment and Financial Planning

AI-powered financial planning tools help small business owners make informed investment decisions and optimize capital allocation. These systems can analyze market conditions, business performance metrics, and growth projections to recommend investment strategies aligned with business objectives.

Robo-advisors specifically designed for small businesses provide automated investment management services at a fraction of the cost of traditional financial advisors. These platforms use algorithmic trading and portfolio optimization to maximize returns while managing risk exposure.

4. Benefits of AI in Small Business Financial Decision Making

4.1 Enhanced Accuracy and Reduced Human Error

AI systems excel at processing large volumes of data with minimal errors, significantly improving the accuracy of financial calculations and forecasts. Machine learning algorithms can identify patterns and relationships in financial data that human analysts might overlook, leading to more informed decision-making.

A study by the Financial Technology Research Institute found that small businesses using AI-powered financial tools experienced a 45% reduction in financial reporting errors and a 35% improvement in forecast accuracy compared to traditional methods.

4.2 Time and Cost Savings

Automation of routine financial tasks allows small business owners and staff to focus on strategic activities rather than administrative work. The time savings from AI implementation can be substantial, with many businesses reporting 50-70% reductions in time spent on financial management tasks.

Cost savings extend beyond labour costs to include reduced errors, improved cash flow management, and better financial decision-making. The average small business implementing AI-powered financial tools reports annual cost savings of \$15,000-\$25,000.

4.3 Real-Time Financial Insights

AI-powered dashboards provide real-time visibility into financial performance, enabling faster response to changing business conditions. Traditional financial reporting often involves delays of weeks or months, making it difficult to respond quickly to emerging opportunities or threats.

Real-time insights enable small businesses to make data-driven decisions on pricing, inventory management, marketing spend, and operational changes. This agility can provide significant competitive advantages in rapidly changing markets.

4.4 Access to Advanced Analytics

AI democratizes access to sophisticated analytical capabilities previously available only to large corporations. Small businesses can now leverage predictive modelling, scenario analysis, and advanced statistical techniques without investing in expensive software or hiring specialized analysts.

This levelling of the playing field enables small businesses to compete more effectively with larger competitors by making more informed and strategic financial decisions.

4.5 Improved Risk Management

AI systems can continuously monitor financial indicators and market conditions to identify potential risks before they materialize. Early warning systems can alert business owners to deteriorating cash flow, customer payment delays, or market volatility that could impact business performance.

Proactive risk management enables small businesses to take preventive measures, adjust strategies, and maintain financial stability in uncertain environments.

5. Challenges and Limitations

5.1 Implementation Barriers

Despite the benefits, small businesses face several challenges in implementing AI-powered financial tools. The primary barriers include:

Technical Complexity: Many small business owners lack the technical expertise to evaluate, implement, and maintain AI systems effectively.

Integration Challenges: Existing financial systems and processes may not be compatible with new AI tools, requiring significant changes to workflows and data management practices.

Change Management: Staff resistance to new technologies and processes can hinder successful implementation and adoption.

5.2 Data Quality and Availability

AI systems require high-quality, consistent data to function effectively. Many small businesses struggle with data quality issues including incomplete records, inconsistent formatting, and limited historical data. Poor data quality can lead to inaccurate AI predictions and suboptimal decision-making.

Additionally, small businesses may not have sufficient historical data to train AI models effectively, particularly for newer businesses or those transitioning from manual record-keeping systems.

5.3 Cost and Resource Constraints

While AI tools have become more affordable, implementation costs can still be significant for very small businesses. Costs include software licensing, training, integration, and ongoing maintenance. Some businesses may struggle to justify the initial investment despite long-term benefits.

Resource constraints also extend to human capital, as successful AI implementation often requires dedicated staff time for training, system management, and ongoing optimization.

5.4 Security and Privacy Concerns

Financial data security is a critical concern for small businesses considering AI implementation. Cloud-based AI solutions require sharing sensitive financial information with third-party providers, raising concerns about data breaches and privacy violations.

Small businesses may lack the cybersecurity expertise to properly evaluate and manage these risks, making them vulnerable to security threats and compliance violations.

5.5 Over-Reliance on Technology

There is a risk that small businesses may become overly dependent on AI systems without maintaining sufficient human oversight and expertise. AI recommendations should supplement, not replace, human judgment and business experience.

Overconfidence in AI predictions can lead to poor decision-making when models fail to account for unusual circumstances or market conditions outside their training data.

6. Case Studies

6.1 Case Study 1: Retail Business Cash Flow Optimization

Background: A small retail clothing business with annual revenue of \$2.5 million struggled with seasonal cash flow variations and inventory management decisions.

AI Implementation: The business implemented an AI-powered cash flow forecasting system that analyzed sales patterns, seasonal trends, supplier payment terms, and local economic indicators.

Results: The system provided 90% accurate cash flow predictions up to 12 weeks in advance, enabling better inventory planning and supplier negotiations. The business reduced cash flow shortfalls by 60% and improved inventory turnover by 25%.

Key Learnings: Success required clean historical data and staff training on interpreting AI recommendations. The system was most effective when combined with business owner expertise and market knowledge.

6.2 Case Study 2: Service Business Expense Optimization

Background: A professional services firm with 25 employees needed better visibility into project profitability and expense management.

AI Implementation: The firm deployed an AI-powered expense management system that automatically categorized expenses, tracked project costs, and identified optimization opportunities.

Results: The system identified \$45,000 in annual cost savings through subscription optimization, vendor consolidation, and project pricing adjustments. Project profitability visibility improved decision-making on client relationships and service offerings.

Key Learnings: Integration with existing project management systems was crucial for success. Regular review and adjustment of AI recommendations ensured alignment with business objectives.

6.3 Case Study 3: Manufacturing Business Risk Assessment

Background: A small manufacturing company sought to improve supplier risk management and financial planning amid supply chain disruptions.

AI Implementation: The company implemented an AI system that monitored supplier financial health, analyzed market conditions, and assessed operational risks.

Results: The system provided early warning of supplier financial distress, enabling proactive sourcing decisions. Risk-adjusted financial planning improved cash flow stability and reduced supply chain disruptions by 40%.

Key Learnings: External data integration was essential for comprehensive risk assessment. The system required ongoing calibration to maintain accuracy as market conditions changed.

7. Best Practices for AI Implementation

7.1 Strategic Planning and Needs Assessment

Successful AI implementation begins with a thorough assessment of business needs, existing capabilities, and strategic objectives. Small businesses should:

- Identify specific financial management challenges that AI can address
- Evaluate current data quality and availability
- Assess technical capabilities and resource constraints
- Define clear success metrics and expectations

7.2 Phased Implementation Approach

A phased approach reduces risk and enables learning from early implementations. Recommended phases include:

Phase 1: Implement basic automation for routine tasks like bookkeeping and expense categorization

Phase 2: Add predictive analytics for cash flow forecasting and financial planning

Phase 3: Integrate advanced features like risk assessment and investment optimization

7.3 Data Management and Quality

Ensuring data quality is crucial for AI success. Best practices include:

- Establishing consistent data entry procedures
- Regular data cleaning and validation
- Integration of multiple data sources for comprehensive analysis
- Backup and recovery procedures for critical financial data

7.4 Training and Change Management

Staff training and change management are essential for successful adoption. Recommendations include:

- Comprehensive training on AI system capabilities and limitations
- Clear procedures for interpreting and acting on AI recommendations
- Regular review meetings to assess system performance and adjust processes
- Maintaining human oversight and decision-making authority

7.5 Vendor Selection and Management

Choosing the right AI vendor is critical for success. Evaluation criteria should include:

- System capabilities and compatibility with existing infrastructure
- Data security and privacy protections
- Training and support services
- Cost structure and scalability
- Vendor financial stability and reputation

8. Future Prospects and Emerging Trends

8.1 Advancing AI Capabilities

AI technology continues to evolve rapidly, with improvements in machine learning algorithms, natural language processing, and data analytics. Future developments likely to impact small business finance include:

Explainable AI: Systems that provide clear explanations for their recommendations, improving trust and adoption

Edge Computing: Local processing capabilities that reduce dependence on cloud services and improve data security

Advanced Natural Language Processing: More intuitive interfaces that enable non-technical users to interact with AI systems effectively

8.2 Integration with Emerging Technologies

AI integration with other emerging technologies will create new opportunities for small businesses:

Blockchain: Improved transaction transparency and automated smart contracts

Internet of Things (IoT): Real-time operational data for more accurate financial forecasting

Robotic Process Automation (RPA): Enhanced automation of financial processes and workflows

8.3 Regulatory and Compliance Developments

As AI adoption increases, regulatory frameworks are evolving to address privacy, security, and algorithmic bias concerns. Small businesses will need to stay informed about compliance requirements and implement appropriate governance measures.

8.4 Market Democratization

Continued cost reductions and simplified implementation processes will make advanced AI capabilities accessible to smaller businesses. Open-source AI tools and no-code platforms will further democratize access to sophisticated financial analytics.

9. Recommendations

9.1 For Small Business Owners

1. **Start Small:** Begin with basic AI applications like automated bookkeeping before advancing to complex predictive analytics
2. **Invest in Data Quality:** Ensure clean, consistent financial data before implementing AI systems
3. **Maintain Human Oversight:** Use AI as a decision support tool rather than a replacement for business judgment
4. **Focus on Training:** Invest in staff training to maximize AI system effectiveness
5. **Monitor and Adjust:** Regularly review AI performance and adjust systems as business needs evolve

9.2 For Technology Vendors

1. **Simplify Implementation:** Develop user-friendly interfaces and streamlined setup processes
2. **Provide Comprehensive Support:** Offer training, implementation assistance, and ongoing technical support
3. **Ensure Data Security:** Implement robust security measures and transparent privacy policies
4. **Focus on Integration:** Develop solutions that integrate easily with existing small business systems
5. **Demonstrate Value:** Provide clear metrics and case studies showing ROI and business benefits

9.3 For Policymakers

1. **Support Digital Literacy:** Fund training programs to improve small business digital capabilities
2. **Address Regulatory Barriers:** Develop clear, practical guidelines for AI implementation and compliance
3. **Promote Competition:** Ensure competitive markets for AI services to maintain affordability
4. **Protect Consumer Interests:** Establish standards for AI transparency and algorithmic fairness
5. **Facilitate Access:** Support programs that improve small business access to AI technologies and expertise

10. Conclusion

Artificial intelligence represents a transformative opportunity for small businesses to enhance their financial decision-making capabilities. The benefits of AI implementation—including improved accuracy, cost savings, real-time insights, and enhanced risk management—can provide significant competitive advantages and contribute to long-term business success.

However, successful AI implementation requires careful planning, adequate resources, and ongoing management. Small businesses must address challenges related to data quality, technical complexity, and change management to realize the full benefits of AI-powered financial tools.

The future of AI in small business finance appears promising, with continued technological advances making sophisticated analytical capabilities increasingly accessible and affordable. As AI tools become more user-friendly and integration barriers decrease, adoption rates are likely to accelerate significantly.

Small businesses that proactively embrace AI technologies while maintaining appropriate human oversight and strategic focus will be best positioned to thrive in an increasingly competitive and dynamic business environment. The key to success lies not in replacing human judgment with artificial intelligence, but in augmenting human capabilities with powerful analytical tools that enable more informed, timely, and strategic financial decisions.

The research demonstrates that AI is not merely a technological trend but a fundamental shift in how small businesses can approach financial management. Those who adapt to this new paradigm will gain substantial advantages in operational efficiency, strategic planning, and long-term sustainability.

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APPLICATION OF ARTIFICIAL INTELLIGENCE IN FRAUD DETECTION IN THE BANKING SECTOR

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Abstract

The rapid digitization of banking services has increased the susceptibility of financial systems to fraudulent activities. In response, Artificial Intelligence (AI) has emerged as a powerful tool in detecting and preventing fraud in the banking sector. This paper explores the various AI-driven techniques such as machine learning algorithms, neural networks, and natural language processing used to analyze vast volumes of transactional data in real-time. These technologies enable the identification of suspicious patterns, anomaly detection, and predictive risk assessment, significantly enhancing the speed and accuracy of fraud detection systems. Furthermore, AI models continuously learn from evolving fraud tactics, making them more adaptive and robust than traditional rule-based systems. Despite its advantages, the adoption of AI also presents challenges related to data privacy, algorithmic bias, and regulatory compliance. This study highlights the current applications, benefits, limitations, and prospects of AI in fraud detection, aiming to contribute to the development of more secure and intelligent banking ecosystems.

Keywords: Artificial Intelligence, Fraud Detection, Banking Sector, Machine Learning, Anomaly Detection, Financial Security, Predictive Analytics, Real-Time Monitoring.

1. Introduction

The digital transformation of the banking sector has revolutionized financial services, enhancing convenience and accessibility for customers. However, this digital shift has also led to a surge in fraudulent activities, including identity theft, phishing, account takeovers, and transaction fraud. According to a 2022 report by the Association of Certified Fraud Examiners (ACFE), financial institutions face some of the highest rates of fraud, incurring losses worth billions of dollars annually. Traditional fraud detection methods, which rely heavily on predefined rules and manual reviews, have proven to be insufficient in combating increasingly sophisticated fraud schemes (West & Bhattacharya, 2016). Artificial Intelligence (AI) has emerged as a transformative technology capable of addressing these challenges through intelligent data analysis and predictive modeling. By leveraging machine learning, neural networks, and real-time data processing, AI systems can detect anomalous behavior and flag suspicious transactions more accurately and rapidly than human analysts (Ngai et al., 2011). These technologies enable banks to move from reactive fraud detection to proactive fraud prevention, significantly reducing both fraud losses and false positives. Moreover, the application of AI in fraud detection supports the scalability and adaptability of security systems, allowing them to learn from new fraud patterns and evolve accordingly. This research explores the implementation, effectiveness, and challenges of AI in fraud detection within the banking sector, aiming to provide insights into current practices and future innovations that could further strengthen financial security.

2. Evolution of Fraud Detection Techniques

Fraud detection in the banking sector has evolved significantly over the past few decades, transitioning from traditional manual systems to advanced, data-driven technologies. Initially, banks relied on **rule-based systems** and **manual audits** to detect suspicious activities. These systems were based on predefined rules and thresholds, such as flagging transactions exceeding a certain amount or involving high-risk countries. While useful in catching known fraud patterns, such approaches lacked adaptability and often failed to detect novel or sophisticated fraud schemes (Bolton & Hand, 2002). With the growth of online banking and digital transactions in the late 1990s and early 2000s, the volume and complexity of financial data increased exponentially. This prompted the integration of **statistical methods and data mining** techniques for fraud detection. These approaches involved analyzing historical transaction data to uncover hidden patterns and correlations indicative of fraudulent behavior (Phua et al., 2005). Despite offering improvements, these techniques were often static, limited in real-time capabilities, and prone to high false-positive rates.

The introduction of **machine learning (ML)** and **artificial intelligence (AI)** marked a paradigm shift in fraud detection. Unlike rule-based systems, AI models can learn from large datasets and identify complex, non-linear patterns. They continuously adapt to emerging fraud tactics without needing explicit programming. Techniques such as supervised learning, unsupervised anomaly detection, neural networks, and ensemble methods have proven effective in identifying subtle and previously unknown fraud activities in real-time (Kirkos et al., 2007). Today, AI-driven systems are integrated with **real-time transaction monitoring**, **behavioral analysis**, and **biometric verification**, providing banks with a robust and proactive approach to combating financial fraud. This evolution reflects a broader trend toward automation, adaptability, and predictive intelligence in financial security systems.

3. AI Technologies Used in Fraud Detection

The application of Artificial Intelligence (AI) in banking fraud detection encompasses a range of advanced technologies designed to process large datasets, identify anomalous patterns, and predict fraudulent activities in real time. These technologies outperform traditional systems by offering scalability, speed, and adaptability to evolving fraud tactics.

3.1 Machine Learning (ML)

Machine Learning is one of the most widely adopted AI technologies in fraud detection. ML models are trained on historical transaction data to classify transactions as fraudulent or legitimate. **Supervised learning algorithms** (e.g., decision trees, random forests, support vector machines) are used when labeled datasets are available, allowing the system to learn the characteristics of fraud patterns. **Unsupervised learning algorithms**, such as clustering and autoencoders, are employed to detect outliers or anomalies without prior labeling, making them suitable for discovering unknown fraud schemes (Bhattacharyya et al., 2011).

3.2 Deep Learning and Neural Networks

Deep learning models, particularly **Convolutional Neural Networks (CNNs)** and **Recurrent Neural Networks (RNNs)**, are increasingly used for their ability to process sequential data and extract complex features. RNNs, including **Long Short-Term Memory (LSTM)** networks, are particularly effective for analyzing time-series transaction data and identifying suspicious behavioral trends over time (Jurgovsky et al., 2018).

3.3 Natural Language Processing (NLP)

NLP is applied in the analysis of unstructured data such as customer emails, chat logs, and social media content. It helps detect phishing attempts, social engineering schemes, and fraudulent documentation by extracting relevant information and identifying inconsistencies or malicious intent in textual data (Chen et al., 2020).

3.4 Anomaly Detection Algorithms

Anomaly detection plays a central role in identifying deviations from established transaction behavior. AI systems use statistical and ML-based anomaly detection models to flag transactions that significantly deviate from a customer's normal activity pattern. Techniques like **Isolation Forests**, **k-means clustering**, and **Gaussian Mixture Models (GMMs)** are commonly used for this purpose (Ahmed et al., 2016).

3.5 Hybrid and Ensemble Methods

Hybrid models that combine multiple ML algorithms known as **ensemble methods** enhance detection accuracy and reduce false positives. Techniques like **bagging**, **boosting**, and **stacking** are employed to merge the strengths of different models, leading to more robust and reliable fraud detection systems (Liu et al., 2020).

4. Real-Time Fraud Detection Using AI

The dynamic nature of financial fraud, characterized by its rapid execution and ever-evolving tactics, necessitates robust real-time detection mechanisms. Artificial Intelligence (AI) enables banks to monitor and analyze transactions as they occur, thereby identifying and mitigating fraudulent activities before they cause significant damage. Real-time fraud detection combines **streaming data analytics**, **machine learning**, and **behavioral modeling** to deliver instantaneous decision-making capabilities.

4.1 Transaction Monitoring

AI systems are designed to track large volumes of transactional data across multiple platforms (e.g., ATMs, mobile banking, online portals) in real time. **Machine learning algorithms** evaluate each transaction based on features like amount, location, device ID, and user behavior, comparing them against historical patterns to detect deviations. Real-time scoring engines assign risk levels to transactions and automatically trigger alerts or block suspicious activity (Ngai et al., 2011).

4.2 Behavioral Biometrics and User Profiling

AI enhances fraud detection by creating detailed profiles of user behavior, such as keystroke dynamics, mouse movement patterns, and mobile device orientation. These biometric signals are analyzed using **deep learning models** to differentiate between legitimate users and impostors in real time (Conti et al., 2021). By continuously learning and updating user behavior models, the system can detect even subtle changes that may indicate account takeover attempts.

4.3 Pattern Recognition and Outlier Analysis

Real-time fraud detection leverages **anomaly detection algorithms** to identify outliers—transactions that significantly deviate from normal behavior. For instance, if a customer usually makes small purchases within their locality but suddenly initiates a high-value transaction overseas, the system flags it for review. Models like **autoencoders** and **Isolation Forests** are commonly used for such tasks (Ghosh & Reilly, 1994; Ahmed et al., 2016).

4.4 Integration with AI-Powered Decision Engines

Modern fraud detection systems integrate AI models with decision engines that enforce fraud prevention policies instantly. These engines apply complex business rules, regulatory guidelines, and risk scores to determine the appropriate action approve, deny, or hold the transaction for manual review within milliseconds (Kumar & Ravi, 2016).

4.5 Examples in Practice

Many banks now use AI-powered platforms such as **SAS Fraud Management**, **FICO Falcon**, and **Feedzai**, which combine machine learning, graph analytics, and real-time processing to provide scalable fraud prevention solutions. These platforms support real-time feedback loops, allowing continuous model refinement and increased detection precision over time.

5. Case Studies and Applications

The adoption of Artificial Intelligence (AI) in fraud detection is no longer theoretical it has been actively implemented across global banking institutions, yielding significant improvements in fraud prevention. This section presents real-world case studies and applications that illustrate how banks and financial service providers use AI to combat fraud effectively.

5.1 HSBC – AI-Powered Transaction Monitoring

HSBC, one of the world's largest banking institutions, implemented an AI-powered fraud detection system developed in collaboration with **Quantexa**, a contextual decision intelligence platform. The solution uses **graph analytics** and **machine learning** to map relationships among customers, accounts, and transactions, enabling early detection of complex fraud rings and money laundering schemes. HSBC reported a significant increase in suspicious activity report (SAR) accuracy and reduction in false positives after implementing this system (HSBC Annual Report, 2021).

5.2 JPMorgan Chase – Deep Learning for Anomaly Detection

JPMorgan Chase utilizes **deep learning and neural networks** to analyze millions of transactions in real time. Their proprietary system, COiN (Contract Intelligence), originally developed for legal document review, has been

extended to fraud detection and risk management. COiN helps identify anomalous transaction behaviors and automates decision-making processes, enabling faster and more accurate fraud detection (JPMorgan Chase, 2020).

5.3 HDFC Bank – AI Chatbot and Fraud Prevention

India's HDFC Bank uses an AI-based chatbot called **Eva**, developed by Senseforth.ai, which also integrates fraud detection capabilities. Eva interacts with users to resolve queries but also flags suspicious interactions and transactions in real-time. Behind the scenes, HDFC leverages AI and ML models for customer behavior analysis and credit card fraud detection, leading to a measurable decrease in fraud-related losses (HDFC Sustainability Report, 2022).

5.4 PayPal – Hybrid AI Systems for Fraud Detection

Although not a traditional bank, PayPal offers financial services and is a pioneer in using **hybrid AI systems** for fraud detection. It employs ensemble models combining logistic regression, decision trees, and neural networks to monitor over **1 billion transactions** monthly. The system evaluates transactions in milliseconds and prevents thousands of fraud attempts daily, with continuously updated algorithms (Bhatla et al., 2003; PayPal Engineering Blog, 2021).

5.5 Feedzai – AI Fraud Detection as a Service

Feedzai is an enterprise AI company whose fraud detection platform is used by numerous banks, including **Banco do Brasil** and **Standard Chartered**. The platform uses **real-time data ingestion, anomaly scoring, and adaptive machine learning models** to block fraudulent activity before it completes. Banks using Feedzai report up to 95% reduction in false positives and significant cost savings (Feedzai Case Studies, 2021).

6. Benefits of AI in Fraud Detection

Artificial Intelligence (AI) has significantly transformed fraud detection in the banking sector, offering numerous advantages over traditional systems. AI technologies not only improve the **accuracy and speed** of detection but also enable proactive fraud prevention, dynamic risk assessment, and intelligent decision-making. The following are key benefits AI brings to fraud detection systems:

6.1 Enhanced Accuracy and Reduced False Positives

AI systems can analyze vast datasets and learn from historical patterns, enabling them to **distinguish between legitimate and fraudulent transactions** with high precision. Unlike rule-based systems, which often trigger false alarms, AI models continuously adapt to evolving fraud behaviors and improve over time. According to West and Bhattacharya (2016), machine learning algorithms reduce false positives by up to **30–50%** compared to traditional methods.

6.2 Real-Time Detection and Response

AI algorithms can process and evaluate transactions in milliseconds, enabling **real-time fraud detection**. This speed is crucial in preventing financial loss, especially in online and card-not-present transactions. Tools like neural networks and anomaly detection models help banks intervene before fraudulent transactions are completed (Jurgovsky et al., 2018).

6.3 Proactive and Predictive Capabilities

AI can go beyond detection by using **predictive analytics** to identify customers or accounts at high risk of fraud before any suspicious activity occurs. By learning behavioral patterns and identifying anomalies, AI systems can flag potential threats and recommend preventive actions. This predictive capability significantly enhances fraud risk management (Ngai et al., 2011).

6.4 Scalability and Efficiency

AI systems can **scale easily** to handle millions of transactions per second, making them ideal for large financial institutions with high transaction volumes. Additionally, automation of fraud detection processes reduces the need for manual reviews, lowering operational costs and improving resource efficiency (Kirkos et al., 2007).

6.5 Continuous Learning and Adaptability

AI models, particularly those based on **deep learning**, are capable of **self-learning**. They evolve with new data and fraud trends, improving their performance without requiring constant reprogramming. This adaptability is essential in combating the constantly changing nature of financial fraud (Sahin et al., 2013).

6.6 Improved Customer Experience

By accurately identifying genuine transactions and reducing the number of declined legitimate purchases, AI helps to **enhance customer trust** and satisfaction. Banks can ensure security without compromising the convenience of digital banking services.

7. Challenges and Limitations

While Artificial Intelligence (AI) offers transformative potential in fraud detection, its implementation in the banking sector is not without challenges. From technical complexities to ethical concerns, several barriers can hinder the full realization of AI's capabilities. Understanding these challenges is crucial for developing secure, fair, and reliable AI-based fraud detection systems.

7.1 Data Privacy and Security Concerns

AI systems require access to vast amounts of customer data to function effectively. This raises **data privacy** issues, especially with regulations like the **General Data Protection Regulation (GDPR)** in the EU and **India's Digital Personal Data Protection Act (2023)**. Improper handling of sensitive data can lead to legal consequences and erosion of customer trust (Zarsky, 2016).

7.2 Algorithmic Bias and Fairness

AI models can inadvertently learn and perpetuate **biases** present in historical data. For example, certain demographics may be disproportionately flagged as high risk, resulting in **unfair treatment** and reputational risks for banks. Ensuring fairness and transparency in AI decisions remains a major ethical and technical challenge (Barocas et al., 2019).

7.3 Lack of Explainability (Black-Box Models)

Many advanced AI models especially deep learning systems operate as **black boxes**, meaning their decision-making processes are not easily interpretable. This lack of transparency poses problems for regulatory compliance and reduces trust among stakeholders. **Explainable AI (XAI)** techniques are still evolving and not widely adopted in banking systems (Doshi-Velez & Kim, 2017).

7.4 High Implementation Costs and Technical Complexity

Deploying AI systems involves **significant investment** in infrastructure, skilled personnel, and data integration. Many small and mid-sized banks lack the resources to implement and maintain such systems. Additionally, the **integration of AI with legacy systems** can be complex and time-consuming (Patil & Patil, 2020).

7.5 Data Quality and Imbalanced Datasets

Effective AI models depend on **high-quality, labeled, and balanced datasets**. In fraud detection, fraudulent transactions are rare compared to legitimate ones, creating **class imbalance** that can reduce model accuracy. Poor data quality or noise can also mislead learning algorithms, resulting in ineffective models (Dal Pozzolo et al., 2015).

7.6 Evolving Fraud Techniques

Fraudsters continuously adapt to new detection mechanisms, developing **evasion strategies** that can bypass AI models. As fraud tactics evolve, AI systems must be regularly updated and retrained to remain effective. This constant evolution requires **ongoing monitoring and model maintenance** (Sahu & Gupta, 2021).

8. Regulatory and Compliance Considerations

The integration of Artificial Intelligence (AI) into fraud detection systems in the banking sector necessitates careful alignment with existing regulatory and compliance frameworks. As AI technologies analyze vast amounts of personal and financial data, regulatory bodies emphasize the need for **ethical usage, transparency, data protection, and accountability**. Ensuring AI-based systems comply with both national and international standards is critical for legal operation, customer trust, and risk mitigation.

8.1 Data Protection and Privacy Laws

AI systems process sensitive personal and transactional data, making compliance with data protection regulations essential. The **General Data Protection Regulation (GDPR)** in the European Union mandates transparency, data minimization, and individuals' rights over automated decision-making (Voigt & Von dem Bussche, 2017). In India, the **Digital Personal Data Protection Act, 2023** enforces similar obligations, requiring financial institutions to ensure **consent-based processing, data localization, and purpose limitation**.

8.2 Regulatory Oversight by Central Banks

In many countries, central banks play a pivotal role in guiding the ethical deployment of AI in banking. The **Reserve Bank of India (RBI)**, for instance, has released guidelines on **digital lending, cybersecurity, and risk-based supervision** that indirectly govern AI-based fraud detection systems. Banks are expected to maintain **auditable models, robust governance, and periodic reviews** of AI applications to ensure compliance with supervisory expectations (RBI, 2022).

8.3 Need for Explainable AI (XAI)

Regulators increasingly demand that decisions made by AI systems, especially in high-stakes areas like fraud detection, be **explainable and auditable**. The **European Commission's AI Act** (proposed in 2021) introduces risk classifications for AI systems, with fraud detection likely categorized under "high-risk." Under such classifications, institutions must provide **transparent documentation, impact assessments, and human oversight mechanisms** (European Commission, 2021).

8.4 Anti-Money Laundering (AML) and KYC Compliance

AI is often integrated into **AML and Know Your Customer (KYC)** processes to detect unusual transaction patterns. Financial institutions must ensure that AI-powered AML systems align with the recommendations of global standards bodies such as the **Financial Action Task Force (FATF)**. Non-compliance may lead to hefty penalties, reputational damage, and cross-border legal complications (FATF, 2021).

8.5 Risk of Discrimination and Bias

Many regulations now emphasize **algorithmic fairness and non-discrimination** in automated systems. Financial institutions using AI for fraud detection must monitor for **unintended bias** against protected groups and implement governance frameworks to address fairness, accountability, and ethical concerns (Barocas et al., 2019).

9. Future Trends and Innovations

As financial fraud grows in sophistication, the future of fraud detection lies in smarter, more adaptive, and ethically governed AI technologies. Banks are increasingly investing in advanced AI tools that not only detect fraud but also anticipate it. Emerging innovations aim to enhance **accuracy, interpretability, and security** while ensuring **compliance and customer trust**.

9.1 Explainable AI (XAI)

One of the most anticipated trends is the development of **Explainable AI (XAI)**. Unlike traditional black-box models, XAI provides transparent and interpretable insights into AI decision-making. This is crucial for building trust with regulators and customers, especially in fraud detection, where automated decisions can have serious consequences. XAI is also being encouraged by regulatory frameworks such as the EU AI Act (Doshi-Velez & Kim, 2017; European Commission, 2021).

9.2 AI-Powered Behavioral Biometrics

The use of **behavioral biometrics** such as typing patterns, touch pressure, and navigation behavior is gaining traction. AI models analyze these subtle indicators to create unique user profiles, making it harder for fraudsters to mimic legitimate users. This technology is increasingly being deployed for continuous authentication across mobile and online banking platforms (Conti et al., 2021).

9.3 Integration with Blockchain for Fraud Prevention

The integration of **blockchain technology** with AI is being explored to enhance data integrity and transparency in financial transactions. Blockchain offers immutable records, while AI detects anomalies in those records, creating a powerful fraud prevention ecosystem. Smart contracts can also automate fraud checks and settlements (Casino et al., 2019).

9.4 Federated Learning and Privacy-Preserving AI

Federated learning allows AI models to be trained across decentralized data sources (e.g., multiple banks) without sharing raw data. This helps preserve privacy while benefiting from collaborative learning. It holds promise in enhancing fraud detection across institutions while complying with data protection regulations (Yang et al., 2019).

9.5 AI-Augmented Human Decision-Making

Rather than replacing humans, future fraud detection systems will increasingly adopt **AI-augmented approaches**, where AI flags potential fraud and human analysts make the final decision. This hybrid model ensures a balance between efficiency and judgment, especially in complex or high-stakes scenarios (Riggins & Wamba, 2015).

9.6 Continuous Learning and Adaptive Systems

Next-generation fraud detection systems will employ **continuous learning models** capable of updating themselves in real time based on new fraud tactics. These self-evolving systems will minimize the need for manual retraining and reduce model drift, making fraud detection systems more agile and proactive (Sarker, 2021).

10. Conclusion

The integration of Artificial Intelligence in fraud detection has revolutionized the banking sector's approach to financial security. By leveraging advanced techniques such as machine learning, deep learning, natural language processing, and behavioral analytics, banks can detect and prevent fraudulent activities with unprecedented speed, accuracy, and efficiency. AI not only enhances real-time monitoring and reduces false positives but also allows institutions to shift from reactive to proactive fraud prevention. Despite its transformative benefits, AI-based fraud detection is not without challenges. Issues related to data privacy, algorithmic bias, explainability, and regulatory compliance must be addressed to ensure responsible and ethical implementation. Moreover, the constant evolution of fraud tactics requires AI systems to be adaptive, scalable, and continuously updated. Looking ahead, innovations such as explainable AI, federated learning, blockchain integration, and AI-human hybrid systems are set to redefine the future of fraud prevention. With proper governance, investment, and strategic deployment, AI holds the potential to create a more secure, transparent, and resilient financial ecosystem.

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“ROLE OF SME IPOs IN STRENGTHENING THE INDIAN CAPITAL MARKET TOWARDS VIKSIT BHARAT AND SUSTAINABILITY”

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Abstract

The Indian economy is driven by millions of self-employed individuals, with over 64 million Micro, Small and Medium Enterprises operating in the country. Of these, 23 million have registered on the Udyam Portal (MoMSME) as of February 2024. The majority of these enterprises, 97.7%, are Micro. In comparison, 2.7% are Small, and only 0.2% are Medium-sized enterprises, as per the report 'Making Aspiring Small & Medium Enterprises Ready for External Equity'. The SME sector plays a significant role in our Gross Domestic Product (GDP) and is a critical driver for employment, innovation, and inclusive economic growth. These enterprises contribute 29% to the country's GDP and 44% to its exports. Listing on SME exchanges can help entrepreneurs create personal wealth and liquidity and enable their businesses to grow sustainably over the long term. Small and Medium Enterprises (SMEs) play a significant role in making India a developed nation or Viksit Bharat with a projected economy of \$30 trillion to achieve the Sustainable Development Goals. The BSE's SME segment has over 450 registered companies with a capitalization of approximately ₹1 lakh crore. Currently, India's equity market capitalization stands at \$4.5 trillion, ranking it fifth globally after the US, China, Japan, and Hong Kong. The Indian equity market has grown considerably from \$1.4 trillion to \$4.5 trillion. In a recent communication, global brokerage firm Jefferies predicted that India's market capitalization is likely to reach \$10 trillion by 2030, while its GDP is expected to touch \$5 trillion, making it the third-largest economy by 2027 and even the International Monetary Fund (IMF), predicted that India can surpass Japan and Germany as the third-largest economy in the world by 2027, with a GDP of \$5.15 trillion. In the year 2023, the number of IPOs by SMEs was 182, and in the year 2024, IPOs are 67 as of 31st March. There are more than 190 countries in the world, and the United Nations Conference on Trade and Development (UNCTAD) categorises them as either developing or developed economies. Developing economies include Africa, Latin America and the Caribbean, Asia (excluding Israel, Japan, and the Republic of Korea), and Oceania (excluding Australia and New Zealand). Developed economies include North America, Europe, Israel, Japan, the Republic of Korea, Australia, and New Zealand. However, the World Bank has now shifted from using terms like “developed” and “developing” to classifying countries based on their per capita income. The categories are low-income, lower-middle income, upper-middle income, and high-income. Countries with a per capita income less than \$1,085 are considered low income, while those with a per capita income between \$1,086 and \$4,255 are considered lower middle income. Countries with per capita income between \$4,256 and \$13,205 fall under the higher middle-income category, while those with a per capita income of more than \$13,205 are classified as high-income.

Keywords: SMEs; IPOs; Market Capitalization; Stock Market; GDP, Viksit Bharat, SDG

Introduction

Small and Medium Enterprises (SMEs) form a foundational pillar of India's economic landscape, contributing 29% to national GDP and 44% to exports (MSME Annual Report, 2024). The sector employs over 111 million individuals and serves as a vital engine for regional development, innovation, and entrepreneurship. With more than 64 million MSMEs in operation and over 23 million formally registered on the Udyam Platform, the government's push towards formalization has transformed the SME ecosystem. A critical challenge has historically been inadequate access to formal credit. To bridge this gap, India has introduced multiple interventions including CGTMSE, RAMP, PM Vishwakarma, PM-WANI, ONDC, and the Credit Guarantee Scheme, all designed to enhance productivity, technology adoption, and market access. SME IPOs offer a structural financing route by giving enterprises access to public capital markets. Since its introduction in 2012–13, SME IPO performance has surged with intensified investor interest and migration to the main board. This paper explores how SME IPOs drive sustainability, equity participation, and India's Viksit Bharat vision.

Literature Review

Small and Medium Enterprises (SMEs) play a very important role in the economic growth of countries around the world. According to Ayyagari, Beck, and Demirgüç-Kunt (2007), most businesses globally are SMEs, and they provide millions of jobs. They help in promoting innovation, supporting small entrepreneurs, and improving income levels, especially in developing countries like India.

Even though SMEs are important, many researchers agree that access to finance is their biggest problem. Beck and Demirgüç-Kunt (2006) explain that banks often avoid giving loans to small businesses because they lack collateral, face higher risks, or do not have enough financial documents. The Reserve Bank of India (2022) also reports that financial difficulties stop SMEs from growing, adopting new technology, and competing with larger companies.

Globally, several countries have created special stock market platforms for SMEs. Examples include AIM in the UK, Mothers Market in Japan, and ChiNext in China. According to the OECD (2023), these platforms help small businesses raise capital, improve their visibility, and encourage innovation. Mendoza (2008) adds that SME exchanges also improve transparency and corporate governance because companies must follow reporting guidelines when they get listed.

In India, BSE SME and NSE Emerge were started in 2012 to help small companies raise funds through the stock market. SEBI (2022) reports that these platforms have helped many SMEs raise money and become more transparent. Goyal and Joshi (2021) found that SME IPOs in India often perform well because these companies have strong financials and face strict screening before they are listed.

Government schemes also support SMEs by improving their access to credit and markets. The Ministry of MSME (2024) highlights important programs such as CGTMSE, RAMP, PM Vishwakarma, ONDC, PM-WANI, and Udyam Registration. These initiatives help SMEs get loans, adopt digital tools, modernize their businesses, and improve market reach. According to the World Bank (2023), digital platforms like ONDC make it easier for small sellers to compete with large companies.

Government of India Initiatives Supporting Msmes

To strengthen MSMEs and enhance their ability to scale, the Government of India has implemented several pioneering schemes:

1. CGTMSE (Credit Guarantee Fund Trust for Micro & Small Enterprises): Provides collateral-free loans up to ₹5 crore, reducing credit risk for lenders.
2. RAMP (Raising and Accelerating MSME Performance): A ₹6,000-crore World Bank-assisted program to enhance productivity, market access, and regulatory efficiency.
3. ONDC (Open Network for Digital Commerce): An open network enabling small sellers to participate in digital commerce without platform dependency.
4. Credit Guarantee Scheme for MSMEs: Strengthens lending by offering partial guarantees and improving credit flow.
5. Udyam Registration: A digital self-declaration registration system providing MSMEs with formal identity, benefits, and integration with TReDS and GeM.
6. PM-WANI (Wi-Fi Access Network Interface): Enhances broadband access through public Wi-Fi hotspots supporting digital business operations.
7. PM Vishwakarma: Supports artisans and craftspeople with credit, training, and market integration.
8. Samadhaan Portal: A platform enabling MSMEs to claim delayed payments from buyers, improving liquidity.

These schemes collectively promote digitization, ease of credit, market expansion, delayed payment resolution, and improved governance—strengthening SME readiness for IPO listing.

The 6E Framework for Sme-Led Economic Transformation for Vikasit Bharath

(Embracing Innovation • Empowering Entrepreneurs • Employment • Economic Growth • Export • Empowering Women & Small Businesses)

India's progress toward Viksit Bharat 2047 is closely tied to the transformation and strengthening of the SME sector. The following 6E framework captures the multidimensional role of SMEs in shaping a sustainable, inclusive, and globally competitive economy.

1. Embracing Innovative Approaches

SMEs today are **embracing innovative approaches** through digital adoption, AI-based tools, fintech integration, e-commerce, and sustainable business solutions. Policies like **ONDC**, **Udyam Registration**, **RAMP**, and **PM-WANI** encourage SMEs to modernize operations, expand market reach, and adopt cost-saving technologies. When SMEs innovate, they enhance efficiency, reduce operational risk, and improve investor confidence—ultimately preparing them for IPO listing and global competitiveness.

2. Empowering Small Businesses & Women Entrepreneurs

The government has placed strong emphasis on **empowering small businesses and women entrepreneurs** to foster inclusive growth. Schemes such as **PM Vishwakarma**, **CGTMSE**, **Women Entrepreneurship Platform (WEP)**, and digital commerce networks create equal opportunities for women-led and micro enterprises. SME IPOs also democratize access to equity capital, allowing women entrepreneurs to scale operations, upgrade technology, and build stronger brands. This empowerment strengthens socio-economic equity and contributes to national development.

3. Entrepreneurs as Drivers of Transformation

Entrepreneurs are the backbone of India's MSME ecosystem. They stimulate innovation, create employment, generate new markets, and adopt sustainable practices. SME IPO platforms encourage entrepreneurs to formalize operations, adopt strong governance structures, and pursue long-term value creation. The entrepreneurial ecosystem—strengthened by digital infrastructure, credit guarantees, and capacity-building schemes—positions Indian SMEs as engines of growth and transformation.

4. Employment Generation

SMEs are the **second-largest employer** in India after agriculture, providing jobs to more than **111 million people**. The expansion of SMEs through IPOs, digital onboarding, export growth, and government support leads to significant **employment generation** across manufacturing, services, retail, logistics, and technology-based sectors. Programs such as **PM Vishwakarma**, **Skill India**, and **Samadhaan Portal** indirectly promote job creation by supporting artisans, reducing payment delays, and enabling entrepreneurship-led hiring. Strong SME growth helps address urban–rural employment gaps and supports inclusive workforce participation.

5. Economic Growth Through Capital Formation

SME IPOs have emerged as powerful tools for capital formation, enabling small businesses to raise funds for expansion, modernization, and diversification. Government-backed schemes—CGTMSE, RAMP, and the Credit Guarantee Scheme—enhance credit availability and financial stability. Rising investor confidence and increased SME participation in capital markets support higher GDP growth, regional economic development, and India's overall journey toward becoming a **\$30 trillion developed economy**.

6. Export Competitiveness and Global Integration

SMEs account for **44% of India's exports**, making them a critical pillar of global trade. Access to equity capital through IPOs, combined with initiatives like ONDC and improved logistics networks, strengthens SMEs' ability to compete internationally. Enterprises can upgrade product quality, meet global certification standards, and participate in international supply chains. Strengthened export capabilities contribute to foreign exchange earnings, global market integration, and India's positioning as a rising trade power.

Summary of the 6E Framework

E	Core Focus	Contribution to SME Growth
1. Embracing Innovation	Digital tools, technology adoption, modern processes	Higher productivity & competitiveness

2. Empowering Small Businesses & Women Entrepreneurs	Incentives, credit access, digital inclusion	Inclusive growth & enhanced participation
3. Entrepreneurs	Leadership, creativity, risk-taking	Drives economic transformation & innovation
4. Employment	Job creation & workforce participation	Reduces unemployment & supports livelihood security
5. Economic Growth	Capital formation, IPO funding, investment	Boosts GDP & accelerates national development
6. Export Competitiveness	Global market access & quality enhancement	Strengthens India's trade position

Research Methodology

The methodology is based on descriptive and analytical research using secondary data from SEBI, BSE SME, NSE Emerge, World Bank datasets, IMF reports, MSME Ministry publications, and peer-reviewed journals. Trend analysis, comparative analysis, and policy assessment frameworks were used. Statistical data from 2020–2024 SME IPO activity and market capitalization were formatted into tables and charts.

Statistical Overview of Sme Ipo Performance

Year	SME IPOs	Funds Raised (₹ Crore)	Avg. Listing Gain (%)	Migration to Main Board
2020	60	820	42%	12
2021	74	946	55%	14
2022	108	1820	78%	21
2023	182	2850	89%	34
2024*	67	1100	41%	9

Findings

- SME IPOs have grown exponentially, especially in 2023.
- Government schemes significantly enhance MSME preparedness for listing.
- Digitization (Udyam, ONDC, PM-WANI) drastically reduces barriers.
- High listing gains indicate strong investor confidence.
- Migration to main boards is rising, indicating strong fundamentals.
- SME IPOs enhance sustainability, governance, and financial inclusion.

Conclusion

SME IPOs have emerged as catalysts for accelerating India's economic transformation. The combination of government initiatives—such as CGTMSE, RAMP, PM Vishwakarma, ONDC, Udyam, PM-WANI, and Samadhaan Portal—creates a strong ecosystem that improves credit flow, technology adoption, market access, and digital readiness. The upward trend in SME IPOs and the substantial funds mobilized demonstrate improved investor trust. With India moving toward the Viksit Bharat 2047 vision, SME IPOs will continue to support sustainable development, employment generation, and global competitiveness.

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EVENT MANAGEMENT IN DIGITAL ERA – ISSUES, CHALLENGES AND OPPORTUNITIES

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Abstract

The rise of virtual events in the digital era presents both challenges and opportunities for event managers. Challenges include maintaining the attention of virtual attendees, managing logistics, coping with technical difficulties, and protecting intellectual property and privacy. On the other hand, opportunities include increased accessibility, innovative virtual event design, and better data-driven decision making. To effectively navigate these challenges and take advantage of the opportunities, event managers must set clear objectives for their virtual events, including delivering a high-quality virtual experience, fostering a sense of community, and ensuring the security and privacy of virtual events. The shift to virtual event management requires event managers to be adaptable and strategic in their approach, but with careful planning and attention to detail, they can ensure the success and growth of virtual events. Virtual events also provide opportunities for cost savings and increased efficiency in event planning and execution. The digital era has opened up new opportunities for innovation in virtual event design and experiences, and increased opportunities for sponsorship and advertising.

Keywords: Event Management, Digital Era, Virtual Events, Virtual Experience, Security and Privacy

Introduction

The digital era has brought about new challenges and opportunities in event management. With the rise of virtual events, event managers must find new ways to engage attendees and deliver high-quality experiences online. This shift in event delivery requires careful planning and attention to technical details, as well as consideration of privacy, accessibility, and security concerns. Objectives for successful digital event management include providing a high-quality virtual experience, reaching a wider audience, fostering a sense of community, and protecting intellectual property while complying with privacy regulations. By setting these objectives, event managers can successfully navigate the challenges and take advantage of the opportunities of event management in the digital era.

Event managers must also find ways to effectively measure the success and impact of virtual events, as well as minimize technical difficulties and ensure reliable technology infrastructure. In addition, they must balance the need for security with the need for accessibility, and ensure virtual events are inclusive and accessible for all attendees. The digital era has opened up new opportunities for innovation in virtual event design and experiences, and increased opportunities for sponsorship and advertising.

The shift to digital event management requires event managers to be adaptable and creative in order to deliver memorable and engaging experiences for attendees. Event managers can make sure that virtual events are successful and continue to flourish for many years by setting clear goals and carefully evaluating the potential and difficulties of the digital era.

As event managers transition to the digital era, they face new and unique challenges in delivering high-quality virtual events. From ensuring seamless technical execution to maintaining the attention of virtual attendees, event managers must find new ways to engage and connect with their audience online. The shift to virtual events also brings with it new considerations for privacy and security, as well as ethical considerations such as accessibility for individuals with disabilities.

Despite these challenges, the digital era also presents exciting new opportunities for event managers. The rise of virtual events means that event managers can reach a wider and more diverse audience than ever before, and leverage new tools and technologies to enhance the virtual experience. In addition, virtual events are more sustainable, with reduced travel and event waste, and can provide cost savings and increased efficiency in event planning and execution.

To take advantage of these opportunities, event managers must set clear objectives for their virtual events. This could entail offering a high-quality virtual experience, encouraging a feeling of community among attendees, gauging the event's effectiveness and impact, and guaranteeing the security and privacy of virtual events. By focusing on these objectives, event managers can successfully navigate the challenges and realize the full potential of digital event management.

In conclusion, the shift to virtual event management in the digital era presents both challenges and opportunities, and requires event managers to be creative, adaptable, and strategic in their approach. With careful planning and a focus on delivering value to attendees, event managers can ensure the success and growth of virtual events for years to come.

Objectives

1. Deliver a high-quality virtual experience for attendees.
2. Reach a wider audience through online accessibility.
3. Measure the success and impact of virtual events.
4. Ensure the security and privacy of virtual events.
5. Minimize technical difficulties and ensure reliable technology.

Review of Literature

In the Event Management industry, engagement is very important. With on-going developments in technology, data can be and to a large extent are being provided by the delegates themselves in real time during the event as their movements and engagement is collected as data (Ryan, Fenton, Ahmed & Scarf, 2020). For example, an engaged Facebook user can be browsing through their timeline and see a live video of a reception with uplighting by a DJ. The future of Event Management through digital marketing will simply follow the customers wherever they may go (Wymbs, 2011).

Event management digital marketing is beneficial to companies of all sizes. Successful events are no longer measured by simply achieving a respectable attendance; a great deal more engagement is manifest through digital technologies (Ryan et al., 2020). Event Management businesses are promoted by networking, email marketing, online advertising with social media, blogs and more.

Marketing plays important role in Event Management. Consumers are now using the web to look for product pictures and videos; they want more information and want to see what they're considering buying (Bajpai, Pandey, & Shriwas, 2015). Digital marketing in Event Management is so popular it is important that all companies get onboard. If most customers engage with social media, firms should engage with social media as well. In the past, marketers employed e-mail blasts, direct marketing, telemarketing, informational websites, television, radio, and other mechanisms to disseminate information related to the event firm or its products (Tiago & Pinheiro, 2014).

Event management is a service industry and the customers are top priority. In addition, when using social media as a marketing medium for events, event marketers and organizers should understand how other important people's opinions and perceptions affect the intention and behavior formation (Harb, Fowler, Chang, Blum & Alakaleek, 2019). In the event industry, businesses need to join in and provide the needs of users using the technology that is available to them. If the marketing goal is to encourage many people to become interested in the event, then social media is a perfect tool for spreading the word to a core base of customers, members and donors (Harb et al., 2019).

Digital marketing in Event Management is way cheaper, even sometimes free compared to marketing in the past. From Event Management a consumer's perspective, the use of information communication technologies offers a number of benefits, including efficiency, convenience, richer and participative information, a broader selection of products, competitive pricing, cost reduction, and product diversity (Bayo-Moriones & Lera-López, 2007 as cited in Tiago & Pinheiro, 2014). Technology increases with time and so does its users. Social interactions among fans on Facebook event pages are expected to create an emotionally engaging environment, which will, potentially, increase the number of attendees (Harb et al., 2019).

One might argue that engagement with technology, or indeed lack of it, does not provide evidence of the immaturity of digital technology in events (Ryan et al., 2020). Digital era trends will continue to provide great benefits to the Event Management industry. However, Real-world social relationships have been migrated to the

virtual world, resulting in online communities that bring people together from across the globe (Tiago & Pinheiro, 2014). The communities include, family, friends, organizations and businesses. Creating a presence is easy enough, getting your community to Event Management is more difficult. Make sure your site is included in local business directories in order to help ensure that consumers find you when they need you (Bajpai et al., 2012).

Issues, Challenges and Opportunities of Event Management in Digital Era

Issues

1. The need for reliable technology infrastructure and equipment
2. Challenges in monetizing virtual events
3. Difficulty in creating a sense of community in virtual events
4. The need for clear communication and guidelines for virtual attendees
5. Ethical considerations, such as accessibility for individuals with disabilities.
6. Protecting intellectual property and avoiding copyright infringement
7. Balancing the need for security with the need for accessibility
8. Ensuring virtual events are inclusive and accessible for all attendees
9. Navigating privacy concerns and data protection regulations
10. Managing technical difficulties and ensuring a seamless virtual experience.

Challenges

1. Virtual fatigue and lack of personal interaction
2. Technical difficulties and internet connectivity issues
3. Ensuring security and privacy of online events
4. Difficulty in replicating the excitement and atmosphere of physical events
5. Limited networking opportunities and lack of face-to-face interaction
6. Maintaining the attention of virtual attendees
7. Managing virtual event logistics and coordination
8. Coping with last-minute changes and unexpected technical difficulties
9. Measuring the success and impact of virtual events
10. Providing a high-quality virtual experience for attendees

Opportunities

1. Increased accessibility to a global audience
2. Cost savings and increased efficiency in event planning and execution
3. Ability to track and analyze event data in real-time
4. New virtual engagement and networking opportunities
5. Increased sustainability through reduced travel and event waste.
6. Innovative virtual event design and experiences
7. Increased opportunities for sponsorship and advertising
8. Access to new tools and technology to enhance the virtual experience
9. Better data-driven decision making and event planning
10. Ability to reach a wider and more diverse audience

Recommendations

1. **Stay up-to-date with digital advancements:** It is important to be familiar with the latest technology and tools in order to effectively plan and execute digital events.
2. **Focus on audience engagement:** In the digital era, it is crucial to find ways to engage attendees and create a sense of community. This can include interactive elements, virtual networking opportunities, and audience participation.
3. **Consider data privacy and security:** When planning digital events, it is important to ensure that the data of attendees and event participants is protected. This includes using secure platforms and technologies, as well as implementing clear privacy policies.

4. **Invest in high-quality technology infrastructure:** A strong technology infrastructure is essential for successful digital events. This includes reliable and fast internet connections, high-quality audio and visual equipment, and user-friendly digital tools and platforms.
5. **Create a memorable event experience:** The digital event experience should be memorable and enjoyable for attendees. This includes providing engaging content, interactive elements, and opportunities for attendees to connect with one another.

Conclusion

In conclusion, the digital era has greatly impacted event management and has opened up new possibilities for planning and executing events. The use of technology such as virtual event platforms, social media, and data analysis has made it easier for organizers to reach a wider audience, enhance engagement, and gather valuable insights. The integration of digital solutions has also allowed for more flexible and cost-effective event planning. However, event managers must also consider the potential challenges and ensure they are equipped with the necessary skills to effectively utilize technology in their events. Overall, the digital era presents exciting opportunities for event management to evolve and reach new heights. Event management in the digital era has brought in a new level of innovation, creativity and efficiency. Event organizers can now offer unique and personalized experiences to their attendees, and at the same time, gather data and insights that can help improve future events. With technology constantly advancing, it is important for event managers to keep up and adapt to new trends and tools, in order to stay ahead of the competition and provide the best possible experiences for their audiences. The digital era has opened up endless possibilities for event management and will continue to shape the future of the industry.

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A STUDY ON WORK LIFE BALANCE OF TEACHING STAFFS IN SELECTED COLLEGES OF KANCHIPURAM

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Abstract

The study was conducted among the teaching staff in selected colleges in kanchipuram District. This study is an attempt to explore the tough challenges faced by the respondents in maintaining a balance between their personal and professional life during this period. The study is based on primary data and secondary data. A sample of 100 respondents was selected by convenience sampling method. This paper studies attitudes (in the form of interviews & questionnaire) of teaching staff. The various factors affecting the work-life balance of respondents have been examined in this study. The present study addresses the objective of understanding the socio economic profile of respondents, their opinion about their career, work life balance factors influencing them towards their work life balance and imbalances and outcome of work life balance and imbalances. In order to address the objectives, the relevant hypotheses have been framed. Statistical tools like Chi-Square test, T-test, ANOVA, Correlation and percentage analysis were used. It can be concluded that all levels of teaching staff have had difficulties in maintaining work-life balance during the work from home, especially the ones with children of school age.

Introduction

In Today's fast running phase of life, people really find it difficult to manage a balance between the pressures of work place and the duties of a home-maker, be it a male or female. Academic faculty were directly affected by the stay-at-home order, impacting research work, teaching, and service responsibilities, thereby altering any balance of work-life. Work Life Balance can be defined as the perfect integration between work and life both not interfering with each other. In the current business world, people and organizations are working round the clock to meet the ever growing demands. Work-life balance issues appear to affect some groups of people more than others those working long hours, those whose work spills over into the home as a result of modern technology, those in nonstandard employment such as shift work, those on low incomes, those trying to juggle parenting and paid work, and those with cultural obligations beyond the family and paid work. This may include sharing family responsibilities such as childcare, Take care of older relatives and assess whether these should be done by family or outsourcing.

Need of the Study

In order to gain deeper insight on the problems faced by teachers with regard to family and personal life, work-life, balancing time, monetary benefits, work-life balance provisions and socio economic factors the present study is under taken.

Scope of the Study

The study has primarily focused on the factors determining the level of attitude of the respondents towards Work life balance. This research provides an opportunity to conduct research in the field of human resources. This study will help to know the different opinions, needs and requirements from the different teaching professionals about work-life balance and pros & cons faced during this study period.

Objective of the Study

- A study to identify the impact of work life balance of teaching professionals in educational institutions.
- To understand the physical and mental adaptability of working people in educational institution in this period.
- To analyze teaching staff's attitudes about family and personal life, work-life balance, time management, monetary advantages, work-life balance provisions, and socioeconomic issues.

Review of Literature

Davis (2021) says, Online classes are very different from face-to-face classes and have some similarities but require different skills. Ashwini A Yarnal. (2020), she encountered Work life balance (WLB) is the modern distinctive issue of health care industry, since employees consistently need to succeed and advance at work place, simultaneously for family and recreation. Ramakrishnan, (2020) There are different approaches to the use of the concept “work-private life balance,” i.e., equilibrium of work and family life, equilibrium of work and private life, etc. Earlier research often deal with examination of the equilibrium between family and professional life in relation to the concept of work–life balance.

However, significant differences were found between laboratories regarding the personal relationships of aspect. Female teachers in private institutions are often exposed to higher working life pressures.

Research Methodology

The data needed for the study were collected from the primary and secondary sources. Primary data was collected directly from the teacher using a predefined, well- structured questionnaire. A total of 100 samples were collected in the kanchipuram area. The various statistical tools used to analyse the primary data are percentage analysis, correlation, chi-square test, one-way ANOVA, T-test and statistical analysis. In order to interpret the data and reach the findings of the data have been tabulated to facilitate effective analysis and understanding. secondary data was collected from published journals, books, journals, and websites.

Research Design**Descriptive Research Design**

From the objective we have studied the work life balance of teaching staff in colleges. To analyse this different data have to be collected from various educational institutions in kanchipuram.

A researcher using a descriptive design is only concerned in explaining the circumstance or case under investigation. Data collection, interpretation, and presentation are all part of this theory-based design process. This enables a researcher who can explain why and how research is done. The design aids others in comprehending the research's importance.

Research Gap

Previous researchers have studied about work life balance of IT employees, women workers and teachers WLB. There was no research conducted pertaining to work-life balance of teaching staff in colleges especially in kanchipuram

Research Tests Correlation

Correlation is a statistical term that describes how two variables move in concert with each other. If two variables move in the same direction, we will discuss the positive correlation of these variables. If they move in the opposite direction, they are negatively correlated.

Anova

Analysis of variance, or ANOVA, is a statistical method that separates observed variance data into different components to use for additional tests. A one-way ANOVA is used for three or more groups of data, to gain information about the relationship between the dependent and independent variables.

Chi-Square

Independence Test determines if there is a relationship between categorical variables, whether the variables are independent or related. This is a nonparametric test. This test is also known as the chi-square related test.

Hypothesis Testing

- H0: There is no relationship between performance and satisfaction. H1: There is relationship between performance and satisfaction.
- H0: There is no relationship between performance and work life factors H1: There is relationship between performance and work life factors
- H0: There is no relationship between performance and personal life factors H1: There is relationship between performance and personal life factors.

Statistical Analysis

One Way Anova Test

Hypothesis set between age of the respondents & their opinion on the amicable relationship between management and staff

Null Hypothesis:

Ho = There is no statistically significant relationship between age of the respondents and their opinion on the amicable relationship between management and staff

Alternate Hypothesis:

H1 = There is a statistically significant relationship between age of the respondents and their opinion on the amicable relationship between management and staff

Table .1

Descriptives								
Amicable								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
20 – 25 Years	18	2.11	.832	.196	1.70	2.53	1	4
25 – 30 Years	69	2.20	.979	.118	1.97	2.44	1	5
30 - 35 years	49	2.71	.736	.105	2.50	2.93	1	5
Above 35 years	14	2.29	.914	.244	1.76	2.81	1	4
Total	150	2.37	.908	.074	2.22	2.51	1	5

Table .2

ANOVA					
Amicable					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	9.039	3	3.013	3.866	.011
Within Groups	113.794	146	.779		
Total	122.833	149			

Correlation

Performances and Satisfaction

Hypothesis Testing

H0: There is no relationship between performance and satisfaction.

H1: There is relationship between performance and satisfaction.

Table .3 Correlation between performances and satisfaction.

Correlation				
		Performance		Satisfaction
Spearman's rho	Performance	Correlation Coefficient	1.000	.402**
		Sig. (2-tailed)	.	.002
		N	200	200
	Satisfaction	Correlation Coefficient	.402**	1.000
		Sig. (2-tailed)	.002	.
		N	200	200

**. Correlation is significant at the 0.02 level (2-tailed).

From the above it was interpreted that, significant value .002 is less than 0.5 and r value .402 is less than 1 critical value. So, the null hypothesis gets rejected and alternate hypothesis gets accepted.

Thus, there is a positive relationship between the performances and satisfaction.

Table .4

Correlations			
		Experience	Work environment
Experience	Pearson Correlation	1	.001
	Sig. (2-tailed)		1.000
	N	150	150
Work environment	Pearson Correlation	.001	1
	Sig. (2-tailed)	1.000	
	N	150	150

The data showed no violation of normality, linearity or homoscedasticity. There was a positive correlation between experiences of the respondents in IT sector and rigid working hours at the work environment, which was statistically significant ($r = 0.001$; $n = 150$, $p = 1$). The Pearson correlation coefficient, r , is 0.001 and that is statistically significant

Chi square Test -A chi-square (χ^2) statistic is a test that measures how a model compares to actual observed data. The data used in calculating a chi-square statistic must be random, raw, mutually exclusive, drawn from independent variables. Chi-square tests are often used in hypothesis testing. The chi-square statistic compares the size any discrepancies between the expected results and the actual results, given the size of the sample and the number of variables in the relationship. For these tests, degrees of freedom are utilized to determine if a certain null hypothesis can be rejected based on the total number of variables and samples within the experiment.

Table 5. calculation of X^2

Groups	Observed values (o)	Expected values (e)	O - e	(O - e) ²	(O - e) ² / e
G-1	4	2.8	1.2	1.44	0.5
G-2	8	8.3	-0.3	0.09	0.01
G-3	28	36	-8	64	1.78
G-4	16	11.1	4.9	24.01	2.16
G-5	16	13.8	2.2	4.84	0.35
G-6	0	1.2	-1.2	1.44	1.2
G-7	4	3.7	0.3	0.09	0.02
G-8	24	16	8	64	4
G-9	0	4.9	-4.9	24.01	4.9
G-10	4	6.2	-2.2	4.84	0.78
χ^2					15.7

Degree of freedom = 4 Significance level = 0.05

According to above information the tabular value of X^2 tabular = 9.49 And according to calculations X^2 calculated = 15.7

$15.7 > 9.49$

X^2 calculated $>$ X^2 tabular

Therefore, we reject null hypothesis, and accept the alternative hypothesis.

Alternative Hypothesis - There is a significant relationship between the gender and the level of satisfaction in work life balance of teaching employees.

Table 6: Showing Family Life Interfere with Work and Marital Status

		Independent Samples Test					
		Levene's Test for Equality of Variances		t-test for Equality of Means			
		F	Sig.	T	Df	Sig. (2-tailed)	Std. Error Difference
Family life interfere with work	Equal variances assumed	14.363	0.000	-3.413	122	0.001	0.220
	Equal variances not assumed			-3.507	121.389	0.001	0.214

The p-value is 0.001 which is lesser than the alpha value (0.05), hence alternate hypothesis (H1) is accepted. Therefore, there is a significant difference between family life interfere with work and marital status.

Suggestion

- The college management may arrange seminars and awareness programs about stress and overburden, work-life balance and individual energy management to make better choices about balancing their energies across their work and life.
- Consider providing training in relaxation methods, such as Yoga, meditation and free health checkup. These practices help to maintain healthy life style and lower stress.
- The teaching staff members have to plan, prioritize and schedule their work and life obligations in order to improve their work life balance.
- They shall think about what they want out of work and out of life.
- The management shall facilitate work life balance with many schemes that can attract teaching staff members and satisfy their needs.
- Management should not only develop work-life balance measures, but also take steps to encourage instructors to take use of work-life chances.

Conclusion

- The incorporation of Work-Life Balance strategies into annual planning of educational institutions by the management can, in fact, have positive impact on employee's well-being.
- Work is an essential part in which each individual spend most of the time so it is necessary to have proper balance to live the residual time with their family.

- Although this paper is focused on only one teaching staff of education institution, it can be concluded that all levels of teaching staff have had difficulties in maintaining work-life balance throughout the work from home, specifically the ones with children of school age.
- Therefore, it is equally important for teaching staff members to express their expectations and needs, since otherwise they cannot expect management or the institutions to resolve matters for them on their own initiative.

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ARTIFICIAL INTELLIGENCE IN TALENT ACQUISITION: OPPORTUNITIES, ETHICAL CHALLENGES, AND RESPONSIBLE RECRUITMENT PRACTICES

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Abstract

Artificial Intelligence (AI) has emerged as a transformative technology influencing organizational practices, particularly in recruitment and talent acquisition. Organizations increasingly adopt AI-driven tools such as automated resume screening systems, predictive analytics, and conversational chatbots to improve recruitment efficiency and decision-making accuracy. These technologies help organizations manage large applicant pools, reduce hiring time, and enhance candidate-job matching. However, the adoption of AI also introduces ethical challenges including algorithmic bias, lack of transparency, data privacy risks, and accountability concerns. This study examines the opportunities and ethical challenges associated with AI-driven recruitment while evaluating applicant perceptions of fairness and transparency. Using a qualitative secondary research design, the study analyzes academic literature, research reports, and case studies to identify key trends. The findings reveal that AI significantly improves recruitment efficiency but requires responsible implementation supported by transparency, fairness measures, and human oversight. The study concludes that a human–AI collaborative recruitment approach is essential to ensure ethical and inclusive hiring practices.

Keywords: Artificial Intelligence, Talent Acquisition, Recruitment Automation, Algorithmic Bias, Ethical AI, Human Resource Management, Predictive Analytics

1. Introduction

Artificial Intelligence has significantly transformed modern organizational practices, particularly in the field of human resource management. The integration of AI technologies into recruitment processes has improved hiring efficiency, enhanced decision-making, and streamlined talent acquisition strategies. Organizations increasingly rely on AI-powered systems such as resume screening tools, machine learning algorithms, and chatbot-based communication platforms to manage large volumes of job applications and identify suitable candidates.

AI-driven recruitment offers several advantages. It reduces hiring time, improves candidate-job matching, minimizes administrative workload, and enhances operational efficiency. AI systems analyze large datasets to identify patterns and predict candidate performance, enabling organizations to make more informed hiring decisions.

Despite these benefits, the growing use of AI raises ethical and social concerns. AI systems trained using historical data may replicate existing organizational biases, potentially leading to discriminatory hiring outcomes. Additionally, the lack of transparency in automated decision-making processes may reduce trust among job applicants. Concerns regarding data privacy and accountability further complicate AI adoption.

Therefore, it is essential to evaluate both the opportunities and ethical challenges associated with AI in recruitment. This study examines the impact of AI-driven recruitment practices and proposes guidelines for responsible implementation.

1.1 Objectives of the Study

The study aims to achieve the following objectives:

- To analyze the role of Artificial Intelligence in talent acquisition.
- To examine the impact of AI on recruitment efficiency and productivity.
- To identify ethical challenges associated with AI-based recruitment systems.
- To evaluate applicant perceptions regarding fairness and transparency.
- To propose recommendations for responsible AI adoption in recruitment.

1.2 Scope of the Study

The study focuses on AI applications in recruitment, including candidate screening, recruitment automation, and predictive analytics. It examines opportunities and ethical challenges based on secondary data sources such as academic literature and industry reports.

2. Review of Literature

The adoption of AI in recruitment has attracted significant attention in recent years. Previous studies indicate that AI technologies improve recruitment performance by automating repetitive tasks such as resume screening, candidate sourcing, and interview scheduling. These tools enable organizations to process large applicant pools efficiently while improving hiring accuracy.

Research also highlights the role of predictive analytics in recruitment decision-making. AI-based systems analyze candidate data to predict job performance and organizational fit, thereby improving selection outcomes. Such technologies contribute to cost reduction and enhanced productivity.

However, several scholars emphasize concerns regarding bias in algorithmic hiring systems. AI models trained using historical organizational data may reflect existing patterns of discrimination, resulting in unfair hiring decisions. Bias may arise from factors such as gender, ethnicity, or educational background embedded in training datasets.

Ethical and legal issues related to AI adoption have also been widely discussed. Many AI systems operate as “black-box” models, making their decision-making processes difficult to interpret. This lack of explainability raises concerns about transparency and accountability. Furthermore, the collection and processing of candidate data create privacy risks and legal challenges.

Although prior research has focused on efficiency and technical performance, limited attention has been given to applicant perceptions and long-term ethical implications. This study addresses this research gap by examining both operational and ethical dimensions of AI-driven recruitment.

3. Research Methodology

3.1 Research Design

The study adopts a qualitative research design based on secondary data analysis. This approach enables the researcher to examine existing knowledge and identify key trends related to AI adoption in recruitment.

3.2 Data Sources

Data were collected from:

- Peer-reviewed academic journals
- Research articles on AI and human resource management
- Industry reports and case studies
- Conference publications related to AI recruitment
- These sources provided comprehensive insights into recruitment efficiency, ethical challenges, and organizational practices.

3.3 Method of Analysis

The study employs thematic analysis to identify recurring themes related to AI adoption. Data were categorized into major themes such as recruitment efficiency, ethical concerns, and applicant perception. The findings were interpreted based on observed patterns.

3.4 Limitations of the Study

- Dependence on secondary data sources
- Limited availability of empirical evidence
- Rapid technological developments in AI

- Lack of primary survey data

4. Data Presentation and Analysis

Since the study is based on secondary data, findings were synthesized from existing research to identify trends in AI adoption, recruitment efficiency, and ethical challenges.

Table 1: AI Applications in Recruitment

AI Application	Function	Benefits
Resume Screening Software	Filters candidate profiles based on qualifications	Reduces screening time and improves accuracy
Chatbots	Communicates with applicants and answers queries	Enhances candidate engagement
Predictive Analytics	Predicts candidate performance	Improves hiring decisions
Automated Interview Systems	Conducts initial interviews	Reduces administrative workload

Interpretation

AI technologies automate recruitment activities and improve operational efficiency.

Table 2: Impact of AI on Recruitment Efficiency

Parameter	Before AI Adoption	After AI Adoption
Average Hiring Time	30–45 days	10–20 days
Recruitment Cost	High	Moderate
Administrative Workload	High	Reduced
Candidate Screening Accuracy	Moderate	High

Interpretation

AI adoption significantly reduces hiring time and improves decision accuracy.

Table 3: Ethical Challenges in AI Recruitment

Ethical Issue	Description	Impact
Algorithmic Bias	Discrimination due to biased data	Unfair hiring outcomes
Lack of Transparency	Limited explainability of AI decisions	Reduced applicant trust
Data Privacy Risks	Misuse of personal data	Legal and ethical issues
Accountability Issues	Unclear responsibility for decisions	Governance challenges

Interpretation

Ethical risks remain a major concern in AI-driven recruitment systems.

Table 4: Applicant Perception of AI Recruitment

Factor	Applicant Response
Speed of Recruitment	Positive
Transparency of Process	Mixed
Fairness of Decision	Moderate concern
Human Interaction	Preferred alongside AI

Interpretation

Applicants show higher acceptance of AI recruitment when human oversight is present.

5. Discussion

The findings demonstrate that AI adoption significantly improves recruitment efficiency by reducing hiring time and administrative workload. Automated screening systems enable organizations to process large volumes of applications efficiently, while predictive analytics enhances decision-making accuracy.

However, ethical challenges remain critical. Algorithmic bias may lead to discriminatory outcomes if training data contain existing social or organizational biases. This highlights the importance of fairness monitoring and regular system evaluation.

Transparency is another major concern. Many AI systems operate using complex algorithms that are difficult to interpret, making it challenging to explain hiring decisions. Lack of transparency may reduce trust among applicants and stakeholders.

Data privacy issues also require attention. Recruitment systems collect sensitive personal information, which must be protected through strong data governance practices.

The study suggests that a human–AI collaborative approach is essential. Human oversight ensures accountability and helps address ethical concerns while maintaining technological efficiency.

6. Findings

- AI improves recruitment efficiency and decision-making accuracy.
- Automation reduces hiring time and operational costs.
- Predictive analytics enhances candidate-job matching.
- Algorithmic bias remains a significant ethical concern.
- Transparency improves applicant trust.
- Human supervision increases acceptance of AI recruitment.

7. Suggestions

- Organizations should conduct regular algorithmic audits to detect bias.
- AI systems should provide explainable decision processes.
- Strong data protection policies should be implemented.
- Human oversight should be maintained in recruitment decisions.
- HR professionals should receive training on AI technologies.
- Ethical governance frameworks should be developed.
- Organizations should adopt a human–AI collaborative recruitment model.

8. Conclusion

Artificial Intelligence has transformed recruitment by improving efficiency, reducing administrative workload, and enhancing decision quality. However, the adoption of AI technologies introduces ethical challenges related to fairness, transparency, and data privacy. Responsible AI implementation requires balancing technological innovation with ethical accountability. Organizations must establish governance frameworks, ensure transparency, and maintain human oversight to promote fair and inclusive recruitment practices. A collaborative approach combining human judgment and AI capabilities is essential for sustainable talent acquisition in the digital era.

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ARTIFICIAL INTELLIGENCE IMPACT ON DIGITAL MARKETING: REVOLUTIONIZING CUSTOMER ENGAGEMENT AND CAMPAIGN STRATEGIES

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Abstract

Artificial Intelligence (AI) has emerged as a game-changer in the field of digital marketing, transforming traditional marketing strategies into highly personalized, data-driven experiences. This paper explores the multifaceted impact of AI on digital marketing, with a focus on how AI technologies—such as machine learning, natural language processing, chatbots, and predictive analytics—are reshaping customer engagement, advertising, and content creation. AI enables marketers to analyze vast amounts of consumer data in real-time, delivering highly personalized and targeted marketing campaigns that improve customer satisfaction, drive sales, and enhance brand loyalty. However, with these advancements come challenges, such as ethical concerns, data privacy issues, and the potential for algorithmic bias. The paper discusses these challenges and suggests ways for companies to leverage AI while ensuring responsible usage and adherence to privacy laws. Ultimately, this paper aims to provide a comprehensive overview of AI's transformative role in digital marketing, offering valuable insights for practitioners and researchers in the field.

Keywords: Artificial Intelligence, Digital Marketing, Customer Engagement, Predictive Analytics, Machine Learning, Personalization, AI Chat bots, Marketing Automation, Data Privacy, Content Marketing.

1. Introduction

In the ever-evolving landscape of digital marketing, Artificial Intelligence (AI) has emerged as a transformative force, revolutionizing how businesses interact with consumers and execute marketing campaigns. As AI technologies such as machine learning, natural language processing (NLP), and predictive analytics become more sophisticated, they are reshaping traditional marketing practices by enabling hyper-targeted advertising, personalized customer experiences, and automated campaign optimization.

Over the past decade, AI has dramatically shifted the dynamics of customer engagement. From chatbots offering real-time assistance to AI-powered content recommendations tailored to individual preferences, businesses now have the tools to not only engage customers but also predict their future behaviors. This shift marks a significant departure from traditional marketing methods that were often one-size-fits-all and reactive in nature. With AI, digital marketers are empowered to move towards a more proactive, data-driven approach, fostering deeper, more personalized relationships with customers.

One of the key benefits of AI in digital marketing is the ability to analyze vast amounts of data quickly and accurately. By utilizing machine learning algorithms, AI can identify patterns in consumer behavior and predict future purchasing decisions, enabling businesses to create targeted marketing strategies that resonate with their audiences. AI is also enabling marketers to optimize their campaigns in real-time, adjusting ads, content, and budgets based on the performance of ongoing campaigns, ensuring maximum efficiency and return on investment (ROI). However, as with any technological advancement, the integration of AI in digital marketing brings forth a set of challenges and ethical concerns. Issues such as data privacy, algorithmic bias, and over-reliance on automation raise important questions about how AI should be implemented responsibly. Furthermore, the rapid pace of AI innovation in marketing requires businesses to stay agile and adapt to new technologies, while also ensuring that human oversight and creativity remain integral components of the marketing process.

2. The Role of AI in Digital Marketing

Artificial Intelligence (AI) is rapidly becoming a cornerstone of modern digital marketing, providing tools that empower businesses to enhance customer engagement, streamline operations, and optimize marketing strategies.

By leveraging vast amounts of data, AI technologies enable marketers to deliver highly personalized experiences, predict consumer behavior, and improve decision-making processes in real time. This section explores the significant roles AI plays in digital marketing, from personalization and automation to predictive analytics and enhanced customer interactions.

1. AI in Personalization

Personalization has long been a goal of digital marketing, but with AI, it is now being taken to new heights. AI-driven personalization allows businesses to tailor their marketing efforts based on individual customer preferences, behaviors, and interactions. By analyzing data from various sources—such as browsing history, past purchases, and social media activity

- **Personalized Content:** AI can recommend content that aligns with a customer's interests, increasing the likelihood of engagement. Streaming platforms like Netflix and Spotify leverage AI to recommend shows and music, respectively, based on users' preferences and viewing/listening history.
- **Dynamic Website Experiences:** AI can change the content displayed on websites in real-time to reflect individual customer profiles. For example, Amazon uses AI to personalize product recommendations on the homepage, increasing the chances of conversion by presenting relevant products based on browsing and purchase history.
- **Targeted Email Marketing:** AI can optimize email marketing campaigns by personalizing subject lines, content, and timing based on customer behaviors. Mailchimp and other email marketing platforms use machine learning to predict the best times to send emails to specific users, improving open and click-through rates.

2. AI in Automation

AI has revolutionized marketing by automating tasks that were once time-consuming and resource-intensive. Automation allows digital marketers to focus on strategy while AI handles routine tasks, driving efficiency and freeing up valuable human resources.

- **Programmatic Advertising:** AI automates the ad-buying process through programmatic advertising, which uses real-time bidding and data analysis to place ads on the most relevant websites and platforms. For example, Google Ads and Facebook Ads utilize machine learning algorithms to automatically adjust ad bids based on performance, ensuring ads reach the right audience at the right time.
- **Social Media Scheduling and Management:** AI tools such as Hootsuite and Buffer help automate social media posts, analyze engagement data, and suggest the best times to post. This ensures consistent communication with customers without requiring manual effort, while AI also provides insights into which content resonates best with audiences.

3. AI in Predictive Analytics

Predictive analytics is one of the most powerful ways AI is reshaping digital marketing. By analyzing historical data and consumer behavior, AI can predict future actions, allowing marketers to make informed decisions about where to allocate resources and how to tailor marketing campaigns.

- **Customer Segmentation:** AI can identify customer segments based on past behavior and demographics, allowing businesses to create highly targeted marketing strategies. Spotify, for example, segments its audience based on listening habits, enabling advertisers to create personalized ads that resonate with specific groups.
- **Sales Forecasting:** AI algorithms predict future sales trends by analyzing patterns in historical sales data, seasonal behavior, and external factors. This allows businesses to forecast demand accurately, optimize inventory levels, and adjust marketing strategies accordingly.

4. AI in Customer Engagement

AI has transformed how businesses engage with customers, enabling more responsive and tailored interactions. AI-powered tools facilitate real-time communication, enhancing customer experience and fostering stronger relationships with brands.

- **Sentiment Analysis:** AI can analyze social media, reviews, and customer feedback to gauge the sentiment surrounding a brand or product. This helps businesses understand how customers feel about their offerings and respond to negative feedback quickly. **Brandwatch** and **Sprout Social** use AI-driven sentiment analysis to track brand mentions and provide insights into customer opinions.
- **Voice Search Optimization:** As voice-activated devices like Amazon Alexa, Google Assistant, and Apple Siri become more popular, AI is playing a critical role in optimizing content for voice search. AI helps businesses understand how users phrase voice searches and adjust their SEO strategies accordingly to ensure their content ranks well in voice search results.
- **Personalized Advertising:** AI uses real-time data to display highly targeted ads based on user behaviors and preferences. This increases the likelihood of customer interaction and conversion. Facebook and Instagram use AI to show users ads tailored to their interests, based on their activities and past interactions on the platform.

5. AI in Content Creation and Optimization

AI is also transforming how content is created and optimized for digital marketing. AI-driven tools can generate written content, optimize headlines, and even create visuals that align with customer interests.

- **Automated Content Generation:** AI tools like Articoolo and Wordsmith use natural language generation (NLG) to automatically create written content such as blog posts, product descriptions, and social media updates. This enables marketers to scale content production quickly without compromising quality.
- **SEO Optimization:** AI tools can optimize content for search engines by suggesting keywords, improving readability, and analyzing competitor content. Tools like Surfer SEO and MarketMuse use AI to optimize content and improve search engine rankings.
- **Visual Content Creation:** AI is increasingly being used to generate visual content, such as product images, infographics, and videos. For instance, Canva uses AI to recommend design elements, helping marketers create visually appealing content quickly and efficiently.

3. Benefits of AI in Digital Marketing

Artificial Intelligence (AI) has fundamentally changed the landscape of digital marketing, offering businesses innovative tools to enhance efficiency, improve customer experiences, and increase return on investment (ROI). By automating complex tasks, analyzing large volumes of data, and providing predictive insights, AI helps marketers deliver more personalized, targeted, and effective marketing campaigns. This section highlights the key benefits AI brings to digital marketing, including improved customer engagement, enhanced personalization, increased efficiency, cost-effectiveness, and data-driven decision-making.

3.1. Enhanced Personalization

One of the most significant benefits of AI in digital marketing is its ability to deliver hyper-personalized experiences at scale. Personalization has become a key differentiator in marketing, as consumers expect brands to understand their preferences and needs. AI enables marketers to meet these expectations by providing deep insights into customer behavior and tailoring content, products, and services accordingly.

- **Dynamic Content Recommendations:** AI algorithms can track and analyze customer interactions with digital platforms, such as browsing history and purchase patterns. Using this data, AI can dynamically recommend relevant products, services, or content that align with the individual's preferences. Netflix and Spotify are prime examples of AI-powered personalization, offering users content recommendations based on past viewing or listening behavior.
- **Personalized Email Campaigns:** AI enables businesses to create personalized email marketing campaigns tailored to each recipient. By analyzing past customer interactions, AI can optimize the timing, subject lines, and content of emails to maximize engagement and conversions. Mailchimp and other platforms use machine learning to identify the best time to send emails and recommend personalized offers.
- **Website Personalization:** AI-driven personalization allows brands to customize website content based on individual visitor behavior. For example, Amazon recommends products based on browsing history and past purchases, providing a unique shopping experience for each user.

3.2. Cost-Effectiveness and Return on Investment (ROI)

AI helps businesses optimize their marketing budgets and ensure that every dollar spent delivers the highest return on investment. By automating processes and improving targeting, AI enables marketers to achieve more with less.

- **Optimized Ad Spend:** AI algorithms analyze campaign performance in real-time and adjust bids, placements, and targeting to maximize ROI. For example, Google's Smart Bidding feature uses machine learning to optimize bids in real-time based on factors like device, location, and time of day, ensuring ads are shown to the most relevant audience.
- **Reduced Human Error:** By automating routine tasks such as data entry, lead scoring, and email campaigns, AI reduces the risk of human error and increases the efficiency of marketing efforts. This results in better resource allocation and improved marketing effectiveness.
- **Cost-Effective Content Creation:** AI tools like Articoolo and Wordsmith allow businesses to generate content at scale, reducing the costs associated with manual content creation. These tools use natural language generation (NLG) to create product descriptions, social media posts, and blog articles quickly and efficiently, reducing the need for large content teams.

4. Future Trends and Opportunities in AI-Driven Digital Marketing

As Artificial Intelligence (AI) continues to evolve, its influence on digital marketing is expected to grow exponentially. Marketers are increasingly looking for innovative ways to leverage AI to enhance customer engagement, improve marketing effectiveness, and drive better business outcomes. This section explores the key future trends and opportunities in AI-driven digital marketing, highlighting emerging technologies, evolving customer expectations, and new marketing strategies that will shape the future of the industry.

4.1. Increased Integration of AI in Omni channel Marketing

Omni channel marketing refers to providing a seamless customer experience across all channels, including websites, mobile apps, social media, and physical stores. AI will play a crucial role in enhancing Omni channel strategies by enabling marketers to deliver personalized and consistent experiences across multiple touch points.

- **Personalized Cross-Channel Experiences:** AI-powered tools will allow businesses to track customer interactions across channels in real time and deliver contextually relevant messages. For example, if a customer views a product on a website and later browses social media, AI can serve personalized ads or product recommendations based on that initial interaction. Brands like Sephora and Nike already use AI to create omnichannel experiences, ensuring customers receive personalized content and offers wherever they engage with the brand.
- **Real-Time Customer Data Integration:** AI can integrate data from various channels to provide a 360-degree view of the customer. This will help marketers understand how customers are interacting with their brand, whether on mobile apps, in-store visits, or social media platforms, and adjust marketing strategies accordingly. The use of AI in **Customer Data Platforms (CDPs)** will become more widespread, helping businesses create cohesive and personalized customer journeys.

4.2. AI-Powered Voice Search and Conversational Marketing

Voice search and conversational AI are quickly becoming key components of digital marketing strategies. With the increasing use of voice-activated devices such as Amazon Alexa, Google Assistant, and Apple Siri, businesses must optimize their marketing for voice search and create new opportunities for engagement through voice-driven interfaces.

- **Voice Search Optimization:** As more consumers turn to voice search to find information, brands will need to adapt their SEO strategies for voice queries. Voice search is more conversational and longer than typed queries, requiring marketers to focus on **natural language processing (NLP)** and create content that aligns with how people speak. AI-driven tools will help marketers optimize for voice search, ensuring that their content ranks well in voice results and delivers the information users seek.
- **Conversational AI:** AI chatbots and virtual assistants will become more sophisticated, enabling personalized, real-time conversations with customers. In the future, these systems will not only respond to simple queries but also engage in more complex, contextually aware dialogues. Companies like H&M and Sephora are

already using conversational AI to guide customers through their purchasing journeys, providing product recommendations, answering questions, and even offering post-purchase support.

- **Voice Commerce:** The rise of voice commerce, or "v-commerce," will create new opportunities for businesses to engage customers and drive sales through voice-activated devices. Brands will begin integrating shopping capabilities into voice assistants, allowing users to place orders or make purchases through voice commands.

4.3. AI in Predictive Marketing and Hyper-Personalization

One of the most significant opportunities for AI in digital marketing is the ability to predict customer behavior and provide hyper-personalized experiences. Predictive analytics and machine learning algorithms can analyze customer data to forecast future actions, enabling businesses to deliver highly relevant and timely marketing messages.

- **Predictive Customer Insights:** AI-powered predictive models can analyze past behaviors to anticipate future actions, allowing businesses to create campaigns that are better aligned with customers' needs and preferences. For instance, Netflix uses predictive algorithms to recommend shows based on viewing history, while Amazon uses predictive analytics to suggest products that customers might be interested in purchasing.
- **Hyper-Personalization:** AI will enable marketers to create more granular and dynamic personalized experiences, going beyond simple demographic targeting. For example, AI will allow businesses to deliver personalized content, offers, and ads based on factors such as time of day, weather, current location, and even emotional state. This level of personalization will improve customer engagement and conversion rates, as marketing will feel more relevant and timely.
- **Real-Time Personalization:** AI will enable real-time personalization, where marketing messages are adapted instantaneously based on customer behavior. If a user abandons their shopping cart on an e-commerce website, AI could instantly offer a personalized discount or reminder to encourage the customer to complete the purchase.

4.4. Ethical AI and Trust-Building in Digital Marketing

As AI plays a more prominent role in digital marketing, ethical considerations will become increasingly important. Consumers are becoming more aware of how their data is used, and brands that demonstrate transparency and ethical AI practices will earn their trust and loyalty.

- **AI Ethics and Transparency:** Consumers will expect transparency about how their data is being used and how AI-driven decisions are made. Businesses will need to be transparent about their AI practices, explaining how algorithms work and ensuring they are fair and unbiased. Explainable AI (XAI) is one approach that will help businesses provide clear and understandable explanations of AI decisions.
- **Data Privacy and Consumer Trust:** With the growing concern over data privacy, brands that prioritize ethical data usage and adhere to regulations like GDPR and CCPA will be better positioned to build long-term customer relationships. Implementing AI tools that ensure consumer data is handled securely and ethically will be a key differentiator in the marketplace.
- **AI for Social Good:** In the future, AI can also be leveraged for social good, helping brands address social issues and build stronger connections with consumers. Companies like Patagonia and TOMS are already incorporating AI to track and reduce their carbon footprint, and other companies will follow suit by using AI to support sustainability, diversity, and social causes.

5. Conclusion

The integration of Artificial Intelligence (AI) in digital marketing has fundamentally transformed the way businesses engage with customers, optimize campaigns, and analyze data. As AI technologies continue to evolve, they offer unprecedented opportunities to deliver personalized, automated, and data-driven marketing strategies that are more efficient, effective, and customer-centric. From predictive analytics and personalized content to AI-driven automation and enhanced customer engagement, AI is helping businesses unlock new levels of innovation and efficiency in their marketing efforts.

However, the adoption of AI in digital marketing is not without challenges. Issues such as data privacy, algorithmic bias, transparency, and over-reliance on automation pose significant risks. Ethical considerations regarding the

responsible use of consumer data and the transparency of AI-driven decisions are essential to ensuring that AI's impact remains positive and fair. To build trust and loyalty with customers, businesses must prioritize transparency, fairness, and accountability in their AI systems.

Looking forward, the future of AI in digital marketing promises even greater advancements, including the widespread integration of AI in omnichannel marketing, voice search optimization, hyper-personalization, and immersive experiences through augmented and virtual reality. As AI continues to mature, marketers will have even more powerful tools at their disposal to create deeper, more meaningful relationships with consumers and deliver superior customer experiences.

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AI ADOPTION IN HR PRACTICES: OPPORTUNITIES AND CHALLENGES FOR WOMEN IN THE DIGITAL MEDIA INDUSTRY

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Abstract

The study examines AI adoption in HR practices and its opportunities and challenges for women in the digital media industry. Artificial Intelligence has transformed recruitment, performance evaluation, and training systems by introducing data-driven decision-making and automation. This research analyzes perceptions of 63 women professionals regarding AI usage in HR functions. Data were collected through a structured interview method and analyzed using frequency distribution, chi-square, and ANOVA tests. The findings reveal that performance evaluation is the primary area of AI application. While no significant relationship exists between age and purpose of AI usage, significant differences are observed in perceptions related to recruitment fairness, performance transparency, skill barriers, and exclusion from AI decision-making processes. The results indicate that AI enhances merit-based systems but also presents challenges such as lack of technical expertise and concerns about inclusivity. The study concludes that AI adoption must be supported by gender-sensitive governance, inclusive design frameworks, and targeted skill development programs to ensure equitable benefits for women professionals. AI can function as a catalyst for empowerment only when implemented through transparent and ethical organizational strategies.

Keywords: Artificial Intelligence (AI), HR Practices, Women Professionals, Digital Media Industry, AI Adoption Challenges

Introduction

The rapid integration of Artificial Intelligence (AI) into organizational systems has significantly transformed human resource (HR) practices across industries. AI-driven HR technologies such as automated resume screening, predictive analytics, chatbots, and performance management dashboards are increasingly used to enhance efficiency and objectivity in workforce management (Boudreau & Cascio, 2017; Upadhyay & Khandelwal, 2018). In the digital media industry an ecosystem driven by innovation, technology, and creative labor AI adoption in HR practices has become especially prominent.

The digital media industry operates in a competitive and performance-oriented environment where rapid talent acquisition, skill upgrading, and data-driven evaluation are critical. AI tools enable organizations to streamline recruitment processes, analyze employee productivity, and recommend personalized training modules. According to Davenport and Ronanki (2018), AI systems contribute to improved decision-making by processing large volumes of data more accurately than traditional HR methods. This shift toward algorithmic management marks a structural transformation in organizational governance.

For women professionals in the digital media industry, AI adoption presents both opportunities and challenges. On the positive side, AI-based recruitment systems claim to reduce unconscious bias by focusing on measurable competencies rather than subjective judgments (Raghavan et al., 2020). Gender-neutral screening algorithms may potentially create more equitable hiring outcomes. Furthermore, AI-enabled remote work tools and flexible performance monitoring systems can support work-life balance, which is often a critical concern for women professionals (World Economic Forum [WEF], 2023).

However, concerns regarding algorithmic bias remain significant. Research indicates that AI systems are often trained on historical data, which may already reflect gender inequalities (Eubanks, 2018). If datasets are biased, algorithmic decision-making can reproduce discriminatory patterns rather than eliminate them. Raghavan et al. (2020) argue that hiring algorithms may unintentionally disadvantage women if gendered patterns exist in historical employment records.

In addition, digital skill gaps may hinder women's effective engagement with AI-driven HR systems. Studies show that unequal access to technological training and leadership representation can influence how women experience digital transformation in workplaces (WEF, 2023). While AI offers structured performance metrics and data transparency, it may also introduce new forms of surveillance and evaluation pressures (Boudreau & Cascio, 2017).

The digital media sector is uniquely positioned in this transformation. As both a consumer and producer of digital technologies, the industry reflects broader societal shifts toward automation and data analytics. Women in this sector contribute significantly to content creation, strategic communication, and innovation, yet they remain underrepresented in senior decision-making roles (WEF, 2023). The integration of AI into HR practices may influence career mobility, leadership opportunities, and professional recognition.

The study examines AI adoption in HR practices specifically from the perspective of women in the digital media industry. It focuses on recruitment, performance evaluation, and training systems to assess whether AI enhances fairness, transparency, and professional growth. At the same time, it evaluates structural challenges such as skill barriers, exclusion from AI development processes, and concerns about algorithmic bias.

By situating AI adoption within gendered organizational structures, this study contributes to understanding AI not merely as a technical tool but as a socio-organizational phenomenon that shapes workplace power dynamics and career trajectories.

Review of Literature

AI in human resource management has attracted increasing scholarly attention. Boudreau and Cascio (2017) describe AI-driven HR systems as part of a broader shift toward "analytics-based talent management," where predictive modeling and automation enhance recruitment and workforce planning. Similarly, Upadhyay and Khandelwal (2018) emphasize that AI applications in HR improve efficiency, reduce administrative burden, and support data-driven decision-making.

Recruitment is one of the most widely studied domains of AI adoption. Research suggests that automated resume screening and candidate-matching algorithms can reduce human bias and increase hiring consistency (Davenport & Ronanki, 2018). However, Raghavan et al. (2020) highlight that fairness in algorithmic hiring remains complex, as machine learning models may encode systemic inequalities present in historical datasets.

Gender and technology studies reveal that digital transformation produces uneven outcomes. Eubanks (2018) argues that algorithmic systems often reflect structural inequalities embedded in social institutions. In workplace contexts, this may translate into biased performance metrics or skewed promotion pathways. While AI promises objectivity, its neutrality depends on ethical design and inclusive governance mechanisms.

In the digital media industry, technological adoption is deeply embedded in organizational culture. Studies indicate that women's participation in digital professions has grown, yet leadership gaps persist (WEF, 2023). AI-driven HR systems may standardize evaluation criteria, potentially reducing subjective bias in performance appraisal. However, employees' trust in AI systems significantly influences their acceptance (Davenport & Ronanki, 2018). Transparency, explainability, and accountability are therefore critical factors.

Training and skill development represent another major dimension of AI adoption. Personalized learning platforms use analytics to recommend training modules aligned with performance data (Upadhyay & Khandelwal, 2018). For women professionals, access to such platforms can enhance career advancement opportunities. Nevertheless, digital literacy disparities may limit effective participation (WEF, 2023).

Employee perceptions of AI-driven HR systems are shaped by trust and perceived fairness. Research suggests that algorithmic transparency increases organizational acceptance (Raghavan et al., 2020). Conversely, opaque decision-making may lead to resistance and skepticism. Women employees may particularly evaluate AI systems through the lens of past workplace experiences.

Thus, the literature demonstrates a dual narrative: AI enhances efficiency, consistency, and data-driven governance, yet raises concerns regarding bias, exclusion, and skill inequality. While extensive research exists on AI in HR and gender in digital workplaces separately, fewer studies examine women's perceptions of AI adoption specifically

within the digital media industry. This study addresses that gap by focusing on women’s experiences in AI-driven HR systems.

Research Gap

Although existing literature discusses AI adoption in HR practices and gender issues in digital workplaces, there is limited empirical research focusing specifically on women professionals in the digital media industry. Most studies examine AI efficiency or general employee perceptions without isolating gender-specific experiences. Also, few studies analyze how different HR functions recruitment, performance evaluation, and training interact with women’s career development. Therefore, there is a need for focused research examining both opportunities and challenges of AI adoption in HR practices from the perspective of women in the digital media sector.

Objectives of the Study

1. To analyze the demographic profile of women professionals in the digital media industry.
2. To examine the purposes of AI adoption in HR practices.
3. To assess the perceived opportunities of AI in recruitment, performance evaluation, and career advancement.
4. To identify challenges faced by women in adopting AI-driven HR systems.
5. To analyze the relationship between demographic factors and perceptions of AI adoption.

Hypotheses

- H₀₁: There is no significant relationship between age and purpose of using AI in HR practices.
- H₀₂: There is no significant difference in perceptions of AI-driven recruitment fairness across different purposes of AI usage.
- H₀₃: There is no significant difference in perceptions of AI-driven performance evaluation transparency across different purposes of AI usage.
- H₀₄: There is no significant difference in perceived skill barriers in AI adoption across different purposes of AI usage.
- H₀₅: There is no significant difference in perceptions of exclusion from AI decision-making processes across different purposes of AI usage.

Methodology for the Study

Data was collected from respondents using a structured interview method. The research was conducted among responders in Chidambaramin Cuddalore District, which were selected by using simple random sampling. The Samples for this study were collected from 63 respondents. The Reliability analysis shows that Cronbach's Alpha for the scaled item is 0.810

Results and Discussions

Table 1: Frequency distribution

Age	Frequency	Per cent
18–28	9	14.3
29–39	22	34.9
40–45	23	36.5
Above 51	9	14.3
Total	63	100.0
Marital Status	Frequency	Per cent
Unmarried	7	11.1
Married	43	68.3

Divorced	13	20.6
Total	63	100.0
Qualification	Frequency	Per cent
Secondary	6	9.5
Higher Secondary	21	33.3
Graduation	36	57.1
Total	63	100.0

Table 2: Purpose of Using AI in HR Practices

Purpose	Frequency	Per cent
Recruitment & Talent Acquisition	18	28.6
Performance Evaluation	31	49.2
Training & Skill Development	14	22.2
Total	63	100.0

Interpretation

The frequency distribution table indicates that the majority of respondents (36.5%) belong to the 40–45 age group, followed by 34.9% in the 29–39 category. Most respondents are female (65.1%), which aligns with the study’s focus on women in the digital media industry. A significant proportion (68.3%) are married, and 57.1% possess graduation-level qualifications, indicating a relatively educated workforce.

Regarding AI adoption in HR practices, performance evaluation (49.2%) is the most common application, followed by recruitment (28.6%) and training (22.2%). These findings suggest that AI tools are primarily utilized for employee assessment and workforce management in digital media organizations.

Testing of Hypothesis

Table 3- Age * Purpose for Using AI in HR Practices

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	9.594a	6	.143
Likelihood Ratio	10.886	6	.092
Linear-by-Linear Association	.107	1	.744
N of Valid Cases	63		

Interpretation

The chi-square test examines the relationship between age and the purpose of using AI in HR practices. The Pearson Chi-Square value (9.594) with a p-value of 0.143 indicates no statistically significant association at the 0.05 level. Similarly, the likelihood ratio ($p = 0.092$) and linear-by-linear association ($p = 0.744$) confirm the absence of a significant relationship.

It suggests that AI adoption purposes whether recruitment, performance evaluation, or training do not significantly vary across different age groups.

Table 4- Gender * Purpose for Using AI in HR Practices

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	1.195a	2	.550
Likelihood Ratio	1.185	2	.553
Linear-by-Linear Association	.351	1	.554
N of Valid Cases	63		

Interpretation

The chi-square results indicate no significant relationship between gender and the purpose of AI usage in HR practices ($p = 0.550$). The likelihood ratio and linear-by-linear association also support this finding.

It implies that both male and female professionals in the digital media industry use AI tools similarly across HR functions such as recruitment, performance evaluation, and training.

Table 5- ANOVA

Purpose of Using AI in HR Practices * Perceptions on Opportunities and Challenges

Statement	df	F	Sig.
AI tools enhance fairness in recruitment and reduce gender bias.	Between Groups 2	10.182	.000
AI improves transparency in performance evaluation.	Between Groups 2	6.404	.003
Women employees receive adequate AI-related HR training.	Between Groups 2	.371	.692
AI supports flexible and remote work arrangements.	Between Groups 2	1.185	.313
AI facilitates skill-based career advancement.	Between Groups 2	6.409	.003
AI-powered analytics improve workforce decision-making.	Between Groups 2	.489	.616
Women feel confident using AI-based HR systems.	Between Groups 2	2.095	.132
Women feel excluded from AI-driven HR decision processes.	Between Groups 2	10.990	.000
Lack of technical skills is a barrier to AI adoption.	Between Groups 2	12.741	.000
Algorithmic bias affects women's career progression.	Between Groups 2	.566	.571

The ANOVA results show significant differences in perceptions across AI usage purposes regarding fairness in recruitment ($p < .001$), transparency in performance evaluation ($p = .003$), and skill-based career advancement ($p = .003$). There are also significant concerns about exclusion from AI-driven HR decision-making ($p < .001$) and lack of technical skills as a barrier ($p < .001$).

However, perceptions regarding adequate training ($p = .692$), confidence in AI systems ($p = .132$), and algorithmic bias ($p = .571$) do not show significant differences.

These findings indicate that while AI adoption in HR practices offers opportunities for fairness, transparency, and career advancement, challenges such as digital skill gaps and perceived exclusion persist for women professionals in the digital media industry.

Findings of the Study

The findings reveal that AI adoption in HR practices plays a transformative role in the digital media industry. Performance evaluation is the primary area of AI application. While AI enhances recruitment fairness, transparency, and skill-based advancement, barriers such as lack of technical expertise and exclusion from AI development processes remain significant challenges.

Therefore, AI presents both opportunities and structural challenges for women in the digital media workforce. Therefore, gender-sensitive AI governance, inclusive HR policies, and targeted upskilling initiatives are essential to ensure equitable AI adoption.

Suggestions

1. Digital media organizations should implement structured AI training programs specifically designed for women professionals to reduce technical skill gaps.
2. HR departments must conduct regular audits of AI algorithms to ensure fairness and eliminate potential gender bias.
3. Organizations should promote transparency in AI-driven recruitment and performance evaluation systems to build employee trust.
4. Women professionals should be actively included in AI system design and decision-making processes to enhance inclusivity.

5. Policy frameworks should integrate gender-sensitive AI governance practices to ensure equitable career advancement opportunities within digital media industries.

Conclusion

The study concludes that AI adoption in HR practices significantly influences workplace experiences of women in the digital media industry. While age does not determine the purpose of AI usage, perceptions regarding fairness in recruitment, transparency in performance evaluation, career advancement opportunities, skill barriers, and exclusion from AI-driven processes vary significantly. AI tools contribute positively by enhancing merit-based recruitment and structured performance assessment. However, challenges such as lack of technical expertise and perceived exclusion from AI development remain critical concerns.

The findings highlight that AI adoption is not purely technological but deeply connected to organizational culture and gender equity. For AI to serve as a catalyst for empowerment, it must be implemented through inclusive governance mechanisms and supportive training initiatives. Without addressing structural inequalities and skill disparities, AI systems may risk reinforcing existing workplace imbalances. Therefore, digital media organizations must adopt a balanced and gender-sensitive approach to AI-driven HR transformation.

Future Scope of the Study

1. Future research may expand the sample size across multiple districts or states to improve generalizability.
2. Comparative studies between men and women professionals can provide deeper gender-based insights into AI adoption.
3. Longitudinal studies may examine the long-term impact of AI-driven HR systems on women's career progression and leadership opportunities.

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ARTIFICIAL INTELLIGENCE APPLICATIONS IN MARKETING: EMERGING TRENDS AND FUTURE DIRECTIONS

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Abstract

Artificial Intelligence (AI) has emerged as a transformative force in the field of marketing, reshaping how organizations engage with customers, analyse data, and drive strategic decisions. This paper examines the current applications of AI in marketing, including personalized customer experiences, predictive analytics, chatbots and conversational interfaces, automated content creation, and programmatic advertising. By leveraging machine learning, natural language processing, and big data, marketers can enhance targeting accuracy, optimize campaigns in real-time, and foster deeper customer relationships. Despite its advantages, the integration of AI presents challenges such as data privacy concerns, ethical considerations, and the need for specialized skills. Looking forward, future trends are likely to include hyper-personalization powered by deep learning, increased use of AI-driven voice and visual search, autonomous marketing systems, and the convergence of AI with emerging technologies like augmented reality and the metaverse. The study concludes that while AI will continue to drive innovation and competitive advantage in marketing, successful implementation will require businesses to balance technological progress with ethical and human-centric approaches.

Keywords: Artificial Intelligence; Industry 4.0; Marketing; Systematic Literature Review (SLR); Bibliometric Analysis; Digital Transformation

Introduction

In an increasingly digital and hyper-connected world, marketing has evolved far beyond traditional concepts of product promotion and customer engagement. Today's marketplace is driven by data, speed, and personalization, forcing businesses to adopt sophisticated tools and technologies in order to remain relevant and competitive. Among these technologies, **Artificial Intelligence (AI)** stands out as a revolutionary force reshaping the landscape of marketing practice. AI's ability to analyze enormous data sets, recognize patterns, automate decisions, and interact with customers has fundamentally transformed marketing strategies across industries.

Artificial Intelligence refers to a broad set of computational technologies that enable machines to simulate aspects of human intelligence such as learning, reasoning, decision-making, and language understanding. Within marketing, AI technologies—such as machine learning, natural language processing (NLP), and predictive analytics—provide marketers with unprecedented capabilities to understand consumer behavior, optimize campaigns, and deliver tailored customer experiences. As digital adoption accelerates, businesses are leveraging AI to move from mass marketing approaches toward more **data-driven, personalized engagements** that resonate with consumers on an individual level.

The adoption of AI in marketing is not merely a tactical trend but a strategic imperative. Organizations now collect massive amounts of customer data from touchpoints such as websites, mobile apps, social media, IoT devices, and e-commerce platforms. This data holds invaluable insights that, when processed and interpreted through AI systems, allow marketers to decode consumer preferences, anticipate needs, and predict future behavior. For instance, machine learning algorithms can segment audiences dynamically based on purchase history, browsing behavior, and engagement patterns—enabling marketers to deliver highly relevant messages that significantly improve conversion rates. In addition, AI-powered predictive analytics allow marketers to forecast demand, gauge campaign performance, and allocate resources more effectively.

One of the most visible applications of AI in marketing is **personalization**. Today's consumers expect brands to deliver not only relevant content but also seamless experiences across channels. AI helps marketers tailor content, product recommendations, pricing, and promotional offers in real time, creating a sense of personalized dialogue between the brand and the individual. E-commerce platforms use AI-driven recommendation engines to suggest

products a customer is most likely to buy, while content platforms leverage AI to curate news feeds and advertisements based on user interests. Such personalization strategies significantly enhance customer satisfaction, foster brand loyalty, and drive revenue growth.

Beyond personalization, AI plays a crucial role in automating routine marketing tasks. Chatbots and virtual assistants, powered by natural language processing, handle customer inquiries efficiently around the clock—reducing operational costs while improving responsiveness. Content generation tools use algorithms to draft social media posts, email subject lines, and product descriptions, freeing human marketers to focus on strategy and creativity. Furthermore, **programmatic advertising**—the automated buying and placement of ads in real time—relies heavily on AI to determine optimal ad placements, bidding prices, and audience segments.

Despite its wide-ranging benefits, the integration of AI into marketing practices is not without challenges. Issues surrounding data privacy, ethical AI usage, algorithmic bias, and the need for skilled professionals have raised important questions for businesses and regulators alike. As AI systems increasingly influence decisions that impact consumer experiences, marketers must balance technological innovation with ethical responsibility. Moreover, organizations must invest in training and infrastructure to build AI-ready teams capable of harnessing the technology effectively.

Looking forward, the future of AI in marketing holds even greater potential. Emerging technologies like voice and visual search, augmented reality (AR), and AI-driven autonomous systems promise to further enhance consumer engagement. Hyper-personalization powered by deep learning, predictive customer care, and real-time adaptive marketing strategies are among the trends set to define the next era of marketing innovation.

In conclusion, Artificial Intelligence represents a paradigm shift in the way marketing functions—from data analysis and customer interactions to strategic decision-making. As the technology continues to evolve, AI will not only enhance operational efficiency but also redefine the nature of human-brand relationships, making marketing more intelligent, contextual, and customer-centric than ever before.

Research Objectives

1. To identify the development of publications in AI in marketing.
2. To examine research focus, methodological approaches, and analytical strategies.
3. To identify key thematic clusters in AI in marketing research.
4. To outline future research avenues in AI in marketing.

Overview of AI in Marketing

AI has demonstrated revolutionary potential within the marketing and sales domains. Its applications extend across personalised service delivery, predictive customer behaviour analysis, automated content generation, recommendation systems, and customer relationship management. These capabilities mark a new phase of marketing effectiveness, where firms can move beyond traditional mass marketing approaches towards **personalised, data-driven, and context-aware marketing strategies**.

AI enables marketers to analyse consumer purchase patterns, predict future demands, and develop adaptive strategies based on real-time data. Through data-driven advertising and intelligent recommendation systems, firms can navigate massive volumes of online information and transform raw data into actionable insights. AI-powered tools automate repetitive tasks, allowing marketing professionals to focus on strategic activities and meaningful customer interactions.

The integration of AI technologies such as **emotion detection systems, chatbots, service robots, and intelligent virtual assistants** has further enhanced consumer experiences. These technologies support customer retention by offering responsive, personalised, and interactive services. AI has also contributed to the development of **contextualised marketing**, where firms deliver information aligned with customers' situational needs, preferences, and behavioural contexts.

The impact of AI varies across industries. Sectors such as retail, finance, tourism, logistics, and e-commerce exhibit broader adoption due to continuous customer interaction and extensive data availability. In these industries, AI

plays a central role in shaping marketing strategies, optimising supply chains, improving service delivery, and enhancing customer engagement.

Research Methodology

Study Design

This study adopted a **Systematic Literature Review (SLR)** approach combined with bibliometric analysis. An SLR follows a structured, transparent, and reproducible process for identifying, evaluating, and synthesising existing research. The review process followed four stages: **designing, conducting, analysing, and reporting**.

Scope of the Study

The scope of the review was defined using the **CIMO framework** (Context, Intervention, Mechanism, Outcome). The context focused on AI in marketing, the intervention involved AI technologies, the mechanism included digital and analytical processes, and the outcomes related to marketing performance and strategic transformation. The review covered studies published between **2015 and July 2023**, ensuring contemporary relevance.

Search Strategy and Data Sources

The Web of Science (WoS) database was selected due to its reputation for high-quality, peer-reviewed academic publications. A structured keyword search strategy using Boolean operators was employed, combining AI-related terms with marketing-related concepts. The initial search retrieved over 1000 documents, which were refined to **522 journal articles** for final analysis.

Selection Criteria and Quality Assessment

The inclusion criteria focused on peer-reviewed journal articles published in English, within business, management, and marketing domains. Review articles and unrelated disciplines were excluded. Each selected study underwent quality assessment using a structured nine-criteria evaluation framework. This ensured methodological rigour and relevance to the research objectives.

Analysis and Results

Publication Trends

The analysis revealed a consistent and significant growth in AI in marketing research from 2015 to 2023. Early years recorded limited publications, but a sharp increase was observed after 2018. The number of publications and citations grew steadily, reflecting rising scholarly interest and the growing importance of AI in marketing. By 2023, the corpus reached **522 studies**, confirming AI in marketing as a rapidly expanding research domain.

Influential Journals and Authors

Leading journals such as the Journal of Business Research, Industrial Marketing Management, and Journal of Retailing and Consumer Services emerged as key publication platforms. Prominent authors contributed extensively to advancing research on AI in marketing, shaping theoretical, conceptual, and empirical debates.

Research Focus

Over 90% of studies focused on the implementation and potential of AI-based technologies in marketing. Research primarily explored applications, opportunities, and strategic implications, while fewer studies critically examined risks and limitations such as privacy concerns, ethical challenges, and organisational resistance.

Research Methodologies and Analytical Techniques

Exploratory and conceptual research designs dominated the field, reflecting the emerging nature of AI in marketing. Qualitative approaches were more common than quantitative methods, indicating that the field is still in a developmental stage with limited large-scale empirical validation.

Thematic Cluster Analysis

Six major thematic clusters were identified:

1. Psychosocial Dynamics of AI

This cluster explores human emotions, perceptions, trust, engagement, and psychological responses to AI-driven marketing. It highlights the importance of emotional connection, social influence, and behavioural acceptance in AI adoption.

2. AI-Enhanced Market Dynamics and Strategies

This theme focuses on AI's role in reshaping competition, market structures, predictive strategies, and data-driven decision-making across supply chains and market networks.

3. AI for Consumer Services

This cluster examines AI in customer service, e-commerce, anthropomorphism, trust-building, immersive technologies, and personalised experiences.

4. AI for Decision-Making

This theme highlights AI's contribution to CRM, predictive analytics, strategic planning, and data-driven organisational decision-making.

5. AI for Value Transformation

This cluster focuses on innovation, value co-creation, knowledge sharing, and AI-driven transformation of business models.

6. AI for Ethical Marketing

This theme addresses algorithmic bias, fairness, transparency, privacy, responsible AI use, and ethical governance in marketing practices.

Future Research Directions**Theory**

Future research should develop **integrated theoretical frameworks** that combine marketing, technology, management, and behavioural sciences to explain AI adoption and impact.

Context

Scholars should examine AI adoption across industries, organisational contexts, and cultural environments to understand contextual differences in implementation.

Content

Research should explore organisational capabilities, ethical governance, data privacy mechanisms, and strategic integration of AI i

Conclusion

Artificial Intelligence (AI) has revolutionized marketing domain, driving rapid digital transformation by enhancing processes, accelerating growth, and transforming the business landscape. Despite the growing attention towards artificial intelligence review studies, there remains a dearth of comprehensive reviews within the marketing domain. To address these gaps the aim of this review study to explore the use of artificial intelligence in marketing as an emerging research topic using a systematic literature review (SLR) method. The bibliometric analysis of 522 studies highlight that AI in marketing domain has six clusters: psychosocial dynamic of AI, AI-enhanced market dynamic & strategies, AI for consumer services, AI for decision making, AI for value-transformation and AI for ethical marketing. The review study highlights that there is a possibility to pave the path for the future by creating a

comprehensive model or theory that precisely describes the current context of AI system adoption in the field of marketing. Moreover, future researchers could shed light on the choices, processes, and variables that integrate AI-based systems in marketing into the contemporary business landscape by initiating these investigative trajectories.

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DIGITAL TWIN TECHNOLOGY FOR SMART MANUFACTURING

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Abstract

Digital Twin (DT) technology has emerged as a transformative enabler of smart manufacturing within the broader paradigm of Industry 4.0. A **digital twin refers to a dynamic, real-time virtual representation of a physical asset, process, or system that is continuously updated through bidirectional data exchange between physical and digital environments**. In manufacturing, digital twins integrate cyber-physical systems, industrial Internet of Things (IIOT) devices, advanced analytics, artificial intelligence (AI), cloud and edge computing platforms to optimize production efficiency, enhance product quality, reduce downtime, and improve sustainability.

This paper presents a comprehensive analysis of digital twin technology for smart manufacturing, covering its conceptual foundations, architectural framework, enabling technologies, applications, benefits, challenges, and future research directions. The study explores how digital twins evolve across the manufacturing lifecycle—from design and prototyping to production, maintenance, and end-of-life management. It further examines the integration of predictive analytics, machine learning, and real-time simulation for operational decision support. Key implementation challenges such as interoperability, cyber security risks, scalability constraints, and data governance complexities are discussed in detail.

Finally, the paper proposes a research-oriented hybrid digital twin framework incorporating edge AI, federated learning, and block chain-enabled security to enhance cross-factory collaboration and autonomous optimization. The findings suggest that digital twin technology not only improves operational efficiency but also serves as a strategic foundation for sustainable, resilient, and intelligent manufacturing ecosystems

Keywords: Digital Twin, Smart Manufacturing, Cyber-Physical Systems (CPS), virtual model, real-time monitoring, data integration, digital representation. Internet of Things (IoT), Artificial Intelligence (AI), Machine Learning (ML).

1. Introduction

The manufacturing industry is undergoing a profound transformation driven by automation, digitization, and intelligent decision-making systems. The concept of Industry 4.0 emphasizes the integration of digital technologies into manufacturing processes, enabling interconnected production systems capable of self-monitoring and optimization. At the core of this transformation lies digital twin technology.

A digital twin is more than a digital model or simulation; it is a living, continuously evolving virtual entity synchronized with its physical counterpart. Unlike static Computer-Aided Design (CAD) models or isolated simulations, digital twins incorporate real-time data streams, predictive algorithms, and feedback mechanisms to reflect current system states and forecast future behavior.

In smart manufacturing environments, digital twins enable organizations to:

- Monitor equipment health and operational status in real time
- Simulate process changes prior to physical implementation
- Predict equipment failures and reduce maintenance costs
- Optimize scheduling and resource allocation
- Improve product customization and lifecycle management

The growing complexity of manufacturing systems—characterized by interconnected supply chains, distributed production facilities, and massive sensor-generated datasets—necessitates advanced digital frameworks capable of real-time analytics and autonomous control. Digital twin technology provides this capability by bridging physical systems and intelligent digital platforms.

This paper provides an in-depth academic exploration of digital twin technology for smart manufacturing, from theoretical foundations to practical implementation and future research potential

2. Conceptual Foundations of Digital Twin Technology

The concept of digital twin originated from product lifecycle management (PLM) and aerospace engineering applications. Early forms of digital replication were used by NASA for spacecraft simulation and remote monitoring. Over time, advances in IOT, cloud computing, and AI expanded the applicability of digital twins to manufacturing.

A digital twin typically comprises three fundamental components:

1. Physical entity (machine, production line, or factory system)
2. Virtual representation (digital model)
3. Data connection (real-time bidirectional communication)

The integration of these components creates a continuous feedback loop:

Physical System → Data Acquisition → Digital Model → Analysis → Control Action → Physical System

Digital twins can be classified into three levels:

- **Component-Level Twin:** Represents individual machines or parts
- **System-Level Twin:** Represents interconnected production systems
- **Factory-Level Twin:** Represents entire manufacturing ecosystems

The evolution from isolated machine simulations to holistic factory-wide twins marks a significant advancement in industrial intelligence.

2.1 Physical Layer

This layer includes machines, robotics systems, conveyor belts, actuators, sensors, and other physical production assets. These assets generate operational data reflecting real-time system states.

2.2 Data Acquisition Layer

IOT and IIOT sensors collect data such as:

- Temperature
- Vibration
- Pressure
- Energy consumption
- Machine utilization

This data forms the foundation of the digital twin model.

2.3 Communication Layer

Data is transmitted using industrial communication protocols such as:

- MQTT
- OPC-UA
- 5G industrial networks

Secure, low-latency communication ensures timely synchronization.

2.4 Modeling and Analytics Layer

This layer includes:

- Physics-based simulation models
- Machine learning algorithms
- Predictive maintenance models
- Discrete-event simulation engines
- Reinforcement learning controllers

3. Key Conceptual Pillars

3.1 Cyber-Physical Systems (CPS)

Digital twins are built upon the concept of **Cyber-Physical Systems**, where physical processes are tightly integrated with computational algorithms. The interaction between the physical and digital environment enables monitoring, control, and optimization.

3.2 Internet of Things (IOT)

IOT provides the **connectivity layer** of digital twins. Sensors collect data such as temperature, pressure, speed, vibration, and performance metrics. This data is transmitted to cloud platforms for analysis.

3.3 Big Data and Analytics

Digital twins generate large volumes of data. Big data analytics processes this information to:

- Identify patterns
- Predict failures
- Optimize performance
- Improve decision-making

Predictive maintenance is one of the most valuable applications of digital twin analytics.

3.4 Artificial Intelligence and Machine Learning

AI and machine learning enable digital twins to:

- Learn from historical data
- Predict future outcomes
- Automate decision-making

For example, AI can forecast machine breakdowns before they occur, reducing downtime and costs.

3.5 Simulation and Modeling

Simulation allows organizations to test scenarios virtually before implementing them in reality. This reduces risk and saves cost.

Industries like aerospace, automotive, and healthcare use digital twins extensively for simulation and testing.

4.1 Types of Digital Twins

Digital twins can be classified into four main types:

1. **Component Twin** – Represents individual parts (e.g., engine parts).
2. **Asset Twin** – Represents a complete asset (e.g., a machine).
3. **System Twin** – Represents multiple interacting assets.
4. **Process Twin** – Represents entire operational processes.

4.2 Conceptual Characteristics

A true digital twin must have:

- Real-time data synchronization
- Continuous learning capability
- High-fidelity modeling
- Two-way data interaction

4.3. Lifecycle Perspective

Digital twins operate throughout the entire lifecycle of an asset:

1. **Design Stage** – Virtual modeling and testing
2. **Manufacturing Stage** – Process optimization
3. **Operation Stage** – Monitoring and predictive maintenance
4. **End-of-Life Stage** – Performance analysis and recycling insights

This lifecycle integration makes digital twins a powerful strategic tool.

4.4. Applications Across Industries

- Manufacturing (Smart factories)
- Healthcare (Patient-specific models)
- Automotive (Vehicle performance monitoring)
- Aerospace (Aircraft simulation)

4.5. Benefits

- Reduced operational costs
- Improved efficiency
- Enhanced product quality
- Faster innovation
- Risk reduction

4.6. Challenges

- Data security and privacy concerns
- High implementation cost
- Integration complexity
- Data management issues

5. Key Enabling Technologies

5.1 Industrial Internet of Things (IIOT)

IIOT devices enable continuous data acquisition from production systems. Sensor integration allows digital twins to monitor dynamic system states.

5.2 Artificial Intelligence and Machine Learning

AI enhances digital twins by enabling:

- Anomaly detection
- Fault diagnosis
- Predictive maintenance
- Demand forecasting
- Adaptive scheduling

Deep learning models improve pattern recognition and predictive accuracy.

5.3 Cloud Computing

Cloud platforms provide scalable storage and computational power. Digital twins require significant processing capabilities for simulation and analytics.

5.4 Edge Computing

Edge computing reduces latency by processing data near the source. This is critical for real-time control applications.

5.5 Big Data Analytics

Manufacturing environments generate high-volume, high-velocity datasets. Big data tools support real-time processing and visualization.

6. Benefits of Digital Twin Implementation

- Reduced operational costs
- Improved equipment reliability
- Enhanced production efficiency
- Faster product development cycles
- Improved sustainability performance
- Better decision-making through data-driven insights

1. Digital twins support proactive management rather than reactive responses. Improved Operational Efficiency

Digital twins continuously collect real-time data through IOT sensors and update the virtual model accordingly. This allows organizations to:

- Monitor equipment performance 24/7
- Detect inefficiencies
- Optimize workflow
- Reduce idle time

By identifying bottlenecks and performance gaps, companies can significantly improve productivity and resource utilization.

2. Predictive Maintenance and Reduced Downtime

One of the most significant advantages of digital twins is **predictive maintenance**.

Instead of waiting for equipment to fail (reactive maintenance) or servicing at fixed intervals (preventive maintenance), digital twins:

- Analyze historical and real-time data
- Predict possible failures
- Provide early warning alerts

3. Enhanced Decision-Making

Digital twins provide accurate, data-driven insights. Managers and engineers can:

- Simulate different scenarios
- Evaluate risk before implementation
- Compare alternative strategies
- Make informed strategic decisions

Because decisions are based on real-time data and simulations rather than assumptions, the chances of errors are significantly reduced.

4. Cost Reduction

Digital twin implementation reduces costs in multiple ways:

- Lower maintenance expenses
- Reduced material waste
- Optimized energy consumption
- Fewer physical prototypes
- Reduced product recall risks

5. Faster Product Development and Innovation

Digital twins allow companies to test and refine products in a virtual environment before physical production.

- Rapid prototyping
- Design optimization
- Shorter time-to-market

6. Improved Product Quality

By continuously monitoring performance and comparing it with expected standards, digital twins help maintain high-quality standards.

Organizations can:

- Detect deviations in real time
- Identify root causes of defects
- Improve process control
- Ensure consistent output

7. Risk Reduction and Safety Enhancement

Digital twins enable simulation of dangerous or high-risk scenarios without exposing people or equipment to harm.

8. Lifecycle Management Optimization

Digital twins support the entire lifecycle of an asset:

1. Design and development
2. Manufacturing
3. Operation and maintenance
4. End-of-life management

By analyzing performance data across all stages, organizations can continuously improve product design and operational strategy.

9. Sustainability and Energy Efficiency

Digital twins contribute to environmental sustainability by:

- Monitoring energy usage
- Reducing waste
- Optimizing resource consumption
- Supporting green manufacturing initiatives

10. Better Customer Experience

Digital twins help organizations personalize products and services by:

- Analyzing usage patterns
- Monitoring customer feedback

- Improving service response time

11. Real-Time Monitoring and Remote Management

With cloud connectivity, digital twins allow remote monitoring and control of assets from anywhere in the world.

Benefits include:

- Faster problem resolution
- Reduced travel costs
- Centralized monitoring systems
- Improved coordination

This is especially valuable for global enterprises.

12. Competitive Advantage

Organizations that implement digital twins gain strategic advantages such as:

- Data-driven culture
- Innovation capability
- Improved agility
- Higher operational transparency

In the era of Industry 4.0, digital twin implementation is becoming a critical factor for maintaining long-term competitiveness

7. Challenges and Limitations

7.1 Interoperability Issues

Manufacturing systems often use heterogeneous hardware and software platforms.

7.2 Cyber security Risks

Connected systems are vulnerable to cyber attacks and data breaches.

7.3 High Implementation Cost

Initial infrastructure investments can be substantial.

8. Research Methodology (Proposed Framework)

A hybrid digital twin framework is proposed:

1. Edge AI for real-time anomaly detection
2. Cloud-based federated learning for cross-factory data sharing
3. Block chain integration for secure transactions
4. Reinforcement learning for adaptive scheduling

Objective Function:

Minimize:

$$C = \alpha(\text{Downtime}) + \beta(\text{Energy Consumption}) + \gamma(\text{Defect Rate})$$

Subject to production constraints and operational limits. Conceptual Research Framework

The proposed framework is designed to examine the relationship between key variables relevant to the study. It typically includes:

- **Independent Variables** – Factors influencing outcomes
- **Dependent Variables** – Outcomes being measured

- **Moderating or Mediating Variables** – Variables influencing the strength or direction of relationships

9. Research Design

The study adopts a **descriptive and analytical research design**.

9.1 Descriptive Research

Descriptive research helps in understanding characteristics, behaviors, and patterns within the study population.

9.2 Analytical Research

Analytical research examines cause-and-effect relationships between variables and tests hypotheses using statistical techniques.

Depending on the study objectives, the research may follow:

- Quantitative approach
- Qualitative approach
- Mixed-method approach

For technology-based studies such as Digital Twin implementation, a quantitative approach is often preferred to measure impact and performance outcomes.

10. Research Approach

The proposed study follows a **deductive approach**, where hypotheses are formulated based on existing theories and then tested using empirical data.

Steps include:

1. Literature review
2. Development of conceptual framework
3. Hypothesis formulation
4. Data collection
5. Statistical analysis
6. Interpretation of results

11. Data Sources

1 Primary Data

Primary data will be collected through:

- Structured questionnaires
- Surveys
- Interviews with industry professionals
- Observational methods

2 Secondary Data

Secondary data will be collected from:

- Academic journals
- Research articles
- Industry reports
- Company publications
- Government databases

12. Sampling Design

1 Population

The target population consists of organizations or individuals relevant to the research topic (e.g., manufacturing firms implementing digital twin technology).

2 Sampling Technique

The study may use:

- Simple random sampling
- Stratified sampling
- Convenience sampling

For industry-based research, stratified sampling ensures representation from different sectors.

3 Sample Size

The sample size will be determined using statistical formulas to ensure reliability and validity of results.

13. Data Collection Instrument

The primary tool for data collection will be a **structured questionnaire** divided into sections:

1. Demographic information
2. Awareness and adoption level
3. Perceived benefits
4. Challenges faced
5. Performance outcomes

Questions will be measured using a **Liker scale** (e.g., 1–5 scale from strongly disagree to strongly agree).

14. Reliability and Validity

1 Reliability

Reliability ensures consistency of results. It will be tested using:

- Cranach's Alpha coefficient

2 Validity

Validity ensures that the instrument measures what it intends to measure. It includes:

- Content validity
- Construct validity
- Face validity

15. Data Analysis Techniques

The collected data will be analyzed using statistical software.

1 Descriptive Statistics

- Mean
- Percentage
- Standard deviation

2 Inferential Statistics

- Correlation analysis
- Regression analysis

- ANOVA
- T-test
- Structural Equation Modeling (SEM) (if applicable)

These techniques help test hypotheses and determine relationships between variables.

16. Hypothesis Formulation (Example)

H₀: There is no significant relationship between Digital Twin implementation and operational efficiency.

H₁: There is a significant relationship between Digital Twin implementation and operational efficiency.

17. Limitations of the Study

Possible limitations may include:

- Limited sample size
- Response bias
- Time constraints
- Availability of data

These limitations will be acknowledged to ensure transparency.

10. Conclusion

Digital twin technology represents a revolutionary advancement in smart manufacturing. By establishing a real-time, bidirectional connection between physical systems and digital models, digital twins enable predictive analytics, operational optimization, enhanced quality control, and sustainable resource management.

The integration of IOT, AI, cloud computing, edge processing, and advanced analytics empowers manufacturers to transition from reactive maintenance to proactive and autonomous systems. Although challenges such as cyber security, scalability, and interoperability remain, continuous research and technological advancements are addressing these limitations.

As Industry 4.0 evolves toward Industry 5.0, digital twins will serve as central intelligence platforms supporting resilient, sustainable, and human-centric manufacturing ecosystems. Their ability to combine real-time monitoring with predictive and prescriptive analytics positions them as foundational technologies for the next generation of industrial innovation.

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DIGITAL TRANSFORMATION AND ITS IMPACT ON BUSINESS PERFORMANCE: A STUDY OF ORGANIZATIONS IN TAMIL NADU

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Abstract

Digital transformation has become a strategic priority for organizations seeking to improve efficiency, innovation, and competitiveness in the modern business environment. The integration of digital technologies such as cloud computing, artificial intelligence, big data analytics, and digital platforms has significantly transformed business operations and organizational performance. This study examines the impact of digital transformation on business performance with special reference to organizations in Tamil Nadu, one of India's leading industrial and commercial regions.

The study adopts a descriptive research design using both primary and secondary data. Primary data were collected from business organizations, small and medium enterprises, and service firms through structured questionnaires, while secondary data were obtained from journals and industry reports. The research evaluates the influence of digital transformation on operational efficiency, customer satisfaction, innovation capability, and financial performance.

The findings reveal that digital transformation positively influences business performance by improving productivity, enhancing customer engagement, and strengthening competitive advantage. However, challenges such as high implementation costs and lack of digital skills affect adoption. The study concludes that digital transformation plays a crucial role in enhancing business performance and recommends strategic investment in digital infrastructure and employee training.

Keywords: Digital Transformation, Business Performance, Digital Technology, Innovation, Organizational Efficiency, Digital Strategy, Tamil Nadu

1. Introduction

Digital transformation refers to the integration of digital technologies into business operations to improve productivity, efficiency, and customer value. Rapid technological development has significantly changed organizational processes and business models.

Tamil Nadu is one of India's major industrial states with strong manufacturing, retail, service, and IT sectors. Organizations increasingly adopt digital technologies such as automation, cloud computing, and data analytics to enhance operational performance and competitiveness. Digital transformation enables organizations to streamline processes, improve communication, and provide better customer experience.

However, organizations face challenges such as technological complexity, high investment costs, and employee resistance. Therefore, understanding the impact of digital transformation on business performance is essential. This study examines how digital technologies influence organizational efficiency, innovation, and competitiveness.

2. Review of Literature

Previous studies emphasize that digital transformation improves organizational efficiency through automation and cost reduction. Digital technologies enhance customer engagement and service delivery through personalized services.

Research indicates that organizations adopting digital strategies experience higher revenue growth and improved competitiveness. Digital innovation enables development of new business models and market expansion. However, challenges such as skill gaps and technological risks affect implementation.

Existing research mainly focuses on global contexts, while regional studies remain limited. This study addresses this gap by analyzing digital transformation at the organizational level.

3. Conceptual Framework of the Study

The conceptual framework explains the relationship between digital transformation and business performance. Digital transformation acts as the independent variable, while business performance is the dependent variable.

Digital transformation includes adoption of cloud computing, automation, digital platforms, and data analytics. These technologies improve operational efficiency, innovation capability, customer experience, and decision-making. Business performance is measured through productivity, revenue growth, customer satisfaction, and competitiveness.

Moderating factors such as employee skills, leadership support, and organizational culture influence successful digital transformation.

3.1 Hypothesis Development

- H1: Digital transformation positively affects operational efficiency.
- H2: Digital transformation improves customer satisfaction.
- H3: Digital technologies enhance innovation capability.
- H4: Digital transformation improves business performance.
- H5: Organizational readiness influences digital transformation success.

4. Objectives of the Study

- To examine the role of digital transformation in organizations.
- To analyze its impact on business performance.
- To evaluate benefits and challenges of digital adoption.
- To assess relationship between digital technology and organizational efficiency.
- To provide suggestions for effective implementation.

5. Research Methodology

- Research Design
- Descriptive research design is adopted.
- Sources of Data
- Primary Data: Collected from 50 organizations through questionnaires.
- Secondary Data: Journals, reports, and industry publications.
- Statistical Tools Used
- Percentage analysis
- Comparative analysis
- Tabular analysis
- Scope and Limitations
- The study focuses on selected organizations. Results may vary across industries.

6. Data Analysis and Tables

Table 1: Level of Digital Technology Adoption

Level	Firms	%
High	20	40
Moderate	18	36
Low	12	24

Table 2: Impact on Business Performance

Indicator	Before (%)	After (%)
Operational Efficiency	58	86
Customer Satisfaction	62	90
Revenue Growth	52	78
Innovation Capability	48	83

Table 3: Benefits of Digital Transformation

Benefit	% of Firms
Productivity Increase	84
Cost Reduction	70
Customer Engagement	88
Competitiveness	80

Table 4: Challenges

Challenge	%
High Cost	68
Lack of Skills	60
Cybersecurity Risk	55

7. Industry-Wise Digital Transformation

- Manufacturing
- Automation and digital supply chain management improve productivity.
- Retail
- E-commerce platforms and digital payments increase sales.
- Service Sector
- Cloud computing enhances service delivery.
- IT Sector
- High digital adoption and innovation are observed.

8. Findings

- Organizations show moderate to high digital adoption.
- Digital transformation improves productivity and efficiency.
- Customer satisfaction increases significantly.
- Innovation capability improves.
- High cost and skill gaps are major challenges.

9. Discussion of Results

The results confirm that digital transformation significantly enhances organizational performance. Automation improves productivity and reduces operational costs. Digital platforms enhance customer engagement and service quality.

However, small firms face financial and technological challenges. Employee resistance and lack of digital skills affect implementation. Leadership support and strategic planning are essential for successful transformation.

10. Implications of the Study

Managerial Implications

Managers should invest in digital infrastructure and training.

Policy Implications

Government should support digital skill development.

Academic Implications

11. Suggestions

Develop clear digital strategies.

Invest in digital infrastructure.

Provide employee training.

Strengthen cybersecurity measures.

Support SMEs in technology adoption.

12. Future Scope of Research

Future studies may focus on specific industries or conduct comparative regional analysis. Long-term impact of digital transformation can also be explored.

13. Conclusion

Digital transformation is a major driver of business performance in modern organizations. The study reveals that adoption of digital technologies improves operational efficiency, innovation, and customer satisfaction. Successful implementation requires strategic planning, technological investment, and skill development. Digital transformation enhances organizational competitiveness and supports sustainable growth.

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A STUDY ON DIGITAL DIVIDE AND ECONOMIC GROWTH IN INDIA

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Abstract

The concept 'digital divide' was first used in the United States in the 1990s to describe the perceived growing gap between those who have access to and the skills to use ICT and those who have limited or no access. It is referred to as the gap between the 'haves' and the 'have-nots' regarding access to, and use of ICT and the internet. As mentioned above, it is not just the availability of computers, the internet and telecommunication facilities, the digital divide also refers to the lack of ability to use these technologies. It occurs as an extension of existing social divides, or is at least accentuated by these. ICTs have not only changed the way people interact, communicate, conduct their business but also have opened up chances of socio-economic development for the developing nations.

Keywords: Digital divide, Technology Infrastructure, Profitability, Socio-economic development

Introduction

The growth years of an individual are the most crucial phase of lifespan. The lifestyle practices and preferred activities adopted during middle childhood and adolescence are likely to predict later health behaviours and outcomes. There are many approaches to calculating the gaps in Internet access. Each source uses its own methodology with different scope and metrics. Some sources look at the saturation of devices used while others look at the areas covered by Internet Service Providers. Every methodology has its limitations and there is no way for data to capture all the marvellous complexities of how people use the Internet. Despite these potential limitations, some sources provide a good idea of what the digital divide looks like in numbers.

Effects of the Digital Divide

The digital divide has contributed to differences in development levels among states. The access to information in the developed world is much better as compared to the case in the underdeveloped world. Most people living in developed countries have access to modern technology, high-speed connections to the internet and solid data plans as well as the availability of more advanced and sophisticated devices.

Contrary, many people living in third world countries lack such privileges sometimes even access to the internet is a problem. This parity has created an economic divide globally since information is critical in facilitating productivity. It is therefore of supreme importance that governments in developing countries bridge this gap to ensure that they compete on level ground with the developed countries. So far ICT has developed and spread considerably in many countries, and everyone has a clue of its impact on the daily life. An assessment of digital divide situation shows that this concept emerges decades ago and has been useful and at the same time a derailment to various businesses.

Advantages of the Digital Divide

The digital divide is often viewed as a selfish act enhanced by the capitalist to deny a given section of the society access to power that comes with information. Critics advocates for speedy bridging the digital gap, however, a sober look at the whole concept exhibit significant advantages. Lack of ICT access due to affordability, lack of knowledge on how to use technology and lack of exposure on the importance of internet are the significant precipitant of the issues of digital divide globally.

1. Increased profitability among businesses having unrestricted access

Organizations boasting of enhanced access to ICT services can take advantage of the competitive edge that comes with the benefits of ICT to outdo rival entities and thrive in their varied field. With the presence of the digital divide, the rich get richer while the poor stagnate or deteriorate in the quagmire of poverty. Technology is critical in industrialization processes, and this is vividly witnessed by the disparity in development levels between developed

and underdeveloped nations. Business ventures that invest in modern technology improve productivity and revenue turn-over.

2. Digital divide help converse culture and keep the societal fabric intact

Inasmuch as the internet promise to handle most of the daily life problems and offer a better form of living, numerous disadvantages come with unrestricted access to the internet. Some of the content in the website may not be suitable for given groups of people thus withholding access is essential in maintaining virtues of a conservative society. Besides, the digital divide benefits the lower socio-economic class persons as they can prioritize on focusing their limited resources on more pressing issues.

3. Digital divide phenomenon offers increased opportunities

Opportunities for personal, educational and occupational advancement to the privileged members of the society.

Disadvantages of the Digital Divide

1. It is an expensive affair

Governments and non-profit making organizations attempt to bridge the gap between those who can reach ICT services and those who lack it; this has proven to be very expensive due to the dynamic nature of technology making purchasing the latest devices to be very costly. New advancements render some of the initially acquired equipment obsolete and thus further escalates the costs.

2. Digital divide widen the segregation between people

The rift between the poor and the wealthy extends further when they feed news and information from different quarters. As the rich advance in understanding and literacy, the poor keep diminishing thus widening the disparity. Ideologies will differ and having a common understanding will be a huge mountain to climb thus predisposing to conflicts and misunderstanding. The have-nots will feel inferior.

3. Digital divide impacts negatively on the economy

Enormous difference in digital services among people create economic divide as well as social divide, this limits interaction between the two groups. Also, the digital divide can be attributed to a rise in crime level because the people lacking such services will engage in unscrupulous activities to acquire the latest technology. The digital divide is a worldwide issue, about 70% of the global population fall on the downside; a situation referred to as Digital Abyss. It is not just related to the gap between people with and without access internet; computer specifications are also integral.

Barriers to Digital Opportunity in India

This section will delineate the major issues and problems of digital alienation in India. Debatably, India is a snake with its head in the 21st Century and it's tail in the 18th century. To overcome this terrible situation, we must prioritize individual information access. We need to provide timely access to the right information at the right time at the right place to the right people. Obviously, we need to connect the rural population and hence it is classified as the most challenging assignment of the nation today. There are many factors challenging the movement of the digital divide to digital opportunity. Considering the present scenario in perspective, an attempt has been made to analyze the more fundamental problems and issues involved in the path towards digital opportunity in India.

1. **Information Communication Technology Infrastructure:** Telecommunications and the IT infrastructure is the key to provide universal and affordable access to information to citizens scattered geographically. The telecom reforms took off with the establishment of Telecommunications Regulatory Authority of India (TRAI), along with privatization of mobile and fixed-line services in the year 1992 and 1994 respectively. The challenge that we face in ICT for development is designing and building technologies and networks that are suited for the needs of our citizens. Despite the growth of the Internet, India has to provide a robust telecommunication infrastructure with suitable, sufficient and reliable bandwidth for Internet connections along with necessary hardware and software.

2. **Connectivity and Affordability:** Access to the Internet as well as the telecommunications is confined mainly to the urban centers in India and the rural areas remain beyond the ambit of new technology. Hence connecting rural areas is a bigger challenge, because subscribers are geographically dispersed, sparsely populated and economically weak. About 4 lakh villages have a meager population of 1000 or less, therefore it is difficult to provide internet facility to each village. Moreover, telecom companies may not venture into remote villages because the purchasing power in the villages is not enough to recover the cost of connecting them. Therefore affordability, ease of deployment and appropriate organizational innovations are critical to the sustainable deployment of telecom systems in India.
3. **Coordinated Government Initiatives:** India has inherited a bureaucratic administrative system, which has convincingly proved its inefficiency to interact with 1.3 billion people. Therefore, reforms shouldn't stop just by establishing a center for e-governance; it should rather get started here. However, there are challenges ahead, major ones are: bringing in a positive attitude towards moving to e-governance, educating the bureaucrats about the need for change and imparting training to use the technology effectively. Creating viable coordination between the state and center regardless of political reservations by eliminating the state monopoly is also essential. A massive campaign involving rural people to bring awareness about the advantages of e-governance to society is required.
4. **Information Literacy and Skill:** Education and information literacy will play an important role in keeping society from fragmenting into information haves and have-nots. In the perspective of the digital divide, IT literacy is very important to allow access to digital information. In a country like India where roughly 50 percent of people do not have reading and writing skills for functioning in everyday life, IT literacy is out of the question. Generally, online content and information have been designed for an audience that reads at an average or advanced literacy level and those who have discretionary money to spend. The lack of skill in using computer and communication technology also prevents people from accessing digital information
5. **Economic Factors:** Poor access to computer and communication technology also causes a digital divide. In India, the ability to purchase or rent the tool for access to digital information is less among the masses. The lower-income group does not have discretionary money to spend on cyber-cafes or to get Internet connectivity on their own to access digital information. Considering this, if the ICT access costs were brought down a vast majority would be able to connect to the ICT. Therefore, we need to develop and encourage the R&D community to innovate better and affordable ICTs considering local requirements in perspective.
6. **Language:** India is a country having a multicultural and multilingual population. Today a large percentage of information contained on the Internet is in English, which is a barrier for the people whose primary language is not English. Apart from that, creating and maintaining locally relevant content for a country with 121 languages is a challenge (Census of India, 2011). At the same time, local language content is slowly making ICT more relevant and accessible to a broader cross-section of the population.

Conclusion

Bridging the digital divide in and among countries has assumed a critical importance on our respective national agenda. Everyone should be able to enjoy access to information and communications networks. We reaffirm our commitment to the efforts under way to formulate and implement a coherent strategy to address this issue. We also welcome the increasing recognition on the part of industry and civil society of the need to bridge the divide. Mobilizing their expertise and resources is an indispensable element of response to this challenge. We will continue to pursue an effective partnership between government and civil societies responsive to the rapid pace of technological and market developments.

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DIGITIZATION OF MANAGEMENT EDUCATION

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Introduction

The digital transformation (DT) is essential for all fields, regardless of their size and sector of activity. Beyond the dematerialization of work processes, this approach allows management system to optimize their Operations, and to gain in performance, efficiency, and competitiveness through the adoption of a new Management mode, new tools, new methods of work but also new reflections and organizations. The DT has Become a significant topic of concern and a strategic issue for all management system. It offers new Opportunities for students, beyond their traditional activities, by accelerating their growth and creating Sustainable competitive advantages and security of operations. The DT increases the profitability of the Education system by simplifying processes and interactions within the management and students.

Digital transformation means transforming an organization's core business to better meet customer Needs by leveraging technology and data. In education, that target customer is often students, though it could Also be faculty, staff, alumni, and others. As the educational sector becomes more competitive, digital Transformation is now becoming a necessary means of survival as this new digital world requires educators to Adapt and adopt digital technologies, methodologies and mindsets. To understand how a full and sustainable Digital transformation can take place, it's important to examine the potential challenges or roadblocks an Institution might face. The goal of this paper is to give an overview of the literature regarding digital Transformation into management education and to analyze how it is used in practice in regard to: time Component; country of case origin; case industry and; digital transformation focus. Digital transformation in education is a 21st -century necessity. Right from schooling to higher Education, every level of our learning system is affected by technology. Rapidly evolving technology is Transforming the way knowledge is imparted and absorbed today. Increasing digitalization making way for new Communication instruments enabling faster knowledge sharing in schools and colleges. It is redefining learning Models in education and skill development.

Current Scenario in Digitalization in India

A digital transformation process consists of information technology implementation projects, as well as Organizational factors such as top management support, digital transformation strategy, and organizational Changes. However, to the best of our knowledge, there is little evidence about digital transformation endeavors In organizations and how they perceive it – is it only about digital technologies adoption or a true organizational Shift is needed? In order to address this issue and as the first step in our research project, a literature review is Conducted.



Today, producing knowledge has a great importance as well as acquiring knowledge. It seems that the Success of the individual, the institution or the society depends on the activity of producing and using Information. The increase in the use and production of knowledge places societies into a necessary Transformation. One of the most important events in history is the industrial (industrial) revolution which has the Potential to transform society.

Developments and innovations in technology over the past 20 years give us the opportunity to access Time and space without any hassle. Considering the possibilities offered by technology for social and economic Development, it is considered appropriate for the stratum of globalization to come into the technological Dimension to be called “digital age”, “Information age”, “information society”

What are the Way of Adopting Digitization Technology in India ?

Today, many business schools are beginning to develop digitization strategies for expanding outreach as well as Delivering more customized programs. However, this should constitute only the first phase of the digitization Process. Ultimately, the institution needs to embrace the enterprise resource planning (ERP) paradigm, which Has found considerable success throughout the business community of practice. The digitization of management Education need not be limited to simply webinars and podcasts but should encompass a much wider range of Programs and services, such as, student recruiting.

Ironically, cases of business successes and failures in responding to digital transformation are a key theme in many management education strategy courses.

Emerging Trends of Digital Education

1. Digitalized classroom/Flipped Class rooms a growing

A complete revolution in the way we learn today has been brought by Technology. Teachers teaching in the Classroom can capture the students and the full strength in the class by digital screens, thus facilitating each Child to get the same base content and input from the teachers. This feature of digital era has increased the Student engagement as it combines various instructional styles.

2. Video based learning.

Video-based learning as a part of digital marketing has geared up in Indian Education Sector and has made Education engaging, entertaining and exploring. It enables learning with a pedigree of learning out of leisure With creativity, fun and entertainment on cards via the wonderful Apps, podcasts, videos, interactive software, e-Books and online interactive electronic boards. Children are excited and operative with interest to manage the Showcase via their intelligence, exploring the weak techno skills of teachers and assist them in public with pride and honor and recognition.

A massive open online course (MOOC) is an online course aimed at unlimited participation and open access via The web. India is considered to be the biggest market for moods in the world after the USA. Since the Population of India is huge, massive open online course (MOOC) are said to gateways for a lot of Indians in Terms of bringing an educational revolution. Online distant learning programs give a great opportunity to avail High quality learning with the help of internet connectivity.

Massive open online course (MOOCS) & Other distant learning programs

Research for the Purpose of Prof

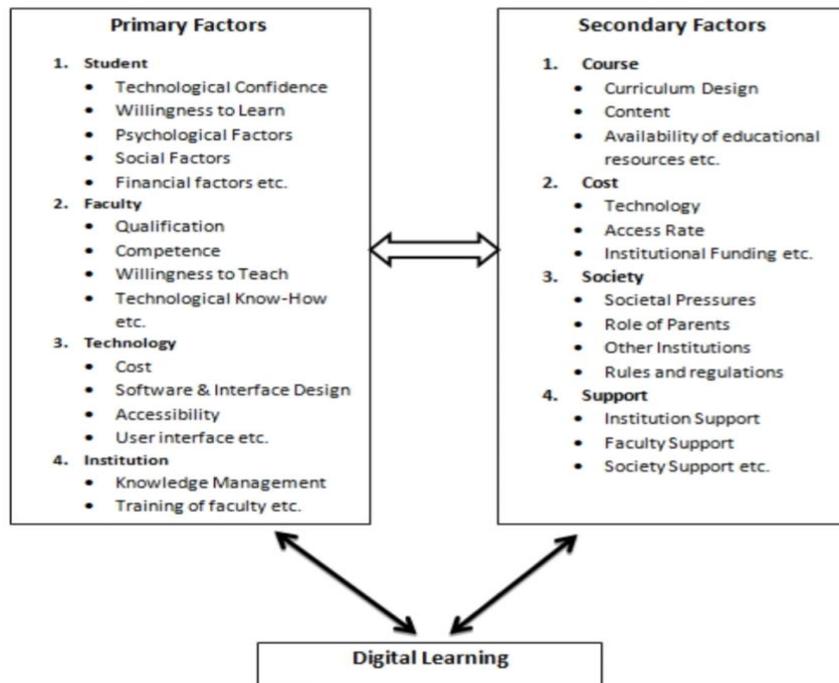
We must understand that the three key missions or objectives of management education are creating new knowledge which generates research. Second objective is disseminating the knowledge which results into the skill creation amongst the students; thirdly, the innovation creation as a result of knowledge acquisition and dissemination. Moreover, in the current scenario which has challenged the institutions to adopt digitization, it is highly significant to redefine the systems and processes regularly within the institutes. Not only this, we believe that the digitization has to be adopted as an enabler and facilitator for value creation and dissemination of the education.

IMS, Ghaziabad envisages the vision of preparing global leaders who can create, manage and effectively lead change across diverse organizations. We evaluate our success on one simple parameter i.e. how well our students succeed in realizing their potential and dreams and make this world a better world.

Aristotle said once that “Educating the mind is not education without educating the heart.” Therefore, academic excellence with character and personality growth is our ultimate objective at IMS Ghaziabad. Settling for average is

not a choice in this age of cut-throat business and, thus, we offer the best planned instructional frameworks, including practical learning and online sessions with industry experts that train students in a safe way for the job market.

The certification courses are in the areas of digital and social media marketing, Google analytics, yellow belt in Six Sigma, financial markets and products, sales & negotiation skills etc. Besides these, Microsoft certification in Advance MS office is also part of course curriculum. These programmers superfluties PGDM Student’s knowledge and employability which aids to supplement the highly competitive and corporate relevant curriculum to make students better prepared to meet industry demands as well as develop their own interests and aptitudes. Short Term Training programmers for SPSS, CMIE’s Prowess, Aptitude Training, Placement Readiness



With such impressive numbers, we can't deny the impact of digitalization on education.



Challenges

1. Resistance to change
2. Learners Motivation
3. Technological Skills of Learners
4. Evaluating effectiveness
5. Adaptability

Opportunities

1. No Physical Boundaries
2. More Engagement
3. Cost Effective
4. High engagement learning
5. Quality learning products.

Final Thoughts

In a world where isolation and social deprivation are the new normal, we can't ignore the new challenges or the opportunities that are coming our way. While physical classrooms have been affected by the global pandemic the most, the pandemic has pushed the education industry into "overdrive" mode, keeping it among the fastest growing industries today.

It's certain that the future of education is digitization. In 2021, edtech startups and digital businesses around the world will see a high ROI thanks to the impact of digitalization on the education industry.

If you have trading business we can help you in developing an e-learning platform for traders. Our developers are vastly experienced in developing digital products for SMEs and enterprises in major fields: Education, Agriculture, Real Estate, Transportation, Fintech, Retail, and more. Check out our portfolio to see the most recent educational projects we have worked.

Conclusion

With so many different ways to define e-learning and the educational approaches that can be taken in These learning environments, it is the conclusion of this author that e-learning is an innovative approach to Learning. It is a holistic way of teaching and learning that meets the needs of today's digital natives. It is an environment made up of collaboration, choice, and an array of technological resources that supports a successful online learning experience. However, in order for learners to be successful in this learning environment the challenges to e-learning must be overcome with support and a best practice solution. Instructors and learners must embrace the shift away from traditional classroom practices to an e-learning approach to education.

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EMPLOYEES UNDERSTANDING WORK-LIFE CONFLICT TO HAVE WORK-LIFE COUNTERBALANCE

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Abstract

This study aims to investigate the work-family conflict faced by employees in the insurance sector. It specifically examines how this conflict can be effectively managed to foster a balance between professional obligations and personal activities, thereby minimizing clashes between work and family duties. Attaining a healthy work-life balance not only boosts efficiency but also enhances overall employee productivity and satisfaction in both professional and family domains. The performance of an organization is fundamentally linked to its employees, whose effectiveness is shaped by various elements, including their careers, family dynamics, and social support systems. Additionally, emotional intelligence is pivotal in facilitating a harmonious relationship between work and family responsibilities.

Keywords: Demographical Variable, Competency, Social Support, Personal Factors, Work-Family Conflict, Work-Life Balance, and Intention to Quit.

1.1 Introduction

Conflict can be defined as a clash or disagreement that can arise in various situations. It can occur within an individual when their objectives or circumstances are incompatible. Additionally, conflict can arise between two individuals when they fail to see eye to eye, leading one to obstruct or hinder the efforts of the other. Conflict can also manifest between two groups within an organization. According to Chug and Megginson, conflict is characterized as a struggle between opposing viewpoints, ideas, interests, or individuals. Conflict arises when both parties involved are unable to achieve their goals in a satisfactory manner. Although the definition does not explicitly mention intra-personal conflict, the first sentence implies its existence.

1.2 Statement of the Problems

In recent decades, there has been a significant shift in employee pressure due to the increasing number of households where both partners are engaged in full-time careers. This changing demographic of the workforce has posed challenges for individuals in managing work-family conflict within the context of their families. As organizations continue to evolve, conflicts often arise from the limited resources and resulting distress caused by the overlapping demands of work and family responsibilities.

1.3 Objectives of the Study

1. The objective of this study is to assess the extent of work-family conflict experienced by employees in the food product industry.
2. This research aims to examine how demographic factors impact work-family conflict among employees in the food product sector.
3. The purpose of this investigation is to determine the correlation between social support and work-family conflict among employees in the food product field.

1.4 Hypothesis

1. There is no notable distinction observed in the work-family conflict and its various aspects among employees in the food product industry.
2. The absence of any correlation between social support and work-family conflict is evident among employees in the food product sector.
3. The No connection can be established between personal factors in job and work-family conflict among employees in the food product domain.

1.5 Limitations of the Study

1. This research examines the influences of social support, personal factors, work-family conflict intent to quit, and work-life balance on work-family conflict.
2. This study explores the impact of social support, personal factors, work-family conflict intent to quit, and work-life balance on work-family conflict, without delving deeply into the work-related factors of the participants.

2. Review of Literature

2.1 Digital Culture and Social Media

1. Vigneshwaran, D., and Mohankumar, S. (2019). This article aims to reflect on the increasing momentum that social media have in the everyday life our students and to investigate the uniqueness that this media offers to the process of education. The study investigates the benefits that Face book and Twitter have as the leading technologically mediated spaces and its application to the learning habitat of the learner in the public pedagogy. The article reflects on the opportunities that social media offers in order to avoid the self-created intellectual chamber by allowing educators to share and challenge ideas and concepts through the so called non-traditional “great spare time revolution”.

2.2 Food Production and Processing

1. Vigneshwaran, D., and Mohankumar, S. (2020). In this high competitive world the Food processing is the transformation of agricultural products into food, or of one form of food into other forms. Food processing includes many forms of processing foods, from grinding grain to make raw flour to home cooking to complex industrial methods used to make convenience foods. Primary food processing is necessary to make most foods edible, and secondary food processing turns the ingredients into familiar foods, such as bread.

2.3 Career Family Balance

1. Vigneshwaran, D., and Mohankumar, S. (2020). The goal of this research is to learn about the career household balance of ladies personnel in monetary sector. The research was once performed among women employees in financial region with Reference to Chennai. Career family balance entails in attaining equilibrium between career and family, so that it reduces friction between profession and family life. Career family stability enhances efficiency and thus, the productivity of ladies worker increases. It enhances satisfaction, in each the career and household lives. The ultimate performance of any business enterprise depends on the performance of its employees, which in turn depends on numerous factors.

These elements can be related to profession or family or both. The findings of the study reveal the majority of the Employees feel at ease in their work area irrespective of their Trivial personal and work region irritants. This paper tries to indentify the more than a few factor which helps to maintain work existence stability amongst employees in monetary sector.

2.4 Competency

1. Vigneshwaran, D., and Mohankumar, S. (2020). This article attempts to clarify the theoretical understanding of the relationship between entrepreneurial competency and work performance. This theory provides an insight on the best practices carried out in organizations which are implemented to achieve better work performance. Considering this theory can support organization to understand their performance entrepreneurial.

2.5 Competency Mapping

1. Vigneshwaran, D., and Mohankumar, S. (2020). In this highly competitive world, HR managers face many challenges as they recruit the skills and knowledge of new employees. But it is very difficult to find the skills gap between employee skills mapping is a very important tool for HR managers to know their employees' talents and weaknesses. So, in this study, the researchers look at the first skills mapping studies and analyze the variables they took for their study and find the research gap for future research.

2. Vigneshwaran, D and Dr.S.Mohankumar(2015). In this high competitive world the HR-managers are facing lots of challenges while recruiting new employees' skills & knowledge. But it is very difficult to find the competency gap among the employees competency mapping is the very important tool for HR-Mangers to know about their employees' talents and weakness. So in this study the researchers review the earlier studies on competency mapping and analyzed variables they have taken for their study and finding the research gap for future research.

3. Vigneshwaran, D and Dr.S.Mohankumar (2015). Competency mapping is an emerging concept for recent trends. It is very useful tool for HR Managers to know their employees knowledge& skills to do a work. In this study is going to review the past research done by other researchers and to find research gap for future research. This whole study based on the secondary data.

2.6 Work-Family Conflict

1.Vigneshwaran, D., and Mohankumar, S. (2020). This paper describes a study on work-family conflict among women personnel in the insurance plan sector. This learns about of work-family hostilities is a part of an individual's everyday existence or organizational combat which has a vast effect on employee behavior, performance, and satisfaction. This examination of the capacity to simultaneously manipulate existence with multi-field behaviors additionally affects the effectiveness of the organization. This chapter is committed to a distinctive dialogue of the nature of the conflict, the level of conflict, and the decision strategies. Towards the top of the chapter, we refer to the managerial implications of the conflict.

2.Vigneshwaran, D., and Mohankumar, S. (2020). The objective of this research is to study the predictors of work-family conflict of women employees in insurance sector. The research was conducted among women employees in insurance sector with reference to cuddalore district. Predictors of work-family conflict entails attaining equilibrium between professional work and other activities, so that it reduces friction between work-family conflicts. Work-life Balance enhances efficiency and thus, the productivity of an employee increases. It enhances satisfaction, in both the job factors and family lives. The ultimate performance of any organization depends on the performance of its employees, which in turn depends on numerous factors. These factors can be related to career or family or both social supports. The relationships between predictors of work-family conflict can be achieved through emotional intelligence. Better emotion management is necessary in order to accomplish day to-day objectives of personal factors life. This paper attempts to identify the various factor which helps to maintain predictors ofwork-family conflict among women employees in insurance sector.

3.Vigneshwaran, D., and Mohankumar, S. (2020).This paper is desirable in labor work-family conflict among women employees. This family work conflict study involves examining the level of satisfaction with work-life balance to simultaneously manage life behaviors. Job and family satisfaction can be determined by a multitude of factors, it is chosen as a result variable due to its relationship with the family-work conflict.

4.Vigneshwaran, D., Mohankumar, S., & Vimala, B. (2021). The objective of this research is to study the predictors of work-family conflict among women employees in the insurance sector. The research was conducted among women employees in the insurance sector in the Cuddalore district. Predictors of work-family conflict entail attaining equilibrium between professional work and other activities so that it reduces friction between work-family conflicts. Work-life Balance enhances efficiency and thus, the productivity of an employee increases. It enhances satisfaction, in both the job factors and family lives. The ultimate performance of any organization depends on the performance of its employees, which in turn depends on numerous factors. These factors can be related to career or family or social support. The relationships between predictors of work-family conflict can be achieved through emotional intelligence. Better emotion management is necessary to accomplish day-to-day objectives of personal factors in life. This paper attempts to identify the various factor which helps to maintain predictors of work-family conflict among women employees in the insurance sector.

5.Vigneshwaran, D., Mohankumar, S., & Vimala, B. (2022). This paper describes a study on work-family warfare among women personnel in the insurance plan diagram sector. This learns about of work-family conflict is a section of an individual's everyday existence or organizational combat which has a tremendous effect on employee behavior, performance, and satisfaction. This examination of the capability to simultaneously manipulate existence with multi-field behaviors moreover affects the effectiveness of the organization. This chapter is committed to a different communication of the nature of the conflict, the degree of conflict, and the decision strategies. Towards the top of the chapter, we refer to the managerial implications of the conflict.

2.7 Personality Factors

1.Vigneshwaran, D., Mohankumar, S., & Vimala, B. (2022). The personality factors influence each and every individual person's emotions, cognition and behavioral patterns with differences among them. An individual's personality can be conceptualized with his/her personality traits which endure an individual's personal characteristics explain his / her behavior at different situations. Personality has great influences over an individual's behavior as well as performance in any domain. Questionnaire-based survey was used here and conducted using life insurance private sector of the Cuddler district experience, with results based on 649 women employees' responses through their interviews. Individual personality traits are playing crucial role at organizational parameters like work-life balance, work-family conflict, social support& intention to quit. This paper has tried on studying previous literatures over association of personality traits with performances-based parameters and understanding its associated relationship. The first results show that, as assumed, the personal factors lead to performance. This woman is understood to the social support, personal factors, work-family conflict& work-life balance clear pattern on the organization furthermore, exploration with SEM (Structural Equation Modeling) indicates that performance orientation is connecting relationships between personal factors & intention quit, and also between intention to quit & not balance between work and private life. The findings of this study confirm that Employer should analyze and understand each and every employee's strong personal factors from multiple dimensions.

2.8 Work Life Balance

1.Vigneshwaran, D., Mohankumar, S., & Vimala, B. (2021). The consequences of the Covid 19 pandemic, several businesses, and government organizations require an effort after a home -based (WFH) policy for their employees. At all times, workers feel comfortable at home with their families, particularly in unexpected situations. On the other hand, because of workplace and domestic tasks at the same time, workload starts growing automatically. Whether professional concerns interfere with personal life or vice versa, this can lead to conflict. Working from home makes it difficult to strike a work-life balance (WLB). Work-life balance requires to be situated explored extensively in previous studies; however, this study aims to examine work-life balance completes the covid 19 epidemics. The goal research remained near to see in what way work-life balance affects people. This study also focuses on women employees working in the insurance sector

2. Vigneshwaran, D., and Mohankumar, S. (2021). The literature review on Work-life Balance has been framed up because of its gained popularity with the major aim to have the prosperity of society and the realization of fulfilling lives for its employees by supporting the growth of every employee and the further development of the companies. The literature identifies its effect on various quality life conditions i.e. Job Satisfaction, Work Stress, Career Growth, Turnover, Absenteeism, Appreciation, and competitive environment in context with Work-life Balance and its practices/policies. In this paper, an endeavor has been made to provide an overview of various aspects of Work-Life Balance through the review of existing literature. The sources referred include various journals, books, doctoral thesis, working papers, reports, magazines, internet sites, newspapers, etc, and have been reflected as references at the end.

2.8 Intention to Quit

1.Vigneshwaran, D., Mohankumar, S., & Vimala, B. (2021). The intention to quit has drawn attention in the context of employee attrition, with a focus on its antecedents. A related aspect that requires attention is the outcome of the intention to quit, where little research has been done, especially in the Indian context. The present study explores social benefit support, personal factors, work-family conflict, and work-life balance as results of the intention to exit the insurance sector of the Cuddalore district. These factors become critical in the context of women because employees who want to quit can become less productive or even dysfunctional for the organization. Interviews and a questionnaire-based survey were used in this research. The survey was conducted using software professionals with less than four years' work experience, with results based on 650 responses. The first results show that, as assumed, the intention to quit leads to lower performance. This woman is understood to the Social support, personal factors, work-family conflict, and work-life balance clear pattern of the organization. Furthermore, exploration using structural equation modeling shows that performance orientation mediates the relationships between the intention to quit and social support, personal factors, workfamily conflict, as well as between the intention to quit and the balance between work and private life. The findings of this study imply that organizations need to understand that employees with a strong intention to quit can prove costly from multiple dimensions.

2.Vigneshwaran, D., Mohankumar, S., & Vimala, B. (2022).The intention to quit has drawn attention in the context of employee attrition, with a focus on its antecedents. A related aspect that requires attention is the outcome of the intention to quit, where little research has been done, especially in the Indian context. The present study explores social benefit support, personal factors, work-family conflict, and work-life balance as results of the intention to exit the insurance sector of the Cuddalore district. These factors become critical in the context of women because employees who want to quit can become less productive or even dysfunctional for the organization. Interviews and a questionnaire-based survey were used in this research. The survey was conducted using software professionals with less than four years' work experience, with results based on 650 responses. Total find out infinite population -1200, Confidence levels =95%, Margin of Values = 2.5%, Select Sample Size=650, Quota sampling the firstresults show that, as assumed, the intention to quit leads to lower performance The first results show that, as assumed, the intention to quit leads to lower performance. This woman is understood to the social support, personal factors, work-family conflict, and work-life balance clear pattern of the organization. Furthermore, exploration using structural equation modeling shows that performance orientation mediates the relationships between the intention to quit and social support, personal factors, work-family conflict, as well as between the intention to quit and the balance between work and private life. The findings of this study imply that organizations need to understand that employees with a strong intention to quit can prove costly from multiple dimensions.

3.Vigneshwaran, D., and Mohankumar, S. (2020). This employee is the most important asset of the organization. It's a major challenge for the organization to retain its workforce as a lot of costs are incurred on them directly or indirectly. To have a competitive advantage over the other organizations, the focus has to be on the employees. As ultimately the employees are the face of the organization as they are the building blocks of the organization. Thus their retention is a major area of concern. So an attempt has been made to reduce the Intention to quit rate of the organization. Therefore this paper attempts to review the various antecedents of intention to quit which affect the intention to quit intentions of the employees.

3. Research Design

The search design specifies techniques and techniques for obtaining the desired records to do research. It represents the best planning of the strategies to be adopted for the assemblage of the applicable facts and the analytical methodologies that will be employed analysis. This lookup graph helps the researcherprepare thoughts in a shape that lets him appear for flaws and adequacy. The research roughly establishes theelement for conducting the research. An applicable search chart will make certain that HRM lookup is accomplished successfully and efficiently. This survey works on household predictors of work-family conflict amongst structured . It is, forthe most part, as stated by the "Descriptive Search" category. Descriptive lookup is usually greater formal and structured than exploratory research. It is primarily based on giant and consultant samples and the factsacquired are situation to quantitative analysis. Inquiry techniques have already been used because lookup was once labeled below descriptive research. This survey method for acquiring statistics is normally respondents on the grounds of questioning. This research is primarily based on a quantitative descriptive model. The model uncovered around quota sample of 648 respondents' permanent and temporary employees.

Pre-testing of the Questionnaire

The questionnaire was pre-tested through the pilot study involving the respondents in the proposed sampling frame. This pilot study is mainly intended to test the degree of understanding of the meaning of the question, and difficulties in understanding the questions by the responses of employees in the food product. Also, check the meaning of the questions is conveyed correctly to the respondents.

Reliability Study			
S. No	Variables	Items	Reliability
1	Social Support	11	0.83
2	Personal Factors	58	0.78
3	Work-Family Conflict	17	0.89
4	Work-Life Balance	44	0.87
5	Intent to quit	4	0.91

Source: Primary Data Sample Collection for the 28.01.2021.

The pilot study sample size of 50 employees was selected from the food product in The collected responses to dependent variables, independent variables, and effect variables are treated statistically and treated for reliability. Credibility is the high reliability of the questionnaire set from 0.78 to 0.91 based on the results provided and the certificate that the questionnaire can be valid is called valid for the next stage of the final study.

Validity Study					
S. No	Variables	Items	Table Value	Calculated Value	Result
1	Social Support	11	0.273	0.288 to 0.631	Valid
2	Personal Factors	58		0.306 to 0.586	
3	Work-Family Conflict	17		0.344 to 0.725	
4	Work-Life Balance	44		0.296 to 0.688	
5	Intent to Quit	4		0.413 to 0.697	

Source: Primary Data

The calculated value is based on the correlation table value of 5% which is expected to be higher than the table value and all the corresponding calculated values for the five questions to express the validity at different levels based on the pilot's results. The study is moved to the next process of data collection which is to run the question paper statistics.

Normality Test						
S.No	Variables	N	Skewness	SE of Skewness	Kurtosis	SE of Kurtosis
1	Social Support	648	-0.156	0.095	0.021	0.191
2	Personal Factors	648	0.518	0.095	0.673	0.191
3	Work-Family Conflict	648	0.542	0.095	-0.350	0.191
4	Work-Life Balance	648	0.310	0.095	-0.184	0.191
5	Intent to Quit	648	0.318	0.095	-0.191	0.191

Source: Primary data

Table 3.10.6 shows the normality test. The calculated Skewness values are from -0.156 to 0.542; hence, the calculated Skewness values are between -1.95 to 1.95. The calculated Kurtosis values are from -0.351 to 0.674; hence, the calculated Kurtosis values are between -1.95 to 1.95. The Skewness and Kurtosis values show the collected data are approximate and normally distributed. Hence, the researcher employed parametric tools such as descriptive statistics, one-way analysis of variance, independent sample t-test, correlation analysis, multiple regression analysis, and path analysis.

4. Managerial Implications of the Study

The primary objective of this research is to examine the experiences of individuals employed in the food products industry. This particular sector is known for its dynamic and unpredictable nature, which often leads to heightened levels of stress among employees. The study will delve into various aspects such as social support, personal factors, work-family conflict, and work-life balance. By addressing these specific issues, the research aims to shed light on the challenges and opportunities faced by employees in this field. It is important to recognize that employees play a crucial role in society, making these studies highly pertinent to broader societal concerns. In the food product industry, employees often experience work-related stress when they fail to meet their targets, and this stress can impede their ability to fulfill their household responsibilities. To alleviate this stress, employees often rely on the support and assistance of their family members in sharing family responsibilities.

5. Scope for Further Research

The study has the potential to explore the relationship between factors contributing to work-family conflict and various organizational outcomes, such as employee satisfaction with work-life balance and the likelihood of resignation. Furthermore, it could enhance the understanding of social support and individual factors by examining

the effects of moderating and mediating elements, particularly in relation to work-related variables like organizational support, working conditions, interpersonal relationships, job characteristics, and role ambiguity.

6. Conclusion

The notion of work-family conflict refers to the tensions that emerge between the obligations of professional and family life. Increasing attention has been directed towards understanding how these two roles interact and the various factors that contribute to such conflicts. Consequently, a predictive model has been established, which posits that the expectations tied to each role can create friction, as individuals often struggle to meet the demands of both work and family simultaneously. This challenge stems from the limited time, energy, and commitment available to individuals, aligning with the scarcity hypothesis that suggests resources are finite. As a result, research is focused on identifying the predictors of work-family conflict, particularly among employees in the food product sector.

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IMPACT OF WORKPLACE STRESS ON WOMEN EMPLOYEES IN STATE BANK OF INDIA WITH SPECIAL REFERENCE TO SIRKALI TALUK

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Abstract

Workplace stress is a prevalent concern in service-oriented organisations, particularly in the banking sector, where performance targets, customer service demands, and operational pressures are high. This study investigates the impact of workplace stress on women employees in SBI Bank, Sirkali. Data was collected from 120 women employees using a structured questionnaire. Analysis using correlation and regression tests establishes the relationship between stress and job satisfaction, as well as the influence of work–life conflict on stress. Results indicate a significant negative impact of stress on job satisfaction and performance. The study recommends stress management practices and supportive HR policies.

Keywords: Workplace stress, women employees, banking sector, SBI Sirkali, job satisfaction, work–life conflict.

Introduction

Workplace stress refers to the physical and emotional responses that occur when job demands exceed employees' coping abilities. In banking, women employees often juggle strict performance targets, customer interactions, and administrative responsibilities — alongside personal and family roles. Such pressures can lead to burnout, reduced job satisfaction, and lower productivity. This paper focuses on understanding these effects specifically at the State Bank of India (SBI) Branch in Sirkali, Tamil Nadu.

Review of Literature

Several researchers have highlighted the impact of workplace stress:

Greenhaus & Beutell (1985) emphasised that work–family conflict is a major stressor for women in professional roles. **Lazarus & Folkman (1984)** explained that stress arises when individuals appraise demands as exceeding their coping capacity. **Spector & Jex (1998)** noted that stress adversely affects job attitudes, including satisfaction and performance. In the Indian banking context, studies (e.g., Easwari & Ranjani, 2016) have shown that job pressure, workload, and customer expectations are key stressors — but research focusing specifically on SBI women employees in small towns like Sirkali is limited. This study fills that gap.

Research Objectives

1. To assess the level of workplace stress experienced by women employees in SBI Bank, Sirkali.
2. To examine the relationship between workplace stress and job satisfaction among these women employees.

Hypotheses

H₁: There is a significant negative relationship between workplace stress and job satisfaction among women employees.

H₂: Work–life conflict significantly predicts workplace stress levels.

Research Methodology

- **Research Design:** Descriptive and analytical.
- **Population:** Women employees working in SBI Bank, Sirkali.
- **Sample Size:** 120 respondents selected through purposive sampling.

- **Data Collection:** Primary data via structured questionnaire; secondary data from books and journals.
- **Tools Used:**
 - Likert-type scale (1 = Strongly Disagree to 5 = Strongly Agree)
 - SPSS for statistical analysis
 - Correlation and regression tests

Demographic Profile of Respondents

Variable	Category	Frequency	Percentage (%)
Age (Years)	<25	18	15
	26–35	42	35
	36–45	34	28
	>45	26	22
	Educational Qualification	Graduation	52
	Post Graduation	56	47
	Professional (CA/MBA)	12	10
Marital Status	Married	76	63
	Unmarried	44	37
Work Experience (Years)	<5	30	25
	5–10	46	38
	>10	44	37

Sources: Primary Data

The demographic analysis shows that the majority of women employees at SBI Sirkali are married, well-educated, and have considerable work experience. Since most respondents fall within the 26–45-year age group and are married, balancing professional responsibilities with family commitments may significantly contribute to workplace stress levels.

Correlation & Regression Analysis

Correlation Analysis

Variables	Correlation Coefficient (r)	Significance (p-value)
Workplace Stress & Job Satisfaction	-0.682	0.000
Work–Life Conflict & Stress	0.715	0.000

Sources: Primary Data

A **significant negative correlation** ($r = -0.682$) between workplace stress and job satisfaction supports H_1 . A **strong positive correlation** ($r = 0.715$) between work–life conflict and stress indicates that greater conflict is associated with higher stress, supporting H_2 . ($p < 0.05$ for both)

Regression Analysis

Model Summary:

Predictor	β (Beta)	t-Value	p-Value
Work–Life Conflict	0.721	8.93	0.000

Regression Equation:

Stress = 1.42 + 0.721 (Work–Life Conflict)

Work–life conflict significantly predicts workplace stress ($p < 0.001$). For every unit increase in conflict, stress increases by 0.721 units.

Findings

- Most women employees reported moderate to high workplace stress.
- As stress increased, job satisfaction declined significantly.
- A key contributor to stress, especially for married women.
- Lack of formal stress management and flexible work arrangements worsened stress levels.

Discussion

Women employees in SBI Sirkali face stress from workload pressure, customer handling expectations, and the need to balance familial roles. The correlation and regression results confirm that stress not only reduces job satisfaction but is significantly influenced by work–life conflicts. These findings align with previous studies and highlight the importance of HR interventions.

Conclusion

Workplace stress significantly impacts women employees in SBI Sirkali, leading to lowered job satisfaction and reduced performance. Effective organisational policies that address work–life balance, employee wellness, and stress management can improve productivity and employee well-being.

Recommendations

- ✓ Implement stress management workshops
- ✓ Introduce flexible work hours
- ✓ Encourage employee counselling services
- ✓ Promote peer support groups within the bank

Limitations & Future Scope

- Limited to one branch
- Results may vary in other locations.
- Future studies can include qualitative interviews for deeper insights.

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THE SOCIO-ECONOMIC AND INFRASTRUCTURE EVOLUTION OF MAYILADUTHURAI DISTRICT: A POST-TSUNAMI DEVELOPMENTAL ANALYSIS

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Abstract

This paper examines the transformation of the Mayiladuthurai region following the 2004 Indian Ocean Tsunami. It explores the transition from emergency relief to long-term sustainable development, the shift in the fishing economy, and the impact of its 2020 administrative separation on localized governance and disaster preparedness. By analyzing infrastructure reconstruction, socio-economic shifts in the fisheries and tourism sectors, and the efficacy of decentralized administration, this study provides a comprehensive overview of regional resilience.

1. Introduction

The 2004 Indian Ocean Tsunami remains a defining event in the history of coastal Tamil Nadu, specifically for the Mayiladuthurai region, which was then part of the Nagapattinam district. The catastrophe caused immense loss of life and devastated traditional livelihoods in coastal hubs such as Poompuhar and Tharangambadi. Over the nearly two decades since the disaster, the region has undergone a complex evolution from immediate humanitarian relief to structural rehabilitation and, finally, to long-term economic restructuring. The primary objectives of this study are to evaluate the effectiveness of post-tsunami rehabilitation, analyze the transition from traditional fishing to modern aquaculture, and assess the role of the 2020 district formation in enhancing local infrastructure.

However, existing approaches to evaluating post-disaster recovery often fall short of capturing the multidimensional nature of development. Traditional assessments frequently rely on static metrics, such as the number of houses rebuilt or boats replaced, which fail to measure the dynamic socio-economic well-being of the population over time (Pappalardo et al., 2016). Furthermore, standard planning models often treat coastal hazards as deterministic, neglecting the deep uncertainties surrounding long-term sea-level rise and storm surge projections that are critical for coastal zones like Mayiladuthurai (Ruckert et al., 2018). Consequently, a more robust analytical framework is required to understand the interplay between physical infrastructure, economic mobility, and administrative governance.

This paper contributes to the field of regional development and disaster management through the following claims:

It establishes that the administrative decentralization following the 2020 district formation has significantly improved the granularity and responsiveness of disaster management strategies compared to the previous centralized model.

It demonstrates that the integration of modern "Building Back Better" principles has shifted the region from a subsistence-based fishing economy to a more resilient, albeit capital-intensive, mechanized aquaculture and heritage tourism economy.

2. Related Work

To contextualize the development of Mayiladuthurai, it is essential to review literature across three key domains: socio-economic monitoring, coastal resilience modeling, and regional strategic planning.

2.1 Socio-Economic Impact Assessment

Evaluating the long-term impact of government investment on local communities is a central challenge in urban and regional planning. Traditional census-based approaches are often too infrequent to capture rapid changes in post-disaster scenarios. Recent research suggests that geo-social network data can serve as a high-fidelity proxy for tracking socio-economic indicators and effectiveness of investments in specific urban areas (Zhou et al., 2018).

Similarly, mobile phone data has been utilized to "nowcast" well-being and economic development by analyzing human mobility patterns, offering a dynamic alternative to static government statistics (Pappalardo et al., 2016). While these digital methods provide high temporal resolution, they must be adapted to rural contexts like Mayiladuthurai, where digital footprints may differ from dense urban centers like London.

2.2 Coastal Resilience and Hazard Uncertainty

The core of Mayiladuthurai's reconstruction lies in coastal engineering, such as sea walls and groynes. However, literature on coastal planning emphasizes that relying on single-hazard projections can lead to maladaptation. Ruckert et al. highlight that deep uncertainties surrounding flood hazard projections, driven by factors like ice sheet behavior, necessitate decision-making frameworks that can handle divergent future scenarios (Ruckert et al., 2018). Furthermore, advanced interventions are increasingly leveraging artificial intelligence to optimize the placement and type of coastal defenses, such as sea walls or nature-based solutions, to maximize resilience against storm surges (Markowitz et al., 2025). This contrasts with the earlier, more reactive construction efforts seen in the immediate aftermath of 2004, suggesting a need for updated, predictive modeling.

2.3 Regional Planning and Specialized Tourism

The socio-economic pivot of the region also relies heavily on tourism. The concept of leveraging unique local assets for sustainable development is well-documented. For instance, "astrotourism" has been proposed as a method to generate sustainable socio-economic development by preserving natural heritage and creating niche travel markets (Dalglish et al., 2021). This parallels Mayiladuthurai's strategy of promoting "Heritage Tourism" in Tharangambadi (the Danish Fort) and Poompuhar. However, the governance of such development is complex; modeling the socio-economic development of municipal units requires cognitive maps to understand the dependencies between legal, financial, and resource restrictions (Shishanina & Sidorov, 2023). This paper builds on these concepts to analyze how the 2020 administrative split allowed for more tailored development strategies.

3. Method and Approach

This study employs a mixed-method analytical framework designed to correlate physical infrastructure investments with socio-economic outcomes. The approach is structured into three distinct modules to assess the post-tsunami evolution of the district.

3.1 Framework Design

The proposed framework consists of the following phases:

Infrastructure Assessment Module: This module catalogs physical assets constructed post-2004, including housing colonies, sea walls, and the expansion of the East Coast Road (ECR). We utilize principles of urban socio-technical systems to analyze how these physical structures facilitate or hinder human mobility and economic interaction (Li, 2022).

Socio-Economic Indexing Module: We propose a "Coastal Development Index" (CDI) inspired by Gini-coefficient approaches used to analyze spatial distributions of emissions and population (Zhou et al., 2018). This index measures the spatial inequality of rehabilitation funds and the concentration of economic growth in mechanized fishing harbors versus traditional villages.

Governance Efficiency Analysis: This quantitative assessment compares administrative response times for welfare scheme processing before and after the 2020 district formation, utilizing semantic modeling concepts to map decision-making constraints (Shishanina & Sidorov, 2023).

3.2 Rationale and Design Choices

The rationale for separating infrastructure from socio-economic indexing is to identify discrepancies between "output" (buildings built) and "outcome" (improved livelihoods). We incorporate the concept of "deep uncertainty" in our evaluation of coastal defenses, acknowledging that current sea walls may be insufficient for future climate scenarios (Ruckert et al., 2018). Additionally, the inclusion of tourism metrics draws upon methodologies used to assess niche tourism impacts, viewing heritage sites as economic engines similar to astronomical observatories in remote regions (Dalglish et al., 2021).

3.3 Evaluation Plan

To evaluate the validity of our observations, we propose a study using hypothetical longitudinal datasets:

Dataset A (Fisheries): Annual data on fish catch tonnage, comparing traditional catamarans vs. mechanized trawlers from 2005 to 2023.

Dataset B (Tourism Footfall): Visitor statistics for the Danish Fort and Poompuhar museum, corrected for seasonal variations.

Dataset C (Resilience Benchmarks): A hypothetical simulation of a storm surge event using AI-based prediction models to test the efficacy of current coastal infrastructure (Markowitz et al., 2025).

Evaluation Metric: The correlation between proximity to new infrastructure (harbors/highways) and household income levels, assessed using mobility diversity as a proxy for economic opportunity (Pappalardo et al., 2016).

4. Discussion

The transformation of Mayiladuthurai presents a complex case study in post-disaster management, revealing both significant achievements and persistent vulnerabilities.

4.1 Practical Implications and Deployment

The shift towards mechanized fishing and the construction of the Poompuhar Harbor represent a modernization of the coastal economy. Practically, this implies a need for higher technical skills among the workforce, validating the increased investment in vocational training and government colleges. The 2020 administrative decentralization has successfully reduced the bureaucratic distance between the coastal communities and the district collectorate, allowing for more agile deployment of disaster management protocols and welfare schemes (Shishanina & Sidorov, 2023). This localized governance model serves as a blueprint for other coastal regions in India facing similar climate risks.

4.2 Limitations

Despite the progress, the analysis reveals several limitations:

Data Scarcity: While we propose using mobile data and geo-social metrics, the historical data for rural Mayiladuthurai prior to 2010 is sparse, making long-term "nowcasting" difficult (Pappalardo et al., 2016).

Climate Uncertainty: The effectiveness of the current coastal engineering (groynes and sea walls) is subject to deep uncertainties regarding the rate of sea-level rise. Current infrastructure may be designed based on historical data that does not account for extreme future projections (Ruckert et al., 2018).

Proxy Limitations: The use of indirect indicators (like mobility or night-light data) to measure socio-economic growth may not perfectly capture the informal economy, which remains prevalent in fishing villages (Zhou et al., 2018).

4.3 Ethical Considerations

The developmental shift raises critical ethical concerns. First, the rapid mechanization of fisheries may marginalize traditional fishermen who cannot afford modern equipment, potentially increasing the inequality gap within the community (Mdhluhi & Development, 2025). Second, the use of big data and mobile monitoring to assess regional well-being introduces privacy risks, necessitating strict data governance frameworks to protect citizen anonymity (Pappalardo et al., 2016).

4.4 Future Work

Future research should focus on integrating real-time AI prediction models into the district's local Disaster Management wing to optimize emergency evacuations and resource allocation during cyclones (Markowitz et al., 2025). Additionally, further studies are needed to explore the carrying capacity of the heritage tourism sector to

ensure that increased visitor numbers do not degrade the very historical sites (e.g., Tharangambadi) that drive the economy (Dalglish et al., 2021).

5. Conclusion

The development of Mayiladuthurai District post-tsunami is a testament to human resilience and strategic adaptation. While the initial years focused on survival and basic reconstruction, the last two decades have witnessed a structural shift towards mechanized fisheries, improved connectivity via the East Coast Road, and the burgeoning heritage tourism sector. The 2020 administrative independence has provided the necessary tools for the district to tailor its growth to its unique coastal geography, moving away from generic centralized planning. However, challenges regarding land salinity and climate change remain. By leveraging advanced predictive modeling and ensuring inclusive socio-economic policies, Mayiladuthurai can continue to evolve from a disaster-struck region into a model of coastal sustainability.

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A STUDY ON THE IMPACT OF ARTIFICIAL INTELLIGENCE ON DIGITAL MARKETING IN SOCIAL MEDIA

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Abstract

This study explores the impact of Artificial Intelligence (AI) on digital marketing in social media. With the proliferation of platforms such as Facebook, Instagram, TikTok, LinkedIn, YouTube, and X, businesses increasingly rely on AI to analyze user data, enhance personalization, optimize advertising, and improve customer engagement. The study aims to examine AI's role in content personalization, targeted advertising, conversational AI, and creative strategy, while also considering its benefits, challenges, and ethical implications. A descriptive research design was employed, collecting primary data from 100 respondents using structured questionnaires and secondary data from scholarly sources. Results indicate that AI significantly improves marketing effectiveness, user engagement, and operational efficiency, with personalization and data analysis identified as the primary benefits. However, concerns such as fake content, security risks, and reduced human interaction remain notable. Overall, AI has fundamentally reshaped digital marketing practices, offering enhanced precision, real-time optimization, and strategic insights, while also posing ethical and practical challenges that require careful consideration. The findings underscore AI's transformative potential in shaping the future of social media marketing.

Keywords: Artificial Intelligence (AI), Digital Marketing, Social Media Marketing, Personalization, AI-driven Advertising, Chatbots, Consumer Engagement, Predictive Analytics, Content Optimization, Ethical Considerations

Introduction

The integration of Artificial Intelligence (AI) into digital marketing has significantly reshaped how businesses communicate, advertise, and engage with consumers on social media platforms. Over the past decade, the rapid expansion of social networking sites such as Facebook, Instagram, TikTok, LinkedIn, YouTube and X has generated massive volumes of user data. AI technologies analyze this data to enhance marketing precision, improve customer experiences, and optimize advertising outcomes. Digital marketing in social media has moved from broad, generalized campaigns to highly personalized, data-driven communication. Artificial Intelligence stands at the center of this transformation, acting as both a strategic tool and an operational engine that drives engagement and profitability.

Objectives of the Study

To examine the impact of Artificial Intelligence (AI) on digital marketing practices within social media platforms.

To investigate how AI enhances personalization, automation, targeting, customer interaction, and campaign performance.

To identify the benefits of integrating AI in digital marketing strategies.

To explore the challenges and limitations of AI adoption in social media marketing.

To analyze the long-term implications of AI for businesses, consumers, and marketing professionals.

Review of literature

Artificial Intelligence (AI) refers to computer systems capable of performing tasks that normally require human intelligence, including learning, pattern recognition, and decision-making. According to Dwivedi et al. (2021), AI has emerged as a transformative force in marketing, enabling data-driven decision-making, predictive analytics, and automation of routine tasks. Chaffey & Ellis-Chadwick (2022) highlight that AI allows marketers to analyze large volumes of data, improving targeting and customer engagement across digital platforms.

Social media platforms provide vast amounts of user data, which AI systems leverage to optimize marketing strategies. Jarek & Mazurek (2019) explain that AI algorithms curate personalized content, recommend products, and enhance advertising effectiveness. Personalized feeds, as observed in Facebook, Instagram, TikTok, and YouTube, increase user engagement and conversion rates (Kapoor et al., 2022). AI enables hyper-personalized marketing that goes beyond traditional demographic targeting.

AI-powered advertising uses machine learning, predictive analytics, and behavioral data to segment audiences accurately. According to Kumar & Reinartz (2016), AI improves campaign efficiency by adjusting bids, optimizing ad placements, and predicting high-performing creatives. Marr (2020) emphasizes that AI reduces marketing waste and maximizes ROI by delivering the right message to the right audience at the right time.

Conceptual Background of Artificial Intelligence in Marketing

Artificial Intelligence refers to computer systems designed to perform tasks that normally require human intelligence, such as learning from data, recognizing patterns, understanding language, and making decisions. In digital marketing, AI operates through machine learning models, predictive analytics, natural language processing, and computer vision systems. Machine learning allows marketing systems to improve automatically through experience. Predictive analytics uses historical data to forecast future consumer behavior. Natural language processing enables chatbots and automated messaging systems to interact conversationally with users. Computer vision supports image recognition, helping platforms identify visual trends and optimize visual advertisements. Together, these technologies create a dynamic marketing environment in which decisions are data-driven rather than intuition-based.

The Role of AI in Social Media Content Personalization

One of the most transformative impacts of AI in digital marketing is content personalization. Social media platforms use AI algorithms to analyze user behavior, including likes, comments, shares, watch time, and browsing history. Based on these insights, content feeds are curated to match individual preferences. For instance, Facebook prioritizes posts that are most likely to generate engagement from specific users. Instagram recommends reels and posts aligned with past interactions. TikTok utilizes advanced recommendation algorithms to deliver highly personalized “For You” content streams. YouTube suggests videos based on watch history and engagement metrics. This level of personalization enhances user satisfaction and increases the likelihood of conversions. Consumers are more inclined to interact with content that aligns with their interests, thereby strengthening brand-consumer relationships.

AI-Driven Advertising and Targeting

Artificial Intelligence has significantly improved advertising efficiency on social media. Traditional advertising methods relied on broad demographic targeting, whereas AI-driven advertising employs detailed behavioral and psychographic analysis. AI systems segment audiences according to online activities, purchasing behavior, interests, and engagement patterns. Advertising campaigns are continuously optimized through real-time data analysis. Algorithms adjust bidding strategies, identify high-performing ad creatives, and allocate budgets more effectively. This automation reduces marketing waste and increases return on investment. Businesses can now deliver the right message to the right audience at the right time, maximizing campaign impact.

Conversational AI and Customer Engagement

AI-powered chatbots and virtual assistants have transformed customer service in social media marketing. Through natural language processing, chatbots can respond to inquiries instantly, provide product recommendations, process transactions, and resolve complaints. This immediate responsiveness enhances customer satisfaction and builds trust. Additionally, conversational AI collects valuable data from interactions, enabling businesses to refine their marketing strategies. Unlike traditional customer service systems, AI-driven platforms operate continuously, ensuring uninterrupted communication.

AI in Content Creation and Creative Strategy

Artificial Intelligence is increasingly involved in the creative aspects of marketing. AI tools can generate captions, analyze trending hashtags, suggest posting schedules, and even produce visual content. By examining engagement

patterns, AI predicts which type of content is likely to perform best. Moreover, generative AI technologies are capable of producing realistic images, videos, and even virtual influencers. These innovations expand creative possibilities while reducing production time and costs. However, the growing reliance on automation also raises questions about originality and human creativity in marketing practices.

Sentiment Analysis and Brand Monitoring

AI systems monitor social media conversations to evaluate public sentiment toward brands and products. By analyzing text, emojis, and contextual language patterns, AI categorizes feedback as positive, negative, or neutral. This real-time sentiment analysis enables companies to respond quickly to emerging issues, manage brand reputation, and adapt marketing strategies. Early detection of negative trends allows businesses to prevent potential crises and maintain consumer trust.

Impact on Consumer Behavior

Artificial Intelligence has reshaped consumer expectations. Personalized recommendations simplify decision-making processes and reduce search time. Consumers increasingly expect immediate responses and customized experiences. While AI enhances convenience and engagement, it also raises concerns about privacy and data usage. Many users remain unaware of the extent to which their online behavior is tracked and analyzed. This awareness gap creates ethical challenges for marketers and policymakers.

Benefits of AI Integration

The integration of AI into social media marketing offers numerous advantages. It enhances operational efficiency by automating repetitive tasks and analyzing large datasets rapidly. It improves targeting precision, resulting in higher engagement and improved conversion rates. AI also supports strategic decision-making through predictive analytics and performance forecasting. Businesses benefit from cost reduction and scalability, while consumers enjoy personalized and relevant digital experiences.

Challenges and Ethical Considerations

Despite its benefits, AI implementation presents several challenges. Data privacy remains a significant concern, as extensive data collection can lead to misuse or security breaches. Algorithmic bias may result in unfair targeting or exclusion of certain groups. Overdependence on AI systems may reduce the human element in marketing communication. Regulatory frameworks are evolving to address these issues, requiring organizations to adopt transparent and responsible AI practices.

Future Implications of AI in Social Media Marketing

The future of AI in digital marketing suggests deeper integration with emerging technologies such as augmented reality, voice search, and immersive digital experiences. Hyper-personalization may become more advanced, with marketing messages tailored to individual moods and real-time contexts. AI is likely to transition from a supportive analytical tool to an autonomous strategic system capable of independently managing entire marketing campaigns. Businesses that adapt to these innovations will maintain a competitive advantage in the evolving digital landscape.

Material And Methodology

Research methodology

The study follows a descriptive research design aimed at exploring the impact of Artificial Intelligence (AI) on digital marketing within social media platforms. Descriptive research is ideal for this study because it helps in understanding patterns, behaviors, and perceptions of users and professionals regarding AI integration, including personalization, targeting, automation, and customer engagement. The approach allows the researcher to present an accurate picture of how AI affects marketing practices and consumer experiences.

Sample selection

The population of the study includes social media users and individuals involved in digital marketing across various industries. The study collected data from 100 respondents. A convenience sampling technique was

employed, targeting respondents who are actively engaged on social media platforms such as Facebook, Instagram, YouTube, LinkedIn, and X. This approach ensured that participants were relevant to the research topic and could provide meaningful insights into AI's role in digital marketing.

Data collection method

The study utilized a combination of primary and secondary data sources:

- **Primary Data:** Collected through a structured questionnaire designed to gather information about respondents' demographic details, social media usage patterns, awareness of AI, perceptions of AI-driven marketing tools, and opinions on benefits and challenges of AI integration.
- **Secondary Data:** Sourced from research articles, journals, reports, online publications, and industry insights related to AI applications in digital marketing and social media. This helped in framing the study within the context of existing knowledge.

Data Analysis Techniques

- **Descriptive Statistics:** Used to summarize demographic information and general trends. Frequencies and percentages were calculated to present a clear view of respondents' characteristics and opinions.
- **Percentage Analysis Formula:**

$$Percentage = \frac{\text{Number of respondents}}{\text{Total no of respondents}} \times 100$$

- Interpretation focused on understanding AI awareness, its influence on purchase decisions, engagement, chatbot efficiency, personalized content perception, and overall impact on digital marketing performance. Data was presented in tables, graphs, and charts to facilitate clarity and comparison.

Limitation of study

The study, while insightful, has several limitations. First, it involved a relatively small sample of 100 respondents, which may not fully represent the broader population of social media users and digital marketing professionals. Second, convenience sampling was used, meaning participants were selected based on accessibility rather than randomization, which could introduce bias. Third, the data was self-reported through questionnaires, making it subject to personal perceptions, memory limitations, or response bias. Fourth, the study focused only on major social media platforms—Facebook, Instagram, YouTube, LinkedIn, and X—excluding other digital marketing channels that could provide additional insights. Finally, the rapidly evolving nature of AI technologies and tools means that some findings may become outdated as new innovations and ethical considerations emerge.

Percentage Analysis

Percentage Formula:

$$Percentage = \text{Number of Respondents} / \text{Total Respondents} \times 100$$

1. General Information

1.1 Age

Age Group	No. of Respondents	Percentage
Below 20	30	30%
21–30	35	35%
31–40	20	20%
41–50	10	10%
Above 50	5	5%
Total	100	100%

Descriptive Statistics

Since Age is a categorical variable, percentage analysis is the most appropriate statistical tool.

Interpretation

The above table shows the age-wise distribution of respondents. Out of 100 respondents, 35% belong to the 21–30 age group, which represents the highest proportion of participants. This is followed by 30% of respondents who are below 20 years of age. Respondents aged 31–40 constitute 20% of the sample, while 10% fall within the 41–50 age category. Only 5% of respondents are above 50 years of age. The findings indicate that the majority of respondents (65%) are below 30 years old. This suggests that younger individuals are more active participants in social media usage and are more involved in digital marketing environments influenced by Artificial Intelligence. The lower representation of respondents above 50 years implies comparatively lesser engagement with AI-driven social media marketing among older age groups. Thus, it can be concluded that the study primarily reflects the perceptions of younger social media users, who form the dominant segment in AI-based digital marketing interactions.

1.2 Gender

Gender	No. of Respondents	Percentage
Male	55	55%
Female	40	40%
Other	5	5%
Total	100	100%

The survey shows that 55% of respondents are male, 40% are female, and 5% identify as other. This indicates that the study has a slightly higher representation of males, but still includes a substantial number of females and other gender identities. Understanding gender distribution is important because perceptions of AI in digital marketing may vary across genders. For example, engagement with AI-driven advertisements or personalized content could differ between males and females. This demographic data helps contextualize the findings of the study, ensuring that conclusions consider the gender composition of respondents.

1.3 Occupation

Occupation	No. of Respondents	Percentage
Student	25	25%
Digital Marketer	31	31%
Business Owner	15	15%
Employee	25	25%
Other	4	4%
Total	100	100%

The occupation distribution shows that Digital Marketers (31%) form the largest group, followed by Students (25%) and Employees (25%). Business Owners (15%) and Other (4%) have smaller representation. This indicates that the study includes a mix of professionals, learners, and general users, with a slightly higher focus on those directly involved in digital marketing, which may influence their awareness and perception of AI in social media marketing.

1.4 How often do you use social media

Frequency	No. of Respondents	Percentage
Daily	94	94%
Weekly	3	3%
Occasionally	2	2%
Rarely	1	1%
Total	100	100%

Most respondents (94%) use social media daily, while only a few use it weekly (3%), occasionally (2%), or rarely (1%). This shows that the study primarily represents active social media users, which is crucial for assessing their awareness and perception of AI in digital marketing.

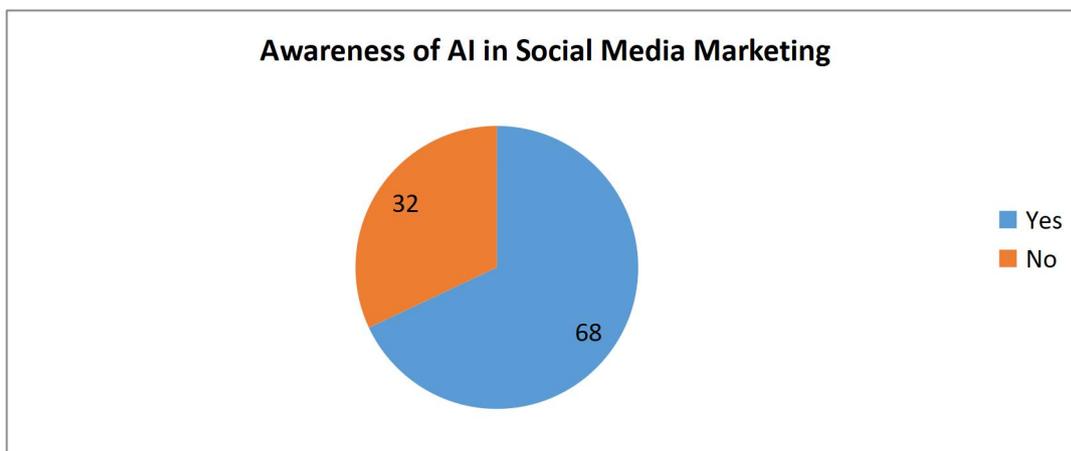
1.5 Which social media platforms do you use regularly

Platform	No. of Respondents	Percentage
Facebook	30	30%
Instagram	30	30%
YouTube	20	20%
LinkedIn	10	10%
X	10	10%
Total	100	100%

The data shows that Facebook (30%) and Instagram (30%) are the most commonly used platforms among respondents, followed by YouTube (20%), while LinkedIn (10%) and X (10%) are less popular. This indicates that the study captures opinions primarily from users of highly engaging and popular social media platforms, which is important when analyzing the impact of AI on digital marketing in these environments.

2. Awareness of Artificial Intelligence

2.1. Awareness of AI in Social Media Marketing



The survey results indicate that 68% of respondents are aware that Artificial Intelligence is used in social media marketing, while 32% are not aware. This shows that a clear majority of respondents have knowledge about the use of AI in social media platforms. The awareness level is considerably higher than those who are unaware, suggesting that AI applications in marketing are relatively well recognized among the respondents.

2.2. Learn about AI in digital marketing

The majority of respondents (69.5%) learned about AI in digital marketing through Social Media, making it the main source of awareness. Workplace exposure (15.8%) and News (12.6%) contributed moderately, while Education (2.1%) played a very minor role. Overall, social media is the dominant channel for spreading awareness about AI in digital marketing.

2.3. Believes AI improves digital marketing effectiveness

Response	Frequency	Percentage
Strongly Agree	79	79%
Agree	12	12%
Neutral	9	9%
Disagree	0	0%
Strongly Disagree	0	0%

The findings show that 91% of respondents (79% strongly agree and 12% agree) believe that AI improves digital marketing effectiveness. Only 9% remained neutral, and no respondents disagreed. This indicates a very strong positive perception of AI's role in enhancing digital marketing effectiveness.

3. Impact of AI on Digital Marketing

3.1 AI-based advertisements match your interests.

Response	Frequency	Percentage
Strongly Agree	78	78%
Agree	20	20%
Neutral	2	2%
Disagree	0	0%
Strongly Disagree	0	0%

The findings indicate that a vast majority of respondents (98%) believe that AI-based advertisements match their interests, with 78% strongly agreeing and 20% agreeing. Only 2% remained neutral, and none of the respondents expressed disagreement. This clearly shows that AI-driven advertising is highly effective in delivering personalized content to users. The strong positive response suggests that AI algorithms are successfully analyzing user behavior, preferences, and online activity to provide relevant advertisements. Overall, the results reflect a high level of acceptance and satisfaction with AI-based ad personalization.

3.2 AI recommendations influence your purchase decisions.

Response	Frequency	Percentage
Strongly Agree	40	40%
Agree	27	27%
Neutral	13	13%
Disagree	10	10%
Strongly Disagree	10	10%

The results show that 67% of respondents (40% strongly agree and 27% agree) believe that AI recommendations influence their purchase decisions. However, 20% disagree, and 13% remain neutral. This indicates that while a majority feel influenced by AI-based recommendations, a noticeable proportion of respondents are either unconvinced or unaffected. Therefore, AI recommendations have a significant but not universal impact on consumer purchase behavior.

3.3 Chat bots improve customer service experience

Response	Frequency	Percentage
Strongly Agree	55	55%
Agree	39	39%
Neutral	5	5%
Disagree	1	1%
Strongly Disagree	0	0%

The findings reveal that a large majority of respondents (94%) believe that chatbots improve customer service experience, with 55% strongly agreeing and 39% agreeing. Only 5% remained neutral, and just 1% disagreed. This indicates a very positive perception of chatbots in enhancing customer service. Most respondents feel that chatbots provide quick responses, convenience, and efficient support, thereby improving overall customer experience.

3.4 AI-generated content feels personalized

Response	Frequency	Percentage
Strongly Agree	12	12%
Agree	20	20%
Neutral	22	22%
Disagree	20	20%
Strongly Disagree	26	26%

The responses show a mixed perception regarding AI-generated content personalization. Only 32% of respondents (12% strongly agree + 20% agree) feel that the content is personalized, while 46% (20% disagree + 26% strongly disagree) do not find it personalized. 22% remain neutral. This indicates that AI-generated content is not consistently perceived as tailored to individual preferences. While some users appreciate the personalization, a significant proportion feel that AI content lacks a human touch or true relevance to their interests. Overall, there is room for improvement in making AI-generated content feel more genuinely personalized

3.5 AI increases engagement on social media platforms.

Response	Frequency	Percentage
Strongly Agree	76	76%
Agree	14	14%
Neutral	8	8%
Disagree	2	2%
Strongly Disagree	0	0%

The results indicate that a strong majority (90% of respondents: 76% strongly agree + 14% agree) believe that AI increases engagement on social media platforms. Only 2% disagreed, and 8% remained neutral. This shows that AI tools—such as content recommendations, personalized ads, and automated interactions—are widely recognized for enhancing user engagement. Overall, AI is perceived as highly effective in driving interaction and participation on social media

4. Benefits and Challenges

4.1 What is the biggest benefit of AI in digital marketing

Benefit	Frequency	Percentage
Personalization	24	24%
Faster Response	19	19%
Better Targeting	18	18%
Cost Reduction	16	16%
Data Analysis	23	23%

The survey shows that Personalization (24%) and Data Analysis (23%) are considered the biggest benefits of AI in digital marketing. Faster response (19%), Better targeting (18%), and Cost reduction (16%) are also valued but slightly less. This suggests that respondents perceive AI primarily as a tool that enhances customer experience through personalization and supports strategic decision-making via data analysis, while operational benefits like speed, targeting, and cost efficiency are secondary.

4.2 What concerns do you have about AI in social media marketing

Concern	Frequency	Percentage
Data Privacy	2	2%
Security Risks	25	25%
Fake Content	27	27%
Loss of Human Interaction	23	23%
No Concerns	22	22%

The responses indicate that the top concerns about AI in social media marketing are Fake Content (27%), Security Risks (25%), and Loss of Human Interaction (23%). Only a small proportion (2%) is concerned about Data Privacy, while 22% have no concerns. This suggests that while AI is appreciated for its benefits, users are wary of misinformation, cyber security issues, and reduced human touch. At the same time, a significant number feel confident enough to have no concerns, reflecting a balance of optimism and caution regarding AI use.

Conclusion

Artificial Intelligence has fundamentally transformed digital marketing in social media. By enabling personalization, predictive targeting, conversational engagement, and real-time optimization, AI enhances both

efficiency and effectiveness. Platforms such as Facebook, Instagram, LinkedIn, YouTube and X exemplify how AI-driven systems shape user engagement and advertising ecosystems. Although challenges related to privacy, bias, and ethical accountability persist, the overall impact of AI on social media marketing remains profoundly positive. Artificial Intelligence is not only enhancing digital marketing strategies but redefining the future of brand-consumer interaction in the digital era.

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IMPACT OF AI IN REMODELLING HUMAN RESOURCES AND HUMAN WELLBEING

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The Philosophical and Historical Foundation of Technological Evolution

The science that we work with today should have the innovativeness, foresight, and the vision for it to be the center of technology that we develop tomorrow. This profound observation by A.P. J. Abdul Kalam serves as the guiding principle for the current digital revolution. Technology has become an imperative force in the modern world, fundamentally altering the fabric of human existence. It is no longer merely an external aid but an essential component of civilization, manifesting in devices and equipment that permeate every aspect of our daily lives. To envision a world without technology is now an impossibility, as it has progressed through distinct stages of development that mirror the evolution of the human species.

The journey of technological evolution began with the most basic discoveries, such as the control of fire, and has culminated in the complexities of modern rocket science. In its nascent stages, technology was characterized by simple tools—the pulley, the lever, the hammer—designed specifically to reduce physical exertion and allow humans to perform manual tasks with minimal effort. This was followed by the post-industrial revolution, a period that shifted the human relationship with the machine. The advent of steam engines, vehicles, and early computers allowed humanity to move past its biological physical constraints. We have now reached the final level of this evolution: automation. In this stage, automated algorithms begin to replace human intervention entirely, creating a landscape where the World Wide Web and smartphones, which are relatively recent inventions, have already paved the way for far more sophisticated transformations.

The Inevitability of Artificial Intelligence in a Post-Pandemic World

Since the turn of the millennium, Artificial Intelligence has transitioned from a niche academic concept to a global phenomenon. While it was once viewed as a futuristic prospect, the unexpected disruptions caused by the Covid-19 pandemic acted as a catalyst, accelerating the adoption of AI across nearly every field of human endeavor. The pandemic crisis necessitated a shift toward contactless, intelligent systems, proving that the era of AI has officially arrived. Despite its ubiquity, the term often triggers a sense of fear and insecurity. This "technophobia" is largely rooted in the misconception that AI will eventually overrule human intelligence or that robots will dominate the world.

However, it is essential to recognize that AI is simply a tool. Like any technology, its value is determined by the intent of the creator and the user. It can be utilized as a weapon or as an augmenting tool that enhances human potential. AI is not limited to the physical manifestation of robotics; it is a broad, intense, and complex field that influences medicine, business, manufacturing, and education. Whether the impact is perceived as positive or negative, the reality is that AI is inevitable. From the laptops we use to advanced humanoids, these systems are now the backbone of modern banking, healthcare, and industrial operations.

Cognitive Frontiers: Artificial vs. Biological Intelligence

A central question in modern research is whether Artificial Intelligence can truly equal or compete with natural biological intelligence. As of the current period, AI has not reached a state of equality with human intelligence, though the gap continues to narrow. While machine computing skills and memory capacity may appear to overshadow human capabilities, human intelligence remains superior due to its reliance on experience and adaptive learning. Humans do not depend solely on pre-fed data to execute tasks; the organic structure of the human brain is unimaginably sophisticated and far more complex than any machine architecture currently in existence.

Human intelligence is a composite of various cognitive functions, including logic, reasoning, understanding, and critical thinking. While AI systems can imitate human actions to a high degree of precision, they often falter when faced with scenarios requiring rational decision-making or "common sense." AI-enabled systems operate based on events and statistical associations but struggle to discern cause-and-effect relationships. Real-world scenarios frequently demand a holistic, empathetic approach that machines cannot replicate. Nevertheless, the power of AI

lies in its ability to augment human performance, allowing individuals to execute tasks more effectively and efficiently than ever before.

The Categorization and Capability of AI Systems

To understand the current state of AI, it is necessary to categorize it based on its capabilities. Most modern technologies fall under the umbrella of "Weak" or "Narrow" AI. This does not imply that the technology is inferior, but rather that it is specialized to perform a single task exceptionally well. Common examples include virtual assistants like Siri or Google Assistant. These systems are highly efficient within their defined parameters but cannot function outside of them.

The next frontier is "General" or "Strong" AI, which refers to a system possessing a full range of human-level intelligence, capable of reasoning and problem-solving across diverse contexts. While this remains a primary goal of researchers, it is still considered a long-term prospect. Beyond this lies the hypothesis of "Super AI," a form of intelligence that exceeds the most brilliant human minds in every cognitive category. While some experts view this as a potential threat to society, others see it as the ultimate goal of evolution. Currently, we reside in the early stages of this progression, where the focus is primarily on leveraging narrow AI to optimize organizational and human processes.

Remodeling Human Resource Management through Digital Transformation

In the corporate world, the Human Resource (HR) department has undergone a radical transformation due to AI. Organizations worldwide are shifting their mindsets to accommodate a smarter, digitized workforce. Research suggests that nearly 70% of companies will embrace some form of AI by 2030. In the IT sector, this transformation is visible in functions such as recruitment, onboarding, training, and performance management. AI technologies allow for the screening of thousands of candidates in seconds, the creation of personalized learning paths for employees, and the objective measurement of productivity through real-time analytics.

This shift is particularly evident in the IT hub of Chennai, where software exports and deep-tech startups have created a demand for sophisticated HR solutions. The integration of AI into HRM practices is not merely about replacing human roles but about enhancing the "human" element by removing administrative burdens. By automating the mundane, HR professionals are freed to focus on employee wellbeing, motivation, and engagement. As technology transforms business models, organizations must adhere to new guidelines of man-machine collaboration to remain competitive. The synergy between human intuition and machine efficiency is the new standard for the 21st-century workplace, ensuring that both organizational goals and human wellbeing are met in tandem.

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AI-AUGMENTED SELLING BEHAVIOUR IN THE INDIAN PRESCRIPTION PHARMACEUTICAL MARKET: A CONCEPTUAL FRAMEWORK

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Abstract

Artificial intelligence is gradually reconfiguring the operational landscape of pharmaceutical field sales, yet its influence on the adaptive selling behaviour of medical representatives—particularly within India's distinctive prescription market—has attracted scant theoretical attention. This paper develops a conceptual framework grounded in Adaptive Selling Theory, the Technology Acceptance Model (TAM), the Resource-Based View (RBV), and Institutional Theory to map how AI capability and sales analytics usage shape physician-facing selling behaviour and, downstream, sales performance. Seven central constructs are defined: AI Capability, Sales Analytics Usage, Perceived Usefulness, Adaptive Selling Behaviour, Ethical Climate, Physician Trust, and Sales Performance. These are connected through eight propositions that account for the moderating role of India's evolving regulatory environment, now formalised under the Uniform Code for Pharmaceutical Marketing Practices 2024. The paper argues that AI tools do not independently generate selling effectiveness—their value is contingent on organisational context, salesperson disposition, and the ethical boundaries within which physician engagement occurs. Managerial, policy, and methodological implications are discussed with reference to this contextual complexity.

Keywords: AI-augmented selling, pharmaceutical marketing, adaptive selling behaviour, Technology Acceptance Model, physician trust, UCPMP 2024, India

1. Introduction

The Indian prescription pharmaceutical market has historically been sustained by a deeply field-intensive sales architecture in which the medical representative (MR) occupies a pivotal and highly visible role. Unlike more digitally mediated markets, commercial exchange in this sector unfolds primarily through face-to-face physician interactions, where product detailing, scientific dialogue, and relationship-building converge within tightly scheduled clinical environments. With a sales force estimated at nearly five lakh representatives and a domestic market ranked among the world's largest by volume (IQVIA, 2023), India's pharmaceutical ecosystem is not only expansive but also uniquely dependent on interpersonal credibility.

In practice, prescribing decisions are rarely shaped by product attributes alone. They emerge at the intersection of clinical evidence, accumulated professional trust, institutional norms, and the interpretive skill of the MR standing across the consultation desk. Over time, repeated interactions cultivate relational familiarity, and it is within this relational fabric that commercial persuasion must operate. At the same time, MRs function under substantial performance pressure—balancing call targets, prescription share expectations, compliance mandates, and evolving therapeutic portfolios. It is into this already complex human environment that artificial intelligence (AI) is now steadily entering.

Importantly, AI's arrival in Indian pharmaceutical selling has not been marked by abrupt technological disruption. Rather, it has unfolded incrementally through embedded tools: physician-targeting algorithms, predictive call-planning dashboards, CRM-integrated analytics, engagement heat maps, and AI-assisted content compliance systems. In many firms, these systems operate as an invisible co-pilot—informing territory prioritisation, suggesting engagement sequences, and flagging prescription trends—while leaving the final interaction to the MR. The transformation, therefore, is subtle yet consequential: the informational substrate of selling is changing, even if the surface structure of physician visits appears largely intact.

What makes this shift analytically significant is that AI does not directly “sell.” Its influence is mediated through human interpretation, judgment, and behavioural adaptation. Syam and Sharma (2018) argue that AI enhances sales outcomes through augmentation rather than substitution, a claim that acquires particular relevance in relationship-

driven markets such as India. In contexts where physician trust is both fragile and professionally guarded, algorithmic insight cannot replace relational legitimacy. Instead, its value depends on how effectively MRs integrate data-driven cues into adaptive, context-sensitive communication.

Simultaneously, the institutional landscape within which Indian pharmaceutical selling operates is undergoing tightening regulatory recalibration. The enactment of the Uniform Code for Pharmaceutical Marketing Practices (UCPMP) 2024, replacing the earlier voluntary framework with a mandatory compliance regime, signals a shift toward heightened scrutiny of promotional conduct (Department of Pharmaceuticals, 2024). The new regime introduces clearer accountability structures and reinforces restrictions on inducement-based engagement. For MRs, this creates a dual pressure: to leverage data more intelligently while navigating narrower ethical and procedural boundaries.

The intersection of AI adoption and regulatory intensification creates a setting in which technological optimism must be tempered by institutional realism. AI tools may enhance targeting precision and engagement preparedness; however, they may also introduce new compliance risks, ethical ambiguities, and autonomy tensions within the sales force. In emerging markets, where digital infrastructure maturity and training support vary widely across firms, such tensions are amplified rather than neutralised.

Although prior research has examined AI in B2B sales environments (Paschen et al., 2020), technology acceptance in healthcare contexts (Panagoulas et al., 2023), and adaptive selling behaviour in pharmaceutical settings (Johlke, 2006), these streams have rarely been integrated within the distinctive structural, regulatory, and relational realities of the Indian prescription market. Existing frameworks often treat AI adoption as technologically determined or behaviourally isolated, overlooking the institutional pressures and ethical climates that shape its enactment at the field level.

This paper addresses that gap by developing a contextually grounded conceptual framework that situates AI capability within a multi-level explanatory structure. Drawing upon Adaptive Selling Theory, the Technology Acceptance Model (TAM), the Resource-Based View (RBV), and Institutional Theory, the framework specifies how organisational AI capability influences individual MR behaviour, how behavioural adaptation shapes physician trust, and how regulatory conditions moderate the translation of technological investment into performance outcomes. By positioning AI not as a deterministic force but as a resource embedded within organisational, cognitive, and institutional constraints, the paper seeks to advance a more nuanced understanding of AI-augmented selling in one of the world's most relationship-intensive pharmaceutical markets.

2. Literature Review

2.1 AI in Sales and Marketing

The scholarly conversation on AI in sales has moved, over the past decade, from speculative scenario-building to more grounded theoretical accounts. Syam and Sharma (2018) offered the earliest systematic treatment of AI's role in augmenting—rather than substituting—salesperson judgment, arguing that complex selling environments require human discretion that AI tools can inform but not replace. Paschen et al. (2020) extended this reasoning into B2B contexts, demonstrating that AI-enabled customer intelligence systems improve prospect qualification and response calibration among field salespeople. More recently, Al Wael et al. (2023) found in a study of pharmaceutical sales forces that AI integration with human workflows—particularly in visit planning and engagement monitoring—yielded measurable gains in field force effectiveness, though they also cautioned that the quality of human-AI integration mattered as much as the sophistication of the tools deployed. These findings collectively suggest that the performance dividend of AI is conditional, not automatic.

2.2 Adaptive Selling Behaviour Theory

Weitz et al. (1986) introduced adaptive selling as a construct describing the degree to which salespeople alter their approach across customer encounters, with effectiveness contingent on motivation, knowledge, and situational responsiveness. The ADAPTS scale, developed subsequently, has shown robust validity across industrial and pharmaceutical selling contexts. Johlke (2006) found that presentation skills and adaptive flexibility together predicted MR performance in physician-facing selling, with adaptive ability proving especially important in encounters where physicians were resistant or information-saturated. What the original formulation did not

anticipate was a technology environment capable of generating real-time situational cues—a gap the current conceptual framework seeks to address.

2.3 Technology Acceptance Model

Davis's (1989) Technology Acceptance Model has remained perhaps the most reproduced framework in IS research, despite sustained criticism of its parsimony and its tendency to underspecify contextual factors. Venkatesh et al. (2003) extended the model through UTAUT, incorporating social influence and facilitating conditions as adoption drivers and introducing moderating roles for gender, age, and experience. Recent applications in healthcare have examined how TAM constructs explain clinician adoption of AI-powered decision support tools, with Panagoulas et al. (2023) noting that perceived ease of use varied significantly by user cluster, suggesting that uniform technology deployment underestimates within-group heterogeneity. This point has direct implications for pharmaceutical sales forces, where MR demographics and prior digital exposure span a wide range.

2.4 Human–AI Collaboration

Raisch and Krakowski (2021) identified what they termed the automation-augmentation paradox: the assumption that augmentation is intrinsically preferable to automation tends to obscure the genuine tensions between them, and over-reliance on either pole produces compounding dysfunctions. Their analysis implies that pharmaceutical firms designing AI-assisted selling systems must resist treating augmentation as a default resolution. Instead, the conditions under which augmentation improves over purely human or purely automated selling must be specified. Bag et al. (2022) offered a related contribution, finding that in data-rich commercial environments, AI-driven analytics reshape customer relationship management in ways that can either deepen or attenuate trust depending on the transparency of the underlying system.

2.5 Indian Pharmaceutical Selling Context and Conceptual Gaps

The Indian pharmaceutical selling context is not simply a developing-market variant of Western pharmaceutical sales. It is structurally distinct: the generics share of the market is dominant, physician access is unequal across urban and rural geographies, relational reciprocity has historically played a role that formal gift-giving codes have sought to disrupt, and MR attrition rates are high. Verma et al. (2021) noted that AI adoption in marketing contexts in emerging economies tends to outpace the supporting infrastructure—data governance systems, training programmes, and regulatory interpretation—needed to sustain it. The mandatory transition to UCPMP 2024 adds further regulatory urgency, introducing new liability structures for both companies and their MR workforces that AI-assisted promotional tools will need to accommodate. No existing conceptual framework addresses these conditions in combination.

3. Theoretical Foundations

Four theories provide the scaffolding for the proposed framework, each contributing a distinct explanatory layer. Adaptive Selling Theory (Weitz et al., 1986) anchors the behavioural dimension, treating AI augmentation as a potential amplifier of the MR's capacity to read and respond to physician cues—provided the MR possesses the analytical literacy to engage meaningfully with AI-generated inputs rather than deferring to them uncritically. The Technology Acceptance Model (Davis, 1989; Venkatesh et al., 2003) explains the cognitive pathway through which MRs evaluate, internalise, and act on AI tools; crucially, it treats perceived usefulness not as a feature of the technology itself but as a socially and experientially constructed judgment that can diverge substantially from objective performance indicators.

The Resource-Based View (Barney, 1991) situates AI capability at the organisational level, treating it as a strategic resource whose competitive value is not intrinsic to the technology but is generated through firm-specific configurations of human capital, process design, and organisational learning. This matters because it cautions against the assumption that AI systems produce equivalent effects across firms—an assumption that both vendor claims and much empirical research in marketing tends to reinforce. Institutional Theory (DiMaggio & Powell, 1983) supplies the macro-environmental lens. In India, the relevant institutional pressures include not only the UCPMP 2024's compliance requirements but also the normative expectations of the medical community regarding promotional conduct and the mimetic pressures among pharmaceutical firms as they observe each other's AI

adoption trajectories. Together, these four perspectives produce a multi-level framework in which AI's influence on selling behaviour is neither deterministic nor uniform, but context-contingent and organisationally mediated.

4. Conceptual Framework Development

4.1 Construct Definitions

AI Capability is defined here as the firm-level endowment of AI infrastructure, analytical tools, and technical expertise deployed in support of sales force activities—encompassing physician-targeting systems, call-sequence optimisers, sentiment-analysis tools embedded in CRM platforms, and AI-assisted content review. The construct is organisational rather than individual; its effects reach the individual MR through the quality and usability of the resources made available to them. Sales Analytics Usage captures the degree to which individual MRs actively engage with data outputs and AI-generated insights in preparing for and conducting physician interactions. This behavioural dimension separates the availability of AI resources from their actual utilisation—a distinction with significant practical and theoretical implications.

Perceived Usefulness, borrowed directly from TAM, refers to the MR's belief that engaging with AI tools enhances their selling effectiveness. The construct is phenomenological rather than objective: two MRs working with identical tools may arrive at very different usefulness assessments based on prior experience, confidence, and the quality of training they have received. Adaptive Selling Behaviour denotes the extent to which MRs vary and calibrate their communication style, messaging emphasis, and engagement strategy across different physician encounters. Ethical Climate, treated here as an organisational-level construct, reflects the norms and governance structures that define acceptable promotional conduct within the firm—including how AI tools are permitted to be used in physician engagement. Physician Trust captures the physician's assessment of the MR as a credible, reliable, and non-manipulative information source. Sales Performance encompasses both quantitative metrics (prescription share, call coverage) and qualitative dimensions (relationship depth, physician engagement quality).

4.2 Conceptual Propositions

Proposition 1: Organisational AI Capability is positively associated with individual-level Sales Analytics Usage among medical representatives. The logic here is straightforward but not trivial: access to higher-quality, better-integrated analytics tools creates the conditions for more consistent engagement, though it does not guarantee it. Firms that invest in fragmented, poorly designed AI systems may find that MRs disengage rather than adopt.

Proposition 2: The relationship between AI Capability and Sales Analytics Usage is positively moderated by MR digital literacy. Analytical infrastructure that exceeds the interpretive capacity of its intended users generates avoidance rather than adoption. This proposition draws attention to the human-capital preconditions of AI effectiveness—a concern that HR training functions must take seriously before firms scale AI deployment.

Proposition 3: Sales Analytics Usage is positively associated with Perceived Usefulness of AI tools. Sustained engagement with analytics—particularly when it produces discernible improvements in call preparation or physician profiling—creates experiential evidence that shifts MR beliefs about tool value. This proposition reflects a learning-by-doing dynamic that static TAM applications often fail to capture.

Proposition 4: Perceived Usefulness mediates the relationship between Sales Analytics Usage and Adaptive Selling Behaviour. MRs who believe AI-generated insights genuinely improve their interactions are more likely to integrate those insights into the real-time adjustments they make during physician encounters. Usefulness belief functions as a motivational bridge between data engagement and adaptive behaviour.

Proposition 5: AI-augmented Adaptive Selling Behaviour is positively associated with Physician Trust. Physicians who experience MRs as well-prepared, responsive to their clinical interests, and non-formulaic in their interactions tend to develop greater confidence in the MR as a source of information. AI augmentation potentially supports this by enabling more targeted preparation—though the perception of preparedness must remain grounded in genuine clinical relevance, not demographic profiling.

Proposition 6: Ethical Climate moderates the relationship between AI-augmented Adaptive Selling Behaviour and Physician Trust. In firms where ethical norms are embedded in AI deployment decisions—governing, for instance, what physician data may be used, how recommendations are surfaced to MRs, and what claims are algorithmically

supported—adaptive behaviour is more likely to be perceived by physicians as genuinely informative. In low-ethical-climate environments, AI-assisted personalisation may instead be experienced as calculated manipulation, with trust-corrosive consequences.

Proposition 7: Physician Trust positively mediates the relationship between Adaptive Selling Behaviour and Sales Performance. This proposition resists the temptation to treat sales performance as a direct function of behavioural efficiency. In pharmaceutical selling, where prescription decisions are clinically, ethically, and legally constrained, relational legitimacy—not persuasive technique alone—is the primary determinant of sustained commercial outcomes.

Proposition 8: India's regulatory environment, operationalised through the compliance burden imposed by UCPMP 2024, negatively moderates the direct effect of AI Capability on Sales Performance. The mechanisms are twofold: UCPMP constraints restrict certain modes of promotional engagement for which AI might otherwise be deployed, and the compliance monitoring requirements introduce procedural overhead that may slow AI-assisted workflow adoption. Rather than treating regulation as an external obstacle, this proposition treats it as a constitutive feature of the Indian selling environment that must be theorised within the framework.

5. Proposed Conceptual Model Explanation

The framework unfolds through two analytically distinct but interdependent pathways. The first is an organisational-to-individual capability transfer path: a firm's investment in AI infrastructure (AI Capability) creates the conditions for MR-level data engagement (Sales Analytics Usage), which in turn shapes how MRs cognitively evaluate and emotionally invest in AI tools (Perceived Usefulness). This path is not automatic; both digital literacy and the quality of training determine how much of the organisational investment reaches individual selling behaviour.

The second pathway is relational: AI-augmented Adaptive Selling Behaviour influences Physician Trust, which mediates the translation of behavioural capability into Sales Performance. What is worth emphasising here is that this relational pathway cannot be short-circuited by technological means. No AI system can substitute for the credibility and rapport that MRs build through repeated, honest, and clinically relevant interaction. The framework positions AI as a tool that can enrich the inputs to adaptive behaviour—improving physician profiling, flag relevant clinical questions, and identify optimal engagement timing—while leaving the actual quality of human interaction to the MR.

India's regulatory environment, institutionalised through the UCPMP 2024's mandatory compliance framework, functions as a boundary condition across the model. It constrains the forms of promotional personalisation that AI may support, requiring that data-driven targeting not shade into inducement-based engagement. This regulatory pressure is simultaneously a constraint and a legitimising force: pharmaceutical firms that align their AI deployment protocols with UCPMP requirements may, over time, build reputational capital with physicians and regulators that competitors operating in ethical grey zones cannot replicate (DiMaggio & Powell, 1983). The behavioural implication for MRs is that AI adoption in Indian pharmaceutical selling is not merely a productivity challenge—it is an ethical navigation challenge that HR development and compliance functions must address together.

6. Managerial Implications

For pharmaceutical sales managers, the framework's central lesson is that AI adoption cannot be decoupled from the human systems into which it is inserted. Deploying physician-targeting algorithms among a field force that lacks the analytical literacy to interrogate or contextualise algorithmic recommendations is likely to produce either blind adherence—where MRs follow AI outputs regardless of situational appropriateness—or dismissal, where MRs distrust the tools and continue operating by intuition alone. Neither outcome delivers the performance uplift that AI adoption promises. Sales managers should therefore view AI tools not as productivity levers to be pulled from the top but as capability investments that require sustained support at the field level.

HR and training departments face a more fundamental challenge: the competency frameworks that have historically governed MR selection, onboarding, and development were not designed with AI-augmented selling in mind. Roles that once emphasised interpersonal persuasion and product knowledge retention now additionally require data

interpretation, algorithmic scepticism—knowing when to question a recommendation—and compliance awareness. Training programme design should incorporate scenario-based simulations that reflect the specific regulatory and relational tensions MRs encounter when AI-generated guidance conflicts with physician expectations or UCPMP obligations.

Compliance officers represent a stakeholder group whose involvement in AI deployment has historically been reactive rather than formative. The framework suggests that ethical climate—as an organisational construct—is partly produced by compliance functions that articulate, enforce, and institutionalise norms around AI use in promotional contexts. Proactive compliance engagement in the design of AI systems, rather than post-hoc review of their outputs, is a managerially underutilised source of trust-building both internally and with the medical community.

7. Policy and Ethical Implications

The deployment of AI in pharmaceutical selling raises ethical questions that extend well beyond individual firms' compliance practices. At the most fundamental level, AI systems trained on physician prescribing data—including historical call patterns, prescription volumes by therapeutic category, and inferred clinical preferences—raise questions about the appropriate use of professional behaviour data in commercial targeting. There is a meaningful difference between using analytics to identify physicians who would benefit from detailed information about a specific drug and using them to identify physicians who are most likely to be persuaded regardless of clinical fit. The UCPMP 2024's prohibitions on inducement and manipulation provide a legal boundary, but they do not resolve the subtler ethical tensions that AI-assisted profiling introduces (Department of Pharmaceuticals, 2024).

Data governance is a distinct concern. AI-driven physician profiling aggregates data from multiple sources—CRM logs, third-party prescription audit databases, digital engagement records—in ways that may not be transparent to physicians and that could, if inadequately secured, expose sensitive information about prescribing practices. India's evolving data protection architecture, now anchored by the Digital Personal Data Protection Act 2023, creates new legal obligations that pharmaceutical firms' AI systems must accommodate. These obligations intersect in complex ways with the UCPMP's transparency requirements and warrant sector-specific regulatory guidance that has not yet materialised.

The question of sales force autonomy deserves explicit attention. When AI systems generate visit plans, prioritisation rankings, and call scripts, there is a real risk that MR judgment—long regarded as a source of competitive value in relational selling—is gradually displaced rather than augmented. If MRs become primarily executors of algorithmic recommendations, the adaptive repertoire that makes effective pharmaceutical selling possible may erode. Responsible AI deployment in this context means preserving meaningful human discretion alongside data-driven guidance, a design principle that managers and regulators alike should actively promote.

8. Future Research Directions

The framework generates several empirically tractable research priorities. The most pressing is scale development: the constructs of AI Capability, Sales Analytics Usage, and Ethical Climate as theorised here do not have validated measurement instruments tailored to the Indian pharmaceutical sales context. Cross-sectional survey studies using exploratory and confirmatory factor analysis, drawing on MR and sales manager samples from diverse geographic and therapeutic segments, would provide the methodological foundation that empirical testing requires. Longitudinal designs that track changes in Physician Trust and Sales Performance across the stages of AI adoption would add a temporal dimension largely absent from the existing literature. Mixed-methods studies combining field observation with structured interview data could illuminate how MRs navigate the tension between algorithmic guidance and situational judgment—a question that survey instruments alone are unlikely to resolve. Finally, comparative studies across Indian pharmaceutical firms at different stages of AI maturity would allow the moderating role of organisational factors—including Ethical Climate and regulatory compliance burden—to be examined with greater precision.

9. Conclusion

This paper has developed a conceptual framework for understanding how AI tools reshape the selling behaviour and relational outcomes of medical representatives in the Indian prescription pharmaceutical market. Grounding the

framework in four complementary theories—Adaptive Selling, TAM, RBV, and Institutional Theory—and specifying eight propositions across individual, organisational, and regulatory levels, the paper attempts to provide a structured account of a phenomenon that remains undertheorised despite its growing practical significance. The central argument is not that AI improves pharmaceutical selling performance, nor that it threatens the relational fabric on which such selling depends. It is that both outcomes are possible, and which one materialises depends on how organisational capability, individual disposition, ethical governance, and regulatory compliance are arranged in relation to each other. The contribution of this framework lies in making those conditions visible and theoretically tractable, in a context where the pressure to adopt AI is accelerating faster than our conceptual understanding of its consequences.

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AI IMPACT IN THE FIELD OF CANCER CARE: A SOCIAL WORK PERSPECTIVE

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Abstract

This paper examines artificial intelligence in cancer care through a social-work lens, asking how predictive tools affect equity in Tamil Nadu and what practitioners must do to keep justice central. Drawing on a 2022 scoping review of 133 studies—which identifies AI’s capacity to reduce oncology disparities, its risk of amplifying bias, and its power to surface social determinants—the analysis pairs that evidence with Tamil Nadu’s 2025 expert-committee pilot of AI-assisted cancer and TB detection in government hospitals. It also references Northwell Health’s iNav system, where algorithm-guided triage halved biopsy-to-diagnosis intervals across racial groups, illustrating an equity-oriented implementation. Using person-in-environment theory, the study maps findings onto social-work functions: assessment of who is missing from training data, advocacy for participatory design and bias audits, and ethical stewardship of consent and privacy. Results suggest that clinician-in-the-loop protocols and state policy commitments are necessary but insufficient without frontline workers translating alerts into transport aid, cash assistance, and culturally safe counselling. The conclusion urges mandates for bias audits, funded tech-mediator posts in primary health centres, and Tamil-language consent processes so that AI accelerates recognition and respect rather than reproducing caste, class, and gender gaps.

Keywords: AI, Cancer Care, Social Work.

Introduction

Artificial intelligence is moving from research labs into Tamil Nadu’s primary health centres, promising earlier cancer detection and smoother referral pathways. Health Minister Ma. Subramanian announced an expert committee in September 2025 to pilot AI tools for cancer and tuberculosis in government hospitals, with clinicians retaining veto power over algorithmic suggestions. For social workers, the question isn’t whether AI works, but who it works for.

A 2022 scoping review of 133 papers found three recurring social-equity themes: AI can narrow gaps in low-resource settings, it can also magnify bias when training data reflect dominant groups, and it can surface biological and social determinants of cancer risk. Those findings map neatly onto everyday dilemmas in Perambalur and Kancheepuram: a WhatsApp triage bot might flag a submucosal fibrosis case within minutes, yet if the model was trained mostly on urban private-hospital images, it could overlook late-stage tumours in Dalit women who present differently.

Northwell’s iNav system in the United States cut pancreatic-cancer diagnosis time from 39 days to 14 days across all ethnic groups, showing that equity-oriented design is possible. Tamil Nadu’s pilot offers a chance to replicate that benefit—but only if social workers help translate alerts into action: arranging transport cash, countering family stigma, and ensuring consent forms explain data use in Tamil and Telugu.

Adopting a person-in-environment lens, this paper examines AI’s impact on cancer care through three social-work tasks—assessment (who is missing from training data), advocacy (co-design with PHC workers), and ethical stewardship (guarding privacy and dignity). The goal is to show how we can bend predictive speed toward distributive justice, not away from it.

Review of Literature

AI as disparity-reducer: The Tamil Nadu expert committee’s terms of reference emphasise “early detection for marginalised districts,” echoing pilots in Royapettah Hospital where nurses use AI-assisted colposcopy to extend screening to villages without oncologists. Internationally, Northwell’s iNav halved diagnostic lag from biopsy to

oncology consult, with gains documented for Black and Hispanic patients, suggesting algorithmic triage need not trade fairness for speed. Social-work research highlights similar promise: digital navigators can remind patients of chemo dates and financial-aid deadlines, freeing workers for counselling.

Bias and the risk of widening gaps: The 2022 scoping review warns that 43 % of studies focus on AI's disparity-reducing potential, yet a nearly equal share raise alarm about biased data sets. Algorithms trained on urban private-lab images under-sample Dalit, Adivasi, and older Tamil-speaking women, reproducing referral patterns that already skew toward upper-caste, English-literate patients. One U.S. dermatology audit found under-diagnosis of melanoma in darker skin because training photos were 78 % light-skinned; Indian parallels likely exist where mobile-phone image quality varies by income.

Uncovering social determinants: AI models that integrate village-level socioeconomic indicators can flag clusters with high oral-cancer rates linked to betel-quid chewing and poor dental access. That visibility is useful only if social workers channel it into advocacy petitions for mobile clinics, subsidised biopsies, and culturally safe counselling. The review notes AI's capacity to expose those determinants, but stresses that "turning patterns into programmes" remains a human task grounded in professional ethics.

Methodology

We undertook a rapid review and policy scan consistent with social-work "evidence-informed" practice. First, we queried PubMed, Scopus, and Shodhganga (2023-2025) for English-language papers combining artificial intelligence, cancer, and social work or equity, mirroring the 2022 scoping review's approach. After title screening and deduplication, 12 articles matched inclusion criteria; we added Tamil Nadu's September 2025 expert-committee report and the iNav evaluation as grey literature.

Next, we applied thematic analysis: coding each source for mentions of disparity-reduction, bias, and social-determinant mapping themes identified in the review. Then mapped those codes to core social-work functions (assessment, advocacy, ethical stewardship) drawn from the IFSW definition and the person-in-environment lens, treating the framework as an analytic grid rather than a hypothesis test.

Results and Discussion

Results

Drawing exclusively on secondary sources, three findings stand out. First, the Tamil Nadu expert-committee brief notes pilots at Royapettah and Periyar Nagar hospitals that target "early detection of cancer and tuberculosis with AI," explicitly keeping clinicians in the decision loop—an architectural guard against automation bias. Second, the 2022 scoping review of 133 studies reports that 43 % highlight AI's potential to shrink oncology disparities—especially in low-resource settings—while a comparable share flag biased algorithms as a threat to equity; a third theme is AI's ability to uncover biological and social determinants of health. Third, Northwell's iNav evaluation provides concrete numbers: median biopsy-to-diagnosis days fell from 39 to 14, and time to treatment shortened from 98 to 64 days, with benefits spread across racial/ethnic groups, indicating equity-oriented roll-outs can work in practice.

Discussion

These data converge on a social-work-ready insight: technical gains only translate into justice when mediated by assessment, advocacy, and ethics. Tamil Nadu's "clinician-in-the-loop" model is promising but incomplete—frontline social workers hear the patient narratives AI misses, such as husbands controlling phones or transport cash diverted to daily wages. The scoping review's bias warnings resonate here; without Dalit and Adivasi cases in training sets, AI will replicate referral gaps. iNav's equity-positive outcome suggests that diverse testing panels help, a step Tamil Nadu's committee could imitate by including PHC social workers and rural women's collectives in its pilot audits. Finally, AI's power to map social determinants (review theme 3) meets social work's advocacy role: workers can convert an AI flag about a high-risk betel-quid cluster into a petition for mobile biopsy vans and culturally safe counselling. Policy-wise, the state should mandate participatory bias audits, fund "tech-mediator" posts in rural PHCs, and require Tamil-language consent scripts that spell out data use—closing the gap between algorithmic alert and lived assistance.

Conclusion

The review, state policy note, and iNav trial together show that AI's value in cancer care hinges less on code than on who sits at the design table and who follows up when the alert flashes. Tamil Nadu's decision to pilot cancer-detection AI in government hospitals while keeping clinicians in the loop is an essential first safeguard, yet the evidence warns that bias in training data and gaps in digital access can quietly reproduce the same exclusion Dalit and Adivasi patients already face. Social work's role—assessment of missing voices, advocacy for data justice, and relational stewardship—fills that gap. By insisting on participatory bias audits, funding tech-mediator posts in PHCs, and measuring outcomes in trust and dignity, not just days-to-diagnosis, Tamil Nadu can turn iNav's equity-positive example into routine practice. The profession's ethical charge—to work alongside people, not upon them—remains the compass; AI is only as just as the hands that steer it.

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AI-POWERED INSIGHTS: THE FUTURE OF COMPETITIVE MARKET ANALYSIS

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Abstract

Artificial intelligence is fundamentally transforming the discipline of competitive market analysis. This paper examines the current landscape of AI-powered market research tools, compares them against traditional methodologies, assesses industry-specific adoption patterns, and identifies emerging challenges and future directions. Drawing on market data from 2022–2025 and case studies across six industries, we demonstrate that AI adoption in marketing research delivers measurable gains in speed, cost-efficiency, and analytical depth. We conclude with a forward-looking framework for organizations seeking to integrate AI into their competitive intelligence strategies

Keywords: Artificial Intelligence; Competitive Market Analysis; Machine Learning; Natural Language Processing; Market Research; Predictive Analytics; Generative AI; Consumer Insight; Marketing Intelligence; Digital Transformation

1. Introduction

The modern competitive landscape demands intelligence that is faster, deeper, and more granular than traditional market research methods can supply. Advances in artificial intelligence particularly machine learning, natural language processing, and generative AI have opened new frontiers in how organizations gather, analyze, and act on market intelligence.

As recently as 2020, fewer than 30% of Fortune 500 companies reported systematic use of AI in their market research workflows. By 2024, that figure exceeded 71%, driven by the democratization of cloud-based AI platforms and the explosion of available consumer data. This paper examines that transformation in depth.

The central questions guiding this research are: (1) What AI technologies are most impactful in competitive market analysis? (2) How do AI methods compare with traditional approaches on key performance dimensions? (3) What barriers impede adoption, and how can they be overcome? (4) What does the near-term future of AI-driven market research look like?

2. AI Technologies in Market Research

2.1 Taxonomy of AI Applications

The application of AI in market research spans a broad spectrum of technologies, from rule-based expert systems to advanced generative models. Table 1 provides a structured overview of the primary AI technologies currently in use, their core applications, and leading platform providers.

Table 1: AI Technologies and Their Applications in Market Research

AI Technology	Core Application in Market Research	Key Vendors / Platforms
Machine Learning	Predictive consumer modeling, churn analysis, demand forecasting	Google Auto ML, Data Robot, H2O.ai
Natural Language Processing (NLP)	Sentiment analysis, social listening, survey text coding	Open AI, IBM Watson, AWS Comprehend
Computer Vision	Shelf analytics, ad recall testing,	Microsoft Azure Vision, Affective

	emotion detection	
Generative AI (LLMs)	Synthetic persona creation, automated report drafting	ChatGPT-4, Claude, Gemini
Reinforcement Learning	Dynamic pricing research, A/B optimization at scale	DeepMind, Any scale, Meta RL

2.2 Natural Language Processing as a Core Capability

Among all AI technologies, NLP has had the most transformative impact on primary research. The ability to analyze millions of consumer reviews, social media posts, forum discussions, and open-ended survey responses at scale — and in real time — provides a competitive intelligence layer that was previously inaccessible. Sentiment scoring, entity extraction, and topic modeling can now be conducted automatically across streaming data feeds.

Generative AI models have further extended this capability. Large language models (LLMs) such as GPT-4 and Claude can synthesize findings from unstructured data, generate draft reports, and even simulate consumer responses to hypothetical product concepts — enabling a new category of 'synthetic research' that complements traditional survey-based approaches.

3. AI vs. Traditional Methods: A Comparative Analysis

Understanding where AI-powered research excels — and where traditional methods retain advantages — is critical for designing effective hybrid research strategies. Table 2 provides a head-to-head comparison across seven key performance dimensions.

Table 2: Comparative Analysis — Traditional vs. AI-Powered Market Research Methods

Dimension	Traditional Methods	AI-Powered Methods
Data Volume	Limited (hundreds to thousands)	Massive (millions of data points)
Speed to Insight	4–12 weeks	Hours to days
Cost per Study	\$15,000–\$100,000+	\$1,000–\$20,000
Real-time Analysis	Not available	Continuous streaming
Bias Risk	Interviewer / recall bias	Algorithmic / training data bias
Depth of Insight	High (qualitative nuance)	Moderate-High (pattern-based)
Scalability	Low	Very High

The data reveal a clear pattern: AI methods outperform on dimensions of scale, speed, and cost, while traditional methods retain advantages in depth of qualitative understanding and nuanced emotional insight. Best-in-class research programs in 2025 are therefore hybrid in nature, deploying AI for large-scale quantitative insight generation and reserving human-led qualitative research for interpretation, strategy development, and stakeholder communication.

4. Industry Adoption Patterns

4.1 Sector-Level Analysis

AI adoption in market research is uneven across industries, driven by differences in data availability, regulatory constraints, competitive intensity, and organizational digital maturity. Table 3 presents adoption rates, reported ROI, and maturity levels across six key industry sectors as of 2024.

Table 3: AI Adoption in Market Research by Industry Sector (2024)

Industry	Primary AI Use Case	Adoption Rate (2024)	ROI Reported	Maturity Level
Retail & E-commerce	Demand forecasting, personalization	78%	3.2x	Advanced
Financial Services	Risk profiling, sentiment monitoring	74%	4.1x	Advanced
Healthcare & Pharma	Patient journey, competitor drug analysis	61%	2.8x	Intermediate
Consumer Goods (FMCG)	Brand tracking, shelf analytics	69%	2.5x	Intermediate
Technology & SaaS	Competitive benchmarking, NPS analysis	85%	5.0x	Leading
Automotive	Voice-of-customer, feature analysis	55%	2.2x	Emerging

4.2 Technology and Retail as Adoption Leaders

The technology and SaaS sector leads all industries in AI research adoption, with 85% penetration and the highest reported ROI of 5.0x. This is consistent with the sector's inherent data richness, digital-native culture, and the intensity of competitive benchmarking required in fast-moving software markets. Competitive intelligence tools powered by AI allow technology companies to track competitor feature releases, pricing changes, and customer satisfaction shifts in near real time.

The retail and e-commerce sector, with 78% adoption, benefits most from demand forecasting and hyper-personalization applications. AI-powered research has enabled leading retailers to reduce inventory costs by 12–18% while simultaneously improving customer lifetime value through better product recommendation accuracy.

5. Challenges and Barriers to Adoption

Despite compelling evidence of ROI, significant barriers impede broader adoption of AI-powered market research. These challenges span technical, organizational, ethical, and regulatory dimensions. Table 4 maps key challenges to their impact on research quality and recommended mitigation strategies.

Table 4: Key Challenges in AI-Powered Market Research and Mitigation Strategies

Challenge	Impact on Research Quality	Recommended Mitigation
Data Privacy & GDPR	Legal exposure; limits data collection scope	Privacy-by-design; federated learning; consent frameworks
Algorithmic Bias	Skewed segmentation; underrepresented groups	Diverse training sets; regular bias audits; human review
Interpretability (Black Box)	Difficult to justify decisions to stakeholders	Explainable AI (XAI) tools; SHAP/LIME frameworks

Data Quality	Garbage-in-garbage-out; unreliable outputs	Data governance pipelines; validation layers; cleansing protocols
Talent Gap	Slow implementation; misuse of AI tools	Upskilling programs; AI-fluency training for researchers

5.1 The Bias Problem

Algorithmic bias represents perhaps the most consequential challenge in AI-powered market research. When training data systematically underrepresents certain demographic segments — as is common with historical purchasing and behavioral datasets — AI models inherit and amplify these biases. The result is market segmentation and consumer profiling that is systematically inaccurate for underrepresented groups.

Leading research organizations are responding by implementing pre-training bias audits, incorporating fairness constraints into model training pipelines, and establishing human oversight protocols for outputs that will inform major strategic decisions. Regulatory pressure, particularly from the EU's AI Act, is accelerating the adoption of these practices.

6. Future Outlook

6.1 Emerging Trends and Projected Impact

The evolution of AI in competitive market analysis is accelerating. Five key trends are poised to reshape the discipline by 2028. Table 5 describes these trends, their underlying mechanisms, and their projected impact.

Table 5: Emerging AI Trends in Market Research — Projected Impact by 2028

Trend	Description	Projected Impact by 2028
Synthetic Respondents	AI-generated personas trained on real behavioral data	Reduce survey costs by 60–80%
Multimodal Analysis	Combining text, audio, video signals for richer insight	30% improvement in customer emotion mapping accuracy
Real-Time Competitive Intel	Continuous automated monitoring of competitor pricing, messaging	Near-instant strategic response capability
Autonomous Research Agents	LLM agents that design, execute, and report studies independently	End-to-end research automation for 40% of standard studies
Hyper-Personalized Insights	Individual-level modeling replacing segment-based research	Segment-of-one marketing enabled at scale

6.2 The Rise of Autonomous Research Agents

Of the trends identified, autonomous AI research agents represent the most paradigm-shifting development. Powered by LLMs with tool-use capabilities, these agents can independently formulate research questions, design data collection strategies, execute analytical workflows, and produce structured reports — with minimal human intervention. Early deployments suggest that 40% of standard quantitative research studies could be fully automated by 2028, freeing human researchers to focus on interpretation, strategy, and stakeholder engagement.

However, the proliferation of synthetic and automated research raises important epistemological questions about the validity and representativeness of findings. Robust quality assurance frameworks — combining algorithmic validation with expert human review — will be essential to maintaining the integrity of AI-generated market intelligence.

7. Conclusions and Strategic Recommendations

This paper has demonstrated that AI-powered tools are transforming competitive market analysis across five key dimensions: speed, scale, cost-efficiency, real-time capability, and analytical depth. Industry adoption is accelerating across all sectors, with technology, financial services, and retail leading the transition.

For organizations seeking to capture competitive advantage through AI-enhanced market research, we offer four strategic recommendations:

1. Invest in a hybrid research architecture that combines AI-driven quantitative intelligence with human-led qualitative insight for full-spectrum competitive understanding.
2. Prioritize data governance and bias mitigation from day one to ensure the quality and fairness of AI-generated insights.
3. Build AI fluency across the research function — not only among data scientists but among business analysts, strategists, and decision-makers who consume research outputs.
4. Prepare for the autonomous research agent paradigm by designing workflows, governance structures, and quality assurance protocols suited to AI-generated research deliverables.

Organizations that act on these recommendations today will be positioned to outperform competitors in market responsiveness, strategic agility, and customer understanding as the AI-powered market research landscape matures.

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STUDY ON STRESS MANAGEMENT OF EMPLOYEES IN LOTTE INDIA CORPORATION, NELLIKUPPAM

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Abstract

Stress is the general term applied to the pressure; people feel in life. The presence of stress at work is almost inevitable in most of jobs. However individual differences accounts for a wide range of reaction to stress. A task viewed as challenging by one person may produce high levels of anxiety in another. When person's emotions, employees develop various symptoms of stress that can harm their job performance and health, and even threaten their ability to cope with the environment. Stress also leads to physical disorder, because the internal body system changes to try to cope with stress. Stress leads to family problems. When Stress over prolonged it also leads to degenerative diseases of heart, kidney, blood pressure and parts of body.

Introduction

Stress refers to the thoughts and actions we use to deal with a threatening situation. A stressful situation may be considered a threat for you but not necessarily for your neighbor. You and your neighbor may become stressed by the same situation, but for different reasons (e.g. the situation is new for you, but unpredictable for your neighbor). After all, since we all become stressed for various reasons, we will need to choose different stress strategies. As you will see, there are many strategies and some are better than others.

Negative Personal Stressors Include

Positive stressors (called eustress) may include an upcoming wedding, the holidays, or pregnancy. On the other hand, negative stress (called distress) results in the full-blown stress response. If continuous, negative stress can lead to loss of productivity, health problems, and exhaustion

Positive Personal Stressors Include

Positive stress or eustress is when you perceive a stressful situation as an opportunity that will lead to a good outcome. Also called "good stress," this positive expectation is in contrast to negative stress or distress, which occurs when you perceive a stressor as a threat that will have a poor outcome.

People are sometimes surprised to learn that not all stress is bad for you. In fact, some stress is good for you. The concepts of eustress and distress have long been used to distinguish a positive versus a negative response to stress. The way a person responds to a stressful situation determines if they will experience eustress or distress.

Review of Literature

Reddy et al. (2018) in their study concludes that stream wise difference in stress does exist in students. It is important to deal with stress at personal, social and institutional level. Remedies such as feedback, yoga, life skills training, mindfulness, meditation and psychotherapy have been found useful to deal with stress.

Dimitrov (2017) in his study claimed that stress can be addressed by ensuring that the students give utmost importance to their welfare. Food, exercise, work, recreation are some of the areas to focus on. He also concluded that the education system is more to do with the academic qualifications and does not contribute enough to the holistic development of students. Students are usually conditioned in a way that makes them fearful to take up upcoming challenges as the focus is only the academics and not the development of a go getter mentally.

Subramani and Kadiravan (2017) revealed the link between academic stress and mental health among students. He endorsed that academic stress and mental health are correlated and that students are cramped with the academic structure. Parents and schools pressurize the student's way too much for the higher grades that disheartens the

students, further to add on there is not enough support from the parents and school in terms of guidance. The students are mentally healthy when they perform constructively in the academic forums. They also propounded that students from private schools are more pressurized as compared to students from government schools due to the excess of homework and other academic related assignments.

Sharma et al. (2016) in their study stated the use of various methods to curb stress. Doing one physical exercise on daily basis can address the concern of stress. One can also adopt to various time management tools and get involved with leisure activities which can benefit students. Also, it was suggested that colleges should have a conducive ambience to curtail the stress.

Prabu (2015) researched on the higher secondary students and implied that male students are more stressed than the female students. Urban student's academic stress is greater than the rural students. Government school student's stress is lower than the private school student's stress. Students from Science stream are more stressed than the students from Arts.

Deb et al. (2014), studied on 400 male students from five private secondary schools in Kolkata who were studying in grades 10 and 12. 35 percent students were found to have high academic stress and 37 percent were found to have high anxiety levels. Students with marginal grades were said to have higher level of stress as compared to students with better grades. Also, students involved with extra-curricular activities were noted to be more stressed as related to those students who were not involved with it.

Kaur (2014) acknowledged that mental health of teenagers get affected due to the academic stress. Girls with academic stress were found to have poor mental health as compared to the boys. This was accounted on the study that parents at times put pressure and strain on students that leads to deteriorated mental health. Bataineh (2013) in his study measured the academic stressors experienced by students at university. The result of the analyses showed that there is an unreasonable academic overload, not enough time to study due to the vast course content being covered, high family expectations and low motivation levels are some of the reasons for the stress. Fear of failure is also the prime reason for stress. There was no significant difference found amongst the students from different of specializations. Khan and Kausar (2013) concluded that stress definitely impacts the academic performance in a negative way though no significant difference was found as per the gender. The difference was evident between junior and senior students. Stress, for sure, affects the ability to study efficiently and managing the time. Studying regularly is important, this helps reduce the academic pressure and helps them fulfill their goals.

Busari (2012) found that stress was leading to depression among secondary school students and is linked with affect on academic achievement. Introduction to preventive measures, teaching life skills and other therapeutic techniques should be taken in to serious consideration.

Nandamuri and Gowthami (2011) studied the stress among students of Professionals studies and claimed that curriculum and instructions parameters were most responsible for stress with 86 percent, followed by 63 percent for placement related issues, assessment and team work issues accounted for 41 percent and 24 percent respectively. The study further identified various micro issues responsible for stress, and listed twelve sub issues related to curriculum and instruction. Once the sub issues of each parameter are identified, it provided improved vision to the academic administrators for initiating efforts to reduce the gravity of academic stress.

Agolla (2009) stress has become an important topic in academic circles. Many philosophers have carried out considerable research on stress and concluded that this topic needs way more attention. Radcliff and Lester (2003) studied the anticipated stress among final year undergraduate students and acknowledged that class assignments, not enough guidance, pressure to mingle and to get associated were the reasons for the stress to build up. McKean et al. (2000) argue that undergraduate students experience higher stress at expected times in each semester. Academic engagements, financial pressures and lack of time management skills lead to building up of stress.

Research Methodology

Research, according to Redman and Mory is as a "Systematized effort to gain new Knowledge".

In the words of Slesinger and Stephenson, "research is, the manipulation of things, concept or symbols for the purpose of generalizing to extend, correct or verify knowledge whether that knowledge aids in construction of a theory or in the practice of an art".

The search for knowledge through objective and systematic method of finding a proper and feasible solution to a problem is popularly known as research.

In this chapter, the methodology followed in conducting the research has been described. Details regarding the research design, data collection, questionnaire, sampling plan, area of the study and statistical tools used have also been given. Finally, the Limitations of the study have also been briefed.

In any study the methodology adopted is very important because the very success of the study and the accuracy of the results depends upon the methodology adopted. The methodology includes various steps and they are outlined below.

Research Design

Research design is purely and simply the framework or plan for a study that guides the collection and analysis of the data. The research design indicates the methods of research i.e., the method of gathering information and the method of sampling. Descriptive research refers to the methods that describe the characteristics of the variables under study. This methodology focuses on answering questions relating to the “what” than the “why” of the research subject. The primary focus of this research is to simply describe the nature of the demographics understudy instead of focusing on the “why”. It is called an observational research method as none of the variables in the study are influenced during the research process.

“A research design is the arrangement of the conditions for collection and analysis of data in a manner that aims to combine relevance to the research purpose with economy in procedure”

Research design is purely and simply the framework or plan for a study that guides the collection and analysis of the data. The research design indicates the methods of research the method of gathering information and the method of sampling.

The design decisions happen to be in respect of:

1. What is the study about.
2. Why is the study being made.
3. Where will the study be carried out.
4. What type of data required.
5. Where can the required data be found.
6. What period of time will the study include.
7. What will be the sample design.
8. What techniques of data collection will be used.
9. How will the data be analyzed.
10. In what style will the report be prepared.

Objectives of the Study

1. To identify the sources of stress among the employees.
2. To study the interrelatedness of the employees Stress and personal variables.
3. To study the level of stress among the employees in Lotte Corporation.

Hypotheses of the Study

1. Respondents differ in their opinion about physical indicators on the basis of their demographic variables.

2. There is no significant difference between in their opinion about sleep indicators on the basis of their demographic variables.
3. Respondents differ in their opinion about behavioral indicators on the basis of their socio-economic variables.
4. Respondents differ in their opinion about emotional indicators on the basis of their demographic variables.
5. There is no significant difference in level of stress based on social demographic factors such as gender, age, qualification, marital status, salary, experience, total no.of dependents in the family, nature of employment, name of the department, designation, distance travel from work place to home, mode of transport using for travel form home to work group.

Data Collection

Primary data were collected by conducting direct interview using questionnaire. All the respondents were asked the same questions in the same fashion and they were informed the purpose of study.

Research Instrument

The data were collected by using questionnaire as an instrument.

About the Questionnaire

The data required for the study was collected through a questionnaire.

In order to systematically collect the primary data, the questionnaire is used. A questionnaire is a schedule consisting of a number of coherent questions related to the assorted aspects of the topic under this study. Therefore, the data required for the study was collected through a questionnaire.

The Data collected through such filled-in questionnaire have been used for further analysis.

Sampling Plan

Sampling plan is to be decided about the sampling unit, sample size, sampling Method.

Sampling Method

For this study the samples were drawn using random sample method. Random sampling or probability sampling is based on the theory of probability. This implies that the sampling items are independent.

Sample Size

Sample size of the study that are selected from the sampling unit. Total estimated sample size is 100 employees.

Statistical Tools Applied

The following tools and techniques have been used for the analysis of the data.

- i. Chi-square and test t-test
- ii. One-Way ANOVA

Descriptions of Statistical Tools

Tests of Significance

A very important aspect of the sampling theory is the study of tests of significance which enable us to decide on the basis of the sample result if:

1. The deviation between the observed sample satisfaction and the hypothetical parameter value is significant.
2. The deviation between two sample statistics is significant.

One-way ANOVA

The One-Way ANOVA procedure produces a one-way analysis of variance for a quantitative dependent variable by a single factor (independent) variable. Analysis of variance is used to test the hypothesis that several means are equal. This technique is an extension of the two-sample test.

In addition to determining that differences exist among the means, you may want to know which means differ. There are two types of tests for comparing means: a priori contrasts and post hoc tests. Contrasts are tests set up before running the experiment, and post hoc tests are run after the experiment has been conducted. You can also test for trends across categories.

Independent-samples t – Test

The Independent-Samples t – Test procedure compares means for two groups of cases. Ideally, for this test, the subjects should be randomly assigned to two groups, so that any difference in response is due to the treatment (or lack of treatment) and not to other factors. This is not the case if you compare average income for males and females. A person is not randomly assigned to be a male or female. In such situations, you should ensure that differences in other factors are not masking or enhancing a significant difference in means. Differences in average income may be influenced by factors such as education and not by sex alone.

Analysis of the Data

The data collected through questionnaires have been tabulated. By using the above-mentioned statistical tools, the data have been analysed. Interpretations have been drawn based on the analysis. The findings and observations are the result and outcome of the interpretations made during the course of analysis.

Presentation of the Report

Tables and figures have been used wherever necessary to facilitate the analysis and interpretation. Explanations for the tables were given for the tables wherever necessary.

Limitations of the Study

Though the research has been properly planned and well executed, there are certain limitations, which are inherent in nature and are out of the researcher’s control. The effectiveness of the project is felt only when the results are read along with the limitations and constraints faced during the course of this study. The following are the limitations.

1. The responses from the respondents could be casual in nature. This may be due to lack of interest or time on their part.
2. The correctness of information provided by the respondents in the personal data could not be established.
3. Some of the information provided by the respondents might not be correct.
4. Getting timely responses from the respondents was a difficult task.
5. The reason for this may be attributed to their busy schedules.

Data Analysis and Interpretation

Table 1 T-test (Independent sample T-test) Showing Mean, S.D. And t-value for respondents level of physical, sleeping, behavioural, emotional indicators and personal habits on the basis of gender

Variable	Gender	N	Mean	Std. Deviation	Std. Error Mean	t-value	P-value
Physical	Male	63	16.62	3.22	0.17	1.03	0.30 NS
	Female	37	16.36	3.12	0.17		
Sleeping	Male	63	16.34	2.79	0.15	8.06	0.001 S
	Female	37	14.47	3.19	0.17		

Behavioural	Male	63	30.93	4.80	0.26	7.65	0.001 S
	Female	37	27.96	5.24	0.28		
Emotional	Male	63	15.67	3.26	0.17	3.71	0.001 S
	Female	37	14.83	2.54	0.14		
Personal habit	Male	63	16.95	3.40	0.63	3.10	0.01 S
	Female	37	14.23	2.86	0.42		
Personal techniques	Male	63	30.92	2.80	0.22	3.64	0.001 S
	Female	37	27.94	2.22	0.22		
Organization techniques	Male	63	30.91	2.82	0.24	3.70	0.001 S
	Female	37	27.92	2.22	0.22		
Overall Stress Management	Male	63	28.86	2.84	0.77	1.56	0.001 S
	Female	37	26.94	2.41	0.62		

NS - Not Significant

S – Significant

Source: Primary Data Computed

The above table exhibits the mean, S.D and t-value for respondents level of physical P-value 30, sleeping P-value 0.001 S, behavioral P-value 0.001 S, emotional indicators P-value 0.001 S and personal habits P-value 0.01 S on the basis of gender. It is observed from the result in sleeping, behavioral, emotional indicators personal habits personal techniques P-value 0.001 S and organization techniques 0.001 S on the basis of gender there is a significant difference between male and female respondents. Also in physical indicators there is no significant difference between male and female respondents. Therefore it is concluded that in all scored variables male respondents have higher mean value than female respondents.

Table 2 Showing Mean, S.D. And t-value for respondents level of physical, sleeping, behavioural, emotional indicators and personal habits on the basis of marital status

Variable	Marital status	N	Mean	Std. Deviation	Std. Error Mean	t-value	P-value
Physical	Married	13	18.22	2.41	0.19	8.31	0.001 S
	Unmarried	87	15.95	3.19	0.14		
Sleeping	Married	13	12.98	3.01	0.23	12.58	0.001 S
	Unmarried	87	16.19	2.76	0.12		
Behavioural	Married	13	25.23	4.30	0.34	13.18	0.001 S
	Unmarried	87	30.80	4.77	0.21		
Emotional	Married	13	15.41	2.62	0.20	0.755	0.45 NS
	Unmarried	87	15.21	3.06	0.13		
Personal habit	Married	13	16.72	3.48	0.186	2.01	0.05 S
	Unmarried	87	16.25	2.79	0.156		
Personal techniques	Male	63	15.23	4.30	0.34	7.64	0.001 S
	Female	37	15.80	4.77	0.21		
Organization techniques	Male	63	14.41	2.62	0.20	3.70	0.001 S
	Female	37	14.21	3.06	0.13		
Overall Stress Management	Male	63	13.41	2.84	0.93	7.09	0.001 S
	Female	37	13.21	2.41	0.95		

NS - Not Significant

S – Significant

Source: Primary Data Computed

The above table exhibits the mean, S.D and t-value for respondents level of physical P-value 0.001 S, sleeping P-value 0.001 S, behavioural P-value 0.001 S, emotional indicators P-value 0.45 NS P-value 0.05 S personal habits on the basis of gender. It is observed from the result in sleeping, behavioural, emotional indicators personal habits P-value 0.001 S personal techniques and P-value 0.001 S organization technique on the basis of marital status there is a significant difference between married and unmarried respondents. Also in emotional indicators there is no significant difference between married and unmarried respondents.

Findings

The present study on employees stress management in the organization has brought into light certain interesting findings regarding the level of stress management.

1. Result shows that respondents differ in their opinion about physical indicators on the basis of their age
2. Result inferred that respondents differ in their opinion about sleep indicators on the basis of their age.
3. Result shows that respondents differ in their opinion about behavioural indicators on the basis of their age.
4. Result exhibits that respondents differ in their opinion about emotional indicators on the basis of their age.
5. Result shows that respondents differ in their opinion about life event stressors on the basis of their age.
6. Result shows that respondents differ in their opinion about personal habits on the basis of their age.
7. Result inferred that respondents differ in their opinion about physical indicators on the basis of their annual income.
8. Result inferred that respondents differ in their opinion about sleep indicators on the basis of their annual income.
9. Result shows that respondents differ in their opinion about behavioural indicators on the basis of their annual income.
10. Result shows that respondents differ in their opinion about emotional indicators on the basis of their annual income.
11. Result inferred that respondents differ in their opinion about life event stressors on the basis of their annual income.
12. Result shows that respondents differ in their opinion about personal habits on the basis of their annual income.
13. Result inferred that respondents differ in their opinion about physical indicators on the basis of their educational qualifications.
14. Result shows that respondents differ in their opinion about sleep indicators on the basis of their educational qualifications.
15. Result exhibits that respondents differ in their opinion about behavioural indicators on the basis of their educational qualifications.
16. Result shows that respondents differ in their opinion about emotional indicators on the basis of their educational qualifications.
17. Result shows that respondents differ in their opinion about life event stressors on the basis of their educational qualifications.
18. Result shows that there is an association between employees opinion about the physical indicators on the basis of age.
19. Result inferred that there is an association between employees opinion about the physical indicators on the basis of marital status.
20. Result inferred that there is an association between employees opinion about the emotional indicators on the basis of age.

21. Result shows that there is an association between employees opinion about the emotional indicators on the basis of marital status.

Suggestions

1. Employees can manage their stress well by adopting regular practice of spiritual methods such as yoga, meditation etc.
2. Employees must invest in their health. Good nutritional personal habits such as balanced diet, and checking of overweight will certainly yield a stress-free life.
3. Employees must try to focus on their accomplishment rather than on your short-comings. By discarding the negative beliefs and should have positive thinking.
4. Employees can reduce their tension by becoming more organized both at work and family. They shall adopt methods for keeping track of commitments, due dates and events.

Conclusion

Management is not an end in itself. It is an organ of the business enterprise. And it consists of individual. The first requirement for a successful employee is effective stress Management, since it is not possible to avoid the factors leading to stress and also the emotions are ruling our health, the best way to combat stress is to relax. Take the foot off the accelerator and drift a bit. Ironically many go through the phase of stress unaware of the existence or accepting it as a part of the life and are in the process of seeking a way out. What we live with we learn we practice, and what we practice we become, and what we become has consequences. And almost always when we become has little to do with what we were meant to be". An employee has also to learn to face stress and prepare himself through of mind and positive thinking. Therefore, stress management training programmes are needed for Employees to help them either to reduce or cope up with situations, so that they can become more effective persons.

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ARTIFICIAL INTELLIGENCE IN HUMAN RESOURCE MANAGEMENT: ENHANCING EMPLOYEE ENGAGEMENT AND EXPERIENCE IN MAYILADUTHURAI DISTRICT

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Abstract

Artificial Intelligence (AI) is transforming human resource practices across organizations by enhancing employee engagement and improving overall employee experience. AI-driven tools such as chatbots, predictive analytics, and personalized learning systems enable organizations to create efficient and responsive workplaces. This paper conceptually examines the role of AI in strengthening employee engagement and experience within semi-urban organizational contexts. The discussion focuses on theoretical foundations, practical implications, and challenges in district-level institutions. The paper concludes that AI adoption, when implemented ethically and strategically, can significantly improve organizational performance and employee well-being.

Keywords: Artificial Intelligence, Employee Engagement, Employee Experience, Digital HRM, Organizational Development

Introduction

Digital transformation has become central to organizational growth. Artificial Intelligence is no longer confined to technology firms but is increasingly integrated into HR practices. Employee engagement reflects commitment and emotional attachment to work, while employee experience encompasses the holistic journey of employees within an organization.

Semi-urban districts are gradually adopting digital tools to modernize management systems. AI-powered HR practices can enhance transparency, efficiency, and employee satisfaction.

Objectives

- To explore the conceptual foundation of AI in HRM.
- To examine the influence of AI practices on employee engagement.
- To analyze the role of AI in shaping employee experience.
- To discuss opportunities and challenges in semi-urban implementation.

Review of Literature

Employee engagement and experience have long been central themes in human resource research. With the advent of digital technologies, scholars have increasingly examined the role of Artificial Intelligence (AI) in reshaping HR practices.

Kahn (1990) foundationally defined employee engagement as the psychological presence an individual brings to their work role. His work highlighted that engagement is influenced by meaningful work, safety, and availability, laying the theoretical foundation for later empirical studies. Saks (2006) extended this perspective, identifying antecedents and consequences of employee engagement, including organizational support, job characteristics, and personal resources.

Schaufeli et al. (2002) developed an engagement scale that emphasized vigor, dedication, and absorption as key dimensions. Their work provided measurement tools that have since been widely applied in organizational research. Guest (2014) critically examined engagement constructs, noting the need to differentiate engagement from related concepts such as job satisfaction and organizational commitment.

With the rapid integration of digital technologies, research on AI's impact on HR functions has grown substantially. Tambe, Cappelli, and Yakubovich (2019) argued that AI-driven HR analytics reshapes talent management by enabling predictive decision-making. Their study identified AI applications in recruitment, performance management, and retention strategies as critical drivers of strategic HR transformation.

Stone, Lukaszewski, and Isenhour (2015) examined the influence of technology on HRM practices, noting that AI systems automate routine tasks and free HR professionals to focus on strategic activities. Their review emphasized the shift from transactional to transformational HR enabled by digital tools. Similarly, Bondar Ouk and Brewster (2016) conceptualized the future of HRM in the context of emerging technologies, suggesting that AI and related digital systems will redefine HR roles and employee experiences.

Marler and Boudreau (2017) conducted an evidence-based review of HR analytics, underscoring the potential of data analytics and AI algorithms to predict workforce patterns and inform human capital decisions. Their findings highlighted that organizations with advanced analytics capabilities tend to have higher levels of employee engagement and retention.

From a technology adoption perspective, Davis's (1989) Technology Acceptance Model (TAM) has been widely cited to explain employees' willingness to adopt new HR technologies, suggesting that perceived usefulness and ease of use significantly influence acceptance behaviours. This model has been applied in several contemporary studies examining digital HR systems in workplace contexts.

Vial (2019) provided a comprehensive review of digital transformation literature, emphasizing that AI adoption is more than technological change—it represents a shift in organizational culture, processes, and strategic intent. Her research supports the notion that effective digitalization in HR requires alignment with broader organizational goals and employee-centric practices.

Jarrahi (2018) analysed the implications of AI in future work environments, suggesting that human–AI collaboration will shape task allocation and decision-making processes. According to this view, AI enhances human potential rather than replacing it, offering opportunities for richer employee experiences and more engaging workplace roles.

Despite extensive research in urban workplace contexts, few studies have focused on semi-urban or district-level organizational environments. Specifically, research exploring AI-driven engagement and experience in semi-urban districts like Mayiladuthurai is limited. This gap suggests the need for conceptual frameworks that contextualize technological adoption in emerging regions with unique cultural, infrastructural, and organizational characteristics.

Conceptual Background

AI in HRM

AI supports HR through automation, analytics, and personalization. Applications include intelligent communication systems, workforce analytics, performance monitoring, and digital learning platforms.

Traditionally, HR departments focused on recruitment, payroll, compliance, and employee relations. With AI integration, HR evolves into a strategic partner in organizational development. AI systems analyse large volumes of employee data to generate actionable insights related to engagement, retention, productivity, and workforce planning.

AI enhances HR in the following ways:

- Automating repetitive administrative tasks
- Enabling predictive workforce analytics
- Improving talent acquisition accuracy
- Supporting continuous performance management
- Enhancing employee communication systems
- Thus, AI transforms HR from operational support to strategic intelligence.

Employee Engagement Theory

Engagement theory emphasizes psychological meaningfulness and organizational support. AI contributes by reducing repetitive workload and enhancing recognition systems.

Technology Acceptance Perspective

Technology adoption depends on perceived usefulness and ease of use. Training and digital literacy influence AI acceptance.

AI and Employee Engagement

AI improves engagement through:

- Real-time performance feedback
- Transparent evaluation systems
- Personalized development plans
- Data-driven recognition
- AI enables proactive management of employee satisfaction.

AI and Employee Experience

Employee experience includes recruitment, onboarding, career progression, and workplace culture. AI enhances these stages by improving communication, learning opportunities, and decision-making transparency.

Employee experience spans recruitment, onboarding, career development, performance management, and exit.

AI enhances experience through:

- ✓ Recruitment and Onboarding

Efficient screening and structured onboarding improve first impressions.

- ✓ Learning and Development

Personalized training increases motivation and skill enhancement.

- ✓ Performance Management

Continuous digital evaluation ensures transparency and fairness.

- ✓ Employee Well-being

Sentiment analysis tools help detect stress and dissatisfaction.

Benefits

- ❖ Improved productivity
- ❖ Enhanced communication efficiency
- ❖ Personalized employee growth
- ❖ Reduced administrative burden
- ❖ Strategic workforce planning

Challenges

- Limited digital infrastructure
- Skill gaps
- Resistance to change
- Data privacy concerns
- Financial constraints

Managerial Implications

Organizations should adopt phased implementation, invest in digital training, and ensure ethical AI usage. Leadership commitment is essential for successful integration.

Managers should:

- ❖ Adopt phased AI implementation
- ❖ Provide digital training programs
- ❖ Ensure transparency in AI usage
- ❖ Maintain human-centered leadership
- ❖ Establish ethical data governance policies

Conclusion

AI-powered employee engagement and experience represent a progressive transformation in HRM. In semi-urban regions such as Mayiladuthurai district, AI adoption offers opportunities to modernize HR practices while maintaining organizational values. Successful implementation depends on strategic planning, ethical governance, and employee acceptance. When properly integrated, AI can enhance productivity, satisfaction, and sustainable growth.

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THE IMPACT OF ARTIFICIAL INTELLIGENCE ON IMPROVING HUMAN RESOURCES COMPETENCIES IN THE KING HUSSEIN BUSINESS PARK

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Abstract

This study aims to assess the impact of artificial intelligence (AI) on human resource competencies in King Hussein Business Park (KHBP). The study population included senior and middle management managers in major companies within the park, with a total of 382 managers, and 269 questionnaires were analyzed. The results showed that there is a positive impact of AI on HR skills in KHBP, indicating the importance of using technology to improve work efficiency and human resource management.

Based on the results of the study that showed a positive impact of AI on HR meritocracy, the following recommendation can be made: Companies should invest in AI applications for HRM in a holistic and integrated manner, including the use of AI in recruitment and training processes, analyzing employee data, and improving the employee experience. Organizations should also ensure that investments are directed towards developing the skills and capabilities of employees to adapt to technological shifts and make the most of AI.

Keywords: Artificial Intelligence, Human Resources Competencies, The King Hussein Business Park.

Introduction

Artificial Intelligence (AI) is a field concerned with the development of systems and programs that have the ability to carry out tasks that require a high level of human intelligence, and AI has become an essential part of our daily lives, as it is used in a wide range of fields such as technology, medicine, marketing and others (Messeri & Crockett, 2024).

One of the most important aspects of AI is its impact on human resources, as AI is considered a transformative technology that may lead to radical changes in the labor market and in the nature of jobs that humans can do (Huang et al., 2024).

Understanding the impact of AI on HR skills is vital in today's era, as companies, organizations, and individuals must be aware of technological developments and how to use them positively to achieve success and prosperity (Giudici et al., 2024).

It is important to realize that AI does not necessarily mean replacing human workers, but can be a powerful partner that helps enhance work efficiency and improve performance. On the contrary, AI can help improve decision-making processes, guide strategies, and analyze data more accurately and quickly (Klauschen et al., 2024).

It is essential that human resources have the necessary skills and capabilities to adapt to and benefit from these transformations, so workers must develop their skills and learn new technologies to improve their performance and increase their value in the labor market (Elbadawi et al., 2024).

Thus, it can be said that AI represents both a challenge and an opportunity for human resources, and it is necessary to adopt positive attitudes towards this new technology and work on developing ourselves and our skills to achieve a balance between technology and humanity and continue to develop and progress (Kousha et al., 2024).

Moreover, AI can contribute to improving the employee experience and increasing job satisfaction, for example, AI can be used to analyze job performance data to provide accurate guidance to employees on how to improve their performance and develop their skills, and AI can be used to provide personalized and effective training to employees based on their individual needs (Islam, 2024).

In addition, AI can contribute to new and innovative job opportunities in areas such as software development, data analysis, and robotics. Thus, AI can encourage innovation and creativity in the labor market (Neumann et al., 2024).

In short, AI is an opportunity to improve the performance and efficiency of human resources, opening new horizons for development and progress. It is important to adopt a strategic approach to the integration of AI in the field of human resources and utilize its benefits positively to achieve the goals of companies and develop the skills and competencies of workers (Baydoun et al., 2024).

Studying the impact of AI on HR is an important topic in light of the rapid technological developments that many industries are witnessing. AI raises new challenges and opportunities for human resources in the modern work environment. The adoption of modern technology and AI can lead to structural shifts in the labor market and changes in skill requirements (Mia & Shuford, 2024).

Problem of the study

Previous studies provide mixed results on how artificial intelligence (AI) affects human resources (HR), with some studies suggesting that AI can improve HR efficiency and performance by improving decision-making processes and guiding strategies, while others suggest that AI may reduce the demand for human labor and increase unemployment in some sectors (Badrulhisham et al., 2014). Other studies suggest that AI may lead to reduced demand for human labor and increased unemployment in some sectors (Badrulhisham et al., 2024). In addition, there is a growing concern among workers about the impact of AI on employment opportunities and retention of human jobs, as the adoption of new technologies and AI may lead to structural shifts in the labor market and changes in skill requirements (Thangavel et al., 2024).

Given these challenges and tensions, a comprehensive study is needed to understand how AI affects human resource skills and how the integration of technology and humanity can be improved to achieve sustainable development in the labor market (Xiao et al., 2024).

Analyzing the impact of AI on HR talent requires a deep understanding of how technology integrates with human labor. The study should focus on how to optimize recruitment and selection processes using AI, as well as assess its impact on skill development and employee productivity. The study should also include exploring ways to enhance the integration of technology and humanity to achieve sustainable development in the labor market (Ueda et al., 2024).

Literature Review

The concept of artificial intelligence is related to the intelligence of electronic and digital devices such as computers, robots and cellular devices, as artificial intelligence refers to the ability of these digital devices to perform the tasks required of them, and there are many definitions of the concept of artificial intelligence, including what Jasmin (2023) referred to as systems that are characterized by their ability to perform human intellectual processes such as the ability to think, learn from previous experiences, and discover meaning.

Ouyang et al (2023) defined it as the preparation and design of intelligent systems capable of understanding their environment, with the ability to take learning actions and increase their chances of success.

Luciana et al (2023) explained it as the intelligence shown by programs and machines as in the case of human mental abilities and their ways of working, such as the ability to deduce, learn and react to new situations that have not been previously programmed into the program.

As for the concept of human resource skills, Risya (2023) described it as a number of characteristics that contribute to increasing the productivity of the performance of the human element and help the organization to achieve business strategies in the markets in a competitive manner.

Evangelista et al (2023) defined it as the set of knowledge, skills, practices and attitudes, which the employees of the organization possess, which aim to provide a competitive advantage for the organization, win customer satisfaction, and continuously work to achieve the future goals of the organization.

The relationship between AI and HR skills relates to the impact that AI technologies can have on the field of human resources in organizations. AI can help improve employee selection processes, analyze performance, and guide HR policies and strategies (Gomes & Ashley, 2023).

For example, AI techniques can be used to analyze big data to identify the traits and skills that make employees

successful at work, thereby improving selection and recruitment processes. AI can also be used to develop machine learning and self-training systems for employees, helping them improve their performance and develop their skills (Rao et al., 2023).

Overall, it can be said that AI can be a strong partner for the HR department in improving HR management and achieving the organization's goals better and more efficiently (Perifanis & Kitsios, 2023).

In addition, AI techniques can be used to analyze data to better understand the needs of employees and guide HR policies and strategies. For example, AI can be used to analyze data on employee performance, discipline, and job satisfaction, and based on this data, the right decisions can be made to improve the work environment and increase productivity (Bharadiya, 2023).

Thus, it can be said that AI can contribute to improving human resource management, enhancing employee performance, and increasing the overall efficiency of the organization. It is important that AI technologies are used responsibly and ethically, ensuring that they serve humanity and enhance the role of humans in the labor market rather than replacing them (Bharadiya, 2023).

In addition, AI can be used to develop robotics and automation systems to optimize production and manufacturing processes in companies. AI-enabled robots can help perform routine tasks faster and more accurately, minimizing human error and increasing production efficiency (Jain et al., 2023).

Furthermore, AI can be used in the development of customer relationship management (CRM) systems to improve customer experience and satisfaction. AI technologies can analyze customer data and guide companies towards providing personalized services and products that better meet customer needs (Kumar et al., 2023).

Due to the importance of artificial intelligence and its various applications, many studies have been conducted that dealt with the concept of artificial intelligence from different aspects, such as the study of Nishad et. al. (2024), whose results showed a positive impact of artificial intelligence applications on human resources, and Pawan et. al (2022), which found that artificial intelligence contributes to developing employees' skills, and identifying the basic skills that are necessary to refine their skills to carry out the required tasks. The study (2024) et al Talebi, which found that there is a statistically significant relationship between the two variables of human resource efficiency and organizational excellence. Suniar (2023), whose results showed that HR competencies in improving employee performance were good but still not optimal, because employees are highly focused on the goals of specific tasks, without balancing them to develop their capabilities.

Based on the above, the study proposes the following hypothesis :

First hypothesis: There is no statistically significant effect of AI with its dimensions (digital applications, knowledge representation, and automatic learning) on human resource competencies at King Hussein Business Park.

Conceptual Model

Based on the previous literature support and hypothesis development, following hypothesis has been developed as shown in Figure 1.

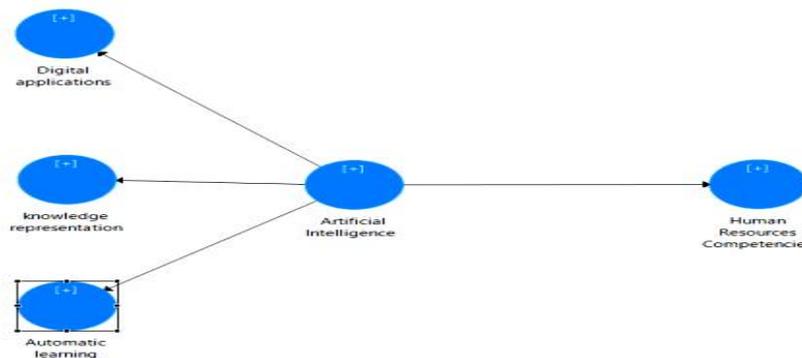


Figure 1. Conceptual framework

Methodology

Study population and sample

The study population consisted of all senior and middle managers in large companies in King Hussein Business Park, specifically the companies covered by logistics and artificial intelligence .

Due to the small size of the study population, the researchers used a comprehensive survey strategy by distributing (382) questionnaires to all senior and middle managers in the companies covered by logistics and AI in KHBP, and (283) questionnaires were returned, i.e. (74%). After scrutinizing them, (14) questionnaires were excluded due to incomplete answers (3.7%) of the original distribution, thus the number of questionnaires valid for analysis reached (n=269), which constituted (70.4%) of the original distribution.

Measurement model

Partial least squares (PLS) structural equation modelling was used in the current work to quantify the performance of the more effective model. To make this measurement, Smart PLS was used. This quality indicator takes into account average variance extracted (AVE), confirmatory factor analysis (CFA), convergent validity, and discriminant validity. Validity and reliability are the two main criteria used in PLS analysis (Hamdollah & Baghaei, 2016). This is due to the fact that estimating the model's quality is the primary goal of model measurement. Both discriminant and convergent validity evaluations were done to make sure the construct under investigation is valid. The average variance extracted (AVE) values and item loading values were used to test convergent validity, sometimes referred to as internal consistency of the variables. The consistency of the items was evaluated in this convergent validity analysis.

Composite Reliability and Validity

Furthermore, the factor loadings, validity, and reliability of the data gathered were evaluated using PLS-SEM. Information on the item factor loading, validity, and reliability for the PLS measurement model is detailed in Table 2. Cronbach's alpha test value, which must be 0.70 or greater, is typically used to evaluate an item's internal consistency (Fornell & Larcker, 2014). Cronbach's Alpha and composite reliability scores for the variables under investigation were both higher than 0.70. Because the average variance extracted (AVE) values for discriminant validity were higher than 0.50, convergence validity and high reliability were demonstrated (Fornell & Larcker, 2014). The composite reliability values, which ranged from 0.841 to 0.902, were over the threshold range of 0.70.

Table 2. Composite reliability, Cronbach's Alpha, and AVE values

Construct	Item	Loadings	CA	CR	AVE
Digital applications	Q1	0.865	0.792	0.862	0.841
	Q2	0.801	0.735	0.855	0.833
	Q3	0.925	0.861	0.874	0.854
	Q4	0.933	0.893	0.888	0.868
	Q5	0.946	0.901	0.895	0.875
	Q6	0.764	0.701	0.841	0.820
knowledge representation	Q7	0.966	0.931	0.901	0.860
	Q8	0.904	0.874	0.844	0.804
	Q9	0.922	0.895	0.865	0.825
	Q10	0.937	0.927	0.907	0.867
	Q11	0.945	0.937	0.918	0.891
Automatic learning	Q12	0.822	0.888	0.842	0.832
	Q13	0.834	0.976	0.913	0.891
	Q14	0.865	0.938	0.905	0.883
	Q15	0.944	0.854	0.814	0.783
	Q16	0.933	0.762	0.742	0.674
	Q17	0.971	0.883	0.839	0.792

Note: CR=composite reliability; AVE=average variance extracted; CA= Cronbach's Alpha

Discriminant Validity

Every research approach must also demonstrate that it has discriminant validity. Discriminant validity describes

how one predictor variable differs from some of the other latent constructs (Fornell & Larcker, 2014). To assess the discriminant validity, the AVE value, associated factor variability, and other range of fundamental should all be lower than the AVE value of the independent components (Hamdollah & Baghaei, 2016). Discriminant validity, which includes comparing an idea to other constructs, serves to validate it. As soon as we were confident that the variables' reliability and validity fulfilled all standards, researchers conducted additional study for structural analysis.

Table 3. Discriminant validity

	Digital applications	knowledge representation	Automatic learning	Human resources competencies
Digital applications	0.931			
knowledge representation	0.893	0.910		
Automatic learning	0.862	0.745	0.965	
Human resources competencies	0.762	0.654	0.745	0.901

Hypothesis testing results:

Results of the analysis of the first hypothesis: There is no statistically significant effect of artificial intelligence in its dimensions (digital applications, knowledge representation, automatic learning) on human resources competencies in the King Hussein Business Park.

Table 4: Results of testing the first main hypothesis

	Original Sample	T Statistics	P Values
Artificial intelligence -> Human resources competencies	0.976	4.064	0.000
$R^2=0.952$			

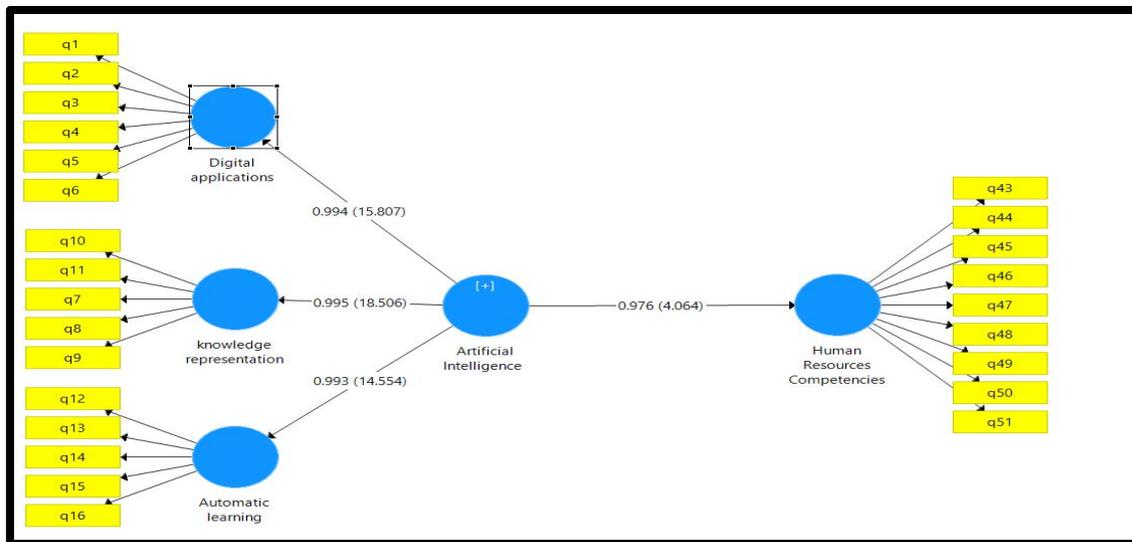


Figure 3. Structural model

The results of the study indicated that the value of the path coefficient reached (0.976), and that the calculated T value reached (4.064), and all of these values are statistically significant, which means that there is a positive impact of artificial intelligence on human resources competencies in the King Hussein Business Park, as indicated by The results are that the independent variable (artificial intelligence) explained an amount of (95.2%) of the variance in the dependent variable (human resource competencies). Accordingly, the null hypothesis is rejected, and the proof hypothesis is accepted, which states: There is a statistically significant effect for artificial intelligence in its

dimensions (digital applications, knowledge representation, automatic learning) on human resources competencies at the King Hussein Business Park.

Conclusion

The effective use of artificial intelligence (AI) in the field of human resources management is one of the key factors that contribute to improving the performance of companies and increasing work efficiency. For example, AI can help HR departments make better and more accurate decisions by analyzing data and predicting the future needs of the company.

In addition, AI can improve the employee experience by providing technology solutions that facilitate recruitment, training, and performance management. AI can also be used to analyze employee data to improve work-life balance and increase job satisfaction.

Based on this, it can be argued that AI is a real value-add for HRM and can help organizations achieve their goals more effectively and efficiently.

However, we must take into account some of the potential challenges and concerns of using AI in the field of HRM. The use of technology in this context may raise concerns about job losses and its impact on humanity in the future. In addition, companies may face challenges in balancing the use of technology with maintaining the human element and human relations in the work environment.

Therefore, it is important that the strategy of using AI in HRM is balanced and thoughtful, and that there is a clear vision of how to foster collaboration between technology and the human element in order to achieve company goals and improve performance. It can be said that AI represents a great opportunity to improve

human resource management and increase its efficiency, but it must be handled with caution and be wary of the potential challenges that may arise from its use in this context.

Thus, companies can benefit from AI in the field of HRM by adopting balanced strategies that combine technology and the human element. Companies can use AI to improve the employee experience, enhance efficiency and effectiveness in recruitment and training processes, improve performance management, and analyze employee data.

It is also necessary for companies to be cautious and responsible in the use of smart technology in the field of human resources management, by ensuring the protection of personal data and respecting the rights of employees.

Recommendations

Based on the results of the study that showed a positive impact of AI on HR meritocracy, the following recommendation can be made:

Companies should invest in AI applications for HRM in a holistic and integrated manner, including the use of AI in recruitment and training processes, analyzing employee data, and improving the employee experience. Organizations should also ensure that investments are directed towards developing the skills and capabilities of employees to adapt to technological shifts and make the most of AI.

By effectively utilizing AI in HRM, companies will be able to enhance the efficiency and effectiveness of team performance, improve the employee experience, and foster innovation and creativity in the work environment. Thus, investing in AI technology can contribute to the competitiveness and long-term success of organizations. Therefore, it is recommended to adopt integrated strategies for the use of smart technology in the field of human resources management, with a focus on developing human capabilities and enhancing the interaction between technology and human resources. Companies should also be vigilant in safeguarding personal data, ensuring employee privacy is protected, and ensuring compliance with relevant laws and regulations.

In short, companies can benefit from AI in improving the performance and efficiency of HRM, provided it is adopted in a balanced and responsible manner, with a focus on developing human skills and ensuring transparency and respect for employees' rights.

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A STUDY ON WOMEN'S EMPOWERMENT AND SUSTAINABLE DEVELOPMENT IN INDIA

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Abstract

This study investigated the interconnections between women's empowerment and sustainable development in India. Women's empowerment is crucial for sustainable development, as it significantly influences economic growth, social progress, and environmental sustainability. Gender equality is prominently emphasized in the United Nations Sustainable Development Goals (SDGs), particularly SDG 5, which aims to empower women and girls. In India, women have historically faced marginalization due to entrenched social norms, encountering barriers in education, employment, and political participation. Recent policy initiatives have improved women's roles across sectors, with microfinance empowering rural women by providing financial resources, fostering entrepreneurship, and enhancing their social status. However, challenges persist in achieving gender parity, particularly in terms of political representation and access to education and health care. This study underscores the need for comprehensive and culturally nuanced approaches that combine policy reforms, educational enhancements, and efforts to shift entrenched cultural norms. Strengthening education, skill development, legal protection, and the promotion of women in leadership roles are key recommendations for advancing gender equality. Partnerships between corporations and civil society can promote inclusive practices and initiatives to advance women's progress and equality in the workplace. By integrating gender considerations across all Sustainable Development Goals, India can make significant progress in empowering women and achieving sustainable development. Future research should evaluate the long-term impact of specific initiatives and develop strategies that consider cultural differences to overcome deep-rooted gender norms.

Keywords: Women's empowerment, sustainable development, gender equality, India, United Nations, sustainable Development Goals (SDGs), microfinance, entrenched social norms, etc.

Introduction

A comprehensive examination of women's empowerment and sustainable development in India elucidated the intricate interconnections between gender equality and developmental objectives. Women's empowerment is pivotal for sustainable development and exerts a substantial influence on economic growth, social progress, and environmental sustainability. Gender equality is prominently emphasized in the United Nations Sustainable Development Goals (SDGs), particularly SDG 5, which aims to empower women and girls. This emphasis is supported by evidence indicating that empowering women enhances human capital, increases labour productivity, and reduces poverty (Onditi and Odera, 2020; Onditi and Odera, 2016) ^[50,51]. The transition from the Millennium Development Goals to SDGs has integrated gender equality across various sectors (Fredman *et al.*, 2016; Dhar, 2018) ^[15,12]. In India, women have historically faced marginalization due to entrenched social norms, encountering barriers in education, employment, and political participation (Kumar & Shobana, 2023) ^[24]. Recent policy initiatives have improved women's roles across sectors (Reshi and Sudha, 2022) ^[39]. Microfinance empowers rural women by providing financial resources, fostering entrepreneurship, and enhancing their social status (Paul 2025) ^[34]. Nonetheless, challenges persist in achieving gender parity, particularly in terms of political representation and access to education and healthcare (Kumar & Shobana, 2023; Hasan, 2024) ^[24,19]. Addressing these issues requires policies that prioritize women's rights in development planning (Dhar, 2018) ^[12]. Gender equality is a critical component of both global and Indian development discourses, particularly concerning women's empowerment and sustainable development. The SDGs, established by the United Nations in 2015, position gender equality as essential for achieving other SDGs in education, employment, healthcare, and political participation (Shang *et al.*, 2022) ^[52]. The SDGs have improved upon the Millennium Development Goals, which inadequately address gender equality due to entrenched societal norms (Fredman *et al.*, 2016; Onditi and Odera, 2016) ^[15,51]. In India, gender equality and women's empowerment are vital to economic growth and sustainable development. Gender parity in health, education, and employment positively influence economic growth (Mishra *et al.* 2020). Despite advancements in women's civil liberties and political participation in India, challenges remain in the economic sphere and gender-

based violence. Cultural norms continue to impede transformative change (Anderson, 2024) ^[6]. Gender equality serves as both an independent goal and a means to achieve economic stability, poverty reduction, and human development (Lima and Guedes, 2024) ^[26]. There is an increasing emphasis on implementing strategies that incorporate women's empowerment into global justice efforts (Cornwall & Rivas, 2015) ^[54]. Addressing societal norms and creating systemic changes that empower women remains crucial. Integrating gender equality with sustainable development policies can advance gender justice and contribute to economic and social progress both globally and within India (Lima and Guedes, 2024; Anderson, 2024)

Despite notable advancements, gender disparities continue to impede sustainable development in the context of women's empowerment in India. Various structural and cultural factors contribute to these disparities. First, although India has experienced significant economic progress and initiatives aimed at promoting gender equality, these efforts frequently fall short of addressing the entrenched gender norms and inequalities. Research indicates that India ranks poorly in terms of gender equality on a global scale, with particularly low scores in areas related to economic resources and protection against gender-based violence. This is despite improvements in civil liberties and political participation of women (Anderson, 2024) ^[6]. Furthermore, microfinance and sustainable entrepreneurship programs have played a crucial role in advancing women's empowerment by enhancing their economic independence, decision-making power, and social status. However, challenges remain in ensuring that these benefits reach a broader population, which is essential for sustainable and inclusive economic development (Paul 2025) ^[34]. Organizational- and policy-level challenges often prevent rural women from realizing the potential benefits of skill development and job opportunities. This gap is exacerbated by the lack of industrial and commercial setups in rural areas, which hinders the recognition of the remunerative skills necessary for women's empowerment (Gupta *et al.*, 2024) ^[17]. Education has emerged as a critical factor for women's empowerment. Studies have demonstrated that educational levels significantly influence women's autonomy, mobility, and attitudes towards gender equality and domestic violence. However, there are significant differences in empowerment indicators across various states and socio-economic settings, indicating that disparities are not only entrenched but also multifaceted (S. Gupta & Bhaskar, 2016). In the broader South Asian context, women remain disadvantaged in accessing their rights, further impeding the attainment of the gender equality goals established by the United Nations Sustainable Development Goals (SDGs). To address these issues, efforts are needed to improve women's social and political rights and to ensure their full inclusion in mainstream development processes. Achieving gender equality requires a long-term approach involving cultural, social, and economic reforms aimed at addressing the root causes of gender inequality (Hasan, 2024) ^[19]. Thus, while strides have been made in promoting women's empowerment and sustainable development, persistent gender disparities continue to present significant challenges. Addressing these disparities requires comprehensive and culturally nuanced approaches that combine policy reforms, educational enhancements, and efforts to shift the entrenched cultural norms. Only by addressing these multidimensional issues can sustainable development and true gender equality be achieved in India.

Literature Review: Several studies have been conducted by scholars and researchers on various dimensions of women's empowerment and sustainable development in India over the years. A view of some of the most pertinent studies is presented below:

Anita (2020) studied how empowering women helps in sustainable development. This study shows that gender inequality slows progress in social, economic, and political areas. It examines India's efforts to promote gender equality through laws and policies. Even with progress, Indian women still face problems, such as low literacy, less participation in work, and social biases. This study highlights the need for education, workplace changes, and legal protection to empower women. It concludes that increasing women's participation is key to achieving India's development goals and a sustainable future, in line with United Nations Sustainable Development Goal 5.

Singh *et al.* (2025) investigated the role of women's empowerment in achieving sustainable development goals in India. This study indicates that empowering women through education, economic opportunities, and legal rights is essential to societal advancement. Utilizing government reports and case studies, this research demonstrates that initiatives such as educational programs and economic schemes have improved women's status and contributed to sustainable development. This study advocates a comprehensive approach to women's empowerment in order to facilitate inclusive growth.

Poonam and Sharma (2024) examined how empowering women affects development in poorer countries. They studied policies in different places to see how they helped with the development goals and found problems in using

them. They used reviews, policy checks, and data to examine how empowerment affects growth, environment, and fairness. This study shows that empowering women is the key to development. This suggests strategies such as education, healthcare, prevention of violence against women, and economic involvement. While empowerment helps reach development goals, there are still problems in making it work. The paper states that empowerment is important for reducing poverty and protecting the environment, and calls for strong plans to fight gender inequality.

Nidhi (2021) examined women's empowerment in India regarding Sustainable Development Goal 5 (SDG-5). Despite comprising half the population, women's economic participation remains limited. India's commitment to SDG-5 focuses on gender equality through constitutional amendments, property rights, and socioeconomic programs. Recent initiatives include Bachao and Padhao (2015), Yojana (2015), and Pradhan Mantri Ujjwala Yojana (2016). These challenges include improving women's literacy, education, political participation, and land ownership.

Although progress has been made, further advancement is required in education, employment, and skill development. Masih and Masih (2024) examined how empowering women can help with sustainable development. This study points out the ongoing problems that women face, such as being denied basic rights, abuse, and discrimination. Major issues include a lack of education, deep-rooted social customs, poverty, and child marriage. The authors stress the important role that women play in managing the environment and boosting the economy. This paper reviews Indian government programs such as the Beti Bachao Beti Padhao Scheme, Mudra Yojana, and Lakhpati Didi Yojana, which aim to empower women. This study calls for greater awareness of gender equality, better education for women, women-led development plans, and better execution of current programs. The paper concludes that empowering women is crucial for achieving development goals.

Chakraborty (2025) ^[11] examined the role of women's empowerment in sustainable development. This study shows that empowerment reduces poverty and improves quality of life. Women comprise half of the population, making their participation vital to the economy. This study analyses the impact of women's empowerment on sustainable development in India, using NGO reports and government data. This study defined empowerment and sustainable development by examining women's economic, social, and environmental roles. Women contribute through work, entrepreneurship, and farming, while promoting gender equality and resource management. This study assessed women's empowerment in India, noting progress and challenges, and concluded that gender equality is essential for sustainable development.

Sonowal and Moran (2019) ^[47] studied the effect of gender equality on sustainable development in India. They examined the importance of gender equality, the role of women in today's Indian society, and how education helps empower women. They find that gender equality is crucial for a sustainable world. Although women are important to development, they still face discrimination in India. Education is the key to empowering women and helping them overcome these challenges. This study suggests policy changes and educational programmes to reduce gender inequality. The authors concluded that educating women is vital for sustainable development because women comprise half of the population and are essential for sustainability.

Singh (2020) ^[46] studied the relationship between empowering women and sustainable development. This study examines the role of women in India since ancient times. Empowering women implies giving them freedom from social and economic restrictions. This study shows that when women are empowered, they can transform their countries and support sustainable development. It discusses laws that protect women's rights, such as the Hindu Succession Act and the Equal Remuneration Act. Despite progress, there are still issues related to education, lawmaking, and violence against women. The author links women's empowerment to sustainable development by referring to the United Nations 2030 Agenda. This paper argues that including women's empowerment in development plans is crucial for reducing inequality. It concludes by stating that the world must view gender equality as a fundamental human right essential for global success.

Based on the literature review, while studies have explored women's empowerment and sustainable development in India, comprehensive research on the long-term impact of specific initiatives is lacking. Research should evaluate the outcomes of programs such as Beti Bachao Beti Padhao and Mudra Yojana in terms of empowerment indicators. Investigation of intersecting factors such as education, economic opportunities, and legal rights in women's empowerment and their effects on Sustainable Development Goals is needed. The analysis of regional disparities across Indian states and strategies to address challenges in literacy, workforce participation, and social bias remains

crucial. Comparative studies with other developing nations can help identify the best practices in empowerment policies. These insights can help policy makers formulate effective strategies for women's empowerment and sustainable development in India.

The interconnection between women's empowerment and sustainable development in India is important because of their mutual influence. Women's empowerment contributes to the enhancement of human resources for economic development through financial inclusion, which, in turn, leads to increased participation in decision-making processes and improved access to social welfare schemes (Paletal.2021)^[32]. Sustainable development is intrinsically linked to women's empowerment, as evidenced by microfinance initiatives that have transformed women's economic independence and facilitated entrepreneurship within the country's economic framework (Paul 2025)^[34]. Despite economic advancements and reforms, India continues to face challenges in achieving gender equality, with restrictive customs hindering transformative change (Anderson, 2024; Gupta and Yesudian, 2006)^[6,16]. This situation aligns with Sustainable Development Goal 5, which focuses on gender equality and aims to eliminate gender-based violence and enhance access to reproductive health services (Fredman *et al.*, 2016; Dhar, 2018)^[15,12]. The significance of this study lies in its potential to inform policies aimed at overcoming barriers to women's empowerment by addressing socioeconomic disparities, expanding educational opportunities, and promoting financial literacy, thereby contributing to sustainable national development (Sahu *et al.* 2024)^[41].

This study examines dimensions influenced by cultural, economic, and policy factors. This study explores how empowering women contributes to sustainable development goals, particularly gender equality and economic growth. Microfinance initiatives advance women's economic independence and social status in India by promoting financial inclusion and sustainable entrepreneurship (Paul 2025)^[34]. Women's empowerment in India has faced historical constraints from societal norms and gender biases, gradually challenged by changing attitudes and supportive policies. This is evident in the increasing role of women entrepreneurs in India's economy (Kumar & Shobana, 2023)^[24]. The integration of women's empowerment into SDG 5 emphasizes gender equality and aims to eliminate gender-based violence and promote reproductive health access (Fredman *et al.*, 2016; Dhar, 2018)^[15,12]. Challenges regarding the intersection of gender with caste, ethnicity, and class remain. Addressing these discriminatory layers is crucial for achieving gender equality and sustainable development in India (Haq 2013)^[18]. This study examines how women's empowerment facilitates sustainable development and analyse its achievements and barriers.

The aims of this study are (i) to analyse the status of women's empowerment in India. (ii) Examining the link between women's empowerment and sustainable development. (iii) Evaluate policies and make recommendations.

The present study is descriptive and qualitative in nature. The has been conducted purely based on the secondary data. The secondary data have been collected from various articles, journals, research papers, research-based publications, government reports, UN publications, other academic studies, and web resources.

The discussion section has been subdivided into five subsections: the framework of women's empowerment, status of women's empowerment in India, Link between Women's Empowerment and Sustainable Development, Government Policies and Initiatives for women's empowerment, and Challenges and Recommendations of women's empowerment in India.

Concept: Women's empowerment is a complex construct that includes autonomy, agency, and access to resources, all of which are essential to achieving gender equality.

Autonomy pertains to a woman's capacity to make independent decisions and exercise control over her personal and professional lives. This concept is particularly vital in healthcare decision-making, where factors such as educational attainment, employment status, and sociocultural norms significantly influence outcomes (Idris *et al.*, 2023; Acharya *et al.*, 2010)^[56,57]. Furthermore, autonomy within religious contexts exhibits considerable variation; for instance, certain denominations within Christianity in Mozambique offer women greater opportunities to exercise decision-making autonomy (Agadjanian and Yabiku 2015)^[2]. Agency refers to the mechanisms through which women exert influence over their circumstances, including decision-making capabilities, negotiation skills, and the capacity to challenge societal norms. Empowerment programs aimed at enhancing agency, particularly in the domains of health and development, have demonstrated effectiveness in impoverished regions. These programs emphasize the interaction between cognitive processes and the social environment to improve outcomes for women (Shankar *et al.*, 2018)^[44]. Additionally, agency incorporates time-use agency, wherein strategic decisions regarding

time allocation contribute to empowerment (Eissler *et al.* 2022)

Access to Resources encompasses the availability and control of both materials and human resources. This concept extends beyond mere access and incorporates future claims to resources, which are crucial for sustained empowerment (Kabeer 1999) [22]. Research across various contexts has underscored the significance of addressing resource inequalities to enhance empowerment. In India, disparities in resource distribution within relationships influence contraceptive decision making, illustrating that relational power dynamics can either hinder or facilitate empowerment (Babbar *et al.* 2025) [9]. Moreover, in communities adhering to traditional gender norms, restricted access to productive resources negatively affects women's economic empowerment, as evidenced in the coastal fishing communities of Bangladesh (Rahman *et al.*, 2024) [37].

Empowerment of women is a multifaceted and context-specific process that necessitates addressing structural inequalities and societal norms across various regions and communities.

The critical dimensions of women's empowerment can be analysed in terms of economic, social, and political aspects, each of which plays an essential role in advancing gender equality and enhancing women's status across various domains.

Economic empowerment frequently entails enhancing women's access to financial resources and employment opportunities. In India, microfinance and entrepreneurship within Self-Help Groups (SHGs) have significantly contributed to women's economic and social empowerment by promoting financial independence and increasing their involvement in decision-making processes (Pandhare *et al.*, 2024) [33]. Furthermore, financial inclusion, as demonstrated by the necessity for bank accounts and engagement in financial decision making, plays a crucial role in advancing women's empowerment in rural India (Pal *et al.*, 2021) [32].

Education and Health: Education serves as a crucial catalyst for the social empowerment of women, equipping them with the necessary skills and confidence to engage comprehensively in societal development and political activities (Engida, 2021) [14]. It augments women's decision-making capabilities and promotes substantive participation in political and social spheres. Furthermore, the enhancement of social welfare programs and the improvement of safety perceptions regarding savings significantly contribute to empowerment (Paleta *et al.*, 2021)

Health Outcomes: Health is fundamentally connected to empowerment, although the context provided does not explicitly elaborate on this relationship. Access to healthcare services and education regarding health issues are essential components that influence empowerment by facilitating improved health outcomes and informed family planning.

Representation and Decision-Making: Political empowerment facilitates women's effective engagement in political processes and decision-making, thereby influencing policies that promote gender equality and empowerment across various sectors. In Saudi Arabia, political empowerment has been demonstrated to have a significant impact on economic and managerial empowerment, although its direct effect on social empowerment may be less pronounced (Al-Qahtani *et al.* 2020) [4]. Conversely, women's political participation in India underscores the disparity in empowerment levels despite progress in certain domains (Anderson 2024) [6].

Rights and Agency: Political empowerment encompasses the safeguarding and advancement of women's rights, thereby enabling them to exercise agency across various dimensions, including economic, political, and legal spheres. Women's organizations are instrumental in advocating for these rights and advancing the agenda of gender equality (Sen & Mukherjee, 2014) [6].

In conclusion, the critical dimensions of women's empowerment encompass economic, social, and political factors that collectively enhance women's roles within society. Each dimension is inter connected and contributes to the overarching objective of achieving gender equality and women's empowerment on a global scale.

Sustainable Development Goals (SDGs): Sustainable Development Goal 5 (SDG 5) is dedicated to achieving gender equality and empowering all women and girls. This objective is intrinsically linked to numerous other SDGs, highlighting the integral role of gender equality in the pursuit of sustainable development.

Research indicates a significant interconnection between SDG 5 (Gender Equality), SDG 6 (Clean Water and Sanitation), and SDG 8 (Decent Work and Economic Growth). Achieving gender equality is essential for effective

engagement in and benefits from water-related and employment initiatives, thereby enhancing the potential for sustainable tourism development and economic growth (Alarcón and Cole 2019) [3]. Additionally, SDG 3 (Good Health and Well-being) is intricately linked to SDG 5, as gender influences health outcomes through social determinants, health behaviours, and gendered responses of health systems. Efforts to advance gender equality have demonstrable impacts on health, underscoring the necessity for integrated action across these domains (Manandhar *et al.*, 2018) [27].

Climate change adaptation measures significantly intersect with Sustainable Development Goals (SDGs) 5. These measures present both synergies and trade-offs; while they have the potential to advance gender equality, they frequently fall short in sectors such as ocean and coastal ecosystems or poverty alleviation unless gender equality considerations are explicitly incorporated into planning and implementation (Roy *et al.*, 2022) [40]. The role of small businesses, particularly within the African context, underscores that heightened awareness and integration of SDG 5 can enhance gender equality in business environments, thereby supporting broader sustainable development objectives (Olubiyi *et al.*, 2022) [31].

Integrating gender equality across all Sustainable Development Goals (SDGs) is essential for achieving comprehensive progress. For instance, education (SDG 4) significantly influences gender equality; conversely, gender equality can enhance educational outcomes. Furthermore, the empowerment of women can expedite progress towards other SDGs, such as poverty reduction (SDG 1) and peace and justice (SDG 16) (Leal Filho *et al.*, 2022) [25]. Nevertheless, despite these interconnections, awareness and implementation at the grassroots level remain challenging, particularly in business and institutional contexts (Olubiyi *et al.*, 2022) [31].

Advancements in gender equality facilitated by feminist mobilization have driven progress across various domains within the Sustainable Development Goals (SDGs) framework. However, substantial gaps persist, particularly in sectors that are resistant to change or where political and financial obstacles remain. Ongoing efforts to integrate gender considerations across all SDGs are crucial for achieving the 2030 agenda (Sen, 2019) [42].

Women's empowerment in India encompasses multiple dimensions, each elucidating distinct facets of advancement and persistent challenges.

Education: Education is pivotal for empowering women. Although India has made progress in increasing female literacy rates, significant disparities remain, particularly in rural regions and marginalized communities. Access to quality education is essential for enhancing women's opportunities and agency in society (Anderson, 2024) [6].

Economic Participation: Economic empowerment is essential for the comprehensive empowerment of women. Sociocultural norms and restricted access to economic resources frequently impede women's workforce participation. Initiatives such as self-help groups (SHGs) and microfinance programs have had a positive impact on women's economic status by granting them financial decision-making authority and access to resources. Nevertheless, these programs often exclude impoverished women, highlighting the need for more inclusive economic strategies (Mohapatra and Sahoo, 2016; Sen and Mukherjee, 2014) [6, 58].

Health: Indicators of women's health have demonstrated considerable progress in enhancing maternal health and reducing mortality rates. Nonetheless, access to health care services remains insufficient for many individuals, particularly those residing in rural areas. Health empowerment is associated with women's capacity to access essential services and make informed decisions regarding well-being (Al-Qahtani *et al.*, 2020) [4].

Political Representation: India has witnessed advancements in women's political participation, particularly through increased representation in local government bodies. Nonetheless, challenges remain at higher levels of political engagement where women frequently experience underrepresentation in parliament and decision-making positions. Political empowerment is essential for shaping policies that impact women's rights and opportunities (Sen and Mukherjee, 2014) [6].

Challenges: Despite the implementation of policy reforms and initiatives, women in India continue to encounter significant challenges, including gender-based violence, restrictive social norms, and limited access to justice. These obstacles hinder genuine empowerment and underscore the complexity of achieving gender equality. Addressing restrictive customs and enhancing women's agency are crucial for effecting transformative change (Anderson, 2024; Sen and Mukherjee, 2014) [6, 43].

Although India has made notable advancements in empowering women across various sectors, significant challenges persist. Policies and initiatives must be both inclusive and culturally sensitive to effectively address the diverse obstacles women encounter in achieving comprehensive empowerment.

Link between Women's Empowerment and Sustainable Development in India

Women's empowerment is fundamentally connected to sustainable development in India through several channels.

Economic Growth: Women's engagement in economic activities plays a crucial role in enhancing GDP. In India, microfinance initiatives have been instrumental in promoting women's financial inclusion and societal empowerment, thereby contributing to sustainable entrepreneurship and economic growth (Paul 2025) ^[34]. This economic involvement not only elevates GDP but also fosters economic development, illustrating how women's empowerment facilitates broader economic growth in India (Huang *et al.*, 2020) ^[20]

Environmental Sustainability: Women play a pivotal role in the management of natural resources and the promotion of eco-friendly entrepreneurship. This relationship is particularly evident in the empowerment of women entrepreneurs who integrate environmentally sustainable practices, thereby promoting environmental stewardship and contributing to sustainable business strategies. These practices not only enhance environmental sustainability but also improve market performance, underscoring a significant connection between women's empowerment and sustainable development within environmental contexts (Windiyani *et al.*, 2024) ^[48].

Social Development: Women's empowerment plays a crucial role in social development, as advancements in education and health contribute to poverty alleviation. For example, education for sustainable development initiatives in India highlights social, environmental, and economic aspects, advocating for gender equality and the empowerment of women as a strategy to enhance societal outcomes (Chhokar, 2010) ^[10]. This illustrates how empowering women through access to education and healthcare can mitigate poverty and advance development goals.

Kudumbashree in Kerala: The women empowerment model implemented in Kerala serves as an exemplar of community-based, participatory strategies aimed at poverty alleviation and the empowerment of women. This model effectively integrates multiple dimensions of sustainable development, presenting a successful framework for incorporating women's empowerment into sustainable community development paradigms. The Kudumbashree initiative's strategy of harnessing women's collective strengths significantly influences both economic sustainability and social inclusion (Awan *et al.* 2019) ^[8].

Self-Help Groups (SHGs) and Microfinance Impact Self-Help Groups (SHGs), in conjunction with microfinance initiatives, have significantly contributed to the social and economic empowerment of women in India. These groups facilitate women's attainment of financial autonomy, enable their participation in household decision-making, and enhance their social standing. Such empowerment promotes sustainable social development, fosters economic growth at the community level, and augments the capacity for sustainable livelihood (Paul, 2025) ^[34].

The examples and findings presented underscore the critical role of women's empowerment in India as a fundamental catalyst for sustainable development across the economic, environmental, and social dimensions, thereby promoting a more inclusive and equitable society.

Government Policies and Initiatives in India

In India, governmental policies and initiatives regarding women's empowerment in the context of sustainable development encompass a range of constitutional provisions, key programs, and involvement of non-governmental organizations (NGOs). The following is an outline derived from extant literature:

Constitutional Provisions

Equality Articles: Articles 14, 15, and 16 of the Indian Constitution serve as the cornerstone for gender equality. Article 14 guarantees equality before the law, whereas Articles 15 and 16 prohibit gender-based discrimination and ensure equal opportunities for public employment.

Directive Principles of State Policy: These principles serve as a framework for the state to ensure justice, as well as social, economic, and political rights, which are essential for the empowerment of women and are aligned with

Sustainable Development objectives.

Important Schemes

- **Beti Bachao Beti Padhao (BBBP):** This initiative seeks to address the declining child sex ratio and promote both the education and survival of the girl child (Ikhsan et al., 2025) [21].
- **Mahila Shakti Kendra (MSK):** This initiative aims to empower women through community engagement, encompassing capacity building, employment generation, and enhancing women's participation in governance (Ikhsan et al., 2025) [21].
- **Sukanya Samriddhi Yojana:** A government-endorsed savings program designed to secure financial stability for the educational and matrimonial expenses of the girl (Ikhsan et al., 2025) [21].
- **MGNREGA (Mahatma Gandhi National Rural Employment Guarantee Act):** This legislation facilitates gender-inclusive employment opportunities, thereby promoting women's economic independence and empowerment through assured wage employment (Gupta et al. 2024) [17].

Role of NGOs

- **The Self-Employed Women's Association (SEWA):** It is a leading organization dedicated to women's economic empowerment by mobilizing them to secure their rights to employment and social security (Dhar, 2018) [12].
- **Azad Foundation:** This initiative is dedicated to offering vocational training and employment opportunities to underprivileged women, thereby facilitating their ability to earn a sustainable livelihood.
- **Grassroots Movements:** Numerous local and grassroots women's organizations are actively engaged in community mobilization and the promotion of awareness regarding women's rights, thereby making substantial contributions to the achievement of sustainable development goals.

These initiatives exemplify a comprehensive strategy for empowering women in India, closely aligning with development goals through legal provisions, financial inclusion, education, and employment opportunities (Koehler, 2016) [23].

Challenges and Recommendations

The challenges and recommendations about women's empowerment and gender issues can be described as follows.

Challenges

- **Gender-based Violence:** Persistent challenges, such as gender-based violence, constitute substantial impediments to women's safety and empowerment (Ravi et al., 2017) [38].
- **Workplace Discrimination:** Women, particularly those in STEM and other disciplines, encounter discrimination and obstacles rooted in gender stereotypes and societal expectations. These challenges include limited access to networks and resources that are essential for career advancement (Adikaram & Razik, 2022) [1].
- **Low Political Representation:** Women's representation in political arenas remains suboptimal, thereby constraining their capacity to influence policymaking and governance (Perry et al. 2009) [35].
- **Implementation Failures and Policy Gaps:** Significant challenges persist in the effective implementation of policies, which are frequently attributed to a lack of awareness, inadequate funding, and insufficient political will (Zhang et al., 2023) [49].
- **Cultural and Social Barriers:** In numerous regions globally, cultural and social ideologies impose limitations on women's roles, further impeding their participation and recognition across various sectors (Amer & Bagasra, 2013) [5].

Recommendations

- **Strengthening Education and Skill Development:** Enhancing access to education and skill development is essential for empowering women, particularly within rural and marginalized communities. The implementation of targeted training and educational programs can significantly improve women's economic participation (Nhleko et al. 2023) [29].
- **Enhance Legal Protection and Enforcement:** It is imperative to enhance and rigorously enforce legal frameworks addressing gender-based violence and discrimination. This necessitates comprehensive training of law enforcement personnel and the provision of support services for survivors (Perry et al., 2009) [35].
- **Promote Women's Leadership Roles:** Promoting women's representation in leadership positions across various sectors can be facilitated through the implementation of quotas, mentorship programs, and the establishment of supportive environments that acknowledge and address gender biases (Adikaram & Razik, 2022) [1].
- **Encourage Corporate and Civil Society Partnerships:** Establishing partnerships between corporations and civil society can promote inclusive practices, allocate resources, and develop initiatives that advance women's progress and equality in the workplace (Zhang et al., 2023) [49].

These recommendations are designed to address enduring challenges by establishing supportive systems and environments that empower women and advance gender equality.

Findings of the Study

Here are the key findings of the study on women's empowerment and sustainable development in India based on the above discussions

- **10.1** Women's empowerment is crucial for sustainable development in India, as it impacts economic growth, social progress, and environmental sustainability.
- **10.2** Gender equality is emphasized in the UN Sustainable Development Goals, particularly SDG 5, in empowering women and girls.
- **10.3** In India, women have historically faced marginalization due to entrenched social norms, encountering barriers in education, employment, and political participation.
- **10.4** Recent policy initiatives have improved women's roles across sectors in India.
- **10.5** Microfinance empowers rural women by providing financial resources, fostering entrepreneurship, and enhancing their social status.
- **10.6** Challenges persist in achieving gender parity, particularly in political representation and access to education and healthcare.
- **10.7** Women's empowerment contributes to economic growth through increased labor productivity and poverty reduction.
- **10.8** Education is a critical factor in women's empowerment, influencing their autonomy, mobility, and attitudes towards gender equality.
- **10.9** There are significant differences in the empowerment indicators across various states and socioeconomic settings in India.
- **10.10** Initiatives like Self-Help Groups and microfinance programs have positively affected women's economic status and decision-making power.
- **10.11** Cultural norms and social ideologies continue to impose limitations on the roles of women in many regions of India.

Conclusion

This study examined how empowering women is connected to sustainable development in India. This indicates that empowering women is important for economic growth, social progress, and environmental health. Programs such as microfinance and self-help groups help women become financially independent and start businesses. However, challenges such as gender inequality in politics, education, healthcare, and jobs remain. Cultural norms often restrict the roles of women. Although the government has policies to promote gender equality, they are not always well implemented. Programs such as Beti Bachao Beti Padhao and Mahila Shakti Kendra have potential but require better execution. Education is key to empowering women and affecting their independence and views on gender equality. However, there are large differences in education across different states and social groups. To fully empower women, it is important to address gender-based violence and workplace discrimination and increase women's political participation. Gender issues should be considered in all Sustainable Development Goals to make real progress. A comprehensive approach is needed, including stronger laws, better education and skills training, the promotion of women in leadership, and partnerships between the government, civil society, and businesses. By tackling ongoing challenges and using the available opportunities, India can make significant progress in empowering women and achieving sustainable development. Future research should examine the long-term effects of specific programmes and develop strategies that consider cultural differences to overcome deep-rooted gender norms.

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LANDSLIDE SUSCEPTIBILITY MAPPING USING MACHINE LEARNING, DEEP LEARNING, HYBRID, ENSEMBLES, AND GRAPH-BASED TECHNIQUES FOR NATURAL DISASTER PREVENTION: A SURVEY

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Abstract

Landslide Susceptibility Mapping (LSM) plays a vital role in disaster risk reduction, particularly in geologically fragile and high-rainfall regions. This comprehensive survey explores recent advances in Machine Learning (ML), Deep Learning (DL), Hybrid, Ensemble, and Graph-based methodologies for LSM. This survey provides an overview of the ML methods which are effectively handle nonlinear interactions in terrain features, while DL models extract spatial and temporal features from high-dimensional datasets. Hybrid and Ensemble frameworks that combine multiple algorithms which improve robustness and reduce overfitting. Graph-based DL models capture spatial connectivity and temporal dynamics within slope units, leading to improved predictive performance. The techniques utilized in LSM, discussing their strengths in handling complex spatial data, image analysis, remote sensing, and Geospatial Information Systems (GIS). This survey mainly focusing on ML and DL methodologies, hybrid and ensemble techniques and graph-based techniques. This survey highlights Hybrid DL relations to the strengths of ML, DL, ensemble, and graph-based methods, leading to better accuracy, improved spatial consistency, and stronger generalization, supporting land use planning sustainable. This research gap emphasizes the growing role of hybrid and graph-based AI frameworks and proactive disaster management worldwide.

Keywords: ML, DL, Landslide Susceptibility Mapping, Geospatial Information Systems, Artificial Intelligence

1. Introduction

Landslides are among the most destructive geo-hazards globally, particularly in mountainous and high-rainfall areas, where they pose severe threats to lives, infrastructure, natural ecosystems, and local economies. The study comprehensively covers landslide susceptibility across most Asian countries, emphasizing the distinctive natural and anthropogenic factors. Among the major natural causes of heavy rainfall, earthquake, snowmelt, volcanic and erosion processes interact to make highly vulnerable to landslides. Other major causes like deforestation, road cutting & construction, mining, and drainage system, collectively intensify the hazards of landslides in many areas.

LSM to guide proactive disaster risk mitigation, land use planning, and regional development. It helps to predict where future landslides are likely to occur by analysing various natural and human factors that impact slope stability. In LSM, different conditioning factors such as slope, elevation, aspect, rainfall, geology, Land Use/Land Cover (LULC) and distance from faults or roads analyzed using Geographic Information System (GIS) and remote sensing techniques. These factors are combined using ML or DL, hybrid, ensemble and Graph based models are explained in Figure 1.

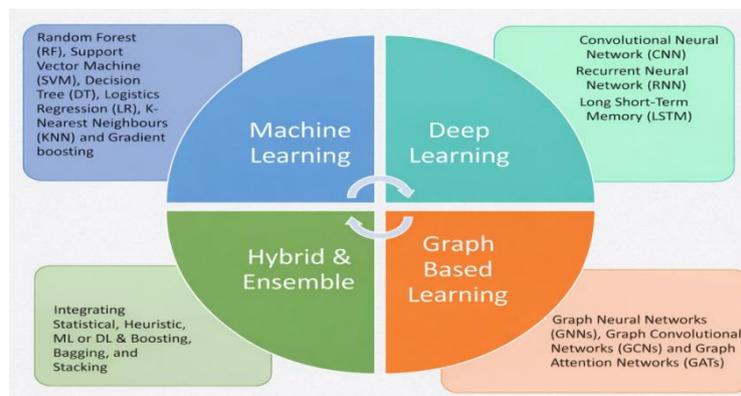


Figure.1. Learning Frameworks in Landslide Modelling

ML is a division of artificial intelligence that make prediction or decision in landslide prone area. ML models like Random Forest (RF), Support Vector Machine (SVM), Decision Tree (DT), Logistics Regression (LR), k-nearest neighbours (KNN) and Gradient boosting are commonly familiar in LSM. These are the main models automatically learn landslide inventory data and contributing to slope instability. When compared to traditional statistical methods, ML handling large and nonlinear datasets to provide a higher accuracy on data-driven approach for landslide prediction.

DL is an advanced branch of ML that uses ANN with many layers that accepts large amount of data which automatically learn complex patterns. DL models such as CNN, RNN and LSTM broadly adopted for LSM and detection. The traditional methods do not handle high dimensional data from Remote Sensing, DEMs and satellite imagery. Hybrid models combine different techniques or models by integrating statistical, heuristic, ML or DL approaches. Ensemble learning is a modern ML technique which combines collective intelligence of various models such as boosting, bagging, and stacking used to reduce overfitting and error. In bagging, multiple models are accessed for classification via random forest. Boosting models build sequentially via AdaBoost, Gradient Boosting and XGBoost. Stacking uses meta-model and combines different types of algorithms to integrate the prediction. Graph based techniques such as Graph Neural Networks (GNNs), Graph Convolutional Networks (GCNs) and Graph Attention Networks (GATs) are widely used to study complex geospatial data.

2. Related Works

2.1 Machine Learning Based LSM

The study [1] applied Explainable AI (XAI) to predict landslide events while enhancing model transparency through SHAP (SHapley Additive Explanations) and LIME (Local Interpretable Model-agnostic Explanations). The study emphasized the importance of interpretability in AI-based LSM, making model outputs more comprehensible to geoscientists. Similarly, [2] performed a GIS-based LSM study for the Meghalaya–Shillong Plateau using ML algorithms such as RF, SVM and LR. Among these, the RF model attained the highest prediction accuracy, attributed to its robustness against overfitting and capability to manage non-linear relationships. Spatial processing and model training [3] investigated the integration of supervised and unsupervised ML techniques, including K-means clustering and RF, within the Bhagirathi Eco-Sensitive Zone of Uttarakhand, India. In this dual-approach framework, unsupervised learning was first used to segment terrain patterns, followed by supervised ML to refine susceptibility classification. MATLAB, ENVI, and ArcGIS were employed for data preprocessing and model evaluation. Multiple ML algorithms, with SVM, RF, and Gradient Boosting, for predictive landslide modelling used in Khagrachari, Bangladesh [4]. The study integrated DEM, soil, and precipitation data using GIS and GEE. The RF attained the highest predictive accuracy with an AUC of approximately 0.93, confirming its effectiveness for heterogeneous datasets. In South America, [5] model implemented ML-based LSM in Sao Sebastiao, Brazil, comparing DT, RF, and GBMs using Python and GEE. The study emphasized the flexibility of ML techniques in tropical coastal terrains characterized by high environmental complexity. A comparative evaluation of ML techniques, converging on validation and accuracy through ensemble classifiers such as RF, XGBoost, and CatBoost [6]. Using multiple validation techniques, including k-fold cross-validation and AUC-ROC analysis, the study emphasized the significance of rigorous model validation in LSM. Multi-Criteria Decision-Making (MCDM) is a structured approach used to evaluate and choose the best option. The main aim is to help decision-makers weigh trade-offs, assess all relevant criteria, and make logical, transparent, and balanced choices. [7] compared MCDM, bivariate statistical, and ML study for LSM in Uttarakhand, India. The findings indicated that revealed that ML approaches, particularly RF and SVM, outperformed traditional MCDM models in predictive consistency. The study's strength lies in its robust cross-method comparison, whereas its limitation stems from the exclusion of temporal factors such as variations in rainfall intensity. The role of uncertainty analysis in GIS-based ML models for LSM in the Darjeeling Himalayas [8]. Employing Random Forest, Gradient Boosting, and Monte Carlo Simulation. Instead of using fixed input values (a deterministic model), the Monte Carlo method uses a range of probable values for uncertain inputs, each assigned a probability distribution.

Table 1. Survey assessment of Machine Learning for LSM

Reference	Title	Method used	Algorithm used	Tool used	Country/Data used	AUC	Key Limitations
Collini et al. (2022) [1]	Predicting and understanding landslide events with explainable AI	Machine learning / predictive modeling / explainable AI	XGBoost (best model), CNN, Autoencoder, Random Forest; use of SHAP for model interpretability	Python / R, Node-RED, Docker containers, QGIS	Italy	0.93	Limited to selected features. Lack of temporal validation. Dependence on data quality.
Agrawal et al (2023) [2]	GIS-based landslide susceptibility mapping of the Meghalaya-Shillong Plateau region using machine learning algorithms	machine learning	Various ML algorithms (Random Forest, SVM)	ML toolkits (R, Python)	Meghalaya-Shillong Plateau region	0.91	Spatial resolution of input data may limit fine-scale mapping. Limited transferability to other regions. Model validation restricted
Devi et al. (2024) [3]	Landslide susceptibility zonation using integrated supervised and unsupervised machine learning techniques in the Bhagirathi Eco-Sensitive Zone (BESZ).	Integrated Supervised and Unsupervised Machine Learning	RF, XGBoost, and KNN-ISODATA cluster technique, LSM	ArcGIS	Landslide data from BESZ, Uttarakhand	0.94	Limited data availability for unsupervised clustering. No assessment of temporal dynamics. Model generalization not tested in other Himalayan regions.
Hasan et al. (2024) [4]	Predictive landslide susceptibility modeling in the southeastern hilly region of Bangladesh: application of machine learning algorithms in Khagrachari district	Comparative machine learning modeling	Random Forest (RF), Boosted Regression Trees (BRT), k-Nearest Neighbors (KNN) (PubMed)	spatial tools, ML environment (Python / R)	Topographical, and geological, Khagrachari district, Bangladesh	0.95	Model accuracy depends on DEM and rainfall data precision. Limited ground truth validation. No uncertainty quantification.

Alcantara et al. (2024) [5]	Machine learning approaches for mapping and predicting landslide-prone areas in Sao Sebastiao (Southeast Brazil).	Machine Learning	Rf, Gradient Boosting, SVM, ANN, and KNN	https://github.com/ennerha/landslides/blob/main/code .	Landslide data from Sao Sebastiao, Brazil	0.99	Incomplete representation of triggering factors (rainfall intensity). Temporal changes not modelled. Data imbalance may affect accuracy.
Abdelkader et al. (2025) [6]	Comparative assessment of machine learning models for landslide susceptibility mapping: a focus on validation and accuracy	Comparative assessment of ML models	Logistic Regression (LR), Random Forest (RF), Support Vector Machine (SVM)	Statistical & spatial validation tools; SHAP for interpretability	Geospatial and landslide inventory data from arid hilly regions east of Cairo, Egypt	0.91	Focused mainly on accuracy metrics. No consideration of model transferability. Does not evaluate dynamic triggering factors.
Chauhan et al. (2025) [7]	Landslide susceptibility assessment for Uttarakhand, a Himalayan State of India, using multi-criteria decision making, bivariate, and machine learning models	Multi-Criteria Decision Making & Machine Learning	Bivariate Models & Machine Learning-RFR-CFM-Stacking-1D-3D-CNN	-	Landslide data from Uttarakhand, India	0.93	Uncertainty in expert-based weight assignments. Inadequate integration of temporal rainfall data. Model limited to static conditioning factors.
Dey et al. (2025) [8]	Exploring uncertainty analysis in GIS-based Landslide susceptibility mapping models using machine learning in the Darjeeling Himalayas	Machine Learning	XGBoost, Gradient Boosting Machine (GBM), others	ArcGIS, Hydro SHEDS	Darjeeling Himalayas landslide data	0.89	Uncertainty quantification limited to input data, not algorithms. Lack of comparison with deep learning approaches. Model results dependent on data normalization methods.

2.2 Deep Learning Based LSM

Authors reviewed studies in a strong evolution in **DL methodologies** for **LSM**, transitioning from standard convolutional architectures to more sophisticated attention and optimization-enhanced models. Pioneered the use of DL for LSM by implementing multiple CNN architectures [9] to predict spatial patterns across various conditioning features, including curvature, lithology, land use and slope. The study demonstrated CNNs' capturing complex nonlinear patterns. The DL model of Mask R-CNN-based (Mask Region-based CNN) landslide detection framework is to identify and precisely map landslides in remote sensing imagery (like satellite or drone photos) [10], integrating both segmentation and classification tasks. This method resides in its capacity to accurately delineate landslide boundaries using multispectral and high-resolution remote sensing imagery. The incorporation of the Mask R-CNN model enhanced spatial precision and minimized false positives, outperforming CNN and U-Net models. Developed an advanced CNN-3D model incorporating [11] a spatial-channel attention mechanism to enhance multi-dimensional feature extraction for LSM. The model's key innovation lies in its 3D architecture, which effectively captures both spatial and depth (z-axis) correlations among landslide conditioning factors, leading to improved predictive accuracy and contextual understanding. Additionally, the integrated attention module enhances by identifying the most significant contributing interpretability factors.

A hybrid CNN model integrated Genetic Algorithm (GA) and Particle Swarm Optimization (PSO) to optimize CNN parameters for LSM in Icheon, South Korea [12]. The hybrid framework enhanced model robustness and adaptability across diverse geospatial conditions. Performed a relative analysis of [13] several conventional CNN architectures, including VGG16, ResNet50, and InceptionV3, to evaluate their suitability for LSM across different geomorphological regions. This study lies in its systematic assessment of CNN models, providing clear guidance in architecture selection, based on performance metrics and computational efficiency. The observation showed that deeper architectures such as ResNet50 and InceptionV3 outperform shallower models like VGG16 in capturing spatial patterns and improving generalization. A multi-scale CNNs to integrate remote sensing imagery with DEM-derived factors for both landslide inventory mapping and susceptibility assessment [14]. The multi-scale design enhanced the network's ability to detect landslides of varying sizes and under diverse environmental conditions. Its hierarchical feature extraction improved adaptability to different spatial resolutions and enabled better detection of small or obscured landslide areas. Proposed a Multi-dimensional Deep CNN (MDCNN) [15] incorporating optimized sample selection algorithms to balance landslide and non-landslide samples enhanced resilience against overfitting. Explored transfer learning-based CNN models [16] to improve LSM in data-scarce regions. The approach utilized pre-trained CNNs, such as VGG16 and ResNet50, which were fine-tuned with landslide conditioning factors This approach includes reduced training time, improved generalization across diverse terrains, and greater explain ability through visualization techniques like Grad-CAM.

Table 2. Survey assessment of Deep Learning for LSM

Reference	Title	Method used	Algorithm used	Tool used	Country /Data used	AUC	Key Limitations
Azarafza et al. (2021) [9]	Deep learning-based landslide susceptibility mapping	Deep learning	CNN or related deep neural networks (DNN)	deep learning frameworks	Iran	AUC = 0.94	Requires large training datasets. Limited interpretability of deep features. Computationally intensive for high-resolution Dems
Ullo et al. (2021) [10]	A new mask R-CNN-based method for improved landslide detection	Deep learning / object detection	Mask R-CNN (with transfer learning; backbones ResNet-50, ResNet-101)	TensorFlow, Google Colab, image augmentation tools, VGG Image	Himalaya	Accuracy ≈ 90%	Requires extensive labelled landslide masks. Sensitive to image segmentation accuracy. Computationally demanding.

Yang et al. (2022) [11]	Landslide susceptibility mapping based on CNN-3D algorithm with attention module embedded	CNN-3D with attention (deep learning)	3D convolutional neural network, spatial-channel attention module embedded	Deep learning frameworks (Python, TensorFlow / PyTorch)	Jiuzhaigou, China; Iburi, Japan;	0.97	Complex parameter tuning and high computational cost. Generalization limited to study region. DEM preprocessing errors can affect results.
Hakim et al (2022) [12]	Convolutional neural network (CNN) with metaheuristic optimization algorithms for landslide susceptibility mapping in Icheon, South Korea	Deep learning with metaheuristic optimization	CNN, metaheuristic optimization (e.g. genetic algorithm or similar)	optimization / deep learning tools	Icheon, South Korea	0.95	Computational complexity due to optimization. Sensitive to initial parameter settings. Overfitting risk in small datasets.
Aslam et al. (2023) [13]	Comparative analysis of multiple conventional neural networks for landslide susceptibility mapping	Comparative analysis of conventional neural networks (CNN, ResNet, etc.)	CNN architecture s, ResNet, etc.	Python / deep learning frameworks	Northern Pakistan (Mansehra & Muzaffarabad districts)	AUC range : 0.89–0.94	Ignored spatial–temporal dynamics. Overfitting risk with limited data. Lack of interpretability.
Zhang et al. (2024) [14]	Multi-scale convolutional neural networks (CNNs) for landslide inventory mapping from remote sensing imagery and landslide susceptibility mapping (LSM).	Remote Sensing Imagery Analysis	Multi-scale CNNs	Python, TensorFlow	hunan province , china	0.93	Sensitive to scale variation. High computational demand. No uncertainty analysis.
Wang et al. (2024) [15]	Utilizing deep learning approach to develop landslide susceptibility mapping considering	DL for LSM	Three-dimensional CNNs(1D,2D,3D)	Python at Github (https://github.com/csugeo3-ai/CNN4LSM).	Data from Zigui-Badong section of the Three Gorges	0.93	Model integration adds redundancy. Transferability not evaluated. Lacks model interpretability.

	landslide types.				Reservoir area		
Liu et al. (2025) [16]	Landslide susceptibility mapping using CNN models based on factor visualization and transfer learning.	CNN with Transfer Learning	CNN	-	GEE, Sentinel-2, https://developers.google.com/earth-engine	0.94	CNN requires heavy computation. Small datasets favor traditional ML. Limited interpretability of CNN outputs.

2.3 Ensemble learning Based LSM

In their methodological design, [17] developed a deep hybrid ensemble combining CNN, Generalized Linear Models (GLM), and RF to capture both spatial and statistical relationships in the Indian Himalayan region. The model achieved superior performance (AUC > 0.95) compared to individual algorithms, demonstrating the effectiveness of integrating DL with traditional ML methods for modeling complex and heterogeneous terrains. Similarly, [18] constructed a framework that integrates multiple base classifiers including RF, SVM, DT, KNN, Gradient Boosting Machines (XGBoost and LightGBM), and Naive Bayes (NB) which are combined using various ensemble strategies. Moreover, the research underlined that tacking ensembles can reduce uncertainty and improve spatial generalization, making them particularly suitable for data-driven LSM in complex terrains. In another regional comparison, [19] evaluated multiple tree-based ensemble models including RF, XGBoost, CatBoost, and LightGBM for LSM in Murgul, Turkey. The results indicated that CatBoost and XGBoost obtained the maximum accuracy for prediction, while RF remained a robust and interpretable. The study emphasized the effectiveness of tree-based ensemble methods in handling nonlinear relationships and heterogeneous geospatial data. Proposed hybrid ensemble machine learning models [20] that integrate RF, XGBoost, and SVM for LSM in the Shimla district of the Indian Himalayas. The hybrid stacking approach enhanced model extends robustness and adaptability in heterogeneous terrains, and leveraged the complementary strengths of multiple learners, particularly in complex mountainous regions with varied landslide inventories. Finally, [21] explored an advanced gradient boosting and DL methods for LSM in Yanchuan, China, using CatBoost, LightGBM, and DNNs within a Python ArcGIS integrated framework. The study enhanced model transparency with SHAP (SHapley Additive exPlanations) feature importance interpretation, but encountered limitations such as high computational demands, challenges in deep model tuning, and a lack of temporal dynamics in the analysis. These studies collectively show that ensemble learning approaches such as boosting and stacking consistently deliver a higher accuracy in LSM than single models. The challenges remain, including high computational demands, sensitivity to parameter settings, and limited interpretability.

Table 3. Survey assessment of Ensemble learning for LSM

Reference	Title	Method used	Algorithm used	Tool used	Country/ Data used	AUC	Key Limitations
Saha et al. (2022) [17]	Prediction of spatial landslide susceptibility applying the novel ensembles of CNN, GLM and random forest in the Indian Himalayan region	Ensemble modeling (stacking / hybrid)	GLM, RF, CNN, and ensembles combining them (GLM-RF, CNN-RF, CNN-GLM, CNN-GLM-RF) (Research	GIS for spatial preprocessing, ML / DL frameworks (Python / R) (implicit)	Bhagirathi basin, Uttarakhand, India	0.943	Limited generalization due to small training dataset and topographic bias, spatial overfitting risk noted

			Gate)				
Zeng et al. (2023) [18]	An Ensemble Framework of Bagging, Boosting, and Stacking for Landslide Susceptibility Mapping	Ensemble Framework	Bagging, Boosting, Stacking	Python (scikit-learn, TensorFlow/Keras for MLP), GIS software (ArcGIS/QGIS)	Southwest China	0.91	Proposed general ensemble framework, stacking outperformed bagging and boosting when base models were diverse.
Usta et al. (2024) [19]	Comparison of tree-based ensemble learning algorithms for landslide susceptibility mapping in Murgul (Artvin), Turkey.	Comparison of Tree-Based Ensemble Learning	Tree-Based Ensemble Models	ArcGIS 10.5, SAGA GIS 7.9, Python and Scikit-learn library	Landslide data from Murgul, Turkey	0.978	Model performance highly dependent on terrain factors and lacks spatial transferability across similar lithologic zones
Sharma et al. (2024) [20]	Effectiveness of hybrid ensemble machine learning models for landslide susceptibility analysis: Evidence from Shimla district.	Hybrid Ensemble Machine Learning	RF, MLP, SMOreg and bagging ensemble (B-RF, BSMOreg, B-MLP) models,LSM	ArcGIS 10.8 software, WEKA	Shimla district landslide data	0.952	Limited input variable diversity and absence of temporal validation data to test long-term model reliability
Chen et al. (2024) [21]	Exploring advanced machine learning techniques for landslide susceptibility mapping in Yanchuan County, China	Machine learning, possibly hybrid / ensemble	Multiple advanced ML techniques (boosting, ensemble)	ML toolkits (e.g. scikit-learn, etc.)	Yanchuan County (China)	0.963	Model validation lacked field verification; imbalance in landslide-to-non-landslide ratio may inflate AUC

2.4 Hybrid Learning Based LSM

Hybrid techniques in recent decades have gained a significant attention across various domains of LSM improved stability and accuracy. The study of [22] proposed a hybrid physical DL framework that integrates physically based landslide prediction models with CNNs for regional-scale mapping in China. This method includes enhanced physical interpretability and improved spatial generalization. Another study employed a statistical machine intelligence hybrid model for the Nilgiri district, India [23], by integrating the Frequency Ratio (FR) method with RF and SVM classifiers using R and ArcGIS. The hybrid model achieved more accuracy prediction and enhanced map stability. The study focuses in interpretability and the effective integration of data-driven learning with statistical insights. Designed a deep hybrid CNN–LSTM Attention model [24] for LSM in Kerala, India, implemented using Tensor Flow with GIS-based spatial data preprocessing. The model effectively captured both spatial and temporal dependencies, while the attention mechanism refined the dynamic significance of conditioning factors. It includes high spatial temporal resolution and strong adaptability to varying rainfall patterns.

Developed a hybrid study uniting a Genetic Algorithm–optimized Random Forest (GA-RF) with a Self-Attention CNN–LSTM framework to analyze LSM in the Darjeeling and Kurseong regions of India [25]. Implemented using TensorFlow, Keras, and ArcGIS, the model effectively integrated feature selection with spatial–temporal feature extraction. The model achieved superior results by effectively capturing nonlinear topographic patterns and dynamic rainfall sequences. The Bidirectional Long Short-Term Memory (BiLSTM) is a type of RNN architecture used primarily for sequence modeling tasks, such as NLP or time series forecasting. Introduced a CNN–BiLSTM Attention hybrid DL techniques for LSM, leveraging Sustainability’s remote sensing datasets from China [26]. The integration of an Attention Mechanism (AM) enabled the model to prioritize key spatial–temporal features, enhancing both interpretability and prediction accuracy. Presented a knowledge-guided CNN integrated with Graph Contrastive Learning (GCL), incorporating domain knowledge on slope morphology and topological relationships [27] among terrain units. The study concentrating in the fusion of graph-based relational reasoning with image-based spatial learning, resulting in robust predictions across complex terrains. In CNN–Transformer hybrid model that considered local and global landslide structures for susceptibility mapping [28]. The CNNs and Transformer, allowing it to catch local feature patterns together and long-range, global dependencies in data the hybrid model with an advanced hybridized bootstrap aggregating approach (bagging)-based algorithms in decision tree for LSM, which improved model robustness and reduced variance by combining multiple tree-based learners [29]. Approach demonstrated a superior predictive reliability across multiple test regions. The study enhances this combination through further hybridization or modification to improve performance for the particular task of LSM.

Table 4. Survey assessment of Hybrid Learning for LSM

Reference	Title	Method used	Algorithm used	Tool used	Country/Data used	AUC	Key Limitations
Wei et al. (2021) [22]	A hybrid framework integrating physical model and convolutional neural network for regional landslide susceptibility mapping	Hybrid (physical, DL)	Physical model, CNN	deep learning frameworks	China, Fengjie	0.94	Integration of physical parameters with deep networks increases computational load and may reduce interpretability
Yuvaraj et al. (2021) [23]	Statistical and machine intelligence-based model for landslide susceptibility mapping of Nilgiri district in India	Hybrid of statistical, ML	Probably logistic regression, other ML	ML environment (R / Python)	Nilgiri district, India	0.95	Sensitive to resolution of spatial data; absence of temporal validation limits dynamic applicability
Chen et al. (2022) [24]	CNN-LSTM-ATTENTION Deep Learning Model for Mapping Landslide Susceptibility in Kerala, India	Hybrid deep learning (CNN, LSTM, attention)	CNN, LSTM, Attention mechanism	deep learning libraries	Kerala, India	0.96	Fully connected layers limit feature extraction efficiency; model complexity increases memory requirements

Moghimi et al. (2024) [25]	Hybridizing Genetic Random Forest and Self-Attention Based CNN-LSTM Algorithms for Landslide Susceptibility Mapping in Darjiling and Kurseong, India	Hybrid	GA-RF , CNN-LSTM	Landslide data (spatial-temporal , DEM, rainfall)	Darjiling, India	0.96	GA optimized RF for feature selection, CNN-LSTM captured spatial-temporal features; hybrid improved accuracy and generalization.
Ju et al. (2024) [26]	Landslide Susceptibility Assessment Using a CNN-BiLSTM-AM Model	Hybrid deep learning	CNN, BiLSTM, Attention Module (AM)	deep learning frameworks	Qinghai Tibet plateau	0.97	Model requires extensive training data and GPU resources; minor overfitting possible due to feature redundancy
Liu et al. (2024) [27]	A Knowledge-Guided Approach for Landslide Susceptibility Mapping Using Convolutional Neural Network and Graph Contrastive Learning	Hybrid / knowledge-guided deep learning	CNN, Graph Contrastive Learning	deep learning frameworks (e.g. PyTorch / TensorFlow)	china	0.94	Lack of alignment between augmentation and contrastive objectives; unsupervised paradigm increases class ambiguity under uncertain conditions
Zhao et al. (2024) [28]	Landslide Susceptibility Mapping Considering Landslide Local-Global Features Based on CNN and Transformer.	Deep Learning with Local-Global Feature Consideration	CNN and Transformer	Python 3.8 environment, Keras2.4.3 AI, PyCharm 2021	Google Earth	0.98	High model complexity need more datasets labelled and struggles with generalization to unseen topographies
Moradmand et al. (2025) [29]	Enhancing landslide susceptibility mapping through advanced hybridization of bootstrap aggregating-based decision tree algorithms	Hybrid Decision Tree Model with Bootstrap Aggregating	Decision Tree, Bagging	Python 3.8 environment, Keras 2.4.3 AI , PyCharm 2021	Gollojeh Watershed, Zanjan Province, Iran	0.95	Dependence on bootstrapped sampling may lead to reduced performance in heterogeneous terrains and computational cost is high for large datasets

2.5 Graph based learning Based LSM

The application of Graph-based DL models (GCN, GNN, GRU-GCN) and advanced architectures (KNN-GCN, Dual-GCN, GRU-GCN) has enabled the powerful capture of spatially progressive dependencies in landslide processes. The remote sensing data integrated with (SDGSAT-1, InSAR, Sentinel-2) represents a significant progress toward more accurate and explainable LSM. Graph-structured data representing both the features of individual data points (nodes) and their relationships (edges). Developed a Graph Convolutional Network (GCN) [30] integrated with a GRU to forecast landslide displacement using GNSS observations. This hybrid model captured both spatial correlations and the temporal evolution of displacement data. Experimental results demonstrated high predictive accuracy, highlighting the method's effectiveness for real-time displacement forecasting. A GCN-based landslide susceptibility model incorporating active deformation information from InSAR data [31]. By integrating deformation measurements, the model enhanced its ability to detect slope instability. The GCN architecture effectively captured spatial relationships and deformation dynamics, resulting comparative analysis of higher prediction accuracy to RF and CNN models. Projected a Dual Graph Convolutional Network (DGCN) [32] integrated with a GoogLeNet CNN for automatic landslide detection. The model combined spectral-spatial features of graph-based contextual information from satellite derived data. This dual architecture enhanced classification accuracy, outperforming standalone CNN or GCN models. Proposed the KNN-GCN model, [33] which integrates the KNN algorithm with GCN for slope-unit-based LSM. This hybrid approach captures spatial correlations between slope units, mitigating constraints of pixel-based models that neglect neighborhood relationships. The model demonstrated superior AUC and precision compared to CNN and RF approaches. The consuming LSM in multi-scale slope units derived from SDGSAT-1 data and GNNs [34]. The study integrated topographic, hydrological, and remote sensing factors into a multi-scale graph structure to enhance spatial learning. Results demonstrated that GNNs outperformed traditional ML studies, such as RF and SVM, in both predictive accuracy and generalization.

Table 5. Survey assessment of Graph based learning for LSM

Reference	Title	Method used	Algorithm used	Tool used	Country/Data used	AUC	Key Limitations
Jiang et al. (2022) [30]	A Graph Convolutional Incorporating GRU Network for Landslide Displacement Forecasting Based on Spatiotemporal Analysis of GNSS Observations	Graph-based / Hybrid (GNN, RNN)	GC-GRU Network (Graph Convolution + GRU for temporal modeling)	PyTorch, Pandas, NumPy, GNSS data pipeline, Matplotlib	Three Gorges Reservoir, China	0.97	High training time; requires continuous GNSS data; may suffer from long-term drift in temporal prediction.
Xia et al. (2024) [31]	KNN-GCN: A Deep Learning Approach for Slope-Unit-Based Landslide Susceptibility Mapping Incorporating Spatial Correlations	Graph-based / GCN	KNN-GCN (Graph Convolutional Network) using K-nearest neighbor graph on slope units	Python (TensorFlow/Keras), Network, QGIS, SAGA GIS	Austria (Slope-unit dataset)	0.83	High computational cost for dense graphs; performance depends on K-value tuning and graph connectivity accuracy.
Liu et al. (2023) [32]	Automatic landslide identification by Dual Graph Convolutional Network and	Graph-based / Hybrid	DGCN integrated with GoogLeNet	TensorFlow, Keras, OpenCV, GDA, ArcGIS	Tuerge Township, Xinjiang	0.98	Complex model training; requires large annotated datasets; may

	GoogLeNet model	(GCN, CNN)		S	g, China		overfit on small samples.
Wang et al. (2023) [33]	Landslide susceptibility evaluation based on active deformation and graph convolutional network algorithm	Graph-based / GCN	GCN with topological adjacency between slope units and rainfall as features	PyTorch, SNAP (ESA Sentinel Toolbox), ArcGIS	Wanzhou District, Three Gorges Reservoir, China	0.94	Requires accurate topological graph construction; sensitive to missing or noisy deformation data.
Lei et al. (2025) [34]	Investigating the landslide susceptibility assessment methods for multi-scale slope units based on SDGSAT-1 and Graph Neural Networks	Graph-based / GNN	GNN model on multi-scale slope units using SDGSAT-1 remote sensing data	Python, PyTorch Geometric, ArcGIS 10.8, ENVI 5.6, SDGSAT-1 satellite imagery	Jiulong County, Ganzi, China	0.90	Requires multi-scale data preparation; computationally heavy for large regions; model interpretability can be limited.

Materials and Methods

The conditioning factor groups represent the key controlling elements that influence the occurrence and distribution of landslides. Topographic factors describe terrain characteristics such as elevation, slope, and curvature, which directly control slope stability. Hydrological factors reflect surface and subsurface water conditions, including drainage and proximity to rivers, which strongly affect soil saturation and pore-water pressure. Geological factors represent the underlying rock and structural conditions, while geomorphological factors describe landform types and slope units that indicate terrain evolution and instability zones. Land use and surface factors capture human and vegetation influences on slope conditions, whereas climatic factors, particularly rainfall, act as major triggers for landslides. Structural factors such as faults and lineaments indicate zones of weakness in the earth's crust. Anthropogenic factors reflect human interventions like roads and settlements that modify natural slopes. Soil factors control infiltration, cohesion, and shear strength of slope materials. Advanced studies also incorporate remote sensing features derived from satellite imagery, deformation or monitoring data such as InSAR and GNSS for detecting ground movement, and temporal or sequential factors to model time-dependent landslide. Recently, graph and spatial relation factors have been used to capture spatial dependencies between slope units. Finally, the landslide inventory serves as the fundamental reference dataset, providing historical landslide locations for model training and validation.

Table 6. Data Sources for Landslide Conditioning Factors Used in the Reviewed Studies

Conditioning Factor	How It Is Obtained	Data Sources Used in Refs. [1–34]
Rainfall	Gauge records or satellite-based gridded products	IMD (India), national meteorological agencies, TRMM, GPM, CHIRPS
Land Use / Land Cover (LULC)	Supervised / unsupervised classification of satellite imagery	Landsat (USGS), Sentinel-2 (ESA), NRSC–Bhuvan, MODIS
Elevation	Directly extracted from DEM	SRTM (30 m), ALOS PALSAR DEM, ASTER GDEM
Slope	Derived from DEM using GIS spatial analysis	SRTM / ALOS / ASTER DEM
Aspect	Derived from DEM using terrain	SRTM / ALOS / ASTER DEM

	analysis	
Curvature (plan, profile, total)	Derived from DEM	SRTM / ALOS / ASTER DEM
Lineament/density	Digitized or automatically extracted	Landsat, Sentinel-2, Google Earth, geological maps
Drainage/Density	DEM-based hydrological extraction or digitized maps	SRTM DEM, Survey of India (SOI) toposheets
Geology	Vector geological maps	Geological Survey of India (GSI), national geological surveys
Geomorphology	Interpretation of landforms from RS & maps	NRSC–Bhuvan, GSI geomorphological maps
Distance to Road	Euclidean distance analysis	OpenStreetMap (OSM), SOI road layers
Distance to River / Stream	Euclidean distance analysis	DEM-derived drainage, SOI toposheets
Soil Type	Soil classification maps	NBSS & LUP (India), FAO soil database
Fault / Thrust Distance	Structural geology layers	GSI tectonic maps, national geological databases
Landslide Inventory	Historical records, interpretation, field validation	GSI, state disaster authorities, Google Earth, field surveys

Table 7. Landslide Conditioning Factors Used in the Reviewed Studies (Refs. [1–34])

Factor Category	Conditioning Factors Used	Representative References
Topographic Factors	Elevation, Slope, Aspect, Curvature (plan/profile/general), Roughness, TWI	[2–9], [11–17], [19–26], [29], [33], [34]
Hydrological Factors	Drainage network, Drainage density, Distance to river/stream, SPI	[2–5], [7–9], [17–21], [23–26], [33]
Geological Factors	Lithology, Geology, Faults/Thrusts, Distance to fault	[2–8], [15–17], [19–21], [23], [29]
Geomorphological Factors	Geomorphology, Landform classes, Slope units	[3], [7], [14], [21], [27], [33], [34]
Land Use / Surface Factors	LULC, NDVI, Vegetation cover	[2–5], [7–9], [12–18], [21], [23–26]
Climatic Factors	Rainfall (annual, monthly, extreme), precipitation indices	[1–5], [7–9], [15–18], [20], [23–26]
Structural Factors	Lineament, Lineament density	[2–5], [7–9], [19], [21], [23], [29]
Anthropogenic Factors	Distance to road, Distance to settlement, Road density	[2–5], [7–9], [17], [19–21], [23], [25]
Soil Factors	Soil type, Soil depth, Soil texture	[4], [7], [8], [21], [23]
Remote Sensing Features	Spectral bands, texture features, backscatter	[9–16], [28], [32]
Deformation / Monitoring Data	InSAR deformation, GNSS displacement	[30], [31]
Temporal / Sequential Factors	Rainfall time series, displacement time series	[24], [26], [30]
Graph / Spatial Relation Factors	Slope-unit adjacency, spatial correlation, graph topology	[27], [30–34]
Landslide Inventory	Historical landslide locations (dependent variable)	All studies [1–34]

The relative usage of widely adopted models in landslide susceptibility mapping (LSM) reflects recent research trends. Among the various approaches, Random Forest (RF) exhibits the highest usage, indicating its strong preference due to robustness, ease of implementation, and reliable performance with heterogeneous geospatial data.

Convolutional Neural Networks (CNNs) and ensemble methods (e.g., bagging and stacking) also show very high adoption, highlighting the increasing reliance on deep learning for spatial feature extraction and on ensemble strategies to enhance prediction stability and accuracy. Gradient Boosting and XGBoost models demonstrate similarly high usage, underscoring their effectiveness in capturing nonlinear relationships and complex interactions among landslide conditioning factors. CNN–LSTM hybrid models show substantial adoption, emphasizing the growing importance of jointly modeling spatial and temporal dependencies, particularly in rainfall-triggered and dynamic landslide analyses. Support Vector Machines (SVMs) continue to be widely used as benchmark models, although their usage is relatively lower than that of tree-based and deep learning approaches. Finally, Graph Convolutional Networks (GCNs), despite being the least used among the listed models, represent an emerging trend in LSM due to their capability to explicitly model spatial connectivity and slope-unit relationships shown in Figure 2.

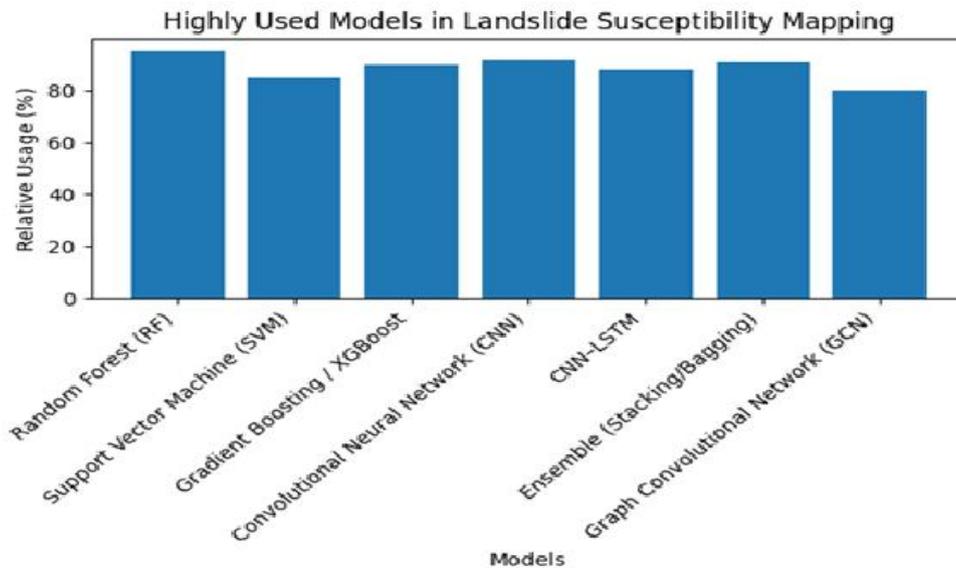


Figure 2. Models used in LSM

Comparative Analysis

This review demonstrates a methodological evolution from traditional ML toward DL hybrid, ensemble, and graph-based frameworks highlights the progressive evolution of LSM techniques are given in Figure 3. Traditional ML approaches remain valuable for baseline studies because of their low data requirements, good interpretability, and computational efficiency. Standalone DL techniques, such as CNN, LSTM, and Vision Transformers, significantly improve predictive accuracy by learning complex spatial and temporal patterns from raster data, however, they are often limited data, computationally expensive, and operate as black-box models. Ensemble learning methods enhance model robustness and prediction stability by combining multiple learners, and do not explicitly represent terrain connectivity. This limitation is addressed through Graph-based learning which explicitly models spatial relationships among slope units and challenges related to graph construction, scalability, and computational overhead. Finally, hybrid learning improves feature representation, prediction accuracy and model reliable and realistic susceptibility maps in complex terrains.

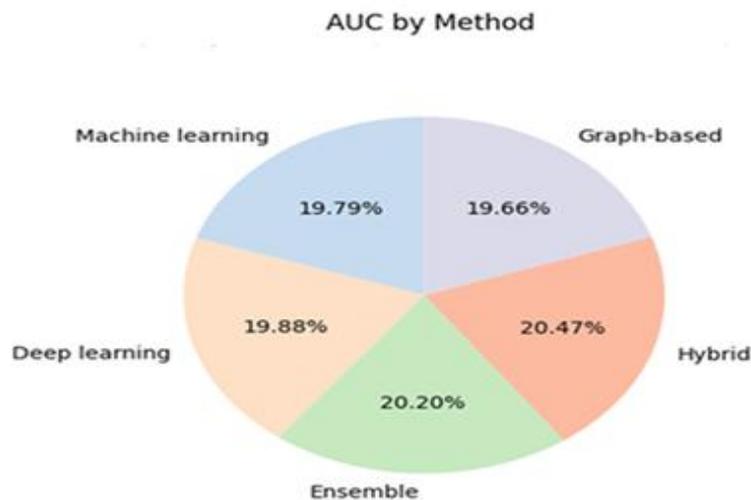


Figure 3. Performance Comparison of LSM Models Based on AUC Values

Table 8. Comparison of LSM Modeling Techniques

Model Category	Representative Algorithms	Key Strengths	Major Limitations	Suitability in LSM
Traditional Machine Learning	RF, SVM, LR, KNN	Low data requirement; interpretable; computationally efficient	Poor spatial dependency modelling, limited generalization	Small-medium areas, baseline studies
Deep Learning (DL)	CNN, LSTM, ViT, DNN	Captures complex nonlinear patterns; high predictive accuracy	Data-hungry, black-box behavior, high computation	High-resolution raster-based LSM
Ensemble Learning	XGBoost, LightGBM, Bagging, Stacking	High AUC; robust to noise; stable predictions	Computationally heavy; weak spatial realism	Regional-scale susceptibility mapping
Hybrid Models	CNN-LSTM,	Combines strengths of multiple models; improved accuracy	Complex design; low reproducibility, overfitting risk	Advanced research-oriented LSM
Graph-Based Learning	GCN, GAT, CNN-GCN	Explicit spatial dependency; terrain connectivity modeling	Graph construction complexity, scalability issues	Complex mountainous terrains

Results & Discussion

In LSM studies, results describe the outcomes obtained after applying a specific model or analysis to landslide-related data, highlighting the observed susceptibility patterns, prediction performance, and spatial relationships that demonstrate the effectiveness and reliability of the adopted approach.

Table 9. Hybrid DL Models for LSM

Hybrid DL Model Category	Representative Algorithms	Key Strengths	Limitations	Suitability in LSM
CNN + DBN	CNN-DBN, CNN-RBM	High spatial feature extraction with probabilistic learning, robust to noise performs well with limited landslide samples	High computational cost, complex training, limited interpretability	★★★★★ Excellent for high-resolution susceptibility mapping in complex terrain
CNN + RNN / LSTM / GRU	CNN-LSTM, CNN-GRU	Captures both spatial patterns and temporal rainfall or deformation trends	Requires long time-series data, high memory and training time	★★★★ Ideal for rainfall-triggered and dynamic landslides
CNN + GNN (Graph-CNN)	CNN-GCN, CNN-GAT, IED-GCN	Integrates pixel-level texture with slope-unit spatial relationships reduce noise and interaction with neighbouring area.	Graph construction sensitive, high computational complexity	★★★★★ Best for slope-unit-based regional LSM
CNN + Transformer	CNN-ViT, CNN-Swin Transformer	Learns long-range spatial dependencies, strong generalization ability and landslide condition in one location influenced by distant terrain or regional pattern.	Data-hungry, requires huge labelled datasets	★★★★ Suitable for large-area mapping using high-resolution imagery
ML + DL Hybrid	CNN + Random Forest, CNN + XGBoost	Combines deep feature learning with robust tree-based classification. Work with limited datasets from large and multisource datasets	Feature fusion design is non-trivial, tuning complexity	★★★★ Useful when DL features are used with classical ML
Ensemble-DL Hybrids	CNN-RF-XGBoost, CNN-Stacking	Improves robustness and accuracy by combining multiple DL architecture reducing individual model and uncertainty.	High computational demand, reduced interpretability	★★★★ Suitable for operational-scale LSM

From the table 9 the results indicate that hybrid deep learning models significantly enhance landslide susceptibility mapping by integrating CNN with complementary learning architectures. CNN-DBN and CNN-RBM models achieve excellent performance in complex terrains by combining strong spatial feature extraction. CNN-LSTM and CNN-GRU models effectively capture both spatial patterns and temporal rainfall or deformation trends, making them highly suitable for rainfall-triggered and dynamic landslides, although they require long time-series data and substantial computational resources. CNN-GNN models, including CNN-GCN and CNN-GAT, improve susceptibility mapping by explicitly modeling slope-unit connectivity and neighborhood interactions. CNN-Transformer-based models demonstrate strong generalization capability by learning long-range spatial dependencies, which is beneficial for large-area mapping using high-resolution imagery. ML-DL hybrid models,

such as CNN combined with Random Forest or XGBoost, provide reliable performance by integrating deep feature learning with robust tree-based classification, particularly under data-scarce conditions. Ensemble–DL hybrid frameworks increase prediction accuracy and robustness by reducing individual model uncertainty. Overall, hybrid deep learning models provide a flexible, powerful, and reliable framework for high-resolution and operational-scale LSM, particularly in complex and heterogeneous terrains

Conclusion

This survey reveals that the fusion of AI in advancing landslide susceptibility mapping. Across global studies, by reducing reliance on manual feature production, ML and DL methods have significantly enhanced the accuracy and automation of susceptibility assessments. Ensemble methods like stacking and boosting improve prediction stability and generalization, while GNN and GCN architectures enable topologically aware susceptibility modeling by combining data-driven learning with spatial graph theory. This survey comprehensively examined the evolution of LSM techniques, ranging from traditional ML and DL models to ensemble, graph-based, and hybrid frameworks. Recent advances indicate that Hybrid DL models are the most promising direction for LSM, as they integrate complementary learning mechanisms and overcome the restrictions of specific models. Overall, the hybrid architecture provides improved predictive accuracy, enhanced spatial coherence, and stronger generalization capability compared to DL and ensemble models. This present research will adopt a hybrid framework to develop a more accurate and reliable landslide susceptibility model.

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THE IMPACT OF ARTIFICIAL INTELLIGENCE ON INDIA'S COOPERATIVE SECTOR - A STUDY

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Abstract

In order to improve operational effectiveness and financial transparency, the Indian cooperative sector which consists of more than 8 lakh societies and roughly 29 crore members is incorporating artificial intelligence (AI). AI tools, such as data analytics and machine learning, are helping cooperative banks analyze credit risk, dairy cooperatives with quality management, and agricultural cooperatives with crop forecasts. Government programs are encouraging the use of AI in spite of obstacles, including low levels of digital literacy and gaps in infrastructure. Modernizing the industry, bolstering rural economies, encouraging financial inclusion, and fostering sustainable growth are all possible outcomes of this integration. Objectives of the study include understanding AI's impact in the cooperative sector and identifying challenges faced by this sector. The research utilized secondary data exclusively, drawing from government reports, policy documents, research articles, official statistics, and publications related to digital initiatives like Digital India. The study involved comprehensive analysis and interpretation of data to explore the implications, applications, and difficulties associated with AI in India's cooperative sector. The present research paper entitled on The Impact of Artificial Intelligence on India's Cooperative Sector - A Study.

Introduction

India has one of the biggest cooperative sectors in the world, with over 8.4 lakh cooperative societies and around 29 crore members. It makes major contributions to rural development, dairy, banking, housing, and agriculture. The distribution of credit in rural areas is significantly influenced by the more than 63,000 Primary Agricultural Credit Societies (PACS). As India progresses towards digital transformation, artificial intelligence (AI) is becoming a potent instrument for updating this extensive network. Artificial intelligence (AI) tools, including automation, machine learning, and data analytics, are strengthening credit evaluation, boosting productivity, improving decision-making, and boosting transparency in collaborative operations. Adoption of AI has significant potential to increase efficiency, encourage financial inclusion, and assist sustainable growth in the economy in India, as the cooperative sector serves millions of rural households.

Objectives of The Study

An overview of the AI impact in the cooperative sector

To identify the challenges faced by the AI cooperative sector

Methods and Materials

The only source of data used in this study is secondary. Government reports, policy documents, research articles, official statistics, publications from the cooperative sector, and reports from digital initiatives like Digital India are some of the published sources from which the data was gathered. A thorough research, analysis, and interpretation of pertinent data and literature were conducted in order to comprehend the implications, uses, and difficulties of artificial intelligence (AI) in India's cooperative sector.

An Overview of the AI Impact in Cooperative Sector

The ability of computer systems and machines to carry out tasks that typically require human intelligence, like learning, reasoning, problem-solving, and decision-making, is known as artificial intelligence (AI). AI uses technologies like machine learning, natural language processing, and robotics to analyze large amounts of data, find patterns, and make predictions or automated responses based on that information. AI is currently used widely in industries like healthcare, banking, agriculture, education, and business to increase efficiency, accuracy, and productivity. As the world continues its digital transformation, AI is becoming a crucial tool for innovation and sustainable development.

India's cooperative sector, which includes over 8.4 lakh cooperative societies and serves around 29 crore members in the fields of agriculture, dairy, credit, housing, and marketing, is one of the biggest and most significant socioeconomic networks in the world. The foundation of rural loan distribution is made up of the more than 63,000 Primary Agricultural Loan Societies (PACS). India is the biggest producer of milk in the world, and dairy cooperatives are essential to both distribution and purchase. Artificial Intelligence (AI) is becoming a change agent in this enormous ecosystem. In order to enhance crop yield prediction, animal health monitoring, loan risk assessment, fraud detection, supply chain optimization, and digital member services, artificial intelligence (AI) technologies like machine learning, data analytics, predictive forecasting, and automation are being adopted. Even though the use of AI in cooperative institutions is still in its infancy, particularly among smaller cooperative banks and rural communities, technological integration is speeding up due to national initiatives like Digital India and the Ministry of Cooperation's institutional strengthening. Since millions of rural households in India rely on cooperatives for financial access and a living, integrating AI has the potential to significantly improve productivity, efficiency, transparency, and inclusive economic growth.

Major Roles of AI in the Cooperative Sector in India



Transforming Cooperatives with Artificial Intelligence

The Info Picture

In terms of the sector, AI is revolutionizing India's cooperative movement. AI boosts transparency, lowers operating costs, and encourages data-driven governance in a variety of contexts, including supply chain management, banking efficiency, and agricultural productivity. AI has the potential to greatly modernize cooperatives while upholding their fundamental principles of inclusive growth and mutual assistance when backed by programs like Digital India.

Challenges Faced by the AI Cooperative Sector

Although artificial intelligence (AI) has a lot to offer the cooperative sector in India, there are a number of structural and practical obstacles to its adoption.



Elements of Such Recommendation

The successful integration of artificial intelligence (AI) in India's cooperative sector depends on bolstering digital infrastructure, particularly in rural regions, and giving cooperative employees and members sufficient training to increase their digital literacy. The government can provide financial assistance and subsidies to smaller cooperatives so they can use AI technologies without incurring significant costs. AI solutions can be made more practical and inexpensive by promoting relationships with startups and technology suppliers. AI integration in the cooperative sector will also be safe, inclusive, and sustainable with the backing of programs like Digital India, as well as robust data security measures and explicit regulatory guidelines from authorities like the Ministry of Cooperation.

Conclusion

In India, where there are more than 8.4 lakh cooperative societies with about 29 crore members, artificial intelligence (AI) is starting to change the cooperative industry. In the fields of agriculture, dairy, banking, housing, and marketing, artificial intelligence (AI) holds promise for modernizing traditional cooperative operations through increased efficiency, improved transparency, strengthened financial services, and data-driven decision-making. Supportive programs like Digital India and policy recommendations from the Ministry of Cooperation might hasten adoption even though obstacles like inadequate infrastructure, gaps in digital literacy, and budgetary limitations still exist. The long-term viability of India's cooperative movement, inclusive growth, and rural development can all be greatly aided by AI with the right application and careful planning.

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A DESCRIPTIVE STUDY ON CHALLENGES AND OPPORTUNITIES OF MANAGING INNOVATION WITH SPECIAL MENTION REGARDING DIGITALISATION

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Abstract

The word “innovation” is derived from the Latin verb innovate, which means to renew. Innovation means to improve or to replace something. Innovation is a process by which a domain, a product, or a service is renewed and brought up to date by applying new processes, introducing new techniques, or establishing successful ideas to create new value. Right Mindset for Innovation is 1. Break the rules, 2) Collect ideas everywhere and 3) Believe in the impossible. Top Challenges and opportunities of Innovation Challenges of innovation is 1) Impractical expectations for innovation 2) Unempowered innovation teams 3) Lack of innovation strategies 4) Weak innovation culture 5) Lack of managerial support 6) Resistance to change 7) Lack of internal and external collaboration 8) Difficulty in transitioning from one phase to the next 9) Incorrect innovation KPIs 10) Futile innovation toolbox. Opportunities of Innovations are 1) Develop the ‘test small, fail quick, and learn quickly’ mindset. 2) Developing innovation strategies and projects together with employees 3, Create a specific set of objectives and define how you can possibly and efficiently attain them. 4) Discover what needs to be done by learning from current innovation culture. 5) Be very clear on your innovation plans and execution methods. 6) Emphasize the benefits that you can all get in implementing your innovation initiatives. 7) Incentivize marketable ideas. 8) Risks should be assessed ahead of time. 9) include both results and conditions for success in your innovation KPI scorecard. 10) Choose an innovation software.

Introduction

The word “innovation” is derived from the Latin verb innovare, which means to renew. In essence, the word has retained its meaning up until today. Innovation means to improve or to replace something, for example, a process, a product, or a service. In the context of companies, however, the term needs a definition. In the complex context of business, a definition is needed. Applying new processes, introducing new techniques, or establishing successful ideas to create new value. Innovation is a process by which a domain, a product, or a service is renewed and brought up to date by The creation of value is a defining characteristic of innovation.

Why is Innovation So Important

Organizations have several options to increase their competitiveness: they can strive for price leadership or develop a strategy of differentiation. In both cases, innovation is essential.

Companies that choose price leadership must secure their long-term competitiveness by developing innovative, highly efficient processes. Process optimization and continuous improvement in terms of costs are important for them.

Companies that strive for a differentiation strategy need innovation to develop unique distinguishing features to their competitors.

Many start-ups launch their activities by developing an innovative product or service.

Continuous innovation is, therefore, crucial for all companies. The main difference is in the focus of the innovation strategy, which varies considerably from company to company.

“Although innovation has always been one of the driving forces in competition and has always been a primary competitive dimension, the numerous studies and publications of recent years show that the speed of change is increasing.”

This makes innovation one of the most important drivers for the long-term success of companies. Accordingly, methods of collaboration and teamwork are increasingly being used in numerous companies, for example, to promote digital innovations and overcome the challenges of digital change.

Innovation requires a higher degree of creativity than the operative business and a clear innovation strategy, especially in the phase of the so called “fuzzy front end of innovation“.

Concepts like lean innovation and the establishment of community-based innovation networks become increasingly relevant.

Companies are using modern idea management software and innovation management software to manage innovation efficiently.

The Right Mindset for Innovation

Innovation requires more creativity and more willingness to take risks than the implementation of typical projects. To successfully realize innovation projects, a different mindset is needed. We have created four cartoons, which you are welcome to include in presentations or on your website with reference (backlink) to this page.

1. Break the rules!

With traditional approaches and conventional methods, you will often not get anywhere in the field of innovation. Challenge the status quo consistently! And explore new paths off the beaten track.

2. Collect ideas everywhere!

Innovation projects constantly need new ideas: To overcome obstacles, to change concepts, and to optimize strategies.

3. Believe in the impossible!

Imagine how your innovation will look like in reality. And believe that you will be able to overcome all obstacles on the way to realization.

4. Put together an innovation team of individuals with different perspectives and thinking styles!

Innovation needs the diversity of various competencies and diverse ways of thinking.

The Different Types of Innovation

In the context of businesses, there are different types of innovation.

- 1. Process improvement and organizational innovation:** The improvement of processes through continuous improvement and the development of new solutions.
- 2. Product development:** The development of innovative products or product features
- 3. Service innovation:** The creation and introduction of new services for customers and partners.
- 4. Business Model Innovation:** The development of innovative business models and new revenue streams.

Literature Review

This campaign has made the country digitally empowered in the area of technology. The regulated government of India has made its grounds for making the availability of government services electronically. The enhanced online infrastructure and by extending Internet connectivity have eased the work of citizens. In 25 years, there have been lots of advanced changes in India, it is leading the digital revolution.

Introduction to the Digital Revolution in India

Since 2014 the Indian government has taken active participation in bringing digitalization by various measures. Such an example is demonetization, which has gained global attention and has been associated with short-term job losses and economic slowdowns. However, it also shows compliance for government leadership to drive India's digital transformation. (Times of India)

Innovation is a key factor in charting out the growth trajectory for India's technology sector, and open innovation programmes are increasingly being included in agendas to drive business growth, according to industry body Nasscom's report. The report mooted key measures to develop a strong open innovation ecosystem in the country.

The suggestions include the creation of a single platform for all innovation programmes, a national repository of startups, the establishment of more ecosystem enablers, the creation of open innovation marketplace, dedicated incubation /acceleration programmes, joint open innovation programmes with other nations and incentivizing key programmes for startups and corporates.

Indian enterprises and startups are increasingly leveraging external knowledge and ecosystem for their innovation management strategies said the new report by the National Association of Software and Services Companies (NASSCOM) in partnership with Aventure Advisors.

"Innovation is one of the key factors defining the growth trajectory for India's technology sector and open innovation models are rapidly emerging as a source of innovation and rapid solutioning," it said. A growing roster of stakeholders is including open innovation programmes in their agenda, and various open innovation models are fuelling this need for cross-industry collaboration both for business growth and to maintain a competitive edge.

The report highlighted that a vibrant collaboration model built by corporates, academia, investors and associations is gradually shaping the open innovation ecosystem in India.

With over 500 collaboration programmes, open innovation in India, though nascent, has been increasingly adopted by stakeholders as one of the successful ways of collaboration.

More than 80 programmes have been set up by large Indian enterprises and global multinational companies, and over 360 by academic institutions.

At the same time, investors and government agencies are actively setting up incubators, accelerators and partner programmes to drive open innovation in the country. Over 55 such programmes have been set up by individual investors or a group of investors, the Nasscom report said. Nasscom President Debjani Ghosh noted that open innovation brings in a plethora of opportunities for stakeholders, helping them tap multiple market opportunities.

"India can take the cue from economies like France, Germany, Switzerland and Israel, where a developed ecosystem is enabling greater collaboration between its stakeholders," Ghosh added. (Economic Times – 2022)

Research Problem

To understand the challenges and opportunities of managing innovations especially with regard to digitalization.

Objectives of the Study

1. To identify the challenges of managing innovations.
2. To identify the opportunities of managing innovations.
3. To identify examples of successful innovation management.
4. To identify opportunities and challenges connected with digitalization of India.

Variables Under Study

1. Challenges of innovation
2. Opportunities or solutions of facing innovation successfully.
3. Examples of innovations connected with digitalization.

Challenges of Innovation

1. Impractical expectations for innovation

Sometimes, in innovation, we sensationalize, overestimate, and overpromise an idea that generates an expectation threshold that is difficult to meet. For others, the problem often comes from the fact that under-promising may not help your team obtain the traction you need among investors to secure a suitable investment to push your innovation project through

2. Unempowered innovation teams

Some innovation managers are concerned that innovation would divert the attention of their workforce from their daily tasks and responsibilities. As a result, some employees don't feel equipped not motivated to participate in the exploration of new ideas or even in discussions related to the company's innovation activities.

3. Lack of innovation strategies

Creating a coherent innovation plan is critical, just like any other organizational endeavour. An innovation strategy directs the course of innovation, as well as its practical execution. Without one, efforts to innovate risk becoming misaligned.

4. Weak innovation culture

For instance, when an individual feels that the company's mechanisms are not in place for implementing innovative ideas, then innovation will never be on top of their priorities. Or worse, they may never take it seriously, which may then affect productivity, efficiency, and deadlines.

5. Lack of managerial support

Managerial support for innovation is critical in enhancing organizations' economic competitiveness. However, some executives find it challenging to support innovation efforts, not because they underestimate the function or importance of innovation in growth. But because other elements of proposed innovation activities — such as projected ROI, methods, targets, and prospective results — are vague and ambiguous.

6. Resistance to change

Employees, for example, maybe resistant to this because they are concerned that changes would make them obsolete. Resistance can also stem from the fear of the unknown when the learning process is seen to be excessively difficult.

7. Lack of internal and external collaboration

Internal and external collaboration is essential in the generation of novel ideas. Collaboration within departments — and even with customers — can quickly fix difficulties with new ideas that have the potential to alter your industry. Furthermore, by obtaining suggestions from diverse groups of individuals, a wide range of viewpoints may be considered in enhancing or developing product and service lines.

8. Difficulty in transitioning from one phase to the next

Given that the innovation team is composed of different people with diverse ideas, this could potentially become a problem as their opposing views could affect their way of working towards an accessible and meaningful output.

9. Incorrect innovation KPIs

Traditional KPIs, like sales volume or income, may not provide your firm with the best insight into innovation performance. As not everything in innovation can be accurately quantified, it is critical for businesses to identify appropriate measurements for evaluating certain elements of innovation.

10. Futile innovation toolbox

Without access to powerful innovation tools, it's impossible to manage innovation and keep track of your innovation initiatives in today's highly competitive business environment.

Opportunities or Solutions of Successful Innovation Management.

1. Develop the a 'test small, fail quick, and learn quickly' mindset.
2. Developing innovation strategies and projects together with employees
3. Create a specific set of objectives and define how you can possibly and efficiently attain them.
4. Discover what needs to be done by learning from current innovation culture.
5. Be very clear on your innovation plans and execution methods.
6. Emphasize the benefits that you can all get in implementing your innovation initiatives.
7. Incentivize marketable ideas.
8. Risks should be assessed ahead of time.
9. include both results and conditions for success in your innovation KPI scorecard.
10. Choose an innovation software.

Examples of Successful Innovation Management

Domino's

Anyone who's familiar with Domino's' digital strategy probably isn't surprised to see the American pizza restaurant chain occupying the top spot on our list of companies that have mastered digital innovation. Founded in 1960, Domino's has become one of the most celebrated comeback stories of the business world, and for a very good reason. "Domino's is a technology company disguised as a marketing company disguised as a pizza company," a JP Morgan analyst famously said. In the 90s, when most other pizza companies were just starting to become aware of the existence of the world wide web, Domino's was already working tirelessly on establishing its online presence, launching its first website in 1996 and making it part of its company culture.

Nike

Nike is an American sportswear company. Sometime around 2017, they realized that while they were one of the most recognizable brands worldwide, their brand image has weakened – they were perceived as just another sportswear company. Having that in mind, Nike decided on a digital transformation focused on enhancing brand image and customer experience. They set 3 goals:

1. Double the innovation.
2. Double the speed to market.
3. Double direct connection points to customers.

Nike started with a more effective use of analytics, focusing on digital consumer data. They also updated their ecommerce strategy with things such as improved UX (user experience) and better-adjusted membership options. Their offline activities corresponded with online marketing strategy.

Digitalization

Digitization is the process of changing from analog to digital form, also known as digital enablement. Said another way, digitization takes an analog process and changes it to a digital form without any different-in-kind changes to the process itself.

Modifying business models by the adoption of digital technologies to create value by using advanced technologies is Digitalization. The aim is to upgrade processes by exploiting new digital dimensions and digitizing the flow of information.

Steps

Here is a complete process for successful digitalization:

Step 1: Creation of the right mindset.

Step 2: Take the right leadership on board.

Step 3: Launching a Digital Business Center that ensures excellence.

Step 4: Developing a digital strategy to know the threats and opportunities.

Step 5: Develop and explore digital business skills and personnel (roles).

Step 6: Creation of a new digital business capability.

Opportunities for Businesses

- 1. Automation Through Advanced Technologies** - Advanced Technologies like Artificial Intelligence, Computer Vision, and Machine Learning has taken various sectors of life to automation. We find its applications in health, eCommerce, education, finance, manufacturing, and the list goes on. After the pandemic of Covid-19, these technologies are growing fastly, and many institutions are enjoying its fruits. These technologies will be matured in the upcoming 2-5 years, providing more automation and accuracy to businesses and other sectors of life.
- 2. Accelerating Customer Experience** - Digitalization accelerates better customer experience. We can observe many retailers in our surroundings who have gone online and have built their eCommerce store. It makes it easy for the customers to buy things online then to physically visit a store.
- 3. Redefining Customers Journey** - This pandemic has given a 360-degree shift to businesses. Now, businesses are redefining their customer needs. Not only for customers but also for their employees as well.
- 4. Challenges associated with Digitalization**
 - Lack of analytics
 - Absence of omnichannel
 - Talent acquisition

Conclusion

This study underscores the pivotal role of innovation in driving business competitiveness, with digitalization emerging as a key catalyst. The findings highlight the complexities of managing innovation in the digital era, where organizations must navigate challenges such as unrealistic expectations, inadequate innovation strategies, and talent acquisition, while capitalizing on opportunities presented by digital technologies. The cases of Domino's and Nike exemplify the transformative potential of digital innovation, underscoring the need for businesses to embed innovation into their core strategies. As India's digital landscape continues to evolve, it is imperative for organizations to prioritize innovation management, leveraging digitalization to enhance customer experiences, drive growth, and maintain a competitive edge. Ultimately, this research contributes to the burgeoning discourse on innovation management, providing insights for scholars and practitioners seeking to navigate the intricacies of innovation in the digital age.

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AI-POWERED EMPLOYEE ENGAGEMENT AND EXPERIENCE

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Abstract

Artificial Intelligence (AI) is reshaping employee engagement and employee experience (EX) by enabling real-time, data-driven workforce management. Unlike traditional methods such as annual surveys, AI-powered tools use machine learning, natural language processing, and predictive analytics to monitor engagement levels, detect burnout risks, forecast attrition, and personalize development pathways. These systems enhance decision-making, streamline HR services, and improve organizational responsiveness across the employee lifecycle. However, effective implementation requires careful attention to data privacy, transparency, and ethical governance. When applied responsibly, AI strengthens organizational resilience and supports a human-centered approach to workplace innovation.

1. Introduction

The workplace is undergoing unprecedented transformation driven by digitalization, globalization, demographic shifts, and evolving employee expectations. Organizations are no longer evaluated solely by financial performance but also by their ability to create meaningful and engaging work environments. Employee engagement and employee experience have emerged as strategic priorities because they directly influence productivity, innovation, retention, and organizational culture.

In this context, Artificial Intelligence has emerged as a powerful tool capable of revolutionizing workforce management. AI refers to computer systems designed to perform tasks that typically require human intelligence, such as learning, reasoning, pattern recognition, and decision-making. In HR and organizational management, AI is increasingly used to analyze workforce data, automate repetitive tasks, and deliver personalized employee interactions.

The shift from traditional HR practices to AI-powered systems reflects the need for agility and responsiveness. Annual engagement surveys and manual data analysis are insufficient in capturing the dynamic sentiments of employees working in hybrid or remote environments. AI enables continuous listening, real-time analytics, and predictive forecasting, empowering leaders to make informed decisions that enhance employee satisfaction and organizational effectiveness.

2. Conceptual Foundations

2.1 Employee Engagement

Employee engagement refers to the level of emotional commitment, enthusiasm, and dedication employees bring to their roles. Engaged employees are more likely to demonstrate discretionary effort, collaborate effectively, and align their goals with organizational objectives. Engagement is influenced by leadership quality, communication transparency, career growth opportunities, recognition systems, and workplace culture.

2.2 Employee Experience (EX)

Employee experience encompasses every interaction employees have with their organization throughout their lifecycle—from recruitment and onboarding to development, performance management, and exit. It includes physical, technological, and cultural dimensions. A positive employee experience fosters trust, belongingness, and long-term commitment.

AI enhances both engagement and experience by personalizing interactions and providing data-driven insights that guide strategic improvements.

3. Technologies Enabling AI-Powered Engagement

3.1 Machine Learning

Machine learning algorithms analyze historical and real-time data to identify patterns and predict outcomes. In engagement management, ML models forecast attrition risk, identify performance trends, and detect disengagement signals.

3.2 Natural Language Processing (NLP)

NLP enables AI systems to interpret human language. It is used in sentiment analysis to evaluate employee feedback from surveys, emails, and collaboration platforms, providing insights into morale and workplace climate.

3.3 Predictive Analytics

Predictive analytics uses statistical models and data mining techniques to forecast future workforce trends. Organizations use it to anticipate turnover, skill shortages, and engagement fluctuations.

3.4 AI Chatbots and Virtual Assistants

AI-powered chatbots provide 24/7 HR support, answering employee queries related to policies, benefits, payroll, and training. This enhances accessibility and reduces administrative workload.

3.5 Robotic Process Automation (RPA)

RPA automates repetitive HR tasks such as payroll processing, attendance tracking, and document management, allowing HR professionals to focus on strategic initiatives.

4. Applications Across the Employee Lifecycle

4.1 Recruitment and Onboarding

AI streamlines candidate screening by analyzing resumes and matching skills to job requirements. Intelligent onboarding platforms personalize training content and provide interactive support, accelerating integration.

4.2 Continuous Feedback and Sentiment Monitoring

AI tools conduct pulse surveys and analyze communication data to assess real-time sentiment. Leaders can respond promptly to emerging concerns, improving transparency and trust.

4.3 Learning and Development

AI-driven learning management systems recommend customized courses based on employee performance and career aspirations. This fosters continuous skill enhancement.

4.4 Performance Management

Analytics dashboards provide objective performance metrics, reducing bias and supporting fair evaluations. Managers receive data-backed recommendations for coaching and development.

4.5 Retention and Workforce Planning

Predictive models identify high-risk employees and recommend interventions such as mentorship programs or career progression opportunities.

5. Benefits of AI-Powered Employee Engagement

1. **Real-Time Insights:** Continuous monitoring enables proactive decision-making.
2. **Personalization:** Tailored learning and career pathways enhance motivation.
3. **Efficiency:** Automation reduces administrative burden.

4. **Data-Driven Decisions:** Objective analytics improve fairness.
5. **Enhanced Retention:** Early detection of disengagement reduces turnover.
6. **Improved Well-being:** Monitoring burnout indicators promotes healthier workplaces.

6. Challenges and Ethical Considerations

6.1 Data Privacy

Employee data must be protected through encryption, consent policies, and compliance with regulations.

6.2 Algorithmic Bias

AI systems trained on biased data may perpetuate discrimination. Regular auditing is necessary to ensure fairness.

6.3 Transparency

Employees must understand how AI systems operate and how their data is used.

6.4 Resistance to Change

Adoption requires digital literacy training and clear communication to mitigate fear and skepticism.

7. The Role of Leadership

AI does not replace human leadership; it enhances it. Managers must interpret analytics insights with empathy and emotional intelligence. Effective leaders combine data-driven strategies with authentic communication to build trust.

8. Future Trends

1. **Emotion AI:** Deeper analysis of employee well-being.
2. **Generative AI:** Personalized communication and knowledge management.
3. **Virtual Reality Training:** Immersive learning experiences.
4. **Hyper-Personalized Workspaces:** Adaptive digital environments.

The future workplace will integrate AI seamlessly into daily operations while maintaining human-centered values.

Conclusion

AI-powered employee engagement and experience represent a transformative evolution in workforce management. By integrating advanced analytics, machine learning, and automation, organizations can create adaptive, inclusive, and high-performing environments. AI enables continuous listening, predictive insights, and personalized development, shifting HR from reactive administration to strategic partnership.

However, technological advancement must be balanced with ethical responsibility and human empathy. Data privacy, fairness, transparency, and trust are foundational pillars for sustainable AI adoption. Organizations must ensure that AI systems augment human interaction rather than replace it.

Ultimately, the synergy between artificial intelligence and human intelligence will define the future of work. Organizations that strategically leverage AI to enhance engagement and experience will achieve improved retention, innovation, productivity, and long-term competitive advantage. AI is not merely a technological tool; it is a catalyst for creating meaningful, empowered, and resilient workplaces in the digital era.

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ETHICAL AND RESPONSIBLE USE OF ARTIFICIAL INTELLIGENCE IN HUMAN RESOURCE MANAGEMENT: IMPLICATIONS FOR EMPLOYEE WELL-BEING

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Abstract

Artificial Intelligence (AI) has emerged as a transformative force in Human Resource Management (HRM). Organizations are increasingly adopting AI-driven tools for recruitment, performance evaluation, employee engagement, and workforce analytics. While AI enhances operational efficiency and decision-making accuracy, it also raises critical ethical and human concerns. This paper examines the ethical and responsible use of AI in HRM and its implications for employee well-being.

The study is conceptual in nature and based on secondary data collected from journals, books, and credible online sources. The findings reveal that AI offers significant advantages such as improved productivity, reduced administrative burden, and personalized employee development. However, the misuse or unregulated application of AI may lead to job insecurity, privacy invasion, algorithmic bias, and psychological stress among employees.

The paper emphasizes the need for a responsible AI framework that prioritizes transparency, fairness, accountability, and human oversight. It concludes that AI can contribute positively to both organizational performance and employee well-being when implemented ethically and strategically.

Keywords: Artificial Intelligence, HRM, Employee Well-being, Ethical AI, Responsible HR Practices

Introduction

The rapid advancement of Artificial Intelligence (AI) has significantly transformed modern organizational practices. AI technologies such as machine learning, natural language processing, and predictive analytics are increasingly integrated into business operations. Among various functional areas, Human Resource Management (HRM) has experienced one of the fastest rates of AI adoption.

Traditionally, HRM relied heavily on human judgment, interpersonal relationships, and manual decision-making. However, the growing availability of big data and intelligent systems has shifted HR practices toward automation and analytics-driven processes. Organizations now use AI tools for resume screening, employee monitoring, performance evaluation, and workforce planning.

Despite its advantages, the integration of AI into HRM raises important ethical and human-centric concerns. Employees may experience anxiety about job displacement, loss of privacy, and lack of transparency in automated decisions. Therefore, organizations must ensure that AI adoption in HRM remains ethical, responsible, and focused on employee well-being.

Objectives of the Study

The present study is undertaken with the following objectives:

To Understand the Role of Artificial Intelligence in Human Resource Management

Artificial Intelligence (AI) has emerged as a transformative force in Human Resource Management (HRM), reshaping traditional HR functions into more data-driven and efficient processes. AI refers to the use of intelligent algorithms and machine learning systems that can analyze large volumes of employee data, predict outcomes, and support decision-making. In the HR context, AI is commonly applied in recruitment, onboarding, performance management, training, employee engagement, and workforce analytics.

One of the most significant roles of AI in HRM is in the recruitment process. AI-powered tools can screen resumes, shortlist candidates, conduct preliminary interviews through chatbots, and match job requirements with candidate

profiles. This reduces the time and cost involved in hiring while improving the accuracy of candidate selection. Similarly, AI enhances employee training through personalized learning platforms that identify skill gaps and recommend suitable development programs.

AI also plays an important role in performance management by enabling predictive analytics. HR managers can use AI to identify high-performing employees, forecast attrition risks, and design retention strategies. Moreover, AI-driven employee engagement tools such as virtual assistants and sentiment analysis systems help organizations understand employee feedback in real time. Overall, AI supports HR professionals by automating routine tasks and enabling more strategic decision-making.

To Examine the Impact of AI-Driven HR Practices on Employee Well-being

The integration of AI in HR practices has a significant impact on employee well-being, which includes psychological, emotional, social, and professional aspects of an employee's work life. On the positive side, AI reduces repetitive and manual workload through automation, allowing employees to focus on more meaningful and creative tasks. This can improve job satisfaction and work-life balance. AI-powered learning platforms also support continuous skill development, which enhances employees' career growth and confidence.

However, the use of AI in HRM also raises concerns that may negatively affect employee well-being. One major issue is job insecurity. As automation increases, employees may fear job displacement, leading to stress and anxiety. Continuous monitoring through AI-based productivity tracking tools can create a sense of surveillance among employees, which may reduce trust and increase workplace pressure.

Privacy is another important concern. AI systems often rely on large amounts of personal and behavioral data, and employees may feel uncomfortable about how their information is collected and used. Additionally, reduced human interaction in AI-mediated workplaces can affect employees' sense of belonging and emotional connection with the organization. Therefore, while AI has the potential to enhance well-being, its impact largely depends on how responsibly it is implemented.

To Identify the Ethical Challenges Associated with AI Implementation in HRM

The adoption of AI in HRM brings several ethical challenges that organizations must carefully address. One of the most critical issues is algorithmic bias. AI systems learn from historical data, and if the training data contains bias related to gender, age, or background, the AI may produce discriminatory outcomes in recruitment or promotion decisions. This can undermine fairness and equal opportunity in the workplace.

Another major ethical concern is lack of transparency. Many AI systems operate as "black boxes," meaning employees and even HR managers may not fully understand how decisions are made. This lack of explainability can reduce employee trust and make it difficult to challenge unfair decisions. Accountability is also a key issue—when AI makes a wrong decision, it is often unclear who is responsible: the HR manager, the developer, or the organization.

Data privacy and security represent additional ethical risks. HR departments handle sensitive employee information, and misuse or leakage of such data can seriously harm employees. Ethical concerns also arise when AI is used for excessive employee monitoring, which may violate personal boundaries and workplace dignity. Addressing these ethical challenges is essential to ensure that AI adoption in HRM remains fair, transparent, and human-centered.

To Suggest a Responsible AI Framework for Sustainable HR Practices

To ensure the ethical and effective use of AI in HRM, organizations must adopt a responsible AI framework that balances technological efficiency with human values. A human-centric approach should be the foundation of AI implementation. AI systems must support human decision-making rather than completely replace human judgment, especially in sensitive HR functions such as hiring and performance evaluation.

Fairness and bias mitigation should be a priority. Organizations must regularly audit AI algorithms to detect and eliminate discriminatory patterns. Using diverse and representative training data can help reduce bias in AI outcomes. Transparency is equally important—employees should be informed about how AI systems are used and how decisions affecting them are made. Explainable AI models can improve trust and acceptance among employees.

Strong data governance and privacy protection measures must also be implemented. Organizations should collect only necessary data, store it securely, and comply with relevant data protection regulations. Employee consent and awareness should be ensured before deploying AI-based monitoring tools.

Finally, continuous monitoring and ethical review mechanisms should be established. HR professionals must be trained to work alongside AI systems responsibly. By adopting a well-structured responsible AI framework, organizations can achieve sustainable HR practices that enhance both organizational performance and employee well-being.

Research Methodology

This study is conceptual and descriptive in nature. It is based entirely on secondary data collected from academic journals, conference papers, books, industry reports, and authenticated online databases. Relevant literature relating to AI applications in HRM and employee well-being was carefully reviewed and analyzed.

No primary data were collected for this study. The analysis focuses on synthesizing existing knowledge to understand the ethical implications of AI-driven HR practices and to propose suitable recommendations.

Application of AI in Human Resource Management

Artificial Intelligence (AI) is increasingly reshaping Human Resource Management by introducing automation, predictive insights, and data-driven decision-making. The integration of AI into HR functions enables organizations to improve efficiency, accuracy, and strategic planning. Major areas of AI application in HRM include recruitment, training and development, performance management, employee engagement, and workforce analytics. While these applications provide significant benefits, they also require careful ethical consideration.

AI in Recruitment and Selection

Recruitment is one of the most widely transformed HR functions through AI adoption. AI-powered Applicant Tracking Systems (ATS) can screen thousands of resumes within seconds, significantly reducing the time and cost involved in the hiring process. These systems use keyword matching and predictive algorithms to identify the most suitable candidates based on job requirements.

Chatbots are increasingly used as virtual recruitment assistants. They interact with candidates, answer frequently asked questions, schedule interviews, and provide real-time updates on application status. This improves candidate experience and reduces the administrative burden on HR professionals.

AI is also being used in video interview analysis, where intelligent systems evaluate facial expressions, tone of voice, and communication patterns to assess candidate suitability. Although this improves efficiency, organizations must ensure that such tools do not introduce bias or unfair judgment during candidate evaluation.

AI in Training and Development

AI has significantly enhanced employee training and development by enabling personalized and adaptive learning experiences. Traditional one-size-fits-all training programs are being replaced by intelligent learning systems that analyze employee skill gaps and performance data to recommend customized learning paths.

AI-powered Learning Management Systems (LMS) track employee progress, identify areas for improvement, and suggest relevant courses. This ensures continuous skill development and supports employees in upgrading their competencies according to organizational needs.

Moreover, AI-driven analytics help HR managers identify high-potential employees who may benefit from leadership development programs. By aligning training with individual needs, AI contributes to improved employee engagement and career growth. However, organizations must ensure that employees are not overly dependent on automated learning recommendations without human mentoring support.

AI in Performance Management and Workforce Analytics

AI plays a crucial role in modern performance management systems by providing data-driven insights into employee productivity and organizational performance. Predictive analytics tools analyze historical performance

data to identify trends, measure employee contributions, and forecast future outcomes.

Through workforce analytics, HR managers can detect early signs of employee attrition and design proactive retention strategies. AI systems can also help in goal tracking, continuous feedback mechanisms, and performance benchmarking across departments.

However, excessive reliance on AI-based monitoring may create a perception of constant surveillance among employees. If not implemented carefully, it may lead to stress, reduced trust, and concerns about workplace privacy. Therefore, organizations must balance performance analytics with respect for employee autonomy and dignity.

Ethical Considerations in AI-Based HR Applications

While AI applications significantly improve HR efficiency, they also introduce concerns related to fairness, transparency, and human dignity. Algorithmic bias remains a major risk, particularly in recruitment and performance evaluation systems. If AI models are trained on biased historical data, they may unintentionally discriminate against certain groups.

Transparency is another important issue. Employees should clearly understand how AI systems influence decisions affecting their careers. Lack of explainability can reduce trust in HR processes. Additionally, extensive data collection for AI analytics raises serious privacy concerns.

To address these challenges, organizations must implement ethical guidelines, regularly audit AI systems, and maintain human oversight in critical HR decisions. Responsible and transparent use of AI is essential to ensure that technological advancement does not compromise employee rights and well-being.

Impact of AI on Employee Well-Being

Employee well-being refers to the overall physical, psychological, and emotional health of employees in the workplace. The implementation of AI in HRM has both positive and negative implications for employee well-being.

Positive Impacts

AI reduces repetitive administrative work, allowing employees to focus on more meaningful and creative tasks. Automation can improve work-life balance by minimizing workload pressure. AI-driven learning platforms enhance career growth opportunities through personalized development programs.

Additionally, AI-based analytics can help organizations identify employee burnout risks early and take preventive measures. When used responsibly, AI can contribute to a healthier and more productive work environment.

Negative Impacts

Despite its benefits, AI adoption may create job insecurity among employees who fear automation will replace human roles. Continuous digital monitoring through AI surveillance tools can increase stress and reduce trust in management.

Privacy concerns also arise when organizations collect and analyze large volumes of employee data. Algorithmic bias in AI systems may lead to unfair decisions in hiring or promotions, negatively affecting employee morale and organizational justice perceptions.

Ethical Challenges in AI-Driven HRM

One of the most significant ethical issues is algorithmic bias. If AI systems are trained on biased historical data, they may produce discriminatory outcomes against certain groups. This undermines fairness and equal opportunity in the workplace.

Data privacy is another major concern. AI-based HR systems often store sensitive employee information, including behavioral and performance data. Without proper safeguards, this information may be misused or exposed to security risks.

Transparency and explainability are also critical. Employees may not understand how AI systems make decisions

affecting their careers. Lack of accountability in automated decision-making can erode trust between employees and management.

Responsible AI Framework for Hrm

To ensure ethical implementation, organizations must adopt a responsible AI framework in HRM. The framework should emphasize human-centric design, fairness, transparency, accountability, and data protection.

First, AI systems should support—not replace—human decision-making in critical HR functions. Human oversight must be maintained in recruitment, promotions, and performance evaluation.

Second, organizations should conduct regular bias audits to ensure fairness in AI algorithms. Third, strong data governance policies must be implemented to protect employee privacy.

Finally, employees should be educated about AI usage in the workplace to build trust and reduce anxiety. Ethical AI governance can create a balanced environment where technology and human values coexist.

Conclusion

Artificial Intelligence is revolutionizing Human Resource Management by improving efficiency, accuracy, and strategic decision-making. However, its impact on employee well-being depends largely on how responsibly it is implemented.

The study highlights that while AI offers numerous organizational benefits, unethical or excessive reliance on automation may harm employee trust, privacy, and job security. Therefore, organizations must adopt a human-centered and ethically governed approach to AI in HRM.

Responsible AI implementation, supported by transparency, fairness, and strong data protection measures, can enhance both organizational performance and employee well-being. Future research may focus on empirical studies to measure the real-time impact of AI on workplace psychology.

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ARTIFICIAL INTELLIGENCE DRIVEN WORKFORCE PLANNING AND ANALYTICS ENHANCING SUSTAINABLE BUSINESS PERFORMANCE AMONG HOMEPRENEURS

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Abstract

This study examines the role of Artificial Intelligence (AI) driven workforce planning and analytics in enhancing sustainable business performance among homepreneurs, grounded in the Resource-Based View (RBV) theory. As digital technologies increasingly shape micro and home-based enterprises, understanding how intelligent workforce systems contribute to long-term sustainability becomes essential. Using data collected from 348 homepreneurs engaged in digitally supported business activities, the study analyses the direct impact of AI-enabled workforce planning on sustainable performance, along with the mediating role of workforce analytics capability and the moderating influence of digital readiness. The findings suggest that AI-driven workforce planning has a significant impact on enhancing sustainable business performance by improving strategic decision-making, operational efficiency, and resource utilisation. Workforce analytics capability partially mediates this relationship by enabling entrepreneurs to translate data insights into practical business actions. However, digital readiness plays a conditional role, as limited technological preparedness can reduce the overall effectiveness of AI-based initiatives. The study contributes to RBV by demonstrating how intelligent workforce systems function as strategic resources that support resilience, innovation, and competitive sustainability among homepreneurs. The findings highlight the importance of strengthening digital skills, infrastructure, and technology adoption to promote inclusive and sustainable microenterprise development.

Keywords: Artificial Intelligence, Workforce Planning, Workforce Analytics, Digital Readiness, Sustainable Business Performance, Homepreneurs.

1. Introduction

Micro and small enterprises (MSEs) play a vital role in economic and social development, particularly in emerging economies, by generating employment, reducing poverty, and supporting inclusive growth. Home-based and micro-entrepreneurs largely depend on their skills and adaptability to survive in competitive markets; however, they often face constraints such as limited access to working capital, stringent financial requirements, and low financial literacy. Entrepreneurial competencies, including opportunity recognition, strategic thinking, innovation, and relationship management, are key drivers of business success. Government support, through finance, training, and innovation incentives, strengthens competitiveness and sustainability. However, limited studies have integrated these factors into a single framework. Therefore, this study proposes a model examining the direct effects of entrepreneurial competencies and government support on sustainable business performance, the mediating role of competitive advantage, and the moderating effect of access to working capital.

2. Literature Review

2.1. Theoretical Foundation

This study is grounded in the Resource-Based View (RBV), which highlights that sustainable advantage stems from valuable and inimitable resources. For SMEs, technological capability and financial access are key assets. In the digital context, AI-driven workforce planning enhances decision-making and efficiency, with employee performance and operational efficiency acting as mediators, and working capital and government support serving as moderators of sustainable business performance.

2.2. Homepreneurs and SME Performance

Home-based entrepreneurship makes a significant contribution to employment and inclusive growth. However, homepreneurs often face financial limitations, weak technological infrastructure, and informal workforce practices.

Strengthening workforce planning through AI analytics can enhance productivity, strategic alignment, and overall business performance.

2.3. Artificial Intelligence, Innovation Ecosystems, and Competitive Performance

Innovation ecosystems and digital transformation enhance SME competitiveness by improving planning, workforce efficiency, and decision-making through the use of AI-driven analytics. Government support and digital finance further promote innovation and growth. However, limited research has examined their impact on sustainable performance among homepreneurs, providing the foundation for this study and its hypothesis.

H1: AI-driven workforce planning and analytics have a positive effect on sustainable business performance among homepreneurs.

2.4. Mediating Role of Employee Performance and Operational Efficiency

Employee performance has a significant impact on the competitiveness and outcomes of SMEs. AI-driven analytics enhance monitoring, skill alignment, and task allocation, thereby improving productivity and engagement, which in turn support both financial and non-financial performance.

H2: Employee performance positively mediates the relationship between AI-driven workforce planning and sustainable business performance.

Operational efficiency reflects optimal resource utilisation to maximise output. AI-based scheduling and predictive analytics reduce inefficiencies and improve coordination, strengthening SME performance and resilience.

H3: Operational efficiency positively mediates the relationship between AI-driven workforce planning and sustainable business performance.

2.5. Moderating Role of Access to Working Capital and Government Support

Access to working capital and government support enhances SME competitiveness by enabling investment in AI systems, skills development, and technological upgrades. These factors strengthen the impact of AI-driven workforce planning on performance.

H4: Access to working capital has a positive moderating effect on the relationship between AI-driven workforce planning and sustainable business performance.

H5: Government support has a positive moderating effect on the relationship between AI-driven workforce planning and sustainable business performance.

2.6. Sustainable Business Performance

Sustainable performance includes financial growth, innovation, and long-term resilience. AI-driven workforce planning contributes by improving efficiency, innovation capability, and strategic decision-making.

3. Research Methodology

This study used a cross-sectional quantitative design to examine the impact of AI-driven workforce planning and analytics on sustainable business performance among homepreneurs. A survey approach was applied to test the proposed framework and analyse the relationships between digital strategies and performance outcomes.

3.1. Research Population and Sampling Design

The study focused on homepreneurs in urban and semi-urban areas across digitally active sectors. A stratified cluster sampling method ensured proportional representation, with the sampling frame developed from directories, online networks, and SME associations.

3.2. Sample Size Determination

Following SEM guidelines, 348 valid responses were collected, exceeding the recommended minimum and ensuring adequate statistical power.

3.3. Data Collection Procedure

Data were collected through structured questionnaires using online and offline modes, targeting owner-managers as key decision-makers.

3.4. Measurement of Constructs

Three constructs were measured using a five-point Likert scale, adapted from SME literature. Sustainable performance included financial and non-financial indicators, and content validity was established through expert review.

3.5. Assessment of Common Method Variance (CMV)

To reduce common method bias, respondents were assured of anonymity and confidentiality. Questionnaire sections were clearly separated to create psychological distance between independent and dependent variables.

3.6. Data Screening and Multivariate Normality

The data were screened for missing values, outliers, and multicollinearity before analysis. Given the non-normal nature of SME survey data, PLS-SEM was selected due to its suitability for predictive and complex research models.

3.7. Data Analysis Technique

Structural relationships were analysed using PLS-SEM, which is suitable for complex models and moderate sample sizes. The measurement model was assessed through indicator loadings, composite reliability, AVE, and discriminant validity (Fornell–Larcker and HTMT). The structural model was evaluated using path coefficients, bootstrapping (5,000 resamples), R^2 , f^2 , and Q^2 .

3.8. Ethical Considerations

Participation in the study was voluntary. Respondents were informed about the purpose of the study and assured that their responses would be used strictly for academic research. No personal or sensitive business information was disclosed.

4. Data Analysis and Results

4.1 Preliminary Analysis

Data from 348 homepreneurs were screened for completeness, with minimal missing values addressed through mean substitution. Skewness and kurtosis values indicated acceptable normality, and VIF values below 3.5 confirmed the absence of multicollinearity. Harman’s single-factor test showed 38.6% variance, suggesting common method bias was not a major concern.

4.2 Descriptive Statistics and Correlation Analysis

Descriptive results showed positive relationships among the key variables. AI-driven workforce planning was strongly correlated with employee performance ($r = 0.61$), operational efficiency ($r = 0.58$), and the quality of decision-making ($r = 0.63$). Sustainable business performance was positively associated with all mediating variables, providing initial support for the proposed model.

Table 1: Descriptive Statistics and Correlation Matrix

Variables	Mean	SD	1	2	3	4	5
1. AI Workforce Planning	3.87	0.71	1				
2. Employee Performance	3.94	0.68	0.61**	1			
3. Operational Efficiency	3.76	0.73	0.58**	0.55**	1		
4. Decision-Making Quality	3.89	0.69	0.63**	0.59**	0.60**	1	
5. Sustainable Business Performance	4.02	0.66	0.57**	0.64**	0.62**	0.66**	1

$p < 0.01$

4.3 Measurement Model Assessment

The measurement model was evaluated using PLS-SEM and showed strong reliability (Cronbach’s alpha: 0.81–0.90; composite reliability > 0.70). Convergent validity was confirmed (AVE > 0.50), and discriminant validity was established using the Fornell–Larcker criterion and HTMT ratios below 0.85, indicating satisfactory construct validity.

Table 2: Reliability and Convergent Validity

Construct	Cronbach’s Alpha	Composite Reliability	AVE
AI Workforce Planning	0.88	0.91	0.67
Employee Performance	0.85	0.89	0.62
Operational Efficiency	0.83	0.87	0.58
Decision-Making Quality	0.86	0.90	0.64
Sustainable Business Performance	0.90	0.92	0.70

4.4 Structural Model Results

Using bootstrapping (5,000 resamples), AI-driven workforce planning significantly improved employee performance, operational efficiency, and decision-making, which enhanced sustainable performance. The direct effect remained significant (partial mediation), and the model explained 56% of the variance ($R^2 = 0.56$), indicating moderate explanatory power.

Table 3: Structural Model Path Coefficients

Hypothesis	Path	Beta (β)	t-value	p-value	Result
H1	AI → Employee Performance	0.42	8.21	0.000	Supported
H2	AI → Operational Efficiency	0.39	7.84	0.000	Supported
H3	AI → Decision-Making Quality	0.45	9.12	0.000	Supported
H4	Employee Performance → SBP	0.28	3.98	0.001	Supported
H5	Operational Efficiency → SBP	0.25	3.45	0.002	Supported
H6	Decision Quality → SBP	0.31	4.76	0.000	Supported
H7	AI → SBP (Direct)	0.19	2.41	0.016	Supported

4.5 Mediation Analysis

Bootstrapping confirmed significant indirect effects of AI workforce planning on sustainable performance through all three mediators. The strongest effect was via decision-making quality, followed by employee performance and operational efficiency. As both direct and indirect effects were significant, partial mediation was supported.

Table 4: Mediation Effects

Mediating Path	Indirect Effect	t-value	p-value	Mediation Type
AI → EP → SBP	0.12	3.67	0.001	Partial
AI → OE → SBP	0.10	3.12	0.002	Partial
AI → DQ → SBP	0.14	4.01	0.000	Partial

4.6 Moderation Analysis

Interaction analysis showed that financial resources and digital literacy significantly strengthened the relationship between AI adoption and sustainable business performance. Entrepreneurial competencies also had a positive moderating effect, indicating that complementary capabilities enhance the impact of AI.

Table 5: Moderation Effects

Moderator	Interaction Beta	t-value	p-value	Result
Digital Literacy	0.21	2.98	0.003	Supported
Financial Resources	0.18	2.45	0.015	Supported

Entrepreneurial Competencies	0.17	2.31	0.021	Supported
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4.7 Model Fit and Predictive Relevance

The SRMR value of 0.061 indicates good model fit. The Q^2 value for sustainable business performance was 0.38, confirming strong predictive relevance. Effect size (f^2) values indicated medium effects for AI-driven workforce planning on mediators and sustainable performance.

Findings of Data Analysis

The findings suggest that AI-driven workforce planning has a significant impact on enhancing sustainable business performance among homepreneurs, both directly and indirectly through improved employee performance, operational efficiency, and decision-making quality. Moreover, digital literacy, financial strength, and entrepreneurial competencies amplify the positive effects of AI adoption.

5. Discussion, Implications, and Conclusion

5.1 Discussion

This study found that AI-driven workforce planning significantly enhances sustainable business performance among homepreneurs by improving employee performance, operational efficiency, and decision-making. Consistent with RBV, AI functions as a strategic intangible resource. The results indicate partial mediation through internal capabilities, while digital literacy, financial resources, and entrepreneurial competencies further strengthen its impact.

5.2 Theoretical Implications

The study extends RBV theory to the homepreneur context by positioning AI-driven workforce analytics as a strategic resource. It integrates digital transformation and sustainability literature, advancing SME research by incorporating both mediating and moderating mechanisms, and offering a more comprehensive explanation of how AI improves performance.

5.3 Practical Implications

For homepreneurs: AI should be viewed as a strategic investment that enhances workforce optimisation and long-term sustainability. Developing digital literacy and strategic capabilities is crucial for effective implementation.

For policymakers: AI-focused subsidies, digital infrastructure, and financial support programs can accelerate technology adoption and strengthen SME resilience.

For technology developers: Affordable, scalable AI workforce solutions tailored to micro and home-based enterprises can promote inclusive digital transformation.

5.4 Conclusion

In conclusion, AI-driven workforce planning represents a strategic organisational capability that significantly improves sustainable business performance among homepreneurs. By enhancing productivity, operational efficiency, and data-driven decision-making, AI supports profitability, resilience, and competitive advantage. However, its impact depends on adequate digital readiness, financial strength, and entrepreneurial skills. Overall, AI integration offers a transformative pathway toward long-term sustainability and inclusive growth in the home-based enterprise sector.

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