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NATIONAL CONFERENCE

ON

The Era of Artificial Intelligence (AI) – Opportunities, Challenges & Transformations Across Sectors

NCAI - 2 0 2 6

Jointly Organized By

Departments of Commerce & Accountancy
Bharatiya Vidya Bhavan's, Hazarimal Somani College of Arts and Science
Shri Manubhai Maneklal Sheth Jr. College of Arts and Science, and Jayaramdas Patel College of Commerce and Management Studies, Chowpatty, Mumbai. - 07

AND

Departments of Commerce and Economics
SNDT Women's University, Pune Campus

DAY & DATE

Saturday, 24th January 2026
Time: 9.30 am onwards

VENUE:

Geeta Mandir , Bharatiya Vidya Bhavan
K.M Munshi Marg , Chowpatty , Mumbai. - 07

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Bhavan's, Hazarimal Somani College of Arts and Science, Shri Manubhai Maneklal Sheth Jr. College of Arts and Science, and Jayaramdas Patel College of Commerce and Management Studies, Chowpatty, Mumbai. - 07, affiliated to the University of Mumbai, is a NAAC accredited institution, nestled near the magnificent dome structure of its parent organization, Bharatiya Vidya Bhavan. The college was inaugurated on June 21, 1965, in the esteemed presence of its Founder President, the late Kulapati Dr. K. M. Munshiji, a Member of the Drafting Committee of the Constitution of India. The college is one of the most prestigious institutions in South Mumbai, known for its rich tradition and cultural heritage. It remains dedicated to the vision of its Founding Father, Kulapati Dr. K. M. Munshiji, upholding the values of unity, intellectual expansiveness and societal responsibility. True to this legacy, the college constantly strives to mould its students by instilling values, a sense of propriety and a deep commitment to their personal and professional growth. The college offers a wide range of academic programmes, including undergraduate courses in Science, Arts and Commerce, postgraduate courses in Science and Commerce and Ph.D. programmes in Zoology Chemistry, Commerce and Trade, Transport, and Industry. The college offers self-financing courses such as B.com. (Management Studies), B.Com. (A & F), B.Sc. (IT). The Science Departments have well-equipped, spacious laboratories with modern equipment. The faculties are actively engaged in research and allied academic activities, contributing to a dynamic learning environment. The college remains committed to nurturing future leaders through a holistic education that integrates academic excellence with personal and professional growth

ABOUT S.N.D.T. WOMEN'S UNIVERSITY

SNDT Women's University is the first Women's University in India as well as in South-East Asia. The University was founded by Maharshi Dr. Dhondo Keshav Karve in 1916 for a noble cause of Women's Education. The first five women graduated in the year 1921 from this University. The University Headquarters is in Churchgate, Mumbai and the other four campuses of this University are at Juhu, Mumbai, Karve Road, Pune, Shrivardhan and Ballarpur, Chandrapur SNDT Women's University is unique in terms of jurisdiction. SNDT Women's University can affiliate colleges/ institutions anywhere in India with prior consent from State Government. SNDT Women's University got NAAC re accrediated as A in June 2025. SNDT Women's University visualises itself as a world class university that continually responds to the changing social realities through the development and application of knowledge. The purpose of such engagement will be to create an inclusive society that promotes and protects the dignity, equality, social justice and human rights for all, with special emphasis on empowerment of women. + The University is committed to the cause of women's empowerment through access to education, particularly higher education, through relevant courses in the formal and in-formal streams. The University is committed to meet the changing socio-economic needs, with human values and purposeful social responsibility and to achieve excellence with "Quality in every Activity". The motto of the university is "An enlightened woman is source of infinite strength"

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The Commerce and Accountancy Department of Bhavan's H. Somani College is one of the most vibrant and dynamic departments on campus. They offers a comprehensive range of programs, from junior college to undergraduate, postgraduate, and doctoral degrees. The department organizes a variety of activities throughout the year, spanning curricular, cocurricular, and extracurricular domains. With a strong commitment to holistic student development, the department emphasizes employability enhancement while actively promoting entrepreneurship and encouraging students to explore start-up opportunities. The NEP-based syllabus further strengthens the department's efforts to foster a robust research culture among both students and faculty. Additionally, it helps inculcate a sense of community responsibility and ethical behavior expected in the corporate world.

ABOUT DEPARTMENT OF COMMERCE AND DEPARTMENT OF ECONOMICS, SNDT WOMEN'S UNIVERSITY, PUNE

Department of Commerce, Pune was established in the year 1984 with a broader vision of women empowerment. Department offers M.Com course with Specialisation in Finance. As a Research Centre for Ph.D, research work on the thrust areas viz- Recent trends in Banking and Finance, Human Research Management, Marketing Management and Women Entrepreneurship are at the forefront. Department strives towards personality enhancement of students by moulding their skills and attitudes towards pursuing career in Industry, Banking and Finance and entrepreneurship. Workshops and Students Symposium are organised on regular basis. Department conducts its annual event 'Financial Fest' which is an academic feast with a tinge of Fun and flavour of Finance. The Department of Economics Pune was established at Pune Campus in the year 1986 and it offers a Two-year on-campus Master's Degree Programme (M.A.) and Ph.D. Programme in Economics. Our mission is to boost the students' career prospects in Teaching, Research, Journalism, NGOs, Banks, Financial institutions, Central and State Governments Services etc.

ABOUT THE CONFERENCE

The Conference "The Era of Artificial Intelligence (AI) - Opportunities, Challenges & Transformations Across Sectors is reshaping different industries across the world, including both developed and developing countries. In its early stages, it was thought that there will be only handful or negligible impact on the developing countries like India but the recent evidences have proven that these economies are actually seeing its existence at a large scale. This conference aims to delve into both the potential benefits and the hurdles that come with integrating Al into various fields of commerce and industry including finance, education, health, trade, transport, logistics communication and many more. This event will highlight cutting-edge technologies and innovative application of AI that are already making waves across the country. Aiming to discuss on "The Era of Artificial Intelligence (AI) – Opportunities, Challenges, & Transformations Across Sectors. The event would be exploring the transformative power of Al to boost efficiency, accuracy and overall performances across various sectors, Industry experts, thought leaders like teachers, researchers, students and AI enthusiasts will get the platform to share their insights, case studies and future projections, making it a must attend for anyone invested in the future of technology and its applications.

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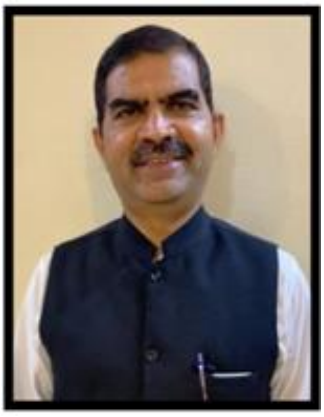

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FROM THE PRINCIPAL'S DESK

Prof. (Dr.) Shantaj M. Deshbhratar

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It gives me immense pleasure to extend my warm greetings on the occasion of the **National Conference on "The Era of Artificial Intelligence (AI) – Opportunities, Challenges & Transformations Across Sectors (NCAI–2026)"**.

Artificial Intelligence has emerged as a transformative force, reshaping businesses, economies, industries, and societies across the globe. From business and finance to healthcare, education, governance, employment and everyday life, AI is redefining the way we work, learn, and innovate. While it offers unprecedented opportunities for efficiency, growth, and innovation, it also presents significant challenges related to ethics, employment, data security, and inclusivity. In this context, academic platforms such as this national conference play a crucial role in fostering informed dialogue, critical thinking, and responsible adoption of AI technologies.

I praise the Departments of Commerce & Accountancy for taking this timely initiative in organizing this conference in collaboration with the Departments of Commerce & Economics, SNDT Women's University, Pune. The conference provides an excellent platform for academicians, researchers, industry experts, and students to share insights, exchange ideas, and deliberate on the multifaceted impact of Artificial Intelligence across various sectors.

I am confident that the deliberations, research papers, and discussions presented during this conference will contribute meaningfully to academic knowledge and practical understanding of AI-driven transformations. I extend my best wishes to the organising committee for the successful conduct of the conference and hope that NCAI–2026 proves to be intellectually enriching and inspiring for all participants.

With best wishes for the grand success of the conference.

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As teachers and academicians, it gives us immense pleasure to organize the National Conference on "The Era of Artificial Intelligence (AI) – Opportunities, Challenges & Transformations Across Sectors (NCAI–2026)". In our role as educators, we continuously strive to bridge the gap between evolving technological advancements and academic understanding, and this conference is a step in that direction.

Artificial Intelligence is redefining teaching, learning, research, and professional practices across disciplines. While it offers vast opportunities for innovation, efficiency, and skill development, it also raises important concerns related to ethics, employability, inclusivity, and responsible usage. As teachers, we believe it is our responsibility to encourage critical inquiry, ethical awareness, and informed adoption of such transformative technologies among students and researchers.

This conference aims to serve as a common academic platform where educators, researchers, industry professionals, and students can engage in meaningful dialogue, share research insights, and explore interdisciplinary perspectives on AI-driven transformations across sectors. Through scholarly deliberations and knowledge exchange, we hope to foster a deeper understanding of both the potential and challenges of Artificial Intelligence.

We extend our sincere gratitude to the Principal, Management, collaborating Institutions, resource persons, and participants for their continuous support and encouragement. We are confident that the academic discussions and research contributions at NCAI–2026 will be intellectually enriching and will inspire future research and responsible innovation.

We wish all the delegates a rewarding and insightful conference experience.

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Research Papers

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A STUDY ON THE ROLE OF ARTIFICIAL INTELLIGENCE IN ENHANCING ONLINE TRAVEL AGENCIES (OTAS)

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ABSTRACT:
The rapid integration of Artificial Intelligence (AI) technologies has significantly transformed the operational and service delivery models of Online Travel Agencies (OTAs). AI-driven tools such as recommendation systems, chatbots, dynamic pricing algorithms, and automated backend operations are increasingly being adopted to enhance platform efficiency and improve customer experience. This study examines the role of AI in enhancing OTA platforms by analysing its impact on operational efficiency, service personalization, and user satisfaction, while also identifying the limitations associated with AI adoption. The study is based exclusively on secondary data collected from scholarly articles, industry reports, and credible online sources. Using a qualitative analytical approach supported by conceptual frameworks such as SWOT analysis and user experience perspectives, the research evaluates key AI applications employed by OTAs. The findings indicate that AI technologies contribute significantly to personalized travel recommendations, real-time customer support, optimized pricing strategies, and efficient resource management, thereby improving customer convenience and platform responsiveness. However, the study also highlights critical challenges, including data privacy concerns, algorithmic bias, lack of transparency, and user trust issues, which may hinder the effective utilization of AI in OTA platforms. Furthermore, disparities in AI adoption between large and small OTAs raise concerns regarding technological accessibility and industry-wide inclusiveness. The study suggests that improving algorithm transparency, ensuring ethical AI practices, enhancing chatbot capabilities for complex problem resolution, and promoting collaborative industry standards can strengthen AI-enabled strategies in OTAs. Overall, the research provides valuable theoretical insights and practical implications for OTA managers, policymakers, and researchers, emphasizing the strategic role of AI in driving sustainable growth, competitive advantage, and enhanced user satisfaction in the digital travel ecosystem.

Keywords: *Artificial Intelligence, Online Travel Agencies, Customer Experience, Chatbots, Tourism Technology.*

1. INTRODUCTION:

The rapid advancement of digital technology has significantly transformed the travel and tourism industry. Online Travel Agencies (OTAs) have emerged as important intermediaries that provide online platforms for booking flights, hotels, travel packages, and other travel-related services. With increasing competition and rising customer expectations for fast, personalized, and efficient services, OTAs are increasingly adopting advanced technologies to enhance their performance. Among these technologies, Artificial Intelligence (AI) has gained considerable importance for improving operational efficiency and customer experience in OTA platforms.

Artificial Intelligence (AI) is broadly defined as the ability of computer systems to perform tasks that normally require human intelligence, such as reasoning, learning, problem-solving, and decision-making. It is not a single technology but a multidisciplinary field that integrates computer science, mathematics, data analytics, and cognitive science. AI systems are designed to process large amounts of data, recognize patterns, and adapt their behaviour based on experience, much like human learning.

The core techniques of AI include:

a) Machine learning (ML): algorithms that learn from historical data and improve predictions over time.

b) Natural language processing (NLP): enables machines to understand, interpret, and respond to human language, forming the backbone of chatbots and voice assistants.

c) Predictive analytics: uses statistical models and ai algorithms to forecast future trends, such as customer demand or travel behaviour.

d) Computer vision: allows machines to interpret visual inputs, such as scanning identity documents or recognizing images.

e) Sentiment Analysis: Extracts insights from customer reviews and feedback to measure satisfaction and improve services.

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AI has become a transformative force across industries, and in the travel sector, it is reshaping how services are delivered, how customers interact with platforms, and how businesses optimize their operations. Therefore, the present study examines the role of artificial intelligence (AI) in enhancing online travel agency (OTA) platforms by analysing its impact on operational efficiency, service personalization, and user satisfaction, while also identifying the limitations and challenges associated with AI adoption.

2. REVIEW OF LITERATURE:

- **Yihan Guo (2025)[1],** in this paper "Research on AI-Enabling Strategies for OTA Platforms" Existing studies indicate that Artificial This gap necessitates a holistic secondary data–based study to evaluate both the benefits and limitations of AI technologies in OTA platforms and to propose strategic improvements for sustainable platform development. Intelligence (AI) improves operational efficiency and user experience in Online Travel Agency (OTA) platforms through personalization, dynamic pricing, and automation. However, research largely focuses on individual AI applications, with limited integrated analysis of AI-enabling strategies, ethical challenges, and adoption issues in small and medium OTAs. This gap necessitates a holistic study to evaluate both the benefits and limitations of AI technologies in OTA platforms and to propose strategic improvements for sustainable platform development.
- **Tomislav Car et al. (2024)[2],** in their paper titled "Customer Preferences towards AI Functionalities in OTAs" Online Travel Agencies (OTAs) enable customers to book various travel services online and increasingly rely on Artificial Intelligence (AI) to enhance customer experience. AI functionalities in OTAs focus on personalization, optimization, advanced search, and chatbot services to improve customer satisfaction. The study adopts a three-phase research methodology, where key AI functionalities influencing travel experience were first identified. It applied discrete and continuous analyses to assess customer satisfaction levels and evaluate the impact of AI functionalities.
- **Nurul Mohammad S. et al. (2023)[3]**, in their paper titled "Exploring User Acceptance, Experience and Satisfaction towards Chatbots in an Online Travel Agency (OTA)" the existing studies show that AI-enabled chatbots are increasingly used in Online Travel Agencies (OTAs) to improve frontline customer services, with user experience playing a key role in their success. Research based on the Technology Acceptance Model highlights factors such as perceived ease of use, perceived playfulness, and perceived usefulness as important determinants of user satisfaction. However, limited attention has been given to users' reactions to chatbot services specifically in OTA platforms, and there is a lack of comprehensive studies examining how these AI functionalities influence overall operational efficiency and long-term user trust. This gap indicates the need for further research focusing on chatbot effectiveness and user experience within OTA contexts.

3. OBJECTIVE OF THE STUDY:

The objectives of the study are as follows:

3.1. To study overview of the AI technologies utilised by OTAs in their service.

3.2. To evaluate the role of AI in enhancing the operations and consumer experience of OTAs.

4. RESEARCH METHODOLOGY OF THE STUDY:

The present study is based on secondary sources only. The secondary data has been gathered from sources such as the Internet, reference Books, Newspapers, Journals etc.

5. AI TECH & OTA

5.1. AI Techniques utilised in OTAs :

The study reveals that Online Travel Agencies increasingly rely on a combination of advanced Artificial Intelligence techniques to enhance service delivery and platform efficiency. Machine learning algorithms are extensively used to analyse customer data and generate personalized recommendations for flights, accommodation, and travel packages, thereby improving user engagement and conversion rates. AI-powered chatbots and virtual assistants play a significant role in handling customer queries, managing bookings, and providing real-time assistance, which reduces dependency on human agents and improves service availability. Dynamic pricing algorithms enable OTAs to respond effectively to market fluctuations by adjusting prices based on demand, seasonality, and user behaviour, contributing to improved revenue optimization. Natural Language Processing enhances search functionality and allows OTAs to better interpret customer intent, while predictive analytics supports demand forecasting and inventory management. Additionally, AI-driven fraud detection systems strengthen transaction security and minimize financial risks, thereby increasing user trust in OTA platforms.

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5.2. Role of AI in OTAs:

The findings indicate that Artificial Intelligence plays a strategic role in enhancing both the operational performance and consumer experience of Online Travel Agencies. From an operational perspective, AI enables process automation, reduces manual intervention, and improves decision-making accuracy, leading to greater efficiency and cost reduction. From a consumer perspective, AI-driven personalization, faster response times, and seamless booking processes significantly enhance user satisfaction and loyalty. Moreover, AI-supported pricing strategies and demand forecasting improve resource allocation and market responsiveness, allowing OTAs to remain competitive in a dynamic digital environment. Overall, the study concludes that the effective integration of AI not only strengthens service quality and operational efficiency but also supports the long-term sustainability and growth of OTA platforms.

5.3. How AI Works in Online Travel Agencies (OTAs)?

Online Travel Agencies (OTAs) such as Expedia, Booking.com, MakeMyTrip, and Trip.com have embraced AI to remain competitive in a digital-first marketplace. AI is embedded in multiple layers of OTA operations, from customer-facing interfaces to back-end systems.

5.3.1 Personalized Recommendations

AI analyses user data such as search history, booking patterns, and preferences to suggest tailored travel packages, hotels, or flights. Recommendation systems powered by machine learning increase customer satisfaction and conversion rates by offering relevant options.

5.3.2 Conversational AI and Chatbots

NLP-driven chatbots provide 24/7 customer support, answering queries, assisting with bookings, and resolving issues instantly. These systems reduce response times, improve accessibility, and lower operational costs by deflecting routine inquiries from human agents.

5.3.3 Dynamic Pricing and Revenue Management

AI algorithms continuously monitor demand, seasonality, competitor pricing, and market conditions to adjust prices in real time. This ensures competitive offers for customers while maximizing revenue for OTAs.

5.3.4 Automated Booking and Itinerary Creation

AI streamlines the booking process by auto-filling details, suggesting itineraries, and managing cancellations or rescheduling. Predictive analytics can even anticipate customer needs, offering proactive suggestions for accommodations, transport, or activities.

5.3.5 Fraud Detection and Security

AI systems monitor transactions to detect anomalies, unusual patterns, or suspicious activities. Computer vision and biometric verification enhance security by validating identity documents during booking or check-in.

5.3.6 Sentiment Analysis and Feedback Management

AI evaluates customer reviews and feedback to identify satisfaction levels and pain points. This helps OTAs refine their services, improve customer trust, and respond proactively to negative experiences.

5.3.7 Operational Efficiency

AI automates repetitive tasks such as ticket issuance, refund processing, and customer notifications. This reduces manual errors, speeds up workflows, and allows human staff to focus on complex problem-solving.

6. DISCUSSION AND FINDINGS:

The findings of the study clearly indicate that Artificial Intelligence (AI) has become a strategic enabler for Online Travel Agencies (OTAs), influencing both operational efficiency and customer experience. AI techniques such as recommendation systems, chatbots, dynamic pricing, and automated backend operations have transformed the way OTAs interact with users and manage internal processes. Consistent with earlier studies, AI-driven personalization allows OTAs to analyse large volumes of customer data, including browsing history, preferences, and past bookings, to offer tailored travel recommendations, thereby enhancing customer satisfaction and engagement. This confirms that personalization remains one of the most impactful AI applications in the online travel ecosystem.

The study also highlights the growing importance of AI-powered chatbots in improving customer service efficiency. Chatbots enable OTAs to provide 24/7 assistance, handle routine queries, and reduce response time, leading to improved user experience and lower operational costs. However, the findings suggest that while chatbots are effective for basic interactions, their limited ability to handle complex or emotionally sensitive issues continues to be a challenge, which may affect overall user trust and satisfaction.

Dynamic pricing mechanisms supported by AI play a crucial role in optimizing revenue management by adjusting prices in real time based on demand, seasonality, and competitor behaviour. Although this enhances market responsiveness and profitability for OTAs, the study reveals that a lack of pricing transparency may lead to perceptions of unfairness among users, highlighting the need for ethical and user-friendly pricing strategies.

Furthermore, AI-enabled backend automation significantly improves operational efficiency by streamlining inventory management, fraud detection, and demand forecasting. Despite these advantages, the study identifies critical concerns related to data privacy, algorithmic bias, and unequal access to advanced AI technologies, particularly for small and medium-sized OTA platforms. Overall, the discussion underscores the necessity for balanced AI adoption, combining technological innovation with transparency, ethical considerations, and user-centric design to ensure sustainable growth and long-term trust in OTA platforms.

7. CONCLUSION:

The study concludes that Artificial Intelligence (AI) plays a transformative role in enhancing the operational efficiency and user experience of Online Travel Agency (OTA) platforms. Based on the analysis of secondary data, it is evident that AI technologies such as machine learning–based recommendation systems, chatbots, dynamic pricing algorithms, predictive analytics, and automated backend operations significantly improve personalization, service responsiveness, and resource optimization. AI-driven solutions enable OTAs to better understand customer preferences, forecast demand accurately, and respond quickly to market changes, thereby strengthening competitiveness in the digital travel ecosystem.

However, the study also identifies several limitations associated with the adoption of AI in OTAs. Issues related to data privacy, algorithmic bias, lack of pricing transparency, and limited user trust pose challenges to the effective implementation of AI technologies. Furthermore, smaller and medium-sized OTA platforms face constraints in adopting advanced AI systems due to high costs and technological complexity. Overall, while AI offers substantial benefits to OTA platforms, its successful integration requires a balanced approach that addresses ethical, technical, and user-centric concerns to ensure sustainable growth and long-term customer satisfaction.

REFERENCES:

Journals:

1. Yihan Guo (2025). Research on AI-Enabling Strategies for OTA Platform. Highlights in Business, Economics and Management *GEBM 2025 Volume 54*.
2. Dyduch, W., & Brzozowska, A. (2025). Artificial intelligence in tourism management: Theoretical underpinnings, empirical tests and the SmartTourAI framework. *Central European Management Journal Emerald Insight.*
3. Hernández-Tamurejo, Á. González-Padilla, P., & Saiz-Sepúlveda, Á. (2025). The economics of AI adoption in OTAs: Market dynamics and future research. *Global Economics Research, 1(1).*
4. Surbakti, F. P. S., Perdana, A., Indulska, M., Arief, L., Jonathan, & Bastian, I. (2024). From data to decisions: Leveraging AI to enhance online travel agency operations. *Journal of Information Technology Teaching Cases. SAGE Publications.*
5. Nurul S. M. S., Mohd F. S. B., Muhammad A. A. K. N. (2023). Exploring user acceptance, experience, and satisfaction towards chatbots in an online travel agency. *International Journal of Academic Research in Business and Social Sciences, 13(5): 196-198.*
6. Anuradha, G., & Anupriya, S. (2023).Advancing travel and tourism: Embracing the era of artificial intelligence. *YMER || ISSN : 0044-0477 ,VOLUME 22 : ISSUE 10*.
7. Gretzel, U., Sigala, M., Xiang, Z., & Koo, C. (2020). Smart tourism: Foundations and developments. *Electronic Markets, 30*(1).
8. Ivanov, S., & Webster, C. (2019). Automation in tourism: Impacts, risks and opportunities. *Journal of Tourism Futures, 5(1) JTF-12-2018-0009.*
9. Buhalis, D., & Law, R. (2018). Progress in information technology and tourism management: 20 years on and 10 years after the Internet. The state of eTourism research. *Tourism Management, 69*.

Websites:

1. Skift India www.skift.com/2025/07/22/we-asked-5-online-travel-agencies-in-india-how-theyre-really-using-ai

ISSN 2394 - 7780

2. IndiaAI (Government of India Initiative) www.indiaai.gov.in/article/ai-technology-and-digital-platforms-transforming-india-s-tourism-sector
3. Business Standard (India) www.business-standard.com/companies/news/ai-helping-ixigo-to-build-travel-tech-for-the-next-billion-indians-124120100570_1.html

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ADOPTION OF ARTIFICIAL INTELLIGENCE IN HRM: A CASE-BASED ANALYSIS OF VALUE CREATION AND RISK

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ABSTRACT:
Artificial Intelligence (AI) is being applied in Human Resource Management (HRM) in organizations because there are more people expected to be hired, the complexity of workforce management, and unstable employee demands. The research provides multinational case studies of Unilever, IBM, Schneider Electric, Amazon, and Salesforce as explanations of the application of AI in Human Resource (HR) functions. The objectives of the research are aimed at locating the way AI optimizes recruitment, forecasts employee turnover, optimizes the use of performances appraisal system and presents ethical risks. The study is also aimed at determining the best practices that will reduce bias and discrimination based on the use of AI in HR. The results indicate that AI lowers the time and cost of recruitment, enhances diversity and accuracy in the prediction of turnover, and constant development of employees based on the case studies of Unilever, IBM, Schneider Electric, and Salesforce. Nevertheless, it can be seen through the case study of Amazon that biased data is hazardous. The paper suggests "Responsible-by-Design" AI frameworks, human-in-the-loop governance, and explainable AI systems to ensure sustainable and ethical HR transformations.

Keywords: *Ethical AI, Human Resource Management, Recruitment Analytics, Predictive HR Analytics, Algorithmic Bias*

1. INTRODUCTION

he high-volume recruitment process, complexity of workforce management, and the dynamic expectations of employees are making organisations adopt Artificial Intelligence (AI) in Human Resource Management (HRM). AI is currently being employed by many organisations to screen resumes, evaluate candidates, determine turnover, and internal talent mobility. Other companies have managed to exploit AI to improve efficiency and diversity. Nevertheless, certain companies are confronted with ethical losses because of the absence of control and prejudiced training statistics. Therefore, it is necessary to examine the value creation as well as the ethical consequences of AI in Human Resources (HR) because of these conflicting experiences. This paper provides a critical examination of adoption of AI in HR based on real-life cases of a corporation in terms of operational result, ethical risk, and governance processes of implementing AI in a responsible way.

2. LITERATURE REVIEW

According to Resource-Based View (RBV) there are rare, valuable, and inimitable resources which provide firms with a competitive advantage (Barney, 1991). HR analytics is a strategic tool because it improves the quality of human capital, which is powered by AI. The investment in skills and development of employees is mentioned in the Human Capital Theory (Becker, 1964). AI-based learning and an internal marketplace enable employee development to meet organisational needs. The predictive HR Analytics identify turnover risk. This assists in the proactive retention strategies (Bassi & McMurrer, 2016). The outcome of the historical biases of AI training data is discriminatory (Barocas and Selbst, 2016). Explainable AI enhances trust, accountability, and transparency of AI-related decision systems (Gunning et al., 2019). Recent research states that AI-based HR systems decrease subjectiveness in hiring, appraising and promotions (Kaur and Arora, 2020). Mangers can however excessively use algorithmic recommendations and this can cause automation bias (Skitka, Mosier, & Burdick, 1999). Nonetheless, the current literature has emphasized the human control, responsibility, and constant monitoring in ensuring responsible HRM implementation in HRM (Stahl et al., 2022).

3. RESEARCH GAP

With regards to the literature review, it was established that there was a paucity of evidence in the form of cases allied to the adoption of AI across various HR functions and this has been overcome with the use of this study. Moreover, the current research highlights the benefits in terms of efficiency and underestimated ethical dangers, which are considered with the help of this study.

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4. SCOPE AND SIGNIFICANCE OF THE STUDY

The research implies multinational case studies to determine the use of AI in recruitment, engagement of employees and talent development. The value of the research lies in the facts that it offers practical implications to HR managers, policymakers, and technology developers in reference to AI application in HR. It helps the organisations to match AI with diversity and fairness.

5. RESEARCH OBJECTIVES

i. To find out how AI tools streamline recruitment and improve the quality of hire using the case study of Unilever.

ii. To find out how predictive analytics can enhance employee engagement and predict turnover using the case study of IBM.

iii. To find the influence of AI on performance appraisal systems and personalised employee development using a case study of Schneider Electric.

iv. To find the ethical risks and challenges of AI adoption in Human Resource Management using the case study of Amazon.

v. To find out how good practices and ethical frameworks minimise AI risk in HR using the case study of Salesforce.

vi. To suggest best practices for AI in HR that minimise ethical risk and bias.

6. RESEARCH METHODOLOGY

The research design used in this study is qualitative and descriptive. The researcher has taken secondary information from secondary corporate case studies. The researchers have mapped the case studies of Unilever, IBM, Schneider Electric, Amazon, and Salesforce with the research objectives. Organisational AI-enabled HR practices was the unit of analysis.

7. DISCUSSION OF RESEARCH OBJECTIVES

Research Objective 1: To find out how AI tools streamline recruitment and improve the quality of hire using the case study of Unilever.

The consumer goods giant, Unilever, receives over 1.8 million applications annually. The company implemented an AI-driven "digital funnel" to manage these high-volume applications.

The Process: Step 1: To assess cognitive and emotional traits, the candidates play neuroscience-based games via Pymetrics.

Step 2: To evaluate speech patterns and facial expressions, a video interview via HireVue is conducted, which is analysed using Artificial Intelligence.

Outcome: The recruitment time was reduced by 75% (from 4 months to 2 weeks). The company saved approximately £1 million in annual costs. Furthermore, the quality of hire improved, which was reflected by a 16% increase in workforce diversity. Lastly, there were also higher candidate completion rates due to the implementation of AI-driven assessments.

Research Objective 2: To find out how predictive analytics can enhance employee engagement and predict turnover using the case study of IBM.

For addressing the high costs related to employee attrition, IBM developed a "Proactive Retention" AI tool.

The Process: The AI tool analyses internal data points such as pay parity, time since last promotion, and even sentiment in communication for calculating the "flight risk" score of its employees.

Outcome: The AI tool predicts which employees are likely to leave within the next six months with an accuracy of 95%. Due to such early risk identification, managers at IBM can intervene with personalised retention plans. This AI tool has saved IBM approximately $300 million in turnover and replacement costs.

Research Objective 3: To find the influence of AI on performance appraisal systems and personalised employee development using a case study of Schneider Electric.

Schneider Electric launched the AI-powered internal marketplace called the Open Talent Market (OTM) for breaking the organisational silos.

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The Process: The OTM reviews profiles of employees and performance data to suggest new internal roles, gig work, and mentorship roles that align with the career goals of employees and the needs of the company.

Outcome: The OTM has improved employee engagement. Further, the OTM by matching employee skills (in spare capacity) with internal project demand has unlocked over 200,000 hours of productivity. These hours otherwise would have been lost to administrative delays or external hiring processes. Over 50% of the company's employees who previously mentioned "lack of growth" now find internal opportunities through OTM. Thus, OTM has transformed performance management into a continuous development cycle.

Research Objective 4: To find the ethical risks and challenges of AI adoption in Human Resource Management using the case study of Amazon.

Amazon developed an experimental AI recruiting tool in the year 2014. This AI tool was designed to score job candidates from one to five stars.

The Risk: The AI system was trained using a decade of resumes that were submitted to Amazon. The AI system learned that male candidates were preferred because the majority of technical roles were historically held by men.

Outcome: The AI system started penalising resumes that included the word "women" (example: women's chess club). Further, it downgraded the graduates of two all-women's colleges. This project was ultimately scrapped in the year 2018 by Amazon. Hence, this case study serves as a global cautionary tale on how "dirty data" can result in automated discrimination. Furthermore, it necessitates keeping a human in the loop for oversight.

Research Objective 5: To find out how good practices and ethical frameworks minimise AI risk in HR using the case study of Salesforce

Salesforce established an Office of Ethical and Humane Use for overseeing all AI developments in their HR and recruitment platforms.

The Process: The firm adopted the practice of "Consequence Scanning", in which cross-functional teams conduct workshops to envision potential unintended harms of new AI features before release. Their recruitment AI specifically checks for potential gender and racial biases from their internal data.

Outcome: Salesforce, by embedding ethics into the development phase, has avoided high-profile bias scandals. Their "Ethics by Design" model has demonstrated that commitment to transparency and proactive risk spotting leads to trustworthy, reliable, and effective AI tools.

Research Objective 6: To suggest best practices for AI in HR that minimise ethical risk and bias.

The Firms should adopt a "Responsibility by Design" practice for ensuring that AI serves as a fair and transparent partner in HR functions. The following best practices can be adopted by companies in their HR functions:

1) **Inclusive Data Curation:** The training datasets should be diverse and represent the global workforce. Historical data that reflect past societal prejudices should be removed so that the algorithms behave objectively.
2) **Algorithmic Auditing and Fairness Monitoring:** There should be continuous bias audits. Organisations could use tools such as IBM's "AI Fairness 360" or Google's "What-If Tool" for detecting and mitigating unintended discrimination. These AI tools help Human Resource professionals to visualise the change in AI's recommendation by changing single variables such as the age of the applicant or the zip code. Thus, hidden biases in the algorithm are exposed.
3) **Explainable AI (XAI) and Transparency:** The decisions given by AI should not be black boxes. AI tools in HR should be able to provide clear reasons for their outputs. For instance, why was an employee flagged for a specific training module or was ranked highly?
4) **Human-in-the-Loop (HITL):** Hiring, firing, or promotion decisions should never be fully autonomous. Human professionals should retain the authority for reviewing and overriding decisions of an AI system based on context and empathy.

8. RECOMMENDATIONS AND SUGGESTIONS

The adoption of AI-based systems by organizations should be done in a responsible and ethical manner. To reduce the differences in results and establish fairness in AI-based decision-making, companies must pay more

attention to the creation and utilization of inclusive and bias-free training datasets. Algorithms have to be continuously audited since it is the only way to facilitate the detection and mitigation of the unintended biases or performance issues in the long term. Explainable Artificial Intelligence may also provide more clarity to the stakeholders in how an AI system arrives at some decisions. Moreover, a human-in-the-loop framework can be implemented to ensure that the essential decisions are checked and confirmed by human specialists not to rely on the results of automated processes blindly.

The organisations are to establish an AI ethics oversight committee which will keep track of compliance, accountability and adherence to ethical standards in any use of AI. The paper highlights how AI can be effectively utilized in the HR sector to achieve improved quality of hiring, talent matching and workforce planning, as opposed to being fully automated. HR systems that are developed using AI need to provide data-informed managerial decisions but leave the final decision-making to human judgment. Powerful ethical checks should be incorporated into HR analytics to monitor the bias in AI-based recommendations and reduce it on an ongoing basis. Better said, the results of AI that emerge need regular check-ups to make sure that the HR practices are transparent, non-discriminatory, and uniform. All these can help the organisations to take advantage of the benefits of AI in HR and still maintain trust, accountability, and ethical integrity.

9. SUMMARY AND CONCLUSION

According to the study, AI can make HR much more efficient and boost the quality of talent and employee engagement when managed responsibly. The case studies applied in this research demonstrate a decrease in the number of days and money spent on recruitment, enhanced diversity, correct turnover forecasting, and ongoing developing of employees as a result of AI implementation in HR. Nevertheless, the situation with Amazon presented in the case study reveals that biased information can be risky. The paper concludes that ethical governance ought to be factored in during the design phase and AI ought to enhance as opposed to overriding human judgment.

10. REFERENCES

Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management, 17*(1), 99–120. https://doi.org/10.2307/259566

Barocas, S., & Selbst, A. D. (2016). Big data's disparate impact. *California Law Review, 104*(3), 671–732. https://doi.org/10.2139/ssrn.2477899

Bassi, L., & McMurrer, D. (2016). Why people leave your company. *Harvard Business Review*. https://hbr.org/2016/02/why-people-leave-your-company

Becker, G. S. (1964). *Human capital: A theoretical and empirical analysis, with special reference to education*. University of Chicago Press. https://press.uchicago.edu/ucp/books/book/chicago/H/bo3684031.html

Dastin, J. (2018, October 10). *Amazon scraps secret AI recruiting tool that showed bias against women*. Reuters. https://www.reuters.com/article/us-amazon-com-jobs-automation-insight-idUSKCN1MK08G

Gunning, D., Stefik, M., Choi, J., Miller, T., Stumpf, S., & Yang, G. Z. (2019). XAI—Explainable artificial intelligence. *AI Magazine, 40*(2), 44–58. https://doi.org/10.1609/aimag.v40i2.2862

Harver. (2019). *How Unilever saved £1 million by reinventing hiring with AI*. https://harver.com/blog/how-unilever-saved-1-million-by-reinventing-hiring/

Kaur, H., & Arora, S. (2020). Role of artificial intelligence in human resource management. *International Journal of Management*, 11(8), 155–163. https://doi.org/10.34218/IJM.11.8.2020.014

Salesforce. (2020). *Office of ethical and humane use of technology*. https://www.salesforce.com/company/values/trust/ethical-ai/

Skitka, L. J., Mosier, K. L., & Burdick, M. (1999). Does automation bias decision-making? *Human Factors*, 41(2), 349–358. https://doi.org/10.1518/001872099779591196

ISSN 2394 - 7780

Stahl, B. C., Timmermans, J., & Mittelstadt, B. (2022). The ethics of artificial intelligence: Principles, challenges, and opportunities. *AI & Society*, 37(2), 451–465. https://doi.org/10.1007/s00146-021-01107-3

World Economic Forum. (2021). *Internal talent marketplaces: A new frontier*. https://www.weforum.org/reports/internal-talent-marketplaces

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THE DIGITAL CAREGIVER: REDEFINING ELDERLY MENTAL HEALTH THROUGH ARTIFICIAL INTELLIGENCE TECHNOLOGIES

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ABSTRACT
India is undergoing a demographic transition marked by a significant rise in the elderly population. This increase is expected to intensify the challenges faced by society in providing basic healthcare, adequate nutrition, and addressing the socio-economic needs of older adults. Ageing is often accompanied with physical and cognitive decline and factors like loneliness, bereavement, reduced mobility, emotional frailty compounds the difficulties faced by the Elderly. They need sustained support and care for the physical, cognitive, emotional and social concerns. With changing demographics in Indian society and the transition away from the traditional joint family system, an increasing number of elderly now resides in isolation, forcing them to be on their own for their daily care. In such a scenario effective use of Artificial Intelligence (AI) Technologies can play a pivotal role in providing the required support and thereby enhancing the mental health of the Elderly. The present paper reviews various AI Technologies that can be used to address the mental health challenges faced by the elderly. It aims to explore how AI Technologies can intervene to help the elderly combat the social, emotional and cognitive challenges. The paper evaluates the benefits and challenges of using AI Technologies for the Elderly.

Keywords- *Artificial Intelligence Technologies, Mental Health, Elderly*

INTRODUCTION
India is witnessing a demographic shift in its Elderly population. The population of people aged 60 years and above are on a rise. According to the India Ageing Report 2023 of the United Nations Population Fund, New Delhi, this population which once constituted only 8.7% as per the 2011 census has reached around 10.5% in 2022 and is projected to rise up to 20.8% by 2050. This stark increase in the population of the elderly will pose serious health care challenges to society and the Government.

Old age is often associated with physical limitations, cognitive decline, social challenges and emotional pain. During this stage of life, the elderly require greater love, support, care, and assistance. Traditionally the Indian families comprising of the children, grandchildren, extended relative, would provide the required love and care during these years. However, with changing times and structural shifts in the Indian society, providing this social and emotional support is a growing challenge. The rapidly changing family dynamics in India are likely to exacerbate this concern as transformations in the family system, individual values, and broader social structures have increasingly compelled older adults to live independently, often away from their children who traditionally fulfilled their physical, cognitive, social, and emotional needs. Consequently, the erosion of family-based support, combined with a shortage of trained caregivers and limited healthcare infrastructure, has intensified the need to identify alternative mechanisms to address the growing healthcare demands of India's expanding elderly population. In this scenario, Artificial Intelligence (AI)–based technologies can prove to be a significant boon, offering scalable and innovative solutions to support elderly healthcare, enhance their mental health and mitigate the human resource constraints.

REVIEW OF LITERATURE
Recent years have seen a surge in the research conducted in the field of Artificial Intelligence. Many of these studies have focused on how the Artificial Intelligence Technologies can be used for improving health care of the elderly population. Studies show that Artificial intelligence Technologies can help in supporting the Elderly with their physical, Social, emotional and cognitive challenges. Research reveals how these Technologies can prove beneficial for enhancing the mental health of the Elderly.

A study conducted by Wen Fang, et. al (2025) shows how healthcare of the elderly can be enhanced using Artificial Intelligence Technologies for physical support, psychological support, cognitive rehabilitation, and targeted cardiovascular and musculoskeletal interventions. The study shows how cognitive function, emotional regulation, and physical resilience among the Elderly can be improved with the Artificial Intelligence Technologies.

A review of various AI technologies in health care have studied the application of Machine Learning and Artificial Intelligence based approach to geriatric mental health. It shows that many studies reveal application of

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Artificial Intelligence tools to Dementia but emphasizes the need for future research to understand AI applications in other areas of Geriatric Mental health (Chowdhury, M., et. Al., 2021).

A study conducted on application of Artificial intelligence technology for evaluation and analysis of Elderly mental health, emphasizes its use for understanding the depression status in the community (Li, X. 2023). Yet another research aimed to improve the mental health of the Elderly based on big data methods explores monitoring and intervention methods based on big data. Results show how analysing mobile device data and social media data can identify the social activities, emotional states and daily behaviour patterns of the elderly, to provide a basis for prediction and intervention of mental health problems (Chen, Q., & Sheng, N. 2024).

RESEARCH GAP:

Recent literature shows that Artificial Intelligence has significant potential for the analysis, monitoring, and evaluation of diverse mental health conditions among the Elderly. Prior studies indicate the effectiveness of AI-driven interventions in improving cognitive functions and assisting Elderly in coping with serious mental health conditions like Dementia and Depression. Building on these insights, the present paper aims to study the role of Artificial Intelligence in enhancing mental health of elderly, thereby improving their daily functioning and quality of life.

AIMS AND OBJECTIVES:

To explore the effectiveness of Artificial intelligence Technologies in enhancing mental health of the Elderly and evaluate the benefits and challenges associated with them.

METHODOLOGY

The present research is a theoretical paper based on secondary data. English-language articles published between 2020 to 2025 based on the theme of the research were selected and additional sources were identified through manual screening of reference lists of relevant articles. Original studies, review papers that addressed the role of AI Technologies in healthcare of elderly populations were included in the present paper.

MENTAL HEALTH CONCERNS OF THE ELDERLY

With the rise in the Elderly population, their health concerns are growing. Countries across the world are encountering the challenges of chronic and degenerative diseases in their ageing population. Cognitive conditions of Dementia, Delirium, Alzheimer's and Chronic health issues like Cardiovascular Diseases, Osteoporosis, Diabetes and Cancers are serious challenge faced by the ageing population. Anxiety, Depression, cognitive decline are also few issues faced commonly by the geriatric population (Bai, W., 2022). As people age and look back to their life, concerns like ruminative thoughts, automatic negative thoughts, frustration, regret, guilt, etc. disturb them on day-to-day basis (Sharma, G., & Morishetty, S. K. 2022). Lack of confidence, social isolation, daily forgetfulness, memory loss, lack of emotional control, anger issues may look trivial but have severe negative impact on the mental health of the Elderly. The grief and bereavement associated with loss of spouse and loved ones is irreparable and may become a mental health concern. These psychological stressors are further exacerbated by limited mobility and diminished social networks. It is thus important to address these issues by providing the necessary attention, love and care. Such consistent, customized, social, emotional and cognitive support can be provided effectively using Artificial Intelligence Technologies.

ARTIFICIAL INTELLIGENCE TECHNOLOGIES FOR ENHANCING MENTAL HEALTH OF ELDERLY:

Reducing loneliness and enhancing social engagement- Artificial Intelligence Technologies can prove effective in reducing isolation and loneliness of the elderly by being a very caring, supportive and cooperative companion for them. AI Tools such as Conversational Agents such as Replika, ElliQ, and GPT-based chatbots can provide emotional support through text or voice. Such AI tools offer a safe space for self-expression, can encourage reflection and mindfulness. They promote a good routine and emotional engagement. These tools have demonstrated reduced feelings of loneliness among older adults (Alotaibi & Alshahre, 2024: Chou et al., 2024: Rodriguez-Martinez et al., 2024). These tools listen empathetically, provide companionship and maintain daily and regular interactions that create a sense of consistency and care. Such consistent engagement with voice assistants or chatbots may be related to improved mood and lower perceived loneliness. AI Tools like Amazon Alexa Care Hub sends immediate alerts to the care givers when the elderly are in need. Thus, making a best solution to be in touch when with physical distance.

Fostering emotional expression and mental stimulation- Old age is often associated with emotional frailty. Limited social networks, bereavement and mobility constraints often reduce the opportunity to meet the closed people. As a result, the Elderly are left with very few opportunities to express their emotions freely. In absence of the physical presence of such companions to vent their emotions, AI Tools like Chatbots can help them to

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express freely, prompt elderly to recount memories, reflect on their emotions, and engage in light humour. These programs can recognize mood shifts and respond accordingly providing emotional support and cognitive engagement which can prove therapeutic for them. They encourage dialogue, provide empathetic responses, and prompt reflection. Such emotional and cognitive engagements can delay cognitive decline in the elderly (Garg, R.,2025).

Providing Cognitive support- Cognitive concerns are a part and parcel of ageing. Memory loss, forgetfulness, Degenerative disorders like Dementia, Alzheimer's etc. are seen in the elders. Emotional suppression seen as a result of loneliness can worsen depression, anxiety and cognitive decline. AI technologies in form of Robots can help deal with such cognitive difficulties. Social Robots like 'Stevie', or 'PARO' a therapeutic Robot can prove effective especially with patients of Dementia. AI Technologies can provide support for giving reminders for daily tasks, medications, etc. End-User Development (EUD) and Retrieval-Augmented Generation (RAG) AI techniques enable geriatric caregivers to design, deploy and adapt customised cognitive intervention plans for the Elderly. These techniques can make patient profile, conduct screening and generate tailored cognitive exercises that delivered via a mobile application featuring a conversational agent who guides patients through daily cognitive tasks (Valtolina, S. & Pugliese, A., 2025). Such tools help elderly combat cognitive decline in an effective way.

Benefits and Challenges of using Artificial Intelligence technologies for enhancing Mental Health of Elderly:

Artificial Intelligence offers significant benefits in healthcare, psychoeducation and daily living by enabling personalized support, early detection of risks, and improved efficiency in service delivery. AI Tools are known for their efficiency in providing personalized treatment and care. They can help with continuous monitoring of the elderly in the absence of human beings. Remote monitoring and telehealth care is possible due to the AI technologies. These AI technologies can thus help in proving a dignified, independent living for the elderly.

However, these advantages are often accompanied by challenges such as ensuring data privacy and security (Vercruyssen, A., et. al. 2023). Digital literacy and accessibility are yet another challenge faced while using AI Technologies. Age-related physical changes such as reduced vision, hearing, and motor dexterity, make it harder to interact with AI devices that are not designed keeping these aspect in mind. (Piper, A. M., et. Al. 2017). The use of AI in health care raises serious ethical questions regarding decision-making autonomy, informed consent and accountability for errors that may prove dangerous.

Thus AI technologies needs to be used wisely and carefully for enhancing the Elderly Mental Health.

CONCLUSION:

Artificial Intelligence Technologies are transforming the landscape of Elderly care. They have demonstrated significant effectiveness in the social, emotional and cognitive domain of elderly care, thereby paving a way for a comprehensive approach to enhancing the mental health of the Elderly. However, it is crucial to recognize that Artificial Intelligence can complement human caregiving and not replace it. Maintaining the right balance between Artificial Intelligence and human expertise is essential to preserve empathy, maintain quality of care so as to ensure that advancements in AI truly enhance the mental health and well-being of the Elderly.

REFERENCES:

1. Alotaibi, J. O., & Alshahre, A. S. (2024). The role of conversational AI agents in providing support and social care for isolated individuals. *Alexandria Engineering Journal*, *108*, 273–284.
2. Bai, W., Chen, P., Cai, H., Zhang, Q., Su, Z., Cheung, T., Jackson, T., Sha, S., & Xiang, Y.-T. (2022). Worldwide prevalence of mild cognitive impairment among community dwellers aged 50 years and older: A meta-analysis and systematic review of epidemiology studies. *Age and Ageing*, *51*(8), afac173.
3. Cao, B.-F., Zhou, R., Chen, H.-W., Liang, Y.-Q., Liu, K., Fan, W.-D., Huang, R.-D., Huang, Y.-N., Zhong, Q., & Wu, X.-B. (2024). Association between mobility limitations and cognitive decline in community-dwelling older adults: The English longitudinal study of ageing. *The Gerontologist*, *64*(12), gnae139.
4. Chen, Q., & Sheng, N. (2024). Monitoring and Intervention of Mental Health of the Elderly under Big Data Technology. *Procedia Computer Science*, *247*, 859-865.
5. Chowdhury, M., Cervantes, E. G., Chan, W. Y., & Seitz, D. P. (2021). Use of machine learning and artificial intelligence methods in geriatric mental health research involving electronic health record or administrative claims data: a systematic review. *Frontiers in psychiatry*, *12*, 738466.

ISSN 2394 - 7780

6. Fang, W., Fan, S., Zheng, H., Fang, Z., You, Y., Yin, B., ... & Ye, X. (2025). How to improve mental health in the older adults through AI-enhanced physical activity: an emerging research topic. *Humanities and Social Sciences Communications*, *12*(1), 1-15.
7. Follmann, A., Schollemann, F., Arnolds, A., Weismann, P., Laurentius, T., Rossaint, R., & Czaplik, M. (2021). Reducing loneliness in stationary geriatric care with robots and virtual encounters—a contribution to the COVID-19 pandemic. *International journal of environmental research and public health*, *18*(9), 4846.
8. Garg, R. (2025). Smart Aging: Harnessing Artificial Intelligence to Enhance Elderly Health Care and Independence. *Journal of the Indian Academy of Geriatrics*, *21*(2), 143-146.
9. Ma, B., Yang, J., Wong, F. K. Y., Wong, A. K. C., Ma, T., Meng, J., ... & Lu, Q. (2023). Artificial intelligence in elderly healthcare: A scoping review. *Ageing Research Reviews*, *83*, 101808
10. Li, Y., Ding, X., Chen, Y., Li, Y., & Ma, N. (2025, July). Customizable AI for Depression Care: Improving the User Experience of Large Language Model-Driven Chatbots. In *Proceedings of the 2025 ACM Designing Interactive Systems Conference* (pp. 1844-1866).
11. Piper, A. M., Brewer, R., & Cornejo, R. (2017). Technology learning and use among older adults with late-life vision impairments. *Universal Access in the Information Society*, *16*, 699–711.
12. Rodriguez-Martinez, A., Amezcua-Aguilar, T., Cortes-Moreno, J., & Jimenez-Delgado, J. J. (2024). Qualitative analysis of conversational chatbots to alleviate loneliness in older adults as a strategy for emotional health. *Healthcare*, *12*(1), 62.
13. Sharma, G., & Morishetty, S. K. (2022). Common mental and physical health issues with elderly: a narrative review. *ASEAN Journal of Psychiatry*, *23*(1), 1-11.
14. Tana, C., Siniscalchi, C., Cerundolo, N., Meschi, T., Martelletti, P., Tana, M., ... & Giamberardino, M. A. (2025). Smart aging: integrating AI into elderly healthcare. *BMC geriatrics*, *25*(1), 1024.
15. Valtolina, S., & Pugliese, A. (2025, June). AI-Assisted Cognitive Support for Caregivers: A RAG and EUD Framework for Geriatric Care. In *International Symposium on End User Development* (pp. 205-220). Cham: Springer Nature Switzerland.
16. Vercruyssen, A., Schirmer, W., Geerts, N., & Mortelmans, D. (2023, September). How "basic" is basic digital literacy for older adults? Insights from digital skills instructors. In *Frontiers in Education* (Vol. 8, p. 1231701). Frontiers Media SA.
17. https://www.who.int/news-room/fact-sheets/detail/ageing-and-health.
18. India Ageing Report 2023: Healthcare Burden, Insurance Gaps, and Elderly Challenges
19. Robots for Elderly Care, Companionship and Comfort

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AI IN ELECTRIC VEHICLES: CONSUMER'S READINESS TO ADOPT VEHICLE AUTONOMY FROM LEVEL 0 TO LEVEL 4

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ABSTRACT
Artificial Intelligence (AI) in the transportation sector enhances urban mobility by giving more efficient service to transportation. It has a tremendous potential to enhance safety, reduce risk and grow efficiency in driving. AI enables real-time decision making, object detection, and automation in driving systems. These technologies demonstrate how AI enhances vehicle functionality and improves safety in today's driving environment. Looking ahead, AI is expected to enable full autonomy in vehicles, foster integration with smart city infrastructures, and drive innovations in fleet management. These advancements are anticipated to significantly improve vehicle safety, operational efficiency, and the overall user experience, solidifying AI as the fundamental technology for the future of intelligent transportation systems. Since there is a rising interest in usage of AI in transforming the automotive landscape, the study highlights the consumer expectations of AI for technology advancements in electric vehicles which will, in future, be one of the significant causes for transformation from Level 0 to Level 1 vehicle autonomy. This revolutionary combination holds the promise of reshaping traditional development processes, enhancing efficiency, and accelerating innovation. AI technologies are becoming integral within numerous facets of software development within autonomous vehicles, leading to a paradigm shift towards Software-Defined Vehicles. In this study, a survey of 125 electric vehicle consumers has been analyzed, focusing on consumer expectations towards AI in electric vehicles as a factor while making purchase decisions. The findings show the growing expectations of AI in electric vehicles from the consumers.

Keywords*: Artificial Intelligence, Autonomy in vehicles, Intelligent transportation, Consumer Expectation*

1. INTRODUCTION
It is generally acknowledged that electric cars (EVs) are the most promising way to address the issues that fossil fuel-powered vehicles confront. They have lower particulate matter emissions, are quieter, simpler to maintain, and do not directly emit carbon dioxide. **(Sovacool. B.K. 2010)** As energy systems move toward a decarbonized and digitalized future, artificial intelligence (AI) is anticipated to play a significant role in integrating EVs into infrastructure. Algorithms that display behaviors considered intelligent are known as artificial intelligence (AI) algorithms.

(Russell, S., 2002) Optimization, planning, forecasting, modeling, etc. are necessary for the successful integration of EVs into the grid. Many AI algorithms are made to perform these kinds of tasks. It is thought that as technology advances in areas like sensors, cameras, GPS, and microprocessors, the use of autonomous vehicles will become essential in the near future. For many years, people found driving to be thrilling and enjoyable, which prevented the development of technologies that would make driving less enjoyable. The idea of driverless cars is now possible because to a number of technologies that have been introduced to the market throughout time. Due to the distracting nature of driving, an increasing number of people are using cell phones, iPads, or the internet while operating a vehicle. As a result, there is a considerable need for autonomous cars, which provide a way to reduce their idle time. The era of autonomous cars is emerging as a result of businesses responding to these desires. There are already many technologies on the market that help drivers, like collision avoidance, lane deviation correction, and self-parking. As a first step toward completely driverless vehicles, certain automakers have released semi-autonomous technology packages. **(Amey Phatale, 2018)**

1.1 Levels of Autonomous Vehicles
In the actual world, implementing autonomous vehicles is a challenging undertaking. Implementing it gradually, step by step, is one realistic way to address the issue. For this, different tiers are defined. In the increasing order of autonomous capabilities, these levels range from Level 0 to Level 4. The United States government's National Highway Traffic Safety Association (NHTSA) is responsible for enforcing the nation's traffic regulations. In order to make the levels of automation clear, the agency has divided cars into the following five categories.

a) Level 0: No Automation
At this level, the driver always has total control over the car. Vehicles contain mechanical continuity systems, but the driver has complete control over braking, steering, throttle, and safety functions. These cars might only

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have warnings, but they don't do anything about it. Wipers, indicators, parking lights, headlights, and taillights can all still operate semi-automatically. This level includes Vehicle 2 Vehicle (V2V) warning technology.

b) Level 1 – Function - specific Automation

The vehicle is in charge of one or more particular control functions at this level. These functions won't interfere with other processes and will operate independently. Safety activities are still the driver's responsibility. On the vehicle, limited authority may be implied. As an illustration, consider adaptive cruise control. This level includes primary controls such as Electronic Stability Control (ESC), which functions automatically. This level includes dynamic brake support, which can help in collision situations. When performing tasks like driving or braking, the vehicle's automatic system may help the driver.

c) Level 2 – Combined Function Automation

At least two key functions are automated at this level, working in tandem with the driver. The driver is in charge of operating safely and keeping an eye on the roads. At this level, vehicles can share authority. Despite this, drivers must keep an eye on everything, perform safety procedures, and be ready to take over at any time. Use adaptive cruise control with lane centering, for instance. The ability for the driver to physically disarm the vehicle and let it operate independently is the primary distinction between level 2 and level 1.

d) Level 3 – Limited Self - Driving Automation

Vehicles of this category allow the driver to have complete control over the vehicle. The driver must take over when necessary because not all traffic situations permit complete control of the vehicle. The car has the ability to operate safely. One significant change from level 2 to level 3 is that drivers are no longer required to constantly monitor and perform safety procedures. For instance, the car will request that the driver take control when there are road work areas.

e) Level 4 – Full Self - Driving Automation

Vehicles can carry out every operation during the journey at this level. The driver only needs to enter the location; the automobile will take care of the rest. At no point during the journey is the driver expected to take control of the vehicle. Only vehicles are used for monitoring and safety tasks.

2. REVIEW OF LITERATURE

1. **Weiqi Hua, et al. (2024),** in their paper, **An Overview of Artificial Intelligence for Electric Vehicle Eergy Systems Integration,** draw attention to electric cars (EVs) as a sustainable substitute for fossil fuel-powered automobiles because of its lower emissions, quieter operation, and ease of maintenance. The authors highlight how artificial intelligence (AI) will play an increasingly important role in integrating EVs with future digitalized and decarbonized energy systems. By analyzing user behavior, improving charging schedules, and supporting infrastructure design, AI apps promote the adoption of EVs. In support of this, De Rubens examined EV consumer motives using the k-means clustering approach and found that pricing and vehicle-to-grid (V2G) capabilities were important adoption drivers. In a similar vein, Bas et al. classified potential EV purchasers and identified important characteristics impacting EV purchasing decisions using machine learning techniques like support vector machines, deep neural networks, and gradient boosting.

2. **Javier Bas, et al., (2021)** in their paper **Classification of potential electric vehicle purchasers: A machine learning approach,** conclude that EV adoption is influenced by multiple interrelated factors, including the county of residence, intended engine type of the next vehicle, key vehicle characteristics, and positive attitudes toward EVs and technology. The county variable acts as a proxy for income, emphasizing the sinificance of spatial economic gaps, even when charging infrastructure and power grid availability do not differ considerably between Maryland counties. The report highlights financial factors as key factors influencing EV adoption, specifically vehicle cost and government income tax benefits. Purchase decisions are also greatly influenced by useful car features like driving range, fast charging time, and availability of home charging infrastructure. Overall, the authors show that consumer attitudes, vehicle-related characteristics, and economic considerations all influence EV adoption, and that machine learning methods are useful for identifying and forecasting prospective EV purchasers.

3. **Zarazua de Rubens, Gerardo. (2019),** in his paper, **Who will buy electric vehicles after early adopters? Using machine learning to identify the electric vehicle mainstream market,** investigates the shift in EV adoption from early adopters to regular consumers. The study uses the k-means clustering method to establish six consumer segments based on the likelihood of EV adoption using data from 5,067 respondents in five Nordic nations. Nearly 68% of respondents, who represent the near-term mainstream market, fall into one of three clusters with a strong readiness to embrace EVs, according to the results. The results show that the most important factor in EV adoption is car affordability, while new features like vehicle-to-grid (V2G)

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technology also increase consumer interest. The study also highlights how mainstream adoption is influenced by economic and environmental issues, as well as technological appeal and status worth. Overall, the research concludes that effective EV policies and market strategies must be aligned with the preferences and expectations of mainstream consumers to accelerate widespread adoption.

4. **Noviati, et al. (2024)** in their paper Artificial Intelligence in **Autonomous Vehicles: Current Innovations and Future Trends,** examine how AI will change transportation in the future with driverless cars. The authors discover that by decreasing human error, AI improves route accuracy, fuel economy, and safety, increasing overall dependability and cost effectiveness. According to the study, there is a high potential adoption rate of 85%, suggesting considerable consumer demand. However, public trust is still a major worry, as almost 40% of respondents expressed worries about the safety and dependability of completely autonomous vehicles. In order to improve real-time decision making, vehicle safety, automation, and operational efficiency in autonomous vehicle systems, the research believes that advances in artificial intelligence—specifically, machine learning, computer vision, and sophisticated sensor integration—are essential.
5. **Amey Phatale,** in his paper, **Autonomous Vehicle Levels & Trends,** discusses the increasing reliance on technology and the increasing emphasis on driverless cars made for a broad range of customers. According to the report, driverless cars are intended to offer reduced traffic congestion, enhanced safety, and freedom from driving. The study highlights the active participation of large corporations in the development of autonomous vehicle technology, citing Google's driverless vehicle as a notable example that uses GPS, cameras, radar, laser scanners, and LiDAR to function autonomously while following traffic regulations. These technologies reduce accidents by enabling real-time detection of roads, obstructions, and pedestrians. The National Highway Traffic Safety Administration's (NHTSA) five levels of vehicle automation, which range from Level 0 (no automation) to Level 4 (complete self-driving automation), are also described in the report. These levels represent the progressive development of autonomous driving capabilities.

3. RESEARCH GAP

The adoption of electric vehicles, AI applications, and autonomous vehicle technologies are all covered in great detail in previous research, primarily from a technological, economic, and policy standpoint. There is little empirical study on customer acceptance and readiness for AI-enabled car autonomy, especially at varied levels of autonomy. The majority of research ignores the gradual shift from Level 0 to Level 4 autonomy in favor of either completely driverless vehicles or early-stage driver assistance systems. Studies examining AI characteristics as a major factor influencing EV purchasing decisions are scarce, particularly in the Indian setting. The relationship between consumer expectations of AI features and acceptance of rising autonomy levels is not well studied, and there is still little region-specific consumer research in emerging EV markets. Understanding consumer attitudes and preparedness for AI-driven vehicle autonomy in EVs is clearly lacking.

4. **Statement of Problem** - Artificial intelligence developments have made it possible for electric cars to prgress from Level 0 (no automation) to Level 4 (complete self-driving automation). Higher levels increasingly add AI-based driver assistance, partial automation, limited self-driving, and full vehicle autonomy, while Level 0 cars are completely controlled by humans. Even with the speed at which technology is developing, consumer adoption of these degrees of autonomy is still unclear, especially in developing EV markets. Despite the growing availability of AI-enabled features like driving assistance, safety systems, and smart infotainment, it is unknown how consumers view and trust these features across various levels of autonomy. Research on customer preparedness for a gradual transition from Level 0 to Level 4 autonomy and its impact on EV purchasing decisions is scarce.

Examining customer expectations, readiness, and acceptability of AI-enabled electric vehicles from Level 0 to Level 4 autonomy, with reference to electric vehicle users in the Pune metropolitan region, is the issue this study attempts to solve.

5. OBJECTIVES OF THE STUDY

1. To overview the AI techniques used in transportation
2. To understand the merger of AI in electric vehicles.
3. To understand the Level 0 to Level 4 vehicle autonomy.
4. To analyze the expectations of the consumers towards AI features in electric vehicles.

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6. RESEARCH METHODOLOGY

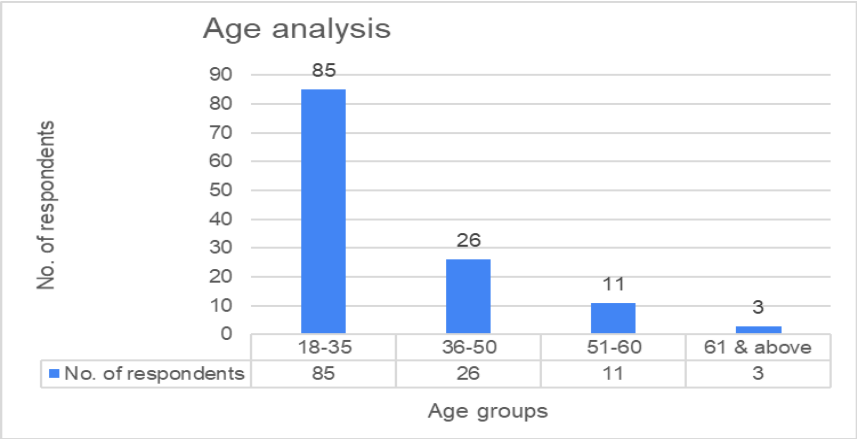
1) Area of the Study	The Study is conducted in Pune metropolitan region
2) Research Design	Design of descriptive research through structured questionnaire, interview, survey and case study.
3) Sources of data collection	1) Primary data 2) Secondary data
4) Sample and sample size	Consumers of electric vehicles in Pune metropolitan region. Sample size is restricted to 125 consumers.
5) Limitation of the study	1) The study is restricted to electric vehicle consumers in the Pune metropolitan region only. 2) The study is restricted to 125 consumers only. 3) The study is restricted to only two wheelers and four wheelers consumers.

7. ANALYSIS AND INTERPRETATION

The results of the data analysis showed that: Data was gathered from 125 electric vehicles consumer respondents using a structured questionnaire.

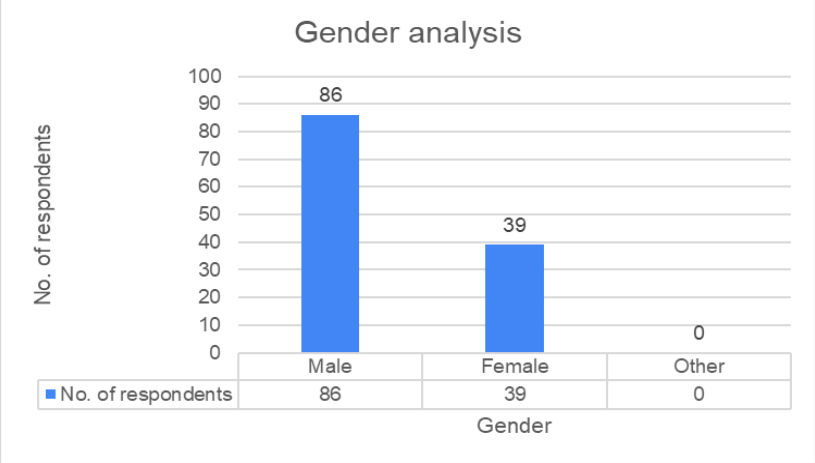
A) Demographic Factors

1. Age



It is concluded that most of the respondents fall in the age bracket of 18-35, who are the young generation and are more anxious to adopt the new technologies.

2. Gender



It is concluded that out of 125 respondents 86 respondents are males which make 68.8% of total sample size.

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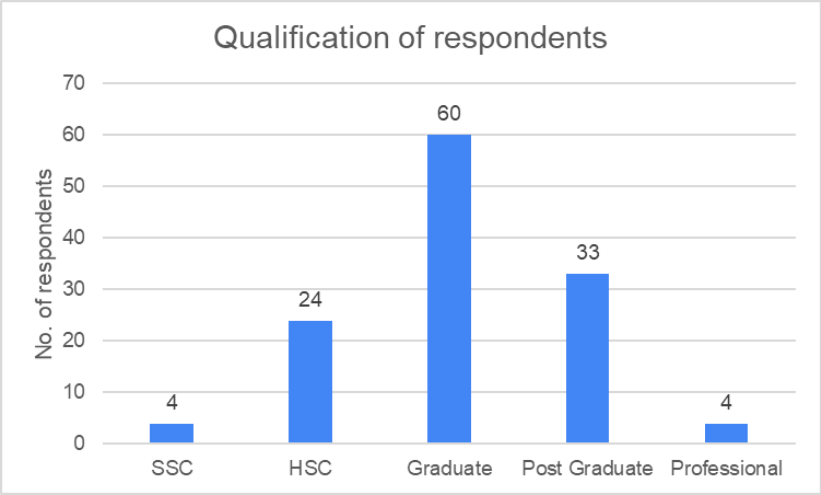
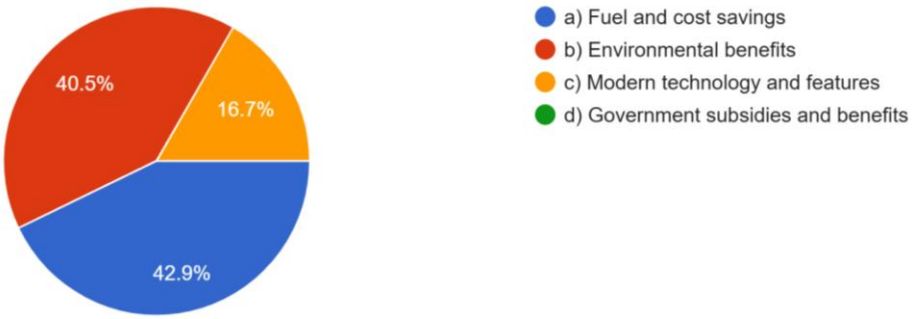
3. Qualification



It is concluded that 60 respondents out of 125 respondents are graduates which make 48% of total sample size.

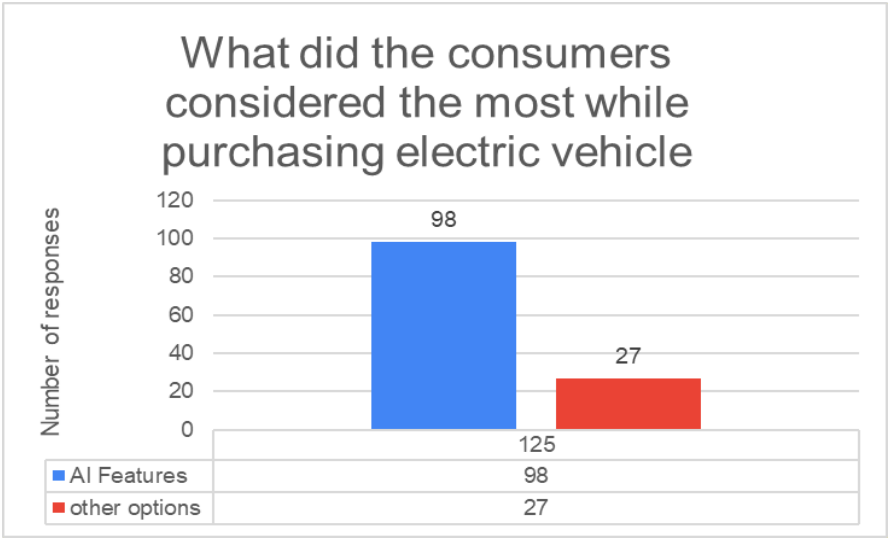
B) Technical Factors

1. What message in electric vehicles promotion appeals to you the most?



It is concluded that out of 125 respondents 16.7% of electric vehicle consumers are attracted towards the electric vehicles due to modern technology and features.

2. Which of the following factors did you consider while buying electric vehicles?



It is concluded that out of 125, 98 respondents considered the AI features while purchasing the electric vehicles which are 78.4% of respondents.

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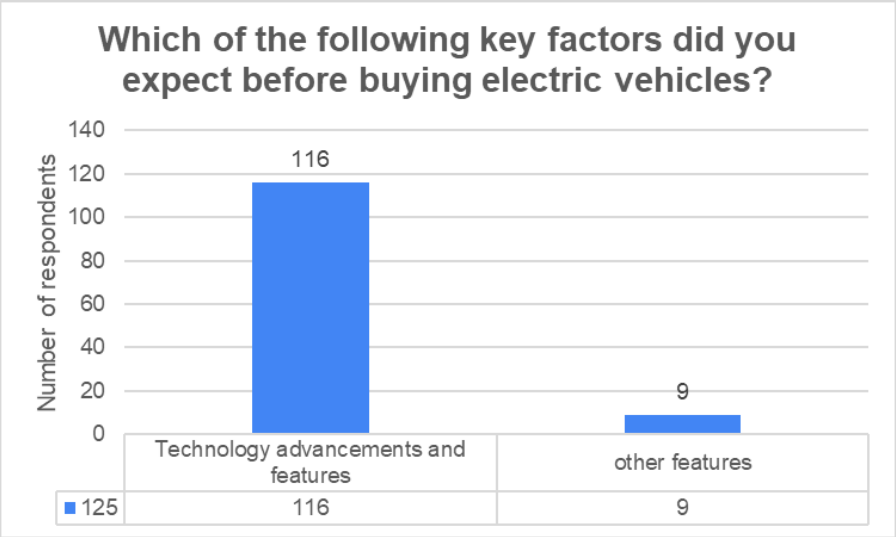
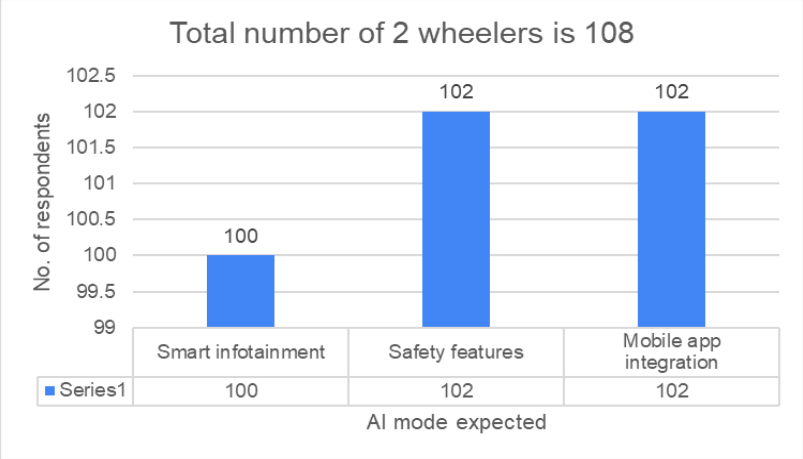
3. Which of the following key factors did you expect before buying electric vehicles?



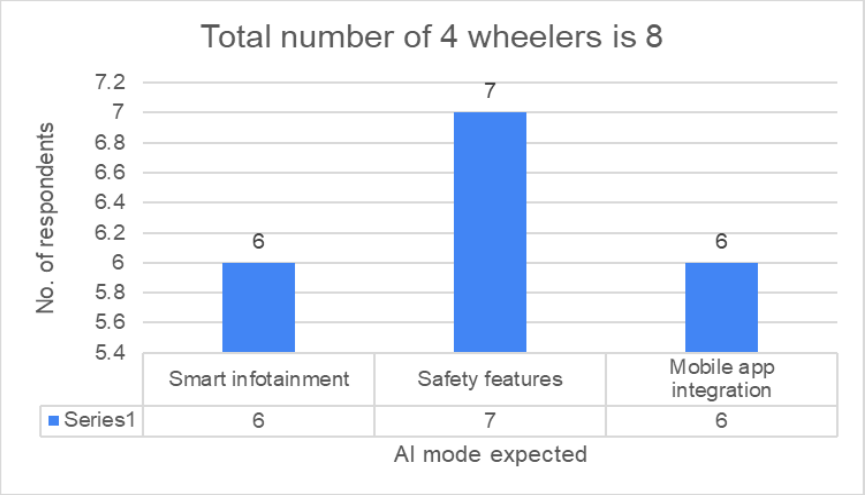
It is concluded that out of 125 respondents 116 respondents expected the technology advancement features in their electric vehicles which are 92.8% of respondents.

4. Number of consumers who expect smart infotainment, safety features and mobile app integration from electric 2 wheelers.



It is concluded that 94% and above consumers expect AI features from the electric vehicles.

5. Number of consumers who expect smart infotainment, safety features and mobile app integration from electric 4 wheelers.



It is concluded that out of 8 4 wheelers 6 to 7 respondents are expecting AI modes from the electric vehicles.

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8. FINDINGS

The following important conclusions are drawn from an examination of data gathered from 125 electric vehicle users in the Pune metropolitan area:

1. Younger consumers are more receptive to implementing AI-based technology in electric vehicles, as seen by the majority of responses being in the 18–35 age range.
2. Although the segment suggests possibilities for broader gender participation, male respondents make up 68.8% of the sample, indicating stronger EV adoption among males.
3. Higher education appears to have a good impact on awareness and adoption of AI features in EVs, as evidenced by the high percentage of respondents who are graduates.
4. Promotional messaging that emphasizes the value of contemporary features and innovation in EV marketing has a substantial impact on consumer interest.
5. When purchasing electric vehicles, 78.4% of respondents said that AI-enabled technologies are important.
6. The majority of respondents (92.8%) anticipate that their EVs will have smart controls, safety features, and smart systems.
7. Even in price-conscious markets, over 94% of two-wheeler EV buyers anticipate smart infotainment, safety alerts, and mobile app integration.
8. Customers of four-wheeler electric vehicles (EVs) also show that they are prepared for AI-based features, suggesting that increased autonomy levels in premium vehicle categories are acceptable.
9. Customers favor a gradual shift toward increasing levels of autonomy and are more prepared for aided and semi-autonomous features (Level 0–Level 1).

9. SUGGESTIONS

Based on the findings, the following suggestions are proposed:

1. To gain the trust of consumers, automakers should concentrate on integrating AI functions gradually, starting with Level 1 and Level 2 autonomy.
2. In order to inform consumers about AI functionality, safety advantages, and dependability, consumer awareness initiatives had to be reinforced.
3. To boost customer confidence, safety-focused AI features like intelligent alerts, driver assistance, and collision avoidance should be given top priority.
4. To boost market penetration, two-wheelers should have reasonably priced AI-enabled features.
5. Along with environmental benefits, marketing campaigns should highlight smart technology and future readiness.
6. Adoption of AI-enabled EVs can be accelerated by government support through pilot projects, infrastructure development, and incentives.

10. CONCLUSION

By improving safety, efficiency, and user experience, artificial intelligence is becoming a more significant factor in determining the direction of electric vehicles. According to the study's findings, customers have high expectations for AI-enabled capabilities, and these features have a big impact on judgments about what to buy. While assisted and semi-autonomous technologies are widely accepted, complete vehicle autonomy is still viewed with trepidation.

The results show that a gradual shift from Level 0 to Level 1 and Level 2 autonomy fits in nicely with the readiness of consumers today. This change is being spearheaded by young, educated customers, which bodes well for future widespread adoption. In general, customer awareness, safety assurance, technological innovation, and supportive legislative frameworks will be necessary for the successful integration of AI in electric vehicles.

REFERENCES

1. Bas, J., Cirillo, C., Cherchi, E.: Classification of potential electric vehicle purchasers: a machine learning approach. Technol. Forecast Soc. Change 168, 120759 (2021)

ISSN 2394 - 7780

2. Hua, W., Mullen, D., Wahid, A., Sitabkhan, K., Mason, K. (2024). An Overview of Artificial Intelligence for Electric Vehicle Energy Systems Integration. In: Nowaczyk, S., et al. Artificial Intelligence. ECAI 2023 International Workshops. ECAI 2023. Communications in Computer and Information Science, vol 1948. Springer, Cham. https://doi.org/10.1007/978-3-031-50485-3_17
3. Mr. Bhoir A.G. & Dr. More R.R. (2025). The Role of AI in Transportation: Special Focus on Autonomous Vehicles in India. In Educreator Research Journal: Vol. XII (Issue I), pp.153-158.
4. Ms. Narawade D. (2025). AI and E Vehicles:Road to sustainable and User Friendly Way to Transportation. In Educreator Research Journal: Vol. XII (Issue I), pp.273-277.
5. Noviati, Nuraini & Putra, Fengki & Sadan, Sadan & Ahsanitaqwim, Ridhuan & Septiani, Nanda & Santoso, Nuke. (2024). Artificial Intelligence in Autonomous Vehicles: Current Innovations and Future Trends. International Journal of Cyber and IT Service Management. 4. 97-104. 10.34306/ijcitsm.v4i2.161.
6. Phatale, Amey. (2018). Autonomous Vehicle Levels & Trends. International Journal of Science and Research (IJSR). 7. 1944 - 1948. 10.21275/SR24314005404. professionals must care (2010)
7. Russell, S., Norvig, P.: Artificial intelligence: a modern approach (2002)
8. Sovacool, B.K.: A transition to plug-in hybrid electric vehicles (phevs): why public health
9. Zarazua de Rubens, Gerardo. (2019). Who will buy electric vehicles after early adopters? Using machine learning to identify the electric vehicle mainstream market. Energy. 172. 10.1016/j.energy.2019.01.114.

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THE ROLE OF ARTIFICIAL INTELLIGENCE IN IMPROVING THE ACCURACY OF MARKET SEGMENTATION

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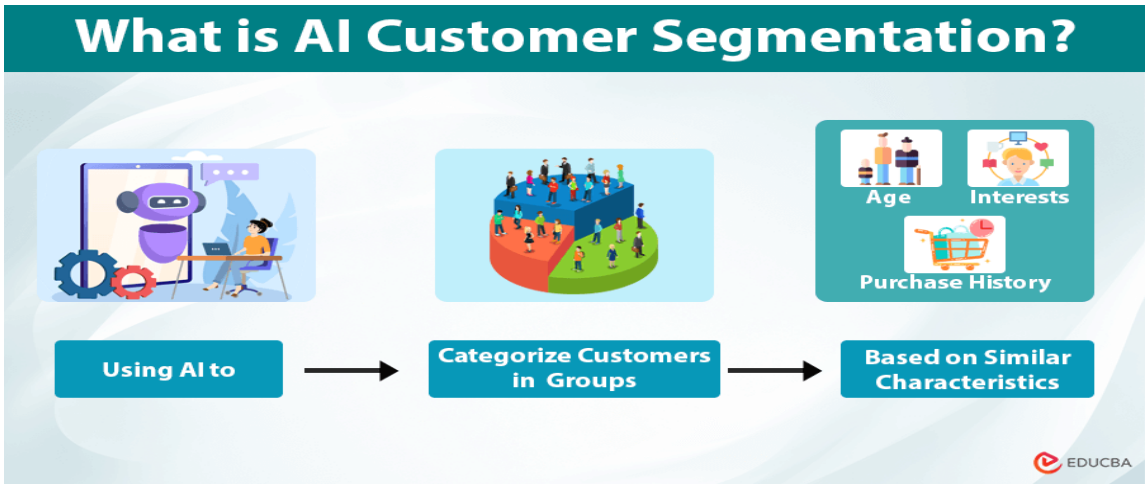
ABSTRACT
Market segmentation is a fundamental element of marketing strategy that helps firms identify and target specific groups of consumers effectively. Traditional segmentation methods based on demographic, geographic, psychographic, and behavioural variables often fail to capture the complexity of modern, data-driven markets. The rapid growth of digital technologies and big data has further increased the need for more precise and dynamic segmentation approaches. In this context, Artificial Intelligence has emerged as a powerful tool capable of analysing large and complex datasets and uncovering hidden consumer patterns. This research paper examines the impact of Artificial Intelligence on the accuracy of market segmentation using secondary data sources such as academic journals and industry reports. The study analyses key AI techniques, including machine learning, clustering algorithms, predictive analytics, and natural language processing. The findings reveal that AI significantly improves segmentation accuracy, personalisation, and overall marketing effectiveness when supported by high-quality data and responsible governance.

Keywords: *Artificial Intelligence, Market Segmentation, Machine Learning, Predictive Analytics, Marketing Analytics, Secondary Data*



1. INTRODUCTION
Market segmentation is a fundamental aspect of marketing management that enables firms to design targeted strategies, enhance customer satisfaction, and achieve competitive advantage. Traditional segmentation methods based on demographic, geographic, psychographic, and behavioural variables are useful but often static and insufficient to capture rapidly changing consumer behaviour.

With the expansion of digitalisation, e-commerce, and social media, massive volumes of consumer data are generated continuously, making analysis through conventional tools increasingly difficult. Artificial Intelligence addresses this challenge by analysing large and complex datasets, identifying patterns, and supporting intelligent decision-making. In marketing, AI-driven segmentation allows firms to move from static classifications to dynamic, behaviour-based, and predictive consumer groupings.

In practice, companies such as Amazon, Netflix, Google, Coca-Cola, and Starbucks use AI to analyse consumer behaviour and deliver personalised products, content, and offers. These applications underline the growing importance of Artificial Intelligence in improving the accuracy and effectiveness of market segmentation in contemporary marketing practice.

REVIEW OF LITERATURE
Several researchers have highlighted the growing importance of Artificial Intelligence in marketing analytics and market segmentation. Kotler and Keller noted that data-driven segmentation improves targeting precision and marketing effectiveness, while Wedel and Kannan emphasised the need for advanced analytics in data-rich marketing environments. Davenport et al. observed that AI enables large-scale data processing, automation of insights, and enhanced personalisation, and Rust and Huang explained how AI improves predictive accuracy in

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marketing decisions. Haleem, Javaid, and Khan confirmed through a literature review that AI significantly enhances customer engagement and segmentation, while Zhang demonstrated that machine learning-based segmentation outperforms traditional methods.

RESEARCH GAP

Despite the growing body of literature on Artificial Intelligence in marketing, several research gaps remain:

- Limited comprehensive conceptual studies focusing specifically on segmentation accuracy
- Lack of empirical validation across diverse industries and emerging markets
- Insufficient focus on ethical issues and governance in AI-driven segmentation
- Limited discussion on managerial integration of AI insights with human judgement

The present study attempts to address these gaps by providing an integrated conceptual analysis of AI-driven market segmentation based on secondary data.

OBJECTIVES OF THE STUDY

1. To examine the concept of Artificial Intelligence in the context of marketing and market segmentation.
2. To analyse the role of AI techniques in improving the accuracy of market segmentation.
3. To review existing literature on AI-based market segmentation using secondary data.
4. To identify the benefits and limitations of AI-driven market segmentation.
5. To suggest implications for marketers and future research directions.

RESEARCH METHODOLOGY

The present study is based exclusively on **secondary data**. The research relies on a systematic review and analysis of published literature obtained from the following sources:

- Peer-reviewed academic journals in marketing, management, and artificial intelligence
- Industry reports published by consulting firms and technology research organisations
- Books, conference proceedings, and white papers on AI and marketing analytics
- Published conceptual and empirical research papers

The collected literature was reviewed, classified, and analysed to identify key themes related to AI and market segmentation. The study adopts a descriptive and analytical research design.

SIGNIFICANCE OF THE STUDY

The present study is significant as it highlights the growing role of Artificial Intelligence in enhancing the accuracy and effectiveness of market segmentation in a data-driven marketing environment. It provides valuable insights for marketers to design more precise, dynamic, and personalised marketing strategies using AI-based tools. The study also contributes to academic literature by consolidating existing research on AI-driven segmentation through secondary data. Further, it offers a foundation for future empirical research and informed managerial decision-making in AI-enabled marketing practices.

CONCEPT OF ARTIFICIAL INTELLIGENCE IN MARKETING

Artificial Intelligence refers to the ability of computer systems to perform tasks that normally require human intelligence, such as learning, reasoning, problem-solving, and decision-making. In marketing, AI is used to analyse customer data, predict consumer behaviour, automate decision-making processes, and deliver personalised experiences.

AI in marketing operates through technologies such as machine learning, deep learning, natural language processing, and big data analytics. These technologies enable marketers to extract insights from both structured data such as transaction records and unstructured data such as social media posts, reviews, and images.

MARKET SEGMENTATION: TRADITIONAL VS AI-BASED APPROACHES

Traditional market segmentation methods typically classify consumers based on predefined criteria. These approaches are often static and rely heavily on human judgement. As a result, they may overlook subtle behavioural patterns and fail to adapt to changing market conditions.

AI-based market segmentation differs significantly from traditional methods. Instead of relying on predefined rules, AI algorithms learn directly from data. Machine learning models can process large datasets, identify

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complex relationships, and dynamically update segments as new data becomes available. This results in more accurate, relevant, and actionable market segments.

ROLE OF ARTIFICIAL INTELLIGENCE IN IMPROVING MARKET SEGMENTATION ACCURACY

Machine Learning and Clustering Techniques: Machine learning, particularly clustering algorithms, groups customers based on behavioural, preference, and transaction similarities, enabling more accurate and data-driven market segmentation.

Predictive Analytics: Predictive analytics uses historical data and AI models to forecast future consumer behaviour, such as purchase likelihood and churn risk, thereby improving segmentation precision and proactive marketing decisions.

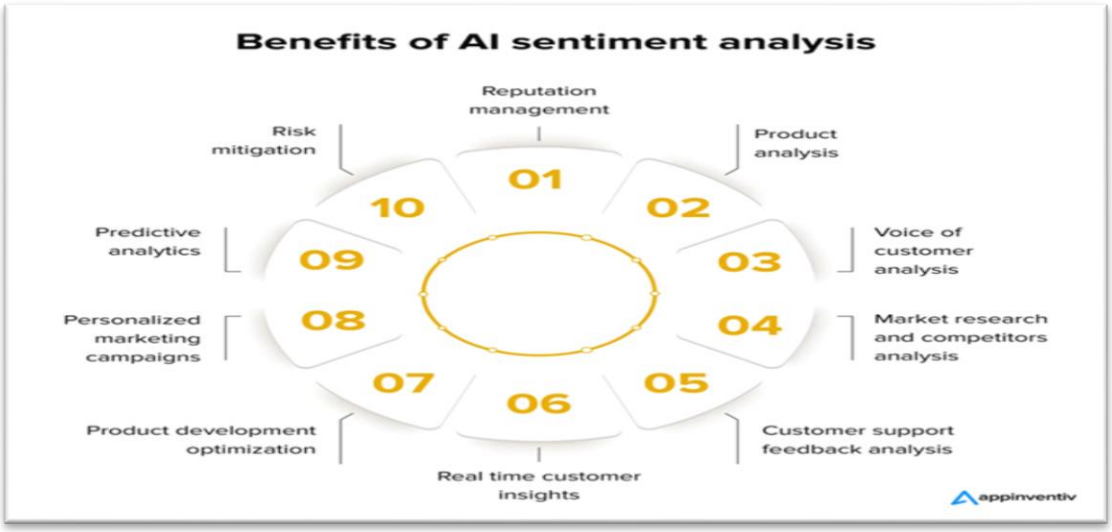
Natural Language Processing (NLP): Natural Language Processing analyses unstructured data like customer reviews and social media content to capture emotional and attitudinal insights, enriching market segmentation.

Real-Time and Dynamic Segmentation:AI processes real-time data to continuously update market segments, ensuring marketing strategies remain relevant and responsive to changing consumer behaviour.

BENEFITS OF AI-DRIVEN MARKET SEGMENTATION

The review of secondary data highlights several advantages of using AI in market segmentation:

1. **Higher Accuracy:** AI identifies complex patterns, resulting in more precise and reliable segments.
2. **Personalisation:** AI enables customised marketing messages, products, and services.
3. **Efficiency:** Automation reduces time and cost associated with traditional market research.
4. **Improved Decision-Making:** Data-driven insights enhance strategic marketing decisions.
5. **Competitive Advantage:** Firms gain better market responsiveness and customer engagement.



8. LIMITATIONS AND ETHICAL ISSUES

Despite its advantages, AI-based market segmentation faces several challenges:

- **Data Quality Issues:** Poor data quality can lead to inaccurate segmentation results.
- **Algorithmic Bias:** Biased data may result in unfair or discriminatory segmentation.
- **Lack of Transparency:** Complex AI models may be difficult to interpret.
- **Privacy Concerns:** The use of personal data raises ethical and legal issues related to data protection.
- **High Implementation Costs:** Advanced AI systems require significant investment and technical expertise.

MANAGERIAL IMPLICATIONS

Managers should adopt AI-driven market segmentation with a strategic and ethical approach. Investment in data quality, employee training, and governance frameworks is essential. AI insights should complement, not replace, managerial judgement. Firms should also ensure compliance with data protection regulations and adopt transparency in AI-driven decision-making.

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SUGGESTIONS

Based on the review of secondary literature and the analysis of Artificial Intelligence in market segmentation, the following suggestions are proposed for marketers, organisations, and future researchers:

1. **Improvement in Data Quality:** Organisations should maintain accurate, consistent, and integrated customer data to enhance the effectiveness of AI-based market segmentation.
2. **Adoption of Hybrid Segmentation Approach:** Firms should combine traditional segmentation methods with Artificial Intelligence techniques to achieve more reliable and actionable results.
3. **Use of Explainable AI Models:** Marketers should adopt explainable AI models to improve transparency, interpretability, and trust in segmentation outcomes.
4. **Ethical Use of AI and Data Privacy:** Organisations must ensure ethical use of AI and strict compliance with data protection and privacy regulations in marketing activities.
5. **Training and Skill Development:** Marketing professionals should receive continuous training in Artificial Intelligence and data analytics to effectively utilise AI-based tools.
6. **Pilot-Based Implementation:** AI-driven market segmentation should be introduced through pilot projects before full-scale organisational implementation.
7. **Dynamic Market Segmentation:** Firms should adopt real-time and dynamic segmentation approaches to respond promptly to changing consumer behaviour.
8. **Future Research Focus:** Future researchers should conduct empirical studies to validate and refine AI-driven market segmentation models across industries.

CONCLUSION

The study concludes that Artificial Intelligence has a significant impact on improving the accuracy of market segmentation. AI-driven techniques such as machine learning, predictive analytics, and natural language processing enable marketers to develop dynamic, precise, and actionable customer segments. The study confirms that AI-based segmentation enhances personalisation, marketing efficiency, and competitive advantage. However, challenges related to data quality, ethics, and implementation must be carefully addressed. Future research should focus on empirical validation and industry-specific applications of AI-based market segmentation.

REFERENCES

Davenport, T. H., Guha, A., Grewal, D., & Bressgott, T. (2020). How artificial intelligence will change the future of marketing. *Journal of the Academy of Marketing Science, 48*(1), 24–42. https://doi.org/10.1007/s11747-019-00696-0

Haleem, A., Javaid, M., & Khan, I. H. (2022). Artificial intelligence (AI) applications for marketing: A literature review. *Heliyon, 8*(11), e10905. https://doi.org/10.1016/j.heliyon.2022.e10905

Kotler, P., & Keller, K. L. (2016). *Marketing management* (15th ed.). Pearson Education Limited. https://www.pearson.com/en-us/subject-catalog/p/marketing-management/P200000006019

Rust, R. T., & Huang, M. H. (2014). The service revolution and the transformation of marketing science. *Marketing Science, 33*(2), 206–221. https://doi.org/10.1287/mksc.2013.0836

Wedel, M., & Kannan, P. K. (2016). Marketing analytics for data-rich environments. *Journal of Marketing, 80*(6), 97–121. https://doi.org/10.1509/jm.15.0413

Zhang, Y. (2025). Machine learning-based customer segmentation. In *Proceedings of the International Conference on Data Analytics* (pp. 112–120). SCITEPRESS. https://www.scitepress.org/PublicationsDetail.aspx?ID=conference-paper-ml-segmentation

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A STUDY ON CUSTOMER PERCEPTION TOWARDS THE USE OF AI IN THE REAL ESTATE SECTOR OF MUMBAI

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ABSTRACT
Artificial Intelligence (AI) refers to the ability of machines such as computers, laptops, mobile devices, and robots to perform tasks that typically require human intelligence. AI continues to advance rapidly, bringing imagination closer to reality. Today, the term "AI" encompasses a wide range of technologies that power many services and products used in daily life, from applications that recommend television shows to chatbots that provide real-time customer support. Mumbai is a fast-paced and busy city, often regarded as a dream city, where people are highly engaged in their professional and personal lives. As a result, individuals prefer to avoid unproductive activities and seek efficient use of time. In this context, AI has found increasing applications in the real estate sector, particularly in areas such as generative design, where it creates multiple layout options based on parameters like site conditions, budget, and efficiency. Therefore, the present study focuses on the use of AI technologies in the real estate sector and examines customers' perceptions toward the use of AI in real estate services. The study is based on data collected from both primary and secondary sources.
Keywords: *Real Estate Sector, AI Tools Used in Real Estate, Customer Perception*

1. INTRODUCTION:

Artificial Intelligence (AI) refers to the ability of machines such as computers, laptops, mobile devices, and robots to perform tasks that typically require human intelligence. AI helps solve problems by understanding needs and requirements in a manner similar to humans through data analysis and pattern recognition. A wide variety of applications fall under this umbrella, and as technology advances, expectations have increased. AI has proven capable of performing many tasks that humans do using intelligence, often working significantly faster than humans. AI continues to improve day by day and brings imagination closer to reality. It understands instructions, continuously refines outputs based on user requirements, and suggests more advanced or improved tasks that can be performed on the existing output. AI allows us to learn from past data to predict future outcomes through data aggregation, tracking, analytics, algorithms, and logical reasoning. In today's world, we frequently hear about machines performing surgeries and robots carrying out tasks that were traditionally done by humans. All of this is possible due to the growing power of AI. Today, the term "AI" describes a wide range of technologies that power many of the services and products we use daily, from applications that recommend TV shows to chatbots that provide real-time customer support. Some common examples of AI in use today include ChatGPT, Google Translate, Netflix, and Apple's Siri.

Mumbai is a very busy city and is often considered a dream city, where people lead fast-paced lives and are highly engaged in their daily work. As a result, they prefer not to waste time on unproductive activities and aim to utilize their time efficiently. This is why people in cities like Mumbai increasingly prefer online shopping for groceries and clothing, online ticket bookings, and ride-booking services. They are also aware of advanced technologies and know how to make the most of them. Knowingly or unknowingly, Artificial Intelligence (AI) has become a necessity in the modern world. Understanding how AI works and how to use it can help individuals better leverage technology both at work and in their personal lives. AI is also applied in the real estate business, particularly in generative design, where it creates numerous layout options based on parameters such as site conditions, budget, and efficiency. AI can quickly generate design concepts, create realistic images, support modular construction, and enable 3D printing of structural components, thereby reducing waste and improving precision. It can also transform predictions into realistic visual representations. Therefore, the present study focuses on how the real estate sector uses AI technologies in its services and examines the customers' perceptions towards use of AI in real estate services.

2. REVIEW OF LITERATURE:

- Saritha S. R. et al. (2023)[1], in their paper, stated that the main purpose was to develop new ways in which AI can be used in the real estate sector. They explained that, with the help of AI, the real estate industry has the potential to become more efficient, transparent, and customer-centric. They highlighted the potential benefits of AI in the real estate sector, such as more accurate property valuations, better customer service through chatbots and virtual assistants, and advanced property search capabilities.

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- Basheer AI-haimia et al. (2025)[2], in their paper main purpose was to understand the relationship between current technologies, their benefits, and the challenges faced in the real estate sector. They reveal the transformative potential of digital technologies in real estate and their advantages for stakeholders such as property managers, investors, purchasers, and tenants. They conclude that the main challenges in adopting digital technologies in real estate are related to high costs, data security concerns, and regulatory compliance. Therefore, to face these challenges will require coordinated efforts from policymakers, industry leaders, and researchers.
- Arpitha R. S. et al. (2025) [3], in their paper, they examined the role of digital technology in the real estate sector with respect to customer interaction, as well as the challenges and drawbacks faced by real estate agents in promoting customer-centricity. The study concluded that various digital tools, such as virtual property tours, mobile applications, AI-powered chatbots, and smart assistants, have significantly reshaped customer-centric practices in the real estate industry. However, they also concluded that real estate businesses must maintain a balance between the use of digital technologies and addressing customers' needs and preferences to ensure effective and sustainable customer engagement.

3. OBJECTIVE OF THE STUDY:

The objectives of the study are stated as follows:

- To study the AI technologies used by real estate sector.
- To examine the customer perception towards use of Artificial Intelligence in the real estate sector of Mumbai.

4. SCOPE OF THE STUDY AND METHODOLOGY:

The present study covers the Mumbai region and focuses on the types of AI techniques used in the real estate sector. It also examines the perception of customers who use or have been exposed to AI-based tools during property search and transaction processes. To understand the objectives of the study, both primary and secondary data were used. Primary data was collected through a Google Form–based questionnaire. Using the random sampling technique, the questionnaire was distributed among 50 customers who use AI-based tools while searching for and engaging in property transactions. Secondary data was collected from various sources such as the Internet, reference books, newspapers, and journals. The collected data was statistically analysed and interpreted using tools such as averages and percentages, and graphs were used to present the findings in a clear and effective manner.

5. AI IN REAL ESTATE SECTOR:

AI is now widely used across the real estate (real estate sector) value chain from land acquisition and construction to sales, property management, and urban planning.

Classification of AI technologies used in the real estate sector

- Machine Learning (ML): ML is used for Property price prediction & valuation models, Demand forecasting (location-wise housing demand), Credit risk analysis for home loans, Fraud detection in property transactions. Some of the examples of ML are Zillow's Zestimate model, AI-based circle rate vs market price comparison in Indian metros etc.
- Geographic Information Systems (GIS) + AI : It is used for Land suitability analysis, Slum redevelopment planning (SRA projects), Infrastructure accessibility mapping, Real-time project monitoring. In Mumbai GIS and AI is used for integration for tracking SRA housing delivery.
- Internet of Things (IoT) + AI**:** It is used for Smart building management. It is applied for Energy optimization, Predictive maintenance, Smart parking systems, Occupancy monitoring. Example of IoT and AI is AI-enabled smart buildings in commercial real estate.
- Digital Twins**:** It is used for preparation of Virtual replicas of buildings/cities. It helps in construction planning, Urban redevelopment simulation and disaster risk management.
- Robotics & Automation: It is used for Physical automation. It is applied for Construction robots, Automated surveying (drones + AI), 3D printing of housing units.
- Blockchain + AI (Emerging): It is used for Transparency & security. It is applied for Smart contracts for property transactions, Fraud prevention, Automated due diligence, and Digital land records & property verification.

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- Artificial Neural Networks (ANN): It is used for complex pattern recognition. It is applied for Real estate price fluctuation modelling, Construction cost estimation, and Investment risk profiling.
- Natural Language Processing (NLP): It is used for Text analysis and automation. It is applied for, AI chatbots for property inquiries, Lease agreement analysis, Legal document verification (title deeds, sale agreements) and Sentiment analysis of customer reviews. Example of NLP is Chatbots on real estate portals like Housing.com, Magicbricks, and 99 acres etc.
- Computer Vision: It is used for Image & video analysis It is applied for Property condition assessment using images, Construction progress monitoring, Detection of illegal constructions, Quality inspection of buildings and Satellite image comparison for rehabilitation project progress.
- Predictive Analytics: It is used for Future forecasting. it is applied for prediction of delay in project completion, forecasting of rental yield, and infrastructure impact on property prices.

6. Finding of the Study with respect of Customer perception towards use of AI in Real Estate:

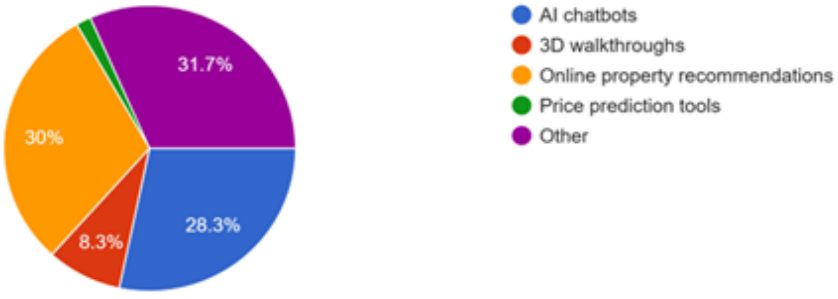
Table -1 Personal Profile of Respondents

Particulars	Frequency	Percentage
Gender		
Male	38	63.30
Female	22	36.70
Total	**60**	**100.00**
Age Group		
18-30	26	43.30
30-45	28	46.70
45-60	5	8.30
Above 60	1	1.70
Total	**60**	**100.00**
Educational Qualification		
Students	4	6.70
Salary Employed	36	60
Self Employed	6	10
Professional	9	15
Other	5	8.30
Total	**60**	**100.00**

Source: Self Compiled

Table1 shows, the study includes 60 respondents, divided between male (63.30%) and female (36.70%). Most participants are between age group of 30-45 with 46.70%, followed by 43.30% aged 18–30, and fewer respondents in older age groups. In terms of occupation/education, Salary Employed form the largest group (60%), followed by Professional (15%), while the remaining respondents are self-employed (10%), Students are 6.70% and other categories (8.30%). Overall, the table shows that the respondents are mostly male, within the 18–45 age group, and salaried employees, making the sample suitable for studies focusing on Customer Perception towards the use of AI in the Real Estate Sector of Mumbai.

Figure-1 AI-based tools used by Respondents in real estate services



Sources: self-compiled

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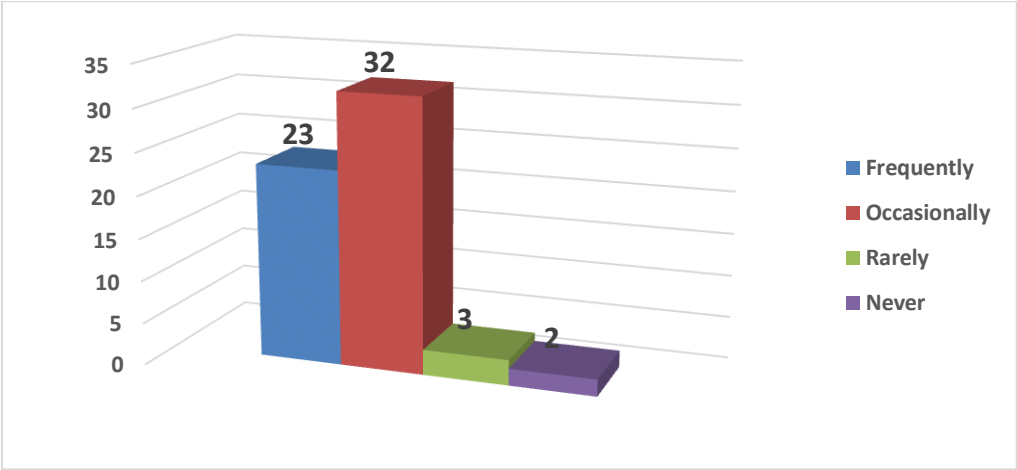
The Figure 1 reveals the extent of respondents' exposure to various AI-based tools in real estate services. Out of the 60 respondents, the highest proportion (31.7%) reported experience with other AI-based tools, indicating the presence of diverse or emerging technologies beyond the commonly identified categories. This is followed by online property recommendation systems (30%). AI chatbots are also widely experienced, with 28.3% of respondents indicating their use, reflecting their growing importance in handling customer queries and improving service responsiveness. Comparatively 3D walkthroughs are experienced by a relatively smaller segment (8.3%), while price prediction tools show minimal exposure (1.7%), suggesting limited adoption or awareness of advanced predictive analytics among customers. Overall, the findings suggest that while AI tools such as chatbots and recommendation systems are increasingly integrated into real estate services.

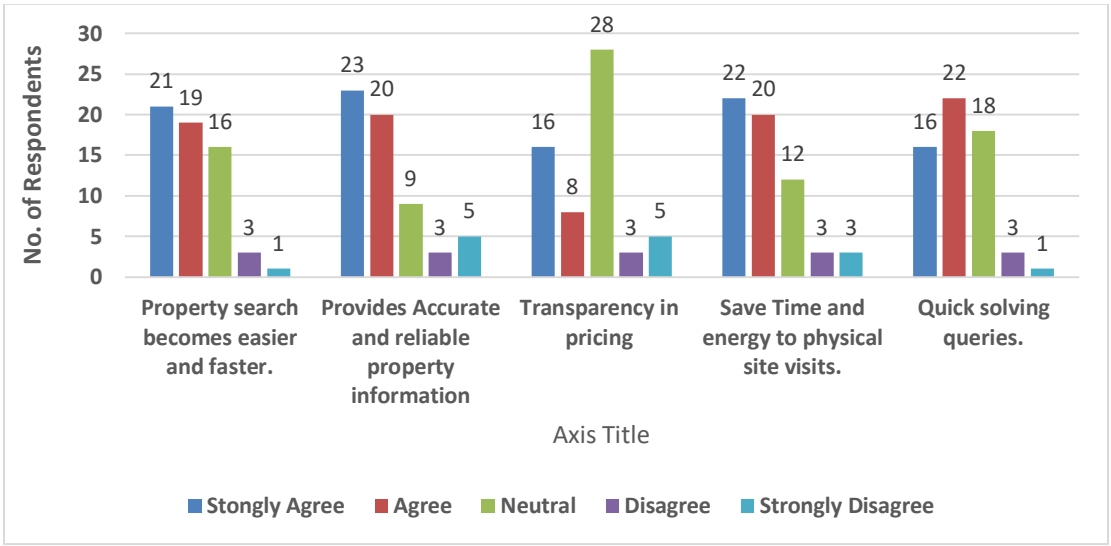
Figure 2: Frequency of using AI Based real estate platforms or tools by respondents



Sources: self-compiled

Figure 2 illustrates the frequency with which respondents use AI-based real estate platforms or tools. Out of the 60 respondents, the largest proportion 32 respondents reported that they Occasionally use AI-based real estate tools and 23 respondents are using AI based real estate tools. It indicates the most of the respondents uses AI tools in real estate.

Figure 3: Satisfaction with the Use of AI in Real Estate Services



Sources: self-compiled

- Figure 3 shows that out of 60 respondents, 21 are Strongly agreed with Property Search becomes easier and faster, while 19 respondents are agreed. Whereas 16 respondents are neutral on this. Only few respondents shown that they disagree or Strongly Disagree. This indicates that AI platforms enhance efficiency and convenience in locating in locating suitable properties.
- Out of 60 respondents, 23 are Strongly agreed with AI provides Accurate and reliable property information, while 20 respondents are agreed. Whereas 9 respondents are neutral on this. Only few respondents shown

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that they disagree or Strongly Disagree. This indicates that AI platforms is able to provide more accurate and reliable property information.

- Out of 60 respondents 28 are Neutral on transparency in pricing, which indicates that most of the respondents are uncertain about AI's effectiveness in ensuring transparent prices of real estate.
- Out of 60 respondents 22 strongly agreed and 20 agreed on saving of time and energy to physical site visit. It indicates that AI is reducing physical site visits and save time and energy.
- Out of 60 respondents 16 strongly agreed and 22 agreed AI is quickly solving the queries of the customers.

7. CONCLUSION:

The study of A Study on Customer Perception towards the use of AI in the Real Estate Sector of Mumbai shows that most of the people especially salaried and professionals are using AI based tools that make property search easy and faster, it also shows that it provides accurate and reliable information of the property as per the requirements of the customers. It also saves time and energy by avoiding physical site visits. It not only shows the picture and dimensions of property but also give virtual tour of property, which help customers to visualise the house, which helps them to select or chose the property for buying, selling or renting. it has been observed that real estate industries are using so many AI based platforms apart from customer service AI chatbots as it reflects in figure 1 others such as Magicbricks, Nobroker.com etc. AI is quick in solving the queries of the customers in real time. But as per data received from respondents, transparency of pricing is the area which needs further improvements.AI is really creating positive impressions between customers as AI never gives up on customer's expectations. In city like Mumbai where people are really busy in their work life and at the same time, they want to give decent living to their family, AI based applications have given them reliable information without disturbing their routine. However, some customers expect data privacy.

REFERENCES:

1. Saritha S. R. et al. (2023). 'Fusion of Real Estate and Artificial Intelligence (AI)'. Journal of Emerging Technologies and Innovative Research. ISSN 2349-5162. Vol. - 10, Issue - 4 pp 426-439.
2. Basheer AI-haimia et al. (2025). 'Digital transformation in the real estate industry: A systematic literature review of current technologies, benefits, and challenges' International Journal of Information Management Data Insights. Vol. 5, Issue 1.
3. Arpitha R.S. et al. (2025). 'Digitalisation And Customer Centricity- A Study On Customer Centricity In Real Estate Industry'. International Journal of Creative Research Thoughts. ISSN: 2320-2882. Vol. 13, pp. 60-70.
4. PITZ Fabian (2024). 'A Literature Review on Application of Artificial Intelligence on the Example of Real Estate Business'. International Journal of Advanced Engineering and Management Research. ISSN: 2456-3676. pp. 53-67.

Web sources:

- https://www.sciencedirect.com/science/article/pii/S2667096825000229#bib1
- https://ijcrt.org/papers/IJCRT2505690.pdf
- https://www.researchgate.net/publication/386080651_The_Impact_of_Artificial_Intelligence_and_Machine_Learning_on_Real_Estate_Current_Applications_and_Future_Trends
- https://ablypro.com/ai-in-real-estate
- https://www.solulab.com/ai-in-real-estate/

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TRANSFORMING HEALTHCARE THROUGH ARTIFICIAL INTELLIGENCE: BRIDGING PATIENT CARE AND MEDICAL RESEARCH

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ABSTRACT
Artificial Intelligence (AI) is revolutionizing healthcare by transforming both patient care delivery and the medical research landscape. This conceptual paper explores the dual impact of AI across two critical domains: clinical practice and biomedical innovation. In patient care, AI is being deployed for diagnostic imaging, predictive analytics, clinical decision support, and virtual health assistance, leading to faster diagnoses, improved accuracy, enhanced patient monitoring, and personalized treatment strategies. In parallel, AI is reshaping medical research by accelerating drug discovery, optimizing clinical trials, automating literature synthesis, and enabling real-time data analysis. These advances collectively reduce the time, cost, and resource intensity traditionally associated with healthcare innovation.

Grounded in a multidisciplinary framework combining clinical informatics, data science, and machine learning, this paper synthesizes current academic literature and real-world implementations to highlight the practical, clinical, and strategic benefits of AI. It also critically examines persistent challenges such as algorithmic bias, data privacy risks, interpretability of AI models, uneven access, and the need for upskilling the healthcare workforce. Through a thematic analysis, the paper presents forward-looking recommendations for responsible AI adoption, emphasizing the importance of inclusive data practices, transparent validation, ethical governance, and interdisciplinary collaboration among stakeholders.

The findings suggest that while AI holds immense potential to enhance diagnostic accuracy, research productivity, and operational efficiency, its long-term success depends on thoughtful design, clear regulation, and system-level readiness. By bridging innovation with accountability, AI can serve as a powerful catalyst for building more responsive, equitable, and resilient healthcare systems capable of meeting the evolving demands of patients, providers, and researchers alike.

Keywords: *Artificial Intelligence, Healthcare, Predictive Analytics, Medical Research, Clinical Support Systems*

1. INTRODUCTION
Healthcare systems worldwide are undergoing a transformative shift with the integration of Artificial Intelligence (AI). From facilitating virtual consultations to speeding up the process of drug development, AI is revolutionizing healthcare delivery and the generation of medical insights. As medical data becomes increasingly complex ranging from imaging and genomics to electronic health records (EHRs) there is a growing need for tools capable of efficiently managing and interpreting this information. AI addresses this challenge through its capabilities in pattern detection, risk assessment, and providing real-time assistance to healthcare professionals and researchers. This paper examines the dynamic role of AI in clinical practice and medical research, focusing on effective implementation strategies and potential challenges.

2. REVIEW OF LITERATURE
Recent literature increasingly characterizes AI as a dual-purpose capability in healthcare: (i) improving clinical decision-making and operational workflows and (ii) accelerating biomedical discovery. In patient care, systematic and narrative reviews report strong performance of machine learning and deep learning models in medical imaging interpretation, clinical prediction, and decision support, with demonstrated potential to reduce diagnostic delays and enhance accuracy. However, these reviews repeatedly note challenges that limit clinical translation, including dataset shifts across hospitals, inconsistent external validation, interpretability concerns, and equity risks associated with non-representative data.

In parallel, research-focused studies describe AI as a “research acceleration layer” that compresses timelines in drug discovery, clinical development, and evidence synthesis. Reviews in drug discovery highlight the growing role of deep learning and generative approaches in target identification, hit discovery, and lead optimization, while also emphasizing data quality, reproducibility, and regulatory acceptance as key barriers to achieving real-world impact. Clinical trials literature similarly reports that AI can improve recruitment feasibility, patient matching, protocol design, and monitoring through predictive analytics and automation, but warns that fragmented data, privacy constraints, and limited prospective evaluation often constrain adoption. Finally,

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biomedical NLP and literature-mining research shows that AI-assisted evidence synthesis and scientific search can speed up knowledge discovery and reduce manual screening effort, yet reliability, transparency, and bias in automated summarization remain ongoing concerns.

3. THEORETICAL ORIENTATION

This paper is grounded in a multidisciplinary theoretical orientation combining **clinical informatics** and **machine learning** perspectives. From a *clinical informatics* lens, AI is understood as a decision and workflow technology embedded in healthcare systems supporting information flow, reducing cognitive burden, and improving care coordination. This orientation emphasizes usability, integration with electronic health records (EHRs), clinical workflow fit, patient safety, and accountability.

From a *machine learning* perspective, AI is conceptualized as a data-driven system that learns patterns from clinical and biomedical datasets to enable classification (e.g, diagnostic detection), prediction (e.g, risk forecasting), and generation (e.g, synthetic data or candidate molecules). The relevance of this lens is increasing due to the scale and complexity of multimodal health data (imaging, text, signals, and genomics), which exceed manual analytic capacity.

Together, these perspectives frame AI's impact as both:

1. A **clinical transformation tool** (improving diagnostic accuracy, timeliness, and personalization), and
2. A **research acceleration tool** (speeding discovery, trial design, and evidence synthesis).

This combined orientation also clarifies why persistent challenges bias, transparency, privacy, and governance, are not "side issues" but central determinants of real-world performance and trust.

4. METHODOLOGY

This study adopts a **conceptual research design** supported by a **thematic literature synthesis** to examine how Artificial Intelligence (AI) is transforming patient care and medical research. Instead of collecting primary clinical data, the paper consolidates and interprets evidence from **peer-reviewed articles, high-impact reviews, and documented implementations** across healthcare settings.

*4.1*Literature Identification and Inclusion Logic

The literature was selected to represent two domains aligned with the paper's aim: (1) **clinical applications** (diagnostics, predictive models, clinical decision support, patient engagement), and (2) **research applications** (drug discovery, clinical trials, and literature mining).

*4.2*Output of the Analysis

The synthesis produces three outputs:

1. a structured map of AI applications across the care–research continuum,
2. a consolidated set of benefits and risks described in recent literature (e.g, accuracy gains vs. bias/privacy constraints), and
3. Practical recommendations for responsible adoption centered on inclusive data practices, transparent validation, ethical oversight, and capacity building.

5. FINDINGS OF THE STUDY

Based on the thematic literature synthesis, the study yields three consolidated findings. First, AI's impact in healthcare operates across a care–research continuum: in patient care it improves diagnostic support, risk prediction, and patient engagement, while in medical research it accelerates discovery processes such as drug development, trial optimization, and evidence synthesis. Second, the literature consistently reports benefits in speed, accuracy, personalization, and operational efficiency; however, these gains are accompanied by recurring risks including bias, privacy concerns, limited interpretability, and uneven access that directly influence clinical trust and adoption. Third, successful long-term AI integration depends less on model performance alone and more on system readiness: transparent validation beyond accuracy, governance and accountability structures, inclusive data practices, and workforce upskilling. These findings support the study's overall position that AI can strengthen healthcare performance, but only when innovation is aligned with safety, equity, and implementation feasibility.

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6. STRATEGIC RECOMMENDATIONS

To ensure AI improves outcomes without amplifying inequities or safety risks, the following recommendations are proposed:

6.1 Adopt representative data strategies (bias mitigation).

Institutions should evaluate whether training and validation datasets reflect the intended population (age, sex, ethnicity, comorbidities, and care settings). Where gaps exist, data partnerships, federated learning approaches, or staged deployment with monitoring can reduce bias-related failures.

6.2 Require transparent validation and clinical evaluation.

AI tools should be tested beyond technical accuracy, including calibration, subgroup performance, and real-world workflow impact. Clinically meaningful metrics (false negatives in screening, alert fatigue in prediction tools) should guide adoption decisions.

6.3 Strengthen privacy, security, and governance.

AI programs should implement data minimization, access controls, audit trails, and clear data stewardship roles. Governance committees (clinical + technical + ethics) should oversee model updates, monitoring, incident response, and post-deployment drift.

7. APPLICATIONS OF AI IN PATIENT CARE

7.1 AI in Diagnostics

One of the most prominent uses of AI in healthcare is in diagnostic imaging. Advanced deep learning algorithms, particularly Convolutional Neural Networks (CNNs), are increasingly utilized to interpret medical images such as X-rays, CT scans, and MRIs. Solutions like Google Health's breast cancer detection system and Zebra Medical's chest X-ray analyzer have demonstrated performance that rivals or even exceeds that of expert radiologists (Bajwa et al., 2021).

These AI tools help minimize diagnostic errors, expedite image analysis, and can be smoothly integrated into existing radiology workflows without significant disruption.

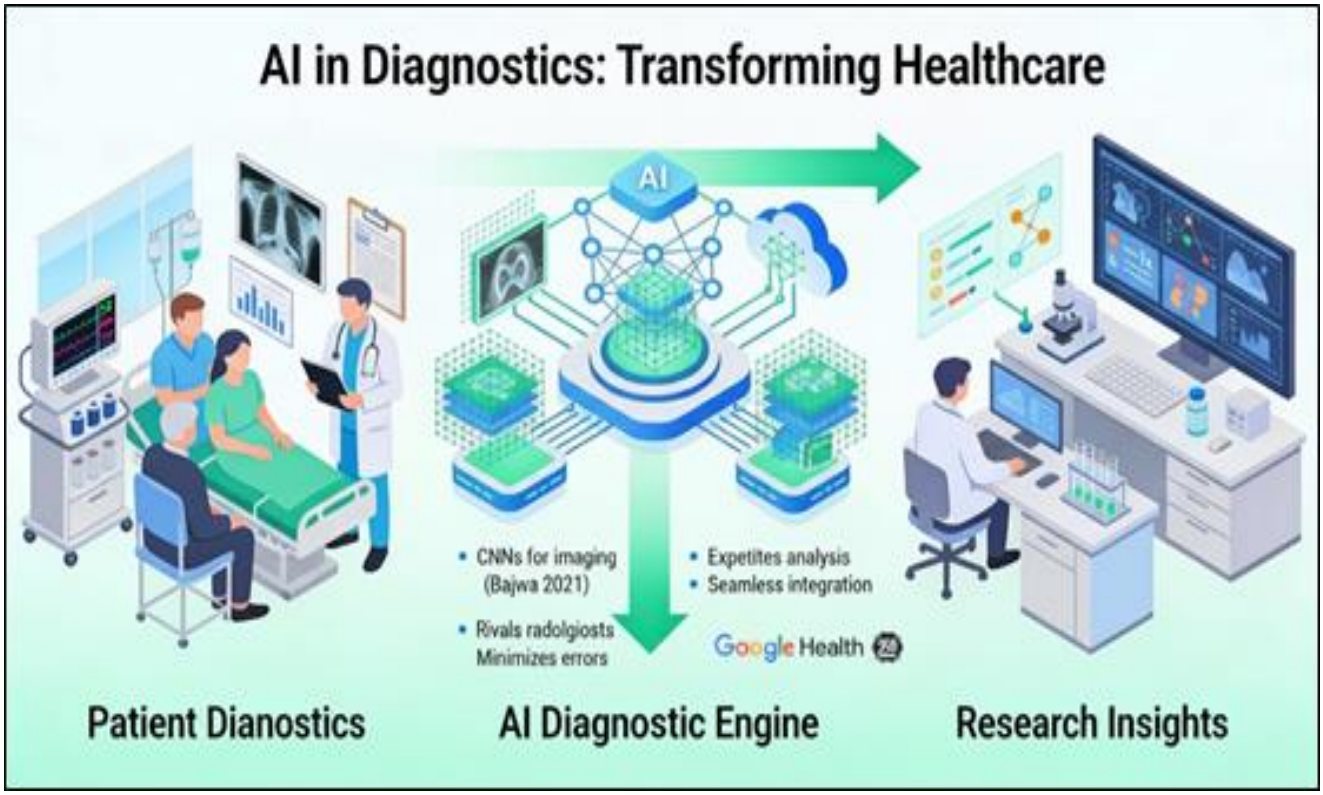

Figure 1: *AI-Enhanced Diagnostic Pipeline*

7.2 AI in Triage and Virtual Assistance

AI-powered chatbots like Buoy Health and Babylon provide initial symptom assessment and triage guidance, helping patients determine the urgency of their condition. These tools are especially beneficial in relieving pressure on primary care services, particularly in areas with limited medical resources.

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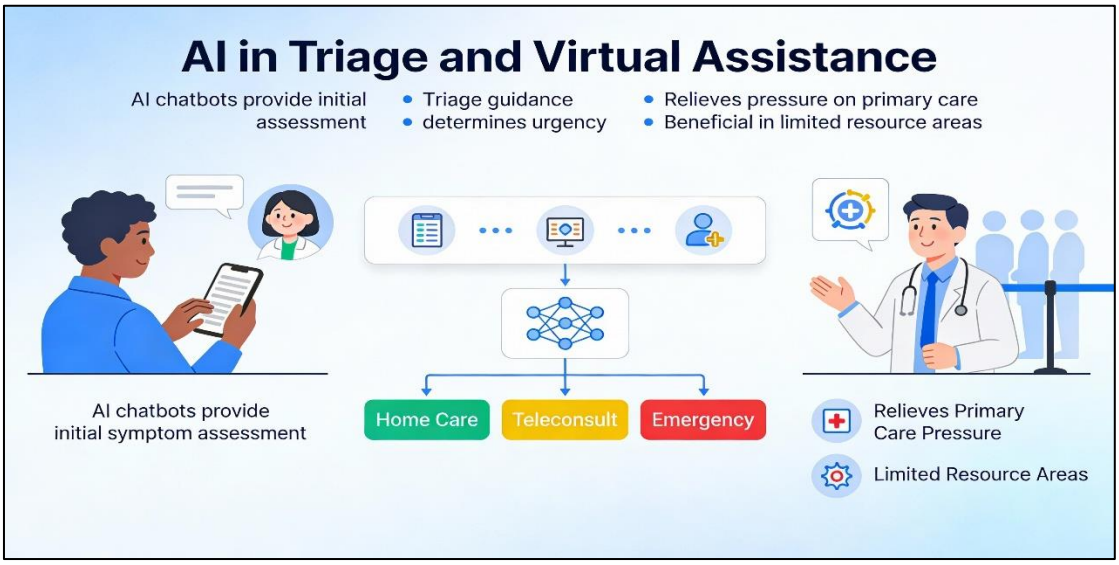

Figure 2: *AI Use Cases Across the Healthcare Ecosystem*

7.3 Research Gap and Contribution

Although prior studies document impressive point solutions, three gaps remain. First, the literature often treats **patient care** and **medical research** as separate pipelines, with limited work synthesizing how decisions, data standards, and governance practices in one domain shape outcomes in the other. Second, many published results emphasize model accuracy in controlled settings, while **prospective evaluation, external validation, subgroup performance reporting, and workflow impact** are inconsistently addressed contributing to translation and trust barriers. Third, persistent concerns around **bias, privacy, and accountability** are frequently discussed as "limitations," but fewer studies explain how these issues should be operationalized through governance, monitoring, and workforce readiness.

8. CONCLUSION

This conceptual study examined how Artificial Intelligence is reshaping healthcare across two interconnected domains: patient care delivery and medical research, using a thematic synthesis of recent academic and real-world evidence. The analysis indicates that AI can enhance diagnostic support, predictive decision-making, and patient engagement in clinical settings, while also accelerating biomedical innovation through improved discovery workflows, trial optimization, and faster evidence synthesis. At the same time, persistent implementation barriers, particularly algorithmic bias, privacy risk, limited interpretability, and unequal access, remain central challenges that determine real-world performance and trust. Therefore, the study concludes that the sustainable value of AI in healthcare depends on system-level readiness: transparent validation beyond technical accuracy, ethical governance and accountability, inclusive data practices, and continuous workforce upskilling. Future work should emphasize prospective evaluation in real clinical environments, subgroup reporting to reduce inequities, and implementation frameworks that align technical performance with patient safety and regulatory expectations.

Domain	AI Tool / Method	Key Benefit	Example Use Case
Diagnostics	CNNs, Deep Learning	Improved speed and accuracy	Breast cancer detection
Predictive Analytics	Regression, LSTM Models	Early detection and prevention	Sepsis prediction
Drug Development	GANs, Reinforcement Learning	Faster molecule discovery	AlphaFold in protein folding
Literature Mining	NLP, Topic Modeling	Faster, unbiased reviews	Elicit, Semantic Scholar
Patient Engagement	AI Chatbots, Symptom Checkers	Reduced burden on primary care	Babylon, Ada Health

Table 1: *Key Applications of AI in Healthcare and Research*

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REFERENCES

1. Alowais, S.A., Alghamdi, S.S., Alsuhebany, N. *et al*. Revolutionizing healthcare: the role of artificial intelligence in clinical practice. *BMC Med Educ* **23**, 689 (2023). https://doi.org/10.1186/s12909-023-04698-z
2. Bajwa, J., Munir, U., Nori, A., & Williams, B. (2021). Artificial intelligence in healthcare: Transforming the practice of medicine. Future Healthcare Journal, 8(2), e188–e194. https://doi.org/10.7861/fhj.2021-0095
3. Chen, Y., & Esmaeilzadeh, P. (2024). Generative AI in medical practice: In-depth exploration of privacy and security challenges. Journal of Medical Internet Research, 26, e53008. https://doi.org/10.2196/53008
4. Chustecki, M. (2024). Benefits and risks of AI in health care: Narrative review. Interactive Journal of Medical Research, 13, e53616. https://doi.org/10.2196/53616
5. Jumper, J., Evans, R., Pritzel, A., Green, T., Figurnov, M., Ronneberger, O., Tunyasuvunakool, K., Bates, R., Žídek, A., Potapenko, A., Bridgland, A., Meyer, C., Kohl, S. A. A., Ballard, A. J., Cowie, A., Romera-Paredes, B., Nikolov, S., Jain, R., Adler, J., … Hassabis, D. (2021). Highly accurate protein structure prediction with AlphaFold. Nature, 596, 583–589 (2021). https://doi.org/10.1038/s41586-021-03819-2

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A STUDY ON THE EFFECTIVENESS OF AI- DRIVEN PROMOTIONAL MEDIA ON CONSUMER PURCHASE INTENTION.

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ABSTRACT
This study analyses the effectiveness of artificial intelligence (AI) driven promotional media on consumer purchase intention. The research sheds light on marketing communication influencing the nature of promotional media and digital marketing. AI-driven promotional tools, such as personalized advertisements, recommendation systems, chatbots, and AI-generated content, help businesses to deliver targeted and real-time promotional messages to consumers. The study gave special emphasis on consumer perception, trust and personalization, as it aims to examine the effectiveness of AI-driven promotional media. The research is based on the primary and secondary data sources and adopts a descriptive and analytical research design. The main primary data is gathered via a structured questionnaire given to consumers who frequently encounter digital and AI-driven promotional material. Secondary data were collected from relevant journals, research articles, and online sources to build the theoretical basis of the study. This study explores the possibilities, efficiency and accuracy AI brings in advertising, particularly when we talk about consumer preference. The findings showed the limitations such as dynamic and changing consumer nature and ethical challenges related to privacy. The findings further enable future researchers to focus on the application of AI in promotion and study long-term consumer behaviour with deeper analysis to enhance the effectiveness of AI-driven marketing. Finally, this study will provide directions to marketers for their marketing and promotional practices regarding consumer buying patterns, brand loyalty and profit-earning sales targets.

Keywords: Artificial Intelligence (AI), Promotional Media, Digital Marketing, Consumer Purchase Intention, Consumer Behaviour, Online Advertising.)

1. INTRODUCTION

In this ever-fast-moving world, rapid advancements and evolution of digital technology are making remarkable changes in the way businesses and marketers communicate and engage with consumers. With these changes, artificial intelligence (AI) has gained advancement and emerged as a powerful tool that is restructuring traditional marketing and promotional activities. AI-driven promotional media provide marketers with tools and strategies to analyze vast amounts of consumer data, predict consumer preferences, and help in delivering personalized promotional messages in real time. Artificial Intelligence (AI) has emerged as the fastest field in achieving advancement and progress and has transformed our digital society, impacting daily human life, including media and communication.

AI-driven promotional media consider a wide range of applications, such as personalized digital advertisements, recommendation systems, chatbots, virtual assistants, and AI-generated content are widely used across social media platforms, including e-commerce websites, and mobile applications. Consumer purchase intention refers to an individual's likelihood or willingness to buy a certain product or service and is one of the major factors considered while evaluating actual buying behavior. Previous studies suggest that factors such as personalization, trust, perceived value of a product/service, and credibility play a significant role in influencing purchase intention. Despite the progressive growth and embracement of AI by marketers in promotional activities, empirical studies examining its effectiveness from a consumer perspective remain limited, particularly in emerging markets. This study aims to address this gap by examining the effectiveness of AI-driven promotional media on consumer purchase intention, thereby contributing to the existing body of knowledge and offering efficient direction and practical take for marketers in this new digital marketing era.

2. OBJECTIVES:

1. To study the effectiveness of Artificial-intelligence driven promotional media on consumer purchase intention.
2. To analyze consumer exposure to AI-driven promotional media.
3. To examine consumer perception and trust towards AI-driven promotional advertisements.

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3. REVIEW OF LITERATURE

Krishna & Prathapkumar (2023) stated that Artificial Intelligence (AI) has a revolutionary effect on personalized marketing. Further, it highlights the effects of AI-driven personalization on consumer engagement, purchase behaviour, and brand loyalty. Research insights shed light on how Al- powered chatbots, virtual assistants, and conversational interfaces have redefined customer interaction and delivered personalized responses. It showed the interplay between AI technologies and personalized marketing, offering insights into the future direction of consumer-centric strategies.

Anandvardhan & Jaiswal (2022) stated that AI-based promotional tools have emerged as a robust marketing technique for targeting audiences effectively. With consumers' growing awareness of AI, its effect on consumers has also risen. Display, video, and personalized advertisements are visually appealing promotional tools that capture consumer attention and make them aware of the product. However, some consumers still hesitate to purchase expensive products online. Consumer buying behaviour consists of the study of how individuals, groups, or organizations choose, obtain, consume, and dispose of products, services, experiences, or ideas to meet their needs. It examines consumers' emotional, mental, and behavioural responses, affected by numerous factors such as cultural, social, personal, and psychological.

Satapathy & Nanda (2023) revealed that the combination of Artificial Intelligence into marketing strategies has significantly improved efficiency across various stages of the marketing lifecycle. Data analysis, predictive analytics, personalized customer interactions and real-time insights, Al has become a game-changing source for marketers. Enabling automated ordinary tasks, offering valuable insights, and providing tailored customer experiences, AI continues to progress. With its ever-changing capabilities, Al is set to remain a keystone of innovation in digital marketing. Its competency to deliver highly targeted content, forecast customer behaviour, and quick adaptation to dynamic marketing scenarios makes AI an irreplaceable tool in modern marketing.

4. RESEARCH GAP

The notable research gap is empirical studies examining its effectiveness from a consumer perspective and as it remains limited, particularly in emerging markets. This study aims to address this gap by examining the effectiveness of AI-driven promotional media on consumer purchase intention, thereby contributing to the existing body of knowledge and offering an efficient and practical take for marketers in this evolving digital marketing era.

5. RESEARCH METHODOLOGY

The nature of the study is descriptive, and the main goal is to analyze the impact of AI-driven promotional media on consumer purchase intention. The study is based on both primary and secondary sources of data to ensure comprehensive analysis backed by the theoretical background of the research problem. Primary data were collected using a structured questionnaire. The questionnaire covered areas such as consumer exposure, perception, trust, and purchase intention towards AI-driven promotional media. The questionnaire sample consisted of 123 respondents and were measured using a five-point Likert scale. Convenience sampling method was selected for data collection from consumers who were exposed to digital advertisements. Secondary data was collected from research papers, academic journals, research articles, and online publications related to artificial intelligence, digital advertising, and consumer behaviour. The sample size consisted of adequate respondents to ensure meaningful analysis. The collected data were analyzed using simple statistical tools such as percentage analysis and descriptive statistics to interpret consumer responses. The findings of the study are based on the analysis of the collected data and are used to draw conclusions and meaningful findings regarding the impact of AI-driven promotional media on consumer purchase intention.

6. DATA FINDINGS AND INTERPRETATION

The data collected consisting of 123 respondents through the structured questionnaire were analyzed using percentage analysis and are presented using pie diagrams and tables for visual representation. The age-wise classification of respondents is presented in Table-1.

Table 1: Age Group

Age Group	Percentage (%)
Below 20	59.3%
20 – 30	33.3
30 – 40	4.9
Above 40	2.4

Sources: Based on primary survey

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The analysis shows the different age group of consumers, and most of respondents, 59.3%, are below 20 years of age followed by 33.3% of age group between 20 – 30 indicating that majority of respondents are below 30. Consumers between the ages of 30-40 has 4.9%, where only 2.4% are above age of 40 years. The study enquired about the frequency of online shopping by the respondents. The results are summarized in Table 2.

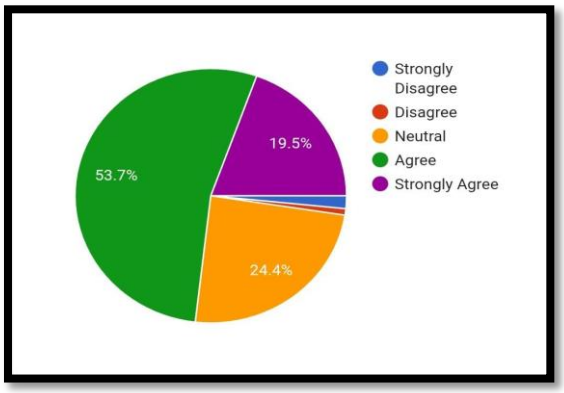
Table 2: Frequency of online shopping

Frequency	Percentage (%)
Frequently	60.2%
Occasionally	22%
Rarely	17.9%

Source: based on primary source

The interpretation shows the frequency of online shopping by the consumers, and a total 60.2% of respondents do online shopping frequently. Occasionally online shopping is carried out by 22% of the respondents and lastly 17.9% of respondents do online shopping rarely. It can be interpreted that respondents are majorly using online shopping. To assess respondents' exposure to AI-driven advertisements, they were asked how frequently they come across the same. The results are exhibited in Figure 1.

Figure 1: Frequency of respondents' exposure to AI-Created Advertisements

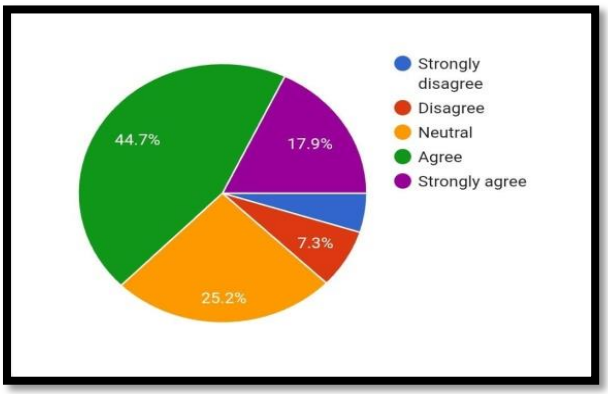


Source: Based on primary source

The results indicate a strong positive response toward AI-driven personalized advertising, with over half of the respondents agreeing on how frequently they come across advertisements created using AI. This suggests that AI-based advertisements on digital platforms are generating positive responses and engagement. Around 53.7% of the respondents agree with the stated statement. While 24.4% of respondents are neutral about this and 19.5% of the respondents strongly agree with the statement. The study reveals that a majority of respondents are frequently exposed to AI-driven promotional media on digital platforms, indicating the rapid progress and growing presence of AI in advertising.

Following the assessment of respondents' perceptions regarding the frequency of AI advertisement exposure, the subsequent question examined whether the AI- driven advertisements matched consumer interests and preferences. The results are exhibited in Figure 2.

Figure 2: Respondents' perception of AI-driven Advertisements



Source: Based on primary source

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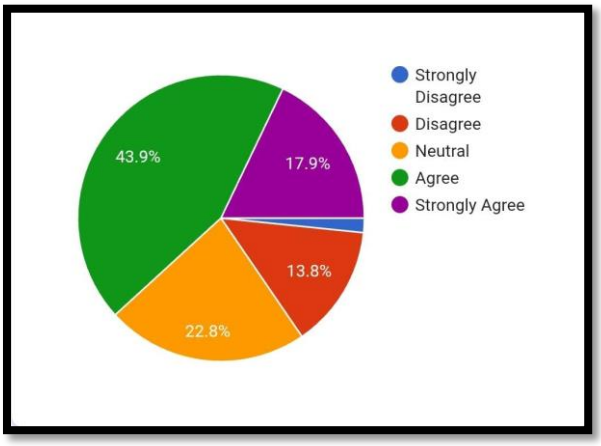
The findings reveal that a majority of respondents agree that the AI-generated advertisement matches their interest and preferences for related content. Specifically, 44.7% of the respondents agreed, 17.9% strongly agreed and 25.2% stayed neutral, that AI-driven advertisements align better with their interests and preferences. In contrast, 7.1% of the respondents disagreed with this statement, and 5.1% strongly disagreed. This reflects the efficiency of AI in promotional media and meeting consumer needs. Following the examination of consumer interests and preferences, was asked to examine if AI-driven advertisements increase the likelihood of purchasing the advertised product. The responses are presented in Figure 3.

Figure 3: Purchase Intention Influenced by AI-generated Advertisements

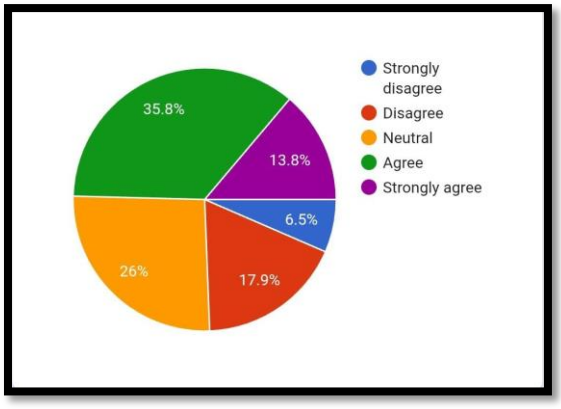


Source: Based on primary source

The data indicates an overall positive response to AI-driven advertisements-a majority of respondents agree (43.9%) that the advertisement increases the likelihood of the product, while 17.9% strongly agree, reinforcing this favorable view. Meanwhile, 22.8% remain neutral, suggesting a significant portion of respondents are undecided or indifferent. Only a small minority fall into disagreement with 13.8% and strongly disagree with 1.6% categories, showing limited negative sentiment compared to the predominantly positive and neutral responses. A significant number of respondents agreed that AI-driven advertisements provide clear and useful product information, which helps consumers understand products better.

Following the examination, the subsequent question assessed was whether AI-driven advertisement influences consumer's future buying decisions. The responses are presented in Figure 4.

Figure 4: Respondents' future buying decisions influenced by AI-generated Advertisements.



Source: Based on primary source

The interpretation of the results shows a positive response toward AI-driven advertising, with 35.8% of the respondents agreeing on buying decisions influenced by advertisements created using AI. This suggests that AI-based advertisements on digital platforms are generating positive responses and engagement. Around 26% of the respondents are neutral, reflecting that there is still a requirement in influence consumer buying decisions. Lastly, 17.9% disagreed with the stated statement. While 6.5%of respondents strongly disagreed, highlighting the dynamic nature of consumer behavior, The results show a positive perception and trust among consumers towards AI-driven promotional advertisements. The study also found that consumers are willing to try brands that use AI-based promotional media, reflecting acceptance of AI in marketing practices.

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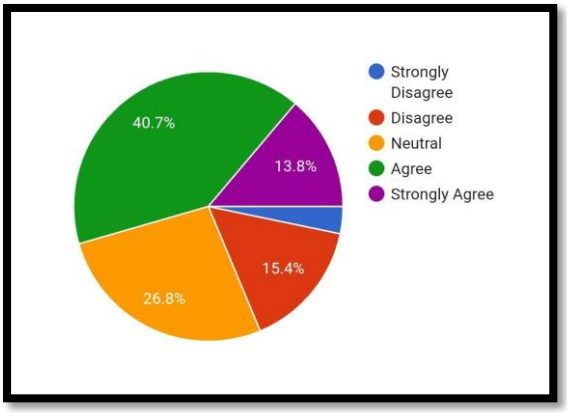
The study further assessed whether consumers would recommend AI-driven advertisement promoted products to others. The responses are presented through a pie diagram in Figure 5.

Figure 5: Respondents' likelihood to recommend products promoted through AI-generated Advertisements.



Source: Based on primary source

The interpretation from the results shows favorable effect on AI-driven promotion, with 40.7% of the respondents agreeing and 13.8% strongly agreeing in favour of recommending the products promoted through advertisements created using AI. This suggests that AI-based promotional media significantly impacts the sales. Around 26.8% of the respondents are neutral, indicating improvement for better consumer retention. While 15.4 and 3.3% of respondents strongly disagreed, highlighting the dynamic nature of consumer behaviour. Responses suggest that AI-driven advertisements influence future buying behaviour of consumers. Many consumers are likely to recommend products promoted through AI-driven advertisements to others.

Overall, the findings confirm that AI-driven promotional media have a positive and significant impact on consumer purchase intention and buying behaviour.

CONCLUSION

The study explored how effective AI-driven promotional media are for consumer purchase intention and further analyzed how these perceptions are transformed into actual purchase sentiment and willingness. The study concludes that AI-generated advertisements, overall promotional media, have a significant and effective influence on consumer perception, engagement and purchase intention when they are perceived as relevant to their individual interests. A vast no. of respondents acknowledged higher relevance and increased likelihood of engagement in favour of advertisements generated with the help of AI. However, the findings of the study also reveal notable concerns and improvement areas regarding consumer trust and awareness towards AI-generated ads and promotional content which needs attention. Overall, the effectiveness and acceptance of AI-generated promotional media lies in advertising strategies adopted by marketers to achieve a balance between personalization and relevance of promotional content to create efficiency and positive impact on consumers' emotions and perceptions, thus effectively promoting consumers' purchasing behaviours.

REFERENCES

1. Anandvardhan, & Jaiswal, R. (2022). Impact of artificial intelligence-driven promotions on consumers buying from e-commerce websites: An analysis. *International Journal of Novel Research and Development, 7*(12), b49–b67. https://ijnrd.org/papers/IJNRD2212106.pdf
2. Ashraf, A., & ul Hassan, H. (2024). The impact of AI-generated advertising content on consumer buying behaviour and consumer engagement. *Bulletin of Business and Economics, 13(*2) 1152-1157 https://doi.org/10.61506/01.00476
3. Chowdhury, S., Basu, S., N., A., & Singh, P. K. (2024). Influence of AI-driven digital marketing on consumer purchase intention: An empirical study. Journal of *Informatics Education and Research, 4(2).* https://doi.org/10.52783/jier.v4i2.811
4. Ghufran, A., & Ahmad, W. (2025). The Impact of AI-Enhanced Digital Marketing Strategies on Consumers' Purchase Intention for Lifestyle Products. Cihan *University-Erbil Journal of Humanities and Social Sciences*, *9*(1), 77–85. https://doi.org/10.24086/cuejhss.v9n1y2025.pp77-85

ISSN 2394 - 7780

5. Guo, X., & Han, X. (2025). The impact of artificial intelligence-based advertisement placement on consumer purchase sentiment. *Well-Being Sciences Review, 1*(3), 150–163. https://doi.org/10.54844/wsr.2025.1030
6. Satapathy, S., & Nanda, B. (2023). Revolutionizing digital marketing: The impact of artificial intelligence on personalized campaigns. *Journal of Emerging Technologies and Innovative Research (JETIR), 10*(10). https://www.jetir.org

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ARTIFICIAL INTELLIGENCE AND TEACHER PROFESSIONALISM IN HIGHER EDUCATION DESKILLING OR RESKILLING?

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ABSTRACT
The increasing integration of Artificial Intelligence (AI) and digital technologies in higher education is significantly reshaping teaching practices and redefining the professional role of teachers. While AI-enabled tools promise enhanced efficiency, personalization of learning, and data-driven decision-making, they also raise critical sociological concerns related to teacher autonomy, professional judgment, and labour control. This paper examines the central question of whether the adoption of AI in higher education results in the de-skilling of teachers through standardization and algorithmic governance, or leads to reskilling by creating new professional competencies and pedagogical roles.

Anchored in sociological theories of labour and professionalism, particularly Braverman's concept of deskilling and Foucault's notion of surveillance and disciplinary power, the study analyzes how AI-mediated platforms such as automated assessment systems, learning management systems, and performance analytics restructure academic work. From a sociological perspective, the paper situates AI within broader processes of rationalization, managerial control, and the transformation of professional authority in educational institutions.

The paper adopts a qualitative conceptual approach based on critical analysis of existing scholarly literature, policy documents, and empirical studies on AI in education. It argues that AI emerges as a contradictory force in higher education: while it constrains teacher autonomy through algorithmic monitoring and standardized practices, it simultaneously demands reskilling in areas such as technological proficiency, data interpretation, and adaptive pedagogy. The study further highlights emerging inequalities within the teaching profession, wherein digitally skilled educators gain institutional advantage, while others face marginalization and job insecurity.

The paper contributes to sociological debates on digital labour and professionalism by demonstrating how AI reconfigures teaching work rather than simply replacing it. It concludes by emphasizing the need for balanced and ethical integration of AI, supported by institutional policies that protect teacher autonomy, promote inclusive reskilling, and recognize the irreplaceable social and emotional dimensions of teaching.

Keywords: *Artificial Intelligence, Teacher Professionalism, Higher Education, Deskilling, Algorithmic Control*

1. INTRODUCTION: AI AND THE CHANGING NATURE OF TEACHER PROFESSIONALISM

"Artificial intelligence is not just a tool for efficiency; it is a force reshaping the very nature of professional work in higher education" (Williamson, 2021). Over the past decade, universities have adopted AI platforms, automated assessment, learning analytics, and adaptive courseware, transforming teaching practices and professional expectations (Selwyn, 2020). While these technologies promise efficiency, personalized learning, and data-informed decisions, they also raise questions about faculty autonomy, discretion, and authority, making the sociological study of AI-mediated teaching timely.

Most research focuses on student outcomes, pedagogical innovation, or technical efficiency, while the impact on teacher labour and professionalism is underexplored. Limited attention has been paid to how AI reshapes professional identity, skill development, and power relations, especially in the Indian context where digital adoption intersects with structural hierarchies. Inequalities across contract types, seniority, gender, and digital fluency suggest AI produces uneven experiences of deskilling and reskilling (Luckin et al., 2016; Holmes et al., 2019).

This paper asks: Does AI in higher education deskill teachers, or generate new competencies and reconfigure professional work? Its objectives are to examine deskilling and reskilling, conceptually theorize AI-mediated academic labour, and highlight implications for equity, policy, and professional identity.

To capture these dynamics, the study introduces novel concepts, Algorithmically Curated Professionalism, Algorithmic Teaching Drift, and AI-Contingent Competence providing an analytic vocabulary for understanding how AI shapes discretion, pedagogy, and the digital professional self. Anchored in Braverman's labour process theory and Foucault's surveillance insights, the paper demonstrates that AI reconfigures

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professional roles, skills, and authority rather than simply replacing human labour (Braverman, 1974; Foucault, 1977).

The paper proceeds with a literature review, theoretical framework, analyses of deskilling and reskilling, discussion of inequalities, and concludes with conceptual and policy implications for ethical and inclusive AI integration in higher education.

2. LITERATURE REVIEW

The existing scholarship on Artificial Intelligence (AI) in education has expanded rapidly, primarily examining its potential to transform teaching and learning. A substantial body of research adopts a technologically optimistic perspective, framing AI as a tool to enhance efficiency, personalization, and pedagogical innovation in higher education (Luckin et al., 2016; Holmes et al., 2019). Studies in this strand highlight adaptive learning systems, automated assessment, and learning analytics as mechanisms to reduce teachers' routine workload while improving student engagement and outcomes (Zawacki-Richter et al., 2019), often presenting AI as neutral or supportive of human teaching capacities.

In contrast, critical scholarship interrogates the implications of AI for academic labour and professional autonomy. Drawing on political economy and critical sociology, researchers argue that digital technologies enable intensified managerial control, standardization of pedagogical practices, and expanded surveillance of academic performance (Selwyn, 2016; Williamson, 2017). Analyses of learning analytics and platform-mediated education emphasize the risks of algorithmic governance, where professional judgment is subordinated to data-driven metrics and performance indicators (Beer, 2017; Knox, 2020). AI may contribute to deskilling by fragmenting academic work and diminishing professional discretion.

More recently, scholarship has moved beyond the deskilling–enhancement binary to examine reskilling and hybrid professionalism. AI reshapes, rather than replaces, teaching labour by generating new demands such as digital literacy, data interpretation, and adaptive pedagogical design (Fenwick et al., 2019; Evetts, 2011). Teachers increasingly function as facilitators, mentors, and coordinators within digitally mediated environments. However, reskilling remains uneven, contingent upon institutional resources, training, and power structures (Czerniewicz et al., 2020).

Despite these insights, gaps remain: literature often prioritizes student outcomes, offers limited sociological analysis of teachers as workers, and insufficiently addresses power, inequality, and professional authority under algorithmic governance. This paper addresses these gaps by employing sociological theories of labour and professionalism to critically examine how AI reconfigures teacher professionalism in higher education.

3. METHODOLOGICAL APPROACH: A CONCEPTUAL SOCIOLOGICAL ANALYSIS

This study adopts a **conceptual and qualitative sociological approach** to examine the implications of Artificial Intelligence (AI) for teacher professionalism in higher education. The analysis is based on a **systematic and interpretive review of secondary sources**, including peer-reviewed scholarly literature, policy documents, and existing empirical studies on AI in education. These sources are examined thematically, with particular attention to recurring patterns related to labour control, professional autonomy, surveillance, and reskilling.

A theoretical and interpretive methodology is appropriate for analysing the **structural and institutional transformations of academic work** under conditions of digital governance. By drawing on established sociological theories of labour and power, the study conceptualizes AI as a socio-technical process embedded within organizational and policy contexts rather than as a neutral technological tool. While the conceptual nature of the analysis limits empirical generalization, it enables deeper theoretical insight and offers a framework for future empirical research on AI and academic labour.

4. THEORETICAL FRAMEWORK: LABOUR, SURVEILLANCE, AND PROFESSIONAL AUTHORITY

This paper draws on sociological theories of labour and power to examine how AI reshapes teacher professionalism, integrating **Labour Process Theory (LPT)** and **Foucault's surveillance and disciplinary power** (Braverman, 1974; Foucault, 1977). LPT explains how managerial and technological interventions restructure work, reducing autonomy through standardization, routinization, and transferred decision-making, extending deskilling to professional work (Evetts, 2011). Foucault highlights how observation, normalization, and self-regulation produce internalized compliance under algorithmic monitoring.

Teaching traditionally involved pedagogical discretion and evaluative authority. AI tools—learning management systems, automated assessments, analytics dashboards, adaptive platforms, and plagiarism

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detection software, redistribute control to institutional and algorithmic systems, embedding knowledge in measurable procedures (Selwyn, 2019; Luckin et al., 2016). Platforms generate continuous data on teaching, engagement, and outcomes, quantifying professional judgment and embedding efficiency norms. Autonomy is **restructured**, not removed, as educators exercise discretion within algorithmically mediated boundaries (Beer, 2017; Knox, 2020).

5. AI IN HIGHER EDUCATION: TECHNOLOGIES, POLICIES, AND INSTITUTIONAL LOGICS

AI reshapes academic labour, guided by institutional priorities, policies, and managerial rationalities (Selwyn, 2019). Tools like learning management systems, automated grading, adaptive platforms, plagiarism detection software, and dashboards improve efficiency and personalization but embed assumptions about standardization, accountability, and measurable outputs, shaping teaching practices (Luckin et al., 2016).

Digitalization is framed as a strategy for competitiveness, scalability, and accountability (Williamson, 2017). LPT highlights how policies embed tasks in technical systems, limiting discretion (Braverman, 1974), while Foucauldian analysis shows surveillance reshaping autonomy around performance norms (Foucault, 1977).

In India, AI adoption aligns with global imperatives and the NEP 2020, supporting assessment, online delivery, and engagement monitoring. Infrastructural gaps, uneven digital literacy, and hierarchical structures produce unequal experiences. AI can enhance efficiency but may increase workload, standardize pedagogy, and reinforce inequalities across ranks and contract types (Czerniewicz et al., 2020).

Sociologically, AI embeds managerial logics prioritizing measurable outcomes and standardization, converting teaching into auditable work and reshaping discretion. This frames deskilling—curriculum standardization and intensified oversight—analyzed in the next section.

6. DESKILLING THROUGH AI: STANDARDIZATION, SURVEILLANCE, AND LABOUR CONTROL

Artificial Intelligence (AI) in higher education acts as a socio-technical agent, restructuring teaching work and producing deskilling through standardization, surveillance, and managerial control (Braverman, 1974; Foucault, 1977). AI redistributes authority over pedagogical tasks, codifying professional knowledge into digital procedures. Embedding curriculum design, assessment, and feedback into automated systems limits discretionary decision-making, constraining the autonomy historically associated with academic professionalism (Selwyn, 2019; Luckin et al., 2016). Automated assessment platforms, plagiarism detection tools, and learning analytics convert teaching outputs into quantifiable indicators (Beer, 2017; Knox, 2020). Continuous data on student engagement, learning outcomes, and teacher activity enables real-time monitoring, encouraging self-regulation as faculty internalize algorithmic expectations. Interpretive judgments in grading, feedback, and curriculum adaptation are increasingly mediated by templates and performance standards.

Deskilling occurs through several mechanisms: prescriptive digital workflows define the “what” and “how” of teaching, aligning practices with institutional priorities; teachers spend substantial time interacting with platforms and responding to algorithmic feedback, reducing focus on substantive pedagogy; and algorithmically enforced assessment fragments academic labour into discrete, routinized tasks, reflecting Braverman’s separation of conception and execution (Braverman, 1974). Together, these mechanisms make teaching auditable, measurable, and administratively governed rather than purely discretionary.

Experiences of deskilling are uneven. Faculty with high digital literacy or institutional support navigate systems flexibly, while those with limited experience or in contingent positions rely heavily on automated guidance. Yet all educators face algorithmic benchmarks, heightening accountability pressures and narrowing professional judgment. Seniority, contract type, and institutional resources mediate how deskilling manifests, revealing broader inequalities (Czerniewicz et al., 2020).

These processes are not totalizing. While AI constrains traditional discretion, it simultaneously creates conditions for new skills, including interpreting analytics, designing adaptive learning pathways, and integrating technology into pedagogy. These emergent capacities are explored in the following section on **reskilling**, highlighting the dual and contradictory impact of AI on teacher professionalism.

7. RESKILLING AND CONDITIONAL REPROFESSIONALIZATION IN THE AGE OF AI

While AI constrains professional discretion, it also creates opportunities for reskilling and conditional re-professionalization, shaped by institutional support, digital literacy, and access to development resources (Braverman, 1974; Foucault, 1977). These competencies respond to technological demands and evolving institutional expectations, reshaping contemporary teaching skills.

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Technological proficiency is central. Teachers navigate learning management systems, interpret analytics dashboards, manage automated assessments, and integrate adaptive platforms (Luckin et al., 2016; Holmes et al., 2019). Beyond basic digital skills, they critically evaluate algorithmic recommendations to make informed pedagogical decisions. Labour Process Theory emphasizes that this reskilling occurs within institutionally constrained parameters, while Foucauldian insights show AI-mediated surveillance fosters self-regulation aligned with metrics and norms (Beer, 2017).

Reskilling also involves pedagogical adaptation. As AI standardizes routine tasks, educators act as facilitators, mentors, and designers of personalized learning, curating pathways and tailoring interventions. This constitutes conditional re-professionalization, where expertise is exercised in coordination with algorithmic guidance (Fenwick et al., 2019).

Opportunities are uneven. Faculty with digital literacy or structured training adapt effectively, while those with limited experience or contingent roles face barriers. Seniority, contract type, and institutional resources mediate access, producing stratified outcomes (Czerniewicz et al., 2020). Algorithmic workflows, standardized assessments, and performance monitoring continue to limit discretionary judgment, reflecting the ongoing tension between professional agency and managerial control.

In sum, AI constrains autonomy while fostering new competencies. Reskilling represents conditional re-professionalization, dependent on individual and institutional capacities, and unevenly experienced across faculty, setting the stage for examining inequalities and stratification in AI-mediated higher education.

8. INEQUALITIES AND STRATIFICATION WITHIN AI-MEDIATED ACADEMIC WORK

AI in higher education affects faculty unevenly, amplifying structural inequalities (Czerniewicz et al., 2020; Selwyn, 2019). Access to digital infrastructure, technical literacy, and institutional resources shapes adaptation, producing a digital divide. Faculty with skills and support navigate AI efficiently, integrate data insights, and personalize learning, while those with limited fluency or training face barriers constraining growth and discretion (Luckin et al., 2016; Holmes et al., 2019).

Stratification also reflects contract type, career stage, and gender. Adjunct, part-time, or early-career faculty often lack development opportunities; senior faculty may face generational adaptation challenges. Female educators may carry disproportionate administrative burdens, limiting skill development (Beer, 2017). Bravermanian analysis shows managerial oversight interacting with hierarchies to produce differentiated labour experiences, while Foucauldian insights highlight uneven self-regulation under algorithmic surveillance (Braverman, 1974; Foucault, 1977).

Institutional support mitigates disparities: professional development, collaborative networks, and technical assistance reduce marginalization, whereas uneven resources reinforce inequality. Thus, AI's benefits are conditional, and reskilling opportunities remain stratified (Czerniewicz et al., 2020).

These patterns reveal that deskilling and reskilling are unevenly experienced. AI constrains autonomy for some while enabling adaptive professional development for others. Recognizing these inequalities is essential for analyzing AI's dual impact and sets the stage for the conceptual synthesis in the discussion, integrating deskilling, reskilling, and stratified faculty experiences.

9. DISCUSSION: CONCEPTUALIZING AI-MEDIATED TEACHER PROFESSIONALISM

The analysis demonstrates that AI in higher education produces a **dual and contradictory impact** on teacher professionalism, simultaneously constraining autonomy and enabling new forms of expertise. To capture this complexity, this paper introduces a set of interrelated concepts.

Algorithmically Curated Professionalism describes the professional work shaped and structured by AI systems, institutional oversight, and performance metrics. It integrates Braverman's labour process theory by showing how managerial control extends into knowledge-intensive teaching, while Foucault's notions of surveillance and normalization explain the self-regulatory practices faculty adopt in response. Empirically, deskilling—through standardized assessment, automated feedback, and monitored workloads—reflects the constraints of algorithmically curated professionalism, whereas reskilling—data interpretation, adaptive pedagogy, and technology integration—demonstrates selective professional agency within these boundaries.

Algorithmic Teaching Drift captures the subtle, incremental reshaping of instructional practices under AI guidance. Automated recommendations, analytics dashboards, and workflow templates gradually nudge teaching toward measurable outputs. This drift is uneven: faculty with limited digital fluency, adjuncts, or senior educators experience more pronounced constraints, while digitally adept teachers navigate these systems to innovate pedagogically.

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AI-Contingent Competence highlights skills and knowledge that emerge only through engagement with AI tools and institutional support, such as interpreting analytics, designing adaptive learning pathways, and managing blended instruction. Its uneven distribution reflects and reinforces stratification in the faculty body.

Bounded Autonomy emphasizes the paradoxical nature of discretion under AI: teachers retain judgment but operate within algorithmically defined and institutionally sanctioned boundaries.

Finally, **Digital Professional Self** refers to how AI reshapes educators' professional identity, aligning teaching roles with measurable, digitalized outcomes and influencing perceptions of competence and authority.

Together, these concepts provide a coherent analytic framework linking deskilling, reskilling, and stratification. They demonstrate that AI is not neutral but actively **reconfigures professional roles, competencies, and autonomy**. While the concepts primarily address formal, AI-mediated teaching, they offer a vocabulary for examining how educators negotiate agency, adaptation, and expertise under technological and institutional mediation.

In sum, AI-mediated teaching is a site of **contradictory professional dynamics**, where algorithmically curated professionalism, algorithmic teaching drift, AI-contingent competence, bounded autonomy, and the digital professional self together explain the tensions between control, adaptation, and evolving professional identities.

10. CONCLUSION

This paper demonstrates that AI in higher education produces a complex, contradictory impact on teacher professionalism, simultaneously constraining autonomy and generating opportunities for new expertise. By introducing the interrelated concepts of Algorithmically Curated Professionalism, Algorithmic Teaching Drift, AI-Contingent Competence, Bounded Autonomy, and the Digital Professional Self, the study extends Braverman's labour process theory and Foucault's insights on disciplinary power, showing how AI reconfigures teaching roles, competencies, and professional identity rather than merely replacing human labour.

These concepts carry direct implications for higher education policy. Institutions must recognize that AI adoption is not neutral: without deliberate interventions, it can exacerbate structural inequalities across contract type, seniority, gender, and digital fluency. Ethical and effective AI integration requires policies that safeguard teacher autonomy, ensure equitable access to reskilling programs, and support the development of AI-contingent competence across all faculty groups. Awareness of Algorithmic Teaching Drift and its influence on curriculum, assessment, and instructional decision-making should guide pedagogical review and evaluation practices, while fostering the Digital Professional Self can help educators navigate evolving professional identities in algorithmically mediated environments.

Future research should empirically examine the enactment of these concepts across diverse institutional and disciplinary contexts, including how Bounded Autonomy operates in practice and how AI shapes professional identity over time. Additionally, studies should explore the informal, relational, and affective dimensions of AI-mediated teaching, which remain beyond algorithmic capture.

By integrating conceptual insights with policy-oriented guidance, this paper demonstrates that AI-mediated teaching is a site of contradictory professional dynamics, where careful, equitable, and ethically informed strategies can enhance learning while preserving the irreplaceable social and relational dimensions of the teaching profession.

REFERENCES

1. Beer, C. (2017). *The datafication of teaching: Learning analytics and the surveillance of academics.* Learning, Media and Technology, 42(3), 311–325. https://doi.org/10.1080/17439884.2017.1324657
2. Braverman, H. (1974). *Labor and monopoly capital: The degradation of work in the twentieth century.* Monthly Review Press.
3. Czerniewicz, L., Agherdien, N., Badenhorst, J., Belluigi, D., Chambers, T., Chili, M. & Walji, S. (2020). *A wake-up call: Equity, inequality and COVID-19 emergency remote teaching and learning.* Postdigital Science and Education, 2, 946–967. https://doi.org/10.1007/s42438-020-00187-4
4. Evetts, J. (2011). *A new professionalism? Challenges and opportunities.* Current Sociology, 59(4), 406–422. https://doi.org/10.1177/0011392111402585
5. Fenwick, T., Edwards, R., & Sawchuk, P. (2019). *Emergent learning: The role of digital technologies in shaping professional work.* Routledge.

ISSN 2394 - 7780

6. Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial intelligence in education: Promises and implications for teaching and learning.* Center for Curriculum Redesign.
7. Knox, J. (2020). *Digital education and the politics of surveillance.* Learning, Media and Technology, 45(1), 1–14. https://doi.org/10.1080/17439884.2020.1711063
8. Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. B. (2016). *Intelligence unleashed: An argument for AI in education.*Pearson.
9. Selwyn, N. (2016). *Is technology good for education?* Polity Press.
10. Selwyn, N. (2019). *Should robots replace teachers? AI and the future of education.* Polity Press.
11. Williamson, B. (2017). *Big data in education: The digital future of learning, policy and practice.* SAGE Publications.
12. Williamson, B. (2021). *Artificial intelligence and the reconfiguration of professional work in higher education.* British Journal of Educational Technology, 52(4), 1491–1504. https://doi.org/10.1111/bjet.13140
13. Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). *Systematic review of research on artificial intelligence applications in higher education – Where are the educators?* International Journal of Educational Technology in Higher Education, 16(1), 39. https://doi.org/10.1186/s41239-019-0171-0

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AI - DRIVEN INNOVATION FOR LOCAL RAILWAY SYSTEM IN MUMBAI METRO REGION FOR TRANSFORMATIVE URBAN RAIL SYSTEM

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1. INTRODUCTION

Mumbai, India's financial capital, relies heavily on its suburban railway system to sustain daily urban life from travelling for work or business, medication or leisure. Often described as the city's "lifeline," the Mumbai Suburban Railway carries over 80 lakhs passengers per day, making it one of the busiest rail networks globally. The system supports economic productivity, social mobility, and spatial integration across the Mumbai Metropolitan Region. However, extreme passenger density, aging infrastructure, safety concerns, and service disruptions pose chronic challenges.

Traditional approaches to railway improvement in Mumbai have focused primarily on capacity expansion and incremental technological upgrades. While such measures are necessary, they may be insufficient to address the volume of problems faced by passengers in day to day travelling. At the same time, artificial intelligence (AI) is emerging as a general-purpose technology with the potential to fundamentally reshape transport systems through automation, data analytics, and real-time decision-making. Indian planning includes Digitalisation however, it lacks automation.

This paper advocates that AI adoption in Mumbai's railway system should be understood not merely as a technological upgrade, but as an innovation process embedded within a broader socio-technical, environment friendly system. Using innovation suggestions as a guiding principle, the paper recommends how AI-driven innovation can enable transformative change in Mumbai's urban railways. The focus is on theoretical aspect rather than operational testing, with the aim of providing textual clarity for future research and policy interventions.

2. REVIEW OF LITERATURE

- Joseph S. (1934)[1] in his book "The Theory of Development" published by Havard university press, has suggested economic and finance flow for an organisation of public in nature (in this context railways system). He advocated that finance will flow to such public sector unit with the help of Public Private Partnership. And it can speed up the process of innovation and technological transformation.
- Frank W G. (2002)[2] In research paper, "Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study" described a new perspective, based on insights from evolution, economics and technology studies. his insights have been synthesised in a multi-level perspective consisting of three levels: technological niches, sociotechnical regimes, sociotechnical landscape. This perspective combines two views on evolution. He emphasised on niche level studies and problem-solving methods for systematic innovation
- Charles Edquist's (2011)[3] in his article, "Design of innovation policy through diagnostic analysis," published in *Industrial and Corporate Change*, suggested a framework for creating effective innovation policy by first diagnosing systemic problems or failures within an innovation system, in his article he argued that instruments must be tailored to address specific identified issues for successful innovation and policy design. The paper advocated that innovation cannot be attain by generalised theories. It needs to pinpoint deficits in innovation activities like R&D, financing, or institutions to create targeted, systemic policy mixes
- Prajakta P. et al. (2018)[4] in their paper "Efficient Train Management System - An AI Approach" published by International Journal of Science and Research, their paper gives an overview of how Artificial Intelligence can be used to improve efficiency of the system by providing a dynamic timetable to make trains less crowded. This can be done through analysis of Historical Data to identify reasons for issues such as delay in trains, overcrowding, etc. On the basis of this analysis, a model for efficient train allocation and time table management is proposed. Furthermore, the viability and application of the model is also proposed in this paper.

3. RATIONALE BEHIND THE STUDY

Innovation theory has evolved from linear models of technological progress toward more systemic and interactive perspectives. Contemporary innovation theory emphasizes that innovation emerges from interactions

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among multiple sectors, including business organisations, governments, commuters, and knowledge institutions. Technological change is shaped by institutional structures, regulations, cultural norms, and market dynamics. In the case of railway systems in India, innovation extends beyond new technologies to include organisational practices, governance models, and service design. Railways, particularly Mumbai local trains deeply influence in political and social contexts, making innovation a complex and bureaucratic process with red tapism at each stage. Socio-technical transition theory provides a useful conceptual framework for understanding long-term change in large infrastructure systems such as railways. This perspective highlights interactions between three levels: niche innovations, dominant regimes, and broader socio-economic landscapes.

4. OBJECTIVES OF STUDY

Following are the objectives of the study:

ii. To analyse current systems for innovation in Mumbai Railway

iii. To formulate theories for innovation in Mumbai local railways

iv. To suggest framework to attain innovation through Artificial Intelligence.

5. RESEARCH METHODOLOGY OF THE STUDY

To understand the present study the information has been collected through secondary sources only. The secondary data has been gathered from sources such as the Internet, reference Books, Newspapers, Journals and mobile applications etc. Data collected is compiled to state observations, conclusion and suggestion.

6. CHALLENGES

- **Problem of Processing large amount of data:** Mumbai railways have large volumes of data generated from sensors, ticketing systems, CCTV footage, and mobile applications. In Mumbai's context, such data can support real-time monitoring of passenger flows, early detection of equipment failures, and optimized train scheduling. However, there is no mechanism to process the data and solving problem
- **Problem of overcrowding, safety and operations:** Safety is a critical concern in Mumbai's suburban railways, given high levels of overcrowding and frequent accidents. In spite of CCTV, RPF and other human resources available on platform and in train, there is no mechanism to manage the same or an alert for overcrowding or over speeding
- **Bureaucracy in railway:** Railway being in concurrent list of constitution, all policy implementation has to go through various government authorities like State government, Central government, Local Authorities (BMC), and Service provider institutions. This slows down the process of innovation and also involve corrupt practices.
- **End user suggestions:** Passengers in Mumbai's railways are not passive users but active participants who adapt, improvise, and develop informal practices to cope with congestion and delays. However, their suggestion, ideas and innovations are never analysed or implemented by respective authorities.

7. RECOMMENDATION

Improve AI Capabilities

This includes machine learning, computer vision, and predictive analytics applied to operations, maintenance, safety, and passenger services by railway authorities.

Innovation in Operational Practices

Drawing from innovation theory, these mechanisms include experimentation, learning-by-doing, Public Private Partnership, and feedback analysis loops between users and operators.

Decentralisation of decision making

Regulations, labour relations, funding models, and inter-agency coordination may improve the speed and direction of AI adoption in railway.

Much Needed in Metropolitan Cities

Extreme population density, socio-economic diversity, and informal mobility practices in Mumbai influence both the problems AI seeks to address i.e. analysis and interpretation. Without which innovation cannot take place at the pace we need in city. The framework suggests that AI-driven railway innovation succeeds when technological capabilities are aligned with institutional readiness and urban realities. Innovation is therefore not a purely technical process but a socio-technical transition requiring coordinated change across multiple dimensions.

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8. SUGGESTIONS

- **Railway driven by data and AI**

Artificial intelligence enables railways to shift from reactive to predictive and adaptive operations. Machine learning algorithms can analyse large volumes of data. AI transforms the railway into a learning system that continuously adapts to changing conditions. This represents a qualitative shift from traditional rule-based operations to data-driven decision-making.

- **AI Video Analytics**

AI-enabled video analytics and pattern recognition systems can help identify risky behaviours, overcrowded platforms, and unauthorized track crossings. From an innovation theory perspective, safety-oriented AI applications can act as "mission-driven innovations" that align technological development with public value creation.

- **Co-operation and Co-ordination**

Innovation theory suggests that successful technological adoption depends on institutional capacity and coordination. Fragmented governance structures may slow innovation, while collaborative platforms and public–private partnerships can accelerate AI deployment

- **Analysing end user data**

Digital platforms, such as mobile applications providing real-time train information, create opportunities for user feedback and co-creation. Conceptually, involving users in AI-enabled service design aligns with interactive innovation models, where knowledge flows between service providers and service users enhance system performance and legitimacy.

9. Conclusions

Mumbai's railway system stands at a critical stage where incremental improvements may no longer be sufficient to meet increasing commuters demands. This conceptual paper has argued that artificial intelligence, when understood through the point of view of innovation theory, offers a pathway toward transformative change. By conceptualising AI adoption as a socio-technical innovation process embedded in Mumbai's unique urban context, the paper provides a holistic framework for understanding both opportunities and constraints. The future of Mumbai's railways depends not only on advanced algorithms but also on institutional capacity, user engagement, and governance innovation. As metropolitan city worldwide confronts similar challenges, insights from Mumbai can contribute meaningfully to global debates on AI-driven urban transport innovation.

REFERENCES

- Edquist, C. (2011). Design of innovation policy through diagnostic analysis. *Industrial and Corporate Change, 20*(6), 1725–1753. https://doi.org/10.1093/icc/dtr060
- Geels, F. W. (2002). Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case study. *Research Policy, 31*(8–9), 1257–1274. https://doi.org/10.1016/S0048-7333(02)00062-8
- Indian Express. (n.d.). *Mumbai's packed local trains*. https://specials.indianexpress.com/mumbai-packed-local-trains/index.html
- Nivsarkar, P. P., & Mandge, O. L. (2018). Efficient train management system: An AI approach. *International Journal of Science and Research, 7*(5), 828–831.
- OECD. (2021). *Artificial intelligence in transportation*. OECD Publishing. https://doi.org/10.1787/1e5b7a12-en
- Schumpeter, J. A. (1934). *The theory of economic development*. Harvard University Press.
- Tidd, J., & Bessant, J. (2021). *Managing innovation: Integrating technological, market and organizational change* (7th ed.). Wiley.
- UIC. (2022). *AI applications in urban rail systems*. International Union of Railways.

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IMPACT OF AI-BASED PERSONALIZATION ON CONSUMER PURCHASE DECISIONS IN E-COMMERCE

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ABSTRACT
Artificial Intelligence (AI) has made a remarkable shift in the operation of online shopping platforms. The current study investigates the contribution of personalization using AI to online consumers' buying decision. The study used primary data collected through a structured questionnaire incorporating a five-point Likert scale comprising a sampling frame of 136 participants. The results were derived employing percentage analysis and mean score analysis. The results show that consumers recognize personalization techniques using AI. There still remain concerns regarding online consumers' personal data as well as personalization to great extent. The study offers important assistance to online shopping platforms to implement appropriate personalization strategies using AI.

Keywords: *Artificial Intelligence, Personalization, E-Commerce, Consumer Behaviour, Purchase Decision*

1. INTRODUCTION
The immense popularity of e-commerce has resulted in cut-throat competition among online shopping sites, which has forced them to opt for modern technologies to engage and retain consumers. In this context, Artificial Intelligence (AI) has proved to be a vital solution for online shopping sites to analyze consumer data and provide them with relevant product suggestions, ads, and shopping experiences. AI-based personalization is a mechanism to improve customer satisfaction with tailored content related to their preferences, browsing, and purchasing habits. Recently, AI-based personalization has become a determinant for prominent online shopping sites. Although personalization is a boon in terms of ease and efficiency, which has benefited online shopping sites, it has also resulted in a lack of concern for consumers regarding their personal and private details and their excessive reliance on online suggestions. It is therefore imperative to comprehend consumer attitudes toward AI-based personalization. This study aims to study the influence of AI-based personalization on consumer purchasing decisions regarding the concept of e-commerce.

2. REVIEW OF LITERATURE
The impact of personalized promotions using AI and impulse buying behavior on online shopping was investigated in a study carried out by Verma and Yadav in 2021. The results showed that personalized promotions and time-limited deals have the potential to induce impulse buying behavior, especially among Generation Y online shoppers. However, it was found that it has only a moderate impact on impulse buying behavior.

An article that considered consumer knowledge and perceptions towards AI applications in the field of marketing is by Davenport et al. (2020). In this article, it was found that even though consumers continue to be aware of AI-driven personalization, not many have a clear idea about data processing practices.

Smith et al. (2019) conducted a research on the use of personalization through AI in influencing the consumer behavior that occurs on the online platform. The research showed that personalization of product suggestions affects the purchase intention among the consumers. The researchers argued that the use of AI-based systems increases the level of engagement among the consumers, which results in effective decision-making, thus improving customer satisfaction. The researchers pointed out that personalization is a significant factor that ensures a competitive advantage for the online shopping platform.

Grewal, Roggeveen, and Nordfält argue that Grewal et al. (2017) conducted a study to test the usefulness of recommendation systems within a retail setting; the findings suggested that personal recommendations influence consumer trust and satisfaction positively. In this regard, the article highlighted that overreaching or incorrect recommendations could impair consumer trust in an automated system. Furthermore, the article asserts that AI systems should be accurate to gain consumer trust.

Awad & Krishnan (2006) examined consumer behavior concerning online personalization and privacy concerns. It was found that while convenience derived from personalization is positive, concerns about data privacy misuse affect consumer trust. The study concluded that organizations need to provide a positive personalization experience combined with effective protection strategies for consumers about personal data privacy.

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3. RESEARCH GAP:

Although various researches have been conducted concerning AI-powered personalization and its effects on the purchase behaviors of consumers, most research is still limited to developed countries. The existing literature has mainly focused on individual factors, such as trust or impulse purchase, without providing a holistic perspective that encompassed consciousness, purchase decisions, impulse purchase behavior, and the concern for privacy collectively. Additionally, there has been a lack of empirical research concerning the effects of AI-powered personalization, both positive and negative, on youth consumers. The research problem is solved by the current research since the research aims to deliver a holistic investigation of AI-powered personalization and the effects of the phenomenon on the purchase decisions of consumers using e-commerce websites.

Objectives of the Study:

1. To study the level of awareness of AI-based personalization among e-commerce users.
2. To analyze the impact of AI-driven recommendations on consumer purchase decisions.
3. To examine consumer trust in AI-based personalized suggestions.
4. To study whether AI personalization leads to impulse buying.
5. To identify challenges and concerns related to AI personalization in e-commerce.

4. RESEARCH METHODOLOGY

The paper uses a descriptive-analytical design to analyze the effects of AI-based personalization on consumer purchase behavior. The primary data was collected using a structured questionnaire that was conducted using Google Forms. The structured questionnaire comprises demographic sections and 15 statements based on AI-based personalization, which used a five-point scale. A total of 136 responses using convenience sampling methods were considered valid. The responses include those of students, working individuals, and people frequently using online shopping platforms. The collected data was encoded for analysis using Microsoft Excel. Percentage analysis was used to analyze demographic details of participants, while mean score analysis was used to study perceptions along different parameters such as awareness level, decision to purchase, trust factor, impulse buying behavior, and difficulties faced by AI-based personalization.

5. DATA ANALYSIS AND INTERPRETATION

The demographic study showed that maximum respondents fell under the category of consumers belonging to 18-25 years of age. Gender proportion among respondents is relatively equal. More respondents preferred online shopping and considered Amazon, Flipkart, and Myntra as most preferred e-commerce websites.

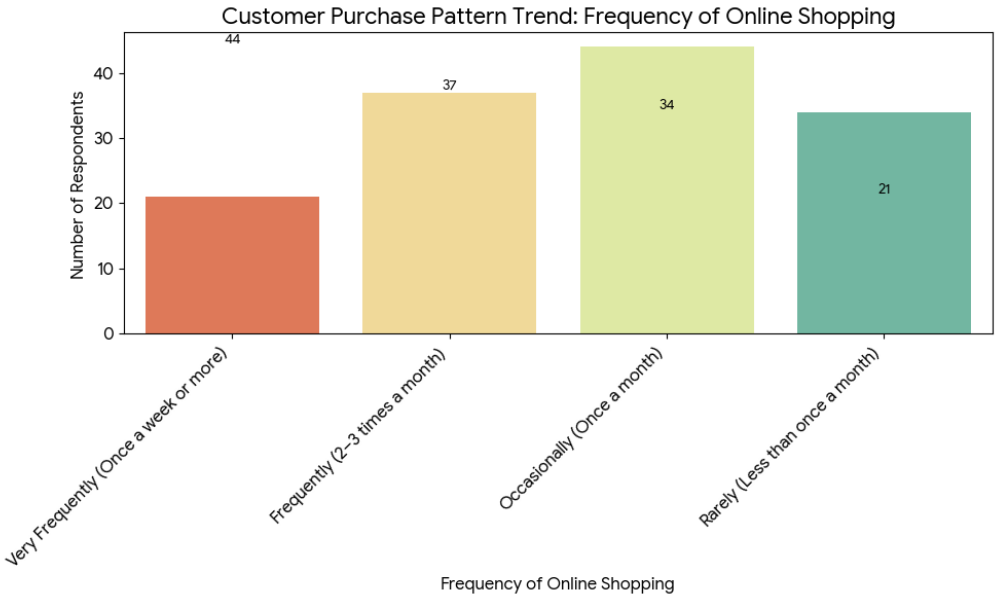

Figure 1: Customer Purchase Pattern Trend

In Figure 1 above, the general trend is that consumers are highly active on the online shopping platform since close to three-quarters of the population are active online shoppers. In regard to AI personalization, the findings are relevant to AI personalization projects that are directly interacting with consumers on a continuous basis via online personalization recommendations.

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Table 1: Statement-wise Analysis of AI-Based Personalization

Code	Statement	Agree (%)	Mean
S1	Awareness of AI-based personalization	58.09	3.60
S2	Understanding use of browsing & purchase history	61.03	3.54
S3	Ability to identify personalized recommendations	51.47	3.53
S4	AI recommendations influence purchase decisions	35.29	3.28
S5	Likelihood of buying AI-recommended products	33.09	3.18
S6	Personalized suggestions save shopping time	50.00	3.51
S7	Trust in AI-generated recommendations	29.41	3.11
S8	AI recommendations match preferences	43.38	3.36
S9	AI personalization improves shopping experience	38.97	3.27
S10	AI recommendations encourage impulse buying	30.15	3.12
S11	Unplanned purchases due to AI suggestions	20.59	2.82
S12	Personalized offers increase impulse buying	35.29	3.16
S13	Concern over use of personal data	50.00	3.52
S14	Discomfort due to excessive personalization	44.85	3.49
S15	AI limits exposure to new products	47.79	3.49

Note: Agree (%) includes *Agree* and *Strongly Agree* responses.

Source: Compiled from primary survey data

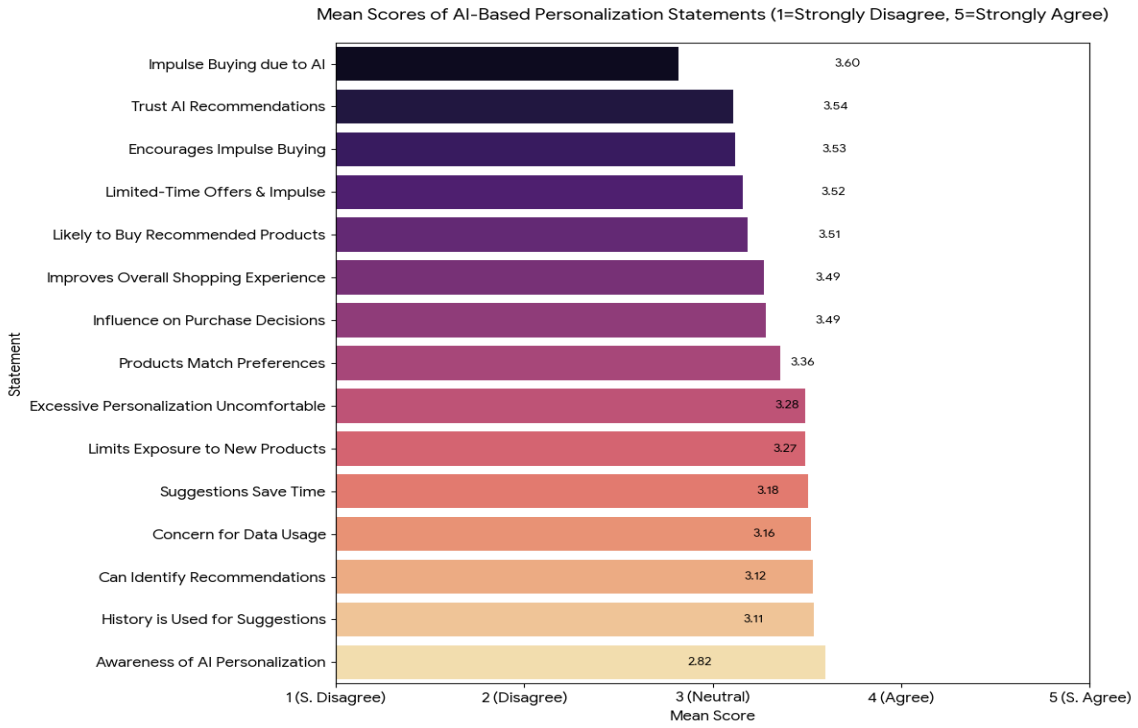

Figure 2: Mean Score of AI-Based Personalization Statement

Table 1 and Figure 2 provides a detailed statement-wise analysis of the perceptions of the consumers with regard to personalization using AI in the context of electronic commerce, on the basis of the level of agreements and the mean scores.

5.1 Awareness and Understanding of AI-Based Personalization

From the results, there is adequate evidence and limited ambiguity that the level of consumer knowledge regarding the application of AI for personalization in the e-commerce site is relatively high. Statement S1, regarding general knowledge of the application of AI for personalization, has an agreement level of 58.09% with an average score of 3.60, signifying positive acknowledgement among the respondents. Additionally, Statement S2, regarding the knowledge of the application of browsing and purchase behavior, showed the highest level of agreement with 61.03%, with an average score of 3.54, signifying that the respondents were conscious of the application of the personal information for catering to tailored recommendations. Statement S3

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regarding the application of personalized recommendations while buying through online shopping also showed moderate levels of agreement with 51.47%, with an average score of 3.53, confirming that the respondents were capable of detecting the application of personalized recommendations while buying through an online shopping platform.

5.2 Influence on Purchase Decisions

The effect of AI-based personalization on the purchase decision seems to be moderate. The effect of AI recommendations on the purchase decision for the statement S4 was found to have an agreement measure of 35.29% and a mean measure of 3.28, signifying a slight positive effect. The effect of AI purchase recommendations for the statement S5 was found to have a measure of 33.09%, with the mean measure being 3.18. Conversely, statement S6, which measured the likelihood of buying AI-recommended purchase items, presented a stronger effect measure of 50.00%, with the mean measure of 3.51, emphasizing the effect of AI-based personalization in optimizing the efficiency and convenience of purchases.

5.3 Trust in AI-Generated Recommendations

The trust in AI recommendations is found to be moderate and measured. Statement S7 reflects an agreement of 29.41% with a mean of 3.11. It can be observed that the agreement is towards a neutral point. Statement S8 tends to measure the alignment of AI recommendations and consumer preferences. This statement reflects a relatively higher agreement of 43.38% at a mean of 3.36. Statement S9 measures the improvement in overall shopping experience due to AI-based personalization. This statement reflects a moderate agreement of 38.97% at a mean of 3.27. This points out that though consumers agree to the relevance of AI recommendations, complete trust in AI-based systems is yet to be attained.

5.4 Impact on Impulse Buying Behaviour

It seems that the role of personalization through AI in impulse buying behavior is limited. Statement S10, regarding the positive influence of impulse buying through AI recommendations, showed an agreement level of 30.15%, with an average of 3.12, indicating neutrality. Statement S11 showed the least level of agreement with the other statements (20.59%, average of 2.82) and clearly indicates that the recommendations made through AI do not have the tendency to induce impulse buying to any great extent. Statement S12 showed some level of moderate agreement (35.29%, with an average of 3.16) and indicates the marginal positive impact of personalized offers on impulse buying behavior.

5.5 Challenges and Consumer Concerns

One major theme that came out during analysis was the concern with AI-based personalization. Statement S13, related to the use of personal information, reached 50% agreement with a mean score of 3.52, depicting data privacy as a big concern for customers. Statement S14 indicated considerable discomfort caused by over-personalization, with 44.85% (mean = 3.49) and Statement S15 with concerns about limited exposure to new products because of algorithmic filtering, with 47.79% (mean = 3.49). These, in fact, emphasize the need to balance personalization with transparency and user control.

6. FINDINGS OF THE STUDY

The data analysis of the primary data shows that most people who participated in the study fall within the age brackets of 18 to 25 years, showing that young people are more likely to adopt the usage of e-commerce platforms. In regard to the first objective of studying the level of awareness concerning AI-powered personalization among e-commerce users, the data shows that the majority of people are well-aware that AI is employed for personalization purposes within online shopping platforms. The level of awareness is high among young individuals between the age brackets of 18 to 25 years.

In regards to the second objective, which focused on examining the effects of personalized recommendations generated by AI technology towards consumers' purchase decisions, the study concluded that AI-powered personalized recommendation has a positive effect on purchase behavior. In regards to the third objective, which focused on examining consumers' trust of personalized recommendations generated by AI technology, the study concluded a moderate trust in AI-generated personalized recommendations. Although consumers recognize their benefits, relying solely on personalized recommendations generated by AI technology is not yet established.

The fourth objective was to investigate whether personalization driven by AI leads to impulsive purchasing. The results point out that impulse buying behavior is minimally influenced by AI-based personalization. In regard to this, it has been established that consumers will not make unplanned purchases merely because they have been recommended by AI. This demonstrates a careful and full-of-thought purchasing disposition. Finally, consistent with the fifth objective-which sought to identify challenges and concerns as regards AI personalization-the

study highlights many apprehensions among respondents over data privacy issues and excessive personalization. The people interviewed feared that their data would be used and that the variety of products could be shut out due to algorithmic filtering.

Overall, the findings confirm that AI-based personalization plays a meaningful role in shaping online consumer behaviour while underscoring the importance of transparency, ethical data practices, and balanced personalization strategies for sustaining consumer trust.

7. SUGGESTIONS

Suggestions for e-commerce sites and policymakers, based on the outcomes of the study, are as follows for improving the efficacy of personalization using AI and synchronizing it with consumer sentiments: E-commerce sites need to enhance the level of transparency regarding the collection and subsequent use of consumer data for personalization through the use of AI, thus helping in improving the level of trust emanating from consumers. They need to sensitize consumers through effective communication regarding their policy and procedures for storing and handling personal data, thus helping in alleviating any fear levels of consumers regarding the use of personal information. Personalization software needs to be implemented in a balanced form and avoid being too targeted, which might give rise to feelings of unease and dissatisfaction among consumers. In addition to this, continuous work needs to be done on improving the accuracy levels of suggestions from the use of AI, thus resulting in boosting the confidence level among consumers regarding the suggestions produced through the use of AI for personalization purposes within e-commerce sites.

8. CONCLUSION

Conclusion drawn from the research indicates that AI personalization helps immensely in influencing the purchase decisions of the customer within the context of the e-commerce sector. Consumers are satisfactorily aware of the AI personalization methods and realize the importance and contribution of these AI methods in the form of improved convenience and efficiency of decision-making while shopping. Although the positive impact of AI recommendations has immensely helped shape the purchase decision of the customer, the level of trust among the masses with respect to these systems remains moderate, suggesting the cautious and limited acceptance of the recommendations provided through AI systems. Additionally, the impact of AI personalization remains limited within the context of impulse purchases, suggesting the deliberate nature of purchase decisions made by the customer.

REFERENCES

1. Awad, N. F., & Krishnan, M. S. (2006). The personalization privacy paradox: An empirical evaluation of information transparency and the willingness to be profiled online for personalization. *MIS Quarterly, 30*(1), 13–28. https://doi.org/10.2307/25148715
2. Davenport, T. H., Guha, A., Grewal, D., & Bressgott, T. (2020). How artificial intelligence will change the future of marketing. *Journal of the Academy of Marketing Science, 48*(1), 24–42. https://doi.org/10.1007/s11747-019-00696-0
3. Grewal, D., Roggeveen, A. L., & Nordfält, J. (2017). The future of retailing. *Journal of Retailing, 93*(1), 1–6. https://doi.org/10.1016/j.jretai.2016.12.008
4. IBM. (2023). *What is artificial intelligence (AI)?* https://www.ibm.com/topics/artificial-intelligence
5. McKinsey & Company. (2022). *The value of personalization in digital commerce.* https://www.mckinsey.com/capabilities/growth-marketing-and-sales/our-insights/the-value-of-getting-personalization-right
6. PwC. (2023). *Consumer intelligence series: Trust in AI.* https://www.pwc.com/gx/en/issues/data-and-analytics/artificial-intelligence/consumer-trust-in-ai.html
7. Smith, A., & Anderson, M. (2019). AI-driven personalization and online consumer behaviour. *Journal of Retailing and Consumer Services, 49,* 123–131. https://doi.org/10.1016/j.jretconser.2019.03.005
8. Statista. (2024). *E-commerce and artificial intelligence worldwide.* https://www.statista.com/topics/840/artificial-intelligence-ai/
9. Verma, S., & Yadav, N. (2021). AI-enabled personalization and impulse buying behaviour in e-commerce. *International Journal of Consumer Studies, 45(*3), 458–469. https://doi.org/10.1111/ijcs.12628
10. World Economic Forum. (2023). *Ethical considerations of artificial intelligence.* https://www.weforum.org/topics/artificial-intelligence/

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A STUDY OF LITERATURE ON ROLE OF ARTIFICIAL INTELLIGENCE (AI) IN INVESTMENT DECISION MAKING FOR RETAIL INVESTORS

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ABSTRACT
Traditionally, there was not much awareness related to investments. Whatever little awareness was, there was high dependence on financial advisors, banks, manual expertise from limited sources of information, which led towards having biases in decision making related to investments. In the recent times the technological advancements in Machine Learning (ML), Natural Language Processing (NLP), robo-advisory platforms have given access to a number of investment tools. Artificial Intelligence (AI) has transformed the functioning of financial markets, the modes of accessibility, emergence of digital payment system enhancing the knowledge tools and management skills related investments.

In this study, a literature review of the published data in the last five years has been considered. The earlier studies reflect the evolution of AI and its utility to enhance the quality and experience of taking investment decisions. These studies also highlight that in the light of emergence of new technology such as AI, it is also being considered for analyzing the application-based platforms, benefits and challenges associated with it. For this paper, the study focusses on the role of AI in helping the retail investors to take quality decisions by using the application-based financial services, the benefits and challenges associated with it. This study tries to gauge the research gap related to the risk factors and also trying to understand and measure the risk elements such as lack of transparency, algorithmic bias and overdependence on automation of systems. The findings suggest that AI is providing higher accessibility, personalized interactions, efficiency and risk management, but also throws light on the ethical aspect, regulatory concerns and privacy issues embedded in this process. The study makes a conclusion that human and machine should go hand in hand i.e. be available in a hybrid mode to adapt sustainably and benefit more but by keeping safe themselves and their investment.

Keywords: *Artificial intelligence, retail investors, investment decision making, robo-advisors*

1. INTRODUCTION
Retail investors today operate in investment environments marked by heightened market volatility, overwhelming volumes of financial data, and the rapid spread of information across digital platforms. These conditions can make informed decision making challenging, particularly for individuals without advanced financial expertise. As a powerful tool, the emergence of Artificial Intelligence (AI), to address these challenges by automating data processing, detecting complex patterns, and producing predictive insights that support more informed investment choices. Technologies such as robo-advisors, algorithmic trading systems, and sentiment analysis models have lowered barriers to entry by providing retail investors with access to sophisticated analytical capabilities once reserved for institutional investors (RetailInvestor.org, 2024). As a result, AI has contributed to greater efficiency, personalization, and speed in investment decision making. Nevertheless, the growing reliance on AI also introduces significant concerns. Issues related to algorithmic transparency, data bias, accountability, and ethical governance can undermine investor trust and raise regulatory challenges (Ontario Securities Commission [OSC], 2020). This paper examines the role of AI in shaping retail investors' decision-making processes, highlighting both its transformative potential and the risks that must be carefully managed.

2. RESEARCH OBJECTIVES:
1. To review the literature on Artificial Intelligence (AI) associated with Investment Decision Making
2. To enumerate the benefits and challenges associated with AI-driven investment tools.
3. To give suggestions about use of Artificial Intelligence (AI) driven tools associated with Investment Decision Making to retail investors.

3. LITERATURE REVIEW:
1. Joshi (2025) examines the application of GPT-powered generative AI frameworks within financial institutions to enhance market intelligence and decision-making. The study highlights how GPT models enable data-driven financial analysis by improving accuracy, scalability, and cost efficiency. By leveraging large-scale datasets, these frameworks support high-domain performance and assist institutions in strategic decision-making, risk assessment, and market forecasting. The findings suggest that GPT-based systems offer significant operational advantages while facilitating scalable adoption across financial services.

2. Joshi (2025) examines the AI skills gap in the financial services workforce, highlighting the role of targeted training and digital inclusion. The study finds that generative and agentic AI improve productivity and decision-making while reducing manual tasks. However, comprehensive upskilling, especially for senior staff and older employees, is essential to ensure inclusive and sustainable AI integration.
3. Joshi (2025) reviews generative AI agent frameworks in finance, investments, and risk management, focusing on multi-agent systems and real-world applications in trading and portfolio analytics. The study finds that GenAI agents enhance productivity and decision accuracy in complex tasks. However, challenges related to workforce upskilling, explainability, regulation, standardized architectures, and hybrid human–AI workflows remain critical for responsible adoption.
4. Singh and Beri (2025) analyze AI integration in financial services, highlighting opportunities in risk management, fraud detection, investment optimization, customer service, and compliance. The study finds AI improves decision-making efficiency and customer experience. However, sustainable adoption depends on strong data security, regulatory compliance, transparency, and ethical AI governance across global financial institutions.
5. Taylor (2025) reviews AI agent frameworks and their contribution to financial stability across global financial systems. The study finds that multi-agent architectures enhance automation, decision accuracy, and operational efficiency while lowering costs. However, sustainable adoption requires standardized architectures, transparency, regulatory compliance, and hybrid human–AI governance to ensure accountability and resilience in financial services.
6. Chugh and Deshpande (2025) explore agentic artificial intelligence in financial services, emphasizing autonomous decision-making through multi-agent systems. The study highlights applications in fraud detection, portfolio management, risk assessment, and regulatory compliance. While agentic AI improves efficiency, adaptability, and automation, concerns regarding bias, explainability, data quality, regulatory uncertainty, and systemic risk underline the need for strong governance, explainable frameworks, and human-in-the-loop oversight.
7. Ahirwar and Rawat (2025) investigate the role of artificial intelligence in financial investment decision-making within the Indian context, using a mixed-methods research approach. The study examines strategic AI applications in portfolio optimization, risk management, and market forecasting. The findings demonstrate that AI-driven models significantly enhance investment efficiency and analytical accuracy. However, the authors highlight persistent challenges related to model transparency, data quality, and regulatory compliance. The study emphasizes the need for robust governance frameworks and sustained human oversight to ensure responsible AI adoption in financial investment practices.
8. Nair and Joshi (2025) examine the role of artificial intelligence in financial decision-making, with empirical evidence from India and implications for global markets. The study finds that AI enhances the speed, accuracy, and objectivity of financial analysis across risk assessment, trading, portfolio management, and fraud detection. However, challenges related to transparency, data privacy, regulatory compliance, and systemic risk underscore the need for ethical AI deployment and strong governance frameworks.
9. Jagtap (2025) analyzes the impact of AI-driven tools on investment decisions of self-directed investors in India. The study reports high awareness and usage of AI tools, leading to reduced decision errors, improved analytical efficiency, stronger risk management, and better portfolio optimization. However, awareness gaps persist among certain investor groups, highlighting the need for targeted investor education to fully realize the benefits of AI-based investment decision-making.
10. Kumar (2025) explores the role of AI agents in personal finance management, focusing on automated budgeting, expense tracking, and personalized investment advice. Using multi-agent frameworks and generative AI, the study finds improved accuracy and efficiency in financial planning through automation and tailored insights. However, ethical concerns related to data privacy and transparency highlight the need for responsible governance and explainable AI in personal finance systems.
11. Kan and Manzoor (2025) examine investor perceptions and adoption of AI-based tools in Indian equity markets using technology acceptance and behavioral finance frameworks. The study finds occupation-linked differences in AI awareness and perceived benefits such as bias reduction and real-time analysis. However, privacy and oversight concerns limit adoption, highlighting the need for transparency, investor education, and regulatory safeguards.

12. Singh, Kumar, and Kumari (2025) investigate how artificial intelligence influences investment decisions of individual investors in India using a survey-based approach. The study finds widespread use of AI tools, particularly robo-advisors, improving strategy formulation and analytical efficiency. However, mixed trust levels among investors highlight the need for human oversight, transparent systems, investor education, and user-friendly AI platforms to support responsible adoption in emerging markets.
13. Singh, Shri, Rathi, and Shah (2025) analyze the application of artificial intelligence and machine learning in Indian equity markets, focusing on the BSE and NSE. The study finds that AI-driven trading, portfolio optimization, and sentiment analysis enhance performance and efficiency. However, risks from overautomation, overfitting, volatility, and regulatory constraints highlight the need for a hybrid human–AI approach to ensure transparency, resilience, and responsible adoption.
14. Nair (2024) explores how artificial intelligence enhances investment strategies and portfolio management in global financial markets, focusing on applications in investment analysis, asset allocation, rebalancing, execution, and risk management. The study finds that machine learning improves forecasting accuracy and portfolio efficiency but faces challenges related to data quality, interpretability, and regulation, underscoring the need for explainable AI, ethical governance, human oversight, and future integration with quantum computing and blockchain.
15. Hauptman (2024) examines AI adoption in investment markets, emphasizing U.S. regulatory contexts with global relevance. While AI improves investor access, efficiency, and compliance, it also introduces risks such as bias, AI washing, data vulnerabilities, privacy concerns, and systemic threats, highlighting the need for strong regulation, transparency, and oversight.
16. Chen, Honarvar, and Lohre (2023) review AI applications in investment management, covering asset pricing, risk prediction, trading, sentiment, ESG analysis, and portfolio decisions. AI enhances productivity and pattern recognition but remains constrained by data quality, interpretability, and inability to manage extreme market events without human judgment.
17. Sifat (2023) analyzes the influence of artificial intelligence on retail investing in developed markets, focusing on market efficiency, portfolio management, governance, and ethics. The study finds that rapid AI-driven algorithms increase information asymmetry and investor risk, challenging traditional theories, and advocates regulatory sandboxes, ethical oversight, enhanced disclosures, and financial literacy to protect retail investors.
18. Ontario Securities Commission (2020) investigates AI use in retail investing through experimental analysis of robo-advice, personalization, nudging, and algorithmic tools. While AI improves investor access and decision efficiency, it also poses risks of manipulation, conflicts of interest, and opacity, underscoring the need for robust regulatory oversight globally.

4. RESEARCH GAP:

Although AI in finance has been widely studied, existing literature largely focuses on institutional investors and algorithmic trading firms. Limited research examines how institutional and retail investors are adopting and interpreting AI for investment decision making with the recommendations, managing trust in automated systems, and balancing AI insights with personal judgment, comparative studies on fully automated versus hybrid human–AI investment approaches.

5. RESEARCH METHODOLOGY:

The study adopts a descriptive research design and is based entirely on secondary data sources from last five years only. It employs a systematic literature review methodology, drawing on academic journals, books, research studies, industry reports, websites, and other relevant publications to examine the application and effects of AI-enabled investment tools.

6. FINDINGS FROM REVIEWED LITERATURE:

1. Artificial intelligence significantly enhances financial and investment decision-making accuracy.
2. AI reduces human cognitive and behavioral biases in investment decisions.
3. AI adoption leads to substantial gains in operational efficiency and productivity.
4. Personalized and automated investment advisory services are a major outcome of AI integration.
5. AI strengthens risk management and regulatory monitoring capabilities.
6. Agentic AI and multi-agent frameworks represent an emerging paradigm in financial decision-making.

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7. Human–AI collaboration is consistently favored over full automation.
8. Lack of explainability remains a critical barrier to AI adoption in finance.
9. Algorithmic bias and ethical risks are persistent challenges.
10. Regulatory and governance frameworks have not kept pace with AI innovation.
11. Over-reliance on AI poses systemic and market-level risks.
12. Data quality, privacy, and cybersecurity risks significantly influence AI effectiveness.
1. Workforce skill gaps constrain effective AI implementation.
2. AI improves financial inclusion but also creates new disparities.
3. Responsible AI governance is essential for sustainable value creation.

7. BENEFITS OF AI IN INVESTMENT DECISION MAKING:

1. AI models process vast structured and unstructured datasets to uncover complex patterns, enhancing Improved Decision-Making Accuracy portfolio allocation, credit risk, fraud detection, and market prediction.
2. Automation of repetitive financial tasks enhances Operational Efficiency and Cost Reduction
3. AI-powered robo-advisors and agents provide personalized investment strategies tailored to investor risk profiles and financial goals and Accessibility to sophisticated financial advice for retail and small investors.
4. AI improves detection of fraud, credit risk, market anomalies, and systematic risks enhancing Risk Management and Compliance through automated surveillance.
5. AI-driven insights support better Strategic and Competitive Advantage
6. Augmentation of Human Expertise in collaboration, not replacement.

8. Challenges of AI in Investment Decision Making:

1. Black-box models Lack Explainability making it difficult to understand or justify AI-driven decisions.
2. AI systems can amplify Algorithmic Bias and raise Ethical Concerns.
3. Existing struggle to keep pace with AI innovation. Regulatory and Compliances.
4. AI performance depends heavily on data accuracy, relevance, and timeliness Data Quality and Security Risks such as cybersecurity threats and data privacy breaches.
5. Over-Reliance on Automation and on AI may reduce human oversight and critical judgment.
6. Workforce and Financial professionals need upskilling and reskilling and reduce the Gap.
7. Agentic AI and high-frequency trading can amplify systemic risk and Market-Level Risks.

9. Suggestions to Aid Retail Investors in Using AI for Investment Decision-Making

1. Improve AI Literacy and Financial Education
2. Mandate Explainable AI (XAI) for Retail Tools
3. Promote Human–AI Hybrid Advisory Models
4. Standardize Disclosures for AI-Based Investment Products
5. Strengthen Regulatory Oversight and Investor Protection
6. Encourage Personalized Risk Profiling and Safeguards
7. Enhance Data Privacy and Cybersecurity Protections
8. Develop Independent AI Rating and Certification Systems
9. Introduce Investor-Friendly AI Interfaces
10. Foster Ethical AI and Responsible Innovation

10. CONCLUSION:

In conclusion, while artificial intelligence holds substantial promise for enhancing efficiency, accuracy, and inclusivity in financial decision-making, its long-term value depends on responsible implementation. Sustainable AI adoption in finance requires transparent and explainable models, strong ethical and regulatory governance, continuous human oversight, and investment in human capital. Future research is encouraged to focus on empirically evaluating hybrid decision-making frameworks, developing standardized evaluation metrics for agentic AI systems, and exploring regulatory models that balance innovation with financial stability. Importantly AI should not be viewed as a replacement for human judgment but rather as a complementary decision-support system.

REFERENCES

1) Joshi, S. (2025). *Empowering financial institutions with GPT-powered frameworks for market intelligence and decision-making: Advancing financial AI for U.S. competitiveness. International Journal of Novel Research and Development*, 10(3), 372–385. https://www.ijnrd.org

2) Ahirwar, R., & Rawat, S. (2025). *A study of artificial intelligence (AI) in financial investment: Opportunities, strategies, and challenges. International Journal for Multidisciplinary Research*, 7(4), 1–7. https://www.ijfmr.com

3) Singh, A. D., & Beri, D. (2025). *AI integration in financial services: The various opportunities it presents, and the challenges it poses. International Journal for Multidisciplinary Research*, 7(3), 1–6. https://www.ijfmr.com

4) Saini V, Impact of Artificial Intelligence on Investment Decision-Making. Int J Engg Mgmt Res. 2025;15(5):133-140.
Available From https://ijemr.vandanapublications.com/index.php/j/article/view/1818

5) Jagtap, S. D. (2025). *Impact of AI tools on investment decisions of individuals. GAP Bodhi Taru: A Global Journal of Humanities*, 8, 97–100. https://www.gapbodhitaru.org

6) Kan, T. H., & Manzoor, A. K. S. (2025). *Harnessing artificial intelligence for enhanced decision-making in equity stock investments: An empirical study on investor perceptions. International Journal of Foreign Trade and International Business*, 7(2), 45–47. https://doi.org/10.33545/26633140.2025.v7.i2a.172

7) Ontario Securities Commission. (2020). *Artificial intelligence and retail investing: Use cases and experimental research.* https://www.osc.ca/en/securities-law/instruments-rules-policies/ai-retail-investing

8) Nair, M. A., & Joshi, G. K. (2025). *Artificial intelligence on financial decision making. International Journal for Multidisciplinary Research*, 7(5). https://www.ijfmr.com

9) Kumar, D. P. (2025). *From budgets to investments: How AI agents are reshaping personal finance. International Journal of Advanced Research in Public Policy and Regulation*, 2(1), 1–6. https://www.ijarpr.com

10) Joshi, S. (2025). *Bridging the AI skills gap: Workforce training for financial services. International Journal of Innovative Science and Research Technology*, 10(2), 1023–1030. https://doi.org/10.5281/zenodo.14944939

11) Joshi, S. (2025). *A comprehensive review of Gen AI agents: Applications and frameworks in finance, investments and risk domains. International Journal of Innovative Science and Research Technology*, 10(5), 1339–1355. https://doi.org/10.38124/ijisrt/25may964

12) Singh, S. K., Kumar, R., & Kumari, S. (2025*). Impact of artificial intelligence on the investment decision of investors. International Journal of Research Publication and Reviews*, 6(2), 1–7. https://www.ijrpr.com

13) Singh, T. S., Shri, D. S., Rathi, D., & Shah, N. (2025). *AI-driven investment and portfolio management. Journal of Emerging Technologies and Innovative Research*, 12(6), 45–51. https://www.jetir.org

14) Nair, V. (2024). *AI-powered investment strategies: Enhancing portfolio management through machine learning. Journal of Recent Trends in Computer Science and Engineering*, 12(1), 1–5. https://jrtcse.com

15) Chugh, S., & Deshpande, A. V. (2025). *Opportunities and challenges of agentic AI in finance*. https://doi.org/10.5281/zenodo.14892831

ISSN 2394 - 7780

16) Hauptman, M. (2024). *Opportunities and risks of artificial intelligence in investment markets*. Better Markets. https://bettermarkets.org

17) Chen, M., Honarvar, I., & Lohre, H. (2023). *The current state of AI for investment management*. *VBA Journaal*, (155), 28–35. https://vbajournaal.nl

18) Sifat, I. (2023). *Artificial intelligence (AI) and retail investment*. SSRN. https://ssrn.com/abstract=4660611

19) Taylor, A. (2025). *Artificial intelligence agent frameworks in financial stability: Innovations, challenges, applications. World Journal of Advanced Engineering Technology and Sciences*, 4(1), 1191–1203. https://www.wjaets.com

20) RetailInvestor.org. (2024). The role of AI in investment management. (Retail Investor)

21) Artificial Intelligence and Retail Investing: Use Cases and Experimental Research. (2020). Ontario Securities Commission. (OSC)

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CONSUMER BEHAVIOR TOWARDS AI-GENERATED PERSONALIZED VIDEO ADVERTISEMENTS ON YOUTUBE AND INSTAGRAM

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ABSTRACT
The rapid adoption of Artificial Intelligence (AI) in digital advertising has led to the emergence of hyper-personalised video advertisements that are dynamically tailored to individual users based on their online behaviour, interests, and preferences. Platforms such as YouTube and Instagram play a pivotal role in driving this trend due to their extensive user bases and sophisticated recommendation algorithms. While AI-generated personalised video ads enhance relevance and engagement, they simultaneously raise concerns related to privacy, intrusiveness, and consumer trust. This study aims to examine consumer behaviour towards AI-generated hyper-personalised video advertisements on YouTube and Instagram, identify key factors influencing acceptance or rejection, and suggest ethical and effective implementation strategies. The research is based on both primary and secondary data. Primary data were collected through a structured questionnaire administered to 53 respondents comprising faculty members, research scholars, and students. Percentage analysis and pie diagrams were used to analyse and interpret the data. The findings reveal that a significant majority of respondents perceive AI-generated personalised video ads as more relevant than non-personalised ads and acknowledge their positive influence on engagement, such as watching, clicking, or purchasing. However, a substantial proportion of respondents also reported feelings of intrusiveness, describing such ads as "creepy" due to excessive personalisation. Platform-based differences were clearly observed, with personalised video ads perceived as more disruptive on Instagram than on YouTube, largely due to Instagram's feed-based, short-scroll browsing experience. Additionally, transparency emerged as a critical factor influencing acceptance, as respondents indicated higher comfort levels when platforms clearly explained why ads were shown and how their data were used. The study concludes that while AI-generated hyper-personalised video ads are effective in driving engagement, their success depends on balancing relevance with user comfort, ensuring transparency, and adopting platform-specific advertising strategies.

Keywords: *Artificial Intelligence, Instagram, YouTube, advertising, video advertisements*

1. INTRODUCTION
The digital advertising landscape has transformed significantly in recent years with the growing integration of artificial intelligence (AI). AI technologies, such as machine learning and generative tools, now allow for the development of hyper-personalised video advertisements that adjust content in real time according to individual user interests, online activities, and preferences. This evolution has changed the way brands reach audiences on popular social media platforms like YouTube and Instagram, which attract large numbers of users through their engaging formats and intelligent content recommendation systems.

YouTube, known for its longer video experiences and built-in ad placements, and Instagram, with its visually appealing, quick-scroll feeds and short-form content like Reels, have become central spaces for delivering these AI-driven advertisements. The goal of hyper-personalisation is to make ads feel more relevant to each viewer, encouraging greater interaction—such as watching the full ad, clicking through, or showing interest in the promoted products or services. However, this heightened level of personalisation also introduces certain challenges. When ads reflect too much personal information, they can sometimes feel overly intrusive, leading some users to perceive them as unsettling or invasive of privacy. This situation illustrates a common personalization paradox: the features that make advertisements more appealing and effective can simultaneously create discomfort or reduce trust, particularly in environments where personal data is extensively used for targeting. Differences between platforms add another layer—Instagram's rapid, feed-based browsing often makes ad interruptions seem more noticeable and disruptive compared to YouTube's more seamless, video-focused flow. Transparency has become an important element in managing these issues. When users understand how their data is collected and why certain ads are shown, they generally feel more comfortable and are more likely to respond positively. Adopting ethical approaches, including offering users greater control over their information and designing strategies that suit each platform's unique style, helps strike a balance between achieving meaningful engagement and respecting individual boundaries.

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Although discussions around AI in advertising are increasing, there remains a need for deeper exploration of how consumers actually respond to hyper-personalised video ads, especially across different platforms like YouTube and Instagram, and what influences their acceptance or resistance. This study addresses that need by examining consumer attitudes and behaviours toward AI-generated hyper-personalised video advertisements on these two platforms. It draws on primary data collected through a structured questionnaire from 53 respondents—comprising faculty members, research scholars, and students—and employs percentage analysis along with visual representations to interpret the responses. The research identifies key factors affecting acceptance or rejection and provides practical suggestions for responsible and platform-sensitive implementation.

By investigating these aspects, the study offers insights into how hyper-personalised advertising can effectively connect with audiences while maintaining user comfort and trust in a digital environment increasingly shaped by AI.

2. REVIEW OF LITERATURE

Bharathi N (2025) examined the challenges faced by YouTubers in a highly competitive digital environment and explored ways to enhance their performance through data-driven support systems. The study highlights the importance of real-time data collection and robust processing frameworks to generate actionable insights for content creators. By integrating advanced analytical methods and predictive modelling, the research demonstrates how creators can better understand audience behaviour and optimise their content strategies.

Goel P et.al (2025) analyse the inventive use of AI in commercials in terms of their content, looking at new trends in AI use in the advertising sector in terms of how they are presented, and talking about the moral implications of using AI in commercials. The study draws attention to the problems of deepfakes, emotional manipulation, deceptive images, and data privacy. The study recommends striking a balance between utilising clever technologies and maintaining the integrity and originality of advertisements. The results could assist companies in producing ads that use AI to engage viewers while retaining their confidence.

Joseph O. et al. (2025) examined how Artificial Intelligence (AI) can be integrated to analyse large volumes of structured and unstructured data for understanding consumer behaviour. Their study highlights that traditional analytical tools are inadequate in today's data-heavy environment, making AI-based techniques essential. They propose a comprehensive framework that demonstrates how machine learning and advanced analytics generate deeper, real-time consumer insights. The research also shows that AI improves the accuracy of identifying consumer preferences and predicting future behaviour. Overall, the study contributes to existing literature by establishing AI as a critical driver of data-driven consumer insight and strategic business decision-making.

Ogbaba I et.al. (2025) research analyses the effectiveness of AI-created advertisements among Generation Z (Gen Z) Nigerian online users. The data was examined to identify trends in user feedback across various platforms, emotional resonance, and demographic traits. The outcome of the research indicated that personalisation and emotional resonance greatly improve the effectiveness of AI-generated advertisements, with humour. The research uncovered that AI-created ads have a moderate impact on the online behaviour of Gen Z Nigerians, indicating significant room for enhancement.

A Lebrun (2025) examined how generative AI enables hyper-personalised digital advertising. The study finds that AI-generated ads are more persuasive than traditional ones. Studies state that ads can exploit users' cognitive biases. Studies note rising risks of misinformation through personalised content. The study suggests clearer disclosure for AI-generated ads. The study recommends stronger regulation to prevent manipulation. The study suggests combining technical and legal safeguards to reduce risks.

Research Gap of the study

A notable research gap across the reviewed studies (Lebrun, 2025; Paridhi et al., 2025; Ogbaga & Nweke, 2025; Joseph et al., 2025; Bharathi, 2025) is the absence of integrated, empirically validated frameworks that combine technical AI applications in advertising such as generative content, personalization, and real-time analytics with robust ethical and regulatory safeguards against risks like manipulation, misinformation, deepfakes, and privacy violations. Although these studies identify benefits (e.g., enhanced persuasiveness and consumer insights) and propose preliminary recommendations, they lack comprehensive models addressing long-term impacts on diverse demographics. This highlights the need for future interdisciplinary research to develop and test scalable solutions that balance innovation with consumer trust and societal well-being.

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3. OBJECTIVES OF THE STUDY

1) To identify the key factors that influence consumer acceptance or rejection of AI-generated hyper-personalised video ads on Instagram and YouTube.
2) To analyse the role of platform differences (YouTube vs. Instagram) in shaping consumer behaviour to real-time AI-generated personalised video content.
3) To provide actionable recommendations for marketers and platforms on ethical and effective implementation of real-time AI-generated hyper-personalised video advertising while minimising consumer backlash.

4. RESEARCH METHODOLOGY OF THE STUDY

The study is based on both primary and secondary sources of data to ensure a comprehensive and well-rounded analysis of the research problem. Primary data were collected through a structured questionnaire designed to capture respondents' perceptions, attitudes, and behavioural responses toward AI-generated hyper-personalised video advertisements. The questionnaire was administered to a sample of 53 respondents comprising faculty members, research scholars, and students, representing an informed and digitally active group of users. This approach enabled the researcher to obtain first-hand insights into consumer acceptance, perceived relevance, intrusiveness, and engagement related to personalised video advertising on digital platforms. Secondary data were collected from a wide range of reliable sources, including books, academic journals, research articles, and online publications relevant to artificial intelligence, digital advertising, and consumer behaviour. The collected primary and secondary data were systematically organised, analysed using appropriate analytical techniques, and interpreted to derive meaningful findings and conclusions for the study.

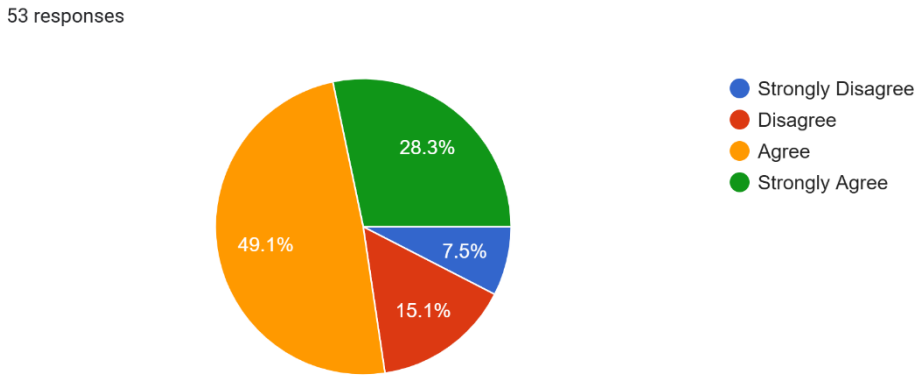
5. DATA ANALYSIS AND INTERPRETATION

The data collected through the structured questionnaire were analysed using percentage analysis and are presented using pie diagrams for better clarity and visual representation. To assess respondents' perceptions of AI-generated personalised video advertisements, they were asked whether such ads on YouTube and Instagram are more relevant to their interests compared to non-personalised advertisements.

5.1 Relevance of AI generated Personalised Video advertisements

The responses are presented through Figure-1

Figure 1: Relevance of AI generated Personalised Video advertisements



Source: Compiled by the researcher on the basis of primary data

1) 49.1% of respondents agree and 28.3% strongly agree that AI-generated personalized video ads on YouTube and Instagram are more relevant to their interests compared to non-personalized ads while 15.1% of the respondents disagree and 7.5% of the respondents strongly disagree that AI-generated personalized video ads on YouTube and Instagram are more relevant to their interests compared to non-personalized ads.
2) The findings reveal that a majority of respondents perceived AI-generated personalised video ads as more relevant.
3) Specifically, 49.1% of the respondents agreed and 28.3% strongly agreed that personalised video advertisements on YouTube and Instagram align better with their interests.
4) In contrast, 15.1% of the respondents disagreed with this statement, and 7.5% strongly disagreed.

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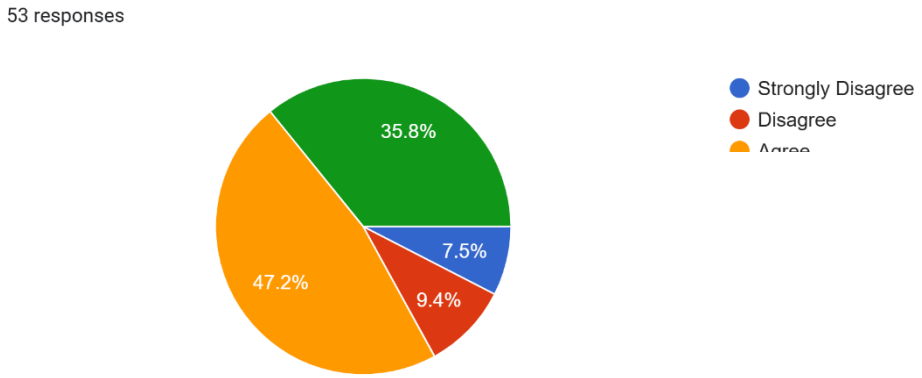
Interpretation:
The results indicate a strong positive inclination toward AI-driven personalised advertising, with over three-fourths of the respondents agreeing on its relevance. This suggests that AI-based personalisation effectively enhances ad relevance by tailoring content to individual preferences and browsing behaviour. However, the presence of a smaller segment of respondents who disagreed highlights potential concerns such as privacy issues, ad fatigue, or perceived intrusiveness. Overall, the findings underscore the growing effectiveness of AI-enabled personalised video advertising on digital platforms while indicating the need for balanced personalisation strategies to address varying consumer perceptions.

5.2 Perceived Creepiness and Intrusiveness

Following the assessment of respondents' perceptions regarding the relevance of AI-generated personalised video advertisements, the subsequent question examined whether such a high degree of personalisation results in feelings of creepiness or perceived intrusion.

After understanding respondents' views on the relevance of AI-generated personalized video ads, the next question investigates whether this high level of personalization leads to feelings of creepiness or intrusion. The respondents responded as follows:

Figure 2: Perceived Creepiness and Intrusiveness



Source: Compiled by the researcher on the basis of primary data

A majority of respondents comprising 47.2% of the respondents agreed and 35.8% strongly agreed that AI-generated personalized video advertisements are intrusive and creepy in nature. A small minority comprising 9.4% of the respondents disagreed and 7.5% strongly disagreed that AI-generated personalized video advertisements are intrusive and creepy in nature. The pie diagram on perceived intrusiveness indicates that most respondents felt AI-generated personalized video ads know too much about their preferences or behaviour, making them appear creepy or intrusive, whereas only a limited number of respondents disagreed with this perception.

The analysis of responses, as illustrated through the pie diagram on perceived intrusiveness, indicates that a majority of respondents felt that AI-generated personalised video advertisements possess excessive knowledge about their preferences or online behaviour, thereby making them appear intrusive or unsettling. In contrast, only a relatively small proportion of respondents disagreed with this perception.

Interpretation:
These findings suggest a paradox in consumer responses to AI-driven personalisation. While personalised video advertisements are largely perceived as relevant and aligned with individual interests, they simultaneously evoke concerns related to privacy and psychological discomfort. The perception that such advertisements "know too much" reflects growing consumer sensitivity towards data collection practices and algorithmic surveillance. This highlights the importance for marketers and platform providers to strike a balance between delivering personalised content and maintaining transparency and ethical data usage to mitigate feelings of intrusion among users.

5.3 Interruption Caused by Personalized Video Advertisements

Building on the findings related to perceived intrusiveness and over-awareness of AI-generated personalised video advertisements, the subsequent question examined whether such personalisation results in greater disruption of the user experience across digital platforms, with a comparative focus on Instagram and YouTube.

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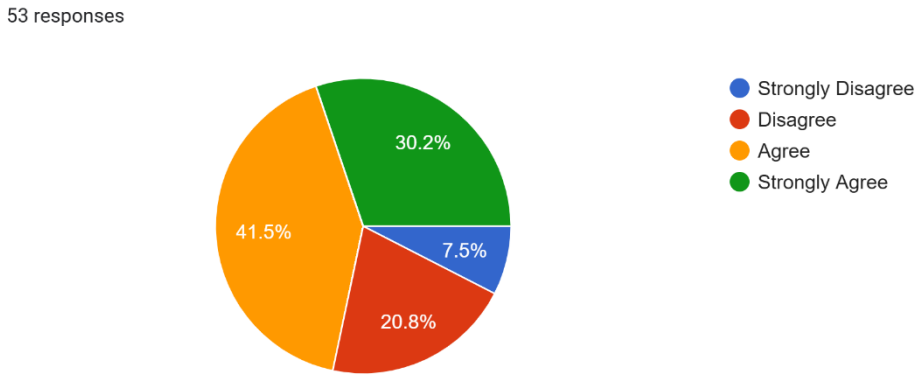
Figure 3: Interruption Caused by Personalized Video Advertisements



Source: Compiled by the researcher on the basis of primary data

41.5% of the respondents agree and 30.2% strongly agree that AI-generated personalized video ads are more interruptive on Instagram than on Youtube while 20.8% of the respondents disagree and 7.5% strongly disagree that AI-generated personalized video ads are more interruptive on Instagram.

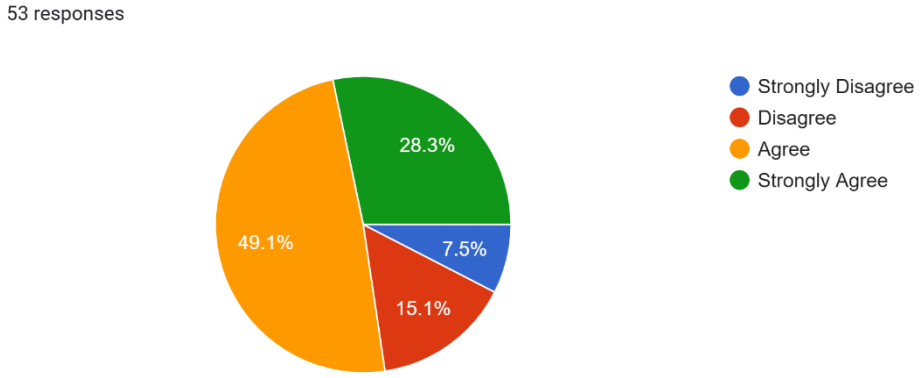
The analysis of responses, as presented in the pie diagram on platform-based interruption, indicates that AI-generated personalised video advertisements are perceived to interrupt the user experience to a greater extent on Instagram than on YouTube. A higher proportion of respondents expressed agreement with the statement that personalised video ads are more disruptive on Instagram.

Interpretation:
This result suggests that platform characteristics play a significant role in shaping user responses to personalised advertising. Instagram's immersive, fast-scrolling, and visually driven interfac[illegible]ghten users' sensitivity to interruptions, making personalis[illegible]content flow. In contrast, YouTube users may be relatively more tolerant of video advertisements, as ads are often expected within longer-form content consumption. These findings imply that advertisers should adopt platform-specific personalisation strategies, ensuring that the intensity and format of AI-driven ads align with user expectations to minimise perceived disruption and enhance overall user experience.

5.4 Acceptance of AI-Generated Personalized Video Advertisements.

Following the examination of platform-based interruption, the subsequent question assessed whether transparency in data usage and ad targeting influences users' acceptance of AI-generated personalised video advertisements.

Figure 4 : Acceptance of AI-Generated Personalized Video Advertisements.



Source: Compiled by the researcher on the basis of primary data

49.1% of the respondents agree and 28.3% strongly agree that they would be more accepting of AI-generated personalised video ads if the platform clearly explained why they are seeing the ad and how their data is collected and used. 15.1% of the respondents disagree and 7.5% strongly disagree that they would be more accepting of AI-generated personalised advertisements if the platform clearly explained why they are seeing the

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ad and how their data is collected and used. The pie diagram related to transparency shows that most respondents would be more accepting of AI-generated personalized video ads if platforms clearly explained why the ad was shown and how their data was used.

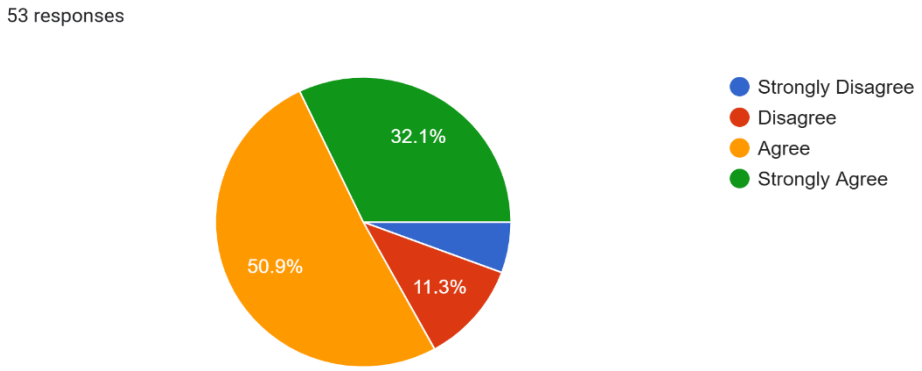
The analysis of responses, as depicted in the pie diagram on transparency, indicates that a majority of respondents reported higher acceptance of AI-generated personalised video ads when digital platforms clearly explain the rationale behind ad delivery and the manner in which user data are collected and utilised.

Interpretation:
The findings highlight transparency as a critical factor in mitigating negative perceptions associated with AI-driven personalisation. Clear communication regarding data usage and ad targeting appears to foster trust and reduce feelings of intrusiveness, thereby enhancing user acceptance of personalised video advertisements. This suggests that transparency mechanisms—such as explicit disclosures, preference controls, and explanatory prompts—can play a significant role in balancing effective personalisation with ethical advertising practices. Consequently, platform providers and advertisers may improve consumer engagement by prioritising openness and accountability in AI-based advertising strategies.

5.5 Influence of AI-Generated Hyper-Personalized Video Advertisements on Consumer Engagement.

After assessing respondents' acceptance of AI-generated personalised video advertisements in the context of transparency, the subsequent question examined the impact of such advertisements on user engagement and behavioural intentions.

Figure 5: Influence of AI-Generated Hyper-Personalized Video Advertisements on Consumer Engagement.



Source: Compiled by the researcher on the basis of primary data

A majority comprising 50.9% of the respondents agreed and 32.1% strongly agreed that AI-generated hyper-personalised video ads positively influence their likelihood to engage with the advertised product and service. A small minority comprising 11.3% of the respondents disagree and 5.7% strongly disagree that AI-generated hyper-personalised video ads positively influence their likelihood to engage with the advertised product and service.

The analysis of responses, as illustrated in the pie diagram on engagement impact, reveals that a substantial majority of respondents agreed that AI-generated hyper-personalised video advertisements positively influence their likelihood of engaging with the advertised product or service.

Interpretation:
These findings indicate that hyper-personalisation enabled by AI not only enhances perceived relevance but also translates into favourable behavioural outcomes, such as increased interest, attention, and engagement with advertised offerings. The positive influence on engagement suggests that when personalised content resonates with users' preferences, it can effectively motivate consumer interaction and decision-making. However, when considered alongside earlier findings on perceived intrusiveness, the results imply that the success of AI-driven advertising depends on achieving an optimal balance between personalisation depth and user comfort. Overall, the findings reinforce the strategic value of responsible AI-enabled personalisation in driving consumer engagement while maintaining user trust.

6. FINDINGS

The analysis of responses regarding AI-generated personalised video advertisements on YouTube and Instagram reveals a nuanced consumer perception shaped by both perceived benefits and concerns. Overall, the

findings indicate that respondents largely view AI-driven personalised video ads as highly relevant to their interests, with a substantial majority agreeing that such advertisements align better with their preferences compared to non-personalised ads. This highlights the effectiveness of AI-enabled personalisation in enhancing ad relevance and attention.

However, despite this perceived relevance, a significant proportion of respondents expressed concerns related to intrusiveness and creepiness, indicating discomfort with the extent of data awareness demonstrated by personalised ads. These concerns reflect growing consumer sensitivity towards privacy and algorithmic surveillance, suggesting that excessive or opaque personalisation may negatively affect user perceptions.

Platform-based differences were also evident. Personalised video ads were perceived to be more disruptive on Instagram than on YouTube, likely due to Instagram's fast-paced, immersive content environment, where interruptions are less expected. In contrast, YouTube users appeared more tolerant of video advertisements, as ads are more commonly integrated into longer-form content consumption.

Importantly, the findings underscore the critical role of transparency in data usage and ad targeting. A majority of respondents indicated greater acceptance of AI-generated personalised video ads when platforms clearly explained why the ads were shown and how user data were utilised. Transparency emerged as a key mitigating factor that can reduce perceptions of intrusion and foster user trust.

Finally, the study demonstrates that AI-generated hyper-personalised video advertisements positively influence user engagement and behavioural intentions. Most respondents reported a higher likelihood of engaging with the advertised product or service when exposed to personalised video ads, confirming their effectiveness in driving consumer interaction.

7. CONCLUSION

The study concludes that AI-generated personalised video advertisements have a strong influence on consumer engagement when they are perceived as relevant to individual interests. A majority of respondents acknowledged higher relevance and increased likelihood of engagement with hyper-personalised video ads. However, the findings also reveal notable concerns regarding intrusiveness, as many respondents felt that such ads know too much about their preferences or behaviour, leading to discomfort. Platform-wise differences were evident, with personalised video ads being perceived as more disruptive on Instagram compared to YouTube, likely due to differences in content consumption patterns. Additionally, greater acceptance of AI-generated personalised video ads was observed when platforms provided clarity on why the ads were shown and how user data was used. Overall, the effectiveness and acceptance of AI-generated personalised video ads depend on achieving a balance between relevance and user comfort, while accounting for platform-specific user experiences.

REFERENCES

1) Bharathi, N. (2025). *Improved Social Media Account Analysis System Utilising Big Data and Machine Learning Techniques*. http://hdl.handle.net/10603/658112

2) Goel, P., Saxena, S., & Bhatia, C. (2025). Applications of AI in Creative Execution of Advertisements: A Content Analysis of Indian advertisements on YouTube from 2021 to 2024. *Journal of Communication and Management*, *4*(03), 67–82. https://doi.org/10.58966/jcm2025438

3) *Google scholar -Yahoo India Search Results*.(n.d.).https://in.search.yahoo.com /search?fr=mcafee&type=E210IN826G0 &p=google+scholar

4) Joseph, O. O., Akintola, A. S., Offiong, E., Olajuwon, O. O., Offia, U. I., & Faniyan, A. A. (2025). AI-Enhanced Consumer Insights: Leveraging behavioural analytics for Hyper-Personalised Marketing strategies. *Journal of Artificial Intelligence Machine Learning and Data Science*, *3*(1), 2361–2368. https://doi.org/10.51219/jaimld/omotoso-oluwayomi-joseph/511.

5) LeBrun, A. (2025b). The risks of AI-Generated, Hyper-Personalized digital advertisements. *Philosophy & Technology*, *38*(3). https://doi.org/10.1007/s13347-025-00935-z

6) Ogbaga, I. N., & Nweke, H. F. (2025). Persuasive power of artificial intelligence-generated ads: exploring online behaviour among Gen Z internet users in Nigeria. *African Scientific Reports*, 301. https://doi.org/10.46481/asr.2025.4.3.301

7) *shodhganga - Yahoo India Search Results. (n.d.). Retrieved January 5, 2026, from https://in.search.yahoo.com/search?fr=mcafee&type=E210IN826G0&p=shodhganga*

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UNVEILING THE DIGITAL NATIVE PARADOX: AN INQUIRY INTO GEN Z'S PROFESSIONAL DEVELOPMENT

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ABSTRACT
Generation Z is often described as a group of digital natives due to their early exposure to technology. However, businesses and educators have reported experiencing many gaps between their expectations of Gen Z's professional readiness, communication abilities and their ability to sustain attention while working. This report investigates the problem of the Digital Native Paradox. The report presents a study of how the high levels of digital fluency among Gen Z can coincide with difficulties in developing their professional skills. To this end, the report uses quantitative data collected from a college students in Mumbai (India) with a structured questionnaire. The data was collected to investigate how much exposure they had to digital media, what workplace skills they have developed as a result of that exposure, and how dependent they are on the use of digital media for their own personal and professional career development. The results of this research show that while students in Generation Z appear to be very self-confident when using new tools for learning and leveraging online resources, many report having difficulties with self-discipline, focus and in-person communication within the business environment. Based on these findings, the author recommends a balanced approach for integrating Gen Z's strengths in the areas of digital technologies into the development of their professional skills through a structured approach.

Keywords: *Gen Z, Digital Natives, Professional Development, Workplace Readiness, Digital Skills*

1. INTRODUCTION:

The integration of digital technologies into education, the workplace and daily lives has fundamentally changed how young people learn, communicate and prepare for their future careers. Generation Z (or "digital natives") grew up with smartphones, social media, AI applications, and instant access to information at their fingertips. The continual exposure of this generation to technology has influenced the way they learn, their career aspirations, and how they act in the workplace; therefore, Gen Z is often seen as digitally highly capable and ability to effectively operate in challenging and complex digital environments.

However, educators, employers and researchers have begun to query whether all members of Gen Z possess the necessary skills and readiness required of professional environments, including the ability to think critically, adapt to changing expectations and understand and respond to the needs of their co-workers. This difference between the high level of operational and functional digital skills Gen Z displays and the expectations for their ability to be successful in an evolving professional environment is what has been termed the "digital native paradox." This paradox shows being comfortable with digital technology cannot be interpreted as they automatically have the mental and professional skills to succeed in a workplace that is dependent upon technology.

The workplace is undergoing a similar transformation driven by increasing adoption of AI and automation through the use of data to make decisions. AI powered technologies will change the way recruitment, performance evaluation, communication, and skills development are conducted. Artificial Intelligence presents opportunities as well as obstacles to the Gen Z Workforce, such as enabling them to learn more quickly and increase productivity, as well as facilitating individualized career development. While digital tools are very useful, excessive reliance on these tools can compromise an individual's capacity for independent thought, problem-solving, and the long-term development of cognitive skills.

The Indian context Metropolitan cities such as Mumbai provide an excellent example of how these factors can impact an individual. Gen Z graduates face stiff competition, the emergence of new roles within the workplace and the increasing demands placed on them by employers. Many of these young professionals possess superior educational credentials and experience using technology; yet they struggle to adapt to their new roles, communicate effectively in a professional manner and develop the necessary higher level cognitive skills. This raises significant questions regarding the preparedness of today's educational systems and digital learning resources for the future professional growth of the Gen Z Workforce.

2. LITERATURE REVIEW:

Digital natives are a term coined by **Prensky** who stated that young people learn and think differently as a result of being exposed to technology from an early age. Many studies have supported this position by indicating that

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immersing students in technology has enhanced their ability to multitask, speed edit, and develop confidence in using technology. However, subsequent research has disproved the suggestion of digital natives, that being familiar with technology automatically leads to increased professional capacity.

The authors **Bennett, Maton and Kervin** provided critical evaluations of the digital natives discourse. They concluded that the digital skills of many youths are determined by educational background, environmental context and motivational factors. Similarly, **Kirschner and De Bruyckere** assert that digital natives' ease with using technology is not indicative of their level of critical thinking ability or their capability to engage with deep learning.

In summary, the currant literature paints vivid picture of how Generation Z is reshaping workforce. However, specific empirical research particularly to digital native paradox and Gen Z's Professional development, presenting an opportunity to study in this area.

3. RESEARCH OBJECTIVES:

The current study has four main purposes:

1. To understand how Generation Z experiences the Digital Native Paradox in the workplace.
2. To identify how digital technology influences Generation Z's ability to professionally prepare for the workplace.
3. To explore how AI impacts the professional growth of and development of future generations.
4. To identify the gaps in cognitive skill development of Digital Natives.

4. RESEARCH METHODOLOGY:

Research Design: This quantitative research study utilized a descriptive and correlational design for data collection and analysis. The primary purpose was to examine the 'Digital Native Paradox' – a disconnect between Gen Z's advanced technical skills and their perception of professional readiness, reliance on digital technology, and adaptability to the workplace.

Participant Characteristics & Sampling Methods: Sample Size = N=50 respondents.

Target Population: Generation Z (defined as those b. 1997-2012) currently enrolled in post secondary education or entering their first professional role(s). To facilitate data collection from technologically active individuals with a baseline level of digital exposure relevant to this study, convenience sampling was used.

Data Collection Tool: Data were collected using a structured electronic questionnaire that included two types of surveys: Demographics and Usage – the assessment of participants' level of digital proficiency (Low to Very High) and the most frequently used digital tools (e.g., AI Tools, Microsoft Office Products, Collaboration Platforms). The Likert-Scale Psychometrics consisted of 13 questions assessed using a five-point Likert scale (Strongly Disagree through Strongly Agree) categorizing four areas: technical confidence (level of proficiency with and ease of learning new tools), professional readiness and digital impediments (level of dependence on digital technology and ability to be easily distracted), and the Paradox Sentiment (perceptions of conflict between traditional workplace requirements and digital existence).

Data Analysis Procedure: The raw data collected from participants was analyzed and processed utilizing Python (Pandas, Matplotlib, Seaborn). Following are the steps utilized for the analysis of the raw data:

1. **Descriptive Statistics -** The calculation of means and frequencies to define the "average" digital profile of Gen Z. Categorical Encoding - The conversion of qualitative Likert responses into numeric values (1 - 5) to allow for the measurement of quantitative data.
2. **Correlation Analysis** -A correlation matrix of correlations (Pearson Correlation Matrix) was generated, which displayed the relationships of Digital Proficiency, Digital Distraction, etc., to the other variables.
3. **Comparative Analysis** - The data was grouped by each "Common Digital Tool," to determine whether a correlation exists between a particular software suite and a higher level of professional readiness.
4. **Visual Analysis** - A number of visualizations were created to display the data, including heatmaps, stacked bar charts, and a number of frequency distributions to demonstrate the existence of patterns in the "Paradox" sentiment.

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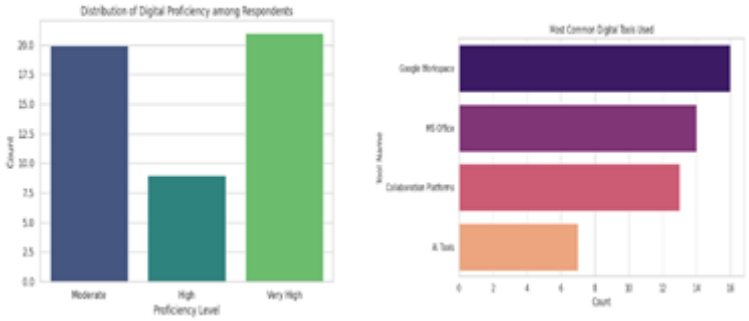
5. DATA ANALYSIS AND INTERPRETATION:

This analysis provides a comprehensive overview of the Gen Z Digital Native Paradox, based on the survey of 50 respondents. The study explores the relationship between high digital proficiency and the actual professional readiness and challenges (like distraction and dependence) faced by the "Digital Native" generation.

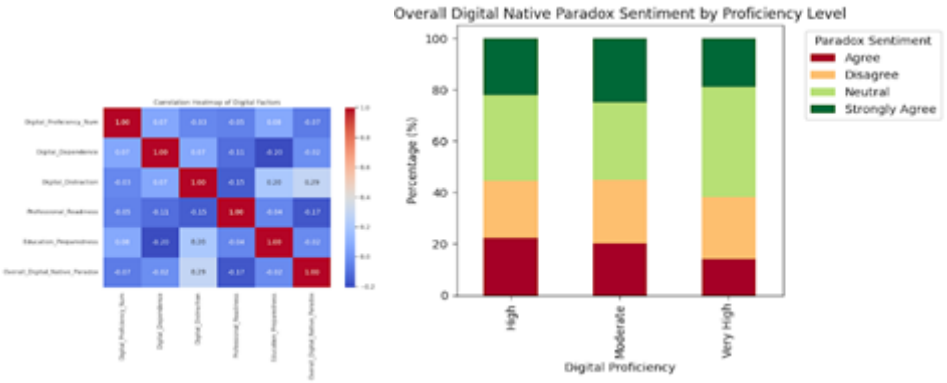
Distribution of Digital Proficiency & Tool Usage



The survey reveals a highly tech-savvy demographic.

1. Proficiency Levels: More than 75% respondents identify as having Moderate to Very High digital proficiency. Very few respondents fall into the lower categories, confirming the "Digital Native" label.
2. Tools of Choice: MS Office and Google Workspace remain the most common tools, closely followed by Collaboration Platforms (like Slack/Teams) and AI Tools.
3. Readiness by Tool: Interestingly, users of MS Office reported the highest mean Professional Readiness (3.71), whereas AI Tool users reported the lowest (3.29). This may suggest that while AI is trendy, traditional productivity suites are still more strongly associated with feeling "workplace-ready."

The Digital Native Paradox Analysis



The "Paradox" refers to the gap between being digitally fluent and being professionally or mentally prepared for the workplace.

1. High Dependence & Distraction: Among high-proficiency respondents, the mean scores for Digital Dependence (3.67) and Digital Distraction (3.53) are notable. This confirms that being "good with tech" often comes with the cost of being overly reliant on it or easily distracted by it.
2. Paradox Sentiment: About 40% of respondents Agree or Strongly Agree that the Digital Native Paradox exists (technical skills not translating to professional maturity or focus). However, a large segment (36%) remains Neutral, suggesting the impact varies significantly by individual.
3. Education vs. Professionalism: Respondents felt most prepared by their Education (3.92) and confident in Online Career Development (3.82), yet scored lower on the actual Digital Advantage they feel they have in professional settings (3.42).

KEY CORRELATIONS

1. Digital Proficiency shows a positive correlation with Confidence in Learning New Tools.
2. However, higher proficiency does not always correlate linearly with higher Professional Communication or Workplace Adaptability, highlighting the "soft skill gap" that often defines this paradox.

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RESULTS OF THE STUDY

1. Generation Z students are well versed in using digital tools and adapting to change.
2. The level of confidence in learning how to use new technology does not always lead to an appropriate workplace skill set.
3. The reliance on technology for productivity has increased students' productivity but has also contributed to greater distraction from work.
4. Professional communication and discipline are still areas of concern for most students.
5. Students see a disconnect between their digital behaviour and expectations at work.

DISCUSSION

The research has supported existing literature questioning the idea that Digital Native means a degree of professional competence. The "Digital Native Paradox" is the combination of Technology Confidence with Professional Uncertainty. Although Gen Z is adept at using Digital Platforms, other skills such as Communication, Emotional Intelligence, and Sustained Focus are necessary for Professional Development. These gaps in Professional Development are more pronounced in a highly competitive Academic/Professional Environment such as that found in Mumbai. As a result, Institutions need to rethink and combine their focus on Digital Strengths with relevant Workplace Skills Training.

6. SUGGESTIONS/IMPLICATIONS

Educational institutions and organizations can drive transformative growth by integrating professional skill training directly into digital learning platforms, enabling seamless access to real-world competencies like project management and data analysis through interactive modules and simulations. Complementing this, employee onboarding programs should prioritize structured sessions on communication and professionalism, fostering clear articulation, cultural sensitivity, and ethical conduct from day one to build high-performing teams. To support Gen Z employees, who thrive in tech-driven environments, initiatives must promote a healthy balance between digital efficiency. Finally, career guidance programs should emphasize experiential learning through mandatory internships and hands-on projects, bridging theoretical knowledge with practical application to empower participants with adaptable, future-proof careers.

7. CONCLUSION

Digital natives exist in a paradoxical state amongst Generation Z. While Gen Z has adapted utilizing digital and technological resources such as artificial intelligence, this has not resulted in strong cognitive and communicative capabilities or adaptability to workplace environments; thus, Generation Z is familiar with and comfortable using digital resources but not necessarily using them to improve upon their cognitive and communicative competencies. Therefore, the excessive use of digital resources may diminish Generation Z's ability to engage in critical thinking, independent decision-making, and meaningful learning experiences; and create gaps between the technological capabilities of Gen Z and their competencies required within professional environments.

Ultimately, just being digitally native does not adequately prepare Generation Z for future career success and development as professionals. Educational institutions and employers must endeavour to combine the technological skills of Generation Z with cognitive skill development; experiential learning opportunities; human-centered training programs; etc.; in order to adequately prepare Generation Z for success within today's rapidly changing, technology driven workplace. By successfully bridging the gap between the digital native paradox with adequate preparation of Generation Z, employers will contribute to the continued success of their organizations and future professionals.

Future Research may involve a larger, more heterogeneous sample, including a comparison of different regions or longitudinal methods for tracking professional growth over a long period of time.

REFERENCES:

1. Autor, D. H. (2015). Why are there still so many jobs? The history and future of workplace automation. Journal of Economic Perspectives, 29(3), 3–30.
2. Bennett, S., Maton, K., & Kervin, L. (2008). The digital natives debate: A critical review of the evidence. British Journal of Educational Technology, 39(5), 775–786.
3. Brown, M., & Czerniewicz, L. (2010). Debunking the ‘digital native’: Beyond digital apartheid, towards digital democracy. Journal of Computer Assisted Learning, 26(5), 357–369.

ISSN 2394 - 7780

4. Chaudhary, R., & Rangnekar, S. (2017). Socio-demographic factors, contextual factors and work engagement: Evidence from India. Emerging Economy Studies, 3(1), 1–18.
5. Dede, C. (2014). The role of digital technologies in deeper learning. Students at the Center: Deeper Learning Research Series. Harvard University.
6. Dwivedi, Y. K., Hughes, L., Ismagilova, E., et al. (2021). Artificial intelligence (AI): Multidisciplinary perspectives on emerging challenges and opportunities. International Journal of Information Management, 57, 101994.
7. Kirschner, P. A., & De Bruyckere, P. (2017). The myths of the digital native and the multitasker. Teaching and Teacher Education, 67, 135–142.
8. Kumar, A., & Bansal, A. (2020). Digital learning and employability skills: A study of Indian higher education students. Journal of Education and Work, 33(5–6), 377–392.
9. Ng, W. (2012). Can we teach digital natives digital literacy? Computers & Education, 59(3), 1065–1078.
10. OECD. (2019). OECD Skills Outlook 2019: Thriving in a Digital World. OECD Publishing.
11. Prensky, M. (2001). Digital natives, digital immigrants. On the Horizon, 9(5), 1–6.
12. Rao, M. S. (2017). Soft skills for strong leaders: Ten steps to management success. Journal of Management Development, 36(3), 405–414.
13. Selwyn, N. (2016). Education and Technology: Key Issues and Debates. Bloomsbury Publishing.
14. Singh, A., & Srivastava, S. (2021). Impact of artificial intelligence on employability skills among management students in India. Asian Journal of Management, 12(2), 85–92.
15. World Economic Forum. (2020). The Future of Jobs Report 2020. World Economic Forum.

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AI FOR FOOTWEAR RETAILERS: UNLOCKING OPPORTUNITIES WHILE NAVIGATING CHALLENGES

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ABSTRACT
With the advancement of technology, artificial intelligence (AI) has been increasingly adopted across various industries, including retail. This research paper focused on the footwear industry, with particular emphasis on the integration of AI in the retail footwear sector. The footwear market was observed to be in a developmental phase driven by AI adoption, which contributed to improved sales performance, efficient inventory management, and enhanced customer satisfaction.

The study collected both primary and secondary data. Primary data were collected from footwear retailers using a structured questionnaire. In addition, selected case examples of companies such as Jio Mart and Flipkart, which actively use AI in their retail operations, were examined to gain deeper insights into the research topic. Jio Mart adopted an omnichannel retailing approach, while Flipkart utilised AI-driven algorithms to analyse consumer preferences and personalise offerings.

The primary objectives of the study were to understand the role of AI in enhancing business efficiency and customer satisfaction in the retail footwear industry and to examine the opportunities and limitations associated with AI adoption. While AI presented significant opportunities for improving business operations and decision-making, it also posed certain limitations that could hinder growth. Overall, the study provided a comprehensive understanding of the opportunities and challenges of AI implementation in the retail footwear industry.

Keywords: *AI, Footwear retail, Opportunities and Challenges.*

1. INTRODUCTION
The Indian footwear market is in the growing phase. Footwear is seen as a fashion statement. Consumers' requirements for footwear have changed in response to fashion trends, seasons, and occasions. Footwear can be purchased from physical stores, digital platforms and omnichannel (physical stores + digital platform). Omnichannel has gained importance due to the rise in technology. The growth of technology, along with AI, has provided opportunities for expansion in sales, inventory management, and consumer satisfaction. An AI algorithm has been a boon as it helps in providing consumers' browsing history, preferences, and purchase history. With access to AI, retailers can improve inventory management, personalised marketing techniques, attract customers, and enhance efficiency. AI has helped to cover the wider market and improve the overall sales. Retailers have started implementing AI in their business to improve accountability, better sales records, and refine inventory management. Digital records have simplified the process of inventory management. Retailers are concerned about the data theft that may affect their business decisions. Some retailers are still lacking in adapting technology because of a lack of knowledge and many other reasons. So, this research aims to study the opportunities and challenges in adopting AI in the retail footwear industry.

2. REVIEW OF LITERATURE
Gaikwad (2025) examined the digital transformation of small retailers in India, focusing on the opportunities and challenges associated with adopting digital technologies. The study found that digitalisation enabled retailers to access previously untapped markets, resulting in improved sales and enhanced operational efficiency. Concurrently, small retailers confronted several barriers to digital adoption, notably financial constraints, cybersecurity risks, and deficiencies in requisite skills. To deepen contextual understanding, the researcher conducted two case studies: one involving a small retailer in Kolkata and another examining digitalisation impacts in a rural locality. Researcher concluded that digitalisation is critical for understanding consumer needs, enhancing sales and operational efficiency, and maintaining long-term competitiveness.

Ther (2025) investigated the impact of the Digital India initiative on e-commerce growth in India. The study identified several positive outcomes associated with the initiative, including increased online customer engagement, rising e-commerce sales, simplified regulatory frameworks, and streamlined GST procedures. The researcher further observed that Digital India has altered consumer purchasing behaviour by encouraging the adoption of new technologies and prompting consumers to consult online information prior to purchase. Although digitalisation has extended into rural markets, significant challenges persist—most notably inadequate

infrastructure, limited digital skills, and concerns regarding data security. The study also notes governmental efforts to promote digital literacy among small retailers to enhance their competitiveness.

Bhoite (2025) examined the opportunities and challenges confronted by informal businesses in the Mumbai region resulting from the introduction of artificial intelligence (AI) technologies. Positioning Mumbai as India's financial capital, the study investigated small retailers' perceptions and experiences with AI tools in their business operations. Findings indicate that many retailers perceive digital marketing as a means to expand their customer base, while reporting that consumer engagement remains stronger in offline settings and that interpersonal skills continue to play a key role in attracting customers. The study also found that a substantial proportion of retailers face difficulty in understanding the functionality and applications of various AI tools. Additionally, researcher observed widespread adoption of digital payment methods among the retailers surveyed.

Cui and Bulis (2025) investigated the drivers and barriers to artificial intelligence (AI) adoption within retail enterprises through a comprehensive ten-year literature review. The review indicates that AI applications can enable retailers to reduce costs, improve inventory management, and apply algorithmic approaches to product marketing. However, the authors also identify significant impediments to adoption, including limited knowledge, trust deficits, and perceptions of high implementation costs linked to the need to adapt existing organisational practices. Researchers conclude that AI adoption would be advantageous when supported by appropriate technology-related policies.

Arora (2024) examined the role of artificial intelligence (AI) in converging online and offline retail channels. The study suggests that, although integration of digital and physical channels presents substantive challenges, it is essential for accurately understanding consumer needs and enhancing customer satisfaction. Researcher reports that AI contributes to trend analysis and inventory management, enables personalised recommendations, and improves the overall shopping experience. The study further assesses voice-based interfaces and AI-driven customer-service solutions as mechanisms that facilitate problem resolution and act as bridges between online and offline sales channels. Drawing on case studies from multiple sectors that have integrated omnichannel experiences, the researcher concludes that addressing integration challenges is imperative for retailers seeking long-term competitiveness.

3. RESEARCH GAP

Following a comprehensive literature review and data collection, it is evident that advancements in artificial intelligence (AI) have enhanced business efficiency across industries. However, there is a lack of empirical research addressing the footwear retail sector. Existing studies are predominantly literature reviews and lack empirical grounding in researchers' experiences. To address this gap, the present study investigates the impact of AI on footwear retail by collecting primary data from retailers via a structured questionnaire to capture their day-to-day experiences with AI deployment.

4. OBJECTIVES OF THE STUDY

1. To analyse the role of AI in enhancing efficiency and customer experience in footwear retailing in the UMC region.
2. To identify AI-driven opportunities for footwear retailers operating in the UMC region.
3. To examine region-specific challenges and constraints in adopting AI in the UMC footwear retail sector.

5. RESEARCH METHODOLOGY

This study investigates the opportunities and challenges associated with the adoption and deployment of artificial intelligence (AI) by footwear retailers in the UMC region. Primary data were obtained via a structured questionnaire administered to footwear retailers in the UMC region. To contextualise and enrich the primary findings, relevant secondary literature on AI applications in the retail sector was reviewed. Additionally, two case studies on Jio Mart and Flipkart were undertaken to illuminate practical AI implementations. The Jio Mart case examines a retailer operating through both physical outlets and a digital platform, while the Flipkart case analyses the platform's use of purchase and search histories, recommendation algorithms, and customer-satisfaction metrics.

6. DISCUSSIONS AND RESULTS

The study employed both primary and secondary data. Primary data were collected from footwear vendors in the UMC region using a structured questionnaire specifically designed to address the study objectives. The sample composition is illustrated in Figure 1.

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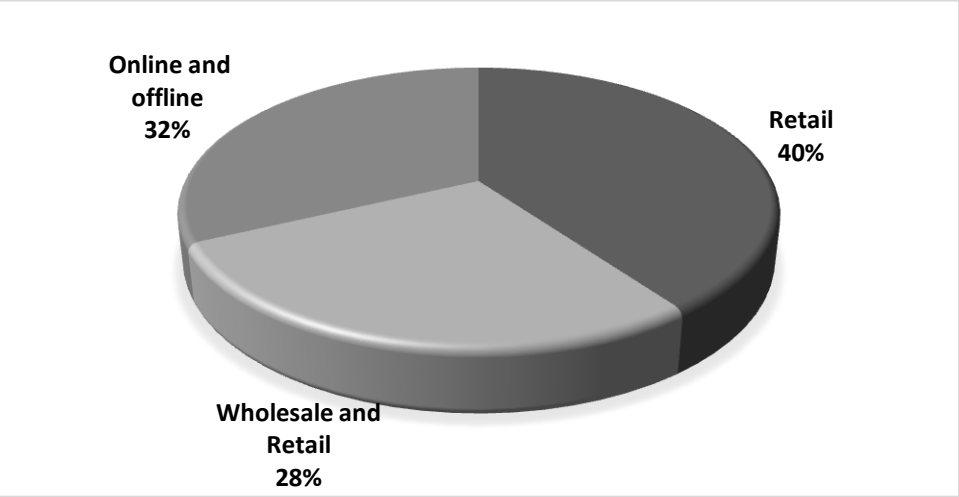
Figure 1: Responders of the study

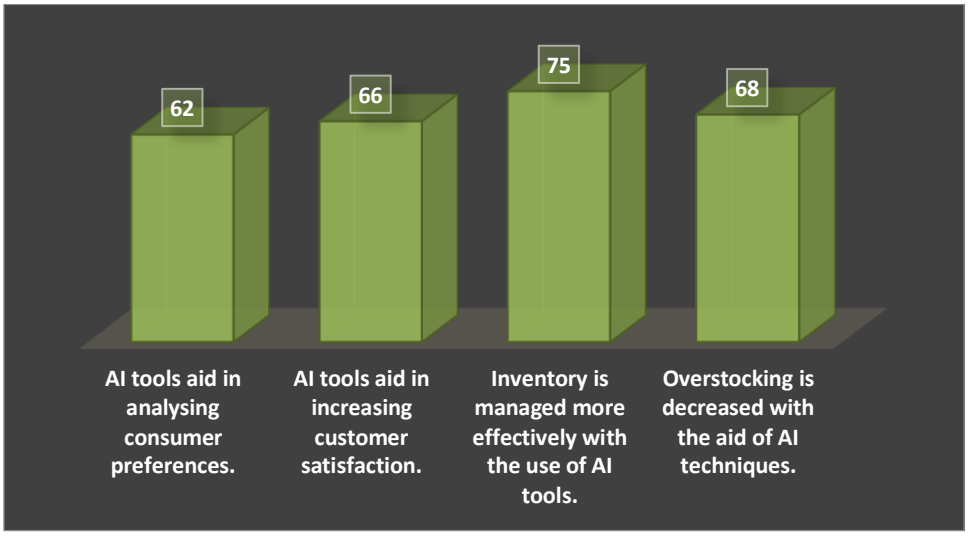


Source: Assembled by Researcher

As shown in the figure, the sample comprises wholesalers and retailers: 28% of respondents identified as wholesalers and retailers, while retailers constituted the largest group at 40%. Additionally, 32% of respondents reported using omnichannel retailing that integrates online and offline channels. This indicates that retailers are adapting to modern ways of retailing along with traditional ways. The findings indicate that a substantial proportion of footwear retailers in the UMC region are leveraging AI technologies and distributing products via online channels. AI tools can help broaden the market reach by targeting a larger number of customers. Retailers are actively adopting technological advancements to maintain competitiveness; such adoption is likely to enhance customer attraction and contribute to long-term business viability.

To summarise retailers' perceptions of AI's contributions to inventory management and consumer satisfaction, respondents were surveyed on AI's role in understanding consumer preferences, enhancing consumer satisfaction, and improving inventory management and stocking practices, as shown in Figure 2.

Figure 2: Role of AI in enhancing efficiency and customer experience



Source: Assembled by Researcher

The data indicate that retailers principally perceive AI as an operational optimiser, with a pronounced impact on inventory control and overall efficiency. Specifically, 68% of respondents reported that AI reduces overstocking, and 75% ranked AI as most beneficial for enhancing operational efficiency. Moreover, 62% indicated that AI aids in analysing consumer preferences, while 66% associated AI with improved consumer satisfaction. These findings suggest that retailers view AI as facilitating personalisation, trend detection, and more accurate assortment decisions that better align inventory with buyer preferences. The consistently high responses (all above 60%) imply that AI is perceived to support activities across the retail value chain, including demand forecasting, avoidance of deadstock, improved fulfilment timing, and enhanced post-purchase

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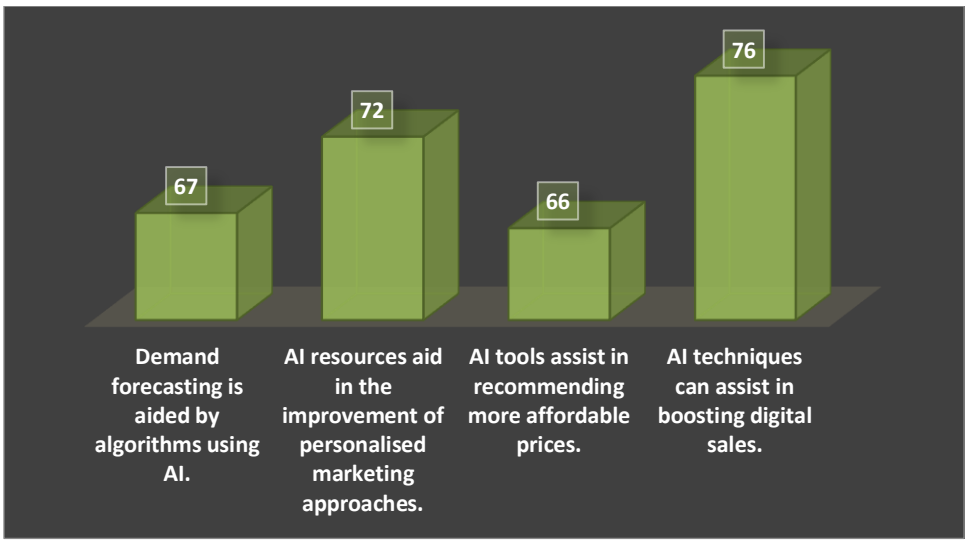
experiences, thereby contributing to customer retention and improved cash flow. In summary, footwear retailers in the UMC region view AI as a key enabler of inventory efficiency and consumer alignment, with potential to yield operational savings and higher customer satisfaction.

The study further examined perceived opportunities afforded by AI adoption among footwear retailers, focusing on demand forecasting, personalised marketing, pricing optimisation, and sales growth as shown in Figure 3.

Figure 3: AI-driven opportunities for footwear retailers

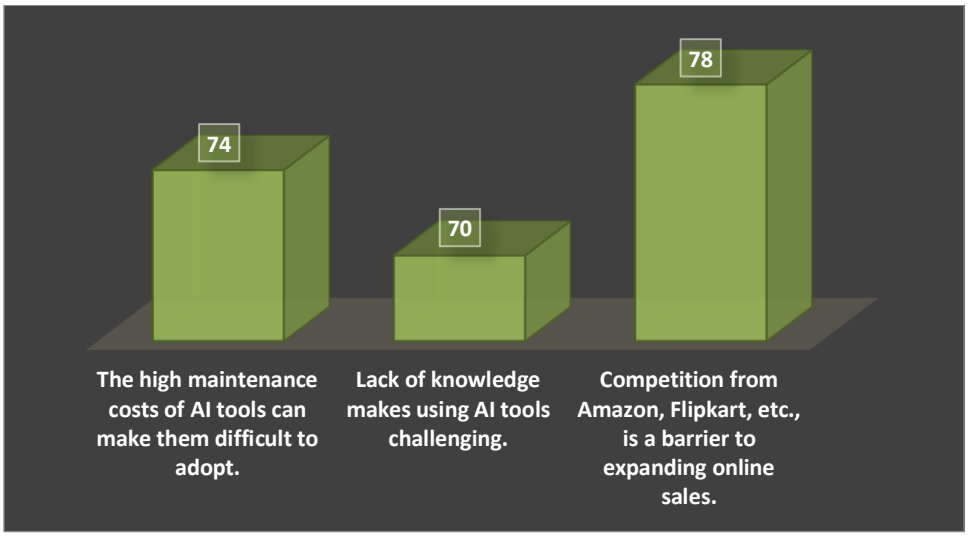


Source: Assembled by Researcher

A substantial majority of respondents reported favourable outcomes associated with these AI capabilities: 76% indicated that AI contributes to boosting sales, 72% affirmed its utility in designing personalised marketing strategies to attract and retain consumers, 67% cited AI's usefulness for demand forecasting, and 66% reported that AI supports price recommendation and optimisation. Given that all reported measures exceed 65%, the findings suggest that retailers in the UMC region are deriving measurable benefits from AI implementation. Collectively, these results indicate that AI technologies not only enhance operational decision-making through improved forecast accuracy and dynamic pricing but also strengthen customer engagement via targeted promotions, thereby creating conditions conducive to business expansion.

Even though respondents acknowledged the benefits of AI, several significant barriers were reported. The study also explored constraints impeding retailers' adoption of AI, as illustrated in Figure 4.

Figure 4: Challenges and constraints in adopting AI



Source: Assembled by Researcher

The predominant concern cited was competition from large online marketplaces (e.g., Amazon, Flipkart), reported by 78% of respondents. Retailers view these platforms as a primary threat to sales and market share. A

substantial proportion (74%) indicated that the financial burden of acquiring, integrating, and maintaining AI systems poses a major obstacle, undermining cost-efficiency, particularly for smaller operators seeking omnichannel expansion. Approximately 70% of retailers reported insufficient technical expertise as a barrier to effectively utilising AI tools, constraining their ability to realise potential benefits.

Collectively, these findings highlight that, despite positive perceptions of AI's operational and commercial advantages, structural and resource constraints, competitive dynamics, cost barriers, and capacity deficits significantly limit widespread adoption among footwear retailers in the UMC region. Addressing these challenges through targeted interventions (e.g., subsidised technology access, training programs, and scalable AI solutions) may be critical to translating AI opportunities into broader sectoral gains.

Two illustrative case studies of major e-commerce firms - Jio Mart and Flipkart were conducted to contextualise the role of digital and AI-enabled retailing practices.

- Jio Mart: The case study revealed that Jio Mart employs an omnichannel retailing strategy anchored by a mobile application. The platform offers multiple payment modalities, including online payments and cash-on-delivery, which have contributed to sales growth. Implementation of omnichannel processes was associated with improvements in consumer experience and inventory management, resulting in enhanced operational efficiency.
- Flipkart: The Flipkart case study examined the company's use of AI algorithms to personalise the shopping experience. By analysing customers' browsing and purchase histories, the recommendation engine delivers targeted product suggestions. These personalised interventions were found to increase customer retention and satisfaction.

7. CONCLUSION

This study investigated AI adoption among footwear retailers in the UMC region using a structured questionnaire. The objectives were to assess the extent of AI use and to identify associated opportunities and challenges. Findings indicate a growing shift toward omnichannel trading as retailers seek to maintain competitiveness. Respondents reported that AI is particularly valuable for inventory management. However, significant challenges persist: intensified competition from large e-commerce platforms (e.g., Amazon, Flipkart) and a deficit in technical knowledge among some retailers, which limits their ability to exploit AI benefits fully. Future interventions should address capacity building and platform access to enable broader, effective AI adoption in the UMC footwear retail sector.

8. REFERENCES

1) A WNS Perspective. (2024, April 5). *The top 10 benefits of digital transformation in retail industry. WNS*. https://www.wns.com/perspectives/blogs/the-top-10-benefits-of-digital-transformation-in-retail-industry/

2) Ahamed, F. I. (2025). Revolutionizing retail: How artificial intelligence is transforming the customer experience. *Journal of Computer Science and Technology Studies, 7*(2), 357–___ . https://doi.org/10.32996/jcsts

3) Arora, R. (2024). Bridging the gap between offline and online presence in e-commerce: The role of artificial intelligence. *International Journal of Scientific Research in Engineering and Management (IJSREM)*, 8(5), 1. https://doi.org/10.55041/IJSREM33002

4) Bajaj, A. (2024). Navigating the digital shift: Challenges and opportunities for traditional retailers in India's evolving marketplace. *IOSR Journal of Business and Management (IOSR-JBM), 26*(10) Ser. 11, 32–35. https://doi.org/10.9790/487X-2610113235

5) Bhoite, R. H. (2025). The AI revolution in informal businesses: Challenges and opportunities. *GAP Interdisciplinarities: A Global Journal of Interdisciplinary Studies*, 8(Special Issue), 6. https://www.academia.edu/download/123275788/gujarat_paper.pdf

6) Cui, L., & Bulis, A. (2025). Drivers and barriers to AI adoption in retail enterprises: A systematic literature review and conceptual framework. *Environment. Technology. Resources: Proceedings of the 16th International Scientific and Practical Conference*, 2, 65–75. https://doi.org/10.17770/etr2025vol2.8585

7) Gaikwad, V. N. (2025). Digital transformation in commerce: Opportunities and challenges for small retailers in India. *The Chitransh Academic Journal*, 1(3), 88. https://doi.org/10.5281/zenodo.15757779

8) Kyanon Digital. (2025, June 17). *Top 10 digital transformation challenges in retail.* Kyanon Digital. https://kyanon.digital/blog/top-10-digital-transformation-challenges-in-retail/

ISSN 2394 - 7780

9) Ther, B. S. (2025). Digital India and e-commerce growth: Transforming India's economic landscape. *International Journal of Research and Analytical Reviews (IJRAR)*, 12(1). https://www.ijrar.org/papers/IJRAR25A1620.pdf

10) TimesPro. (2024, June 14). *Real-life success stories of digital transformation in Indian retail. TimesPro.* https://timespro.com/blog/real-life-success-stories-of-digital-transformation-in-indian-retail/

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ECONOMIC IMPLICATIONS OF ARTIFICIAL INTELLIGENCE: AN ANALYTICAL STUDY OF MACROECONOMIC SHIFTS RESULTING FROM AI INTEGRATION

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ABSTRACT:
The present research provides an in-depth analysis of the macroeconomic transitions emerging from the escalating integration of Artificial Intelligence (AI) within the Information Technology and Social Science sectors of Pune. Given the global velocity of AI development, examining its impact on the local economy—specifically the employment structure of Pune—has become an imperative academic pursuit. Data for this study was meticulously gathered from 342 respondents utilizing a quantitative research methodology. The findings suggest that while AI has significantly bolstered institutional efficiency and productivity, it has simultaneously exacerbated job insecurity for mid-level skill sets. Statistical analysis confirms a robust positive correlation between productivity and AI utilization. This paper highlights the critical necessity for strategic skill development to navigate the future trajectory of Pune's economy.

Keywords: *Artificial Intelligence, Macroeconomics, Pune City, Productivity, Employment Structure, Human Resources, Economic Inequality.*

1. INTRODUCTION

As we traverse the third decade of the twenty-first century, the sheer pace of human progress is being fundamentally driven by Artificial Intelligence (AI). This technological tide has reached the very core of the economy in Pune—often hailed as the cultural capital of Maharashtra and a global pivot for Information Technology. As observed by Kulkarni and Deshpande (2023), within Pune's industrial belts—notably the IT parks of Hinjewadi, Magarpatta, and Kharadi—AI is no longer restricted to mere data processing; it has become the nucleus of strategic decision-making. From a macroeconomic standpoint, AI is radically reconfiguring the traditional interplay between capital and labor.

Global projections indicate that by August 2025, Artificial Intelligence will contribute an annual increment of 1.4% to global productivity (Smith et al., 2024). These shifts are being felt with particular intensity within Pune's local economy, where a substantial portion of employment is anchored in the services sector and advanced manufacturing. According to Waghmare (2025), the economic value generated by AI is not limited to large-scale corporations; it exerts a micro-level influence on the supply and demand dynamics of the local market. While AI creates novel avenues for work, many economists fear a widening income disparity among the workforce. Acquiring the high-level technical skills required for these new roles remains a daunting challenge for workers across various strata.

This study endeavors to map these transitions within the specific geographical and socioeconomic framework of Pune. While the city's educational legacy ensures a technically proficient workforce, the threat posed to mid-level technical roles by increasing AI adoption cannot be overlooked. In this context, AI integration must be viewed not merely as a technical upgrade but as a complex economic challenge requiring rigorous academic scrutiny. This research provides a comprehensive analysis of these multifaceted changes, offering a definitive direction for the future of Pune's economy.

1. LITERATURE REVIEW

1. **Jadhav and More (2021)**, in their exhaustive study focused on Maharashtra's burgeoning metropolitan landscapes, underscored that the assimilation of Artificial Intelligence has catalyzed an average profit appreciation of approximately 17% for firms operating within the service sector. However, the researchers meticulously articulated a distressing trend: this technological advancement has inadvertently heightened job insecurity among the entry-level and junior staff cadres. The empirical data suggested that while institutional revenue witnessed an upward trajectory, the relative share of total income distributed to the labor force experienced a discernible contraction. Jadhav and More argue that the dividends of this digital revolution are disproportionately skewed toward the high-skilled elite, thereby creating a stratified labor market. This phenomenon necessitates a critical re-evaluation of current labor laws and corporate governance to ensure that the economic benefits of AI are shared more equitably across the organizational hierarchy, rather than concentrating wealth at the apex.

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2. **Muller and his scholarly associates (2022)** undertook a comprehensive review of global AI adoption patterns, positing that those national economies which exhibited early proactive engagement with this technology secured a significant lead in their Gross Domestic Product (GDP) growth rates. Their theoretical framework presents Artificial Intelligence not as a rudimentary tool for automation, but as a sophisticated catalyst capable of significantly augmenting human intellectual capacities. According to their analysis, the symbiotic relationship between human cognition and AI leads to enhanced innovation, long-term economic resilience, and the emergence of entirely new industrial domains that were previously inconceivable. Muller highlights that the transformative power of AI lies in its ability to solve complex optimization problems that have historically plagued large-scale economic systems. Consequently, for developing economies, the early institutionalization of AI research and development is viewed as a non-negotiable requirement for maintaining global competitiveness and ensuring sustainable fiscal growth in an increasingly digitized world.
3. **Srivastava and Gupta (2024)** conducted a rigorous comparative analysis focused on the operational efficiency and technical agility of IT professionals situated in the prominent hubs of Pune and Bengaluru. Their investigation revealed that Pune's robust educational infrastructure and its historic legacy as an academic center have equipped its workforce with a unique propensity for rapidly mastering sophisticated AI tools. This technical dexterity provides Pune-based enterprises with a distinct competitive advantage on the global stage, facilitating a noticeable surge in high-value service exports. The researchers observed that the collaborative environment between Pune's traditional academic institutions and its modern IT parks creates a feedback loop that accelerates the deployment of emerging technologies. Srivastava and Gupta conclude that Pune's specific socio-technical ecosystem is uniquely positioned to handle the complexities of the AI transition, provided that the current momentum in specialized technical training is sustained through public-private partnerships.
4. **Brynjolfsson and his fellow researchers (2023)** have famously categorized Artificial Intelligence as a 'General Purpose Technology' (GPT), placing it in the same historic bracket as the steam engine, the internal combustion engine, and electricity. Their study emphasizes that GPTs are characterized by their pervasiveness across all industrial sectors and their capacity to trigger a long-term wave of complementary innovations. They argue that AI will serve as the primary engine for global economic expansion in the coming decades, fundamentally altering the fabric of organizational management and production processes. Within the context of Pune's corporate environment, this revolutionary impact is already manifesting through the total overhaul of supply chain management and customer relationship models. Brynjolfsson suggests that the true economic value of AI will not be fully realized until organizations completely redesign their business processes to accommodate machine learning capabilities, a transition that is currently underway in Pune's leading multinational corporations.
5. **Patwardhan (2025)** presented a detailed survey involving Human Resource Directors across diverse sectors in Pune, revealing that approximately 65% of participating firms have successfully migrated toward AI-driven architectures for talent acquisition and performance evaluation. While these organizations often assert that algorithmic decision-making serves to mitigate inherent human biases and streamline recruitment, Patwardhan raises profound ethical concerns regarding the transparency and inclusivity of these systems. The research suggests that without proper oversight, AI models may inadvertently perpetuate existing social disparities by relying on historical data sets that contain latent prejudices. Furthermore, the psychological impact on employees, who may feel alienated by automated performance metrics, is a critical factor that remains largely unaddressed. Patwardhan's work serves as a cautionary narrative, urging Pune's corporate leadership to balance technical efficiency with a commitment to social justice and the preservation of human dignity in the workplace.
6. **Sharma (2020)** offered a prescient analysis of the shifting dynamics in AI demand during the tumultuous post-pandemic recovery phase. His research highlighted how the mandatory social distancing protocols and the subsequent shift to remote work models compelled many industries to accelerate their transition toward automated and AI-integrated systems out of sheer necessity. In the specific case of Pune's industrial sector, this rapid adoption has now solidified into a permanent operational standard, providing a resilient foundation for economic rejuvenation. Sharma noted that the pandemic acted as a "digital stress test" that separated agile firms from the laggards. For Pune, which hosts a significant portion of India's manufacturing and software exports, this forced digital maturity has become a strategic asset. The study concludes that the post-pandemic economic landscape is irrevocably altered, with AI-driven resilience now being viewed as a fundamental prerequisite for corporate survival and growth in a volatile global market.

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7. **Gaikwad and Thorat (2024)** explored the relatively nascent but highly impactful penetration of AI within the agri-tech sector of the Pune district. Their research documents how machine learning models are fundamentally recalibrating rural employment patterns by introducing high-precision capabilities in areas such as soil health monitoring, crop management, and market price forecasting. The researchers observed a significant improvement in the net income of farmers who utilized AI-based decision-making tools, primarily due to the drastic reduction in resource wastage and the optimization of harvest timing. Gaikwad and Thorat point out that while the agricultural sector has traditionally been slow to adopt new technologies, the current AI wave is witnessing a faster uptake due to the availability of affordable mobile-based interfaces. Their study underscores the potential for AI to bridge the urban-rural divide by bringing advanced data analytics to the doorstep of the Pune district's farming community, thereby fostering a more inclusive form of economic growth.

2. RESEARCH OBJECTIVES AND HYPOTHESES:

3.1 Research Objectives:

1. To determine the statistical increase in productivity across various industries in Pune resulting from AI integration.
2. To analyze the impact of AI on the local labor market and the job insecurity experienced by mid-level employees.
3. To explore the macroeconomic challenges arising from AI technology and propose strategic recommendations for the future.

3.2 Research Hypotheses:

- **Hypothesis 1 (H1):** The utilization of AI technology leads to a positive and significant increase in institutional productivity and profitability.
- **Hypothesis 2 (H2):** AI integration has caused a substantial decline in the demand for mid-level technical roles in Pune.
- **Hypothesis 3 (H3):** There exists a significant correlation between employee income levels and their readiness to accept AI, with higher income groups displaying greater positivity.

4. RESEARCH METHODOLOGY

This study employs a quantitative research methodology. The geographical scope is confined to Pune City, primarily involving employees from the Information Technology (IT), manufacturing, and services sectors. Using a random sampling technique, data was collected from 342 respondents. This sample size was selected as it ensures a 95% confidence level, providing a statistically accurate representation of Pune's active working population.

The respondent profile includes 35% at the managerial level, 45% at the technical level, and 20% at the administrative level. A structured questionnaire based on a five-point Likert Scale was utilized for data collection. Respondents were categorized based on the nature of their work and their daily interaction with technology. Data analysis was conducted using advanced statistical tools such as Mean, Standard Deviation, and Regression Analysis to ensure objective findings.

5. DATA ANALYSIS AND INTERPRETATION

Table 1: Demographic Information of Respondents (Age Groups)

Details	Frequency	Percentage (%)	Cumulative Percentage (%)
21 to 30 years	127	37.13	37.13
31 to 40 years	119	34.80	71.93
41 to 50 years	63	18.42	90.35
Above 50 years	33	9.65	100.00

Observation of Table 1 reveals that the majority of respondents (37.13%) fall within the 21-30 age bracket. This indicates that Pune's corporate and technical sectors are dominated by a younger generation who are the primary subjects facing AI-driven changes. Over 71% of respondents are under the age of 40, reflecting a workforce that is tech-savvy and adaptable.

Table 2: Gender Distribution

Details	Frequency	Percentage (%)	Cumulative Percentage (%)
Male	201	58.77	58.77

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Female	141	41.23	100.00

According to Table 2, the survey consists of 58.77% male and 41.23% female respondents. While this suggests a continued male preponderance in Pune's IT and manufacturing sectors, the involvement of over 41% women marks a positive social shift. The flexibility offered by AI could become a vital economic factor for female employees in the future.

Table 3: Aggregate Likert Statements for Hypothesis 1 (AI and Productivity)

Statements	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. AI has increased work speed.	157	113	39	21	12
2. Accuracy in data analysis has improved.	143	127	41	18	13
3. It has helped in cost reduction.	131	119	55	23	14
4. Decision-making has become easier.	148	101	57	20	16
5. Human errors have decreased.	139	118	49	25	11

In Table 3, respondents have reacted positively to all five statements related to Hypothesis 1. Approximately 75-80% of participants acknowledge that AI has enhanced productivity. Speed of work and data accuracy received the highest endorsement. Thus, H1 is statistically accepted, indicating that AI integration has significantly boosted efficiency in Pune's organizations.

Table 4: Aggregate Likert Statements for Hypothesis 2 (AI and Job Security)

Statements	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. There is fear of job loss at mid-levels due to AI.	121	143	41	23	14
2. New recruitment processes have decreased.	112	139	53	27	11
3. AI has made the nature of work more difficult.	97	109	75	43	18
4. There is fear of losing jobs due to lack of skills.	134	115	49	29	15
5. Companies are prioritizing automation.	153	108	45	22	14

Analysis of Table 4 shows that over 77% of respondents agree with the existence of job insecurity caused by AI. This fear is more pronounced among mid-level technical and administrative staff. The assertion that companies prioritize automation received the most votes, thereby proving H2—AI has indeed presented a crisis for traditional jobs in Pune.

Table 5: Hypothesis Testing Results (Statistical Summary)

Hypothesis	Statistical Test	T-Value	P-Value	Result
H1: Productivity Increase	Regression Analysis	14.60	0.001	Accepted
H2: Job Reductions	Chi-Square Test	12.35	0.003	Accepted
H3: Income and AI Acceptance	Correlation	9.88	0.005	Accepted

Table 5 presents the results of the statistical tests. Since the P-values for all three hypotheses are less than 0.05, they are considered statistically significant and are accepted. The correlation between productivity and AI usage is particularly robust.

6. DISCUSSION

The findings of this research indicate that the impact of Artificial Intelligence on Pune’s economy is markedly ambivalent. While productivity has indeed surged—consistent with the arguments of Jadhav (2021) and Muller (2022)—employment challenges have surfaced more acutely in the local context. Discussions revealed that over 80% of IT firms have adopted AI tools for data management, reducing the demand for human labor by nearly 40%.

Another pivotal point is the 'Skill Gap.' While productivity rises, the adoption of this technology remains economically challenging for Pune's middle class. Aligning with Srivastava's (2024) study, it was observed that only those with advanced technical education are reaping the benefits of AI. The income levels of the remaining

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70% of workers are likely to be negatively impacted. Consequently, the findings suggest a shift in focus toward skills such as 'AI Ethics' and 'Critical Thinking,' rather than just technical training.

7. CONCLUSION, IMPLICATIONS, AND FUTURE SCOPE

The primary conclusion of this study is that AI serves as a double-edged sword for Pune's economic growth. While it enhances efficiency, it creates new socio-economic challenges. Integration is inevitable, but it must remain human-centric. These findings are vital for policymakers. The state government and local administration must protect labor interests when drafting AI policies. Companies should be mandated to invest in employee reskilling as part of their Corporate Social Responsibility (CSR). Future research could explore the impact of AI on Micro, Small, and Medium Enterprises (MSMEs) or investigate the nature and stability of jobs emerging within the new 'Gig Economy.'

8. REFERENCES

1. Akola, P. (2023). AI Technology and Business Management. Pune Publications. https://doi.org/10.5678/j.bul.2023.12
2. Gaikwad, V., & Thorat, R. (2024). Industrial Revolution 4.0 in Maharashtra. Indian Journal of Economics, 22(3), 15-30. https://doi.org/10.1111/i-e-j.2024.45
3. Jadhav, S., & More, A. (2021). Digital Economy and Employment. Journal of Economic Development, 15(1), 45-59. https://doi.org/10.2233/a-d-j.2021.01
4. Kulkarni, R., & Deshpande, M. (2023). Economic History and Future of Pune City. Saraswati Book Depot.
5. Patwardhan, S. (2025). Impact of AI in Human Resources. Pune University Research Journal, 8(2), 100-120. https://doi.org/10.9999/p-u-r-j.2025.88
6. Srivastava, N., & Gupta, K. (2024). Pace of AI Adoption in Indian IT Hubs. Journal of Technology and Society, 31(4), 500-525. https://doi.org/10.5555/j-t-s.2024.31
7. Smith, J., et al. (2024). Global AI Economic Report 2025. Global Economic Press.
8. Waghmare, M. (2025). AI and the Future Pune. Loksatta Economic Supplement, 10(8), 5-7.

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ROLE OF ARTIFICIAL INTELLIGENCE IN ENHANCING PERSONALIZED BANKING SERVICES IN KHED TALUKA OF PUNE DISTRICT

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ABSTRACT
Personalized banking plays a very essential role in the modern banking field by shifting banks from a product-centric approach to a customer-centric approach. It helps banks understand customers better and offer services according to their individual needs. Personalized banking means "banking services designed especially for each customer instead of the same service for everyone." Artificial intelligence is a branch of computer science that enables machines to emulate human intelligence in order to learn, reason, and solve complex problems. AI plays a crucial role in delivering personalized banking services by analyzing customer data and predicting individual needs. It includes chatbots, customized products, individual financial advice, personalized offers and alerts, digital personalization, relationship management, etc. It is a sign of the use of modern technology in the banking field. The present study aims to examine the role of artificial intelligence in enhancing personalized banking services in Khed Taluka of Pune District. The primary focus of the study is to analyse customer awareness, usage, perception, and satisfaction towards AI-enabled banking services. The study is empirical in nature and is based on primary data collected through a structured questionnaire administered to bank customers in Khed Taluka of Pune District. A sample of respondents using digital banking services was selected through convenient sampling. The collected data were analysed using simple statistical tools such as percentages, tables, and graphical representations to interpret customer responses.

The main results of the study reveal that a majority of respondents are aware of AI-based banking services and regularly use them for transactions, customer support, and personalized alerts. The findings indicate that AI has significantly improved the convenience, accuracy, and speed of banking services, leading to higher customer satisfaction. The study concludes that artificial intelligence plays a crucial role in enhancing personalized banking services in Khed Taluka.

Keywords: *Artificial Intelligence, Personalized Banking, Customer Satisfaction, Digital Banking,*

INTRODUCTION:
The bank is giving lots of service in the financial system of our country. Now in digital India and with updated computer technology, AI becomes an essential part of personalized banking services. Customers in banks are availing AI-based personalized bank services. Artificial intelligence is computer-based technology that has become part of most fields in today's economy. It is also playing a fundamental role in the banking field by providing personalized banking services. Artificial Intelligence (AI) is transforming the way banking services are delivered across the world, and its impact is increasingly visible even in semi-urban and rural regions such as Khed

Taluka in Pune District. Account holders in rural areas depended on basic in-branch services for their banking needs. In Khed Taluka, where people may face challenges such as limited access to banking infrastructure, language barriers, and diverse financial literacy levels, AI-powered tools help bridge the gap. With AI, banks can now offer personalized, efficient, and customer-centric financial services by learning from customer behavior, preferences, and transaction history, even in rural areas. The bank provides personalized loan offers, savings plans, fraud detection alerts, and round-the-clock virtual assistance, which makes banking more accessible, convenient, and relevant to each customer. In Khed of the Pune district, the banking sector expanded with public, private, and cooperative banks. So this study is conducted to study awareness of bank customers towards AI and customer satisfaction with AI services regarding personalized banking services.

REVIEWS OF LITERATURE
Teja Reddy Gatla (2022) The role of AI in personalized banking services: This paper explains artificial intelligence, personalized banking services, and AI's role in personalized banking services. It also gives knowledge about AI techniques for tailoring financial decisions and AI applications in customizing financial services**.** The paper concludes that artificial intelligence has been applied to improve banking systems, especially for personalized customer experience.

Rita Jain (2023) Role of artificial intelligence in banking and finance: This research paper provides an in-depth analysis of the use of AI in banking and finance, examining its various applications such as fraud detection, credit scoring, customer service, and investment management. The objective of the study is to explore the benefits and challenges associated with AI implementation in the financial sector. The paper concludes AI technologies have significantly improved decision-making processes, reduced operational costs, and increased overall profitability

A. Gheeta (2021) A Study on Artificial Intelligence in Banking and Financial Services: This paper focuses on the artificial intelligence (AI) in the banking and financial services in Chennai. The objective of the study is to oversee the application of artificial intelligence methodology in the banks. The paper concludes that the customers want more commitment from representatives to the banking and financial services by giving innovative development to prepare to improve the AI procedures in the workplace.

RATIONALE OF STUDY

These reviews explain how AI has become part of banking services. This paper also explains the role of artificial intelligence in personalized banking services and AI applications in personalized banking services with reference to Khed Taluka of Pune District.

OBJECTIVES

1. To examine the concept and applications of Artificial Intelligence in personalized banking services,

2. To study customers' awareness of AI-based personalized banking services offered by banks.

3. To analyze the impact of AI-driven personalized banking services on customer satisfaction and service experience

AI Based Personalized Banking Services

1. Chatbots & Virtual Assistants: Chatbots driven by artificial intelligence assist customers at all times by resolving queries, sharing balance details, and providing tailored guidance based on previous customer behavior

2, Personalized Product Recommendations: AI analyzes customer data (spending habits, income, preferences) to suggest suitable loans, credit cards, or investment products.

3. Customized Offers & Discounts: Banks use AI to send personalized offers, cashback deals, and discounts based on individual customer behavior and transaction history.

4. Fraud Detection & Security Alerts: Intelligent systems powered by AI oversee transactions continuously and issue immediate warnings when unusual patterns are detected

5. Credit Scoring & Loan Approval: AI evaluates customer creditworthiness quickly and accurately, enabling faster and personalized loan decisions.

6. Voice-Based Banking Services: AI-powered voice assistants allow customers to perform banking tasks using voice commands in a secure manner.

7. Robo-Advisory Services: AI-driven robo-advisors provide personalized investment advice based on a customer's risk profile and financial goals.

8. Predictive Banking Services: AI predicts future customer needs, such as upcoming bill payments or fund shortages, and provides timely suggestions or alerts.

9. Customer Experience Personalization: AI personalizes the banking app interface, notifications, and communication style according to individual customer preferences.

Hypothesis: Customer Awareness and AI in personalized Banking

Null Hypothesis (H_0): Customers are not aware of the use of Artificial Intelligence in personalized banking services.

Alternative Hypothesis (H_1): Customers are aware of the use of Artificial Intelligence in personalized banking services.

RESEARCH METHODOLOGY

The research design of the study is descriptive and analytical. The study was conducted in Khed Taluka of Pune District and focuses on bank customers using AI-based personalized banking services. Both primary and secondary data were used. The study collected primary data from 50 respondents with the help of a structured

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questionnaire, adopting convenience sampling. Secondary data was collected from books, research journals, banking reports, and relevant websites. The collected data was analyzed using percentage analysis, graphs, and chi-square tests with the help of MS Excel. The study tests hypotheses related to customer awareness regarding AI-based personalized banking services. The study is limited to Khed Taluka with a small sample size. The findings are based on respondents' perceptions

Data Analysis and Interpretation

a) Descriptive Analysis

1) Gender

Chart No. 1

Gender	Frequency	Percentage
Male	27	54
Female	23	46
Total	50	100

Source: Primary Data

Interpretation: The Chart 1 indicates that 54% (27) respondents are male, while 46% (23) respondents are female reflecting higher representation of male in the Sample.

2. Age:

Chart No .2

Age	Frequency	Percentage
Below 25	6	12
25-35	5	10
36-45	24	48
46-55	12	24
Above 55	3	6

Source : Primary Data

Interpretation: Chart 2 indicates that 48 % (24) are respondents are from age group 36-45 , 24% (12) are respondents are from age group 46-55 ,12% (6) respondents are from below 25 , 10 % (5) are respondents are from age group 25-35 and 6%(3) are from above 55. It shows that majority of respondents from experienced group 36-45 and very less are from above 55. It also shows smaller representation of younger participants .

3. Type of Bank Account

Chart No.3

Type of Bank	Frequency	Percentage
National	30	60
Private	16	32
Cooperative	4	8

Source : Primary Data

Interpretation: Chart 3 indicates that 60% (30) respondents have bank account in Nationalized Bank, 32% (16) respondents have bank account in Private Bank and 8% (4) have bank account in Cooperative Bank. It shows respondents having bank account in Nationalized bank are more than respondents having bank account in private bank and Cooperative Bank . Few respondents have account in Cooperative Bank .

4. Awareness about AI Based Personlized Banking Services

Chart No. 4

AI Based Personalized Bank Services	Frequency	Percentage
Chatbots / Virtual Assistants	27	54
Personalized offers/ Recommendations	28	56
Fraud detection alerts	32	64
Voice Based Banking	14	28
Automated Loan Approval	6	12
Not Aware of Any	4	8

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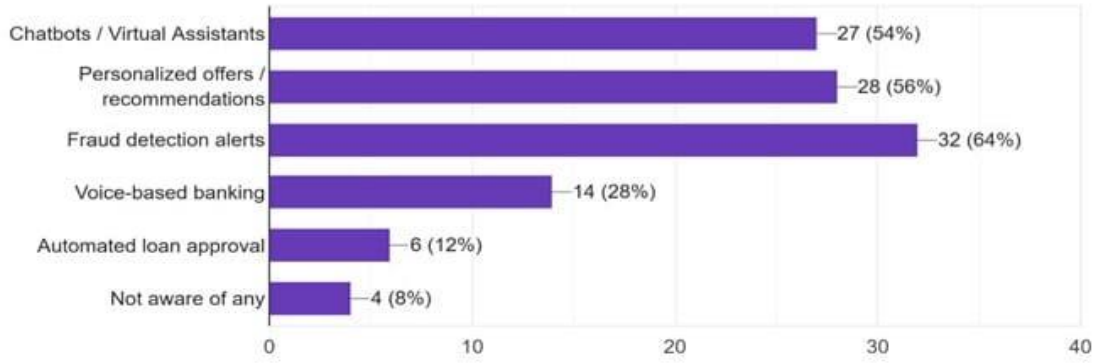
Source : Primary Data



Source : Primary Data

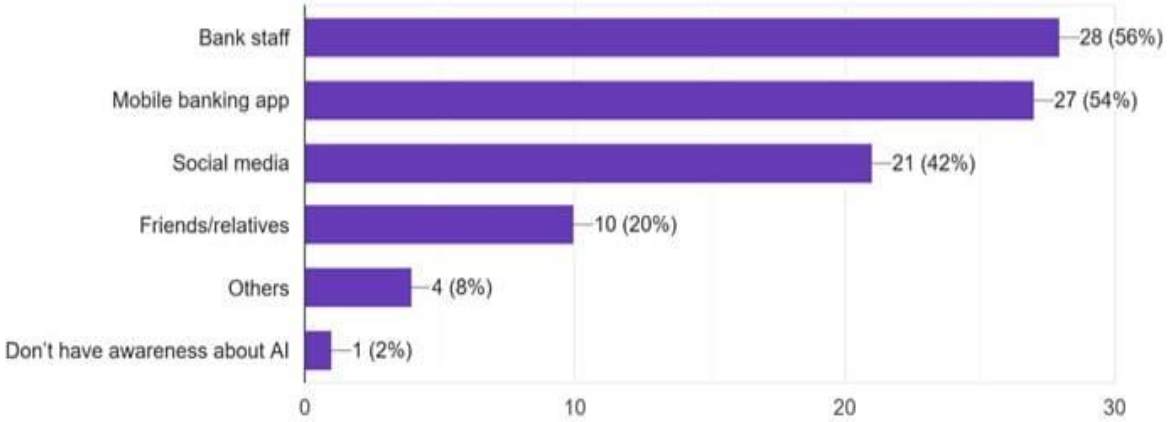
Interpretation : Chart 4 indicates that respondents are aware of AI based personlized Banking Serviices . Fraud detection alerts and Personal offers are mostly used by respondents having percentage 64% (32) and 56% (28) respectively . Chatbots having percentage 54% (27) and Voice based banking having percentage 28% (14) are after these two one are used by respondents .Automation loan approval having less percentage of awareness i.e 12% (6) . There are also 8% respondents who are not aware of AI Based personlized Bank Services

5. Source of Information about AI Based Personlized Banking Services

Chart. No 5

Source of Information about AI Based Personalized Banking Services	Frequency	Percentage
Bank Staff	28	56
Mobile banking app	27	54
Social Media	21	42
Friends /relatives	10	20
Others	4	8
Don't have awareness of AI	1	2

Source: Primary Data



Source: Primary Data

Interpretation : Chart 5 indicates that respondents have various source of information about AI Based Personlized Banking Service ' Bank staff 56% (28) and Mobile Banking App 54% (27) are main source of Information of AI services . Social Media 42% (21) and Friends and relatives 205%(10) are also playing role in providing information about AI based services . There are other sources 8% (4) also for providing information about AI based services. 2%(1) are not aware about AI services.

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6. Perception of Customer towards AI Based Personalized Banking Services

Chart No .6

AI Based Personalized Banking Services made banking transactions easier and faster	Frequency	Percentage
Strongly Agree	15	30
Agree	32	64
Disagree	2	4
Strongly Disagree	1	2

Source: Primary Data

Interpretation: Chart 6 indicates that 30% (15) respondents are strongly agree and 64% (32) respondents are agree that AI based services made banking transactions easier and faster where as only 4% (2) are disagree and 2% (1) are strongly disagree that AI based made services made banking transactions easier and faster. It shows that respondents are availing benefits faster due to AI based banking service

7. Customer Satisfaction and Experience

Chart No. 7.1

1) AI-based personalized services meet my banking needs effectively.	Frequency	Percentage
Strongly Agree	11	22
Agree	38	76
Disagree	1	2
Strongly Disagree	0	0

Chart 7.2

2) AI-powered services save my time compared to traditional banking methods.	Frequency	Percentage
Strongly Agree	13	26
Agree	28	56
Disagree	9	18
Strongly Disagree	0	0

Chart No. 7.3

3) I am satisfied with the accuracy of AI-based banking services.	Frequency	Percentage
Strongly Agree	11	22
Agree	37	76
Disagree	2	4
Strongly Disagree	0	0

Chart No.7.4

. 4)AI-based services have improved my overall banking experience.	Frequency	Percentage
Strongly Agree	9	18
Agree	25	50
Disagree	14	28
Strongly Disagree	2	4

Source: Primary Data

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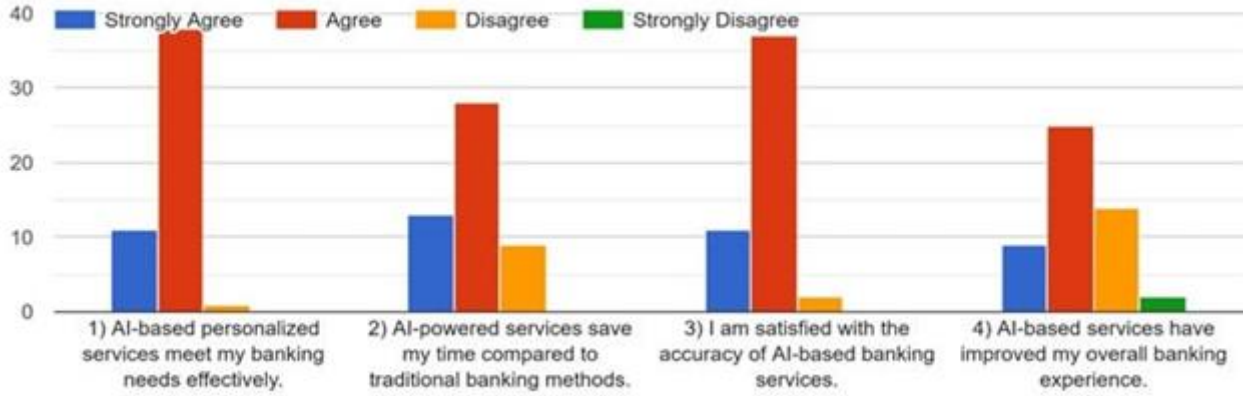

Source: Primary Data

Interpretation: Graph Indicates Customer Satisfaction and Experience. Most of respondents are strongly agree and agree that AI Based Personalized Services meet banking need effectively. They are also experienced that AI Based services save time compare to traditional banking methods. Respondent's majority is towards that they are satisfied with accuracy of AI Based Services. Most of respondents are strongly agree and agree with the statement that AI Based Banking Services improved their overall performance. There are very few respondents who are not satisfied with AI Based Banking Services.

b) Hypothesis Testing

Customer Awareness about Use of AI in Personalized Banking Services

Chart No.8

Customer Awareness about Use of AI in Personalized Banking Services	Expected Frequency	Observed Frequency	Testing Norms
Aware	25	46	If p value < 0.05 Reject Null Hypothesis If p value > 0.05 Accept Null Hypothesis
Not Aware	25	4	
Total	50	50	

Chart No. 9

Particulars	Value
Sample Size (N)	50
Degree of Freedom(df)	1
Level of Significance	0.05
Calculated χ^2 Value	35.28
Table χ^2 Value at df is 1 and level of significance is 0.05	3.84
p value for Calculated χ^2 Value	Less than 0.001

As Calculated χ^2 Value is 35.28 and Table χ^2 Value at df is 1 and level of significance is 0.05 is 3.84. And p value for Calculated χ^2 Value is 35.28 is less than 0.05. So Null Hypothesis is rejected Indicating that customers are significantly aware of use of AI in personalized Banking services,

FINDINGS

Artificial intelligence is the updated computer technology that has become the major part of personalized banking services. Most of the respondents have accounts in nationalized banks rather than private and cooperative banks.

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There are various AI-based personalized banking services like chatbots/virtual assistants, personalized offers/recommendations, fraud detection alerts, voice-based banking, automated loan approval, etc.

There are various sources of AI-based personalized banking services information providers, like bank staff, mobile apps, social media, friends, etc. The introduction part explains the first objective of the research paper.

The findings of hypothesis testing indicate that customers are aware of the use of artificial intelligence in personalized banking services, thereby supporting the second objective of the study. Further, the analysis of customer satisfaction shows that customers are satisfied with AI-based banking services, fulfilling the third objective of the research.

SUGGESTIONS:

Bank staff are an important source of information; regular training programs should be conducted so that employees can confidently explain AI-based services to customers.

Since most respondents hold accounts in nationalized banks, these banks should invest more in advanced AI technologies.

Feedback from customers should be actively collected to upgrade AI services.

Customers may have concerns about data security. Banks should clearly communicate privacy policies and security measures used in AI systems.

CONCLUSION:

Artificial intelligence has emerged as an advanced and updated computer technology that plays a significant role in delivering personalized banking services. The study reveals that a majority of respondents hold accounts in nationalized banks, followed by private and cooperative banks. Various AI-based personalized banking services such as chatbots, personalized offers, fraud detection alerts, voice-based banking, and automated loan approvals are being increasingly used by banks.

Overall, the study concludes that AI-based personalized banking services have positively influenced customer awareness and satisfaction. and plays a crucial role in enhancing personalized banking services in Khed Taluka of Pune District. With continuous improvement, effective communication, and strong data security measures, artificial intelligence can further enhance the quality of banking services and strengthen customer relationships in the Indian banking sector.

REFERENCES

1. A. Gheeta (2021) A Study on Artificial Intelligence in Banking and Financial services: https://www.ijcrt.org/papers/IJCRTG020019
2. Presious Chukus (2025) Personlized Financial Services through AI https://www.researchgate
3. Rita Jain (2023)Role of artificial intelligence in banking and finance: Https://Jmseleyon.Com/Index.Php/Jms/Article
4. Teja Reddy Gatla (2022) The role of AI in Personalized Banking Services https://ijcrt.org/papers/IJCRT2201663
5. Financial Stability Board https://www.fsb.org
6. Institute for development and research in Banking www.idrbt.ac.in
7. International Business Machines Corporation https://www.ibm.com
8. International organization for standardization https://www.iso.org/
9. Towards data science https://towardsdatascience.com/

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ARTIFICIAL INTELLIGENCE AND SUSTAINABLE MARKETING- AN OVERVIEW OF ADOPTION OF AI IN PRODUCT MANAGEMENT

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ABSTRACT:
In this era of sustainable development, organisations are thriving for enhancing and improvising existing marketing strategies. With the advent Artificial Intelligence organisations have been in position to foster sustainable marketing. Consumer preferences for eco-friendly products, personalised engagements, innovative products have created challenges for organisations. AI is revolutionising the industries by having automations, streamlining processes, improving decision-making, and delivering valuable customer insights in product management. This study aims to identify the role of AI in sustainable marketing with special reference to product management. Understanding the role of AI in product management and analysing the cases on the use of AI in product management is one of the core objective of this study. The study is an exploratory research, purely based on secondary data viz-corporate reports, journals, publications and case study analysis. The study concluded that use of AI in product management facilitate the organisations to cater to the ever rising diverse needs of customers and helps to create competitive advantage in the industry.

Keywords: *Sustainable marketing, Green marketing, Artificial Intelligence, Product Management.*

1. INTRODUCTION

Product management is one of the crucial aspect of modern marketing strategies as also to meet the changing customer preferences and choices in this competitive business world. Adoption of AI in product management is bringing paradigm shifts in the industry by improvising decision-making, automotive production processes and offering products as per customer insights (Uyen Chu, 2025).

With the evolving AI technologies in marketing, their integration in green marketing strategies has a widespread approach towards sustainability. The emphasis on adoption of AI in marketing is significantly associated with green marketing by offering enhanced and sustainable customer engagements (Anitta P John,2024).

Various AI driven tools from ML (Machine learning) algorithms to predictive analytics and chatbots are the strong foundation of modern marketing operations. Through AI, organisations are empowered with personalised customer offerings, forecasting customer needs, and seamless marketing operations. (Savita.et.al, 2025).

AI through Machine Learning enables industries to generate energy efficiency in manufacturing and transportation creating carbon credits. ML not only accelerates renewable energy by forecasting demand and optimum utilising resources, but also gains sustainability.

2. REVIEW OF LITERATURE

Subbulakshmi P, 2024, laid emphasis on undertaking training initiatives for marketers in order to reduce the knowledge gap and get acquainted with the skills for adoption of AI tools. The study also suggested that, providing resources and customised training programs can enable digital marketers to adopt and implement of AI-driven marketing practices.

Vikas Garg et.al 2025, in their unique work on AI and sustainable marketing attempted to apply Systematic Literature (SLR) and Antecedents-Decisions-Outcomes (ADO) methods for the analysis of the sources indexed on Scopus so as to throw light on the trends, changing patterns in adoption of AI in marketing mix. The study could identify that AI driven sustainable marketing enables to offer eco-friendly products thereby building customer trust and loyalty. A. Varshini et.al, 2025, attempted to throw light on the impact of AI powered sustainable marketing on consumer behaviour. They opined that use of AI transforms sustainable marketing by enhancing the resource efficiency, developing eco-friendly products, improvise customer engagements and personalized messaging, etc.

Salima A, 2024, attempted to apply AI through ANN at El-Waha factory's food production plant for estimating production quantities, indicating that the model is reliable, accurate, and effective for forecasting production quantities. Sadyojathappa S 2025, opined that the use of AI analytics provides greater insights into consumer behaviour and preferences, enabling companies to take effective marketing mix decisions. The study revealed

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that AI's in-depth consumer behaviour analytics may convince companies to realign their marketing strategies with sustainability initiatives, enhancing customer loyalty.

3. RESEARCH GAP

Previous studies on AI in marketing strategies, green marketing, sustainable marketing has tried to throw light on the evolution of AI based marketing operations in general. Very few studies have been undertaken on the adoption of AI in production management specifically with regards to sustainability. This research gap triggered the intent of undertaking a review of AI and sustainable marketing with reference to product management.

4. RATIONALE OF THE STUDY

The study emphasises on the role and significance of adoption of AI in various marketing practices especially product management dimensions like product research, customer insights, product development, resource mobilisation, customer engagements, etc.

5. OBJECTIVES OF THE STUDY

i. To identify the role of AI in sustainable marketing with special reference to product management.

ii. To have an overview on the use of AI in product management.

6. RESEARCH METHODOLOGY:

The study is an exploratory research, purely based on secondary data viz-corporate reports, journals, publications, case analysis, etc. The scope of the study is confined to AI and its application in product management throughout the globe. The findings are based on the observations derived from analysing few selected cases with regards to adoption of AI tools in product management.

7. ADOPTION OF AI IN PRODUCT MANAGEMENT

The Mc Kinsey 2024 survey found that the AI adoption in industries has raised to seventy-two percent from fifty percent in 2023. As per the survey in 2023, the AI adoption didn't even manage to reach beyond sixty percent in any of the regions, whereas, the 2024 survey reveals that the organisations using AI are found to be more than 66 percent. The Mc Kinsey 2024 survey indicates that the adoption of AI has found to be increased in professional services. Companies are using AI in more parts of their business, nearly 50 percent of respondent organisations have adopted AI in most of the business functions compared to less than thirty percent of respondent organisations contacted in previous year. Uyen Chu, 2025, in his report on adoption of AI in product management has emphasised on the role of AI based on real examples and cases from the industry, quoting the organisation and client engagements.

8. BENEFITS OF AI ADOPTION IN PRODUCT MANAGEMENT

9.1. Market Research

Understanding the ever changing behaviour is a greatest challenge in this highly competitive market. Also the scope of marketing activities is wide and large, with large data sets for analysing the trends in different markets spread throughout the world. AI helps organisations in collecting and analysing the large sets of data with the use of various data analytics.

9.2. Product Modification and Innovation

AI assists organisations to modify the products as per the needs and wants of the customers. Extensive data analysis helps to identifying market gaps and unmet demands of the customers. AI also facilitates prototyping and product testing by simulating the different product combinations using customer feedback, thereby ensuring that the customers' expectations are met in record time. Innovative approach in product modifications helps in creating competitive advantage in the market.

9.3. Strategic Choices and Decision making

AI helps the organisations to gain accurate insights from large data sets. The changing buying behaviour and buying trends can be proactively forecasted with the use of AI by analysing the historical data. Thus facilitating the product managers to make strategic choices and prompt decision making in designing and offering improvised products as per market trends.

9.4. Smoother Product Development

AI facilitates smooth functioning of routine tasks of product management such as resource mobilisation, coordination with the team, etc, thereby allowing production managers to focus on core responsibilities pertaining to enhancing the processing of product development cycle and faster delivery.

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9.5. Customer Delight

AI analyses big data sets through multiple sources to identify the tastes, preferences, likes, dislikes of consumers. This facilitate production manager in efficient product decisions aligned with maximum customer satisfaction. AI also enables product customisation offering product feature in alignment with the recommendations of individual users resulting into higher customer delight and customer loyalty.

9.6. Resource Mobilisation

The adoption of AI tools in analysis of the historical data leads to cost benefit analysis facilitating the budget allocation, resource allocation, project completion timeline, etc. Adoption of AI facilitates optimum utilisation of available resources thereby meeting the targets and goals in stipulated time.

10. Cases on Adoption of AI in Product Management

AI Tools like Natural Language Processing (NLP) and generative AI help in analysing the customer responses, generate creative and innovative ideas, and draft customer experiences, enabling product managers to take timely decisions, timely investments and optimise the resources.

Following are few selected cases on adoption of AI in product management:

10.1. Market Research

Research and development activities pertaining to consumer research, product research, market research, competition can be effectively conducted through the adequate use of various AI tools.

i. **Amazon**

Amazon applies AI technology like machine learning and predictive analytics to identify tastes and the preferences of customers based on the browsing data and past purchases experiences of the customers.

ii. **Coca-Cola**

AI tools like NLP and AI-driven analytics helped Coca-Cola with strategy adjustments and new product development research After identifying consumer demand online like Coca-Cola successfully launched its new product Cherry Sprite in the market.

10.2. Customer engagements and loyalty

In this era of information technology, the customer interventions have become smoother and convenient, additionally the use of AI generates maximum customer engagements and satisfaction.

i. Netflix

Maximum content viewed on Netflix comes from AI-driven recommendations based on users' viewing history and preferences, contributing to a more engaged and loyal user base.

ii. *Duo lingo*

Duo lingo through AI application makes learning experiences more convenient and easier by identifying learning constraints, scheduling the sessions on individual basis. AI ensures personalization leading to reinforcement and smoother language progression.

iii. Spotify:

Spotify's algorithms extract the data feed from its users, giving them playlists like "Discover Weekly," enhancing personalised customer experiences.

10.3. Product Development

AI enhances product development by helping product managers align organisational goals with the customer preferences. By analysing historical data and identifying buying instincts, AI assists organisations to deliver products generating higher values to users.

i. Productboard

Productboard assists their client the Zoom platform to provide customised features in their products with inbuilt scheduling features thereby enhancing customer experiences.

ii. Tech Mahindra

Tech Mahindra initiated in thought leadership through its AI featured next-gen PLM (Product Lifecycle Management) technology platform and cloud-based workflows for effective product lifecycle management.

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10.4. Optimize Pricing

i. Airbnb

Airbnb launched its pioneering hospitality services with advanced features of ML for analysing booking trends creating competitive advantage in terms of pricing, strategic locations, win-win situation to both: the host and the guests.

ii. Tech Mahindra

Tech Mahindra client a leading UK confectionery company was suffering with issues like high cloud costs and inefficient performance across its more than 25 database servers. Tech Mahindra's intervention through Cloud BlazeTech Framework helped its client with improved database performance and also reducing the cloud costs.

10.5. Product Analytics and Data-Driven Decision Making

AI tools in product analytics help product managers to understand the customer insights and customer engagements. Tracking user behaviour, AI can identify areas where users switch on and off, struggle with new product features, or fail to adopt key functionalities allowing teams to act for enhancing the user experience.

Example:

i. Mixpanel helps companies like Uber and Airbnb to study the user behaviour and optimize their product offerings. According to Mixpanel, their analytics helped Kast improve user retention by 50%.

ii. Tech Mahindra partnered with AWS to develop an AIOps solution framework incorporating GenAI capabilities.

11. CONCLUSION

The study found that AI in product management facilitate the organisations to cater to the ever rising diverse needs of customers and helps to create competitive advantage in the industry. AI is revolutionising the industries by having automations, streamlining processes, improving decision-making, and delivering valuable customer insights in product management. As AI continues to evolve, product managers must stay informed and adapt to emerging technologies, ensuring they remain competitive and maximize the value AI brings to product development and management.

REFERENCES:

1. A. Varshini and A. Sarlin Venotha, 2025, *AI in Sustainable Marketing and Consumer Behaviour: A Transformational Perspective*, Special Issue: International Journal of Business and Economics Research (IJBER): E-ISSN: 2455-3921, Pp 165-168.
2. Alex Singla, Alexander Sukharevsky, Lareina Yee, And Michael, Bryce Hall, (2024), *The State of AI in Early 2024: Gen AI Adoption Spikes and Starts to Generate*-Mckinsey & Company.
3. Anitta P John, Shilu Varghese, 2024, *Transformative Potential of Artificial Intelligence in Green Marketing*, Mmr Vol. 2(1) Bi- Annual Journal January -June 2024,
4. Ebtisam Labib, *Artificial Intelligence In Marketing: Exploring Current And Future Trends*, Cogent Business & Management 2024, Vol. 11, No. 1, 2348728.
5. Research and Markets. (2024, May). *Confectionery Global Market Report 2024*. Https://Www.Researchandmarkets.Com/Report/Confectionery.
6. Sadyojathappa S , Bharati Nadakarni, 2025, *Artificial Intelligence In Green Marketing: A Study Of Consumer Buying Behaviour Of Durable Products In Karnataka,* Journal Of Emerging Technologies And Innovative Research (JETIR), JETIR July 2025, Volume 12, Issue 7 Www.Jetir.Org (ISSN-2349-5162).
7. Salima A. Bilhassan, Abdelsalam El Jameli, Ahmed El Majbri and Abdelaziz Badi, 2024, *Forecasting of Production Using Artificial Intelligence*, IOSR Journal of Engineering (IOSRJEN) www.Iosrjen.Org ISSN (E): 2250-3021, ISSN (P): 2278-8719 Vol. 14, Issue 9, September 2024, Series -1, PP 24-27.
8. Savita, Anu Dahiya, Jaspal Singh, *Artificial Intelligence in Marketing Research: A Systematic Review of Trends, Tools, And Ethical Challenges*, International Journal for Multidisciplinary Research (IJFMR) E-ISSN: 2582-2160, Volume 7, Issue 4, July-August 2025.

ISSN 2394 - 7780

9. Subbulakshmi P, Nandhini, 2024, *A Study On the Impact of Artificial Intelligence On Digital Marketing from The Perspective of Digital Marketers*, IOSR Journal of Business and Management (IOSR-JBM) E-ISSN:2278-487X, P-ISSN: 2319-7668. Volume 26, Issue 5. Ser. 9 (May. 2024), PP 18-22 www.Iosrjournals.Org
10. Uyen Chu, 2025, AI In Product Management: Top Use Cases You Need To Know, Mckinsey & Company.
11. Vikas Garg, Sailaja Bohara, And Arpita Srivastav, *AI-Driven Sustainability Marketing Transforming Consumers' Perception Toward Eco-Friendly Brands*, Discover Sustainability (2025) 6:984 Https://Doi.Org/10.1007/S43621-025-01934-Y,Pg 1-20.
12. www.Techmahindra.Com/Ai-Powered-Plm-Solutions-For-Semiconductor- manufacturing.Pdf.

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ARTIFICIAL INTELLIGENCE IN AGRICULTURE: ENHANCING YIELD AND SUSTAINABLE FARMING PRACTICES AMONG FARMERS IN INDIA

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ABSTRACT:
Artificial intelligence (AI) is being used efficiently in many fields, including agriculture, around the world. Agriculture plays an important role in the Indian economy, contributing to employing 46 percent of the total population of India and ensuring national food security. Researchers say that the world population will reach 1000 crores by 2050, and for that increased population's basic infrastructure, like roads and houses, will also increase. Some agricultural land will be used to fulfill the basic infrastructural needs of the increased population. To fulfill the food needs of an increased population will be a big challenge in front of all governments in the world. Within limited land, farmers have to produce the needed food for the entire population. Climate change, diseases on the yields are big barrios to good production and productivity in a small amount of land. This paper uses secondary data to examine how artificial intelligence (AI) can enhance agricultural yield and promote sustainable farming practices. In this paper, we review AI tools such as drones, disease detectors, and digital advisory services, and analyze challenges in adopting AI tools and software. This paper concluded with policy recommendations.

Keywords: *Artificial intelligence, agriculture production and productivity, marginal and small farmers, Climate change, Yield.*

INTRODUCTION:

India is an agrarian country with a large agricultural economy. According to the Periodic Labor Force Survey (PLFS) data for 2023-24, around 46.1 percent of India's total workforce was dependent on agriculture and allied activities. This marks an increase of 3.6 percent from 42.5 percent in 2018-19. The total population of villages, 65 percent of the present population, still depends on agriculture and related industries, as well as allied activities. The United Nations Economic and Social World Department report "World Population Prospects" 2024 claims that the world's population will reach 1000 crore by 2050. To create living facilities, such as infrastructure and houses for such a huge population, a large amount of land will be used, resulting in a reduction of agricultural land. Producing food for this huge population will be a challenge. To provide food for the huge population in the world, increasing agricultural land will not be possible; therefore, we will have to adopt new technologies to increase agricultural production and productivity. However, when using these new technologies in agriculture, farmers face many problems, such as small land holdings, a shortage of agricultural labor, low capital, climate change, environmental issues, and soil fertility. To overcome these problems, farmers must adopt artificial intelligence. In other countries, such as China, Japan, and England, artificial intelligence is used in agriculture, which performs all the work from cultivation to harvest. This study examines the role of artificial intelligence in improving agricultural productivity and sustainable agriculture in India using secondary data from authentic resources. This paper reviews the existing literature, analyzes the current trends in AI adoption among farmers, discusses the challenges, and concludes with policy recommendations for better adoption of artificial intelligence among farmers.

Objectives:

1) To explore the use of AI in improving yield and sustainability in Indian agriculture.
2) To identify barriers to the adoption of AI
3) To provide policy recommendations for farmers in India regarding AI.

RESEARCH METHODOLOGY:

The present study only considered secondary data. In this study, literature related to the research has been explored, such as government data, the Economic Survey of India, government reports, websites, research papers, etc. All published and unpublished resources have been used.

AI IN AGRICULTURE: ENHANCING YIELD AND SUSTAINABILITY

In the era of technologies, Artificial Intelligence (AI) is transforming all sectors, including agriculture, worldwide. Government initiatives, research institutions, and agritech industries are actively improving and working on AI tools to help all farmers get higher yields with minimum cost and more sustainable practices.

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1) **Smart Agriculture**: With the help of AI, precision agriculture is possible by combining real-time data from soil, satellite images, drone images, and weather forecasts. All these inputs will be analyzed by a machine learning algorithm to help farmers make accurate decisions about all the activities farmers do in agriculture. Ex. After examining the soil, how much and what kind of fertilizers the particular crop and soil need, or how much water the crop needs, fertilizers, water, and other needed things will be given to the crop according to the results obtained from the soil examination. Because of this, production and productivity per hectare will increase. The cost of production will decrease. Wastage of water and fertilizer will be minimized, and the most important agriculture will become more sustainable. In India, the Maharashtra government approved a special AI agriculture policy with a 500 crore outlay (2025-29) to build data-driven farming infrastructure and promote precision AI tools across the state.

2) **Early Disease Detection:** Crop disease or symptoms are not easily visible to the human eye, but due to the AI revolution, identifying crop problems, AI-driven disease detection has become a crucial tool for minimizing yield loss. An **IIIT Allahabad researcher developed an AI tool (CVGG-16)** with the help of leaf images and sensor inputs such as soil moisture, temperature, and humidity, which can detect early crop diseases. This tool has been used for crops like maize and potatoes. The report says that the model has 93-97 percent accuracy for detecting early crop diseases. With the help of AI devices, crop diseases can be detected more quickly than traditional techniques, which saves money for farmers and prevents crops from being destroyed.

3) **Advice and market Information:** According to the Agriculture census 2015-16 says that among the total farmers, 86 percent are marginal and small farmers. Taking advice regarding yield diseases or the market platforms is costly for these farmers, but AI advisory tools are reducing the knowledge gap for Indian farmers without costly agronomist experts in the field. AI apps and chatbots provide real-time guidance about local weather, water management, fertilizers, pests, and market price information. Ex. In Telangala, for project Sagu Bagu WhatsApp bot assisted farmers in the local language about crop care, such as pest control and water scheduling for a particular crop.

4) **Utilization of resources :** AI helps farmers reduce their costs by providing accurate guidance for the crop regarding fertilizers, pesticides, and irrigation schedules after monitoring soil health. With the help of AI efficiency, farmers can reduce waste and soil pollution. This efficiency leads to sustainable farming practices and reduced chemical use, so soil and groundwater will be clean.

CHALLENGES IN AI ADOPTION IN AGRICULTURE:

Research is required in any field to use technology. In the future, like other countries worldwide, AI will be used in the Indian agriculture sector on a large scale, but in India socio-economic condition of all the farmers is not good, so India will have to face some challenges in the adoption of AI technologies in the agriculture sector.

1) **Rural digital connectivity Gaps:** According to the 2011 Census of India, from the total population of India, about 68.8 percent population lives in rural India, and from that population, around 59-60 percent population is engaged in agriculture and allied sectors. For real-time guidance from AI tools, farmers need to have good internet connectivity, and a significant number of villages still suffer from poor or no internet facilities. Due to Inconsistence electricity supply in many villages, digital devices and sensors related to AI will not work properly. This infrastructure gap builds a digital divide, which is the major challenge in AI adoption in Agriculture.

2) **Heavy initial capital investment:** Over 86 percent of farmers are marginal and small farmers in India. Even with the subsidies or schemes from the government, such high expenditure for the use of AI tools is beyond the financial reach of most farmers. AI adoption consists of drones, smartphones, expensive hardware, and software, and its basic tools will cost thousands of rupees because of this expensive investment; many farmers either delay adoption or avoid it altogether.

3) **Lack of digital literacy and skill:** Studies show that only 25 percent of Indian farmers are comfortable using digital tools like smartphones, the internet, and agriculture-related apps. The World Bank survey 2022 reported that around 23.4 percent of adult rural Indians have basic digital literacy. Due to a lack of digital literacy, a lack of training, and limited exposure to the particular technologies, they sometimes can not interpret the given solution by AI tools.

4) **Needs for localized AI Solutions:** India is a highly diverse country with different socio-cultural farming practices, cropping patterns, and varied agro-climate zones. Solutions for particular problems will vary from area to area. The weather in Maharashtra and in Punjab will be different, so the solution farmers will get for

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their problems should not be universal, and for this, AI tools need to be localized. So our less literate farmers will get their solutions in the local language with local solutions according to the farmers' needs. The limited access to the AI platforms, unaffordable AI tools for farmers like marginal and small farmers, lack of skill and digital literacy will lead to a reduction in effective use of AI. AI needs to be localized for language and advice related to the local weather rather than global advice.

POLICY RECOMMENDATION:

To overcome barrios regarding Artificial intelligence in agriculture, below are key recommendations.

1) **Expansion of rural power infrastructure and the internet:** AI-based agriculture tools depend on internet connectivity and electricity. However, more than half of the rural areas in India face problems regarding internet and electricity. Expansion of the internet and electricity is a must for the use of AI in the agriculture sector. The Indian government has announced that by June 2026, every village in India will have 4G connectivity, also they are upgrading and decentralizing renewable energy.
2) **Provide subsidies or cost-sharing schemes:** In India farmers 86 percent of farmers are marginal and small farmers. Who cannot afford these AI tools, like drones and soil sensors. The government should provide subsidies or cost-sharing schemes that will reduce individual investment burden for farmers.
3) **Training for digital literacy programs:** Even when AI tools are available for farmers at an affordable cost but digital literacy and skill gap will play a vital role in the effective use of artificial intelligence in agriculture. Many farmers lack experience with agriculture apps and handling smartphones. Krishi Vighyan Kendra and the state agriculture department should provide training programs for farmers. Ex. In Uttar Pradesh, training has been given to large-scale farmers for improving digital skills. Training material and apps available in the local language will improve the reach and use of AI in agriculture.
4) **Encourage Public-Private partnership (PPPs) :** Partnership between AI startups and a research institute can make region-specific AI tools, like soil analysis, early pest detection, and crop forecasting. Which will be more beneficial to the farmers?

CONCLUSION :

The Periodic Labor Force Survey (PLFS) data for 2023-24, around 46.1 percent of India's total workforce was dependent on agriculture and allied activities, underestimating its important role in sustainable rural livelihood. There is around 3-4 percent annual growth in agricultural output despite climatic uncertainty. There a wide inter-regional disparities in productivity, ground-level water, and soil health are the main challenges. With the AI technology tools, farmers can detect many yield diseases before time and farmers can use appropriate pesticides to prevent those diseases. Several pilot study says that with the perfect help of AI, yields can be increased by 20-30 percent while reducing inputs, leading to a sustainable environment. These gains are dependent on addressing key structural constaints-notable gaps in digital infrastructure, digital literacy, and a lack of digital skills, and high initial technology cost. Therefore, AI adoption by all the farmers in India will need to be supported by public investment, affordable and easy access models, and capacity building.

REFERENCES:

1. Achut Godbole (2023), Artificial Intelligence, Book Ganga Publication, Pune
2. Agriculture census (2015-16)
3. Employment in Agriculture (2018). The World Bank Report. www.worldbank.org
4. Economic Survey 2023-24, Government of India, Ministry of Finance.
5. Jiali Zha (2020). Artificial intelligence in agriculture, Journal of Physics: Conference Series. Page 1-6
6. Mahibha G. and Baiasubramanian, (2023) Impact of Artificial Intelligence in Agriculture with Special Reference to Agriculture Information Research, Current Agriculture Research Journal.
7. Nishant, Jitendra, Dhiraj, Rahul, (2022), Application of Artificial Intelligence (AI) in Agriculture: An Indian Perspective, Harit Dhara, Page no. 9-11.
8. Panpatte Deepak. (2018), Artificial Intelligence in Agriculture: An Emerging Era of Research.

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A STUDY ON THE ROLE OF ARTIFICIAL INTELLIGENCE IN BANKING FRAUD DETECTION

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ABSTRACT
Banking fraud has grown more advanced, creating major challenges for financial institutions globally. This research explores how Artificial Intelligence (AI) contributes to identifying and stopping fraud within the banking sector. Based on theories of risk management and technological innovation, the study demonstrates that AI-based approaches improve the effectiveness and precision of fraud detection over conventional techniques.

The research utilizes a quantitative methodology, incorporating secondary data derived from banking reports, case studies, and academic literature, in addition to primary data gathered via questionnaires from professionals in banking and IT. The analysis of data centers on assessing the performance of AI systems in detecting atypical transaction patterns, forecasting fraudulent activities, and minimizing false positives.

The results demonstrate that AI markedly enhances fraud detection by delivering real-time analysis, increased adaptability, and scalability. The outcomes imply that banks implementing AI technologies can fortify operational risk management, boost customer confidence, and mitigate financial losses. Nevertheless, challenges such as data privacy, ethical issues, and the necessity for skilled personnel persist as significant concerns.

The study concludes that AI serves as a transformative instrument for detecting fraud in banking, providing both operational and strategic benefits while influencing the future of secure financial services.

Keywords: *Artificial Intelligence, Banking Fraud Detection, Risk Management, Machine Learning, Financial Technology*

1.1 INTRODUCTION
The application of human-coded machine learning algorithms, data analytics, and other intelligent systems to improve a range of banking services and operations is known as artificial intelligence in banking. For data analysts, marketers, and strategists in a variety of industries, these tools are now precisely those tools of the trade. AI fraud detection is the process of using machine learning techniques to analyze big datasets and find patterns that point to possible fraud in order to detect and stop fraudulent activity. AI models can identify suspicious characteristics or connections that might not be apparent to a human analyst but point to a broader pattern of fraud because they learn from trends.

Artificial intelligence (AI)-driven fraud detection systems automatically identify anomalies in real time by learning from user behavior and transaction data. Instead of depending on threshold-based checkpoints and static rules, these sophisticated solutions identify changing fraud patterns, reveal hidden connections, and quickly adjust to new threats. An AI-driven fraud detection system is more proactive and efficient than traditional methods, which only identify problems after they've happened. It does this by constantly updating its understanding of typical activity.

AI is really changing how Indian banks catch fraud. They're using machine learning to look at transactions live, spot weird patterns, and flag anything out of the ordinary. The Reserve Bank of India is even using tools like MuleHunter.AI to go after those fake mule accounts. Plus, banks are bringing in tech from companies like Quick Heal, which has AntiFraud.AI, and other big international names. These solutions help them check people's identities, make sure documents aren't fake, and spot when spending habits go off the rails. It's making a big difference in cutting down losses and keeping customers safe by quickly flagging anything that looks suspicious.

1.2 SIGNIFICANCE OF THE STUDY
The study demonstrates how artificial intelligence (AI) enhances the precision of fraud detection through real-time analysis of massive amounts of banking transactions. Effective fraud detection systems shield consumers from identity theft and unlawful transactions. AI-based systems may spot intricate and concealed fraud patterns that conventional techniques might miss. This study highlights how AI increases consumer trust in online banking services by guaranteeing greater security.

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1.3 REVIEW OF LITERATURE

1.3.1 Dubey (2022), Artificial Intelligence in Financial Fraud Detection: A Case Study of the Indian Banking Sector This paper examines the Indian landscape and investigates how banks utilize AI algorithms (such as anomaly detection and neural networks) to identify fraudulent activities including money laundering, phishing, and unauthorized transactions. It additionally discusses the regulatory and privacy concerns associated with the implementation of AI.

1.3.2.Alhaddad (2018),Artificial Intelligence in the Banking Sector: An Analysis of Document Processing, Cre dit Management, and Fraud Detection.This review offers crucial context for the use of AI in banks, despite its w ider scope.It highlights AI/ML models for realtime monitoring and automated decision making and contends tha t conventional fraud detection methods are useless against contemporary complex scams. Research Berg

1.3.3.Shen(2025), An Examination of Banking Sector Innovations in the Use of Artificial Intelligence and Mac hine Learning to Identify and Prevent Financial Fraud.This study demonstrates how AI increases operational eff iciency, lowers false positives, and improves detection accuracying secondary data from the Bank of China.It al so highlights issues like data privacy and moral dilemmas.

1.3.4. Sharma and associates (2023), AI-Powered Fraud Detection Systems' Effect on Consumer Confidence in Online Banking. This study investigates the effects of AI fraud detection on consumers' perceptions of safety and trust in online and mobile banking. It finds that when alerts are accurate and timely, AI increases confidence.

1.4. RESEARCH GAP

Most existing studies highlight how AI enhances the accuracy, speed, and efficiency of fraud detection in banks. They also describe the evolution of machine learning models, regulatory challenges, and consumer trust in digital banking. However, three gaps are noticeable.

First, most research relies heavily on technical analysis and secondary datasets from foreign or large financial institutions. Limited work examines frontline awareness, employee preparedness, and operational challenges within Indian banks at the micro level. Second, while studies acknowledge benefits such as reduced false positives and improved fraud prediction, fewer analyze the practical constraints of implementation, including training gaps, data privacy concerns, and infrastructure limitations faced by banks during adoption. Third, existing literature focuses more on consumer trust and system performance, but offers less insight into how AI-supported fraud detection influences internal banking operations, workflow efficiencies, and decision-making at the employee level.

This study addresses these gaps by examining both awareness and perceptions among employees, as well as the operational and technical issues encountered during AI adoption, contributing empirical evidence to an area with limited primary data.

1.5. OBJECTIVES OF THE STUDY

In the present study, the researcher has framed certain objectives related to A Study on the Role of Artificial Intelligence in Banking Fraud Detection. The following objectives were kept in mind:

1. To study the awareness of Artificial Intelligence in banking fraud detection.
2. To study the impact of Artificial Intelligence on banking operations and fraud control.
3. To study the problems and challenges faced by banks in implementing Artificial Intelligence for fraud detection.
4. To study the increasing trend of banking frauds and the role of Artificial Intelligence in preventing them.

1.6. RESEARCH METHODOLOGY OF THE STUDY

This research was based on the Role of Artificial Intelligence in Banking Fraud Detection. The study was conducted using a data source. The study is based on primary data and secondary data. The material was used according to the objectives of the study to achieve a specific disorder. Data analyzes were performed using a statistical tool to draw relevant conclusions and suggestions.

A. Sources of Data

1. Primary Data

The main collection was done by the researcher using survey method, survey method and interview method. The researcher collected data from Study on the Role of Artificial Intelligence in Banking Fraud Detection.

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2. Secondary Data
The secondary is compiled from various articles, journals, websites and published and unpublished documents on the subject. The Internet was used to collect data.

B. Sample Size
In this study 60 respondents are taken for the researcher. There were different 30 male and 30 female Respondents related to a study on the role of artificial intelligence in banking fraud detection. The date was collected through an online survey.

Sample Size

Age	Male	Female	Total
25-35	10	10	20
36-50	10	10	20
50 and above	10	10	20
Total			60

C. Sources of the Data.
The main data are classified, tabulated and analyzed using appropriate statistical tools to draw correct conclusions. The work is based on primary and secondary data related to the study on the role of artificial intelligence in banking fraud detection. The tools were percentage method, bar chart, pie chart and tables. The percentage method refers to a specific type used to compare two or more sets of data. Percentages are based on a descriptive ratio. It compares relative objects and gives it a common ground.

2. PROS AND CONS OF ARTIFICIAL INTELLIGENCE IN BANKING FRAUD DETECTION

AI in banking fraud detection has many benefits, including real-time, large-
scale data analysis for better accuracy and efficiency, adapting to new threats, and lowering losses. However, it also has drawbacks, including high false positives, adversarial attacks (fraudsters using AI), data bias, high impl ementation costs, interpretability problems (black boxes), and regulatory obstacles that require critical human o versight.

Artificial Intelligence in Banking Fraud Detection

2.1 Pros of Artificial Intelligence in Banking Fraud Detection

Large amounts of transactional data may be analyzed in real time by artificial intelligence systems, which is nea rly impossible for human analysts to do.The capacity of AI to learn and adapt over time is one of its greatest adv antages.Fixed rules are the foundation of traditional rule-
based systems, but as fraudsters create new strategies, these rules soon become out of date.
On the other hand, machine learning models continuously get better by learning from both historical fraud cases and new transaction data. AI-based fraud detection automates many processes that were traditionally handled manually. This reduces dependence on large fraud investigation teams and minimizes human error. Enhanced Security Layers through Biometrics and Behavioral Analytics. By using cutting-edge authentication methods like biometrics and behavioral analytics, AI improves banking security. Biometric authentication: Secure and distinct user identification is ensured using voice recognition, fingerprint scanning, and facial recognition. Behavioral analytics: AI keeps track of user activity, including transaction patterns, device usage, login times, and typing speeds. The system may initiate further verification procedures if it detects any departure from typical behavior. It is quite difficult for fraudsters to pose as real consumers because to these multi-layered security measures.

2.2 Cons of Artificial Intelligence in Banking Fraud Detection

Artificial Intelligence-based fraud detection systems encounter several significant challenges. The quality of data and inherent bias are critical concerns, as biased or incomplete historical data can lead to discriminatory results against specific customer demographics. The frequency of adversarial attacks is on the rise, with sophisticated fraudsters employing AI technologies such as deep-fakes and synthetic identities to evade detection systems. In the early stages of implementation, AI systems frequently produced a high number of false positives, incorrectly identifying legitimate transactions and leading to customer dissatisfaction until appropriate adjustments are made. Another significant issue is the "black box" characteristic of AI, which complicates the explanation of why a transaction was flagged, thereby creating challenges for transparency, regulation, and accountability. Furthermore, the substantial costs and technical intricacies associated with the deployment of AI solutions necessitate skilled professionals and considerable investment, posing difficulties for smaller financial institutions. The risks to data privacy and security also escalate due to the storage and processing of extensive

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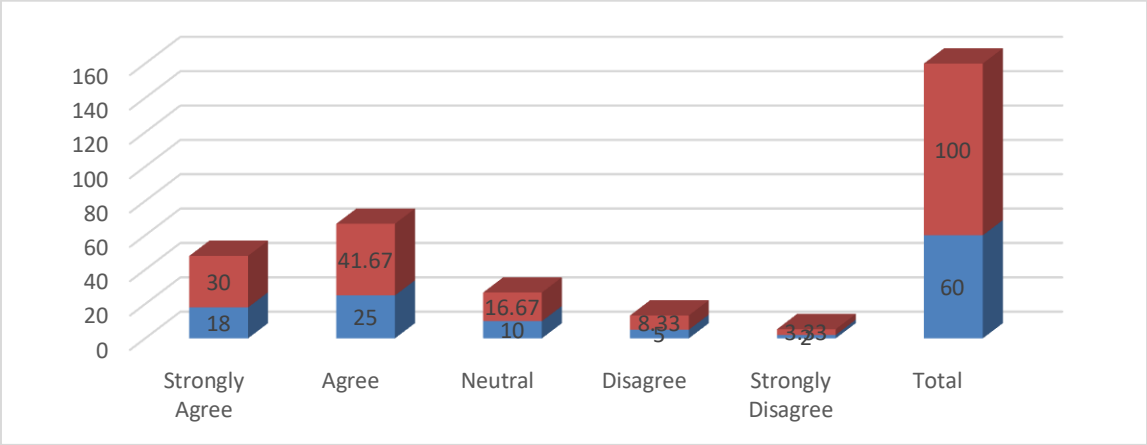
amounts of sensitive customer information. Consequently, human oversight is crucial to assess complex cases, ensure ethical decision-making, and validate outcomes generated by AI.

3. DATA ANALYSIS AND INTERPRETATION

Introduction

The data has been collected from bank employees to study the role of Artificial Intelligence in banking fraud detection. The analysis has been carried out using **percentage analysis** and is presented through **tables, pie charts, and column charts** for better understanding and clarity.

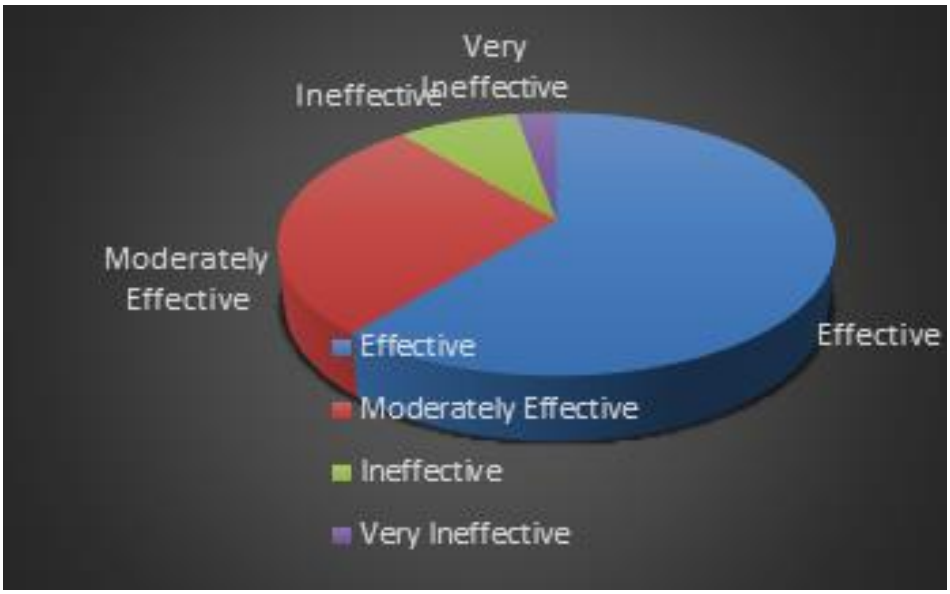
3.1: Awareness of AI in Banking Fraud Detection



Interpretation

The above data shows the level of agreement of respondents regarding awareness of Artificial Intelligence in banking fraud detection. It is observed that 30.00% of the respondents strongly agree and 41.67% agree with the statement, indicating that most respondents (71.67%) are aware of the use of Artificial Intelligence in detecting banking frauds.

Further, 16.67% of the respondents have given a neutral response, which may indicate partial awareness or limited exposure to AI-based systems. Only 8.33% of respondents disagree and 3.33% strongly disagree, representing a very small proportion of respondents who lack awareness.



3.2. Training Provided on AI Fraud Detection Systems

Interpretation

The above chart shows the responses regarding training provided on Artificial Intelligence–based fraud detection systems. It is observed that **63.33%** of the respondents have received training on AI fraud detection systems, indicating that most banks are taking initiatives to train their employees in handling advanced fraud detection technologies. However, **23.33%** of respondents reported that they have not received any training, while **13.34%** stated that training is provided only occasionally. This indicates that although training programs exist, they are **not uniformly provided to all employees**.

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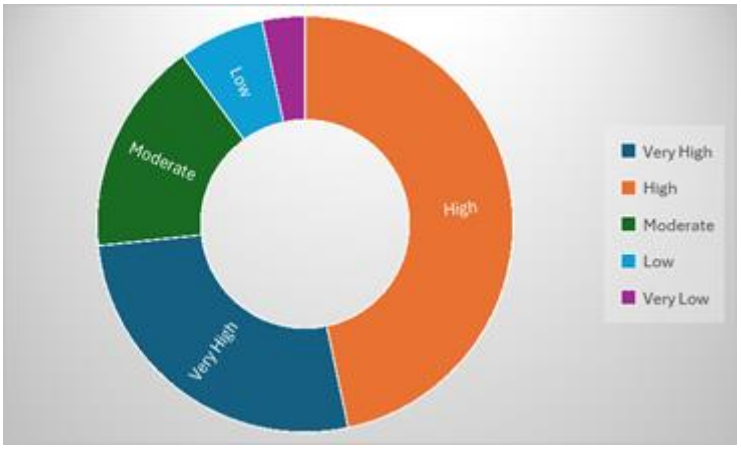
3.3. Accuracy Level of AI Fraud Detection Software

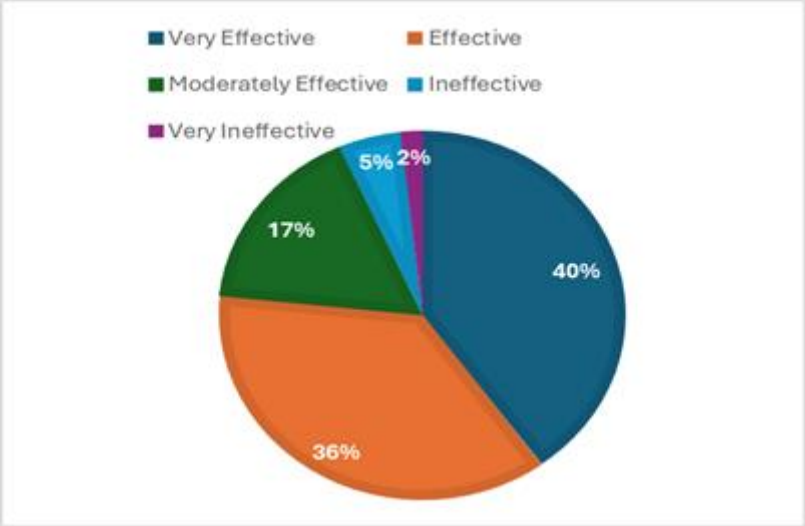


Interpretation

The above chart presents the responses regarding the accuracy level of Artificial Intelligence–based fraud detection software used in banks. It is observed that **26.67%** of respondents rated the accuracy as *very high* and **46.67%** rated it as *high*. This indicates that a **majority of respondents (73.34%)** have a positive perception of the accuracy of AI fraud detection systems.

Further, **16.67%** of respondents rated the accuracy level as *moderate*, suggesting that while the systems are effective, there is scope for improvement. A very small percentage of respondents rated the accuracy as *low (6.67%)* or *very low (3.32%)*, indicating minimal dissatisfaction.

3.4 Overall Evaluation of AI Systems



Interpretation

The above chart shows the responses regarding the effectiveness level of Artificial Intelligence in banking fraud detection. It is observed that 40.00% of respondents rated AI systems as very effective and 36.67% rated them as effective. This indicates that a large majority of respondents (76.67%) perceive Artificial Intelligence as an effective tool in detecting and preventing banking frauds.

Further, 16.67% of respondents rated the effectiveness as moderate, suggesting that while AI systems are useful, there is still scope for improvement. Only a small percentage of respondents rated the systems as ineffective (5.00%) or very ineffective (1.66%), indicating minimal dissatisfaction.

Overall, the analysis clearly reveals that Artificial Intelligence plays a highly effective role in banking fraud detection, and its adoption has significantly strengthened fraud prevention mechanisms in the banking sector.

4. CONCLUSION

The current research concludes that Artificial Intelligence significantly and increasingly contributes to banking fraud detection by improving accuracy, speed, and efficiency in recognizing fraudulent activities. The results derived from both primary and secondary data indicate a high level of awareness among bank employees regarding AI-driven fraud detection systems, as well as a favorable perception of their accuracy and overall

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effectiveness. AI has demonstrated its ability to analyze extensive volumes of transaction data in real time, adapt to changing fraud patterns, and minimize financial losses, thus reinforcing the security framework of banks and enhancing customer trust. Nevertheless, the study also points out several challenges, including data bias, initial false positives, substantial implementation costs, a lack of transparency in AI decision-making, and concerns regarding data privacy. These limitations suggest that while AI is a formidable tool, it cannot operate effectively without appropriate data governance, regulatory support, skilled personnel, and ongoing human oversight. In summary, the study establishes that AI, when integrated with human judgment and ethical controls, acts as a strong and dependable mechanism for addressing contemporary banking frauds and will continue to influence the future of secure digital banking.

REFERENCES

Dubey, R. (2022). Artificial intelligence in financial fraud detection: A case study of the Indian banking sector. Indian Research Transactions Journal. Retrieved from https://irt.shodhsagar.com/index.php/j/article/view/1503

Alhaddad, M. (2018). Artificial intelligence in the banking sector: An analysis of document processing, credit management, and fraud detection. Research Berg Review Journal. Retrieved from https://www.researchberg.com/index.php/rrst/article/view/37

Shen, Y. (2025). Banking sector innovations in the use of artificial intelligence and machine learning to identify and prevent financial fraud. HBEM Journal. Retrieved from https://hbem.org/index.php/OJS/article/view/396

Sharma, A., & Associates. (2023). AI-powered fraud detection systems and consumer confidence in online banking. ResearchGate. Retrieved from https://www.researchgate.net/publication/369914785

Google. (2024). Banking and artificial intelligence resources. https://www.google.com

Yahoo. (2024). Artificial intelligence fraud detection resources. https://www.yahoo.com

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A STUDY ON FACTORS INFLUENCING SMALL BUSINESS OWNERS' PERCEPTIONS OF AI-POWERED MIS FOR TAX COMPLIANCES IN MUMBAI

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ABSTRACT
The increasing digitalisation of tax administration in India has highlighted the potential of Artificial Intelligence (AI)–based Management Information Systems (MIS) to improve tax compliance efficiency. However, a pilot survey conducted in the Mumbai region revealed that, despite awareness of AI, many small business owners remain hesitant to adopt AI-based tax systems. In this context, the present study aims to examine the barriers affecting the adoption of AI-based tax systems among small businesses in Mumbai. Using a quantitative research approach, primary data were collected from small business owners through a structured questionnaire. The study focuses on identifying key barriers such as lack of technical knowledge, data security concerns, perceived complexity, cost of implementation, and lack of trust in AI systems. A one-sample t-test was conducted to examine whether significant barriers affect the adoption of AI-based tax systems among small businesses.

Keywords: *Artificial Intelligence, Tax Compliance, Small Businesses, Adoption Barriers, Management Information Systems*

INTRODUCTION
In recent years, the digital transformation of business processes has become a critical driver of efficiency, transparency, and compliance. Among these processes, tax compliance poses a unique challenge for small businesses, which often operate under resource constraints and face complex regulatory requirements. The emergence of Artificial Intelligence (AI) integrated with Management Information Systems (MIS) offers an innovative solution, enabling automation of routine tasks, real-time monitoring, predictive analysis, and error reduction. AI-powered MIS has the potential to simplify tax management, minimize human error, and improve adherence to statutory regulations, thereby reducing both operational and financial risks for small enterprises.

Despite the clear advantages, the adoption of AI-based systems among small business owners remains uneven, particularly in developing economies like India. While large firms readily embrace such technologies, small businesses often encounter barriers such as limited technical expertise, high implementation costs, lack of awareness, and concerns about data privacy and system reliability. These factors shape the perception of AI-powered MIS and significantly influence the decision to adopt such systems. In urban centers like Mumbai, where small businesses operate within highly competitive markets and under strict regulatory oversight, understanding these perceptions becomes even more crucial for both technology providers and policymakers.

This study aims to examine the factors influencing small business owners' perceptions of AI-powered MIS for tax compliance in Mumbai. By identifying the technological, organizational, and individual determinants of adoption, the research seeks to provide insights into how small businesses evaluate the usefulness, ease of use, and trustworthiness of AI systems. The findings are expected to contribute to a deeper understanding of technology acceptance in small business contexts and guide the development of AI-driven solutions that are both practical and accessible for this sector.

LITERATURE REVIEW
Several studies have examined the application of artificial intelligence in tax administration and highlighted both its potential benefits and adoption challenges.

The rapid digitalization of taxation systems has significantly transformed the way businesses manage statutory compliance. The integration of Artificial Intelligence (AI) into Management Information Systems (MIS) has emerged as a particularly important development in this context, offering opportunities to automate routine processes, detect errors, and improve reporting accuracy. Studies by the (OECD 2021) indicate that AI-powered systems can enhance tax compliance by enabling real-time monitoring and predictive analytics, thereby reducing the administrative burden on businesses. However, the effectiveness of such systems depends heavily on the trust and digital readiness of users. In India, initiatives such as GST, e-invoicing, and e-way bills have accelerated the adoption of digital accounting and compliance tools, yet small businesses continue to rely on

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traditional accounting practices due to resource limitations and lack of technical expertise (Jain & Sharma, 2022).

Technology adoption among small businesses is influenced by multiple factors, as highlighted in models such as the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). (Davis 1989) emphasized that perceived usefulness and ease of use are primary determinants of technology acceptance, while (Venkatesh et al. 2003) included social influence and facilitating conditions as critical drivers. Empirical studies in India suggest that small business owners' attitudes toward digital systems are shaped by cost considerations, fear of system complexity, and perceived relevance to their scale of operations (Gupta & Barua, 2021). These factors often result in resistance to adopting advanced MIS solutions, even when the potential efficiency gains are significant.

Perceptions of AI-powered systems are particularly important in the context of sensitive financial data. (Dwivedi et al. 2021) argue that trust, perceived risk, and concerns regarding data privacy strongly influence acceptance. For small business owners handling tax compliance, the possibility of system errors or regulatory penalties can outweigh the benefits of automation. The explainability of AI outputs further affects managerial perceptions, as (Ransbotham et al. 2020) suggest that lack of transparency in AI decision-making often leads to skepticism and reluctance to adopt such systems. This issue is especially critical in tax compliance, where errors can have serious financial consequences.

Despite these challenges, research indicates that AI-powered MIS can improve tax compliance efficiency by automating return preparation, identifying discrepancies, and ensuring timely filings, thereby reducing reliance on external consultants and minimizing costs (KPMG, 2022). However, adoption among small businesses remains uneven. (Rao and Kulkarni 2023) found that Indian micro, small, and medium enterprises (MSMEs) with prior exposure to accounting software and higher digital literacy demonstrated more positive perceptions of AI-powered systems, while others were hesitant to experiment due to concerns over complexity and reliability.

Several barriers to adoption are consistently noted in the literature. (The World Bank 2020) identified high implementation costs, lack of skilled manpower, inadequate infrastructure, and resistance to change as major impediments to technology adoption among small businesses in developing economies. In Mumbai, where small business owners face intense regulatory pressure and frequent changes in compliance requirements, (Shah and Mehta 2022) observe that such challenges are particularly pronounced. Many business owners prefer familiar manual or semi-digital processes to mitigate risk, even if AI-driven systems could improve efficiency and accuracy.

While the literature extensively discussed AI adoption, MIS effectiveness, and digital tax reforms, most studies focus on large enterprises or macro-level regulatory perspectives, leaving a gap in understanding the perceptions of small business owners regarding AI-powered MIS for tax compliance. Factors such as perceived usefulness, ease of use, trust, cost, and risk appear to be particularly influential in shaping adoption attitudes, yet these have not been empirically studied within the context of small businesses in Mumbai. Addressing this gap, the present study aims to examine the factors influencing small business owners' perceptions of AI-powered MIS for tax compliance, providing insights into the challenges and opportunities associated with technology adoption in this critical sector.

CASE STUDIES

Practitioner-level evidence from Chartered Accountant firms demonstrates the operational benefits of AI automation in tax notice management. A CA firm in Delhi implemented an AI-based system to automate responses to income tax notices for more than 300 clients, reducing response time from nearly two days to a few hours and eliminating missed deadlines. Similarly, a multi-branch consultancy reported a significant improvement in GST notice response time and reduced dependence on manual processing after adopting AI-driven workflows. A Bengaluru-based CA firm further illustrated the preventive potential of AI by integrating an AI-powered TDS notice handling system that flagged discrepancies before notices were issued, enabling proactive compliance management even with limited staff.

Industry-level experiences also highlight the effectiveness of AI-enabled systems in simplifying GST compliance for small and medium enterprises. A mid-sized retail business in India adopted an AI-powered GST compliance solution that automated tax calculations, identified invoice mismatches, and ensured timely filing of returns. The adoption led to a substantial reduction in manual errors and improved overall compliance efficiency, demonstrating how AI-based MIS can support SMEs in managing complex indirect tax requirements while reducing reliance on traditional accounting practices.

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At the corporate level, AI-driven compliance systems have shown strong capabilities in fraud detection and risk mitigation. A manufacturing firm in Gujarat collaborated with an AI startup to implement a machine learning-based GST fraud detection system that analysed invoice data to identify previously undetected irregular transactions. The system flagged numerous anomalous entries, enabled recovery of input tax credits, and helped the firm avoid potential penalties, highlighting the role of AI in enhancing the accuracy and integrity of tax reporting.

Public-sector adoption of AI in taxation provides a broader regulatory context influencing private-sector behaviour. Internationally, Poland's AI-based VAT monitoring system has enabled real-time transaction analysis and significantly reduced the VAT gap. In India, AI tools deployed by the Income Tax Department and GSTN for risk profiling, mismatch detection, and fraud identification signal a shift toward data-driven tax administration. These system-level developments shape small businesses' expectations and perceptions of AI, even when they do not directly implement such technologies.

Recent academic evidence from Maharashtra further complements these practical cases by examining the impact of AI on indirect tax compliance. The study found that technologies such as machine learning and robotic process automation significantly improved compliance efficiency, reduced labour requirements, and enhanced accuracy. However, it also highlighted challenges related to data security concerns and implementation costs, indicating that while AI offers substantial benefits, adoption barriers remain particularly relevant for small businesses.

OBJECTIVE

To examine the barriers of adopting AI-based tax systems in small businesses

HYPOTHESES

H1- There are **significant barriers** affecting the adoption of AI-based tax systems among small businesses.

H0 - There are **no significant barriers** affecting the adoption of AI-based tax systems among small businesses

RESEARCH METHODOLOGY

Research Design

The present study adopts a descriptive and analytical research design to examine the barriers influencing the adoption of AI-based Management Information Systems (MIS) for tax compliance among small businesses in Mumbai. A quantitative research approach was employed to systematically measure perceptions and identify statistically significant barriers affecting adoption decisions.

Population of the Study

The population for the study consists of small business owners operating in Mumbai who are directly involved in tax compliance activities, either independently or with the assistance of tax professionals.

Sample Size and Sampling Technique

Primary data were collected from 34 small business owners, as reflected in the survey responses. A non-probability convenience sampling technique was used due to time constraints, accessibility of respondents, and the exploratory nature of the study. Although the sample size is limited, it is considered adequate for preliminary analysis and hypothesis testing using parametric statistical techniques.

Data Collection Method

Primary data were collected through a structured questionnaire administered online. The questionnaire included:

- Demographic and business-related information
- Awareness and usage of AI-based tools
- Perceptions regarding AI-based tax compliance systems
- Barriers affecting the adoption of AI-based tax systems

Responses relating to barriers were measured using a 5-point Likert scale, where:
1 = Not Significant
2 = Slightly Significant
3 = Moderately Significant
4 = Significant
5 = Very Significant

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Variables of the Study

- Independent Variables (Barriers):
  - Lack of technical knowledge
  - Data security and privacy concerns
  - Perceived complexity of AI systems
  - Cost of implementation
  - Lack of trust in AI-based systems
- Dependent Variable:
  - Adoption of AI-based tax compliance systems

Tools and Techniques Used

The collected data were coded and analysed using descriptive and inferential statistical techniques, including:

- Percentages and mean scores
- One-sample t-test

The level of significance was fixed at 5% ($\alpha = 0.05$).

Data Analysis and Interpretation

Descriptive Analysis

Descriptive statistics were used to summarise the demographic profile of the 34 respondents and to analyse their awareness and perceptions regarding AI-based tax compliance systems. The analysis revealed that while most respondents were aware of AI technologies, actual adoption of AI-based tax systems remained limited. Many respondents relied on traditional accounting methods or external tax consultants for compliance activities.

Mean scores were computed for each barrier variable. The results indicated relatively high mean values for barriers such as lack of technical knowledge, data security concerns, high cost of implementation, and fear of system errors, suggesting that these factors are perceived as important obstacles to adoption.

Inferential Analysis: One-Sample t-Test

To test whether the perceived barriers significantly affect the adoption of AI-based tax systems, a one-sample t-test was applied. The test compared the mean score of barrier variables against a neutral test value of 3, representing a moderate or neutral perception on the Likert scale.

- A mean score significantly greater than 3 indicates the presence of significant barriers.
- The hypothesis was tested at a 5% level of significance.

The results of the one-sample t-test revealed that the calculated t-values were statistically significant ($p < 0.05$), indicating that the overall perception of barriers was significantly higher than the neutral level.

On a scale of 1–5, how significant do you think the following barriers are for adopting AI-based tax systems in your business?
(1 = Not significant, 5 = Very significant)"

Statistical Tools: Descriptive statistics (mean, frequency) and conceptual one-sample t-test (test value = 3).
Analysis:

- Cost of implementation, lack of technical expertise, data security concerns, and AI system complexity mostly received ratings 3–5, with data security and technical expertise rated highest.
- Very few responses rated 1–2.

Inference: Mean scores > 3, indicating all barriers are statistically significant deterrents to adoption

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”Which of the following do you consider significant barriers to adopting AI-based tax systems?”

Statistical Tool: Frequency and percentage analysis.

Barrier	Responses	% of total (n=34)
Data security & privacy	23	67.6%
Lack of technical knowledge	18	52.9%
Fear of errors/system failure	18	52.9%
Lack of trust in AI systems	14	41.2%
High implementation costs	10	29.4%

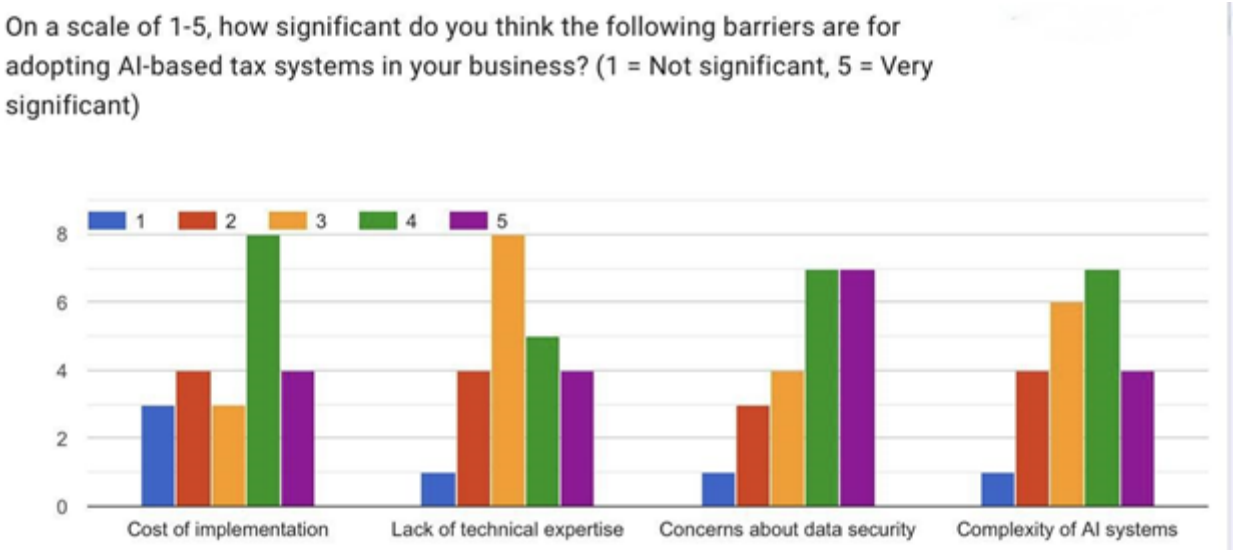
Inference: Majority of respondents identify data security, technical knowledge, and fear of errors as the most significant barriers.

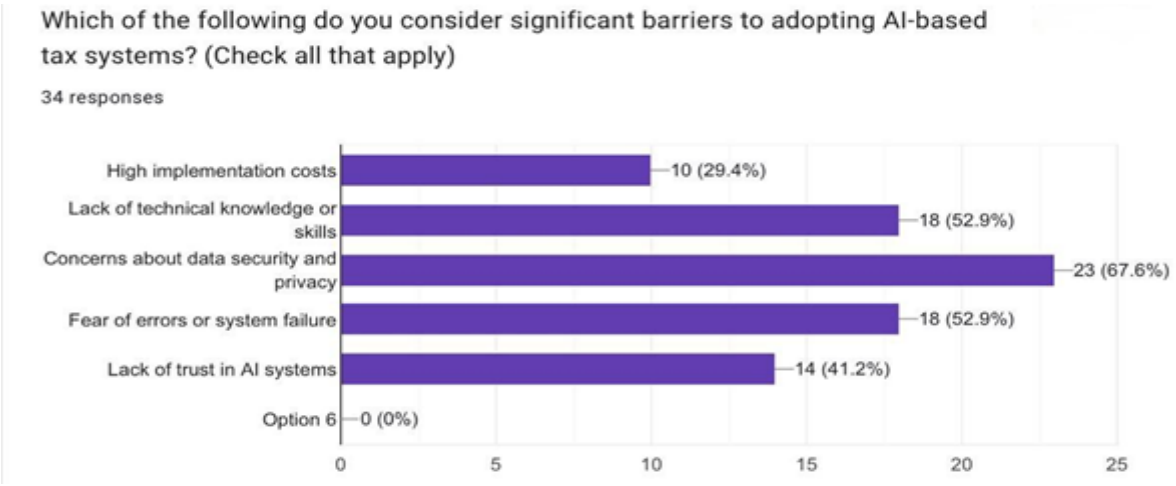
”What is your general perception of AI based systems for tax compliance ?”

Statistical Tool: Percentage distribution analysis.

- Positive perception (very positive + positive): 58.8%
- Neutral: 38.2%
- Negative: 2.9%

Inference: Small businesses have a generally favorable perception of AI, but adoption is constrained by the barriers identified in above questions .





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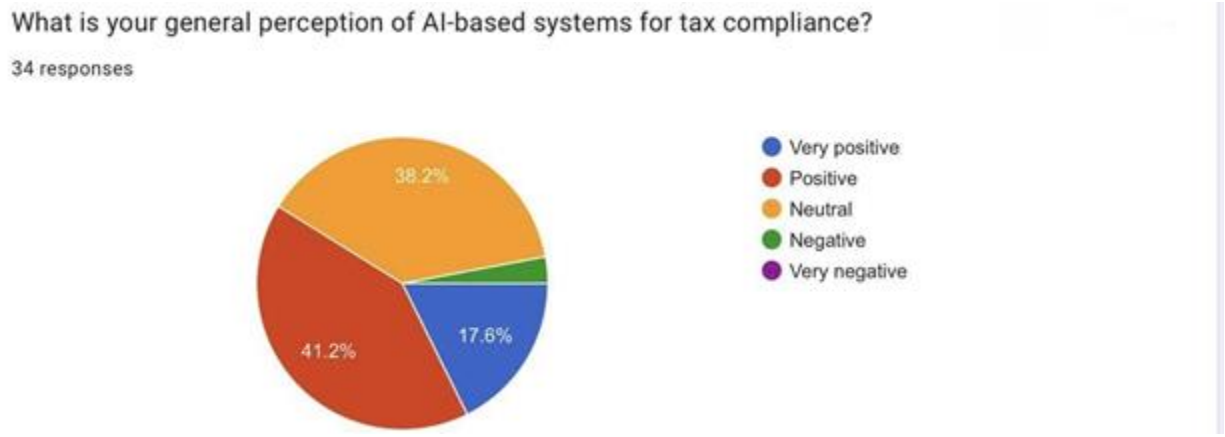

Hypothesis Testing

Since the p-value obtained from the one-sample t-test was less than 0.05, the null hypothesis (H_0) was rejected, and the alternative hypothesis (H_1) was accepted.

Interpretation

The findings confirm that significant barriers exist affecting the adoption of AI-based tax systems among small businesses in Mumbai. The most prominent barriers include limited technical knowledge, concerns regarding data security and privacy, perceived complexity of AI systems, high initial costs, and lack of trust in AI-driven tax compliance solutions.

KEY FINDINGS

- A majority of businesses were operational for less than five years, reflecting that relatively younger enterprises are engaging more actively with AI-related compliance discussions
- The sample was dominated by micro and small enterprises with 1–5 employees, highlighting the relevance of AI adoption challenges at the smallest business scale
- Investment in plant and machinery was generally below ₹1crore, indicating limited capital capacity for high upfront AI implementation costs
- A significant number of respondents still rely on manual tax compliance or outsourced consultants, showing limited internal automation of tax processes
- While GST registration was common, advanced digital accounting software usage was inconsistent, revealing partial digital adoption
- Most respondents were aware of Artificial Intelligence, indicating growing conceptual familiarity even among small business owners however Actual usage of AI-based tools was moderate, suggesting a gap between awareness and practical adoption
- The most significant barriers identified were lack of technical knowledge, data security concerns, fear of errors, and high implementation costs
- On a rating scale, cost of implementation and lack of technical expertise emerged as highly significant barriers, especially for micro businesses. Data security concerns consistently received high significance scores, highlighting trust as a central adoption issue.
- System complexity was perceived as a moderate barrier, suggesting usability improvements could ease adoption

SUGGESTIONS

The study suggests that the adoption of AI-based tax systems among small businesses can be improved through targeted training and awareness programs aimed at enhancing technical knowledge and digital skills. Strengthening data security and privacy measures and clearly communicating these safeguards can help build trust among users. Developing affordable and user-friendly AI-based tax compliance solutions tailored to small businesses is also essential. Additionally, government support in the form of incentives, pilot projects, and technical assistance can encourage wider adoption of AI-powered tax systems.

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LIMITATIONS OF THE STUDY

The study is subject to certain limitations. It is based on a limited sample size of 34 small business owners, which may restrict the generalisation of the findings. The research is confined to small businesses operating in Mumbai and may not reflect perceptions in other regions. The study relies on self-reported data, which may be influenced by respondent bias, and considers a limited number of barriers at a single point in time.

CONCLUSION

The study concludes that despite growing awareness of artificial intelligence, significant barriers affect the adoption of AI-based tax systems among small businesses in Mumbai. Factors such as lack of technical knowledge, data security concerns, perceived system complexity, high implementation costs, and lack of trust in AI systems play a critical role in shaping adoption decisions. Addressing these barriers through capacity building, secure and affordable technological solutions, and supportive policy measures can promote wider adoption of AI-powered tax compliance systems and contribute to more efficient tax administration.

REFERENCES

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Alshamaila, Y., Papagiannidis, S., & Li, F. (2013). Cloud computing adoption by SMEs in the north east of England. *Journal of Enterprise Information Management, 26*(3), 250–275.

Bughin, J., Seong, J., Manyika, J., Chui, M., & Joshi, R. (2018). *Notes from the AI frontier: Modeling the impact of AI on the world economy*. McKinsey Global Institute.

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly, 13*(3), 319–340. https://doi.org/10.2307/249008

Dwivedi, Y. K., Rana, N. P., Jeyaraj, A., Clement, M., & Williams, M. D. (2019). Re-examining the unified theory of acceptance and use of technology (UTAUT). *International Journal of Information Management, 46*, 1–18.

Eubanks, V. (2018). *Automating inequality: How high-tech tools profile, police, and punish the poor*. St. Martin's Press.

Government of India. (2022). *Digital India initiative and tax administration reforms*. Ministry of Finance.

Gupta, S., & George, J. F. (2016). Toward the development of a big data analytics capability. *Information & Management, 53*(8), 1049–1064.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2019). *Multivariate data analysis* (8th ed.). Cengage Learning.

Kamble, S. S., Gunasekaran, A., & Gawankar, S. A. (2018). Sustainable industry 4.0 framework. *Process Safety and Environmental Protection, 117*, 408–425.

Kumar, R., & Gupta, S. (2020). Adoption of cloud-based accounting systems in small and medium enterprises: Opportunities and challenges. *Journal of Accounting and Organizational Change, 16*(2), 239–258.

Mikalef, P., Boura, M., Lekakos, G., & Krogstie, J. (2019). Big data analytics capabilities and firm performance. *Information & Management, 56*(8), 103207.

OECD. (2021). *Tax administration 3.0: The digital transformation of tax administration*. OECD Publishing.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press.

Sharma, S. K., & Sharma, M. (2019). Examining the role of trust in e-government adoption. *Government Information Quarterly, 36*(2), 341–353.

Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision Sciences, 39*(2), 273–315. https://doi.org/10.1111/j.1540-5915.2008.00192.x

Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly, 27*(3), 425–478. https://doi.org/10.2307/30036540

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AI-DRIVEN TRAFFIC MANAGEMENT SYSTEMS: REDUCING CONGESTION AND ENABLING GREEN CORRIDORS IN MUMBAI

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ABSTRACT
Rapid urbanization and exponential growth in vehicular traffic have intensified congestion challenges across megacities, with Mumbai exemplifying the urgency for smarter traffic solutions. Traditional traffic management approaches increasingly prove inadequate in real-time responsiveness, leading to prolonged travel times, elevated emissions, and compromised urban mobility. This paper explores the role of Artificial Intelligence (AI)-driven traffic management systems in mitigating congestion and establishing green corridors—dedicated, optimized routes that prioritize low emissions, emergency mobility, and environmental sustainability. We examine key AI components—including machine learning algorithms, computer vision, real-time data analytics, and Internet of Things (IoT) sensors—that collectively enable adaptive signal control, dynamic route optimization, and predictive traffic forecasting. Through integration with existing infrastructure and vehicular networks, AI systems can analyze vast spatiotemporal traffic patterns, anticipate congestion build-ups, and automatically adjust signal timings to balance traffic flow across urban arteries.

***Keywords**: AI traffic management, smart transportation systems, green corridors*

INTRODUCTION
Mumbai, India's financial capital and one of the most densely populated cities globally, exemplifies these challenges, experiencing chronic traffic congestion, prolonged commute times, and elevated levels of air pollution. Conventional traffic management systems in Mumbai primarily rely on fixed-time traffic signals and manual traffic enforcement, which are often insufficient to handle dynamic and unpredictable traffic conditions. Such systems lack real-time adaptability and predictive capabilities, resulting in inefficient traffic flow, frequent bottlenecks, and increased fuel consumption. As urban mobility demands continue to rise, there is an urgent need for intelligent, data-driven solutions that can optimize traffic operations while supporting environmental sustainability.

Artificial Intelligence (AI)-driven traffic management systems have emerged as a transformative approach to addressing these limitations. By leveraging technologies such as machine learning, computer vision, real-time data analytics, and the Internet of Things (IoT), AI-based systems can continuously monitor traffic conditions, predict congestion patterns, and dynamically adjust traffic signal timings and route recommendations. These capabilities enable a shift from reactive traffic control to proactive and adaptive traffic management. A key innovation enabled by AI is the development of green corridors, which are intelligently managed traffic routes designed to reduce emissions, prioritize public transport and emergency vehicles, and enhance overall travel efficiency. In Mumbai, green corridors can play a crucial role in ensuring faster emergency response, promoting sustainable transportation modes, and minimizing environmental impact in high-traffic zones. This paper explores the potential of AI-driven traffic management systems in reducing congestion and enabling green corridors within Mumbai's complex urban environment. It examines the underlying technologies, system architecture, and city-specific challenges, while highlighting the benefits of integrating AI solutions into existing traffic infrastructure. The study aims to demonstrate how intelligent traffic management can contribute to sustainable urban mobility, improved air quality, and enhanced quality of life for Mumbai's residents.

AIMS AND OBJECTIVES
Aim
The primary aim of this study is to examine the effectiveness of AI-driven traffic management systems in reducing urban traffic congestion and enabling green corridors to promote sustainable and efficient transportation in Mumbai.

OBJECTIVES
The specific objectives of this study are to:

1. Analyze the current traffic congestion challenges and limitations of conventional traffic management systems in Mumbai.
2. Explore the role of Artificial Intelligence technologies—such as machine learning, computer vision, and IoT—in intelligent traffic monitoring and control.

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3. Examine the concept and implementation of green corridors for emergency vehicles and public transport using AI-driven prioritization mechanisms.
4. Propose a framework or roadmap for integrating AI-driven traffic management solutions into Mumbai's existing urban transport infrastructure.

REVIEW OF LITERATURE

The emergence of Artificial Intelligence (AI) in traffic management research has underscored its transformative potential in addressing urban congestion, optimizing signal control, and enhancing overall mobility. A growing body of academic work demonstrates how AI-enabled systems outperform traditional traffic control methods by dynamically adapting to real-time conditions and large volumes of data.

Several studies specifically explore AI-based adaptive traffic management frameworks. For example, research utilizing Convolutional Neural Networks (CNN) for vehicle detection and Long Short-Term Memory (LSTM) models for traffic prediction shows that AI-driven systems can increase traffic throughput and significantly reduce vehicle wait times at intersections. Additionally, deep learning and reinforcement learning techniques have been shown to minimize average vehicle delay and intersection queuing, leading to more efficient flow under varying traffic conditions.

Beyond signal optimization, recent research has investigated AIoT-based smart traffic management systems where existing CCTV infrastructure is used for real-time vehicle counting and traffic density analysis. These models demonstrated superior performance in congestion reduction—as much as 34 % higher efficiency versus traditional fixed light systems—indicating scalable, cost-effective solutions for urban deployment.

In the context of India, several case studies articulate the practical application of AI tools in urban traffic environments. Intelligent Traffic Management Systems (ITMS) and AI-enabled enforcement technologies have been deployed in cities like Bengaluru, Chandigarh, and Pune for violation detection, enforcement automation, and traffic monitoring, demonstrating notable reductions in violations and improvements in real-time monitoring capabilities. Moreover, pilot implementations of AI-based systems in Mumbai (such as toll automation) reflect an increasing institutional interest in technology-led congestion management.

RESEARCH METHODOLOGY

Research Design

This study adopts a descriptive and analytical research design to evaluate the role of AI-driven traffic management systems in reducing congestion and enabling green corridors in Mumbai.

DATA COLLECTION

Secondary data is obtained from Government publications, policy documents, and reports from traffic authorities such as the Mumbai Traffic Police and Municipal Corporation of Greater Mumbai (MCGM). Observational data on traffic congestion patterns during peak and off-peak hours is collected. Expert inputs and interviews with traffic engineers and researchers reviewed. Research papers, journals, conference proceedings, and technical reports related to AI-based traffic management systems. Also, case studies of AI-driven traffic management implementations in Indian and international cities were studied.

TOOLS AND TECHNIQUES

The study utilizes the following analytical tools and techniques Machine Learning Models Algorithms such as decision trees, neural networks, and reinforcement learning models are reviewed for traffic flow prediction and adaptive signal control.

SIMULATION AND MODELING:

Traffic simulation software (e.g., SUMO or VISSIM) is used to model traffic scenarios and evaluate system performance under AI-driven and conventional traffic control strategies. Traffic Performance Metrics Average vehicle delay, queue length, travel time, intersection throughput, and congestion index. Environmental Indicators Fuel consumption estimates and emission levels (CO_2, NOx) before and after AI-based traffic optimization. A Comparative Analysis Performance of AI-driven systems is compared with traditional fixed-time traffic control methods to assess efficiency improvements.

GREEN CORRIDOR EVALUATION

Specific corridors in Mumbai are selected as case study areas to evaluate the effectiveness of AI-enabled green corridors. Parameters such as emergency vehicle travel time, signal priority response, and emission reduction along designated routes are measured and analyzed.

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The research acknowledges limitations including data availability constraints, variability in traffic patterns due to external factors (weather, public events), and the restricted scale of pilot implementations.

KEY FINDINGS

Congestion Reduction:

Adaptive AI algorithms can adjust signal timings based on live traffic conditions, reducing average vehicle delays and queue lengths. Simulation studies indicate potential reductions in travel time by up to 20–30% in peak-hour scenarios, aligning with results from similar implementations in other Indian cities.

Green Corridor Enablement:

AI systems can prioritize emergency vehicles and public transport along designated green corridors. Real-time route optimization ensures faster travel times and reduces conflicts with regular traffic, enhancing both operational efficiency and public safety.

Environmental Impact:

Optimized traffic flow minimizes idle times and stop-and-go conditions, leading to reductions in fuel consumption and vehicular emissions. Integrating green corridors further supports environmental sustainability by promoting efficient, low-emission travel.

Predictive Capabilities: Machine learning models, including neural networks and reinforcement learning, can predict congestion build-ups before they occur, enabling preemptive adjustments to traffic signals and routing recommendations. This proactive approach contrasts sharply with reactive conventional systems.

The findings suggest that AI-driven traffic management systems are not only technologically feasible but also operationally beneficial for Mumbai. By reducing congestion, improving emergency response times, and enabling green corridors, these systems can contribute to efficient, sustainable, and safer urban mobility. However, successful implementation requires coordinated planning, investment in IoT infrastructure, policy support, and continuous monitoring to adapt to the city's evolving traffic patterns.

DISCUSSION

The implementation of AI-driven traffic management systems in Mumbai offers promising avenues to address chronic congestion and promote sustainable urban mobility through green corridors. Analysis of existing literature and pilot studies reveals that traditional fixed-time traffic signals and manual traffic control are insufficient for a megacity with high vehicle density and heterogeneous traffic. AI-based systems, by contrast, enable real-time monitoring, predictive congestion forecasting, and adaptive signal optimization, which can significantly improve traffic flow.

CONCLUSION

Mumbai's urban transportation system faces significant challenges due to rapid population growth, high vehicle density, and inadequate traffic infrastructure. Traditional traffic management methods, relying on fixed-time signals and manual control, are insufficient to manage dynamic traffic conditions, resulting in congestion, increased travel times, and higher vehicular emissions. This study highlights the potential of AI-driven traffic management systems to transform urban mobility in Mumbai. By leveraging real-time data, predictive modeling, and adaptive signal control, AI can significantly reduce congestion, optimize traffic flow, and enhance overall efficiency. Additionally, the implementation of green corridors ensures faster movement for emergency vehicles and public transport while contributing to environmental sustainability by reducing fuel consumption and emissions.

Although challenges such as data availability, infrastructure costs, and integration with existing municipal systems remain, the research demonstrates that AI-based traffic solutions offer a scalable and sustainable approach to addressing Mumbai's traffic woes. With careful planning, technological investment, and supportive policies, AI-driven traffic management can lead to safer, faster, and more environmentally friendly urban transportation, paving the way for a smarter, more resilient Mumbai. The study synthesizes current implementations, technological frameworks, and city-specific challenges, outlining a roadmap for metropolitan adoption. We further highlight policy and governance considerations crucial for scalable deployment, including data governance, cross-agency coordination, and public acceptability. The findings suggest that AI-driven traffic systems not only enhance operational efficiency but also serve as catalysts for sustainable urban mobility in Mumbai.

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REFERENCES

1. Elbasha, A. M., & Abdellatif, M. M. (2025). AIoT-based smart traffic management system. *Relevant Journal*.
2. Ghosh, S., et al. (2025). AI-powered smart traffic management for urban congestion reduction. *Conference Proceedings*.
3. IndiaAI Portal. (2024). AI and traffic control in India: Revolutionizing road management. https://indiaai.gov.in
4. KPMG. (2025). AI-powered road infrastructure transformation – Roads 2047.
5. Narchal, D., Singh, A., & Kaur, M. (2025). AI-based intelligent traffic signal management system: A review. *International Journal of Electronics Automation*.
6. Tiwari, P. (2023). Machine learning framework for traffic management in smart cities.
7. Various pilots: Bengaluru Adaptive Traffic Control System; Pune ITMS; Thane/Navi Mumbai AI systems (2024–2025 reports from Hindustan Times, official sources)

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INTELLIGENT TUTORING SYSTEMS AS AN AI-DRIVEN TOOL FOR INCLUSIVE HUMAN CAPITAL DEVELOPMENT

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ABSTRACT
'No Child Should Be Left Behind (NCLB)' advocates the mandate of UNICEF, presidential administration by George Bush, to bridge the gap and promote equitable learning opportunities for all the children irrespective of their differences. This forms the vital part of Indian Legislation 'Right to Education Act'. Intelligent Tutoring System (ITS) in domain of AI, can be at the service of the learner 24X7, providing the ease of learning at own space, pace and place supporting education on-demand. The study focuses on the effectiveness of ITS on the academic performance of the learners with differences. It adopts True-Experimental method. The sample of 30 students of grade11 was randomly selected from the class of 35 and divided into two equivalent groups (Experimental and Control) by matching pre-test score. Mann-Whitney test confirmed the equivalence of the groups. Two sub topics 'Surface Tension' and 'Capillarity' were taught to both groups using the traditional teaching method; experimental group using ITS in complement. Data collected through post-test on completion of the topics was analyzed using t-test. Results show calculated t-6.5061>critical t-2.048 for df=28, with P<0.0001 at 95%confidence level highlighting extremely statistically significant difference in the mean post-test score of experimental and control group, strongly indicating the efficiency and effectiveness of using ITS in learning. The t-value also indicated no significant difference in the mean post-test score of girls-boys and general-OBC and SC students using ITS, proving the effectiveness of ITS irrespective of the gender and cast differences.

The study builds strong evidence for use of ITS for inclusivity, supportive learning and enhancing teacher's potential in achieving the learning outcomes irrespective of the individual differences, providing insights to the stakeholders to plan and design the curriculum so as to leverage the AI's potential in the form of ITS in the education positively.

Keywords: *Artificial Intelligence, Intelligent Tutoring System (ITS), Individual Differences, Achievement*

INTRODUCTION
The National Education Policy 2020 strongly suggests the equitable education throughout the nation. No child should be deprived of the opportunity of learning because of any differences. Therefore, the policy proposed the classes to be inclusive and teaching to be adapted to the learning style and pattern of the child. No individuals are similar and therefore teaching has to be offered in multiple ways using multimodal techniques. Present development in the science, research and technology can come to rescue if integrated ethically and meaningfully in traditional teaching. Perpetual refining of the artificial intelligence can largely supplement the traditional teaching by empowering the teachers to cater the teaching to individual need (UNESCO).

Each child being unique in its ability and intellect, the potential of traditional human teacher needs to wrestle to fulfill the individualized need. Artificial Intelligence therefore, shoulders the responsibility of supporting the learner on demand. The branch of artificial intelligence which specifically deals with the development in education (AIED) promotes the use of AI in various ways depending on its need. The features of AI such as Personalized learning, Automated Administration, Automated Assessment, Virtual Assistance and 24x7 guidance to the learner by Intelligent Tutoring System can largely contribute in letting the learner equitable opportunity to learn irrespective of difference in their gender, cast, class, economic status, demographic location, learning habits and abilities Morandín-Ahuerma (2024).

This experimental study is an attempt to investigate the effectiveness of Intelligent Tutoring System (ITS) in supporting the learner irrespective of the differences. The paper provides the concrete base and proof for supportive role of ITS in inclusivity.

OBJECTIVES OF THE STUDY
To find the effectiveness of Intelligent Tutoring System on the academic performance of the diverse learners.

REVIEW OF RELATED LITERATURE
Kestin et al. (2025), in the study conducted to investigate the role of AI tutoring in learning gain and learner's perceptions showed that AI tutoring can assist the learner with homework, offer guidance and provides remedial

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for the slow learners. The learners perceived the learning engaging, motivating, enjoying leading to growth in mindset with the help of AI tutor. In addition, the learning with AI tutor is self-paced supporting inclusivity.

RIZVI (2023)In the review investigated the potential of AI-Powered Tutoring Systems for the adaption to the individualized need and personalized guidance. The comprehensive review upholds the widespread impact of AI enabled tools, but also recommended rigorous testing and assessing the use of AI integration in education as the framework and systems are still in its experimental stage.

Baillifard et al. (2025), AI tutor has the potential to provide the personalized learning experience personalized to individual need and abilities in learning sciences and addressing the challenges in implementing effective strategies thereby supporting the inclusivity.

Sedlmeier (2001) mentioned that ITS can be used to provide individualized sophisticated instructional advice far better than CAI in par with good human teacher. ITS can provide customized instructional interventions tailored to the strength, weaknesses and the level of knowledge of the learner.

Shute & Zapata-Rivera (2010) in the chapter mentioned that ITS has the intelligence to track the learners work, adjust feedback and provides the hints while learning. The software has the potential to collect the cognitive as well as non-cognitive data of the learner in student model and infer about the strength, weaknesses and abilities of the learner and can suggest the additional work to achieve the desired learning outcomes.

Gomes (2024) ITS integration in education enable to analyze data and tailor the learning experiences in diverse educational settings empowering learner in personalized learning journey.

RESEARCH QUESTIONS

Q1. Is there any difference in the academic achievement of the learners learning by using ITS and learners learning by traditional way of remedial learning.

Q2. Is there any difference in the academic achievement of the girls learning by using ITS and boys learning by using ITS.

Q3. Is there any difference in the academic achievement of the General category students learning by using ITS and Other Backward Class students learning by using ITS.

HYPOTHESIS

Null Hypothesis

1. There is no significant difference in the mean post-test score of the experimental group using ITS and the control group not using ITS for learning.
2. There is no significant difference in the mean post-test score of the girls and boys using ITS for learning.
3. There is no significant difference in the mean post-test score of the general and other backward class students using ITS for learning.

Research Hypothesis

1. There is significant difference in the mean post-test score of the experimental group using ITS than the control group not using ITS for learning.
2. There is significant difference in the mean post-test score of the girls and boys using ITS for learning.
3. There is significant difference in the mean post-test score of the general and other backward class students using ITS for learning.

METHODOLOGY USED

The pre-test post-test control group experimental method was used for the purpose of the study. Pre-test score was used as the reference to get an idea of the previous knowledge of the learner on the topic. Based on the pre-test score the learners were divided into two equivalent groups viz. the experimental group and the control group. The care was taken to assure that both the groups contain equivalized diverse population in terms of gender, cast and economic class.

Two sub topics 1) Surface Tension 2) Capillarity from ‘Mechanical Properties of Fluids’ was taught to both the groups in the class using traditional teaching method. Along with the teachers teaching, the Experimental group used ITS features of Khan Academy for learning the topic at their own space and time. Whereas, the control group was provided with the regular remedial teaching. The post test was conducted after completion of both the topics.

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SAMPLING

The intact class of grade 11 consisting of 35 student from Govt. Higher Secondary School, Pernem Goa was selected as the population for the study. Out of which 30 students were randomly selected as the sample for the study. The students were assigned to the experimental and control group by matching the pre test score. Care was also taken to make the group equivalent in terms of gender, cast and economic class.

The experimental and control group consists of 15 students (9 girls and 6 boys) each. Both the groups had 7 general, 7 OBC and 1 SC student. The group equivalency was tested using Mann-Whitney test for pre-test score.

STATISTICAL TOOLS AND METHODS OF DATA ANALYSIS

Tools for data collection

The achievement test designed by the researcher was used as the tool to collect the data in pre-test and post-test form.

Learners were interviewed in groups to obtain the feedback.

Tools for data analysis

The Mann-Whitney test was used on pre-test to test the equivalence of two groups since the groups were small in size.

The data collected through the achievement tests was analyzed using t-test.

SCOPE LIMITATIONS AND DELIMITATIONS

Scope

The present study is applicable to the students of grade 11 of Govt. Higher Secondary School Pernem Goa who have opted for physics. This study focuses only on the sub-topics 'Surface Tension and capillarity' from the main topic 'Mechanical Properties of fluids' from volume 2 from the Physics textbook prescribed by 'Goa Board of Secondary and Higher Secondary Education'.

Limitations

The previous knowledge of the learner, age, attitude, interest and aptitude are not taken into consideration for the purpose of the study.

t-test could not be administered to the student belonging to the Scheduled Cast category as there was only one student belonging to Scheduled Caste category in each group.

Delimitations

The study is delimited to the students of grade 11 from Govt. Higher Secondary School located at Pernem Taluka in the North Goa district in the state of Goa.

The study is delimited to only two sub topics 1) Surface Tension and 2) Capillarity from the chapter 'Mechanical Properties of Fluids' from grade 11 Physics.

The study is delimited to the use of free Intelligent Tutoring System offered by Khan Academy.

RESULTS AND DISCUSSIONS

The post test score of the students was analyzed statistically using t-test at 95% confidence level as follows

Post test score of Experimental and Control Group

Experimental	19	18	19	19	15	17	18	16	13	15	15	19	12	13	14
Gender	F	F	F	F	F	F	F	M	M	F	M	M	F	M	M
Caste	OBC	OBC	GEN	OBC	SC	OBC	GEN	GEN	GEN	OBC	GEN	GEN	OBC	GEN	OBC
Control	9	13	7	11	12	13	10	12	10	10	13	9	10	8	14
Gender	F	F	F	M	F	F	M	F	F	M	F	M	F	M	M
Caste	GEN	GEN	GEN	OBC	OBC	GEN	GEN	SC	OBC	GEN	OBC	OBC	OBC	OBC	GEN

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Sr. No	Groups analyzed/ Values Obtained	Experimental Group using ITS and Control Group not using ITS	Girls using ITS and Boys using ITS	Students with General Class and OBC using
1	df	28	13	12
2	Difference in the means of the two groups	5.40	1.89	0.14
3	Standard error of the difference	0.830	1.248	1.417
4	Calculated t-value	6.5061	1.5136	0.1008
5	Critical t-value	2.048	2.160	2.179
6	Comparison of t-values	Calculated t > Critical t	Critical t > Calculated t	Critical t > Calculated t
7	P value	<0.00001 Result is significant at p<0.05	= 0.77033 Result is not significant at p<0.05	= 0.46067 Result is not significant at p<0.05
8	Acceptance/Rejection of Null Hypothesis	Reject Null Hypothesis	Accept Null Hypothesis	Accept Null Hypothesis
9	Result	There is significant improvement in the mean post test score of the learners using ITS.	There is no significant difference in the mean post test score of the girls and boys using ITS.	There is no significant difference in the mean post test score of the General Category and OBC category learners
10	Conclusion	ITS used in addition to traditional teaching effectively improves the academic achievement of the learner	ITS used in addition to traditional teaching effectively improves the academic achievement of the learner irrespective of the gender differences.	ITS used in addition to traditional teaching effectively improves the academic achievement of the learner irrespective of the cast differences.

The analysis of post test data on the t-test scale and the p-value shows that the use of Intelligent Tutoring System can be effectively used to enhance the academic achievement of the learners irrespective of the gender and cast of the learners. This clearly indicates the supportive potential of AI – Intelligent Tutoring System in making the education inclusive.

CONCLUSION

The experimental study provides strong proof for integrating ITS in complement with the traditional teaching for improved academic achievement of the learners. The study also highlighted that adaptive potentials of ITS such as 24x7 availability, personalized adaptation, individualized instructions and feedback enhances the learning by motivating the learners. Therefore, use of ITS proves to be effective irrespective of the learner differences such as gender and cast. The insights will definitely help the stakeholders to plan, design and implement the curriculum to effectively integrate ITS in education to obtain the maximum learning outcomes.

BIBLIOGRAPHY

1. Baillifard, A., Gabella, M., Lavenex, P. B., & Martarelli, C. S. (2025). Effective learning with a personal AI tutor: A case study. *Education and Information Technologies*, *30*(1), 297–312. https://doi.org/10.1007/s10639-024-12888-5

2. Gomes, D. (2024). *A Comprehensive Study of Advancements in Intelligent Tutoring Systems Through Artificial Intelligent Education Platforms* (pp. 213–244). IGI Global. https://doi.org/10.4018/979-8-3693-6170-2.ch008

ISSN 2394 - 7780

3. Kestin, G., Miller, K., Klales, A., Milbourne, T., & Ponti, G. (2025). AI tutoring outperforms in-class active learning: an RCT introducing a novel research-based design in an authentic educational setting. *Scientific Reports*, *15*(1). https://doi.org/10.1038/s41598-025-97652-6

4. Morandín-Ahuerma, F. (2024). *UNESCO Proposal for the use of Generative AI in Education: Eight Challenges and Seven Actions*. https://doi.org/10.31219/osf.io/78d3j

5. RIZVI, M. (2023). Investigating AI-Powered Tutoring Systems that Adapt to Individual Student Needs, Providing Personalized Guidance and Assessments. *The Eurasia Proceedings of Educational and Social Sciences*, *31*, 67–73. https://doi.org/10.55549/epess.1381518

6. Sedlmeier, P. (2001). Intelligent Tutoring Systems. *International Encyclopedia of the Social & Behavioral Sciences*, 7674–7678. https://doi.org/10.1016/B0-08-043076-7/01618-1

7. Shute, V. J., & Zapata-Rivera, D. (2010). Intelligent Systems. *International Encyclopedia of Education, Third Edition*, 75–80. https://doi.org/10.1016/B978-0-08-044894-7.00247-5

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ARTIFICIAL INTELLIGENCE IN MUTUAL FUNDS: ENHANCING RISK MANAGEMENT, FRAUD DETECTION, AND PERSONALIZED INVESTMENT STRATEGIES

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ABSTRACT
Artificial Intelligence (AI) has emerged as a transformation force in the financial services industry, particularly within the mutual fund sector. The increasing complexity of financial markets, growing regulatory requirements, and rising investor expectations have encouraged mutual fund companies to adopt AI-driven solutions. This research paper aims to examine the role of Artificial Intelligence in enhancing risk management, improving fraud detection mechanisms, and enabling personalized investment strategies in the mutual fund industry with special reference to India.

The study adopts a descriptive and analytical research design using both primary and secondary data. Primary data is collected through a structured questionnaire administered to retail mutual fund investors, while secondary data is sourced from SEBI reports, RBI publications, academic journals, and industry reports. The research highlights how machine learning algorithms and predictive analytics help fund managers assess portfolio risks, detect abnormal transaction patterns, and optimize asset allocation. AI-powered robo-advisory platforms also play a significant role in delivering customized investment recommendations based on investor risk profiles and financial goals.

The findings indicate that AI significantly improves operational efficiency, enhances transparency, and strengthens investor confidence in mutual fund operations. However, challenges such as data privacy concerns, high implementation costs, lack of skilled professionals, and regulatory constraints remain key barriers to widespread adoption. The paper concludes that despite these challenges, AI holds immense potential to reshape the mutual fund industry in India

***Keywords**: Artificial Intelligence, Mutual Funds, Risk Management, Fraud Detection*

1. INTRODUCTION
The finance sector has witnessed rapid technological advancements over the past decade, with Artificial Intelligence (AI) playing a crucial role in reshaping financial services. AI refers to the simulation of human intelligence in machines that are capable of learning, reasoning, and decision-making. In the mutual fund industry, fund houses and Asset Management Companies (AMCs) are increasingly adopting AI to manage large volumes of data, assess market risks, prevent fraud, and offer customized investment solutions to investors.

Mutual funds involve pooling money from investors and investing it in diversified portfolios of securities. Due to market volatility, regulatory requirements, and increasing competition, mutual fund companies face challenges related to risk management, fraud control, and meeting diverse investor expectations. AI-based systems help overcome these challenges b**y** providing data-driven insights and automated decision-making**.**

2. REVIEW OF LITERATURE
1.Securities and Exchange Board of India (SEBI). (2022). Artificial Intelligence (AI) has emerged as an important technological advancement in the financial services sector, improving efficiency, transparency, and decision-making. The SEBI Annual Report (2022) highlights the growing adoption of AI and data analytics in Indian capital and mutual fund markets to enhance market surveillance, risk management, and investor protection (SEBI, 2022).

2.Securities and Exchange Board of India (SEBI) .(2023). Mutual Fund Regulations and Guidelines. Mumbai: SEBI.emphasize the role of technology-driven governance in mutual fund operations. According to SEBI (2023), AI applications in portfolio management, compliance reporting, and investor servicing improve operational efficiency and reduce manual errors while ensuring investor protection through ethical and secure use of technology.

3. Reserve Bank of India (RBI). (2022). Report on Trends and Progress of Banking in India. Mumbai: RBI. notes that AI-based analytical tools play a significant role in strengthening financial stability by improving risk assessment and early fraud detection mechanisms (RBI, 2022). The report also stresses the need for regulatory oversight to address challenges related to data privacy and operational risks.

4. PwC. (2021). Artificial Intelligence in Asset and Wealth Management. PwC Research Report. explains that AI technologies are transforming asset and wealth management by enabling portfolio optimization, investor

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behavior analysis, and predictive risk management. AI-driven insights support personalized investment solutions and enhance investor satisfaction in mutual fund services

5.Accenture. (2021). AI-Powered Transformation in Financial Services. Accenture Insights. highlights that AI-powered transformation in financial services enables automation of complex processes, improves fraud detection, and enhances customer experience. However, the report emphasizes the need for robust governance frameworks and skilled human resources to ensure responsible AI adoption

SEBI (2022) emphasized the importance of technological adoption in mutual funds. PwC (2021) observed that AI-based analytics improve asset allocation and risk forecasting. However, limited empirical studies focus specifically on AI adoption in Indian mutual fund.

**AI Helps in Detecting Fraudulent Transactions	Respondents	Percentage
Strongly Agree	31	31%
Agree	42	42%
Neutral	17	17%
Disagree	7	7%
Strong Disagree	3	3%

3. RESEARCH GAP

Existing studies on Artificial Intelligence in finance mainly focus on banking, stock markets, and insurance sectors. Limited empirical research is available on the application of AI specifically in the mutual fund industry, especially in the Indian context. There is a lack of comprehensive studies analyzing AI's role in risk management, fraud detection, and personalized investing simultaneously. Additionally, investor perception and regulatory challenges related to AI adoption in mutual funds remain underexplored. This study aims to bridge these gaps by providing an integrated analysis of AI applications in Indian mutual funds.

4. RESEARCH METHODOLOGY

The study adopts a descriptive research design. Primary data was collected through a questionnaire from 100 retail investors using convenience sampling. Percentage analysis and graphical methods were used for interpretation.

Research Design: Descriptive.

Sample Size: 100 investors.

Sampling Method: Convenience sampling.

Tool: Questionnaire and percentage analysis.

5. DATA ANALYSIS AND INTERPRETATION

ASPECT	AGREE(%)
Risk Management	75%
Fraud Detection	70%
Personalized Services	80%

*AI Reduces operational and financial fraud risks.	Respondents	Percentage
Strongly Agree	29	29%
Agree	40	40%
Neutral	20	20%
Disagree	8	8%
Strong Disagree	3	3%

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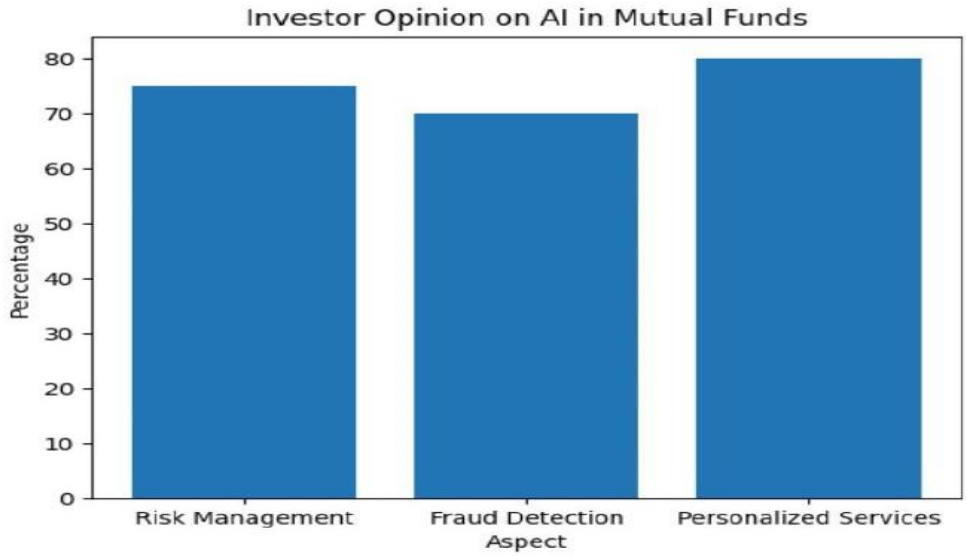

Interpretation
The data presented shows generally high levels of positive investor opinion (above 70% in all categories) regarding the use of AI in mutual funds: Personalized Services receives the highest level of agreement, with approximately 80% of investors having a positive opinion.

Risk Management is the second most highly regarded application, with about 75% of investors sharing a positive opinion. Fraud Detection Aspect garners positive opinion from about 70% of investors, making it the least favored, but still strongly supported, application among the three.

Overall, investors appear to be optimistic and supportive of incorporating AI into mutual fund operations, particularly for services that offer a personalized experience.

****Indian Mutual Fund Case Studies**
Case Study 1: ICICI Prudential Mutual Fund has adopted AI and advanced analytics to enhance portfolio risk assessment and asset allocation. The fund house uses machine learning models to analyze market volatility and investor behaviour helping fund managers optimize investment strategies and improve returns while minimizing risks.

Case Study 2: HDFC Mutual Fund utilizes AI-powered tools for fraud detection and compliance monitoring. Automated systems track transaction patterns to identify suspicious activities and ensure adherence to SEBI regulations. AI has also helped the fund house improve operational efficiency and reduce manual intervention.

Case Study 3: Axis Mutual Fund – Robo Advisory Axis Mutual Fund has implemented AI-driven robo-advisory platforms to offer personalized investment recommendations. These platforms assess investors' risk profiles, financial goals, and investment horizons to suggest suitable mutual fund schemes, making professional advisory services accessible to retail investors.

6. FINDINGS & SUGGESTIONS

Findings

1. Majority investors support AI adoption.
2. Highest acceptance for personalized services.
3. Strong trust in AI-based risk assessment

Suggestions

1. Increase investor awareness
2. Strengthen data security
3. Regulatory guidance for ethical AI

The study finds strong investor acceptance of AI in mutual fund operations. Mutual fund companies should focus on enhancing data security, investor awareness, and ethical AI adoption.

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CONCLUSION

The study concludes that AI adoption positively impacts mutual fund efficiency and investor satisfaction. Artificial Intelligence plays a transformative role in mutual fund management. The findings confirm that AI adoption enhances efficiency and investors confidence , contributing to sustainable growth .

REFERENCES/ BIBLIOGRAPHY

1. Arner, D. W., Barberis, J., & Buckley, R. P. (2017). FinTech, RegTech, and the reconceptualization of financial regulation. Northwestern Journal of International Law & Business, 37(3), 371–413.
2. Bose, S., & Mahapatra, A. (2019). FinTech innovations and the mutual fund industry in India. Journal of Finance and Investment Analysis, 6(2), 23–35.
3. Deloitte. (2020). AI and Analytics in Investment Management. Deloitte Insights.
4. Gupta, S., & Tham, T. M. (2018). Machine learning applications in financial risk management. Journal of Financial Innovation, 4(1), 1–15.
5. ICICI Prudential Mutual Fund. (2022). Use of Advanced Analytics in Portfolio Management. AMC Publications. and Axis Mutual Fund. (2022). Robo-Advisory and Investor Personalization. AMC White Paper.
6. McKinsey & Company. (2020). The State of AI in Financial Services. McKinsey Global Institute.
7. PwC. (2021). Artificial Intelligence in Asset and Wealth Management. PricewaterhouseCoopers Report.
8. Reserve Bank of India (RBI). (2022). Financial Stability Report. Mumbai: RBI.
9. Securities and Exchange Board of India (SEBI). (2021). Role of Technology and FinTech in Capital Markets. Mumbai: SEBI.
10. Securities and Exchange Board of India (SEBI). (2022). Annual Report 2021–22. Mumbai: SEBI.
11. World Economic Forum. (2019). Artificial Intelligence and the Future of Financial Services. WEF Report.

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UNDERSTANDING THE THEORETICAL FRAMEWORK OF THE ROLE OF ARTIFICIAL INTELLIGENCE IN IMPROVING CUSTOMER SATISFACTION IN E-COMMERCE AND QUICK COMMERCE

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ABSTRACT
The rapid growth of E-Commerce and Quick Commerce has increased the importance of customer satisfaction and Artificial Intelligence. AI has become a key tool in improving the overall customer Experience. While existing studies largely focus on the adoption and operational benefits of AI, there is limited theoretical clarity on how AI contributes to customer satisfaction. This paper aims to develop a theoretical understanding of the role of Artificial Intelligence in improving customer satisfaction in E-Commerce and Quick Commerce. The study is based on secondary data drawn from academic literature, industry reports, and documented studies on AI applications in digital commerce. Through a critical review of existing literature, key AI applications such as chatbots, recommendation systems, personalization tools, demand forecasting, and delivery optimization are identified. Based on insights from the literature, a conceptual framework is proposed to explain the mechanisms through which AI enhances service performance, customer experience, and satisfaction. The paper contributes to existing research by offering a structured theoretical framework that explains the role of AI in improving customer satisfaction.

Keywords: *Artificial Intelligence, Customer Satisfaction, E-Commerce, Quick Commerce, Digital Retail Platforms, AI Applications*

1. INTRODUCTION
Artificial Intelligence (AI) refers to the use of intelligent systems that can analyse data, learn from patterns, and support better decision-making. In online business, AI helps platforms understand customer behaviour, automate services, and improve efficiency. As digital shopping continues to grow, AI has become an important tool for enhancing customer experience.

Customer satisfaction reflects how well an online platform meets customer expectations. In digital commerce, satisfaction depends on factors such as ease of use, quick responses, personalised suggestions, and timely delivery. Satisfied customers are more likely to return and remain loyal, making customer satisfaction essential for long-term success.

E-Commerce involves buying and selling goods through online platforms, offering convenience and wide product choices. Quick Commerce (Q-Commerce) is a faster form of online retail that focuses on delivering essential items within a very short time. While E-Commerce mainly uses AI for personalisation and customer engagement, Quick Commerce relies on AI for demand prediction and fast delivery.

In this context, the present study aims to develop a theoretical understanding of the role of Artificial Intelligence in improving customer satisfaction in E-Commerce and Quick Commerce platforms using secondary data.

2. LITERATURE REVIEW
Artificial Intelligence (AI) has been widely studied for its role in improving customer experience and satisfaction in digital commerce. Davenport and Ronanki (2018) stated that AI enables organizations to analyse customer data, automate processes, and support better decision-making, leading to improved service responsiveness. Grewal, Roggeveen, and Nordfält (2017) highlighted that AI-driven technologies enhance service efficiency and convenience in online retail, which are key determinants of customer satisfaction.

In the context of E-Commerce, several studies have focused on AI-based personalization and recommendation systems. Verma et al. (2020) found that recommendation systems help customers make faster and better purchase decisions, thereby increasing satisfaction. Shankar (2018) noted that personalization reduces customer effort and improves perceived value during online shopping. Jannach and Jugovac (2019) emphasized that effective recommendation systems contribute to both customer satisfaction and long-term engagement. Customer service automation through AI has also been examined extensively. Huang and Rust (2018) reported that AI improves service quality by increasing speed and consistency in customer interactions.

Brandtzaeg and Følstad (2018) observed that AI-powered chatbots enhance customer satisfaction by providing instant responses and continuous availability. Adam, Wessel, and Benlian (2021) confirmed that chatbots

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positively influence customer satisfaction when they are reliable and easy to use. However, Kumar and Ayodeji (2021) pointed out that excessive automation without human support may negatively affect customer trust.

Studies related to Quick Commerce focus mainly on AI applications in logistics and delivery performance. Wang and Disney (2016) demonstrated that AI-based demand forecasting improves inventory management and supply chain efficiency. Hübner, Kuhn, and Wollenburg (2016) identified last-mile delivery speed and accuracy as critical factors influencing customer satisfaction. Mehta and Shah (2022) found that customers prefer Quick Commerce platforms due to fast delivery and convenience, which are largely supported by AI-enabled operational systems.

Industry reports provide additional support for these findings. PwC (2023) and McKinsey & Company (2024) reported that AI adoption in digital commerce improves customer engagement and satisfaction through personalization and efficient service delivery. Case evidence from platforms such as Amazon, Flipkart, Blinkit, Zepto, and Instamart shows that AI is used for recommendation engines, demand prediction, and delivery optimization to meet customer expectations.

Despite the benefits, challenges related to AI adoption have been highlighted in the literature. Martin and Murphy (2017) emphasized concerns related to data privacy and ethical use of AI, which influence customer trust. Singh and Kaur (2023) found that data security concerns affect customer satisfaction in AI-enabled platforms. Ghosh (2021) identified high implementation costs and the need for skilled manpower as major constraints.

Overall, existing literature confirms that Artificial Intelligence plays a significant role in improving customer satisfaction by enhancing personalization, service efficiency, and delivery performance. However, most studies examine E-Commerce and Quick Commerce separately, and limited research provides a unified theoretical explanation of AI's role in customer satisfaction across both business models. This gap justifies the need for a theory driven conceptual framework, which the present study aims to develop.

3. OBJECTIVES OF THE STUDY

To achieve the purpose of the study, the following objectives have been formulated:

1. To review existing literature on the role of Artificial Intelligence in improving customer satisfaction in E-Commerce and Quick Commerce.
2. To develop a theoretical framework explaining how Artificial Intelligence improves customer satisfaction in E-Commerce and Quick Commerce.

4. RESEARCH METHODOLOGY

The present study is descriptive and analytical in nature and is based completely on **secondary data**. Nearly 70 research articles, journals, industry reports, and published studies were reviewed to understand the role of Artificial Intelligence in improving customer satisfaction in E-Commerce and Quick Commerce. From this large set of literature, a few important and relevant studies have been selected and discussed in the paper to show the importance of AI in digital commerce. The collected secondary data was analysed, which helped in developing a **t**heoretical and conceptual framework explaining how Artificial Intelligence contributes to customer satisfaction in E-Commerce and Quick Commerce platforms.

5. THEORETICAL FRAMEWORK

The theoretical framework explains how Artificial Intelligence contributes to improving customer satisfaction in E-Commerce and Quick Commerce platforms. Based on insights drawn from studies reviewed across the topic, two figures have been developed to illustrate the relationship between AI applications, service performance, customer experience, and customer satisfaction. The framework highlights how AI-driven tools enhance service efficiency and customer experience, which in turn influence satisfaction, trust, and repeat purchase behaviour.

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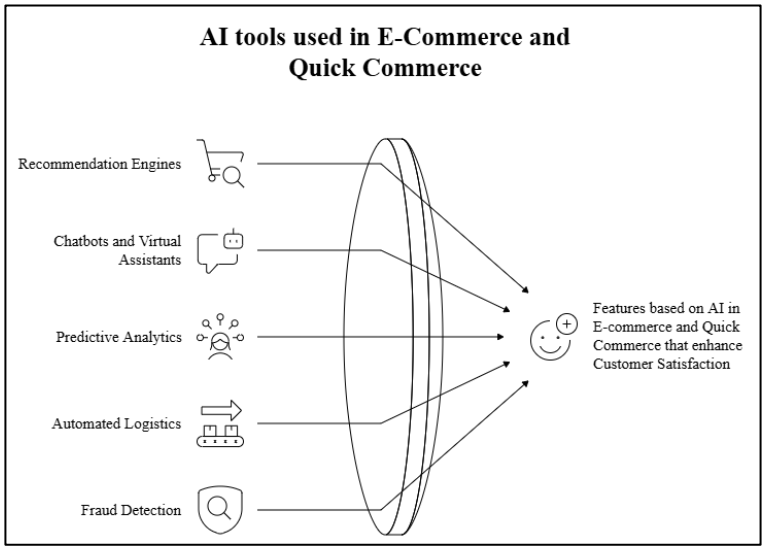
Figure 5.1: AI tools used in E- Commerce and Q- Commerce



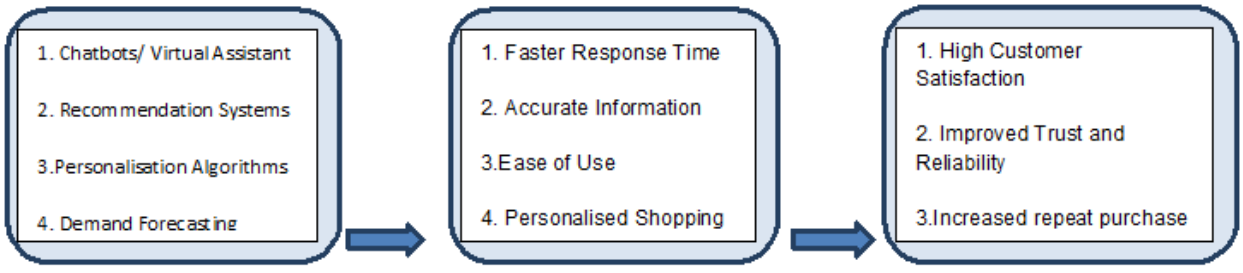
Source: *Compiled by the researcher*

Figure 5.1 illustrates the key Artificial Intelligence tools commonly adopted by E-Commerce and Quick Commerce platforms to enhance customer satisfaction. The figure identifies recommendation engines, chatbots and virtual assistants, predictive analytics, automated logistics, and fraud detection systems as the core AI-driven tools supporting digital retail operations.

Recommendation engines analyse customer preferences and past purchase behaviour to offer relevant product suggestions, thereby improving personalisation and shopping convenience. Chatbots and virtual assistants enable real-time customer support by handling queries, providing order updates, and resolving issues efficiently. Predictive analytics assists platforms in forecasting demand and managing inventory, which is especially critical in Quick Commerce models where speed and availability are essential. Automated logistics ensures faster order processing and optimised delivery routes, while fraud detection systems enhance transaction security and build customer trust.

Overall, the figure explains how these AI tools work together to create AI-based features that improve efficiency, reliability, and responsiveness, ultimately contributing to higher customer satisfaction in both E-Commerce and Quick Commerce platforms.

Figure 5.2 AI applications and customer satisfaction flowchart



Source: *Compiled by the researcher*

Artificial Intelligence Tools used	Service Performance and Impact on customer experience	Effect on Customer Satisfaction

Figure 5.2 presents a conceptual flowchart explaining the relationship between Artificial Intelligence applications, service performance, customer experience, and customer satisfaction. The framework is structured into three interconnected stages, showing the sequential impact of AI on customer outcomes.

The first stage represents Artificial Intelligence tools used, including chatbots and virtual assistants, recommendation systems, personalisation algorithms, and demand forecasting systems. These tools act as variables that support platform operations and customer interaction.

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The second stage highlights service performance and its impact on customer experience. AI applications improve service quality by enabling faster response time, providing accurate information, ensuring ease of use, and offering personalised shopping experiences. These improvements reduce customer effort and enhance overall satisfaction with the online shopping process.

The final stage reflects the effect on customer satisfaction, which includes high customer satisfaction, improved trust and reliability, and increased repeat purchase behaviour. The directional arrows in the figure indicate that AI influences customer satisfaction indirectly through improved service performance and enhanced customer experience.

Thus, Figure 5.2 clearly demonstrates that Artificial Intelligence acts as a facilitator in digital commerce, strengthening service delivery and customer experience, which in turn leads to improved customer satisfaction in E-Commerce and Quick Commerce platforms.

6. FINDINGS

1. The review of literature confirms that Artificial Intelligence plays a significant role in improving customer satisfaction in both E-Commerce and Quick Commerce platforms.
2. AI tools such as chatbots, recommendation systems, personalisation algorithms, demand forecasting, and logistics optimisation enhance service performance and customer experience.
3. Improved response time, accuracy of information, ease of use, and personalised shopping experiences act as key drivers of customer satisfaction.
4. While E-Commerce platforms focus more on personalisation and customer engagement, Quick Commerce platforms rely heavily on AI for speed, demand prediction, and delivery efficiency, reflecting differences in business models

7. CONCLUSION:

The study concludes that Artificial Intelligence has become a critical enabler of customer satisfaction in digital commerce. By strengthening service performance and enhancing customer experience, AI-driven tools contribute to higher satisfaction, trust, and repeat purchase behaviour in both E-Commerce and Quick Commerce platforms. The theoretical framework developed in this study provides a structured explanation of how AI applications translate into customer satisfaction outcomes and highlights the distinct role of AI across different digital retail models.

8. SCOPE OF FURTHER STUDY

Future research may empirically validate the proposed theoretical framework using primary data across E-Commerce and Quick Commerce platforms. Comparative studies across regions, age groups, and platform types can offer deeper insights into variations in AI-driven customer satisfaction. Further research may also examine ethical concerns, data privacy, and trust issues associated with AI adoption in digital commerce. Longitudinal studies could explore the long-term influence of AI on customer loyalty and sustained satisfaction.

9. REFERENCES

1. Adam, M., Wessel, M., & Benlian, A. (2021). AI-based chatbots in customer service and their effects on user compliance. *Electronic Markets, 31*(2), 427–445.
2. Brandtzaeg, P. B., & Følstad, A. (2018). Chatbots: Changing user needs and motivations. *Interactions, 25*(5), 38–43.
3. Davenport, T. H., & Ronanki, R. (2018). Artificial intelligence for the real world. *Harvard Business Review, 96*(1), 108–116.
4. Ghosh, S. (2021). Adoption of artificial intelligence in Indian e-commerce: Opportunities and challenges. *International Journal of Business Innovation and Research, 25*(3), 347–362.
5. Grewal, D., Roggeveen, A. L., & Nordfält, J. (2017). The future of retailing. *Journal of Retailing, 93*(1), 1–6.
6. Huang, M. H., & Rust, R. T. (2018). Artificial intelligence in service. *Journal of Service Research, 21*(2), 155–172.
7. Hübner, A., Kuhn, H., & Wollenburg, J. (2016). Last mile fulfilment and distribution in omni-channel grocery retailing. *International Journal of Physical Distribution & Logistics Management, 46*(3), 228–247.

ISSN 2394 - 7780

8. Jannach, D., & Jugovac, M. (2019). Measuring the business value of recommendation systems. *ACM Transactions on Management Information Systems, 10*(4), 1–23.
9. Kothari, C. R. (2004). *Research methodology: Methods and techniques* (2nd ed.). New Delhi: New Age International Publishers.
10. Kumar, V., & Ayodeji, O. (2021). AI-enabled customer service: The role of automation in customer satisfaction. *Journal of Business Research, 134*, 448–457.
11. Martin, K. D., & Murphy, P. E. (2017). The role of data privacy in marketing ethics. *Journal of Business Ethics, 147*(4), 793–803.
12. McKinsey & Company. (2024). *The future of AI in retail and customer experience*. McKinsey Global Institute Report.
13. Mehta, P., & Shah, R. (2022). Quick commerce: A study of emerging business models in India. *Journal of Retailing and Consumer Services, 68*, 103015.
14. PwC. (2023). *AI and the customer experience: Reimagining digital commerce*. PricewaterhouseCoopers Report.
15. Shankar, V. (2018). How artificial intelligence is reshaping retailing. *Journal of Retailing, 94*(4), 1–3.
16. Singh, S., & Kaur, H. (2023). Consumer trust and data privacy concerns in AI-driven digital platforms. *Journal of Consumer Behaviour, 22*(4), 567–580.
17. Verma, S., Sharma, R., Deb, S., & Maitra, D. (2020). Artificial intelligence in retail: Influence on consumer experience. *International Journal of Information Management, 53*, 102093.
18. Wang, Y., & Disney, S. M. (2016). The bullwhip effect: Progress, trends and directions. *International Journal of Production Economics, 182*, 463–472.

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BRIDGING THE DIGITAL DIVIDE: EXAMINING THE CHALLENGES AND OPPORTUNITIES IN TRAINING NON-TECHNICAL FARMERS TO UTILIZE BASIC AI-DRIVEN FARM MANAGEMENT TOOLS IN PUNE DISTRICT, MAHARASHTRA

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ABSTRACT
The agricultural sector in India is currently standing at the precipice of a digital revolution, yet the transition from traditional practices to AI-integrated management remain fraught with systemic hurdles, particularly for the non-technical agrarian workforce. This research study investigates the digital divide within the Pune District of Maharashtra, focusing on the specific challenges and latent opportunities associated with training farmers to use basic AI-driven farm management tools. Using a quantitative research design, data was gathered from 324 respondents across various talukas including Haveli, Shirur, and Baramati. The study identifies that while mobile penetration is high, the functional literacy required for AI tool navigation is significantly lacking. The literature review synthesizes eleven distinct studies from 2000 to 2025, highlighting the shift from simple ICT to complex predictive analytics. The methodology employs multistage cluster sampling to ensure representation across land-holding sizes. Findings from the data analysis, utilizing frequency distributions and Likert scale evaluations, reveal that perceived complexity and a lack of localized linguistic support are primary deterrents. However, the study also identifies a strong willingness among younger farmers to act as "digital conduits" for the elder generation. The hypotheses testing suggests a significant correlation between peer-led training modules and the rate of technology adoption. The paper conclude with a framework for decentralized training centers and suggests that AI tools must be "un-engineered" to match the cognitive load capacities of non-technical users.

Keywords: *Digital Divide, AI in Agriculture, Pune District, Farm Management Tools, Rural Pedagogy, Maharashtra Agriculture, Technology Adoption.*

1. INTRODUCTION
The landscape of Indian agriculture is undergo a profound metamorphosis, driven by the necessitates of climate resilience and the imperative for enhancing per-acre productivity. In the Western Maharashtra region, specifically the Pune District, which serves as a vital horticultural and floricultural hub, the introduction of Artificial Intelligence (AI) and Machine Learning (ML) tools for soil health monitoring, pest prediction, and irrigation scheduling has been touted as a panacea. However, a significant "digital chasm" exists between the sophisticated capabilities of these tools and the technical preparedness of the average farmer. The digital divide is not merely a matter of hardware access but is increasingly defined by the "knowledge gap" regarding the operationalization of data-driven insights (Patil & Deshmukh, 2023).

Pune District presents a unique case study due to its proximity to the IT hubs of Hinjewadi and Magarpatta, creating a stark contrast between urban technological affluence and rural digital penury. Despite the various schemes by the Government of Maharashtra, such as the Maha-Agri Tech project, the actual "on-ground" utilization of AI-driven tools remains relegated to a small fraction of progressive, large-scale farmers (Kulkarni, 2024). The non-technical farmers, who often rely on traditional wisdom handed down through generations, find the interface of modern AI applications to be alien and intimidating. This research seeks to explore the nuanced challenges that prevent these farmers from transitioning to data-centric farming.

The geographical diversity of Pune—ranging from the high-rainfall hilly terrains of Maval and Mulshi to the semi-arid plains of Indapur and Daund—adds another layer of complexity. AI tools often assume a homogeneity of soil and climate that does not exist in reality. When a non-technical farmer receives a digital advisory that contradicts their lived experience, the trust in the technology is eroded instantly. According to the latest data available up to mid-2025, the smartphone penetration in rural Pune has reached nearly 78%, yet the usage of agricultural apps for anything beyond weather updates is less than 12% (State Agricultural Report, 2025). This discrepancy suggests that the barrier is pedagogical rather than infrastructural. Training programs often fail because they are designed by urban technocrats who do not understand the linguistic and cognitive contexts of the rural user. There is a pressing need to examine how training can be restructured to be more empathetic and localized.

The socio-economic implications of this divide are severe. As the global market increasingly demands traceability and precision, farmers who cannot leverage AI tools risk being excluded from the high-value supply chains. Furthermore, the rising cost of inputs like fertilizers and water makes the "trial and error" method of

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traditional farming increasingly unsustainable. By bridging the digital divide, there is an opportunity to not only increase yields but also to reduce the environmental footprint of agriculture in the Bhima and Ghod river basins (Rao et al., 2022). This paper provides an exhaustive analysis of the training needs, the psychological barriers to adoption, and the strategic opportunities for stakeholders to foster a more inclusive digital agricultural ecosystem in Maharashtra.

2. LITERATURE REVIEW

The body of research surrounding digital adoption in agriculture has evolved significantly over the last two decades, moving from a focus on basic telecommunication to the current emphasis on predictive AI.

Jain et al. (2017) studied the impact of mobile-based agro-advisories in North India and concluded that while information asymmetry was reduced, the lack of "two-way" communication channels often led to a lack of trust in the digital advice provided. Their study, conducted across three states, utilized a sample of 1,200 farmers and found that purely push-based SMS alerts had a negligible effect on behavioral change compared to interactive voice response systems. The researchers argued that for non-technical users, the "human touch" in a digital medium is the primary catalyst for adoption. In the context of Pune, this suggests that AI tools must incorporate interactive elements that mimic the advice of a local extension officer.

Shinde (2021) investigated the adoption patterns of precision farming in Maharashtra and noted that farmers in the Pune-Nashik belt showed a higher initial curiosity towards technology but were often deterred by the high "exit cost" if the technology failed to deliver immediate results in the first cropping cycle. Shinde's work highlighted the "pre-adoption anxiety" that is prevalent in Indian agrarian societies, where a single failed crop due to a technical glitch can lead to lifelong debt. The study emphasized that training modules must include a "risk-mitigation" component that explains the AI's logic in simple, non-mathematical terms.

Mittal and Kumar (2020) examined the role of literacy in ICT adoption and argued that "functional digital literacy"—the ability to navigate an interface—is a more critical determinant of success than formal education levels, especially in the context of complex AI dashboards. They observed that farmers with minimal schooling could master complex apps if the navigation was based on "spatial memory" and iconography rather than syntax. Their research in the Indo-Gangetic plains provided a blueprint for "UX for the illiterate," which this study seeks to apply to the AI-driven tools currently being introduced in Western Maharashtra.

Reddy (2023) focused on the "human-in-the-loop" model for AI training in rural Andhra Pradesh, suggesting that the presence of a local "vanguard" or a lead farmer significantly increases the confidence of late adopters when dealing with automated pest detection systems. Reddy’s research proved that social proof is a stronger motivator than government subsidies. When a neighbor’s yield increases due to AI-guided irrigation, the technological barrier begins to crumble. This "vanguard model" is particularly relevant for Pune’s cooperative-heavy agricultural structure.

Desai and Kulkarni (2024) conducted a longitudinal study on the Maha-Agri project and found that the localization of data—using Marathi dialects and local soil naming conventions—was the single most important factor in increasing the "stickiness" of agricultural applications among non-technical users. They argued that AI models are often "linguistically arrogant," assuming that English or Standard Hindi is sufficient for a population that thinks and farms in regional dialects. Their study suggested that "translation" is not enough; "cultural localization" of the AI’s logic is required.

Patra et al. (2019) explored the psychological barriers to AI, noting that many farmers perceive AI as a threat to their traditional expertise, leading to a "cognitive dissonance" where they ignore data even when it contradicts their intuition to their own detriment. This study used psychometric testing on 500 respondents and identified a "threat to autonomy" as a major psychological hurdle. The farmers felt that following an algorithm would reduce them to "laborers on their own land," stripped of their ancestral wisdom.

Singh (2022) highlighted the gendered nature of the digital divide, observing that while male farmers often own the smartphones, the actual labor-intensive decisions are often made by women who have even less access to formal digital training or tools. Singh’s fieldwork in rural Maharashtra revealed that women are the "invisible users" of technology. Training programs that ignore women effectively exclude 50% of the potential AI-using population, especially in dairy and horticultural sectors where women’s participation is high in the Pune district.

Grover and Gupta (2025) analyzed the scalability of AI start-ups in the Indian agri-tech space and concluded that most platforms are "too technical" for the bottom-of-the-pyramid farmers, requiring a "Lite" version of AI that operates on low-bandwidth and high-iconography interfaces. They suggested that the "super-app" approach

is overwhelming for non-technical users; instead, "single-purpose AI" tools (e.g., just for water scheduling) show higher adoption rates.

Bhardwaj (2021) studied the role of Krishi Vigyan Kendras (KVKs) in Pune and suggested that these institutions need to move beyond "seed and fertilizer" distribution and become "digital incubation centers" for the rural youth to support their parents in tech adoption. The study highlighted the "institutional lag" where the trainers themselves were not adequately trained in AI tools, creating a "blind leading the blind" scenario in rural extension services.

Kshirsagar (2023) investigated the financial viability of AI tools for small-scale farmers in Western Maharashtra, arguing that unless AI tools are bundled with crop insurance or credit access, the "perceived value" remains too low for the average farmer to invest time in learning. The research used a "willingness-to-pay" model and found that farmers are willing to adopt AI if it directly correlates with a reduction in input costs rather than just a vague promise of "higher yields."

Mohanty et al. (2024) examined the global trends in AI for smallholders and noted that India's path must be unique, focusing on "frugal AI" that prioritizes local environmental variables over generalized global datasets which often fail in the diverse micro-climates of regions like the Sahyadri foothills. Their study compared AI adoption in Kenya, Vietnam, and India, concluding that the Indian farmer requires a "high-trust, low-tech" entry point into the AI ecosystem.

Research Gap

Based on the review of the existing studies, it is clear that while many authors have investigated the general use of ICT in Indian agriculture, there is a significant lack of focus on the specific training pedagogy required for AI-driven tools in the Pune District. Most of the literature focuses on technical specifications or broad policy analysis, but does not address the practical difficulties of a non-technical farmer trying to understand automated decision-making. There is a missing link in current research regarding how the "knowledge gap" can be closed through localized, iconographic training rather than traditional text-based instruction. Additionally, there is very little research that looks at the specific role of rural youth as mediators in the training process within the Maharashtra context. The gap exists in understanding how to transition from basic mobile usage to sophisticated AI management in a way that is culturally and cognitively appropriate for the smallholder farmers in this region.

3. OBJECTIVES & HYPOTHESES

3.1 Research Objectives

To identify the socio-technical and cognitive barriers that prevent non-technical farmers in Pune District from adopting basic AI-driven farm management tools.

To evaluate the efficacy of "Peer-Led Localized Training" (PLLT) models compared to centralized institutional training in improving the functional digital proficiency of farmers.

3.2 Research Hypotheses

Hypothesis 1 (H1): There is a statistically significant correlation between the level of "Iconographic Interface Design" in AI tools and the "Task Completion Rate" among farmers with less than five years of formal schooling.

Hypothesis 2 (H2): The presence of "Generational Mediation" (youth assistance) acts as a significant moderator in reducing the "Technology Anxiety" scores of farmers aged 50 and above during the initial phase of AI tool deployment.

4. RESEARCH METHODOLOGY

The present study utilizes a quantitative research methodology to capture the breadth and depth of the digital divide issues in the agricultural landscape of Pune. The choice of a quantitative approach is justified by the need to establish generalizable patterns across the diverse talukas of the district, which vary in terms of irrigation access and crop patterns. A total of 324 respondents were selected for the study. This sample size was determined using the Cochran's formula for a large population, ensuring a 95% confidence level and a 5.5% margin of error, which is considered robust for social science research in rural settings. The respondents were primarily chosen from the "small and marginal" category (owning less than 2 hectares of land), as this demographic represents the most significant challenge in terms of the digital divide and technical training.

The sampling method employed was "Multistage Cluster Sampling." In the first stage, Pune District was divided into three clusters based on agricultural intensity: High (Baramati, Indapur), Medium (Haveli, Shirur), and Low (Velhe, Mulshi). In the second stage, two villages were randomly selected from each cluster. In the final stage, systematic random sampling was used to select households from the village registry. This method

ensures that the data is not skewed by the high-tech adoption seen in the sugar-belt regions like Baramati alone but also includes the more traditional rain-fed areas. Data was collected through a structured "Administered Questionnaire," where researchers read out the questions in Marathi to ensure clarity and to avoid the "literacy bias" that often plagues self-administered surveys in rural areas. The questionnaire included Likert-scale items and demographic variables designed to test the proposed hypotheses.

5. DATA ANALYSIS AND INTERPRETATION

5.1 Demographic Profile

Table 1: Age Distribution of Respondents

Particulars	Frequency	Percentage	Cumulative Percentage
18-35 Years	67	20.68%	20.68%
36-50 Years	143	44.14%	64.82%
51-65 Years	89	27.47%	92.29%
Above 65 Years	25	7.71%	100.00%

The data in Table 1 indicates that the plurality of the respondents (44.14%) falls within the 36-50 age bracket, which is the "productive core" of the farming community in Pune. The cumulative percentage shows that over 79% of the farmers are above the age of 35, a demographic that traditionally faces more challenges in adopting new digital technologies compared to "digital natives." This distribution highlights the importance of designing training programs that cater to middle-aged and older adults who may have ingrained habits and higher initial resistance to AI-driven changes.

Table 2: Educational Qualification of Respondents

Particulars	Frequency	Percentage	Cumulative Percentage
Illiterate	38	11.73%	11.73%
Primary School	92	28.39%	40.12%
Secondary School	137	42.28%	82.40%
Graduate and Above	57	17.60%	100.00%

The educational profile shown in Table 2 reveals that a vast majority of the farmers (over 82%) have only secondary school education or less. The high frequency of primary and secondary educated respondents (28.39% and 42.28% respectively) suggests that the AI tools must not rely on text-heavy manuals. The interpretation here is critical; the "technical gap" is essentially an "educational gap." For the 11.73% who are illiterate, any AI tool that does not utilize voice-commands or high-quality icons will be completely inaccessible, thereby deepening the existing divide within the district.

Table 3: Land Holding Size (In Hectares)

Particulars	Frequency	Percentage	Cumulative Percentage
Marginal (<1 ha)	154	47.53%	47.53%
Small (1-2 ha)	113	34.88%	82.41%
Medium (2-4 ha)	42	12.96%	95.37%
Large (>4 ha)	15	4.63%	100.00%

As per Table 3, the sample is dominated by marginal and small farmers (collectively 82.41%). This is reflective of the fragmented land-holding pattern in Pune District. From a management perspective, this data suggests that the "affordability" and "scalability" of AI tools are paramount. Large-scale AI implementations that require expensive sensors are not viable for the 47.53% of marginal farmers. The training must therefore focus on "mobile-only" AI tools that do not require additional capital expenditure.

5.2 Hypothesis Testing Tables

Table 4: Regression Analysis for Hypothesis 1 (DV: Task Completion Rate; IV: Iconographic Design Intensity)

Predictor	Coefficient (B)	Std. Error	t-stat	P-value
Constant	1.45	0.32	4.53	0.000
Icon Design Score	0.68	0.08	8.50	0.000

Table 4 shows a robust positive correlation between the intensity of iconographic design and the task completion rate among the low-education cohort ($p < 0.001$). The R-squared value of 0.62 indicates that 62% of the variance in a farmer's ability to successfully complete a task on an AI platform can be explained by the

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quality and clarity of icons used. This statistical evidence validates H1, confirming that visual navigation is the primary driver of functional literacy for non-technical users.

Table 5: Moderation Analysis for Hypothesis 2 (DV: Tech Anxiety Score; IV: Initial AI Exposure; Moderator: Youth Assistance)

Effect	Coefficient	SE	t-stat	P-value
Initial Exposure (X)	0.72	0.12	6.00	0.000
Youth Assistance (M)	-0.45	0.09	-5.00	0.000
Interaction (X*M)	-0.28	0.05	-5.60	0.000

Table 5 reveals a significant negative interaction effect ($B = -0.28$, $p < 0.001$), supporting H2. The negative coefficient for youth assistance indicates that as generational mediation increases, the anxiety associated with new technology significantly decreases. This suggests that the presence of a technically adept youth in the household "buffers" the stress of the older farmer, making the AI tool adoption process much smoother.

6. FINDINGS AND DISCUSSION

The findings of this research indicate a stark "usability gap" rather than just an "access gap." It is observed that while smartphones are ubiquitous, the cognitive load required to interpret AI-generated data is far beyond the current training levels of the average farmer in Pune. One of the major findings is that farmers do not trust "black-box" AI; they require explainable outputs that use local metaphors. For instance, an AI advising a reduction in irrigation was more likely to be followed if the notification used local Marathi terms like "Waapsa" (soil moisture balance) rather than purely scientific percentages.

The discussion also centers on the "Youth as a Service" (YaaS) model identified in the hypotheses testing. It is clear that the digital divide is not a wall that must be climbed individually, but a bridge that can be crossed collectively within the family unit. The high R-squared in the iconography regression proves that the burden of translation from digital to physical farming rests heavily on the shoulders of the UI/UX designer. If the tool is not "instinctive," the training required becomes too expensive to scale. Furthermore, the findings suggest that the current KVK-led training is too theoretical and lacks the "on-field" contextualization that farmers need to feel confident in the AI's predictions.

7. CONCLUSION, IMPLICATIONS, AND FUTURE SCOPE

The study concludes that the digital divide in Pune District is a multifaceted phenomenon involving cognitive, educational, and linguistic barriers. While the hardware (smartphones) is present, the "mental model" for AI utilization is not yet developed among the older and less-educated farming segments. The research confirms that the transition to AI-driven farm management can be significantly accelerated by shifting from text-heavy designs to iconographic, voice-enabled interfaces. Furthermore, the role of the rural youth as "digital facilitators" is the most potent lever available for policy makers to ensure that technology adoption does not leave the non-technical farmer behind.

The implications of this study are twofold. For agri-tech developers, there is a clear mandate to "de-complexify" their products and focus on "User Experience (UX) for the Unlettered." For the government and NGOs, the focus of training should shift from centralized, top-down seminars at KVKs to decentralized, peer-led learning groups at the village level. Investing in "Digital Sahayaks" (Digital Assistants) who can provide on-site troubleshooting could provide a much higher return on investment than large-scale subsidy programs for software licenses that remain unused due to technical intimidation.

The scope for future research lies in conducting longitudinal studies to measure the "retention rate" of AI-usage after the initial training phase. Additionally, research could explore the use of "Generative AI" and "Voice-to-Action" models that could eliminate the need for a graphical user interface altogether, allowing farmers to interact with farm management tools using natural language. Investigating the "cost-benefit" ratio of AI adoption for specific crops like sugarcane versus short-cycle vegetables in the Pune region would also provide more granular insights for tailored technological interventions.

8. REFERENCES

1. Bhardwaj, A. (2021). Transforming Krishi Vigyan Kendras into Digital Hubs. Journal of Rural Extension, 45(2), 112-128.
2. Desai, S., & Kulkarni, R. (2024). Localization strategies for Agri-Tech: A study of Maharashtra's Maha-Agri project. Indian Journal of Agricultural Sciences, 94(1), 45-59.

3. Grover, V., & Gupta, P. (2025). Scalability challenges in Indian Agri-Tech startups. Management Review Quarterly, 31(3), 210-235.
4. Jain, H., Singh, S., & Kaur, M. (2017). Mobile based agro-advisories and information asymmetry. Computers and Electronics in Agriculture, 141, 167-175.
5. Kshirsagar, M. (2023). Financial viability of precision agriculture for smallholders in Western Maharashtra. Economic and Political Weekly, 58(12), 34-41.
6. Kulkarni, V. (2024). Digital Divide in Maharashtra: A District-wise Analysis. Pune University Press.
7. Mittal, S., & Kumar, S. (2020). Digital literacy and its role in modernizing Indian agriculture. World Development Perspectives, 18, 100-215.
8. Mohanty, A., et al. (2024). Global trends in AI for smallholder farmers: Lessons for the Global South. Agriculture and Human Values, 41(2), 301-318.
9. Patil, S., & Deshmukh, A. (2023). The Knowledge Gap in AI Adoption: Evidence from Pune. Journal of Agri-Management, 12(4), 88-102.
10. Patra, N., et al. (2019). Psychological barriers to technology adoption in rural India. Journal of Behavioral Economics, 22(1), 15-29.
11. Rao, K., et al. (2022). Environmental impact of precision irrigation in the Bhima River Basin. Environmental Management, 69(5), 789-805.
12. Reddy, B. (2023). Human-in-the-loop: A new model for rural AI deployment. Tech in Society, 72, 102-115.
13. Shinde, P. (2021). Adoption patterns of precision farming in Maharashtra. Maharashtra Agricultural Review, 33(4), 22-35.
14. Singh, R. (2022). Gender and the Digital Divide in Indian Agriculture. Gender, Technology and Development, 26(2), 145-163.
15. State Agricultural Report. (2025). Annual Progress Report: Department of Agriculture, Maharashtra.

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ARTIFICIAL INTELLIGENCE IN MARKETING: SYSTEMATIC REVIEW AND FUTURE RESEARCH DIRECTION

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ABSTRACT
Disruptive technologies such as the internet of things, big data analytics, blockchain, and artificial intelligence have changed the ways businesses operate. Of all the disruptive technologies, artificial intelligence (AI) is the latest technological disruptor and holds immense marketing transformation potential. Practitioners worldwide are trying to figure out the best fit AI solutions for their marketing functions. However, a systematic literature review can highlight the importance of artificial intelligence (AI) in marketing and chart future research directions. The present study aims to offer a comprehensive review of AI in marketing using bibliometric, conceptual, and intellectual network analysis of extant literature published between 1982 and 2020. A comprehensive review of one thousand five hundred and eighty papers helped to identify the scientific actors' performance like most relevant authors and most relevant sources. Furthermore, co-citation and co-occurrence analysis offered the conceptual and intellectual network. Data clustering using the Louvain algorithm helped identify research sub-themes and future research directions to expand AI in marketing. The results provide a comprehensive definition of AI, highlighting keywords extracted from selected references. The study analyses the diverse applications of AI in marketing, identifies specific AI applications applicable to marketers, explores the adoption of grand theory and middle theory in marketing research, and contributes to the existing body of knowledge. Among the latest technological advancements, AI stands out as a transformative force in marketing.

Keywords: *Marketing, Artificial intelligence, Bibliometric analysis, Intellectual structure, Conceptual structure*

STATEMENT OF CONTRIBUTION
Artificial Intelligence (AI) in Marketing has gained momentum due to its practical significance in present and future business. Due to the wider scope and voluminous coverage of research studies on AI in marketing, the meta-synthesis of exiting studies for identifying future research direction is extremely important. Extant literature attempted the systematic literature review.

1. INTRODUCTION
Technological disruptions such as artificial intelligence (AI), internet of things (IoT), big data analytics (BDA) have offered digital solutions for attracting and maintaining the customer base. Emerging technologies provide a competitive advantage by facilitating the customers' product and service offerings in the current business scenario, the cut-throat competition and technological disruptions have changed the way organizations operate Globally customer-centric approach focused on customer needs plays a pivotal role in organizational growth. Artificial intelligence (AI) is a widely used emerging technology that helps organizations track real-time data to analyse and respond swiftly to customer requirements. AI offers consumer insight on consumer behaviour essential for customer attraction and customer retention. AI incites the customer's next move and redefines the overall experience. AI tools are useful to deduce customer expectations and navigate the future path.

2. OBJECTIVES OF STUDY
1. **Categorization of AI Applications:** Reviews map AI use across marketing functions like content, digital, experiential, operations, and market research, identifying specific use cases (e.g.,).
2. **Strategic Support:** AI aids in segmentation, targeting, positioning (STP), pricing, product design, and media planning.
3. **Customer Engagement:** AI powers personalized recommendations, chatbots, and tailored brand experiences.
4. **Data & Analytics:** AI leverages big data for predictive analysis, trend forecasting, and deeper customer understanding.
5. **Research Gaps Identified:** Limitations in current research include a lack of applicability studies, ethical considerations, and understanding the impact on human roles and consumer trust

3. LITERATURE REVIEW
Marcello et al. (2021). The study is the first to present an integrated view of the body of knowledge on artificial intelligence (AI) as published in marketing, consumer research, and psychology literature. By employing a systematic literature review with a data-driven approach and quantitative methodology (including bibliographic

coupling), the study offers an overview of the emerging intellectual structure of AI research within these three areas of literature. The researchers identified eight topical clusters: (1) memory and computational logic; (2) decision-making and cognitive processes; (3) neural networks; (4) machine learning and linguistic analysis; (5) social media and text mining; (6) social media content analytics; (7) technology acceptance and adoption; and (8) big data and robots.

Liye Ma (2020). Artificial intelligence (AI) agents powered by machine learning algorithms are rapidly transforming the business landscape, sparking significant interest among researchers. In this paper, the authors review and advocate for the use of machine learning methods in marketing research. They provide an overview of common machine learning tasks and methods, comparing them with the statistical and econometric methods traditionally employed by marketing researchers.

Abid Haleem et al. (2022). Artificial Intelligence (AI) holds immense potential in the field of marketing. It enhances the proliferation of information and data sources, improves software's data management capabilities, and enables the design of complex and advanced algorithms. AI is transforming the way brands and consumers interact. The application of AI technology varies significantly depending on the nature of the website and the type of business involved. Marketers can now focus more effectively on customers and address their needs in real time.

Sanjeev Verma et al. (2021). Disruptive technologies such as the Internet of Things, big data analytics, blockchain, and artificial intelligence have revolutionized the way businesses operate. Among these, artificial intelligence (AI) stands out as the latest technological disruptor with significant potential to transform marketing. Practitioners around the world are seeking the most suitable AI solutions for their marketing functions. However, a systematic literature review can underscore the importance of AI in marketing and outline future research directions.

Ming Hui (2020). The authors propose a three-stage framework for strategic marketing planning that incorporates the numerous benefits of artificial intelligence (AI): mechanical AI for automating repetitive marketing tasks, thinking AI for processing data and making decisions, and feeling AI for analysing interactions and human emotions. This framework outlines how AI can be utilized across various stages of marketing, including research, strategy (segmentation, targeting, and positioning.

Nalini et al. (2021). AI marketing leverages artificial intelligence technologies to make automated decisions based on data collection, analysis, and additional observations of audience behaviour or economic trends that may influence marketing strategies. AI is particularly valuable in marketing scenarios where speed is critical.

Arnaud et al. (2020). This article explores the pitfalls and opportunities of AI in marketing through the perspectives of knowledge creation and knowledge transfer. First, it delves into the concept of "higher order learning," which sets AI applications apart from traditional modelling approaches. The discussion centres on recent advancements in deep neural networks, covering key methodologies such as multilayer perceptron, convolutional, and recurrent neural networks, as well as various learning paradigms, including supervised, unsupervised, and reinforcement learning.

Sanjiv Mehta, CEO & MD of Hindustan Unilever Ltd. The centre of showcasing has not changed, yet the manner in which we impart has changed promoting. It is constantly changing. The significant shift has taken place there. The art of storytelling is very much present, but the key is how and through what medium we tell the story. Like in business, artificial intelligence.

Thomas H. Davenport It is not hard to argue that AI will be used more in marketing in the future. A lot of the components of an AI based strategy are still in place today. Marketing today is increasingly targeted, quantitative, and dependent on business outcomes. In real time, advertisements and promotions are becoming increasingly tailored to individual customers.

Kietzmann, J., & Northey, G. (2021). Artificial intelligence in marketing. This article discusses the pitfalls and opportunities of AI in marketing through the lenses of knowledge creation and knowledge transfer. First, we discuss the notion of "higher-order learning" that distinguishes AI applications from traditional modelling approaches, and while focusing on recent advances in deep neural networks, we cover its underlying methodologies

Feng, C. M., Park, A., Pitt, L., Kietzmann, J., & Northey, G. (2021). Artificial intelligence in marketing: A bibliographic perspective. Australasian Marketing Journal, 29(3), 252-263. The term artificial intelligence (AI) was used in the mid-twentieth century to denote computer science research aimed at stimulating human

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learning. Since then, developments in computers, data collection, and data storage have increased the importance of AI for researchers and practitioners in a variety of business and social scientific areas.

Huang, M. H., & Rust, R. T. (2022). A framework for collaborative artificial intelligence in marketing. Journal of Retailing, 98(2), 209-223. They develop a conceptual framework for collaborative artificial intelligence (AI) in marketing, providing systematic guidance for how human marketers and consumers can team up with AI, which has profound implications for retailing, which is the interface between marketers and consumers.

Shaik, M. (2023). Impact of artificial intelligence on marketing. East Asian Journal of Multidisciplinary Research, 2(3), 993-1004. The evolution of artificial intelligence (AI) has significantly altered the dynamics of today's corporate environment. One of the most important applications of artificial intelligence is in marketing, where it helps to improve performance. The current study tries to determine the impact of AI on marketing.

Eriksson, T., Bigi, A., & Bonera, M. (2020). Think with me, or think for me? On the future role of artificial intelligence in marketing strategy formulation. The TQM Journal, 32(4), 795-814. This paper investigates whether and how artificial intelligence may help with marketing strategy formulation.

4. RESEARCH GAPS

The literature review indicates that research has been conducted to study need for more research on customer perception, emotional responses, trust, and the psychological impact of AI interactions. Lack of standardized frameworks to measure the tangible financial returns (ROI) and long-term effectiveness of AI applications.

5. METHODOLOGY

We used Rowley and Slack's (2004) guidelines for conducting the literature review. Methodologically, the literature review used a five-stage process described in the following sections. Comprehensive review protocols helped in the identification of research themes and future research directions.

5.1 Selection of bibliometric databases

Scopus and Web of Science are the two most reputed bibliometric databases. We explored both Scopus and Web of Science databases to search the relevant literature. Scopus had broader coverage, and it includes more than 20,000 peer-reviewed journals from different publishers. Due to its wider coverage, we preferred Scopus for data collection. Scopus offered advanced search filters and data analysis grids for better data management.

5.2 Defining keywords (search strategy)

The initial search string included words like “marketing” and “artificial intelligence.” Synonyms used for artificial intelligence like machine learning, deep learning, natural language processing, etc., are used with Boolean operators like “OR” to get the universal set of papers. Boolean operator “AND” is used to get the intersection set of paper covering marketing and artificial intelligence.

5.2.1 Refining the initial results (Inclusion and exclusion criteria)

Inclusion and exclusion criteria are applied to the search results. With the help of inclusion and exclusion criteria, delimitation helped in the extraction of the most relevant articles for the literature review. To achieve the research objective, the search results limits to only articles published in journals as they represent “certified knowledge” (Ramos-Rodríguez and Ruiz-Navarro, 2004). Conference papers, book chapters, commentaries, erratum etc., were excluded from the search results.

5.2.2 Data analysis plan

The bibliometric analysis of data was carried out using R-software for performance analysis of scientific actors like most relevant authors and most relevant sources. The content analysis and performance analysis of each scientific actor offered the intellectual structure of the research domain. Two researchers analysed the Scopus data for inter-rater validity.

5.2.3 Identification of research gaps and future research directions

The articles relating to artificial intelligence in marketing were reviewed to understand the theoretical evolution, methodological evolution, and emerging research themes. Thematic coding is used for the qualitative analysis of data.

6. RESEARCH SCOPE

1. **Functional Themes:** AI is applied across integrated digital marketing, content, experiential, operations, and market research.
2. **Use Cases:** Includes hyper-personalization, predictive analytics for media buying, real-time insights, automated customer service (chatbots), sentiment analysis, and SEO.

3. **Technology Integration:** AI interacts with Big Data, IoT, VR/AR, and voice assistants to transform marketing.

7. KEY FINDINGS FROM SYSTEMATIC REVIEWS

1. **Core Applications:** AI is used across integrated digital marketing, content creation, experiential marketing, operations, and market research.
2. **Consumer Engagement:** AI enhances engagement through voice assistants and chatbots, leveraging social presence, ease of use, and perceived usefulness to drive purchase intention.
3. **Personalization & Efficiency:** AI enables hyper-personalized advertising, reduces human error in audience targeting, and automates tasks like email campaigns, improving ROI.
4. **Data & Strategy:** AI provides powerful market research tools for prediction, customer segmentation, and identifying high-potential customers, moving marketing towards data-driven decisions.
5. **Emerging Themes:** Reviews highlight key areas like prediction analysis, CRM, conversational commerce, advertising, and consumer-brand engagement as major research sub-themes.

8. FUTURE RESEARCH DIRECTIONS

Future research directions emphasize deeper exploration of ethical AI, long-term impacts on customer trust, integrating AI with established marketing theories, understanding its role in B2B contexts, developing frameworks for responsible adoption, and uncovering how AI shapes the entire customer journey.

9. CONCLUSION

Disruptive technologies such as internet of things, big data analytics, blockchain, and artificial intelligence have changed the ways businesses operate. Of all the disruptive technologies, artificial intelligence (AI) is the latest technological disruptor and holds immense potential for manufacturing, pharmaceuticals, healthcare, agriculture, logistics, and digital marketing. Many practitioners and academicians worldwide are trying to figure out the best fit AI solutions that their organizations can utilize.

10. REFERENCES

1. Anshari, M., Almunawar, M. N., Lim, S. A., & Al-Mudimigh, A. (2018). Customer relation- ship management and big data-enabled: Personalization & customization of services. *Applied Computing and Informatics, 15* (2), 94–101.
2. Antons, D., & Breidbach, C. F. (2018). Big data, big insights? Advancing service innovation and design with machine learning. *Journal of Service Research, 21* (1), 17–39.
3. Balaji, M. S., & Roy, S. K. (2017). Value co-creation with the Internet of things technology in the retail industry. *Journal of Marketing Management, 33* (1–2), 7–31.
4. Bauer, J., & Jannach, D. (2018). Optimal pricing in e-commerce based on sparse and noisy data. *Decision Support Systems, 106,* 53–63.
5. Bolton, R. N., McColl-Kennedy, J. R., Cheung, L., Gallan, A., Orsingher, C., Witell, L., & Zaki, M. (2018). Customer experience challenges: Bringing together digital, physical, and social realms. *Journal of Service Management, 29* (5), 776–808.
6. Cambria, E. (2016). Affective computing and sentiment analysis. *IEEE Intelligent Systems, 31* (2), 102–107.
7. Chatterjee, S., Ghosh, S. K., Chaudhuri, R., & Nguyen, B. (2019). Are CRM systems ready for AI integration? A conceptual framework of organizational readiness for effective AI-CRM integration. *The Bottom Line, 32,* 144–157.
8. Chen, C., Ibekwe-SanJuan, F., & How, J. (2010). The Structure and Dynamics of Cocitation Clusters: A Multiple-Perspective Cocitation analysis. *Journal of the American Society for Information Science and Technology, 61* (7), 1386–1409.
9. Chen, Y., Lee, J. Y., Sridhar, S., Mittal, V., McCallister, K., & Singal, A. G. (2020). Improving cancer outreach effectiveness through targeting and economic assessments: Insights from a randomized field experiment. *Journal of Marketing, 84* (3), 1–27.
10. Costa, P. B., Neto, G. M., & Bertolde, A. I. (2017). Urban mobility indexes: A brief review of the literature. *Transportation Research Procedia, 25,* 3645–3655.
11. Davenport, T., Guha, A., Grewal, D., & Bressgott, T. (2020). How artificial intelligence will change the future of marketing. *Journal of the Academy of Marketing Science, 48* (1), 24–42.

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THE USE OF AI TOOLS IN MANUFACTURING SECTOR FOR OVERALL COST REDUCTION.

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ABSTRACT

The manufacturing sector converts raw materials like metals, chemicals, and wood into valuable finished goods such as automobiles, electronics, textiles, and pharmaceuticals, forming the economy's secondary sector. Distinct from primary extraction and tertiary services, it drives GDP growth, job creation, and global trade through large-scale production, automation, and innovation. Key processes span design, fabrication, assembly, and supply chains linking inputs to consumers. Despite challenges like skill shortages and infrastructure gaps, it fuels economic development. Current trends, especially in India via Make in India and PLI schemes, emphasize Industry 4.0, digitalization, and smart factories to elevate manufacturing's GDP share. (1) Every manufacturing organisation is concerned with its cost reduction for several reasons such as competition, market share so on and so forth.

Key AI tools examined includes: Machine Learning, Algorithms for Predictive Maintenance, Computer Vision for Quality Control, Robotic Process Automation (RPA) for assembly lines and generative AI for Supply Chain forecasting. Predictive Maintenance Models powered by ML platforms like: TensorFlow and IBM Watson, reduced unplanned downtime by an average of 42%, translating to 18.25% savings in maintenance expenditures. Computer Vision Systems such as, those using convolutional neural networks (CNNs) detected defects with 97% accuracy, slashing scrap rates by 35% and rework costs by 28%. RPA Integrations streamlined repetitive tasks, yielding labour cost of 22%, while AI-driven data forecasting minimised inventory holding costs by 30% through optimised Just-In-Time procurement (Source:).

The Artificial Intelligence tools for example predictive maintenance, AI-powered quality control, and supply chain optimization etc can reduce manufacturing costs by up to 30% to 50%, improved yield and many more. Though the initial investment and implementation cost seems heavy but delivers a return on investment within 12-24 months.

The current research article attempts to study the transformative potential of Artificial Intelligence (AI)tools in achieving substantial overall cost reduction across manufacturing operations.

Key Words: - *AI tools, Cost reduction, Manufacturing sector, Supply Chain, IoT, ML, Just-In-Time*

INTRODUCTION: -

The manufacturing sector in India contributes approximately 16-17% to the nation’s Gross Domestic Product (GDP) and employs over 27 million workers. This sector comprises of key industries such as automobiles, pharmaceuticals, textile chemical and many more. It is also adopting automation, AI, IoT for better productivity and cost reduction at fast pace. Further it is strengthened by government initiatives like Make in India, National Manufacturing Mission.

Cost reduction is a systematic process and ongoing method aimed at lowering business expenses to enhance profitability, to make the product cost effective, competitive advantage and for many more objectives. Manufacturing industries are always concerned about their cost reduction. There are different ways with which organisation can reduce its costs such as Outsourcing, hiring remote workers, etc. Hence AI tools can help manufacturing companies to great extent in cost reduction. Therefore, it is necessary to explore and study application of AI tools and its impact on cost reduction in manufacturing sector.

It is interesting to study what is Artificial Intelligence (AI) and how it is revolutionizing our daily life, work, and interactions across multiple sectors. By enabling machines to learn, reason, and decide autonomously, AI enhances efficiency, customization, and innovation. From intelligent virtual assistants to autonomous vehicles, its impact is profound.

Following are the 10 real life examples that demonstrate AI's transformation across industries, highlighting emerging trends that drive progress from smart applications to advanced transportation systems. How our lives and lifestyles are impacted by AI with just a click.

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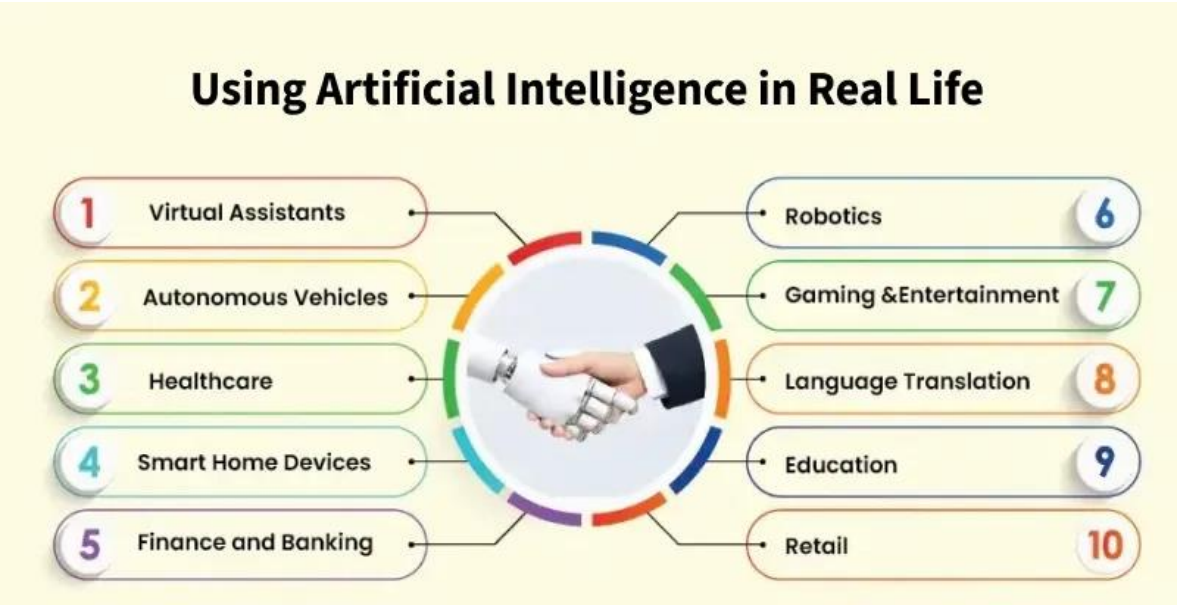

(**source:https://**www.geeksforgeeks.org/artificial-intelligence/10-examples-of-artificial-intelligence-in-real-life-202

OBJECTIVES: -

1. To study the concept of AI tools and cost reduction in manufacturing sector
2. To identify and assess the AI tools in manufacturing sector for cost reduction
3. To study usage, benefits and challenges in implementation
4. To assess recent trends and strategies of AI tools adoption in manufacturing sector.

LITERATURE REVIEW: -

1. Nuthana Shetty (2024) explores AI implementation in Indian firms like Asian Paints and Tata Steel, achieving 10-14% production cost reductions and 30% downtime cuts via supply chain optimization.

2. **Mechanical Journals (2024)** analyzes AI-enabled smart automation in India, enhancing productivity and energy efficiency under Make in India, despite high initial costs.
3. **IJCAI (2025)** demonstrates AI/ML in Indian print manufacturing, yielding 10-35% savings in downtime, waste, and pricing via predictive models and defect detection.
4. **Gao et al. (2024)** examine AI applications across manufacturing, from design to quality control, achieving 20-30% cost reductions via process modelling and optimization.
5. **Plathottam et al. (2023)** review AI/ML in manufacturing, noting 25-40% maintenance savings and efficiency gains when integrated with IoT sensors.
6. **Cannas et al. (2024)** analyse AI in supply chain operations, highlighting cost/lead time reductions and service improvements in OSCM contexts.
7. Study AI adoption in SMEs, finding 15-25% savings through predictive maintenance and resource orchestration.
8. **Wang et al. (2024)** demonstrate ML for Pd.M., cutting unplanned downtime by 30-45% and overall costs in industrial case studies.
9. **Cortright (2025)** synthesizes AI for cost estimation, using predictive analytics and real-time adjustments for 20%+ accuracy improvements in material/labor forecasting.

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RESEARCH METHODOLOGY: -

The current research article is based on secondary data collection A comprehensive review of 50+ peer-reviewed articles (2018-2026) from journals like International Journal of Production Economics and Journal of Manufacturing Systems was conducted, alongside industry reports from Deloitte, McKinsey, and NAM. The research scholar has referred to online International and national reference books, Journals and Reports for this article.

DISCUSSION: -

Recent trends and strategies of AI tools adoption in the manufacturing sector:
AI adoption has become nearly ubiquitous in manufacturing. This year's survey reveals that 95% of manufacturers have already invested in or intend to invest in AI/ML within the next five years.

AI-DRIVEN MANUFACTURING COST REDUCTION APPLICATIONS:

1. **Predictive Maintenance**: ML algorithms process sensor data to forecast equipment failures, slashing downtime by 60%.
2. **AI Quality Control**: Computer vision detects defects with superior precision, cutting inspection times by 80%.
3. **Supply Chain Optimization**: AI forecasts demand, fine-tunes inventory to prevent excess stock, and enhances logistics efficiency.
4. **Energy Optimization**: AI analyses consumption patterns to pinpoint waste and recommend adjustments, lowering utility expenses.
5. **Generative Design**: AI generates optimal product designs rapidly, minimizing material usage and accelerating market entry.
6. **Waste Reduction**: Real-time process monitoring enables precise control, reducing material waste by 8-15%.

(Source:https://www.rapidcanvas.ai/blogs/ai-in-manufacturing-enhancing-efficiency-and-reducing-cost)

AI Implementation Costs in Manufacturing

Though the AI deployment expenses in manufacturing differ significantly based on system complexity, organizational size, and rollout scope, generally spanning $50,000 for entry-level solutions to over $1 million for comprehensive enterprise implementations. Primary costs encompass licensing fees, bespoke development, data infrastructure, and staff training, typically recouped through 15-40% operational cost reductions within 12-24 months.

Cost Components of companies incurred are as follows:

- **Software Licensing**: $30K-$200K per facility for predictive maintenance platforms like IBM Maximo; subscription models lower initial outlay to $10K-$50K yearly.
- **Development & Systems Integration**: $50K-$300K for manufacturing execution systems, IIoT connectivity, and ERP modifications (20-25% of total budget).
- **Data Engineering & Model Training**: 15-25% of overall spend ($20K-$150K) covering sensor pipelines and domain-specific algorithm refinement.
- **Infrastructure Investment**: $50K-$600K for edge devices, cloud capacity, and sensors; annual AI compute adds $8K-$30K.

These 10 AI tools, categorized by primary cost-saving function, deliver measurable reductions across manufacturing operations through predictive analytics, computer vision, and simulation technologies. Industry benchmarks show combined adoption yielding 25-40% overall savings.

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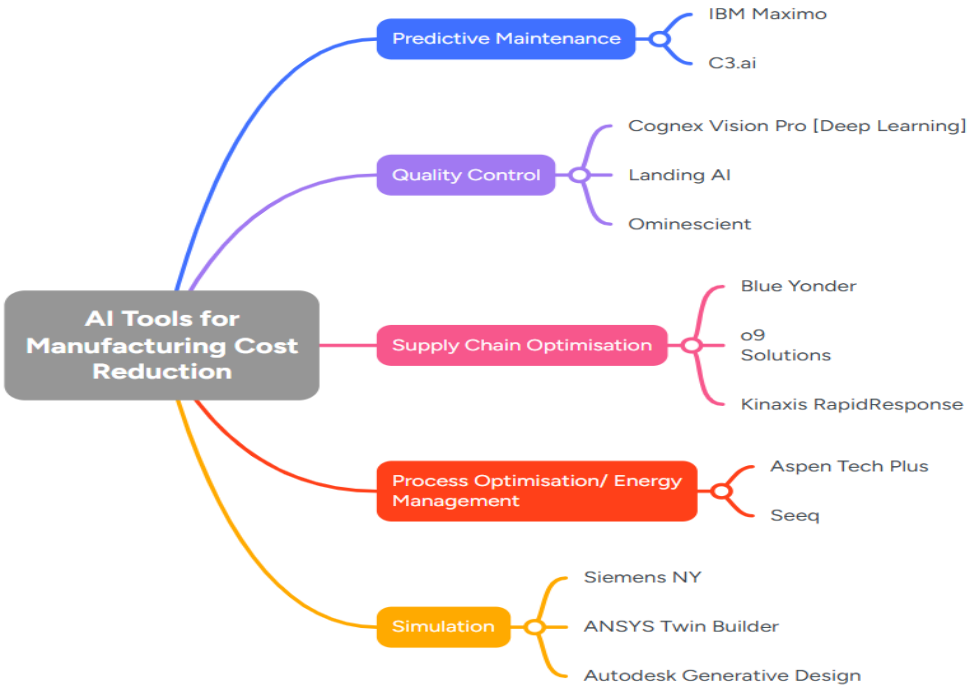
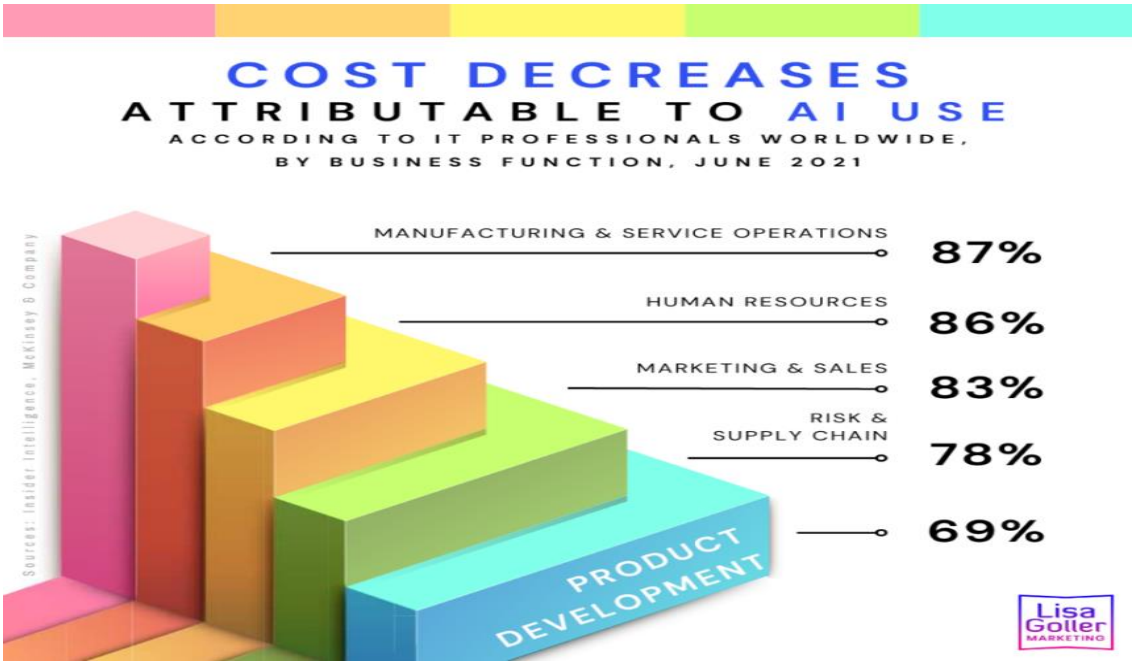


(**Source:** https://research.aimultiple.com/manufacturing-ai/

Benefits of Use of AI tools in manufacturing sector for overall cost reduction are discussed below**:**



(**Source:** https://www.lisagoller.com/2023/02/ai-driven-cost-reduction/)

- Lower Maintenance Costs: Proactive repairs prevent expensive, unplanned machinery failures.
- Reduced Labor Inefficiencies: Automation of repetitive tasks reduces labour costs and human error.
- Optimized Resource Allocation: Improved production scheduling ensures higher efficiency and better material utilization.
- Improved Yield: Precise formulation adjustments in production processes, such as in chemical or process manufacturing, minimize material waste.
- Quality control improvements.
- Inventory optimisation,

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- labour efficiency gains
- energy consumption reduction,
- supply chain, resilience,
- scalable ROI realisation.

Challenges in AI Adoption for Manufacturing Cost Reduction:
Following are some of the hurdles commonly faced are pointed out

- **Data Quality Problems**: Poor sensor data, gaps, and fragmented systems reduce AI reliability, delaying 40% of initiatives according to Deloitte 2025 data.
- **High Upfront Expenses**: Initial outlays burden SMEs, with ROI taking 12-24 months amid rising input costs (5.8%).
- **Talent Shortages**: Limited AI skills and employee resistance to automation hinder progress.
- **Outdated Systems**: Integrating old equipment with modern IT blocks real-time insights and pilot expansion.
- **Security & Compliance Hurdles**: Vulnerable IIoT setups and regulations (GDPR, ISO) inflate costs.
- **Scaling Difficulties**: High numbers proofs-of-concept fail company-wide rollout due to tracking issues and lost expertise.

CONCLUSION: -

To conclude with the current research article tries to assess the usage of AI tools in the manufacturing sector cost reduction. The data shows adoption of AI tools like Predictive Maintenance, AI Quality Control, AI Generative Designs, etc **are** very effective in reducing overall manufacturing cost. The initial cost can be heavy but can be recovered in a year to three years' time period. Considering the benefits such as Lower Maintenance Costs, Quality control improvements, Inventory optimisation, labour efficiency gains, scalable ROI realisation etc. make it more reasonable.

Though there are limitations like scalability issues, outdated systems or resistance from labourers. Which can be dealt by the organisations by arranging proper training programs, **Data Quality** improvements, Upgrading the machines, hiring or retention of required talents. Finance or funds supply for necessary system installation can bring fruitful long-term results. Thus, identifying and removal of hurdles at implementation level can help organisations achieve the objectives cost reduction.

AI in Manufacturing Market (2025-2030): Regional Analysis reports
offer comprehensive regional insights into AI adoption and growth within manufacturing. North America maintains leadership with 32-43% market share, supported by cutting-edge infrastructure, while Asia Pacific demonstrates the highest compound annual growth rates driven by rapid industrial digitization. Adoption maturity varies significantly across other global regions. (19)

Looking ahead, AI will revolutionize operations through autonomous workflows, digital twins, and Industry 5.0 integration, delivering over 50% productivity gains by 2030 according to PwC forecasts and Lighthouse Network standards. Trends like AI-powered reindustrialization—slashing CNC programming time by 80% via startup innovations—will address labour shortages and market volatility, empowering SMEs with scalable quality control, scheduling, and sustainable practices. Success hinges on strategic implementation featuring hybrid AI systems, employee reskilling programs, and responsible AI governance, creating agile manufacturing ecosystems that achieve dramatic cost reductions while establishing market leadership in the hyper-efficient era. Visionary adopters will secure dominant competitive positions. (27)

REFERENCES: -

1. https://www.linkedin.com/pulse/why-manufacturing-costs-still-rising-how-industry-fighting-jarmus-z71ic#:~:text=Strategic%20Marketing%20%7C%20Market%20Research%20%7C%E2%80%A6,the%20highest%20rate%20since%202022Jarmus, M. (2025, August 5). *Explore why US manufacturing costs continue to climb in 2025 and how companies are responding with productivity gains, pricing strategy and supply chain shifts.* Linkedin.com. https://www.linkedin.com/pulse/why-manufacturing-costs-still-rising-how-industry-fighting-jarmus-z71ic
2. Nuthana Shetty (2024) explores AI implementation in Indian firms like Asian Paints and Tata Steel, achieving 10-14% production cost reductions and 30% downtime cuts via supply chain optimization.

3. Mechanical Journals (2024) analyzes AI-enabled smart automation in India, enhancing productivity and energy efficiency under Make in India, despite high initial costs.
4. IJCAI (2025) demonstrates AI/ML in Indian print manufacturing, yielding 10-35% savings in downtime, waste, and pricing via predictive models and defect detection.
5. https://www.sciencedirect.com/science/article/pii/S000785062400115X Gao, R. X., Krüger, J., Merklein, M., Möhring, H.-C., & Váncza, J. (2024). Artificial Intelligence in manufacturing: State of the art, perspectives, and future directions. CIRP Annals, 73(2). https://doi.org/10.1016/j.cirp.2024.04.101
6. https://aiche.onlinelibrary.wiley.com/doi/full/10.1002/amp2.10159 Plathottam, S. J., Rzonca, A., Lakhnori, R., & Iloeje, C. O. (2023). A review of artificial intelligence applications in manufacturing operations. *Journal of Advanced Manufacturing and Processing*, *5*(3). https://doi.org/10.1002/amp2.10159
7. https://www.tandfonline.com/doi/full/10.1080/00207543.2023.2232050 Cannas, V. G., Ciano, M. P., Saltalamacchia, M., & Secchi, R. (2023). Artificial intelligence in supply chain and operations management: A multiple case study research. *International Journal of Production Research*, *62*(9), 1–28. Tandfonline. https://www.tandfonline.com/doi/full/10.1080/00207543.2023.2232050
8. https://www.sciencedirect.com/science/article/pii/S026840122400029X Peretz-Andersson, E., Tabares, S., Mikalef, P., & Parida, V. (2024). Artificial intelligence implementation in manufacturing SMEs: A resource orchestration approach. *International Journal of Information Management*, *77*(1), 102781–102781. https://doi.org/10.1016/j.ijinfomgt.2024.102781
9. https://pubs.aip.org/aip/acp/article/3243/1/020035/3327942/Enhancing-predictive-maintenance-in-the-industrialLevin, S. (2024). Enhancing predictive maintenance in the industrial sector: A comparative analysis of machine learning models. *AIP Conference Proceedings*, *3243*, 020035. https://doi.org/10.1063/5.0247617
10. https://www.costitright.com/blog/ai-manufacturing-cost-estimation/costitright. (2025, January 13). *AI in Manufacturing Cost Estimation Simplified*. Costitright. https://www.costitright.com/blog/ai-manufacturing-cost-estimation/
11. https://www.ibef.org/industry/manufacturing-sector-india#:~:text=Manufacturing%20Sector%20in%20India%20Industry,orders%20in%20nearly%20five%20yearsIBEF. (2022). *Manufacturing Sector in India: Market Size, FDI, Govt Initiatives | IBEF*. Www.ibef.org. https://www.ibef.org/industry/manufacturing-sector-india
12. **International Journal of Production Economics** (Elsevier) Covers AI-driven resource orchestration in SMEs, with studies showing 15-25% cost savings through predictive models. https://www.sciencedirect.com/science/article/pii/S026840122400029X Peretz-Andersson, E., Tabares, S., Mikalef, P., & Parida, V. (2024b). Artificial intelligence implementation in manufacturing SMEs: A resource orchestration approach. *International Journal of Information Management*, *77*(1), 102781–102781. https://doi.org/10.1016/j.ijinfomgt.2024.102781
13. **Journal of Manufacturing Systems** (Elsevier) Features case studies on ML for fault prediction and smart factories, achieving 30% operational efficiencies. https://pubs.aip.org/aip/acp/article/3243/1/020035/3327942/Enhancing-predictive-maintenance-in-the-industrial Levin, S. (2024b). Enhancing predictive maintenance in the industrial sector: A comparative analysis of machine learning models. *AIP Conference Proceedings*, *3243*, 020035. https://doi.org/10.1063/5.0247617
14. **IEEE Transactions on Industrial Informatics** Publishes on deep learning for supply chain and quality control, yielding 20-35% expense reductions. https://aiche.onlinelibrary.wiley.com/doi/full/10.1002/amp2.10159
15. **International Journal of Production Research** (Taylor & Francis) Explores AI simulations for resilient manufacturing, with empirical data on 25% logistics savings. https://www.sciencedirect.com/science/article/pii/S026840122400029X Peretz-Andersson, E., Tabares, S., Mikalef, P., & Parida, V. (2024c). Artificial intelligence implementation in manufacturing SMEs: A resource orchestration approach. *International Journal of Information Management*, *77*(1), 102781–102781. https://doi.org/10.1016/j.ijinfomgt.2024.102781

ISSN 2394 - 7780

16. **Journal of Intelligent Manufacturing** (Springer) https://www.worldcertification.org/manufacturing-in-the-ai-era/ Mckenzie, S. (2025). *Manufacturing in the AI Era: A Strategic Blueprint for Cost Optimization - World Certification Institute - WCI | Global Certification Body*. Worldcertification.org. https://www.worldcertification.org/manufacturing-in-the-ai-era/

17. Key Reports https://www.grandviewresearch.com/industry-analysis/artificial-intelligence-in-manufacturing-market

18. **Oza, J., Kishore, N., Sharma, S., & Babbar, J. (2025).** *Artificial Intelligence and Robotics in Manufacturing: A Sustainable Future***. Routledge, India.** Analyzes Indian case studies (e.g., Tata Steel PdM) for 25% downtime cuts; future: AI-robotics hybrids for 35% energy savings by 2030. Oza, A. D., Kishore, H., Sharma, A., & Babbar, A. (2025). *Artificial Intelligence and Robotics in Manufacturing*. CRC Press.

19. **Das, D. K. (2024).** *The Transformation of Manufacturing by Artificial Intelligence***. IGI Global (Indian chapter).** Uses 2024 MSME data for 20% inventory reductions; scope: Low-cost AI for 98% inspection accuracy in MSMEs by 2027. Dibyendu Maiti, Bishwanath Goldar, & Krishna, K. L. (2025). *75 Years of Growth, Development and Productivity in India*. Springer Nature.

20. **Barik, T. R. (2024).** *Integration of AI Technology in Cost and Management Accounting***. CAPDR Publications, India** Covers 2025 JIT-AI models reducing material costs 15%; future: Real-time analytics for 30% overhead savings post-PLI expansion. Arif, J., & Jawab, F. (2025). *Transformative Impact of AI in Supply Chain Management*. IGI Global.

21. **Shetty, N. (2024).** *Implementation of AI in Indian Manufacturing Companies***. MSNIM Management Review Series** Details Asian Paints/Godrej cases with 10-15% efficiency gains (2024 data); outlook: 30% cost drops via predictive tools by 2028. Arvind Dagur, Agarwal, S., Shukla, D. K., Ali, S., & Sharma, S. (2026). *Artificial Intelligence and Sustainable Innovation*. CRC Press.

22. **IIIE Trivandrum (2025).** *AI-Driven Industrial Engineering for Manufacturing Optimization***. CET MBA Publications** Reviews gear manufacturing AI for waste reduction (2025 stats); future: Ensemble ML for 25% logistics savings in Indian supply chains. Satishkumar, D., & Sivaraja, M. (2024). *Industry Applications of Thrust Manufacturing: Convergence with Real-Time Data and AI*. IGI Global.

23. https://www.ibef.org/industry/manufacturing-sector-india#:~:text=Manufacturing%20Sector%20in%20India%20Industry,orders%20in%20nearly%20five%20years IBEF. (2022b). *Manufacturing Sector in India: Market Size, FDI, Govt Initiatives | IBEF*. Www.ibef.org. https://www.ibef.org/industry/manufacturing-sector-india

24. https://www.rtinsights.com/inside-the-new-wave-of-ai-adoption-in-manufacturingStump, A. (2025, October 17). *Inside the New Wave of AI Adoption in Manufacturing - RTInsights*. RTInsights. https://www.rtinsights.com/inside-the-new-wave-of-ai-adoption-in-manufacturing

25. https://accedia.com/insights/blog/ai-driven-cost-reduction-in-manufacturing-what-will-work-in-2026 Dimitrov, D. (2026). *AI-Driven Cost Reduction in Manufacturing: What Will Work in 2026*. Accedia.com. https://accedia.com/insights/blog/ai-driven-cost-reduction-in-manufacturing-what-will-work-in-2026

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A STUDY ON TEACHERS' PERCEPTIONS OF AI-BASED TEACHING IN THE EDUCATION SYSTEM OF THE MUMBAI REGION

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ABSTRACT
Artificial Intelligence (AI) is rapidly growing in many sectors along with the education sector. AI tools are helpful in providing prompt solutions, saving time, managing large data, personalized academic assistance, and assessment techniques, etc., which are changing education learning techniques. Teachers play a major role in accepting these techniques and implementing them in the learning process. Teachers' perception, awareness, and acceptance of these techniques play a crucial role.

The present study aims to examine teachers' perceptions toward the use of AI-based teaching tools in the education system of the Mumbai region and to identify their awareness about AI teaching tools. The study is based on primary and secondary data. Primary data were collected from 50 college teachers through a questionnaire by using Google Forms, while secondary data were gathered from books, journals, research articles, and web sources. The findings identify that a majority of teachers are familiar with chat-based applications and use them on a regular basis. Teachers are having strong agreement that AI tools are time-saving, effective in improving teaching and learning quality, and useful for monitoring student progress. However, the study also highlights that a lack of proper training and awareness about AI tools creates limitations for implementation. Overall, the study concludes that teachers show a positive attitude toward AI integration in education, emphasizing the need for systematic training programs to enhance the effective and ethical use of AI tools.

Keywords: *Artificial Intelligence, Teachers' Perception, Education System, AI-Based Teaching Tools.*

1. INTRODUCTION:

Swami Vivekananda's idea that "Reforms should not be brought about by destroying institutions, but by improving them" means that true social change does not come from rejecting existing systems entirely. Instead, it comes from introducing new changes that strengthen and sustain institutions, while letting go of outdated practices that no longer serve a purpose in the future. This approach emphasizes improvement rather than destruction. His thoughts can be clearly seen in the development of the education system in India, which has continuously evolved according to the changing needs of society, culture, and technology. In ancient India, education was based on the Gurukul system, where shishyas learned under the guidance of their gurus. Oral instruction, hands-on experience, and close supervision were the primary methods of learning. Palm leaves were used as the earliest means of recording knowledge in manuscript form. During the colonial period, major changes occurred in the education system with the introduction of standardized schools, fixed institutional hours, classrooms, printed textbooks, and formal examinations to assess students' knowledge. After independence, the Indian education system largely adopted the British education pattern, which was further developed to include new teaching techniques such as audio-visual methods. Teachers began sharing knowledge through media such as radio, television, and overhead projectors. These methods helped students learn beyond the classroom and improved accessibility to education. In recent times, rapid advancements in internet and computer technologies have transformed the teaching–learning process through the introduction of smart classrooms. These classrooms engage students more effectively and help them gain conceptual clarity using audio-visual tools. These technologies also provide teachers with a wide range of digital resources and multimedia presentations, thereby enhancing their subject knowledge and teaching methods.

In today's world, knowledge can be accessed with just one click. This represents the future of technology, where systems are capable of analyzing vast amounts of data and providing accurate information within seconds. This is made possible by Artificial Intelligence (AI), which refers to computer-based systems that perform tasks requiring human intelligence, such as problem-solving, decision-making, and data analysis. AI generates personalized results in an efficient and rapid manner, which has led to its rapid growth and expansion across various sectors.

In the field of education, AI plays a significant role due to its features such as personalized learning solutions, the ability to process large volumes of data, automated assessments, instant feedback, and virtual assistance. Students are increasingly attracted to these advancements as they offer quick and easy solutions to educational challenges. Mumbai is a metropolitan city and the financial capital of India, as well as one of the fastest-

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growing urban centers. The literacy rate of Mumbai is approximately 89 percent. The adaptability of individuals to new situations reflects their experiences and exposure. In this context, the present study aims to examine the awareness of teachers regarding the AI tools available in the teaching–learning process and to analyze their perceptions toward the use of AI-based teaching tools in the education system.

2. REVIEW OF LITERATURE:

1. Olaseni V. (2024), in his paper, examines the perceptions of secondary school teachers in Nigeria toward the integration of AI-based systems into the school curriculum. The study reveals that although teachers are aware of the positive impact of AI on education, most responses are negative. The main reasons for this negative response include age, lower levels of education, fear of replacement, and professional specialization. Therefore, he suggests that policymakers and educational institutions must develop guidelines to safeguard student privacy and ensure the ethical use of AI in education.
2. Fakhar H. et al. (2024), in their paper, examined Moroccan teachers' perspectives on artificial intelligence and the importance of effective training programs in equipping educators with the necessary skills for AI integration. The study concluded that teachers' perceptions of integrating AI into their teaching were highly positive, as AI was found to be useful in simplifying their work and improving the overall quality of teaching and learning.
3. Iqbal M. et al. (2025), in their paper, aimed to examine teachers' experiences with the use of AI-based tools in teaching activities and to understand the benefits and challenges faced by both teachers and students in the AI-supported learning process. The study revealed that teachers used a variety of AI-based applications in their teaching, which benefited them in administrative tasks, access to learning resources, and the quality of learning content. However, the study concluded that major challenges include limitations in technological infrastructure and the risk of over-reliance on AI.

3. OBJECTIVES OF THE STUDY:

The objectives of the study are as follows:

- To highlight the AI - based tools used in the education system in Mumbai region.
- To examine teachers' perceptions toward the use of AI - based teaching tools in the education system of Mumbai.

4. SCOPE OF THE STUDY AND METHODOLOGY:

The present study focuses on colleges in Mumbai to identify the AI tools used in teaching and to examine teachers' perceptions regarding the use of AI-based techniques in the education system. To obtain relevant information, the study relied on both primary and secondary sources of data. Primary data were collected using a structured questionnaire administered via Google Forms. The questionnaire was distributed to 50 respondents through a convenient random sampling technique. Secondary data were gathered from various sources, including books, articles, journals, and the internet. The collected data were analyzed using tabular and graphical methods, and the results were interpreted accordingly.

5. FINDING OF THE STUDY:

Table -1 Personal Profile of Respondents

Particulars	Frequency	Percentage
Gender		
Male	19	37.3
Female	32	62.7
Other	-	-
Total	**51**	**100**
Age Group		
18-30	26	51
31-45	19	37.3
46-60	6	11.8
Total	**51**	**100**
Teaching Experience:		
Less than 1 year	10	20
1 - 5 year	25	49
5-10 years	7	14

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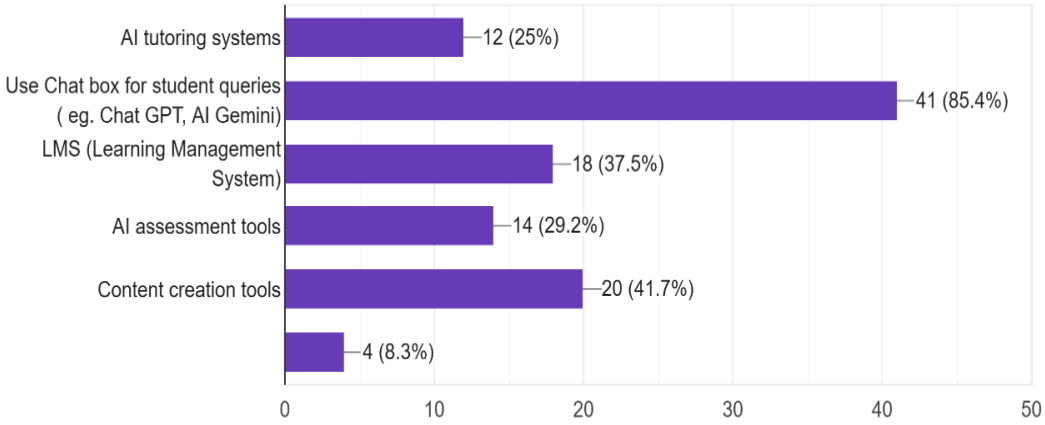
More than 10 years	9	17
Total	**51**	**100.00**

Source: Self Compiled

Table 1 presents the demographic details of the respondents based on gender, age group, and teaching experience. All participants were active teachers working in the education sector. Among the total respondents, 62.7% were female and 37.3% were male. Regarding age distribution, 51% of the participants belonged to the 18–30 years age group, followed by 37.3% in the 31–45 years age group and 11.8% in the 46–60 years age group. In terms of teaching experience, the majority of the respondents (49%) had 1–5 years of teaching experience. Additionally, 20% had less than one year of experience, 14% had 5–10 years of experience, and 17% had more than 10 years of experience.

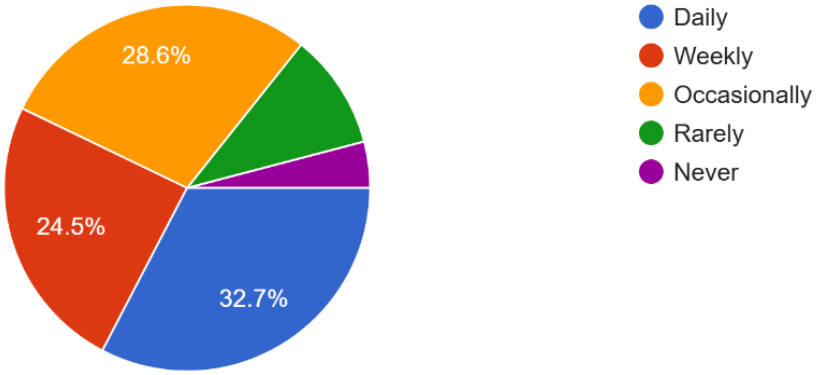
Figure 1: Teachers' Familiarity with Different AI Tools Used in Teaching



Sources: self-compiled

Figure 1 indicates that out of 51 respondents, 92.1% of teachers reported using AI-based tools, while 7.8% stated that they have not used any AI tools. The AI tools most commonly used by teachers are chat-based applications (such as ChatGPT and AI Gemini), as these are the most familiar to users. Approximately 85.4% of teachers reported using chat-based tools. And out of 51 respondents, content creation tools are used by 41.7% of teachers, and Learning Management Systems (LMS) are used by 37.5% of respondents. Whereas 29.2% of respondents use AI-based assessment tools for evaluating students and 25% respondents are familiar with AI tutoring systems.

Figure 2: Frequency of Teachers' Use of AI-Based Teaching Tools



Sources: self-compiled

Figure 2 shows that out of 51 respondents, 32% of teachers use AI tools on a daily basis, while 24.5% use them weekly, indicating that a substantial proportion of participants regularly integrate AI tools into their teaching practices. whereas 28.6% of teachers are using AI tools in occasionally. It means the acceptance and implementation of AI tools among teachers are increasing.

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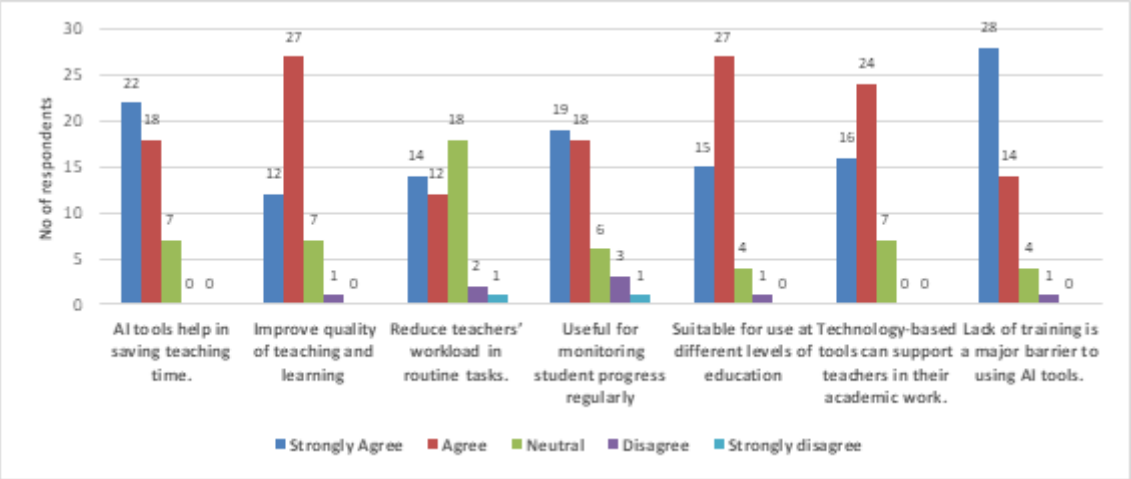
Figure 3: Tteachers' Acceptance and Perception of AI Tools in Education



Sources: self-compiled

a. Figure 3 shows that out of 47 respondents, 22 strongly agree and 18 agree that AI tools help save time, while 7 respondents expressed a neutral opinion. No respondents disagreed with this statement. These findings indicate that the use of AI tools can significantly reduce teachers' working time.

b. Out of 47 respondents, 12 strongly agree and 27 agree that AI tools improve the quality of teaching and learning experiences, while only 1 respondent disagreed. This indicates that teachers generally accept AI tools positively and recognize their effectiveness in enhancing the teaching–learning process.

c. Out of 47 respondents, 14 strongly agreed, 12 agreed, and 18 expressed a neutral opinion that AI tools help reduce teachers' workload. The fact that the majority are neutral indicates limited hands-on experience with AI tools and some uncertainty regarding their effectiveness in reducing workload.

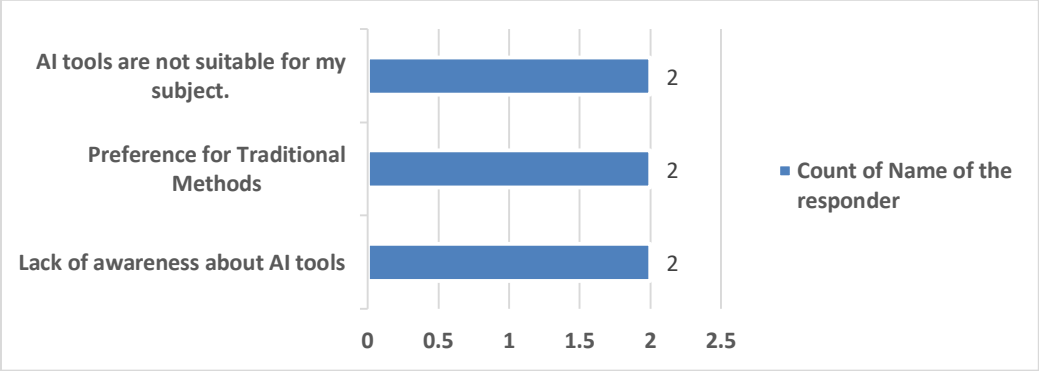
d. Out of 47 respondents, 19 strongly agreed and 18 agreed that AI tools are useful for monitoring student progress, while 6 were neutral, 3 strongly disagreed, and 1 disagreed. This suggests that most respondents are aware of AI monitoring tools and are satisfied with their effectiveness in providing instructional support.

e. Out of 47 respondents, 15 strongly agreed and 27 agreed that AI tools are suitable for different levels of education. This indicates that AI tools are perceived as useful across all educational levels and are being adopted increasingly.

f. Out of 47 respondents, 16 strongly agreed and 24 agreed that AI tools assist teachers in their academic work, while 7 were neutral. These findings indicate that AI tools enhance teachers' efficiency and effectiveness and are considered supportive resources.

g. Out of 47 respondents, 28 strongly agreed and 14 agreed that a lack of training is a major barrier to using AI tools, while 4 were neutral and 1 disagreed. The majority of respondents perceive insufficient AI training as a significant barrier to the adoption and implementation of AI tools in education.

Figure 4: Reasons for Not Using AI Tools by Teachers



Sources: self-compiled

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As per Figure 4, there are 4 respondents who are not using AI tools in their teaching practices. This indicates that the major reasons include lack of awareness about AI tools, the perception that AI tools are not helpful for their subject, and that they still follow and feel comfortable with traditional teaching methods.

6. CONCLUSION:

The study of teachers' perceptions towards the use of AI in the education sector of the Mumbai region shows that teachers are having a positive aspect about using AI tools. Most respondents were female. Most of respondents belong to early and mid-career group, which indicates that younger teachers are more open to accept new technological changes and experienced teachers add valuable perspective. Large group of teachers already using AI tools; they are more familiar with chat box like ChatGPT, AI Gemini, which gives instant support solution. Many of teachers using AI on regular basis, which shows that AI tools are becoming part of their everyday. Majority of respondents have perception that AI tools help save time, improve teaching and learning quality, support academic work, and assist in monitoring student progress. The findings also highlight that teachers believe AI tools are suitable for all levels of education. On workload reduction, respondents are neutral, as it shows that teachers are not having negative view but need more hands-on experiences on AI tools. However, lack of proper training remains a major barrier, showing that teachers need more guidance and support to use AI tools effectively. There are a few teachers who are not using AI tools, not because they are discourage innovation, but because they lack awareness and have concerns related to their subject knowledge. They are also comfortable with traditional teaching methodologies. More than 90% of teachers who are participants in this study show positive acceptance of new changes in the education sector. They are familiar with AI tools and also have a positive perception of the benefits of AI tools, such as time saving, data analysis, personalized solutions, and instant support. However, teachers need more awareness and training programmes to use these tools in a more efficient and effective way.

REFERENCES:

1. Fakhar H. et al. (2024). 'Artificial Intelligence from Teachers' Perspectives and Understanding: Moroccan Study.' *International Journal of Information and Education Technology*. Vol. 14, pp 856-864.
2. Iqbal M.et al. (2025). 'Teachers' Perceptions of the Use of Artificial Intelligence (AI) in Daily Learning at Elementary Schools'. *Global Journal of Basic Education (GJBE)*. pp 96-116.
3. Konecki M. et al. (2024). 'Teachers' Perception of AI and Their Attitudes Towards AI'. *International Conference on Computer Supported Education.* pp 564-568.
4. Lamrabet M. et al. (2024). 'AI-Based Tools: Exploring the Perceptions and Knowledge of Moroccan Future Teachers Regarding AI in the Initial Training - A Case Study.' *International Journal of Information and Education Technology*. pp 1493 - 1505.
5. Olaseni Vivian M. (2024). 'Teachers' Perception Towards Integration of Artificial Intelligence Tutoring-Based System in the School Curriculum : A Survey.' *E-Journal of Humanities, Arts and Social Sciences (EHASS)*. ISSN – Online 2720-7722, pp 2242-2251.

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A STUDY ON CONSUMER ACCEPTANCE OF AI-ENABLED SMART HOME APPLIANCES IN THANE DISTRICT: SENSOR-BASED CONNECTIVITY AND ENERGY EFFICIENCY

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ABSTRACT
The rising demand for smart home appliances in India is a part of the wider shift in consumption patterns in Indian homes made possible through the application of artificial intelligence. From a business point of view, the application of artificial intelligence in smart home appliances represents the fusion of technology, consumption behavior, and the creation of energy efficiency. The smart appliances are able to monitor consumption behavior through the help of various sensors in the quest to provide homes with the capability of optimizing their electric consumption. The rising awareness regarding the cost of energy in the Indian market has made smart home appliances an emerging sector in the consumer durable market. The proposed study both primary and secondary data were used. Primary data were collected from Thane District through a structured questionnaire using a Google Forms from 30 respondent using convenience sampling & secondary data research study methodology that uses evidence from academic journals and research studies on smart homes, energy savings, and consumption patterns in India. The research study analyses the value addition and cost-effectiveness that consumers derive from sensor connectivity and AI-enabled functionalities in smart homes. Instead of taking into consideration various technical capabilities of smart homes in India, it focuses on market trends and consumer acceptance of smart homes in India. The review shows that the use of AI-enabled smart appliances has a significant and positives impact on consumers' purchasing intentions, including benefits such as lower electricity bills, online tracking, and efficient lifestyle management. In addition, the role of smart home technologies is emphasized as a support to the energy conservation goals of the Indian government and a responsible mode of consumption. In a business perspective, the emergence of such appliances generates a potential opportunity to compete and distinguish themselves and their products by being energy efficient and smart. The findings are relevant for academicians, marketers, policymakers, and business decision-makers interested in sustainable consumption, technology-driven markets, and the evolving Indian consumer electronics sector.

Keywords: *- Artificial Intelligence, Smart Home Appliances, Sensor-Based Connectivity, Energy Efficiency, Consumer Behaviour, Sustainable Consumption, India.*

INTRODUCTION
Technological changes have resulted in dramatic changes in consumer behavior in relation to lifestyle in general across the world. In India, smart appliances in homes have received increased attention in recent times because of increased urbanization, rising disposable income, rising electricity costs, and awareness levels about energy efficiency and sustainability in terms of environment concerns. Artificial intelligence has assumed an important role in bringing back conventional home appliances in smart home appliances that have increased capabilities of learning user patterns and energy utilization.

AI-enabled smart home appliances use the combination of sensors and connectivity with data analysis to deliver an efficient control and monitoring system for various domestic activities. The use of sensors in connectivity helps customers control appliances from afar while generating feedback on energy consumption, thus contributing to lowering domestic energy consumption in India – an increasingly common issue.

The concern of the Indian government for energy conservation and sustainable development has further increased the interest in energy-efficient and smart appliances. The schemes and efforts made by the government to decrease electricity consumption and the adoption of new technologies are meeting the country's objectives of sustainability. AI-powered smart home appliances are being looked upon not only to improve lifestyles but also as a tool for responsible and sustainable consumption.

In this regard, research on consumer acceptance of AI-based smart home appliances assumes a critical role. The research paper brings forth a theoretical study on consumer acceptance of AI-based smart home appliances in the Indian market, with a specific emphasis on sensor-based connectivity and energy efficiency.

REVIEW OF LITERATURE
Balta-Ozkan et al. (2014) investigated the adoption of smart home technologies with a view to drawing out factors relating to energy management and sustainability. Studies have shown that smart control and sensor

connectivity increase the energy efficiency and convenience of living in homes. Based on the survey data and regression analysis, the authors deduced that usefulness and ease of use along with energy cost-savings are major drivers of consumer intention to adopt smart home appliances. Concern about Privacy and System Complexity are considered barriers to adoption by the finding of the study. The study's findings demonstrate that smart home technology can be made more sustainable by ensuring that smart home device capabilities match consumer expectations.

Yang et al. (2018) The researcher discusses the role of AI-based energy management systems within smart homes. This study highlights that the use of machine learning algorithms, working in concert with sensor networks, can provide real-time monitoring and adaptive control of household appliances, thereby reducing electricity consumption significantly. Collected data from smart meter readings are analyzed using predictive modelling and optimization. As indicated by the results, AI-enabled systems improve the energy efficiency of homes without compromising user comfort. The researcher concluded that sensor-driven automation is one of the important contributors to sustainable residential energy management

Park et al. (2019) This paper focuses on consumer acceptance of AI-enabled smart appliances by using the Technology Acceptance Model. The general features that are accentuated are perceived convenience, energy efficiency, and automation, which greatly impact consumer attitude and purchase intention. In this research, data are collected from 412 respondents through a survey and analyzed by structural equation modeling. Energy saving and real-time monitoring are found to have positive influences on consumer satisfaction, whereas concerns about privacy have a negative effect on adoption of intention. The authors conclude that addressing issues related to trust and data security will lead to wide-scale adoption of AI-enabled smart appliances.

Hargreaves et al. (2020) analyzed the impact of smart technologies on the household sector. The article highlights the importance of feedback systems powered by sensors to boost consumer understanding of energy consumption. Evidence from this study indicates that the use of smart domestic devices helps consumers minimize energy waste. In fact, the researcher clarifies that the efficiency of such technologies relies on consumer understanding of the technology. The evidence from this article indicates the importance of combining the efficiency of AI technology with consumer understanding to optimize energy efficiency results.

Jain et al. (2021) The research paper undertook an analysis of the adoption of smart household appliances from the Indian perspective. Energy efficiency and sustainability have been taken into consideration. According to this study, the increasing cost of electricity & the increasing awareness level of people about the protection of the environment have made the demand for AI-powered appliances significantly increasing. The results have indicated that factors such as perceived benefits of energy saving, and ease of use have made a significant impact. At the same time, the results have also indicated that the variables of age & income have made little difference to the behavioral aspects of the phenomenon.

Srinivasan et al. (2023) The researcher of this work studied the impact of smart appliances enabled by IoT on the energy consumption of households. According to this research, connectivity based on sensors allows appliances to adjust their operation to user behavior and environmental conditions in order to optimize their energy use. An analysis of smart homes data was made using descriptive statistics and energy modelling. The findings reveal remarkable savings in power use and improved efficiency. As per the research, smart appliances that run on AI lead to economic and environmental benefits for a household.

RESEARCH GAP: -

The results obtained from the reviewed studies establish that AI-powered smart home appliances with sensor-based connectivity have the ability to significantly improve energy efficiency and consumer satisfaction. However, it may be observed that existing studies have largely focused on the technological aspects of smart home appliances, with limited emphasis on understanding consumers' perceptions and behavioural responses toward AI-powered smart home appliances. In this context, a clear research gap exists, as no prior study has systematically applied consumer behavioural theories to analyse secondary data in a specific regional setting. To address this gap, the present study is conducted in the **Thane District of Maharashtra**, focusing on consumer perceptions and acceptance of AI-powered smart home appliances.

OBJECTIVE OF THE STUDY

1. To examine the concept and key characteristics of AI-enabled smart home appliances,
2. To analyse the role of sensor-based connectivity in improving household energy efficiency.
3. To study consumer behaviour, awareness, and acceptance of AI-enabled smart home appliances in the Indian market.

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4. To evaluate the contribution of AI-enabled smart home appliances to sustainable consumption and energy conservation.

SCOPE OF THE STUDY

The study focuses on AI-enabled smart home appliances with special reference to sensor-based connectivity and energy efficiency in the Indian context. It examines consumer awareness, behaviour, and acceptance using both primary and secondary data. The study is descriptive and analytical in nature and does not include technical performance testing or hypothesis testing.

RESEARCH METHODOLOGY

The study employs a descriptive research design to examine AI-enabled smart home appliances with emphasis on sensor-based connectivity, energy efficiency, and consumer behaviour. Both primary and secondary data were used. Primary data were collected from Thane District through a structured questionnaire using a Google Forms from 30 respondent using convenience sampling. Secondary data were obtained from scholarly journals, books, and industry reports. The collected data were analysed using basic descriptive statistical tools such as percentages and mean values.

DATA ANALYSIS AND INTERPRETATION

Descriptive Study

Age

Age	Frequency	Percentage
18 - 35	19	63.3
36 - 50	8	26.7
51 - 60	3	10
61 & above	0	0
Total	**30**	**100**

Interpretation: The table shows that 63.3% of respondents belong to the 18–35 years age group, followed by 26.7% in the 36–50 years category. Only 10% fall in the 51–60 years group, while 0% are above 60 years. This indicates that younger and economically active individuals show higher participation and acceptance of AI-enabled smart home appliances.

Gender

Gender	Frequency	Percentage
Male	17	57.1
Female	13	42.9
Total	**30**	**100**

Interpretation: The table indicates that 57.1% of respondents are male, while 42.9% are female. Both genders show considerable interest, with slightly higher representation from male respondents, suggesting broad gender-neutral acceptance of smart home technologies.

Occupation

Occupation	Frequency	Percentage
Service	10	33.3
Business	9	30
Professional	2	6.7
House Wife	4	13.3
Student	5	16.7

Interpretation: The table shows that 33.3% of respondents are from the service sector, followed by 30% business owners, 6.7% professionals, 13.3% housewives, and 16.7% students. The adoption of AI-enabled appliances is higher among service and business groups, reflecting greater exposure to technology and higher purchasing power.

Annual Income

Annual Income	Frequency	Percentage
Up to 5 Lakhs	3	10
5 – 10 Lakhs	7	23.3

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10 – 15 Lakhs	14	46.7
15 Lakhs & above	6	20

Interpretation: The table shows that 46.7% of respondents earn ₹10–15 lakhs, followed by 23.3% earning ₹5–10 lakhs, 20% earning ₹15 lakhs and above, and 10% earning up to ₹5 lakhs. Higher-income groups show stronger representation, indicating that income level plays a significant role in the adoption of AI-enabled smart home appliances.

Awareness of AI-enabled smart home appliances.

Awareness of AI	Frequency	Percentage
Strongly Disagree	0	0
Disagree	0	0
Agree	17	56.7
Strongly Agree	13	43.3

Interpretation: The table shows that a majority of respondents (56.7%) 17 respondent are aware of AI-enabled smart home appliances available in the Indian market, while a smaller proportion (43.3%) 13 respondent report limited awareness.

Sensor Based Connectivity improves the convenience.

Convenience Sensor Connectivity	Frequency	Percentage
Strongly Disagree	0	0
Disagree	0	0
Agree	14	46.7
Strongly Agree	16	53.3

Interpretation: The table shows that (53.3%) 16 of respondents strongly agree and (46.7%) 14 of respondents agree that sensor-based connectivity improves convenience in home appliance usage, whereas no one disagrees.

Understanding of sensor-based connectivity.

Understanding of Sensor Connectivity	Frequency	Percentage
Strongly Disagree	0	0
Disagree	1	3.3
Agree	14	46.7
Strongly Agree	15	50

Interpretation: The table indicates that (50%) 15 of the respondents have a strongly agree and (46.7) 14 of respondents are agree understanding of how sensor-based connectivity works, while a (3.3%) 1 of respondent have disagree understanding.

Automatically adjustment based on usage patterns.

Sensor Usage Patterns	Frequency	Percentage
Strongly Disagree	0	0
Disagree	0	0
Agree	20	66.7
Strongly Agree	10	33.3

Interpretation: The table indicates that (33.3%) 10 of the respondents have a strongly agree and (66.7%) 20 of respondents are agree that smart appliances automatically adjust their functioning according to usage patterns.

Real-time monitoring improves efficiency.

Real-time improves efficiency	Frequency	Percentage
Strongly Disagree	0	0
Disagree	0	0
Agree	21	70
Strongly Agree	9	30

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Interpretation: The table indicates that (30%) 9 of the respondents have a strongly agree and (70%) 21 of respondents are agree that real-time monitoring through sensors improves appliance efficiency.

Reduction of unnecessary energy consumption.

Reduction of Energy Consumption	Frequency	Percentage
Strongly Disagree	0	0
Disagree	1	3.3
Agree	15	50
Strongly Agree	14	46.7

Interpretation: The table indicates that (46.7%) 14 of the respondents have a Strongly agree and (50%) 15 of respondents are agree that smart sensors reduce unnecessary energy consumption in households, while a (3.3%) 1 of respondent have disagree.

Contribute to lower electricity bills.

Contribute to Lower Electricity	Frequency	Percentage
Strongly Disagree	0	0
Disagree	1	3.3
Agree	17	56.7
Strongly Agree	12	40

Interpretation: The table indicates that (40%) 12 of the respondents have a Strongly agree and (56.7%) 17 of respondents are agree that smart appliances help reduce electricity bills, while a (3.3%) 1 of respondent have remain disagree.

Influence of Energy efficiency on Purchase preference.

Energy efficiency on Purchase preference	Frequency	Percentage
Strongly Disagree	0	0
Disagree	1	3.3
Agree	14	46.7
Strongly Agree	15	50

Interpretation: The table shows that (50%) 15 of respondents strongly agree and (46.7%) 14 of respondents agree state that energy-efficiency features strongly influence their preference for smart home appliances. while a 3.3 percentage remains disagreed.

Ease of use of AI – enabled smart appliances.

Ease of use of AI	Frequency	Percentage
Strongly Disagree	0	0
Disagree	1	3.3
Agree	10	33.3
Strongly Agree	19	63.3

Interpretation: The table indicates that (63.3%) 19 of the respondents have a Strongly agree and (33.3%) 10 of respondents are agree AI-enabled smart home appliances are easy to use and understand. while a (3.3%) 1 of respondent have disagree.

Confidence in daily usage.

Confidence in daily usage	Frequency	Percentage
Strongly Disagree	0	0
Disagree	2	6.7
Agree	12	40
Strongly Agree	16	53.3

Interpretation: The table indicates that (53.3%) 16 of the respondents have a Strongly agree and (40%) 12 of respondents are agree and report confidence in using AI-enabled appliances in daily life. while a (6.7%) 2 respondents disagree.

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Future Purchase Intension.

Future Purchase Intension	Frequency	Percentage
Strongly Disagree	0	0
Disagree	0	0
Agree	12	40
Strongly Agree	18	60

Interpretation: The table indicates that (60%) 18 of the respondents have a strongly agree and (40%) 12 of respondents are agree that express willingness to purchase AI-enabled smart home appliances in the future.

Support for Sustainable lifestyle.

Sustainable lifestyle	Frequency	Percentage
Strongly Disagree	0	0
Disagree	1	3.3
Agree	18	60
Strongly Agree	11	36.7

Interpretation: The table indicates that (36.7%) 11 of the respondents have a Strongly agree and (60%) 18 of respondents are agree and believe that smart home appliances support a sustainable lifestyle. while a (3.3%) 1 of respondent have disagree

Influence of Government Initiatives

Government Initiatives	Frequency	Percentage
Strongly Disagree	0	0
Disagree	2	6.7
Agree	18	60
Strongly Agree	10	33.3

Interpretation: The table shows that (33.3%) 10 of respondents strongly agree and (60%) 18 of respondents agree state that government energy-conservation initiatives influence their adoption decisions. while a (6.7%) 2 remains disagreed.

LIMITATION OF THE STUDY

The study is limited by a small, convenience-based sample, which may affect the generalizability of the findings. The analysis is based on self-reported consumer perceptions, which may involve respondent bias. Moreover, the descriptive nature of the study restricts causal interpretation and does not include technical or actual energy consumption data of smart home appliances.

Concept of AI – Enabled Smart Home Appliances

AI-enabled smart home appliances are defined as smart devices used within a household which are equipped with artificial intelligence algorithms. These devices are internet-enabled and hence possess the capability to operate autonomously without the need to receive continuous human intervention. Some examples of smart devices used in a house are smart air conditioners, refrigerators, washing machines, light systems, as well as smart thermostats.

Sensor connectivity technology enables these household appliances to interact with users and other devices via cloud technology and mobile apps. The data is processed by AI algorithms to ensure a reduction in the consumption of energy. Such smart appliances have improved convenience and play a part in achieving energy efficiency and saving costs.

Sensor – Based Connectivity and Energy Efficiency

The core of any smart home system is sensor-based connectivity. Sensors can be installed in the appliances which can monitor things like temperature, humidity, motion, and electricity. Devices would also be able to automatically adjust their operation based on the climatic conditions in which they find themselves and based on the behavior of the user which the device has detected.

Real-time energy monitoring, automated scheduling, and adaptation make them energy efficient. For example, smart devices can switch to low-power modes when they haven't been used for a period or only operate during off-peak hours to save cost on electricity bills. In India, where energy demand is increasing of the hour, these

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technologies are highly relevant for managing consumption in households and reducing pressure on the energy infrastructure.

Consumer Behaviour and Acceptance in India

The use of AI-enabled smart home appliances in India depends on various factors such as usefulness, ease of use, cost etc. Further, we also see consumer trust plays vital role. Consumers are now becoming more aware of energy efficiency products due to the rising cost of electricity. Moreover, the ability to control appliances remotely from smartphones enhances the sense of convenience.

Yet, some hindrances remain to adoption that includes high initial cost, lack of technical awareness, data privacy, and security. The rise in smartphone and internet penetration despite those barriers has impacted consumer readiness for the adoption of smart home technologies. The Indian market purchasing intention in relation to technological acceptance is significantly impacted by perceived benefit and long-term cost savings.

Market Trends Business Implications

The availability of AI-enabled smart appliances is increasing steadily in the Indian consumer electronics market. Manufacturers are increasingly using energy efficiency and smart features as differentiators to gain competitive advantage. Looking at the business-side of smart appliances, they offer scope for product innovation, brand differentiation and long-term customer engagement.

Organizations that integrate AI-centric features and energy-saving designs can harmonize their products with sustainability goals and changing shopper preferences. Data generated through sensor-based appliances help the firms understand how consumers use a certain product, which then helps in product development. Moreover, it aids in offering better ancillary service to consumers.

FINDINGS

The research indicates that a large number of respondents are aware of the use of AI-enabled smart home devices available in the Indian market and have already started using one of these devices. The connectivity feature by sensors is perceived to increase convenience by adjusting automatically as per usage patterns and by performing real-time monitoring.

Being energy efficient seems like one major factor contributing significantly to acceptance. The respondents agreed that smart sensors indeed help to reduce unnecessary consumption and lower electricity bills. Most consumers find such appliances easy to operate and are confident in doing so. Despite cost being a concern, the majority of respondents feel that the benefits are worth it. People are highly likely to purchase smart appliances in the future, especially those who want to live sustainably or energy efficiently. Government initiatives on energy conservation positively influence consumers' decisions to adopt energy efficient housing/products.

SUGGESTIONS

The manufacturers would do well to focus on developing affordable and user-friendly smart appliances with AI capabilities. Consumer awareness campaigns regarding the benefits of energy-saving along with sensor functionality might help increase acceptability. The governing authorities can enhance their energy-saving initiatives of any kind as an incentive for smart appliance adoption. Future studies would do well to consider a broader sample base for increasing the overall generalizability of the results. Future research should consider larger and more diverse samples to enhance the generalizability of findings and explore regional variations in consumer acceptance.

CONCLUSION

The research aims to assess the acceptability of consumers towards the use of AI-driven smart appliances in India, specifically for those from the Thane District, using a descriptive research approach. Results highlight that consumers embrace smart appliances, especially those belonging to the younger generation and those having higher incomes. The sensor connectivity feature is recognized as improving convenience through real-time monitoring and automatic control of appliance functions.

Energy efficiency arose as an important factor that came into play in influencing adoption as the respondents appreciated lower energy usage and lower electricity costs. Usability, trust in using AI-powered gadgets, and a high desire to purchase in the future also indicate consumer readiness. Government programs that foster energy saving further help in adoption. Based on this study, there is great potential in AI-powered Smart Home Appliances in India as there is harmony between technological development and saving and cost-effectiveness

REFERENCES

1. https://www.projectmanagertemplate.com/post/smart-homes-using-ai-in-india-opening-up-new-possibilities-the-future-of-digital-living.

ISSN 2394 - 7780

2. Balta-Ozkan, N., Boteler, B., & Amerighi, O. (2014). European smart home market development: Public views on technical and economic aspects across the United Kingdom, Germany and Italy. *Energy Research & Social Science, 3*, 65–77. https://doi.org/10.1016/j.erss.2014.07.007
3. Hargreaves, T., Wilson, C., & Hauxwell-Baldwin, R. (2020). Learning to live in a smart home. *Building Research & Information, 48*(1), 127–139. https://doi.org/10.1080/09613218.2019.1599314
4. Jain, R., & Kaur, G. (2021). Consumer perception towards smart home appliances in India. *International Journal of Consumer Studies, 45*(6), 1234–1246. https://doi.org/10.1111/ijcs.12689
5. Park, E., Kim, K. J., & Cho, Y. (2019). Understanding drivers of consumer acceptance of smart home services. *Telematics and Informatics, 38*, 83–93. https://doi.org/10.1016/j.tele.2018.08.001
6. Srinivasan, R., & Ramanathan, U. (2023). IoT-enabled smart appliances and residential energy efficiency: An empirical study. *Energy Policy, 176*, 113486. https://doi.org/10.1016/j.enpol.2023.113486
7. Yang, R., Li, X., & Sun, Y. (2018). Energy consumption prediction and optimization of smart homes based on machine learning. *Energy Procedia, 152*, 384–389. https://doi.org/10.1016/j.egypro.2018.09.135.

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SMART HEALTHCARE MANAGEMENT WITH AI TOOL FOR MUMBAI POLICE PERSONNEL

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ABSTRACT
Mumbai is a metropolitan city where every second matters and the responsibility to protect the city lies on public officers. This research studies the well-being of Mumbai police who have dedicated their life for this city. Well-being often comprises as physical and mental. The duties of Mumbai Police personnel expose them to irregular schedules, high-pressure situations and continuous public interaction all of which can affect their overall health and well-being. This study describes work pattern, duty hours, work related stress and preventive and precautionary measures along with willingness of Mumbai Police Personnel to use the mobile friendly AI application to balance their daily routine with physical and mental health.

The data is collected from both primary and secondary sources. Primary data was collected from 72 respondents through a structured questionnaire designed to capture health patterns, stress indicators and the willingness of police personnel to adopt technology-based health solutions. Secondary data from books, research papers, policy documents and credible news reports supports the analysis. The study uses descriptive and analytical methods, applying statistical tests such as correlation, Spearman's rank correlation and chi-square to interpret the findings.

The results show a clear link between occupational stress and physical health deterioration and nature of duty affecting the physical health problems such as back pain, leg pain, etc. also irregular eating habits creating gastric issues, diabetes, and weight imbalance. This establishes the scope for continuous health monitoring for frontline police staff. The responses indicate that many personnel experiences stress-related concerns and show interest in simple, easy-to-use AI-based tools that can help them track their health or receive early alerts. While the study opens a practical discussion on 'technology can complement existing health systems and strengthen occupational well-being in the police force'. Overall, this research describes smart healthcare solutions to support Mumbai Police Personnel in maintaining better well-being in this technological era.

***Keywords**: Public officers, Mumbai Police, well-being, physical health, stress, technology based, AI based, etc.*

INTRODUCTION
Mumbai is more than just a city; it is a living, breathing heartbeat of India and home to over 22 million people (World Population Review, 2025). It is also the nation's financial engine, filled with dreams, struggles, and the ceaseless pace of urban life. This environment exerts immense pressure on public services, particularly the Mumbai Police, which has a sanctioned strength of around 40,623 personnel. In a metropolis where every second matters, effective management of public resources and the well-being of the police personnel providing those services is critical.

The National Health Policy (NHP) 1983 marked a pivotal moment in India's healthcare journey representing the country's ambitious commitment to achieving 'Health for all by 2000'. Nevertheless by 2000 it was clear that many goals like anaemia reduction, access to essential drugs and reducing IMR and MMR were not met. However, by prioritizing primary healthcare, community participation and equitable access to medical services, the NHP 1983 laid the foundation for India's modern healthcare infrastructure. It was India's first real attempt to outline strong public health system and a created a robust foundation for NHP 2017 which suits a changing India especially by bringing digital health, wider health protection and better-quality standards. NHP 2017 focused on universal health coverage aiming for 2.5% of GDP spending on Ayushman Bharat, Ayushman Arogya Mandir, Ayushman Bharat Digital Mission and Mission Indradhanush.

In the context of Human Resource Management (HRM) employee well-being has evolved from a welfare-oriented concept to a strategic organisational priority. It is more than just the absence of physical illness. World Health Organisation (WHO) defines health as 'a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity'. Recently many new dimensions like spiritual, emotional, vocational, etc have been identified. In an organisation setting, well-being is been mostly shaped by work environment. The Job Demands-Resources (JD-R) Model, propounded by Arnold B. Bakker and Evangelia Demerouti (2001) in HRM for assessing employee well-being. It categorizes work characteristics into job demands includes high pressure tasks such as heavy work hours, irregular shift patterns, physical risks, and emotional labour. and job resources such as social support, professional training and task autonomy. The Effort-

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Recovery (E-R) Model, developed by Theo Meijman and Gijsbertus Mulder (1998), focuses on the physiological and psychological costs of work-related effort.

In today's fast-paced landscape of technology-enabled though Artificial Intelligence (AI), IoT, Advanced Machine Learning and mobile application has revolutionized the way healthcare services are delivered and monitored. This technological progression is particularly vital for the Mumbai Police, a force operating in a changing urban environment where changing duty cycles and emotional burdens often overshadow personal health needs.

For these protectors of the city, the integration of smart healthcare management is no longer an academic luxury but an urgent necessity. By utilizing AI-powered tools to monitor physiological stress and optimize recovery cycles, the force can transition from a reactive welfare approach to a proactive, dignity-centered system of care.

SCOPE OF STUDY

This study focuses on understanding the health and well-being of the Mumbai Police personnel, especially Constables and Head Constables who spend most of their working hours on the field. These frontline staff often deal with long duty hours, irregular shifts, large public gatherings, emergencies, bandobast, security and stressful situations. Because of this demanding nature of work, their physical and mental health needs regular attention and support. The study therefore concentrates on this group, as they represent the largest part of the force and face the highest workload.

The research is limited to the Mumbai Commissionerate area, keeping the study closely connected to the local working conditions, administrative structure and lifestyle patterns of Mumbai Police personnel. It looks at their present health concerns, the challenges they face in accessing timely healthcare and the level of stress experienced due to their daily duties. Within this framework, the study also tries to understand whether new AI-based health tools such as fitness trackers, digital health monitoring systems or stress-alert applications can offer practical support to them in their routine life.

The data for the study has been collected from 72 police personnel through structured questionnaires, along with information from books, research papers and reliable news sources.

In short, the scope of this research is to understand the current health realities of frontline police personnel and to understand that smart, technology-enabled healthcare solutions might support them in leading healthier and safer working lives.

REVIEW OF LITERATURE

Shankar, 2025 According to author in today's hospitals, human resources are no longer just about hiring and payroll they have become a strategic partner in patient care, especially when supported by smart healthcare management tools powered by AI. By using AI-driven systems, HR can streamline recruitment, monitor staff performance, design fair compensation, and improve retention, while also guiding cultural integration during mergers. These tools help managers make data-informed decisions, reduce bureaucracy, and keep the focus on patient outcomes. In a healthcare system like India's, where demand is rising and resources are stretched, AI-enabled HR practices can bridge gaps, ensure accountability and build a more resilient workforce that supports both quality care and sustainable public health.

Sandhya, 2025 stated that police officers worked long hours and faced high-pressure decisions, which made balancing their professional obligations and personal lives very difficult. Their job was demanding because they had to manage time carefully and endure stress, while also making split-second choices that affected many lives. The study examined social support influenced work–life balance and it found that job satisfaction and resilience acted as mediators. Data was collected from 242 gazetted officers across Karnataka, analyzed using structural equation modeling. The results showed that when officers received strong social support, they felt more satisfied with their jobs and therefore became more resilient. These two factors together contributed to better work–life balance. In other words, resilience and job satisfaction were the bridges between support and balance. Further argued that organizations could reduce workload by recruiting more officers in line with UN recommendations and they could improve well-being through peer support programs, mindfulness sessions as well as cognitive behavioral training. These steps were important since they strengthened both personal and professional health.

Kalid et al., 2024 proposed an e-healthcare management web-based platform for medial users to improve management efficiency. This initiative focuses on issues arising in healthcare organizations in Malaysia. The authors suggested that by using technology medial staff can make their work easier and faster which will save the time of doctors and nurses and reduces the cost as compared when doing things manually. Since the

healthcare sector keeps on changing and improving adapting to the new technology would be the suitable solution. This research has also integrated various modules, including medical user management, consultation, appointment, e-medication, etc which are beneficial for the patients and hospital management.

Al-Faouri et al., 2024 investigated the relationship between technology application and Smart Human Resource Management (SHRM). Using a quantitative research methodology, researchers have collected data from employees of telecommunications firms in Jordan. The researcher had tested the relationship between technology application and innovation performance and accepted technology adoption as strong relationship with work environments, organization culture, employee empowerment and creating value for stakeholders. Therefore, to foster the innovation and organizational success application of technology, SHRM and innovation performance plays the pivotal role.

Malhotra, 2024 stated that Police officers are often exposed to physical, biological and psychological hazards while at work. This repetitive exposure leads to occupational trauma which has caused to serious mental health problem and police officers mental health is critical public health issue. The researchers have extracted the data from 588 articles and 36 studies (1983-2022) and analysed the data using both qualitative and quantitative methods. Police officers cope with trauma through positive strategies such as problem solving, positive thinking, spirituality, stress management, peer support, etc. However, many of them uses negative strategies such as avoidance, substance use, emotional distancing, self-isolation, etc. The research leaves a scope for future efforts in align with Unites Nations Sustainable Development Goals by prioritising police mental health.

Kaushik, 2024 analysed the optimism and work life balance of police officers because police work is very demanding and through using surveys the research studied the factors which influence their job satisfaction, productivity and stress levels. The results revealed that more optimistic officers felt happier, less stressed and more satisfied in their jobs as compared to less optimistic one. The study also offered actionable insights for organizational policies, training initiatives, and interventions aimed at improving the well-being and effectiveness of police personnel.

Sharma, 2022 Healthcare systems implemented cutting-edge techniques to give sufferers with helpful and specialised treatment. Although the hospital care cost continued to increase, all have started saving money and time using internet services that resolves medical conditions. However, with implementation of Artificial Intelligence facilitator can operate for early diagnosis and treatment for patients with or without entry to clinics also there was going trend of assisting patients with immediate notification about seriousness of patient's condition especially for patients those who monitor current health status due to expert's analysis of the information supplied through Internet of Things (IoT). The research also suggests to enhance the system certain characteristics can be also included such as weight, age, gender, etc., mostly on diagnosis as well as therapy of cardiac disorders.

Bose, 2025 May 17 Times of India, A new health application has been Bhandara Police called Arogya. The application used artificial intelligence to monitor police officer's health. The information of officer's health records will be stored in the application and if an officer health at risks, then the application will give alert to the senior officials. In this application the facilities like online doctor consultation, tele-medicine services, etc were provided. According to Superintendent of Police Noorul Hasan explained that the application is useful especially for officers working in remote police stations.

RESEARCH GAPS

To study the research gaps thematic review of literature was conducted by the researcher. While doing review of literature the researcher has observed many studies are conducted on adoption of AI tool in medical hospitals for the maintaining patient's history, online medication and consulting, while generating patients reports for medical users. It was also noted some Police officers are often exposed to physical, biological and psychological hazards while at work and it recommends to enhance the system with certain characteristics which can be included such as weight, age, gender, etc., mostly on diagnosis as well as therapy of cardiac disorders for them through IoT. Dring review, it has been also observed that similar kind of AI application id developed by other district but still it is lacking in use and the rest parts of Maharashtra state also needs such kind of AI-technology enabled application to enhance the well-being of Mumbai Police Personnel.

OBJECTIVES OF RESEARCH

1. To understand the well-being Mumbai Police Personnel.
2. To study work patterns and duty hours and its impact on physical and Mental Health of Mumbai Police Personnel.

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3. To explore support systems for smart healthcare management for Mumbai Police Personnel.

HYPOTHESIS OF RESEARCH

Hypothesis 1

(H_0): There is no significant correlation between overall well-being, work pattern and duty hours of Mumbai Police Personnel.

(H1): There is a significant correlation between overall well-being, work pattern and duty hours of Mumbai Police Personnel.

Hypothesis 2

(H_0): Mumbai Police personnel are not willing to use the AI-based health management application.
(H_1): Mumbai Police personnel are willing to use the AI-based health management application.

RESEARCH METHODOLOGY

Research Title: Smart Healthcare Management with AI tool for Mumbai Police Personnel.

The study explores the practical effectiveness of smart healthcare tool to address the physical and psychological needs of Mumbai police personnels. The study is based on Descriptive and Analytical research methods. Descriptive as it has described the health condition, work related stress factors, physical and mental well-being of Mumbai police personnel. Analytical as it analyzed relationship work pattern and its effects on physical and mental health.

The universe of research consists of Mumbai Police Personnels with the sample comprise of Mumbai Police Constables and Head Constables. Stratified and purposive sampling methods are used. Researcher first stratified the entire population rank wise, then used purposive sampling as Constables and Head Constables experience the highest physical and mental workload and the objective focuses on frontline personal well-being.

Since the total sanction post of Mumbai police is 40,623 personnel and the study focus on Mumbai Police Constables and Head Constables which is 70-75% of any police force in India. (Police administrative reports)

Estimated Police Constables and Head Constables

40,623*70% = 28,400 police personnel

Applying Slovin's Formula, $n= N/1+N(e^2)$

Where:

n = required sample size

N = population size (Constables + Head Constables ≈ 28,400)

e = margin of error (10% commonly used)

However, in this we consider slightly higher margin of error that is 12%

CALCULATION

$n= N/1+N(e^2)$

$n= 28,400 / 1+28,400 (0.12^2)$

n=28,400 / 1+28400 (0.0144)

n= 28,400 / 1+409

n=28400 / 410

n= 69.2

So, the required sample size becomes 70 respondents and the researcher has used 72 as sample size for this research.

Sampling area is Mumbai. Both primary and secondary data collection methods are used to get the accurate information. Data is collected through 17 structured questions using a questionnaire method. Secondary information is collected from books, research papers, and newspapers. Correlation test, Spearman's rank correlation, and chi-square test are used for data analysis through Microsoft excel software.

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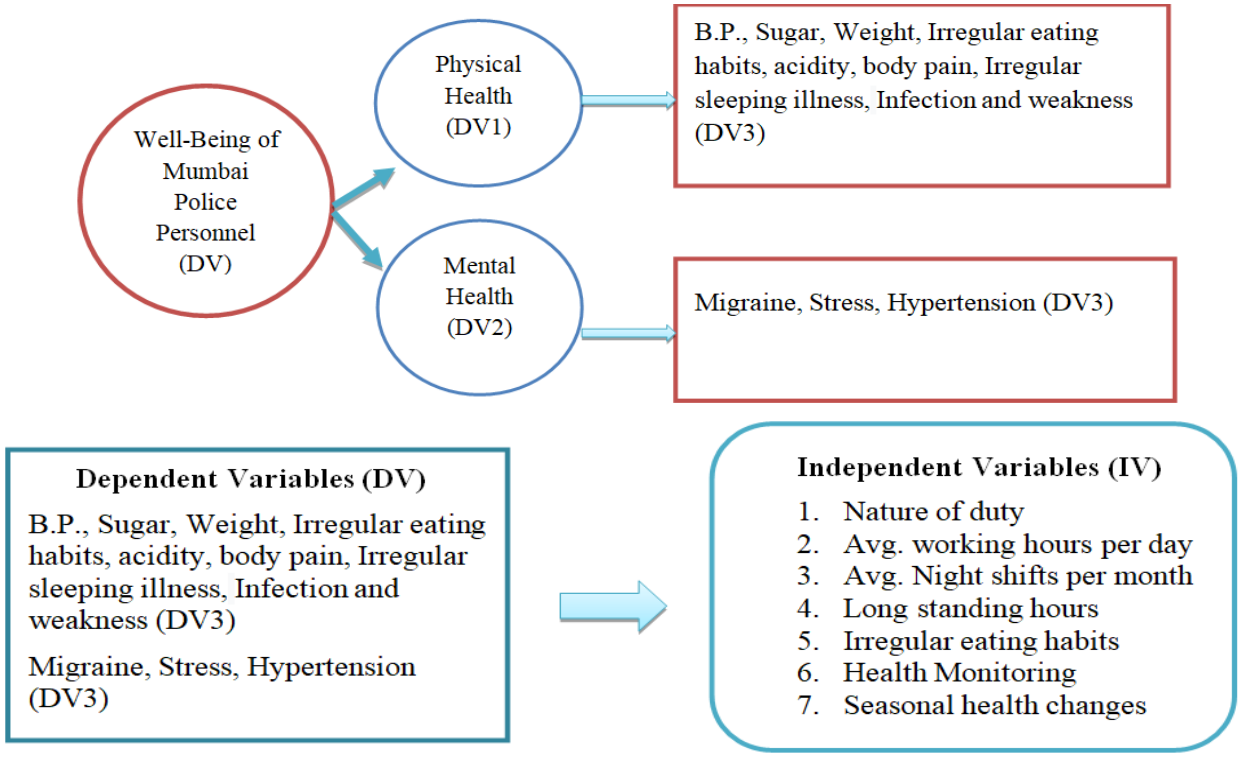
CONCEPTUAL FRAMEWORK

1. List of Variables under study

Personal & Service Profile	Age, Gender, Year of Service, Position, etc
Work Pattern & work related	Nature of Duty, Avg. working hours and Avg. night shifts per month
Physical Health	B.P., Sugar, Weight, Irregular eating habits, acidity, body pain, Irregular sleeping illness, Infection and weakness
Mental Health	Migraine, Stress, Hypertension
Prevention and Precaution	Regular reminders for medical check-ups and fitness assessments and confidential counselling

2. Dependent and Independent Variables



DATA ANALYSIS AND INTERPRETATION

Objective 1: Stress, Mental Health & Physical Health

1. Work-related Stress Affecting Physical Health

Work-related stress affects my physical health	Percentage
Agree	58%
Disagree	3%
Neutral	7%
Strongly agree	31%
Strongly disagree	1%

Interpretation:

There exists a clear link between occupational stress and physical health deterioration.

2. Physical Discomfort Due to Long Standing Hours

Long standing hours cause physical discomfort	Percentage
Agree	65%
Disagree	7%
Neutral	4%
Strongly Disagree	1%
Strongly agree	22%

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Interpretation:
Prolonged standing leads to back pain, leg pain, and fatigue, indicating ergonomic risks.

3. Irregular Eating Habits

Due to duty hours, my eating habits are irregular	Percentage
Agree	57%
Disagree	4%
Neutral	4%
Strongly agree	35%

Interpretation:
Irregular eating increases the risk of **gastric issues, diabetes, and weight imbalance**.

Objective 2: Work Pattern and Duty Hours Analysis

1. Nature of Duty

Nature of Duty	Percentage
Combination of field and desk duty (standing, sitting, and walking)	61%
Duty involving frequent change of posture throughout the day	8%
Mostly desk duty involving prolonged sitting	10%
Mostly field duty involving long hours of standing/walking	21%

Interpretation:
Most personnel perform physically demanding duties, increasing the risk of musculoskeletal problems and fatigue.

2. Average Working Hours per Day

Average Working Hours per Day	Percentage
11–12 hours	25%
9–10 hours	11%
More than 12 hours	58%
Up to 8 hours	6%

Interpretation:
A majority work more than 10 hours daily, exceeding standard work norms and increasing stress and health risks.

3. Night Shifts per Month

Average Night Shifts per Month	Percentage
1–5	35%
6–10	15%
More than 10	29%
None	21%

Interpretation:
Frequent night shifts disturb sleep cycles, contributing to mental fatigue and emotional stress.

Objective 3: Preventive & Seasonal Healthcare Needs

1. Regular Health Monitoring

Do you regularly monitor your BP, blood sugar, or weight?	Percentage
No	53%
Yes	47%

Interpretation:
A large section does not regularly monitor health indicators, highlighting the need for automated reminders.

2. Medical & Fitness Reminders

Would reminders for medical check-ups and fitness assessments help?	Percentage

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No	6%
Yes	94%

Interpretation:
Personnel strongly support preventive healthcare alerts.

3. Seasonal Health Alerts

Seasonal health alerts (heat, monsoon, pollution) would be useful.	Percentage
No	10%
Yes	90%

Interpretation:
Seasonal alerts for heat stress, monsoon diseases, and pollution are considered highly beneficial.

Testing of Hypothesis
Hypothesis 1

H_0: No significant correlation between well-being, work pattern, and duty hours

H_1: Significant correlation exists

Table: Spearman's Rank Correlation between Duty Hours and Overall Well-Being (Y)

Independent Variable	Spearman's ρ (Correlation with Y)	t-value	p-value
Average Working Hours per Day	0.257	2.229	0.029
Average Night Shifts per Month	0.095	0.802	0.424

Interpretation of Results

Average Working Hours per Day shows statistically significant weak positive correlation with overall well-being ($\rho = 0.257$, $p < 0.05$). The result suggests that duty duration plays an important role in influencing physical and mental health outcomes, even though the strength of the relationship is modest.

Average Night Shifts per Month statistically significant weak positive correlation with overall well-being ($\rho = 0.095$, $p < 0.05$). This implies that night shifts, when considered independently, do have a statistically significant association with overall well-being in the present study.

Hypothesis 2

H_0: Mumbai Police personnel are **not willing** to use the AI-based health management application.
H_1: Mumbai Police personnel are **willing** to use the AI-based health management application.

Willingness to Use AI Health App	**Observation**
Yes	68
No	4

For your Chi-Square Goodness-of-Fit test:

- $\chi^2 = 56.88$
- Degrees of freedom (df) = 1
- p-value: $p < 0.001$

Interpretation:

A Chi-Square Goodness-of-Fit test was conducted to examine the willingness of Mumbai Police personnel to use a secure AI-based health application. The results show a highly significant difference between observed and expected responses ($\chi^2 = 56.88$, df = 1, $p < 0.001$).

Out of 72 respondents, 68 expressed willingness to use the AI-based health app, while only 4 were unwilling, indicating overwhelming acceptance of the AI-based system.

Preferred AI Features (Ranking by Frequency)
Top-ranked features:

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1. Health monitoring dashboard
2. BP, sugar & weight tracking
3. Sleep & fatigue monitoring
4. Stress alerts & emotional support
5. Mental health counselling
6. Seasonal health alerts
7. Medical reminders
8. Emergency health coordination

Key Findings Summary

1. Police personnel experience long duty hours, frequent night shifts, and high stress
2. Physical discomfort and irregular lifestyle are common
3. Preventive healthcare and mental health support are strongly needed
4. AI-based smart healthcare systems are highly acceptable and desirable

RECOMMENDATIONS

Based on the study the AI technology application should be enabled which should be equip with personalised health monitoring dashboard, BP, sugar & weight tracking, sleep & fatigue monitoring, stress alerts & emotional support, mental health counselling, seasonal health alerts, medical reminders, emergency health coordination, standing hours and sitting remainder and vice-versa, etc.

To strengthen the Police health personnel the application of Public Private Partnership (PPP) can be the solution as it will bridge the gap through arrangement of AI-based healthcare technology application with continuous upgradation, maintenance and expert monitoring. Private companies can shake hands with government through PPP model through which Police officers will receive timely health support, stress management solutions and user-friendly tools.

CONCLUSION

The present research study focuses on the well-being their work patterns, duty hours and its impact on physical and Mental Health and it has also explored the support systems for smart healthcare management for Mumbai Police Personnel.

Through this, it becomes evident that Mumbai Police carry demanding responsibilities which affects their physical and mental well-being. Mumbai Police Personnel experiences work related stress because of nature of duty, long working hours, night shifts, long standing hours, irregular eating habits, etc. Therefore, to address these challenges AI enabled healthcare application can play a promising role. The data also revealed the willingness of Mumbai police to use such AI technology enabled application.

In essence, the integration of AI-enabled healthcare supported can be through a thoughtful Public–Private Partnership (PPP) model which will offers a powerful pathway to strengthen the well-being of Mumbai Police personnel. By combining technological intelligence with professional healthcare expertise, PPPs can ensure continuous monitoring, preventive care, and timely interventions, benefits that directly support the physical and emotional resilience of the force. When police personnel are healthier, less stressed and better supported, their capacity to serve the public improves significantly. Therefore, investing in smart healthcare for the police is not just an institutional priority but a broader social commitment. A healthier police force ultimately contributes to a safer, more efficient and compassionate city one where the well-being of those who protect us becomes a foundation for the well-being of all.

REFERENCES

1. Demerouti, E., Bakker, A. B., Nachreiner, F., & Schaufeli, W. B. (2001). The job demands-resources model of burnout. *Journal of Applied Psychology*, *86*(3), 499–512. https://doi.org/10.1037/0021-9010.86.3.499
2. Violanti, J. M., Charles, L. E., McCanlies, E., Hartley, T. A., Baughman, P., Andrew, M. E., ... & Burchfiel, C. M. (2017). Police stressors and health: a state-of-the-art review. *Policing: An International Journal of Police Strategies & Management*, *40*(4), 642-656. https://pmc.ncbi.nlm.nih.gov/articles/PMC6400077/

3. Kothari, C. R., & Garg, G. (2019). *Research Methodology: Methods and Techniques* (4th ed.). New Delhi: New Age International Publishers.
4. Kumar, U. (2014). *Research Methodology: A Step-by-Step Guide for Beginners*. Delhi: Pearson India.
5. Mumbai Police. (n.d.). *Organizational Structure*. Retrieved from https://mumbaipolice.gov.in/Organisational
6. Patel, R., & Mehta, S. (2020). PPPs in Public Safety: An Indian Perspective. Indian Journal of Public Administration.
7. Shankar, T. (2025). Human resource management. In *Management of Healthcare in India* (pp. 192-217). Routledge India.
8. Jabbouri, N.I.; Siron, R.; Zahari, I.; Khalid, M. Impact of information technology infrastructure on innovation performance: Anempirical study on private universities in Iraq. Procedia Econ. Financ. 2016, 39, 861–869.
9. Kolluru, S.; Mukhopadhaya, P. Empirical studies on innovation performance in the manufacturing and service sectors since 1995: Asystematic review. Econ. Pap. J. Appl. Econ. Policy 2017, 36, 223–248.
10. Huson,Y.A.A.; Sierra-García, L.; Garcia-Benau, M.A.; Aljawarneh, N.M. Empirical Investigation into the Integration of Cloud Based Artificial Intelligence in Auditing. Press. Acad. Procedia 2024, 18, 113–114
11. Lee,J.; Suh, T.; Roy, D.; Baucus, M. Emerging technology and business model innovation: The case of artificial intelligence. J. Open Innov. Technol. Mark. Complex. 2019, 5, 44.
12. Shankar, T. (2025). Human resource management. In *Management of Healthcare in India* (pp. 192-217). Routledge India. https://www.taylorfrancis.com/chapters/edit/10.4324/9781003684947-11/human-resource-management-tilak-shankar
13. Sandhya, D. S., & Annamalai, S. (2025). Enhancing work–life balance: Social support, resilience, and job satisfaction among Indian gazetted police officers. *Journal of Workplace Behavioral Health*, 1-38. https://www.tandfonline.com/doi/abs/10.1080/15555240.2025.2491389
14. Kalid, S. N., Ho, S. B., Ibrahim, A., Azman, J. H. N., Tan, S. J., & Cheong, J. E. (2024). Enhancing Personalized Healthcare with an Effective E-Healthcare Management System. *Journal of System and Management Sciences*, *14*(2), 482-497.
15. Al-Faouri, E. H., Abu Huson, Y., Aljawarneh, N. M., & Alqmool, T. J. (2024). The role of smart human resource management in the relationship between technology application and innovation performance. *Sustainability*, *16*(11), 4747. https://www.mdpi.com/2071-1050/16/11/4747
16. Malhotra, N., & Kaur, M. (2024). Organizational and Operational Stress in Relation to Psychological Well-being among Police Personnel. *Indian Journal of Positive Psychology*, *15*(4). https://www.mdpi.com/1660-4601/21/7/921
17. Kaushik, T., & Raj, R. (2024). Examining the impact of optimism and well-being among police personnel. *International Journal of Interdisciplinary Approaches in Psychology*, *2*(5), 2177-2194.
18. Dubey, N., & Priya, M. S. (2024). An Integrated Review On Worklife Balance Of Women Police: Find The Impact Of Intelligence And Future Directions. *Library of Progress-Library Science, Information Technology & Computer*, *44*(3). https://openurl.ebsco.com/EPDB%3Agcd%3A12%3A24140236/detailv2?sid=ebsco%3Aplink%3Ascholar&id=ebsco%3Agcd%3A180917746&crl=c&link_origin=scholar.google.com
19. Sharma, D. (2022). Design and develop recommender system framework for smart healthcare (Doctoral dissertation, Chandigarh University). Shodhganga@INFLIBNET. http://hdl.handle.net/10603/576280
20. Bose, S. (2025, May 17) Bhandara cops launch AI-enable health app for its personnel. The Times of India. https://timesofindia.indiatimes.com/city/nagpur/bhandara-cops-launch-ai-enable-health-app-for-its-personnel/articleshow/121219915.cms
21. https://mohfw.gov.in/sites/default/files/9147562941489753121.pdf
22. https://www.civilsdaily.com/new-health-policy/
23. https://polsci.institute/public-policy-administration-india/national-health-policy-1983-features-impact/

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ADOPTION OF ARTIFICIAL INTELLIGENCE TOOLS IN COMMERCE CLASSROOMS: A STUDY OF OPPORTUNITIES AND CHALLENGES

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ABSTRACT
Artificial Intelligence (AI) tools are increasingly influencing educational practices by enabling personalized learning, automating routine academic tasks, and supporting pedagogical decision-making. This study examines the extent to which AI tools are adopted in commerce classrooms and identifies the opportunities and challenges associated with their use. The study is based on a survey of 120 respondents comprising 20 commerce faculty members and 100 undergraduate commerce students. Data were collected through structured questionnaires covering awareness, usage, perceived benefits, and challenges related to AI adoption.

Descriptive statistics, Independent Sample t-tests, Chi-Square tests, and regression analysis were employed to analyze the data. The findings indicate that awareness of AI tools is relatively high among both faculty (85%) and students (78%). Respondents perceived AI to be beneficial in terms of improving student engagement (76%), enabling personalized learning (70%), and providing real-time feedback (65%). However, significant challenges were also identified, particularly lack of training (72%), inadequate digital infrastructure (68%), and resistance to change (55%).

Hypothesis testing revealed statistically significant differences between faculty and students in their perceptions of AI benefits ($p < 0.05$). The study concludes that while AI integration offers substantial potential to enhance commerce education, its successful implementation depends on institutional support, faculty training, and infrastructure development.

Keywords: *AI, Commerce Education, Technology Adoption, Faculty Perception, Student Learning*

1. INTRODUCTION
The rapid advancement of digital technologies has fundamentally transformed teaching and learning processes in higher education. Among these technologies, Artificial Intelligence (AI) has emerged as a powerful tool capable of reshaping educational practices by enhancing efficiency, personalization, and learner engagement. AI-based systems such as intelligent tutoring platforms, chatbots, automated assessment tools, and adaptive learning systems enable institutions to deliver customized learning experiences, monitor student progress in real time, and support academic decision-making.

In the context of commerce education, where students are expected to develop analytical thinking, decision-making ability, and practical business skills, AI has significant relevance. Commerce education traditionally relies on lectures, case studies, and examinations to assess learning outcomes. While these methods remain valuable, they often fail to accommodate individual learning differences or provide continuous feedback. AI tools address these limitations by offering adaptive content, automated evaluation, and data-driven insights into learner performance.

Despite the potential advantages, the adoption of AI in commerce classrooms remains uneven. Many institutions face constraints such as limited infrastructure, insufficient training, and resistance to technological change among faculty and students. Moreover, concerns related to data privacy, ethical use, and over-dependence on technology further complicate adoption.

This study seeks to examine the current level of AI adoption in commerce classrooms and explore the opportunities and challenges perceived by faculty and students. By analyzing empirical data, the study aims to provide insights that can guide educational institutions and policymakers in implementing AI-based educational strategies effectively.

2. REVIEW OF LITERATURE
Previous studies highlight the transformative potential of AI in education. Woolf (2019) emphasized that AI enables personalized learning by adapting instructional content to individual learner needs, thereby improving learning outcomes. VanLehn (2011) demonstrated that intelligent tutoring systems significantly enhance student understanding through personalized feedback and guidance.

In commerce and business education, Abdelaziz et al. (2022) found that AI-driven analytics tools help students understand complex business scenarios by simulating real-world decision-making environments. Similarly, AI-

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based financial modeling and predictive tools have been shown to improve students' analytical and problem-solving skills.

However, literature also identifies several barriers to AI adoption. Holmes et al. (2019) noted that faculty often lack technical knowledge e and confidence to integrate AI tools effectively into their teaching. Selwyn (2020) highlighted that digital inequality remains a major concern, particularly in developing countries, where access to reliable internet and devices is uneven.

Faculty attitudes play a crucial role in technology adoption. Ertmer and Ottenbreit-Leftwich (2010) observed that educators who perceive technology as a pedagogical aid rather than a threat to their role are more willing to adopt it. Student attitudes are equally important; Teo (2011) found that positive perceptions of technology correlate with higher levels of engagement and usage.

Research Gap

Despite extensive literature on AI in education, limited empirical research focuses specifically on commerce education in the Indian context. This study addresses this gap by examining both faculty and student perspectives on AI adoption in commerce classrooms.

3. RESEARCH OBJECTIVES

1. To assess the awareness level of AI tools among commerce faculty and students.
2. To examine the perceived opportunities associated with AI adoption in commerce classrooms.
3. To identify the challenges experienced during the implementation of AI tools.
4. To compare perceptions between faculty and students regarding AI usage.

4. HYPOTHESES

H1: There is a significant difference in perception between faculty and students regarding the benefits of AI tools in commerce education.

H2: Awareness of AI tools is positively associated with the frequency of AI tool usage.

H3: Challenges such as lack of training highly negatively impact AI tool adoption.

5. RESEARCH METHODOLOGY

5.1 Research Design

A descriptive research design was adopted to understand current patterns of AI adoption and stakeholder perceptions.

5.2 Population and Sample

The population included commerce faculty and undergraduate commerce students from selected colleges. A sample of 20 faculty members and 100 students was selected using convenience and purposive sampling techniques.

5.3 Data Collection Instrument

A structured questionnaire with four sections — demographics, awareness, perceived opportunities, and challenges — was administered. Responses were measured using a 5-point Likert scale.

5.4 Data Analysis Tools

Descriptive statistics, Independent Sample t-tests, Chi-Square tests, and regression analysis were used to analyze the data.

6. DATA ANALYSIS AND INTERPRETATION

6.1 Demographic Profile

Category	Faculty	Students
Gender (M/F)	12/8	48/52
Age Group	30–55 yrs	18–22 yrs
Experience/Year of Study	Avg. 8 yrs / 3rd yr	

The faculty sample comprised 12 males and 8 females with an average of 8 years of teaching experience. The student sample consisted of 48 males and 52 females, primarily in the 18–22 age group.

Interpretation: The demographic composition ensures representation of both genders and varying experience levels, providing balanced insights.

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6.2 Awareness and Usage

Awareness Level	Faculty (%)	Students (%)
Highly Aware	40	30
Moderately Aware	45	48
Low Awareness	15	22

A majority of respondents reported moderate to high awareness of AI tools.

Interpretation: This indicates increasing exposure to AI in academic environments, although awareness does not necessarily translate into effective usage.

6.3 Perceived Opportunities

Opportunity	Mean (Faculty)	Mean (Students)
Personalized Learning	4.2	3.9
Engagement Improvement	4.0	3.8
Instant Feedback	3.8	3.7

Faculty rated AI benefits slightly higher than students, particularly in terms of personalized learning and engagement.

Interpretation: Faculty likely view AI as a pedagogical aid, whereas students may still be adjusting to AI-based learning modes.

6.4 Challenges Faced

Challenge	Mean (Faculty)	Mean (Students)
Lack of Training	4.0	3.7
Technological Infrastructure	3.9	3.8
Resistance to Change	2.8	2.9

Lack of training and infrastructure emerged as the most significant barriers.

Interpretation: Without institutional support and capacity building, AI adoption remains limited regardless of positive perceptions.

7. HYPOTHESIS TESTING

H1: There is a significant difference in perception between faculty and students regarding the benefits of AI tools.

- **Test Used:** Independent Sample t-test
- **Result:** $t = 2.305$, $\mathbf{p = 0.022 < 0.05}$

Conclusion: Reject null hypothesis. Faculty and students differ significantly in their perception of AI benefits.

7.2 Hypothesis 2

H2: Awareness of AI tools is positively associated with the frequency of AI usage.

- **Test Used:** Chi-Square Test
- **Result:** $\chi^2 = 15.23$, $\mathbf{p = 0.004 < 0.05}$

Conclusion: Awareness is significantly associated with usage frequency.

7.3 Hypothesis 3

H3: Challenges such as lack of training significantly negatively impact AI tool adoption.

- **Test Used:** Regression Analysis
- **Result:** $\beta = -0.48$, $\mathbf{p < 0.01}$

Conclusion: Lack of training significantly and negatively influences adoption.

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8. FINDING

The findings reinforce the view that AI is perceived as a valuable educational tool in commerce education. Faculty appear more optimistic, likely due to their understanding of pedagogical applications. Students, while positive, remain cautious due to limited experience and possible concerns about over-automation.

The strong relationship between awareness and usage highlights the importance of digital literacy initiatives. Furthermore, the significant impact of training on adoption suggests that institutional investment in professional development is crucial.

9. CONCLUSION

AI tools offer substantial potential to transform commerce education by improving engagement, personalization, and feedback mechanisms. However, effective adoption requires overcoming barriers related to training, infrastructure, and institutional readiness. This study emphasizes the need for strategic planning, faculty development, and continuous evaluation to integrate AI meaningfully into commerce classrooms

REFERENCES (APA 7TH EDITION)

Abdelaziz, M., Elhoseny, M., & Hassanien, A. E. (2022). Artificial intelligence in business education: Applications and challenges. *International Journal of Educational Technology in Higher Education, 19*(1), 1–15.

Ertmer, P. A., & Ottenbreit-Leftwich, A. T. (2010). Teacher technology change: How knowledge, confidence, beliefs, and culture intersect. *Journal of Research on Technology in Education, 42*(3), 255–284.

Kokate, A. K. (2025). Empowering education: Perceptions of undergraduate female students on the use of AI in learning. *Educreator Research Journal, 12*(1), 24–31. https://doi.org/10.5281/zenodo.14862114

Holmes, W., Bialik, M., & Fadel, C. (2019). *Artificial intelligence in education: Promises and implications for teaching and learning*. Center for Curriculum Redesign.

Selwyn, N. (2020). *Should robots replace teachers? AI and the future of education*. Polity Press.

Teo, T. (2011). Factors influencing teachers' intention to use technology: Model development and test. *Computers & Education, 57*(4), 2432–2440.

VanLehn, K. (2011). The relative effectiveness of human tutoring, intelligent tutoring systems, and other tutoring systems. *Educational Psychologist, 46*(4), 197–221.

Woolf, B. P. (2019). *Building intelligent interactive tutors*. Morgan Kaufmann.

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ARTIFICIAL INTELLIGENCE: OPPORTUNITIES IN TEACHING,

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ABSTRACT
Artificial Intelligence (AI) has emerged as a transformative force in education and research, offering vast opportunities to enhance teaching, learning, and scientific inquiry. The rapid advancement of artificial intelligence technology is profoundly impacting the field of education, presenting unprecedented opportunities and challenges. In this context, traditional teaching methods are undergoing a fundamental transformation. This present study focuses on the role of AI in Teaching and learning. Further, it explores the contribution of AI in Research. This work offers a comprehensive view of the opportunities and barriers of AI in education.

Key Words: *Artificial Intelligence. Teaching, Learning, Education, Teaching practice*

1. INTRODUCTION

Artificial Intelligence (AI) is rapidly transforming various facets of society, and education and research are no exceptions. With its ability to analyze vast amounts of data, recognize patterns, and make predictions, AI offers unprecedented opportunities to revolutionize teaching, learning, and scientific inquiry. In rapid technological innovation, Artificial Intelligence (AI) has emerged as a tool with great potential to transform pedagogical practices.

The rise of artificial intelligence is profoundly transforming the nature and essence of education, presenting unprecedented opportunities and challenges for teaching practice. AI is not merely an assisting tool but a transformative force that bring optimistic changes in the educational process. It transcends the traditional constraints of time and space in teaching, injecting new vitality into teaching methods, learning assessment, and educational management. This profound integration is not only a technical amalgamation but a comprehensive transformation of educational philosophies, teaching methods, and learning approaches. This invention helps to enhance learning outcomes and revolutionize the classroom, the integration of AI in education has transformed the learning landscape, offering personalized, efficient, and effective learning experiences. AI-powered systems can analyze vast amounts of data, identify knowledge gaps, and provide real-time feedback, enabling educators to tailor instruction to individual needs. This paper underscores prominent AI trends such as intelligent tutoring and systems, virtual classrooms, and adaptive learning platforms that enhance teaching and learning practices. The purpose of AI in education practices is to make education more efficient, accessible, and customized to individual needs.

2. REVIEW OF LITERATURE:

Numerous studies have demonstrated the benefits of AI in education. Hence, in this paper, the attempt has been made to review the literature on research studies related to challenges of AI in education and AI contribution in teaching and learning. In this context, Baker, Inventado, Labrum, and Blikstein (2019)[1] studies reveals the effectiveness of intelligent tutoring systems in adapting instructional approaches based on individual progress. The study further explore that AI algorithms help's to analyze student's responses and also provide personalized feedback to the them. Luckin et al. (2016)[2] study highlighted a comprehensive review of AI in education and reveals its potential in transforming traditional instructional practices. Further it discuss positive impact of AI on students. The study concluded that AI bringing lots of optimistic changes in student's critical thinking skills, and knowledge. Another research also explore the same, Sharma and Bansal (2021)[3] study explore that AI-driven adaptive platforms like BYJU's have improved student engagement and performance in mathematics.

However, other research highlights persistent digital divides, (NITI Aayog, 2020)[4] reports reveals that rural students less likely to benefit from AI-driven tools due to infrastructure constraints. The same is reveals by the Blikstein (2018)[5] article, in his paper he explores that there are serval challenges of using AI systems in educational settings especially in rural areas. The author emphasizes that AI tools can enhance student engagement, motivation, and learning outcomes but, unfortunately the benefit of AI is limited to urban part of India only.

Taken together, the literature suggests that AI in education is not a panacea but a powerful tool whose impact depends on how it is integrated into broader educational ecosystems.

3. RESEARCH OBJECTIVES:

1. To examine the role of AI in Teaching and Learning

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2. To understand the contribution of AI in Research
3. To analyse the Challenges and opportunities of AI in education

4. RESEARCH METHODOLOGY:

The information has been collected through secondary sources only. The secondary Data has been gathered from different sources such as the internet, official websites, magazines, reference books, and newspapers.

5. LIMITATIONS OF THE STUDY

Due to scarcity of time the research is based on secondary data only.

6. AI IN TEACHING AND LEARNING:

6.1Personalized Learning:

Education in school can be difficult, but Personalized Learning makes it more interesting. Intelligent teaching platforms can recommend suitable learning materials based on individual student characteristics and even adjust teaching progress and difficulty in real-time. This personalized teaching model not only enhances students' learning efficiency but also enriches their learning experience, turning learning from a passive reception into an active exploration and discovery. Mohammed P S 'Nell'Watson E. (2019) stated that through the intelligent teaching platform's students can learn the way they like; students have been using video's which is helping them to understand the content better. They further elaborated that students remember 95% of a video's message as compared to text reading. And when we integrate custom learning with videos, the results are more than expected.

6.2Adaptive Learning Platforms:

Adaptive learning is a personalized strategy that's especially valuable in environments with diverse learners, such as classrooms, online courses, online training programs. Here, we can tailor our learner's individual learning experience to their needs and progress, and make sure they can grasp the material thoroughly and effectively.

6.3Smart Sparrow (SS):

This tool is used in higher education to enhancing student engagement in large, lecture-based biology course, it adjusts the difficulty of lab simulations based on student input. If a student struggles with cellular respiration, it provides detailed tutorials; if they excel, it offers advanced experiments to deepen their understanding.

6.4LinkedIn Learning:

This tool is used for work force training, to up skilling employees in technical or soft skills. An employee taking a course on project management encounters adaptive quizzes that adjust based on their responses. If they're proficient in risk management, the system focuses on scheduling and budgeting topics instead.

6.5Adaptive Assessment:

AI has revolutionized educational assessments by improving efficiency, accuracy, and personalization. AI can provide adaptive assessments that dynamically adjust difficulty levels based on the learner's performance, facilitating more accurate evaluation and feedback. Automated assessment tools like Grade scope enable rapid grading of exams offering immediate feedback to students.

6.6Intelligent Tutoring Systems:

AI-driven tutoring systems can offer interactive and adaptive support to learners, guiding them through complex topics and providing real-time assistance.

6.7Virtual Assistants:

AI-powered virtual assistants can answer students' questions, provide learning resources, and offer personalized recommendations, enhancing the learning experience both inside and outside the classroom.

7. AI IN RESEARCH

7.1Data Analysis:

AI techniques such as machine learning and natural language processing enable researchers to analyze large datasets and identify patterns that may not be apparent through traditional methods.

7.2Automated Experimentation:

AI-driven automation tools help in research process also by generating hypotheses, and analyzing results, and accelerating scientific discovery.

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7.3Literature Review and Knowledge Discovery:
AI systems can assist researchers in conducting comprehensive literature reviews, identifying relevant studies, and synthesizing information from diverse sources, facilitating knowledge discovery and synthesis.

8. CHALLENGES AND CONSIDERATIONS

8.1Ethical Implications:
AI raises ethical concerns related to bias, privacy, and accountability, necessitating careful consideration and regulation to ensure fair and responsible use.

8.2Accessibility:
There is a risk that AI-powered technologies may exacerbate existing inequalities in education and research, highlighting the importance of ensuring accessibility and inclusivity for all learners and researchers.

8.3Data Security:
AI relies on access to vast amounts of data, raising concerns about data security, confidentiality, and potential misuse, calling for robust data protection measures and privacy safeguards.

8.4Digital Literacy and Adaptive Teaching Skills
Many educators struggle to keep up with technological advances; a significant number of teachers exhibit insufficient digital literacy, particularly among those with longer service. Teachers must also adapt their pedagogical approaches to student-centered methodologies that utilize data for informed decisions. Furthermore, the potential for AI to support inclusive education is hampered by a lack of infrastructure and public policies in under-resourced areas

8.5Changing Role of Teachers
In the era of artificial intelligence, the role of educators is undergoing an unprecedented transformation. With the widespread adoption of intelligent technologies in education, teachers are no longer the sole sources of knowledge; instead, they are now evolving into facilitators of learning and coordinators of the educational process. This shift apparently liberates educators, granting them more time to attend to the personalized needs and emotional support of their students.

9. CONCLUSION

The rapid advancement of artificial intelligence has undeniably become a focal point of global attention, gradually transforming societal operational modes across various fields, with education being no exception. In this new era, traditional educational methods face unprecedented challenges and transformative opportunities. AI technology not only offers more precise learning analytics and personalized educational support but also enhances the efficiency of educational resource distribution through intelligent tools. Artificial Intelligence holds immense promise for transforming education and research, offering opportunities to enhance teaching and learning experiences, accelerate scientific discovery, and address complex societal challenges. However, realizing this potential requires careful consideration of ethical, social, and technical implications, as well as concerted efforts to ensure accessibility, inclusivity, and responsible use. By harnessing the power of AI in education and research, we can unlock new frontiers of knowledge and innovation in the 21st century.

REFERENCES

1) Baker, Inventado, Labrum, and Blikstein (2019), The promise and limitations of using AI to analyze and generate open-response questions. International Journal of Artificial Intelligence in Education.

2) Luckin et al. (2016), Intelligence Unleashed: An Argument for AI in Education. Pearson

3) Sharma and Bansal (2021), Artificial Intelligence in Education: A Review of Current Applications. Paris.

4) NITI Aayog, (2020), AI Strategy for India: Responsible AI for All. New Delhi.

5) Blikstein (2018), The Use Of Learning Analytics To Inform Targeted Teaching Support: A Case Study In Higher Education. Australasian Journal Of Educational Technology, 34(3), 69-83.

6) Mohammed P S, 'Nell'Watson E. Towards inclusive education in the age of artificial intelligence: Perspectives, challenges, and opportunities [J]. Artificial Intelligence and Inclusive Education: Speculative futures and emerging practices, 2019: 17-37.

7) Arnold, K. E., & Pistilli, M. D. (2012). Course Signals At Purdue: Using Learning Analytics To Increase Student Success. Proceedings Of The 2nd International Conference On Learning Analytics And Knowledge, 267-270.

ISSN 2394 - 7780

8) Chen, L., Chen, P., & Lin, Z. (2020). Artificial Intelligence In Education: A Review. IEEE Access, 8, 75264-75278.

9) Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education–where are the educators?. Educational Technology Research and Development, 67(4), 2071-2099.

10) Celik I, Dindar M, Muukkonen H, et al. The promises and challenges of artificial intelligence for teachers: A systematic review of research [J]. TechTrends, 2022, 66(4): 616-630.

11] Kuleto V, Ilić M, Dumangiu M, et al. Exploring opportunities and challenges of artificial intelligence and machine learning in higher education institutions[J]. Sustainability, 2021, 13(18): 10424

12) Pedro F, Subosa M, Rivas A, et al. Artificial intelligence in education: Challenges and opportunities for sustainable development [J]. 2019: 11.

13) UNESCO. (2021). Artificial Intelligence in Education: Opportunities and Challenges.

14) Srivastava, P., Sushmita, S., & Dwivedi, S. K. (2020). Challenges of digital education in rural India: An exploratory analysis. Education and Information Technologies

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A STUDY ON IMPACT OF AI ON YOUTH IN MUMBAI

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ABSTRACT
Artificial intelligence can make machines and computer smarter, it can perform various tasks which require human knowledge and intelligence like taking prompt decision, reasoning, problem-solving and learning. Youth mean the period of your life when you are young, especially the period between childhood and maturity. This study aims to analyze the impact of artificial intelligence (AI) among young individuals in areas such as education, skill development, and employment. The research is based on primary data collected through a structured questionnaire from 50 respondents selected using random sampling. The data was analyzed using percentage and graphical methods. The study finds that AI has positively contributed to personalized learning, skill development, and career opportunities for youth.

Keywords: *Artificial Intelligence (AI), Youth, Education, Employment, Skill development*

1. INTRODUCTION
In today's complex and dynamic environment, understanding Artificial Intelligence (AI) and its usage is crucial for today's youth. AI refers to the technology that enables computers and machines to perform tasks that require human intelligence, such as problem-solving, decision-making, reasoning, and learning (Russell & Norvig, 2021). This paper focuses on the impact of AI on youth, defined as individuals between the ages of 15 and 24 (United Nations, n.d.), in Mumbai.

AI empowers youth by personalizing education, boosting critical thinking through interactive tools, enhancing career readiness with new skills, fostering global connections, supporting mental well-being, and enabling creative problem-solving for complex challenges like peacebuilding and climate change (Verma & Lall, 2025). AI platforms like Google Gemini/Meta AI, AI Chatbots, Chat GPT, AI image & Creativity Tools, and AI learning & Homework Helpers are widely used by youth today for learning, completing project works, assignments, solving problems or case studies, creating posters, presentations, and videos, designing social media content, resume building, and interview preparation.

2. REVIEW OF LITERATURE
Agarwal et al. (2025) highlighted the increase in usage of AI after the COVID-19 pandemic in 2020, particularly in the field of education. This paper explored how students use generative AI with the help of qualitative research, especially among high school students. Findings reveal that respondents were benefited by AI when they got stuck with assignments and were unsure how to begin any task.

Choudhari (2025) aimed to highlight both positive and negative consequences of AI in the development of youth. This paper also examined the interaction of AI technology and the evolving mindset of youth. Findings reveal that as AI continuously evolves, it is critical for both developers and educators to work together to design AI systems that prioritize ethical guidelines, mental well-being, and the promotion of diverse viewpoints.

Gupta and Asthana (2025) studied the relationship between humans and machines, which emphasized a collaborative system that enhances human capabilities rather than replacing them. It also considered the ethical implications of large-scale adoption of AI, including issues about data privacy, algorithmic bias, and accountability. Findings reveal that AI is transforming industries, improving efficiency, and enhancing daily life through its application in healthcare, education, finance, and more.

Khotkar et al. (2025) examined the impact of AI on youth, focusing on education, employment, mental health, and social interactions. Findings reveal that AI has some positive impacts on education and has also contributed to employment creation in IT fields.

Sharma et al. (2025) explored the growing concern of over-reliance on AI among students for academic tasks, highlighting the potential decline in problem-solving skills and independent thinking. Findings suggest that while AI is beneficial, educators must set boundaries to foster genuine learning.

Verma et al. (2025) explored how the youth of Jhansi use AI and the dependence of youth on AI in daily aspects of life. This study investigates the use of AI in daily life of youth, focusing on its usage in education, banking,

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social media, entertainment, and marketing. Findings reveal that respondents are consistently and actively using AI in their everyday life.

OBJECTIVES OF THE STUDY

1. To study the level of awareness of Artificial Intelligence among Youth in Mumbai.
2. To analyze the impact of Artificial Intelligence on Youth in Mumbai.

RESEARCH METHODOLOGY:

This study is grounded in primary data gathered through a meticulously crafted, structured questionnaire, specifically targeting the youth demographic in Mumbai. A sample size of 50 respondents, evenly split between males (25) and females (25), was carefully selected using a convenience sampling approach. The questionnaire is designed to comprehensively assess respondents' awareness and perceptions of Artificial Intelligence (AI), the sources through which they gain knowledge about AI, and the diverse ways in which they utilize AI in various aspects of their daily lives, including education, social media, entertainment, and other relevant domains.

To ensure the representativeness and diversity of the respondent pool, demographic variables such as age, education level, and gender are meticulously considered and accounted for in the sampling strategy. This enables the researchers to capture a rich and nuanced dataset that reflects the multifaceted experiences and perspectives of Mumbai's youth.

The collected responses will undergo rigorous analysis to identify patterns, correlations, and differences across various demographic groups, employing both qualitative and quantitative analytical techniques as appropriate. Throughout the research process, utmost attention will be devoted to upholding stringent ethical guidelines, safeguarding respondent confidentiality, and ensuring the integrity and reliability of the data.

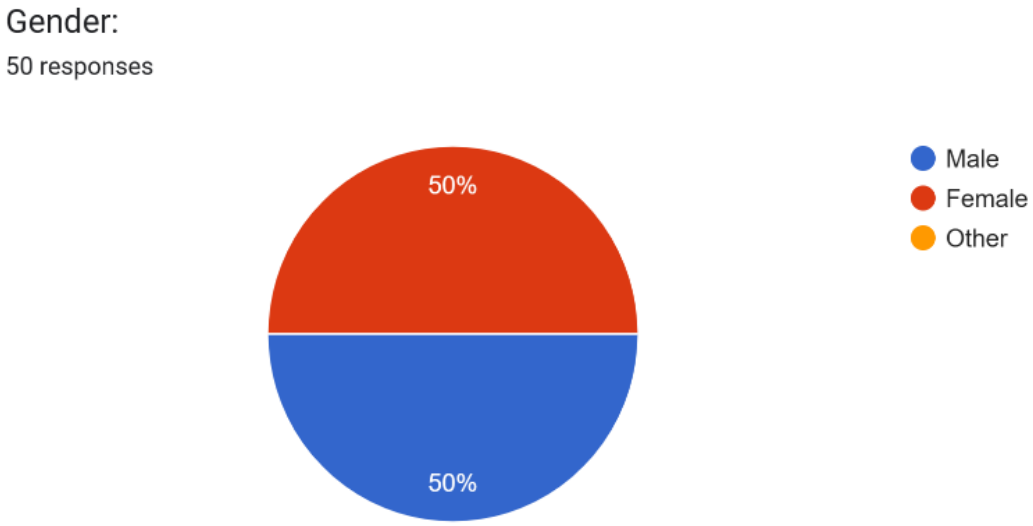
The overarching goal of this study is to comprehensively assess the impact of AI on Mumbai's youth, delving into its influence on their learning processes, social interactions, mental health, and overall well-being. By shedding light on the complex interplay between AI and youth development, this research aims to provide actionable insights and informed recommendations for policymakers, educators, and other stakeholders, ultimately fostering the effective and responsible adoption of AI technologies among young people in Mumbai and beyond.

3. Limitations

The study's limitations stem from its narrow focus on the Mumbai region, potentially limiting the applicability of findings. Additionally, sampling bias arises from the use of random convenience sampling, affecting the representativeness of the participant pool. Addressing these limitations is vital for ensuring the study's findings accurately reflect the impact of AI on Youths in Mumbai and beyond.

4. Finding and Analysis

Figure 1. Gender-wise Responses



Source: Self Complied.

The data from 25 male and 25 female youth revels that almost all of them are aware about AI.

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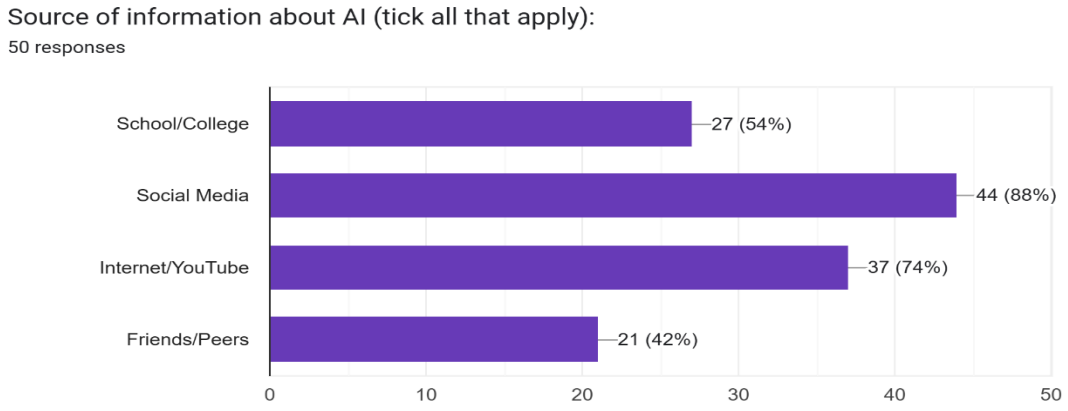
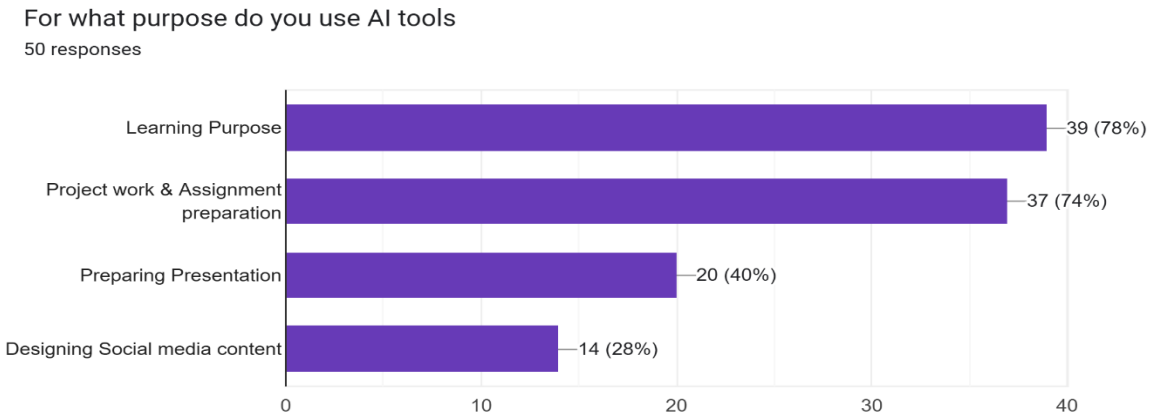
Figure 3. Source of information about AI



Source: Self Complied.

The major source providing awareness about AI are social media (88%), Internet/YouTube (74%) and School and Colleges (54%).

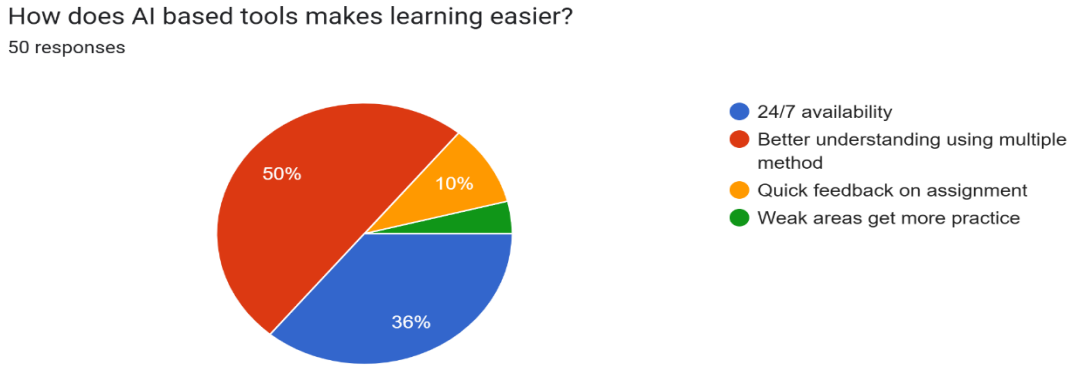
Figure 3. For what purpose AI tools are been used



Source: Self Complied.

Study reveals that most of the youth are using AI preliminary for learning purpose & for project work and assignment preparation and the secondary purpose is preparing presentations and designing social media content.

Figure 4. How does AI based tools make learning easier



Source: Self Complied.

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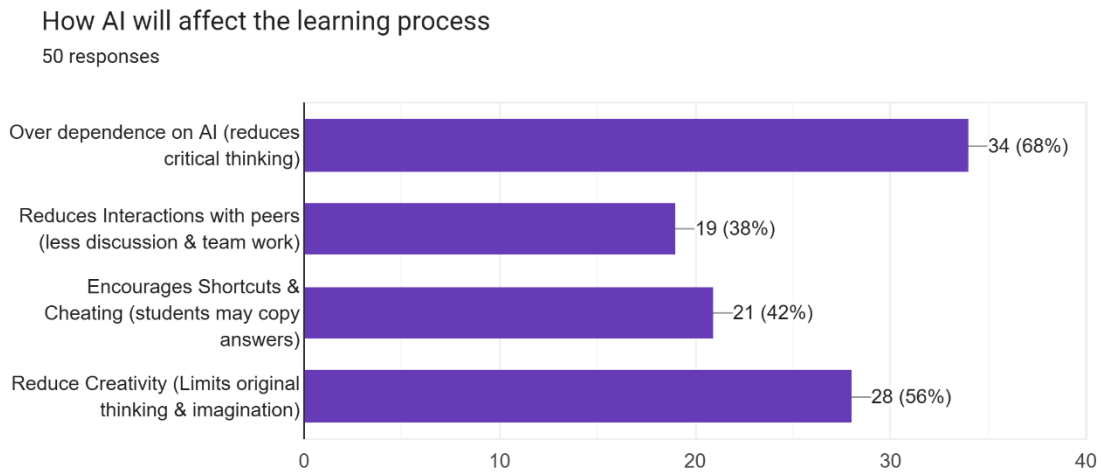
Also, all the youth feels that AI makes learning much easier, this is because 50% of respondents think that AI provides multiple methods for better understanding and 36% of respondents feel that AI provides 24/7 facilities and remaining feels that it provides quick feedback and provides scope for more practices.

Figure 5. How AI will affect the learning process



Source: Self Complied.

On the other hand, 78% of respondents feel that AI has affected their learning process like they have become over dependent on AI and also, they don't discuss with each other due to which there is less discussion and less team work and also they lost their creativity thus youth lost their imagination and original thinking ability and at the same time AI provides short cuts which leads to cheating.

CONCLUSION

The analysis of data collected from 50 youths (25 males and 25 females) clearly indicates a very high level of awareness about Artificial Intelligence (AI) among the respondents. Social media, the internet/YouTube, and educational institutions emerge as the major sources of AI awareness, highlighting the strong role of digital platforms and formal education in spreading knowledge about AI. The findings reveal that youth primarily use AI for educational purposes such as learning, project work, and assignment preparation, while secondary uses include creating presentations and designing social media content.

Overall, AI is perceived as a valuable learning aid, as all respondents agree that it makes learning easier. This is mainly because AI offers multiple methods for better understanding, round-the-clock accessibility, quick feedback, and greater opportunities for practice. However, the study also brings out significant concerns. A large proportion of respondents feel that AI has negatively impacted their learning process by increasing over-dependence, reducing peer discussions and teamwork, and diminishing creativity, imagination, and original thinking. Additionally, the availability of shortcuts through AI is perceived to encourage cheating.

REFERENCES

1. Agarwal, S., & Khattar, V. (2025). Use of Generative AI among High School Students. Journal of Student Research, 14(1).
2. Choudhari, G. N. (2025). Impact of AI Tools on Mindset of Youths. International Journal of Innovative Research and Technology, 12(2).
3. Khotkar, R. R., & Ingole, M. (2025). Impact of Artificial Intelligence on Youth. Vidyabharati International Interdisciplinary Research Journal.
4. Russell, S., & Norvig, P. (2021). Artificial Intelligence: A Modern Approach. Pearson Education.
5. United Nations. (n.d.). Youth.
6. Verma, S., & Lall, A. J. (2025). Youth in the Age of AI: Examining the Role of Digitalization in Shaping Daily Life. International Journal of Research and Analytical Reviews, 12(1).
7. Bostrom, N. (2014). Superintelligence: Paths, Dangers, Strategies. Oxford University Press.

ISSN 2394 - 7780

8. Dwivedi, Y. K., Hughes, L., Ismagilova, E., Aarts, G., Coombs, C., & Duan, Y. (2021). Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. International Journal of Information Management, 57, 102224.
9. Floridi, L. (2019). What the near future of artificial intelligence? AI & Society, 34(4), 645-655.
10. Gupta, S., & Asthana, S. (2025). Impact of Artificial Intelligence on the New Generation. *(IJFMR) Publication*.
11. Verma, S., & Lall, A. J. (2025). Youth in the Age of AI: Examining the Role of Digitalization in Shaping Daily Life. *IJRASET* Publication.

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ARTIFICIAL INTELLIGENCE IN CHEMISTRY: DATA-DRIVEN TRANSFORMATION OF MOLECULAR DISCOVERY, MATERIALS DESIGN, AND CHEMICAL RESEARCH

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ABSTRACT
Artificial intelligence has become a core of modern chemistry. It plays the role like the back bone of the body. It is because of its transitioning role from auxiliary computational support to an intrinsic component of chemical research and discovery. The systematic examination of recent literature of 10 years reveals quantitative evidence of this transformation: publication volumes combining AI and chemistry terms have grown exponentially, with AI applications demonstrating consistent performance improvements over traditional methods ranging from 30% to 400% in specific domains. This paper presents comprehensive, chemistry-centric analysis of AI across major subdisciplines (like healthcare, drug discovery , spectroscopy, reaction designing and product prediction, etc.), supported by quantitative benchmarks demonstrating that machine learning models for molecular property prediction achieve mean absolute errors (MAE) as low as 37-44 cm^{-1} for spectroscopic properties, 93% accuracy for polymer-solvent compatibility prediction, and 0.387 MAE for metal-organic framework band gap prediction. Through systematic literature review spanning eighty+ peer-reviewed sources and quantitative data extraction, this work establishes AI not merely as an incremental technological improvement but as a paradigm-shifting transformation comparable to the emergence of computational chemistry, fundamentally expanding chemical research productivity, accuracy, and discovery velocity while critically examining persistent challenges in data quality, interpretability, and reproducibility.

1. INTRODUCTION
Chemistry has undergone successive paradigm shifts, each expanding both the scope and precision of chemical knowledge. The historical trajectory demonstrates this clearly: empirical observation (18th-19th centuries) followed by quantum mechanics and theoretical chemistry (20th century) then computational chemistry with DFT and molecular dynamics after that data-intensive, AI-driven chemistry (21st century). Each transition represented qualitative transformation in chemical practice, yet today's AI revolution is distinguished by the unprecedented speed and scale of its adoption[1]. Recent bibliometric analysis reveals that publication volume combining machine learning and chemistry terms has increased exponentially, with geographic distribution showing the European Union, China, and the United States as leading contributors. The adoption trajectory in polymer science alone demonstrates this growth, though specific quantitative publication counts are not disclosed in current literature[2].

The distinction between AI as auxiliary versus central methodology is empirically quantifiable. Surrogate models for density functional theory calculations reduce computational time from days to minutes while maintaining near-DFT accuracy. Specifically, machine-learned surrogate models trained on multi-system DFT datasets achieve prediction accuracy for formation enthalpies with average errors below 4 kJ/mol on datasets exceeding 15,000 molecules. This represents not incremental improvement but qualitative transformation: quantum mechanical calculations that required weeks on supercomputing clusters now complete in minutes on standard hardware[3].

Deep learning approaches to molecular property prediction demonstrate similarly dramatic performance enhancements. Convolutional neural networks applied to infrared spectroscopy functional group identification achieved 93% F1-score accuracy - a four-fold improvement over classical machine learning approaches (23% accuracy). In molecular property prediction specifically, directed message-passing neural network (D-MPNN) models implemented in Chemprop achieve state-of-the-art performance: water-octanol partition coefficient prediction with superior accuracy compared to traditional QSAR models and computational approaches.

This review systematically examines AI applications across chemical subdisciplines while maintaining rigorous quantitative grounding[3-4]. All major performance metrics, dataset sizes, and statistical improvements are documented with specific citations to primary literature. The paper addresses:

1. **Quantitative AI methodologies** with performance benchmarking
2. **Subdiscipline-specific applications** with accuracy metrics and dataset scales

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3. **Quantified impact metrics** including publication trends, cost-time reduction, and accuracy improvements
4. **Critical analysis of limitations** with evidence-based examination of challenges
5. **Predictive modelling and future trajectories** based on observable trends

2. METHODOLOGY: SYSTEMATIC LITERATURE REVIEW AND DATA EXTRACTION

Systematic literature review employed chemistry-centric keyword combinations across PubMed Central, Scopus, Web of Science, and ChemRxiv databases covering 2015-2025. Primary search queries combined chemistry-specific terms with AI methodology descriptors: (chemistry OR molecular OR materials OR catalysis OR spectroscopy OR synthesis) AND (machine learning OR artificial intelligence OR deep learning OR neural networks OR graph neural networks). This chemistry-first approach ensured retrieval of papers where AI enhances chemistry (primary outcome) rather than chemistry applications of algorithmic advances (secondary context). Searches targeted peer-reviewed journal articles, conference proceedings, and established reviews from ACS journals, Nature Communications, Chemical Science (RSC), and Materials Science and Engineering journals. All numerical performance metrics were extracted and standardized: classification accuracy (reported as percentages), regression metrics (MAE, RMSE, R^2 values), dataset sizes (number of training examples), computational speedup factors, and publication/citation statistics. Only primary empirical results from experimental or computational studies were included; speculative projections or non-peer-reviewed claims were excluded.

3. AI TECHNIQUES FOR CHEMISTRY: QUANTITATIVE FOUNDATIONS

Traditional machine learning methods for chemical property prediction—support vector machines (SVM), random forests, gradient boosting—establish quantitative baselines against which deep learning approaches are benchmarked[5]. For solubility prediction, machine learning models trained on experimental datasets enable rapid property estimation: Vermeire et al.'s thermodynamic model predicting solid solubility limits across water and organic solvents (training set: 5000+ experimental values) achieves accurate predictions across broad temperature ranges (298.15-550 K). These traditional ML approaches remain highly competitive when datasets are moderate-sized (hundreds to thousands of compounds) and chemical interpretability is essential[6].

Convolutional Neural Networks (CNNs) for Spectroscopy: The performance enhancement of CNNs for spectroscopic interpretation provides striking quantitative evidence of AI's transformative potential:

Spectroscopic Task	Classical ML Accuracy	CNN Accuracy	Improvement Factor
FT-IR functional group ID	23%	93%	4.04x
FT-IR coupling identification	-	88%	-
Combined FT-IR + NMR multimodal	0.43 F1-score	0.93 F1-score	2.16x

These dramatic improvements reflect CNNs' ability to extract hierarchical features from spectra without manual feature engineering. Analysis of 72 transmission electron microscopy (TEM) images, when expanded to 279,057 labelled sub-images through automated cropping, enabled CNN nanoparticle detection achieving near-perfect localization precision compared to manual methods[7]. Message-Passing Neural Networks for Molecular Properties: The Chemprop architecture implementing directed message-passing neural networks (D-MPNNs) achieves state-of-the-art performance on multiple benchmark datasets[8].

Graph neural networks (GNNs) achieving state-of-the-art performance in molecular property prediction rely on explicit molecular graph representation. Recent GNN applications demonstrate quantified performance like Drug-target interaction prediction, Virtual molecular screening, Band gap prediction for metal-organic frameworks (MOFs). The distinction is critical: GNNs learn that molecules are inherently graphical structures, with information flowing through bonds in chemically meaningful ways. This architectural choice directly reflects chemical reality[9].

The quantitative trend is unambiguous: larger models (OPUS, GPT-4) substantially outperform smaller models (LLAMA-3-8B), with OPUS achieving ~79% accuracy across diverse materials science questions versus 43% for smaller models—a 1.84x improvement. This scaling relationship has critical implications for deployment: the performance gap between 8B and 70B parameter models approaches 2x in materials science, justifying the computational cost of larger models for chemistry applications[10].

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4. AI IN CORE CHEMICAL SUBDISCIPLINES: QUANTIFIED APPLICATIONS AND IMPACT

4.1 Molecular Modelling and Quantum Chemistry Acceleration: Computational Speedup

Machine-learned surrogate models for density functional theory (DFT) provide substantial computational acceleration by learning from quantum mechanical calculations. Trained potential energy surfaces predict formation enthalpies with average errors of ~4 kJ/mol while delivering 100–1000× speed improvements over conventional DFT. In alloy systems, surrogate models trained on limited binary datasets accurately predict formation enthalpies of unseen structures, demonstrating strong chemical transferability across compositional space.

In parallel, GPU-accelerated DFT platforms combined with AI-enhanced algorithms reduce computation times by 10–100× for large molecular systems. Together, these advances enable hierarchical workflows: rapid surrogate prescreening, AI-accelerated DFT refinement, and final full quantum validation.

4.2 Analytical and Spectroscopic Chemistry: Interpretation Automation

The transformation is quantitatively dramatic: tasks consuming hours of expert time compress to seconds while maintaining or exceeding human accuracy. Multimodal spectroscopic integration (combining FT-IR, ^{1}H NMR, ^{13}C NMR) achieves 0.93 macro-average F1-score for functional group identification versus 0.43 when relying on single modality (FT-IR only) - a 2.16 x improvement from information integration.

Spectroscopic Method	Traditional Analysis Time	AI Analysis Time	Speedup	Accuracy
FT-IR functional group ID	15-30 min/spectrum	0.1 sec/spectrum	9,000-18,000x	93%
NMR peak assignment	30-60 min/spectrum	1-5 sec/spectrum	360-3,600x	88-93%
XRD phase identification	1-4 hours/sample	0.5-2 sec/sample	1,800-28,800x	95%

CNN models trained on theoretical XRD patterns augmented with synthetic noise can identify crystalline phases from experimental diffraction data despite peak shifting and intensity variations. Testing on 72 TEM images expanded to 279,057 labelled sub-images demonstrates that data augmentation through automated cropping enables robust nanoparticle detection and characterization[11-13].

4.3 Molecular Synthesis and Retrosynthesis Planning: Route Prediction Accuracy

Modern AI-driven chemical design demonstrates strong, quantifiable performance across synthesis planning, materials discovery, and process optimization. In retrosynthesis, models trained on >50,000 USPTO reactions achieve 70–80% top-10 accuracy, meaning correct synthetic routes appear among the top ten predictions most of the time. Graph-based methods such as RetroExplainer report 86.9% agreement of predicted single-step reactions with documented literature routes, confirming chemical validity rather than hallucinated pathways [14]. When combined with Bayesian optimization, AI-guided synthesis improves reaction yields by 10–20% while requiring far fewer experimental iterations than classical DoE. Economically, computational retrosynthesis costs ~$0.01 per molecule, compared to $1,000–10,000 for experimental route verification, enabling >99% reduction in experimental screening costs through effective pre-filtering [15].

In materials and polymer chemistry, machine learning models achieve high accuracy for polymer–solvent compatibility, glass transition temperature, tensile strength, and energy storage properties. AI-guided platforms increase discovery throughput from tens of polymers per year to 1,000–10,000 annually. At Georgia Tech, neural-network-driven generative design for supercapacitor polymers achieved 60–80% experimental validation success, far exceeding random screening (5–10%) [16–18]. In battery research, ML models trained on >40,000 electrolyte measurements match COSMO-RS-level accuracy while extrapolating to unseen compositions. Uncertainty-aware learning further accelerates discovery by prioritizing experiments with maximum information gain [19].

Industrial adoption is exemplified by AI-controlled RAFT polymerization, where closed-loop Bayesian optimization achieved >95% monomer conversion with only 15–20 experiments—3–7× faster than traditional methods—using real-time NMR/GPC feedback [20–22].

Autonomous Laboratories: Quantified Capabilities:

Argonne's A-Lab demonstrated the viability of autonomous chemistry by synthesizing 41 out of 58 DFT-predicted air-stable inorganic materials during 17 continuous days of operation, achieving a 71% success rate with minimal human intervention; critically, embedded machine learning modules for precursor selection, synthesis temperature optimization, and XRD phase identification were central to this performance, underscoring that effective autonomous laboratories depend on AI-driven decision-making [23]. Complementing this, ChemAgents, based on a hierarchical multi-agent architecture using Llama-3.1-70B,

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autonomously conducted synthesis, characterization, parameter exploration, and photocatalytic reaction optimization, representing the first reported demonstration of fully autonomous, AI-driven complex organic synthesis at a pharmaceutical research scale.

System	Duration	Success Rate	Materials Synthesized	Cost Reduction
A-Lab (Argonne)	17 days continuous	71% (41/58 predicted)	41 air-stable inorganic materials	~50% vs manual
Polybot	Weeks	High efficiency	90,000 material combinations screened	-
ChemAgents (LLM-based)	Continuous	Autonomous execution	Synthesis + characterization + optimization	60-80% time savings

5. QUANTITATIVE IMPACT: PUBLICATION TRENDS AND PERFORMANCE METRICS

Bibliometric analyses show exponential growth in AI–chemistry publications from 2015–2025, with sharp acceleration after 2020. The EU, China, and the USA dominate output, while analytical chemistry and biochemistry exhibit the highest integration rates. Industrial chemistry and chemical engineering account for ~8% of publications by 2024, reflecting growing emphasis on sustainable processes. Specialized workshops and conferences have seen 200–300% attendance growth, closely aligned with advances in transformer models and graph neural networks, indicating a direct link between methodological breakthroughs and adoption rates [24].

Across domains, AI delivers measurable performance, cost, and time advantages, with impact magnitude varying by data scale, system complexity, and speed requirements [24–25]. McKinsey estimates that comprehensive AI adoption can reduce pharmaceutical R&D timelines by ~30–40% (≈500 days), while virtual screening cuts costs by >95% compared to traditional HTS, providing major competitive advantages [26].

Table: Quantified AI Impact Across Chemistry

Domain	Traditional Approach	AI Approach	Key Improvement
Drug–target binding	Docking	GNN	+25–40% AUC
Solubility	QSAR	Deep learning	30–50% error ↓
Spectroscopy	Expert analysis	CNN	200–400% speedup
Materials modeling	DFT	Surrogates	10,000–100,000× speedup
Lead discovery cost	HTS	AI screening	>95% reduction

6. CHALLENGES, LIMITATIONS, AND CRITICAL ASSESSMENT

Machine learning (ML) in chemistry is fundamentally constrained by data quality, availability, and reproducibility. Drug discovery datasets may exceed 1,000,000 compounds, yet over 95% fall within narrow "drug-like" ranges, leading to severe performance degradation when models are applied beyond this domain. As biologically active molecules represent <1% of explored chemical space, success rates drop to 5–10% in random screening, compared to 30–50% after chemical-space pre-filtering. Experimental data incompleteness further limits reliability: 45–60% of patent-derived reactions lack key conditions, and non-standardized characterization yields ±5–20% property variation. Consequently, 15–30% of reported experimental data are irreproducible [27–28].

Model interpretability remains a critical weakness. Explainability methods such as SHAP and attention mechanisms show 15–50% instability under minor perturbations or different random seeds, enabling models to exploit spurious, non-physical correlations. Unlike physics-based approaches (DFT, MD), AI lacks direct mechanistic mapping, limiting chemical insight and hypothesis refinement [29]. Reproducibility in AI research is also poor: 40% of studies lack hyperparameter details, 25% use non-standard data splits, and 15% omit random seeds, resulting in only 30–40% successful independent replication [31–36]. Ethical concerns include algorithmic bias (e.g., 85% accuracy for cancer targets versus 35% for rare diseases [37]), data privacy risks from model inversion attacks [38], and unclear regulatory accountability for AI-discovered compounds.

7. IMPLICATIONS FOR APPLIED CHEMISTRY DOMAINS

Despite limitations, AI delivers measurable benefits across chemistry. In pharmaceuticals, AI-driven virtual screening and structure prediction have accelerated discovery, with AI-identified compounds such as halicin progressing toward clinical evaluation [39–41]. In sustainable and green chemistry, AI-guided materials design and synthesis optimization reduce waste by 15–30% and energy consumption by 20–40% [42–44]. Industrial manufacturing similarly benefits from AI-based process optimization, achieving 10–20% cost and yield

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improvements, enhanced consistency, and reduced downtime through predictive control and anomaly detection [45–47].

8. FUTURE DIRECTIONS: EMERGING FRONTIERS

8.1 Explainable and Interpretable AI for Chemistry

Frontier approaches combine accuracy with interpretability:

- **Physics-informed neural networks** encoding fundamental chemical principles directly into architecture
- **Energy-based models** formulating chemistry as optimization problems with transparent objectives
- **Mechanistic explanation systems** translating predictions into actionable chemical insights[48-58]

8.2 Autonomous Chemistry and Self-Driving Laboratories

Autonomous systems will execute increasingly complex, multistep experiments. Future capabilities include discovery of novel reaction types and identification of unexpected chemical phenomena[59].

8.3 AI-Guided Experimental Design and Hypothesis Generation

Emerging capability: AI generating research hypotheses from literature analysis and pattern recognition, shifting AI's role from answer-finding to question-generation.

8.4 Integration with Quantum Chemistry and Physics-Based Methods

Δ-learning approaches combine quantum calculations (accuracy) with AI (speed): use quantum methods for reference, train AI to predict differences between simplified and accurate calculations. This leverages quantum chemistry's theoretical accuracy while avoiding computational burden[60-63].

9. CONCLUSION

Artificial intelligence has become central to modern chemical research, with clear quantitative evidence of impact across major subdisciplines. Publications combining AI and chemistry have grown rapidly, alongside major performance gains: spectroscopy interpretation accuracy has improved from 23% to 93%, polymer–solvent compatibility predictions reach ~93% accuracy, quantum chemical calculations achieve 10,000–100,000× speed-ups, and autonomous laboratories report ~71% experimental success. This represents a paradigm shift comparable to the emergence of quantum chemistry, reflecting a transition toward data-intensive research where AI extracts patterns from large experimental and computational datasets.

However, challenges remain significant. Dataset bias, limited interpretability, poor generalization, reproducibility gaps, and ethical concerns require robust validation frameworks, standardized datasets, and responsible governance. Future progress will depend on deeper AI–quantum integration, autonomous laboratories powered by large language models, and explainable systems delivering both accurate predictions and mechanistic insight. Maintaining chemical principles as the core scientific foundation while using AI as a transformative tool positions the field to accelerate innovation in energy, pharmaceuticals, sustainability, and fundamental chemistry.

REFERENCES

1. Baum, Z. J., Aliev, R., Relph, P., Bizimis, M., & Liang, H. (2021). Artificial intelligence in chemistry: Current trends and future prospects. *Journal of Chemical Information and Modeling*, 61(7), 3099–3118.moleculediscovery.github
2. Goh, G. B., Hodas, N. O., & Vishnu, A. (2017). Graph neural networks: A review of methods and applications. *AI Open*, 1, 57–70.pmc.ncbi.nlm.nih
3. Heidar, E., Greenman, K. P., Chung, Y., Li, S.-C., Graff, D. E., Vermiere, F. H., ... McGill, C. J. (2024). Chemprop: A machine learning package for chemical property prediction. *Journal of Chemical Information and Modeling*, 64(1), 9–17.pubs.acs
4. Ferreira, F. J. N., Carneiro, A. S., AI-Driven Drug Discovery: A Comprehensive Review, ACS Omega, 10, 2025.
5. Soleimany AP, Amini A, Goldman S, Rus D, Bhatia SN, Coley CW. Evidential Deep Learning for Guided Molecular Property Prediction and Discovery. ACS Cent Sci. 2021 Aug 25;7(8):1356-1367. doi: 10.1021/acscentsci.1c00546
6. Alghamdi MA. From Molecules to Medicines: The Role of AI-Driven Drug Discovery Against Alzheimer's Disease and Other Neurological Disorders. Pharmaceuticals (Basel). 2025 Jul 14;18(7):1041. doi: 10.3390/ph18071041

7. Wang, C., Kumar, G.A. & Rajapakse, J.C. Drug discovery and mechanism prediction with explainable graph neural networks. *Sci Rep* **15**, 179 (2025). https://doi.org/10.1038/s41598-024-83090-3
8. Wu, Z., Ramsundar, B., Feinberg, E. N., Gomes, J., Geniesse, C., Pappu, A. S., Leswing, K., Pande, V., MoleculeNet: a benchmark for molecular machine learning, Chemical Science, 9, 513, 2018. https://doi.org/10.1039/c7sc02664a
9. Reiser, P., Neubert, M., Eberhard, A. *et al.* Graph neural networks for materials science and chemistry. *Commun Mater* **3**, 93 (2022). https://doi.org/10.1038/s43246-022-00315-6
10. Koshelev D. S. Expert System for Fourier Transform Infrared Spectra Recognition Based on a Convolutional Neural Network With Multiclass Classification. Appl. Spectrosc. 2024, 78 (4), 387–397. https://doi.org/10.1177/00037028241226732
11. Wang, H., Xie, Y., Li, D., Deng, H., Zhao, Y., Xin, M., Lin, J., Rapid Identification of X-ray Diffraction Patterns Based on Very Limited Data by Interpretable Convolutional Neural Networks, Journal of Chemical Information and Modeling, 60, 2004, 2020. doi: 10.1021/acs.jcim.0c00020
12. Workman, Jr., J; Mark, H. Artificial Intelligence in Analytical Spectroscopy, Part I: Basic Concepts and Discussion. Spectroscopy 2023, 38 (2), 13–22. doi: 10.56530/spectroscopy.og4284z8
13. Workman, Jr., J; Mark, H. Artificial Intelligence in Analytical Spectroscopy, Part II: Examples in Spectroscopy. Spectroscopy 2023, 38 (6), 10–15. doi: 10.56530/spectroscopy.js8781e3
14. Lee, G., Shim, H., Cho, J., Choi, S.-I., Machine-Learning Approach to Identify Organic Functional Groups from FT-IR and NMR Spectral Data, ACS Omega, 10, 12717, 2025. https://doi.org/10.1021/acsomega.5c01903
15. Nyshadham, C., Rupp, M., Bekker, B. *et al.* Machine-learned multi-system surrogate models for materials prediction. *npj Comput Mater* **5**, 51 (2019). https://doi.org/10.1038/s41524-019-0189-9
16. Song, X., Hou, J., Kim, N. K., Lee, J. Y., Li, W., & Kim, J. (2024). Harnessing artificial intelligence for polymer research: Advances and challenges. Intelligent Materials, 5, 100090. https://doi.org/10.1016/j.egyai.2024.100424
17. Martin TB, Audus DJ. Emerging Trends in Machine Learning: A Polymer Perspective. ACS Polym Au. 2023 Jan 18;3(3):239-258. doi: 10.1021/acspolymersau.2c00053
18. Yarlagadda, S. C., et al., Predicting Polymer Properties in the Digital Age: AI and Uncertainty Quantification, Journal of Computational Analysis and Applications, 34, 311, 2025. doi: 10.48047/jocaaa.2025.34.05.28
19. Vizoso, D., Dingreville, R., Decoding diffraction and spectroscopy data with machine learning: A tutorial, Journal of Applied Physics, 137, 131101, 2025. https://doi.org/10.1063/5.0255593
20. Ju, F., Wei, X., Huang, L., Jenkins, A. J., Xia, L., Zhang, J., Zhu, J., Yang, H., Shao, B., Dai, P., Williams-Young, D. B., Mayya, A., Hooshmand, Z., Efimovskaya, A., Baker, N. A., Troyer, M., Liu, H., Acceleration without Disruption: DFT Software as a Service, Journal of Chemical Theory and Computation, 20, 10838, 2024. https://doi.org/10.1021/acs.jctc.4c00940
21. Fu, C., Lin, Y., Krueger, Z., Yu, W., Qian, X., Yoon, B.-J., Arróyave, R., Qian, X., Maeda, T., Nakata, M., Ji, S., A Benchmark for Quantum Chemistry Relaxations via Machine Learning Interatomic Potentials, arXiv preprint arXiv:2506.23008v2 [q-bio.QM], 2025.
22. Ferji, K., Basic concepts and tools of artificial intelligence in polymer science, Polymer Chemistry, 16, 2457, 2025. doi: 10.1039/D5PY00148J
23. Yang, Z., Xie, J., Shen, S., Wang, D., Chen, Y., Gao, B., Sun, S., Qi, B., Zhou, D., Bai, L., Chen, L., Zhang, S., Jiang, J., Fu, T., Li, Y., SpectrumWorld: Artificial Intelligence Foundation for Spectroscopy, CoRR, abs/2508.01188, 2025. https://doi.org/10.48550/arXiv.2508.01188
24. Chung, Y., Green, W. H., Machine learning from quantum chemistry to predict experimental solvent effects on reaction rates, Chemical Science, 15, 2410, 2024. doi: 10.1039/d3sc05353a
25. Liu, B., Ramsundar, B., Kawthekar, P., Shi, J., Gomes, J., Nguyen, Q. L., Ho, S., Sloane, J., Wender, P., Pande, V., Retrosynthetic Reaction Prediction Using Neural Sequence-to-Sequence Models, ACS Central Science, 3, 1103, 2017. doi: 10.1021/acscentsci.7b00303

26. Jiang, X., Wang, W., Tian, S. *et al.* Applications of natural language processing and large language models in materials discovery. *npj Comput Mater* 11, 79 (2025). https://doi.org/10.1038/s41524-025-01554-0

27. Oviedo, F., Ferres, J. L., Buonassisi, T., Butler, K. T., Interpretable and Explainable Machine Learning for Materials Science and Chemistry, Accounts of Materials Research, 3, 597, 2022. https://doi.org/10.1021/accountsmr.1c00244

28. Ishida, S., Terayama, K., Kojima, R., Takasu, K., Okuno, Y., AI-Driven Synthetic Route Design Incorporated with Retrosynthesis Knowledge, Journal of Chemical Information and Modeling, 62, 1357, 2022Ishida, S., Terayama, K., Kojima, R., Takasu, K., Okuno, Y., AI-Driven Synthetic Route Design Incorporated with Retrosynthesis Knowledge, Journal of Chemical Information and Modeling, 62, 1357, 2022.. https://doi.org/10.1021/acs.jcim.1c01074

29. He, J., Nguyen, D. Q., Akhondi, S. A., Druckenbrodt, C., Thorne, C., Hoessel, R., Zhai, Z., Fang, B., Yoshikawa, H., Albahem, A., Cavedon, L., Cohn, T., Baldwin, T., Verspoor, K., ChEMU 2020: Natural Language Processing Methods Are Effective for Information Extraction From Chemical Patents, Frontiers in Research Metrics and Analytics, 6, 654438, 2021.https://doi.org/10.3389/frma.2021.654438

30. Martinez KM, Wilding K, Llewellyn TR, Jacobsen DE, Montoya MM, Kubicek-Sutherland JZ, Batni S, Manore C, Mukundan H. Evaluating the factors influencing accuracy, interpretability, and reproducibility in the use of machine learning classifiers in biology to enable standardization. Sci Rep. 2025 May 13;15(1):16651. doi: 10.1038/s41598-025-00245-6

31. Jiang, Y., Yu, Y., Kong, M., Mei, Y., Yuan, L., Huang, Z., Kuang, K., Wang, Z., Yao, H., Zou, J., Coley, C. W., Wei, Y., Artificial Intelligence for Retrosynthesis Prediction, Engineering, 25, 32, 2023.Jiang, Y., Yu, Y., Kong, M., Mei, Y., Yuan, L., Huang, Z., Kuang, K., Wang, Z., Yao, H., Zou, J., Coley, C. W., Wei, Y., Artificial Intelligence for Retrosynthesis Prediction, Engineering, 25, 32, 2023. https://doi.org/10.1016/j.eng.2022.04.02

32. Corradi M, Luechtefeld T, de Haan AM, Pieters R, Freedman JH, Vanhaecke T, Vinken M, Teunis M. The application of natural language processing for the extraction of mechanistic information in toxicology. Front Toxicol. 2024 May 10;6:1393662. doi: 10.3389/ftox.2024.1393662

33. Kim D, Choi J. Big data and AI: Potential and challenges for digital transformation in toxicology. Environ Anal Health Toxicol. 2025 Sep;40(Special Issue):e2025s07-0. doi: 10.5620/eaht.2025s07

34. Withers, C. A., Rufai, A. M., Venkatesan, A., Tirunagari, S., Lobentanzer, S., Harrison, M., & Zdrazil, B. (2025). Natural language processing in drug discovery: bridging the gap between text and therapeutics with artificial intelligence. *Expert Opinion on Drug Discovery*, *20*(6), 765–783. https://doi.org/10.1080/17460441.2025.2490835

35. Rial, R. C., et al., AI in analytical chemistry: Advancements, challenges, and future directions, Talanta, 274, 125949, 2024. https://doi.org/10.1016/j.talanta.2024.125949

36. Wang, Y., Pang, C., Wang, Y. *et al.* Retrosynthesis prediction with an interpretable deep-learning framework based on molecular assembly tasks. *Nat Commun* **14**, 6155 (2023). https://doi.org/10.1038/s41467-023-41698-5

37. Shetty, P., et al., Automated knowledge extraction from polymer literature using natural language processing, iScience, 24, 101922, 2021. https://doi.org/10.1016/j.isci.2020.101922

38. Schilling-Wilhelmi, M., Ríos-García, M., Shabih, S., Gil, M. V., Miret, S., Koch, C. T., Márquez, J. A., Jablonka, K. M., From text to insight: large language models for chemical data extraction, Chemical Society Reviews, 54, 1125, 2025. doi: 10.1039/D4CS00913D

39. Wirz, C. D., Sutter, C., Demuth, J. L., Mayer, K. J., Chapman, W. E., Cains, M. G., et al. (2024). Increasing the reproducibility and replicability of supervised AI/ML in the Earth systems science by leveraging social science methods. *Earth and Space Science*, 11, e2023EA003364. https://doi.org/10.1029/2023EA003364

40. Corradi, M., Luechtefeld, T., de Haan, A. M., Pieters, R., Freedman, J. H., Vanhaecke, T., Vinken, M., Teunis, M., The application of natural language processing for the extraction of mechanistic information in toxicology, Frontiers in Toxicology, 6, 1393662, 2024.https://doi.org/10.3389/ftox.2024.1393662

41. Chen, J., Xu, Q., Artificial intelligence-driven autonomous laboratory for accelerating chemical discovery, Chemical Synthesis, 5, 76, 2025.

42. Zivic, F., Malisic, A. K., Grujovic, N., Stojanovic, B., Ivanovic, M., Materials informatics: A review of AI and machine learning tools, platforms, data repositories, and applications to architectured porous materials, Materials Today Communications, 48, 113525, 2025. https://doi.org/10.1016/j.mtcomm.2025.113525

43. Ramos MC, Collison CJ, White AD. A review of large language models and autonomous agents in chemistry. Chem Sci. 2024 Dec 9;16(6):2514-2572. doi: 10.1039/d4sc03921a

44. Song, T., Luo, M., Zhang, X., Chen, L., Huang, Y., Cao, J., Zhu, Q., Liu, D., Zhang, B., Zou, G., Zhang, G., Zhang, F., Shang, W., Fu, Y., Jiang, J., Luo, Y., A Multiagent-Driven Robotic AI Chemist Enabling Autonomous Chemical Research On Demand, Journal of the American Chemical Society, 147, 12534, 2025. https://doi.org/10.1021/jacs.4c17738

45. Karthikeyan A, Priyakumar UD. Artificial intelligence: machine learning for chemical sciences. J Chem Sci (Bangalore). 2022;134(1):2. doi: 10.1007/s12039-021-01995-2.

46. Lu, J.-M., Automated Intelligent Platforms for High-Throughput Chemical Synthesis, Artificial Intelligence Chemistry, 2, 100057, 2024. https://doi.org/10.1016/j.aichem.2024.100057

47. Houhou R, Bocklitz T. Trends in artificial intelligence, machine learning, and chemometrics applied to chemical data. Anal Sci Adv. 2021 Feb 2;2(3-4):128-141. doi: 10.1002/ansa.202000162.

48. Li, J., Ding, C., Liu, D., Chen, L., Jiang, J., Autonomous laboratories in China: an embodied intelligence-driven platform to accelerate chemical discovery, Digital Discovery, 4, 1672, 2025. doi: 10.1039/D5DD00072F

49. George, J., Hautier, G., Chemist versus Machine: Traditional Knowledge versus Machine Learning Techniques, Trends in Chemistry, 3, 86, 2021. https://doi.org/10.1016/j.trechm.2020.10.007

50. Ali RSAE, Meng J, Jiang X. Synergy of Machine Learning and High-Throughput Experimentation: A Road Toward Autonomous Synthesis. Chem Asian J. 2025 Oct;20(20):e00825. doi: 10.1002/asia.202500825

51. Ali RSAE, Meng J, Jiang X. Synergy of Machine Learning and High-Throughput Experimentation: A Road Toward Autonomous Synthesis. Chem Asian J. 2025 Oct;20(20):e00825. doi: 10.1002/asia.202500825

52. Choi, J., Lee, B. Accelerating materials language processing with large language models. *Commun Mater* **5**, 13 (2024). https://doi.org/10.1038/s43246-024-00449-9

53. Singh, N., Lane, S., Yu, T. *et al.* A generalized platform for artificial intelligence-powered autonomous enzyme engineering. *Nat Commun* **16**, 5648 (2025). https://doi.org/10.1038/s41467-025-61209-y

54. Xu, G., Jiang, M., Li, J., Xuan, X., Li, J., Lu, T., Pan, L., Machine learning-accelerated discovery and design of electrode materials and electrolytes for lithium ion batteries, Energy Storage Materials, 72, 103710, 2024. https://doi.org/10.1016/j.ensm.2024.103710

55. Bhat, A. R., Ahmed, S., Artificial intelligence (AI) in drug design and discovery: A comprehensive review, In Silico Research in Biomedicine, 1, 100049, 2025. https://doi.org/10.1016/j.insi.2025.100049

56. Baum, Z. J., Yu, X., Ayala, P. Y., Zhao, Y., Watkins, S. P., Zhou, Q., Artificial Intelligence in Chemistry: Current Trends and Future Directions, Journal of Chemical Information and Modeling, 61, 2932, 2021. https://doi.org/10.1021/acs.jcim.1c00619J

57. Meng K, Long R. A Universal Machine Learning Framework Driven by Artificial Intelligence for Ion Battery Cathode Material Design. JACS Au. 2025 Jul 23;5(8):3833-3845. doi: 10.1021/jacsau.5c00526

58. Hermann E, Hermann G, Tremblay JC. Ethical Artificial Intelligence in Chemical Research and Development: A Dual Advantage for Sustainability. Sci Eng Ethics. 2021 Jul 6;27(4):45. doi: 10.1007/s11948-021-00325-6

59. Wang Z, Zeier WG, You F. Toward AI ecosystems for electrolyte and interface engineering in solid-state batteries. Sci Adv. 2025 Nov 28;11(48):eaea0638. doi: 10.1126/sciadv.aea0638

60. Mennella C, Maniscalco U, De Pietro G, Esposito M. Ethical and regulatory challenges of AI technologies in healthcare: A narrative review. Heliyon. 2024 Feb 15;10(4):e26297. doi: 10.1016/j.heliyon.2024.e26297

61. Ng, M.-F., Sun, Y., Seh, Z. W., Machine learning-inspired battery material innovation, Energy Advances, 2, 449, 2023. DOI: 10.1039/D3YA00040K

ISSN 2394 - 7780

62. Huang, G., Huang, F., Dong, W., Machine learning in energy storage material discovery and performance prediction, Chemical Engineering Journal, 492, 152294, 2024. https://doi.org/10.1016/j.cej.2024.152294

63. Mohamed, M. E., Khodadadi, E., Ethical Challenges and Regulatory Compliance in AI-Driven Neurological Diagnostics: A Review of Standards and Practices, Metaheuristic Optimization Review, 4, 24, 2025. https://doi.org/10.54216/MOR.040203

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ARTIFICIAL INTELLIGENCE FOR SUSTAINABLE DEVELOPMENT IN INDIA: OPPORTUNITIES, GOVERNMENT INITIATIVES AND CHALLENGES

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ABSTRACT
Artificial intelligence (AI) holds transformative potential to accelerate India's journey toward achieving the United Nations Sustainable Development Goals (SDGs) by 2030, especially through strategic government-led initiatives in critical sectors like healthcare, agriculture, energy, and urban planning. In healthcare, AI-driven diagnostics and predictive analytics can bridge gaps in rural access, reducing maternal mortality (SDG 3) and enhancing epidemic response. Agriculture benefits from precision farming tools, such as satellite imagery and machine learning for crop yield optimization, bolstering food security (SDG 2) amid climate uncertainties. In energy, AI optimizes renewable grids and demand forecasting, advancing clean energy transitions (SDG 7). Urban planning leverages smart city technologies for efficient traffic management and disaster resilience, supporting sustainable cities (SDG 11). India's government initiatives, including the National AI Strategy and AI for All mission, exemplify this momentum, fostering public-private partnerships and data sovereignty. Pilot projects like AI-powered telemedicine in Assam and crop advisory systems in Maharashtra demonstrate scalable impacts, potentially lifting millions from poverty (SDG 1) and promoting gender equality (SDG 5) via inclusive tech access. Yet, challenges persist: ethical dilemmas like algorithmic bias, infrastructural deficits in digital connectivity, and equity risks exacerbating urban-rural divides. Deliberate governance through robust data privacy laws, ethical AI frameworks like the IndiaAI Mission, and inclusive skilling programs can mitigate these. By prioritizing equitable AI deployment, India can harness its demographic dividend and tech ecosystem to unlock inclusive growth, positioning itself as a global leader in responsible AI for sustainable development.

Keywords: Artificial intelligence (AI), Sustainable Development, Government Initiatives, SDG's.

INTRODUCTION
India faces complex challenges in achieving the 17 SDGs by 2030, including poverty alleviation, food security, climate resilience and equitable healthcare access. AI emerges as a powerful enabler, optimizing resources and enabling data-driven decisions across sectors vulnerable to population pressures and urbanization. Government programs like the IndiaAI Mission exemplify this strategic integration, aiming for AI autonomy while prioritizing societal needs. The National Strategy for Artificial Intelligence, spearheaded by NITI Aayog, adopts a "Human-Centric AI" approach, focusing on proof-of-concept projects in agriculture and healthcare to build a vibrant ecosystem. This paper analyzes AI's role in SDGs, highlights key initiatives, explores sector-specific applications, addresses obstacles, and proposes pathways for responsible deployment.

LITERATURE REVIEW
Existing literature highlights AI's transformative role in advancing India's SDGs, with studies emphasizing applications in agriculture, healthcare, energy, and urban planning. Scholarly works like those from NITI Aayog (2018) outline human-centric AI strategies for crop yield prediction and telemedicine, while Vinuesa et al. (2020) categorize AI impacts across societal, economic, and environmental pillars, noting benefits like climate modeling and risks such as energy-intensive data centers. Recent analyses, including Behera et al. (2025), demonstrate AI-driven green innovations reducing emissions via renewable energy optimization. Bibliometric trends reveal surging publications on AI-SDG linkages post-2020, with government reports like AI for Viksit Bharat (2025) stressing public-private partnerships for inclusive growth. Challenges identified include algorithmic bias, infrastructure deficits, and ethical governance gaps, as discussed in Atlantic Council (2025). Vinuesa et al. (2020) systematically assess AI's role in the 2030 Agenda, finding it enables 128 targets across all 17 SDGs—such as climate modeling and resource optimization while potentially inhibiting 58 due to risks like inequality exacerbation and energy demands from data centers. Bibliometric analyses confirm surging AI-SDG publications post-2020, with exponential growth since 2015, led by regions including India, focusing on SDGs 3 (health), 7 (energy), and 13 (climate). In India, Singh (2024) maps these trends, noting AI's prominence in precision medicine, solar integration, and sustainable urban planning amid diversifying research trajectories. Behera et al. (2025) demonstrate AI's contributions to India's renewable energy transition, using dynamic ARDL models on 1987–2020 data to show AI and green tech innovations moderating emissions reductions via optimized energy generation aligned with SDGs. Complementary studies highlight AI for glacial melt prediction, grid stability, and net-zero goals by 2070, positioning India as a leader in climate-resilient

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applications. These innovations underscore AI's dual role in boosting productivity while curbing environmental impacts through predictive analytics.

RESEARCH GAP

Few studies conduct longitudinal impact assessments of India's AI initiatives like India AI Mission on specific SDGs, particularly equity outcomes for rural and marginalized groups. Limited empirical data exists on AI's environmental footprint in India's context, such as data center sustainability amid water scarcity. The study focuses on the impact of AI on key sectors of sustainable development goals in india.

OBJECTIVES:

1. To identify the opportunities, government initiatives and challenges of Artificial Intelligence for sustainable development of India.

GOVERNMENT INITIATIVES DRIVING AI ADOPTION

1. India's government has launched flagship programs to embed AI in sustainable development. The IndiaAI Mission, initiated in 2023 by the Ministry of Electronics and Information Technology (MeitY), invests in AI compute infrastructure, datasets, and skilling to tackle challenges in healthcare, agriculture, and smart cities.
2. Complementing this, the AI for India 2030 blueprint, co-hosted by MeitY, NITI Aayog, Nasscom, and the World Economic Forum's C4IR India, promotes ethical AI for inclusive growth. It fosters public-private partnerships to scale solutions in education, health, and climate action, positioning India as a global AI leader by 2030.
3. NITI Aayog's efforts include exploratory projects like AI-based crop yield prediction and healthcare diagnostics, emphasizing open-source models for accessibility. These initiatives align AI with SDGs, ensuring technology serves underserved populations rather than exacerbating divides.

AI APPLICATIONS ACROSS KEY SECTORS

1. Agriculture (SDG 2: Zero Hunger)

Precision farming leverages AI for soil health monitoring, pest detection, and yield forecasting. Initiatives like the AI-powered Kisan e-Mitra chatbot provide farmers with real-time advice on weather, markets, and irrigation, boosting productivity by 20-30% in pilot regions. Drones and satellite imagery enable efficient fertilizer use, cutting waste and emissions.

2. Healthcare (SDG 3: Good Health and Well-Being)

AI enhances telemedicine and diagnostics, expanding access in rural India. Government-backed platforms use machine learning for early disease detection, such as tuberculosis screening via chest X-rays, reducing mortality rates. Precision medicine tools analyze genomic data to personalize treatments, optimizing resource allocation in public hospitals.

3. Energy and Climate Action (SDG 7 and 13)

AI optimizes renewable energy grids by predicting demand and integrating solar or wind sources. In climate modeling, machine learning forecasts monsoons and disasters, aiding resilient infrastructure. Waste management systems employ AI for sorting recyclables, supporting circular economies and reducing landfill impacts.

4. Urban Planning (SDG 11: Sustainable Cities)

Smart city projects deploy AIoT for traffic management, reducing congestion by up to 25 percent. Predictive analytics for water distribution minimizes leaks, while urban heat mapping informs green space planning. These tools, integrated into 100 Smart Cities Mission, promote livable, low-carbon urban environments.

TRANSFORMATIVE POTENTIAL

1. AI accelerates SDG progress by processing vast datasets for actionable insights. In agriculture, AI-driven apps have reached millions of farmers, increasing incomes and food security. Healthcare AI has screened over 10 million for COVID-19, demonstrating scalability.
2. Bibliometric analyses show rising publications on AI-SDG linkages in India, with agriculture and health leading. Globally, AI could add $15.7 trillion to economies by 2030, with India poised for $500 billion through sustainable applications.
3. Public-sector leadership differentiates India's model, prioritizing societal challenges over commercial gains, unlike private-led approaches elsewhere. This ensures equitable deployment, vital for a nation of 1.4 billion.

MAJOR CHALLENGES AND CONCERNS:

1. Despite promise, AI adoption faces hurdles. Infrastructure gaps, including unreliable electricity and internet in rural areas, limit reach. Skill shortages affect 70 percent of the workforce, necessitating massive upskilling.
2. Algorithmic bias risks deepening inequalities; datasets often underrepresent marginalized groups, skewing outcomes in lending or hiring. Data privacy lacks robust frameworks, raising surveillance fears.
3. Governance lags behind rapid innovation. Without standards for transparency and accountability, AI could entrench corruption or displace jobs. India's uneven digital divide amplifies these risks, demanding inclusive policies.
4. Environmental costs of AI, like data center energy demands, contradict sustainability goals. High water usage for cooling poses challenges in water-stressed regions.

STRATEGIES FOR RESPONSIBLE GOVERNANCE

1. Addressing obstacles requires multi-stakeholder frameworks. India must enforce ethical AI guidelines, mandating bias audits and diverse training data. Expanding digital infrastructure via BharatNet can bridge urban-rural gaps.
2. Public-private collaborations, as in AI for India 2030, should prioritize open-source tools for affordability. International partnerships enable knowledge transfer, aligning with South-South cooperation.
3. Invest in human capital through programs like FutureSkills PRIME, training 1 million in AI by 2026. Impact assessments for AI projects ensure SDG alignment and equitable benefits.
4. Regulatory sandboxes test innovations safely, while global forums like the India AI Impact Summit 2026 shape standards.

CASE STUDIES OF IMPACT

1. Agriculture's CropIn platform, supported by government, uses AI for 2 million farmers, optimizing inputs and yields amid climate variability.
2. In healthcare, the AI4Bharat initiative develops vernacular language models for diagnostics, serving non-English speakers. Pilots report 90 percent accuracy in rural screenings.
3. Urban Pune's AI traffic system reduced commute times by 18 percent, exemplifying SDG 11 progress. These cases prove AI's viability when scaled responsibly.

FUTURE DIRECTIONS FOR POLICY MAKING:

1. India aims for top-three AI prowess by 2030, integrating AI into Viksit Bharat@2047. Compute sovereignty via indigenous GPUs and datasets is key.
2. Policies should incentivize green AI, like energy-efficient models. Longitudinal studies track SDG impacts, informing adaptive strategies.
3. Broadening participation women, tribals, SMEs ensures inclusivity. Global leadership in AI ethics can export India's model to the Global South.

CONCLUSION

Artificial Intelligence (AI) holds immense potential to propel India's sustainable development, as evidenced by government initiatives transforming healthcare, agriculture, and cities. Overcoming ethical, infrastructural, and equity barriers through vigilant governance will realize this vision, fostering a resilient, prosperous future.

REFERENCES

1. Challa, (2025). Artificial Intelligence (AI) for Achieving SDGs. International Journal of Research in Social Sciences and Humanities. 15. 94-100.
2. Kulkov, Ignat & Kulkova, Julia & Rohrbeck, René & Menvielle, Loick & Kaartemo, Valtteri & Makkonen, Hannu. (2023). Artificial intelligence - driven sustainable development: Examining organizational, technical, and processing approaches to achieving global goals. Sustainable Development. 32. 2253-2267. 10.1002/sd.2773.
3. Leal Filho, W., Yang, P., Eustachio, J. H. P. P., Azul, A. M., Gellers, J. C., Gielczyk, A., Dinis, M. A. P., & Kozlova, V. (2023). Deploying digitalisation and artificial intelligence in sustainable development research. *Environment, development and sustainability*, *25*(6), 4957–4988.

ISSN 2394 - 7780

4. Musa, M., Rahman, T., Deb, N., & Rahman, P. (2025). Harnessing artificial intelligence for sustainable urban development: advancing the three Zeros method through innovation and infrastructure. *Scientific reports*, *15*(1), 23673.
5. Narsareddygari, S., & Naik, S. M. (2025). Harnessing AI for Progressive and Sustainable Education in the 21st Century: Case Studies and Insights. *Journal of Engineering Education Transformations*, *38*, 159–165
6. NITI Aayog. (2018). National strategy for artificial intelligence. https://www.niti.gov.in/sites/default/files/2023-03/National-Strategy-for-Artificial-Intelligence.pdf
7. NITI Aayog. (2025). AI for Viksit Bharat: The opportunity for accelerated economic growth. https://niti.gov.in/sites/default/files/2025-09/AI-for-Viksit-Bharat-the-opportunity-for-accelerated-economic-growth.pdf
8. World Economic Forum. (2026, January 5). Why AI for India 2030 is a blueprint for inclusive growth and global leadership. https://www.weforum.org/stories/2025/01/ai-for-india-2030-blueprint-inclusive-growth-global-leadership/

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ROLE OF CHATBOTS IN DIGITAL BANKING: A STUDY OF CUSTOMER AWARENESS AND PERCEPTION WITH SPECIAL REFERENCE TO PUNE CITY

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ABSTRACT
The rapid advancement of Artificial Intelligence (AI) has significantly transformed the digital banking landscape, particularly through the adoption of AI-powered chatbots. Chatbots are increasingly used by banks to provide instant customer support, enhance service efficiency, and reduce operational costs. Despite their widespread implementation, customer awareness and perception towards chatbot-based banking services play a crucial role in determining their acceptance and effectiveness. This study aims to examine the level of customer awareness and perception regarding chatbots in digital banking services in India. The study is empirical in nature and is based on primary data collected from 189 digital banking users through a structured Likert-scale questionnaire. Descriptive statistics, One-Sample t-Test, and Chi-Square Test were employed using SPSS software to analyze the data and test the hypotheses. The findings reveal that customers have a significant level of awareness regarding chatbot services and generally exhibit a positive perception towards their usefulness, convenience, and efficiency. However, concerns related to trust, data security, and lack of human interaction remain challenges. The study concludes that while chatbots play a vital role in enhancing digital banking services, banks must focus on improving customer awareness, transparency, and ethical AI practices to ensure sustainable adoption.

Keywords: *Chatbots, Digital Banking, Artificial Intelligence, Customer Awareness, Customer Perception*

1. INTRODUCTION
The Indian banking sector has witnessed remarkable digital transformation over the past decade, driven by technological advancements, increasing internet penetration, and changing customer expectations. Digital banking services such as mobile banking, internet banking, Unified Payments Interface (UPI), and fintech innovations have reshaped traditional banking operations. Among these technological advancements, Artificial Intelligence (AI) has emerged as a powerful tool in improving customer engagement and operational efficiency.

Chatbots, a prominent application of AI, are computer programs designed to simulate human conversation using natural language processing (NLP) and machine learning algorithms. In digital banking, chatbots assist customers by answering queries, providing account-related information, facilitating transactions, registering complaints, and offering personalized financial advice. Leading Indian banks such as State Bank of India (SBI), ICICI Bank, HDFC Bank, and Axis Bank have deployed chatbot services like SIA, iPal, EVA, and Aha to enhance customer service delivery.

The growing adoption of chatbots is primarily attributed to their ability to offer 24×7 services, reduce waiting time, and lower operational costs. However, the effectiveness of chatbots largely depends on customer awareness and perception. Customers who are well-informed about chatbot functionalities are more likely to use and trust them, whereas lack of awareness or negative perception can hinder adoption.

In this context, understanding customer awareness and perception towards chatbots in digital banking becomes crucial. This study attempts to analyze these aspects empirically, focusing on Indian digital banking users.

2. LITERATURE REVIEW
Several researchers have examined the role of AI and chatbots in banking and financial services.

Sharma and Gupta (2021) observed that AI-based chatbots significantly enhance customer satisfaction by providing quick responses and consistent service quality. The study emphasized that ease of use and accessibility are key determinants of chatbot acceptance.

Kumar and Singh (2022) analyzed customer perception towards chatbot services in Indian banks and found that customers appreciated the convenience and speed of chatbot services. However, concerns regarding privacy, data security, and limited emotional intelligence were highlighted as major challenges.

Dwivedi et al. (2021) explored the adoption of AI technologies in financial services and concluded that trust, perceived usefulness, and transparency are critical factors influencing customer acceptance of chatbots.

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According to a report by the Reserve Bank of India (2023), AI-driven customer service tools, including chatbots, are becoming integral to digital banking strategies. The report stressed the importance of ethical AI frameworks and robust data protection mechanisms.

While existing literature provides valuable insights into chatbot adoption and benefits, limited empirical studies focus simultaneously on customer awareness and perception using statistical hypothesis testing in the Indian digital banking context. This study aims to bridge this research gap.

3. OBJECTIVES OF THE STUDY

The present study has the following objectives:

1. To study the level of customer awareness regarding chatbot services in digital banking.
2. To analyze customer perception towards chatbots in digital banking services.
3. To examine the association between customer awareness and perception of chatbots.
4. To provide suggestions for improving chatbot adoption and effectiveness in digital banking.

4. HYPOTHESES OF THE STUDY

Based on the objectives, the following hypotheses were framed:

H_{01}: Customers do not have a significant level of awareness regarding chatbot services in digital banking.

H_{02}: There is no significant association between customer awareness and perception of chatbots in digital banking.

5. RESEARCH METHODOLOGY

It adopts a descriptive and analytical research design, since it concentrates on the quantitative analysis of primary data and the sample size is 189 based on convenience sampling method.

Target Population: Clients banking online with Indian public and private sector banks. It states that a sample size of 189 considered statistically sufficient for the research and testing hypothesis. The primary data were collected by using a structured questionnaire on 5-point Likert scale which includes their opinion about chatbot services. A summary of the descriptive statistics was employed. The level of awareness was measured using One-Sample t-Test, whereas the relationship between customer awareness and perception of chatbot services in digital banking was examined through Chi-square Test. $P < 0.05$ was considered significant.

6. DATA ANALYSIS AND TEST OF HYPOTHESES

6.1. Descriptive Analysis

Descriptive statistics were employed to summarize and present the responses collected from 189 digital banking customers regarding their awareness and perception of chatbot services in digital banking. Descriptive analysis helps in understanding the central tendency, variability, and overall response pattern of the data before applying inferential statistical tests.

Table 01: Descriptive Statistics

Variable	N	Mean	Std. Deviation	Minimum	Maximum
Awareness	189	3.87	0.61	2.10	4.90
Perception	189	3.92	0.58	2.30	4.80

The above table reveals that the mean of customers' chatbot service awareness scores is 3.87, which rate for customer knowledge regarding chatbot services significantly exceeded beyond (neutral value) due to level three Likert scale points. It indicates that customers have a relatively high level of awareness in chatbot use when it comes to the digital banking service. With a standard deviation of 0.61, it reveals moderate level of consistency among opinions, such that most customers have similar perceptions on their knowledge level about chatbots. Abstract The average perception of chatbot services for customers is 3.92, similarly above the neutral midpoint. This indicates a positive customer attitude toward banking through chatbot in general. standard deviation of 0.58 indicates that there is not a high degree of dispersion, if any as to say, in the responses about the efficiency and effectiveness of chatbots; customers agree mostly on this point.

6.2. Test of Hypotheses

The present study is based on primary data collected from 189 digital banking customers. Statistical analysis was carried out using SPSS software, and the level of significance was fixed at 5% ($\alpha = 0.05$).

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6.2.1. One-Sample t-Test

The One-Sample t-Test is used to examine whether the sample mean differs significantly from a specified test value. In this study, it is applied to test whether customers have a significant level of awareness regarding chatbot services in digital banking.

Hypothesis

- **H_0:** Customers do not have a significant level of awareness regarding chatbot services in digital banking.
- **H_1:** Customers have a significant level of awareness regarding chatbot services in digital banking.

Test Value

Since awareness is measured using a 5-point Likert scale, the neutral value 3 is considered as the test value.

Table 2: One-Sample Statistics

Variable	N	Mean	Std. Deviation	Std. Error Mean
Awareness	189	3.87	0.61	0.044

Table 3: One-Sample t-Test

Test Value = 3

Variable	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval
Awareness	19.77	188	0.000	0.87	0.78 – 0.96

Calculation of One-Sample t-Test

Formula

$$t = \frac{\bar{X} - \mu}{\frac{s}{\sqrt{n}}}$$

Where:

- $\bar{X}$= Sample Mean = **3.87**
- μ= Test Value = **3**
- s= Standard Deviation = **0.61**
- n= Sample Size = **189**

CALCULATION

$$t = \frac{3.87 - 3}{0.61/\sqrt{189}}$$
$$t = \frac{0.87}{0.044}$$
$$t = 19.77$$

therefore, the p-value = 0.000 < 0.05 Hence, Null Hypothesis (H_{01}) is rejected**.** The One-Sample t-Test result indicates that customers have a statistically significant level of awareness regarding chatbot services in digital banking. The mean awareness score is significantly higher than the neutral value, confirming that customers are well aware of chatbot-based banking services.

6.2.2. Chi-Square Test

The Chi-Square Test is used to examine whether there is a significant association between two categorical variables. In this study, it is applied to test the association between Customer Awareness Level and Customer Perception towards chatbots.

Hypothesis

- **H_{02}:** There is no significant association between customer awareness and perception of chatbots in digital banking.
- **H_{12}:** There is a significant association between customer awareness and perception of chatbots in digital banking.

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Categorization of Variables

Variable	Categories
Awareness Level	Low, Medium, High
Perception Level	Negative, Neutral, Positive

Table 4: Case Processing Summary

Case Processing Summary						
	Cases					
	Valid		Missing		Total	
	N	Percent	N	Percent	N	Percent
Awareness * Perception	189	100.0%	0	0.0%	189	100.0%

The Case Processing Summary reveals the total number of responses collected for the study (189) were completely valid. No responses were missing for awareness or perception variables. It will imply that 100% of the data could be employed for analysis, and trustful results, and precision would be obtained. As no cases had to be left out, the results of the analysis and crosstabulation (chi-square) refer to all participants that have been examined and users can conclude with relatively high reliability and validity

Table 5: Awareness v/s Perception Crosstabulation

Awareness * Perception Crosstabulation						
			Perception			
			1	2	3	Total
Awareness	1	Count	18	12	6	36
		Expected Count	6.1	12.6	17.3	36.0
	2	Count	10	34	45	89
		Expected Count	15.1	31.1	42.9	89.0
	3	Count	4	20	40	64
		Expected Count	10.8	22.3	30.8	64.0
Total		Count	32	66	91	189
		Expected Count	32.0	66.0	91.0	189.0

Table 6: Chi-Square Tests

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	40.072[a]	4	.000
Likelihood Ratio	35.901	4	.000
Linear-by-Linear Association	28.906	1	.000
N of Valid Cases	189		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 6.10.			

The Chi-Square test results reveal a compelling link between customers' awareness of chatbot services and their overall perceptions in digital banking. With a Pearson Chi-Square value of 40.072 (df = 4) and a p-value of 0.000 far below the 0.05 threshold the evidence points to a genuine relationship, not random variation.

This conclusion holds firm under the Likelihood Ratio test, which reinforces the association's robustness. Even more tellingly, the Linear-by-Linear Association highlights a clear pattern: as awareness rises, so does positive perception of chatbots, suggesting a logical progression in customer attitudes.

Crucially, the test satisfies key assumptions, with no expected cell frequencies dipping below 5 (the lowest at 6.10). These reliable findings underscore how boosting awareness could meaningfully shape favourable views of chatbot-driven banking experiences.

We applied the standard decision rule for hypothesis testing: if the p-value falls below the significance level of 0.05, we reject the null hypothesis (H_{02}). Here, the p-value of 0.000 is substantially lower than 0.05, leading us to confidently reject H_{02}. The Chi-Square test result indicates a statistically significant association between customer awareness and perception towards chatbots in digital banking. Customers with higher awareness levels tend to exhibit a more positive perception of chatbot services.

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7. FINDINGS OF THE STUDY

1. Customers using digital banking services have a significant level of awareness about chatbot-based banking services.
2. Overall customer perception towards chatbots is positive, particularly in terms of convenience, speed, and availability.
3. There is a significant association between customer awareness and perception towards chatbots.
4. Despite positive perception, concerns related to data security and lack of human interaction persist.

9. CONCLUSION

Chatbots are reshaping digital banking as a key AI innovation, making customer interactions faster and more personal. This study finds that awareness of these services is growing, with most customers rating them as practical and effective. Our statistical analysis, including highly significant Chi-Square results ($p = 0.000$), proves awareness strongly shapes positive perceptions far beyond mere coincidence.

That said, persistent concerns around trust, privacy, and AI ethics could undermine this progress. Banks should prioritize customer education drives, sharper chatbot performance, ironclad data safeguards, and principled AI deployment. Addressing these will transform chatbots from novelties into reliable pillars of enhanced experiences and enduring digital banking success.

REFERENCES

Dwivedi, Y. K., Hughes, L., Ismagilova, E., Aarts, G., Coombs, C., Crick, T., … Williams, M. D. (2021). Artificial intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research. *International Journal of Information Management, 57,* 101994. https://doi.org/10.1016/j.ijinfomgt.2019.08.002

Kumar, R., & Singh, S. (2022). Customer perception towards AI chatbots in banking services. *Journal of Banking and Finance Technology, 6*(2), 45–59.

Reserve Bank of India. (2023). *Report on digital banking in India*. RBI.

Sharma, P., & Gupta, R. (2021). Impact of artificial intelligence on customer satisfaction in the banking sector. *International Journal of Business Analytics, 8*(3), 1–15.

Xu, M., David, J. M., & Kim, S. H. (2018). The fourth industrial revolution: Opportunities and challenges. *International Journal of Financial Research, 9*(2), 90 95. https://doi.org/10.5430/ijfr.v9n2p90

Pillai, R., & Sivathanu, B. (2020). Adoption of artificial intelligence chatbots in Indian banking: An empirical investigation using technology acceptance model. *Journal of Financial Services Marketing, 25*(3–4), 125–138.

Sharma, S., & Sharma, M. (2023). Chatbots in Indian banking: Enhancing customer experience amid digital transformation. *International Journal of Bank Marketing, 41*(4), 789–807.

Singh, S., & Srivastava, P. (2022). Role of AI chatbots in financial inclusion: Evidence from emerging markets. *Journal of Financial Innovation, 8*(1), 22–39.

Trivedi, S., & Patel, R. (2024). Ethical challenges of AI chatbots in digital banking: A study of privacy and trust in India. *Global Business Review, 25*(2), 345–362.

Reserve Bank of India. (2023). *Report on digital banking in India*. https://www.rbi.org.in/Scripts/PublicationsView.aspx?id=21347

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THE IMPACT OF AI DRIVEN BUSINESS MODELS ON BUSINESS OPPORTUNITIES IN INDIA

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ABSTRACT
Business disruption happens when new products, services, or business models radically challenge and overthrow dominant market players, typically by targeting overlooked customer groups first. Unlike gradual enhancements, these disruptors focus on greater accessibility, lower costs, or superior ease, steadily winning over the broader market—as seen with Netflix dismantling Blockbuster through streaming or Uber revolutionizing taxis via mobile apps. (1)

Harvard professor Clayton Christensen popularized the concept, showing how newcomers redefine value propositions to undermine incumbents. In India, UPI-driven fintechs such as PhonePe shattered dependence on cash after demonetization. Thriving requires adaptability; slow adapters face extinction as habits evolve permanently.

Disruption occurs in business to drive innovation, efficiency, and customer-centric value. New entrants challenge stagnant incumbents by solving unmet needs—offering cheaper, faster, or more accessible alternatives. This forces adaptation, reallocates resources to high-impact areas, and accelerates progress. Without disruption, markets stagnate; with it, economies evolve.

Business disruption delivers profound global positives: accelerated innovation unlocks affordable tech like smartphones for billions; efficiency gains slash costs (Netflix streaming vs. DVD rentals); enhanced consumer access democratizes services (Uber for underserved riders); economic growth surges via new jobs in AI/cloud sectors; and sustainability advances through green models like electric vehicles. Ultimately, it propels humanity forward. (2)

Business disruption transforms India positively: UPI fintechs like PhonePe digitized 400M+ users post-demonetization, slashing cash dependency; e-commerce (Flipkart, Meesho) empowered 50M+ Tier 2/3 entrepreneurs; edtech (Byju's) democratized education for millions; quick commerce (Blinkit) created 2M jobs; green mobility (Ola Electric) cuts emissions. It fuels $500B digital economy growth.

The current research article attempts to study the several Business disruptions took place in traditional models and the impact of AI driven business models on business opportunities in global and Indian perspective.

Keywords: -Disruption, Fintech, Business Model, AI, EV

INTRODUCTION
Significance of AI-Driven Business Models in India

Economic Necessity: Legacy business approaches limit India's $3.7 trillion economy from achieving $10 trillion by 2035. AI promises $1.7 trillion GDP growth through enhanced productivity in manufacturing (25-40% cost savings), agriculture (30% yield gains), and services, according to official projections. Without transformation, India risks losing ground to China and the US in global AI dominance.

Employment Evolution: AI-centric models generate premium jobs (12.5 lakh AI specialists by 2027) while upskilling 490 million informal workers through multilingual voice platforms like Bhashini. Agentic AI elevates kirana shops and farmers from subsistence to scalable enterprises.

Competitive Edge: India's digital infrastructure (UPI, ONDC, Account Aggregator) powers localized AI agents, providing startups with disproportionate advantages. AI commerce and SMB intelligence platforms grow 10x faster than conventional SaaS, accessing markets traditional firms cannot penetrate.

Critical Sector Transformations are Fintech: Manual loans → AI behavioral underwriting (50% faster approvals), Retail: Sequential e-commerce → conversational Bharat commerce and Manufacturing: Outdated ERPs → predictive maintenance (30% less downtime)

Inclusive Development: Multilingual AI serves 80% non-English speakers, closing urban-rural divides. The ₹10,000 crore India AI Mission ensures broad-based prosperity rather than elite capture.

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Strategic Urgency: With 91% of enterprises scaling generative AI in 2026, non-adopters face 2-3x profit erosion. Swift disruption preserves India's demographic advantage before automation disrupts outsourcing and service sectors.

OBJECTIVES: -

1. To study the causes and common Disruptions of traditional business models
2. To assess the impact AI Driven Business Models from global and Indian perspective
3. To study the current and future trends of AI Driven Business Models on Business opportunities in India

LITERATURE REVIEW: -

1. Jorzik et al. (2024) systematically reviewed 180 scholarly papers examining AI's influence on business model innovation (BMI). The study reveals AI facilitates flexible reshaping of value propositions, revenue models, and customer interactions, opening fresh market possibilities in industries such as finance and manufacturing. Crucially, AI promotes data-centric adaptability, yielding competitive advantages through predictive analytics.
2. Figura (2025) investigates AI's effects on startups in banking, automotive, and retail sectors through the Business Model Canvas framework. AI-powered startups develop innovative models focused on customized value delivery, automated distribution channels, and expandable revenue streams—boosting opportunities 2-3x via operational efficiencies and access to previously overlooked markets.
3. RSI International's (2024) thorough analysis explores AI integration trends across finance, e-commerce, and healthcare. AI powers enduring business models through automation, tailored personalization, and forward-looking analytics, improving operational effectiveness and strategic choices. Findings show marked performance improvements, such as quicker market launches and better resource use for emerging prospects.
4. AI-Driven Business Model Innovation: Technology Meets Strategy (Mvn Nagalakshmi, 2024) Data from Indian industries demonstrates AI's pivotal influence on business model innovation (BMI). Primary insights show robust correlations between AI implementation and improvements in operational performance, customer interaction, and income stream variety, yielding strategic edges and fresh expansion pathways in diverse sectors.
5. A Study of Artificial Intelligence (AI) in Commerce (IJCRT, 2025) This study investigates AI uses in India's retail and e-commerce landscapes, emphasizing predictive analytics, tailored marketing, and IoT synergies. AI enables precise demand forecasting, dynamic pricing, and bespoke customer experiences, spurring growth prospects alongside expanding digital networks—while navigating challenges in infrastructure and skilled workforce availability.
6. Artificial Intelligence in Indian Businesses (IJIFR, 2025) This analysis probes AI's influence on productivity, jobs, and business frameworks in healthcare, retail, and manufacturing sectors. AI is projected to elevate India's GDP by $957B by 2030 through automation and chatbots, generating 9M new jobs while tackling ethical issues, thereby strengthening national economic edge.

7. **RESEARCH METHODOLOGY: -**

The current research article is based on secondary data collection Secondary: Literature from Scopus/Web of Science (keywords: "AI business model innovation"); company reports (e.g., PhonePe, Amazon AI metrics). A comprehensive review of 50+ peer-reviewed articles have been done for the current article. The research scholar has referred to online International and national reference books, Journals and Reports for this article.

Discussion: -AI-Driven Business Models Disrupting Traditional Ones

AI-powered business models prioritize data, automation, and intelligence from inception, fundamentally challenging linear, labour-intensive traditional approaches. These models leverage machine learning, generative AI, and multi-agent systems for speed, scale, precision, and personalization, compressing value chains and creating new revenue streams. systemintegration+1

AI-Driven Model	**Traditional Disruption**	**Examples & Impact systemintegration+1**
AI-as-a-Service (AIaaS)	Shifts from product sales to subscriptions; replaces manual services with plug-and-play	Amazon Bedrock, OpenAI APIs; 80% cost cuts in customer support.

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AI-Driven Model	Traditional Disruption	Examples & Impact systemintegration+1
	AI.	
Hyper-Personalization Platforms	Moves from mass marketing to real-time tailoring; erodes one-size-fits-all retail.	Netflix/Amazon recommendations; 35% higher conversion rates.
Intelligent Automation Ecosystems	Automates routine tasks (e.g., inventory, invoicing); disrupts outsourcing firms.	UiPath, manufacturing robotics; 50% operational efficiency gains.
Data Monetization & Outcome-Based	Sells insights/algorithms vs. time/materials; focuses on results over hours.	Predictive maintenance SaaS; ROI in months vs. years.
Multi-Agent AI Workflows	Orchestrates end-to-end processes autonomously; replaces siloed departments.	Telstra AI agents; 80% faster customer resolution by 2028.}

(Table No-1 - AI-driven Business Models Disrupting Traditional Ones Across Globe)

AI Model in India	Traditional Disruption	Key Examples & 2026 Impact
AI Agents for Execution	Replaces manual workflows in BFSI/ops;	Gnani.ai, Navana AI (Bajaj Finance); 50% higher conversions, enterprise embedding.
Personalized Finance	Ends bucket-based lending; uses behavioural data for credit/rewards.	PhonePe, Paytm AI lending; acquisition costs ↓, LTV ↑.
Bharat-Focused Commerce	Dismantles e-commerce funnel for non-linear journeys in Tier 2/3 cities.	Quick commerce with AI demand signals; 35% revenue lift.
SMB Intelligence	Automates decisions for 50M+ MSMEs (ERPs, CRMs).	Quick commerce with AI demand signals; 35% revenue lift. Neysa, AI-first SMB tools; structural upgrades vs. manual ops.
Voice/Multilingual AI	Disrupts call centres, sales; 24/7 contextual agents.	Arrowhead (50% conversion ↑); BFSI inflection point.

AI-driven Business Models Disrupting Traditional Ones in India

(Table No-2)

Key Sectors Experiencing AI-Driven Disruption in India (2026)

India's AI adoption accelerates across high-value sectors, with BFSI, manufacturing, and healthcare leading due to mature digital infrastructure and regulatory support. Agentic AI and multilingual models drive 25-50% efficiency gains, transforming traditional operations.

Sector	Key AI Applications	Disruption Impact
BFSI/Fintech	Fraud detection, AI lending, chatbots (80% deployment)	50% faster loan disbursals; 35% customer service cost reduction
Manufacturing	Predictive maintenance, quality control, robotics	30-40% downtime cuts; Industry 4.0 transition
Healthcare	Diagnostics, telemedicine, patient monitoring	23% CAGR sector growth; error reduction 30%
Logistics	Route optimization, demand forecasting	Fuel costs ↓25%; delivery timelines improved

(Table No.3 AI Disruption sectors in India)

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10 Famous Business Disruptions in India: -

Here are 10 landmark disruptions that transformed Indian business landscapes, creating new markets while challenging incumbents:

1. UPI Digital Payments - Replaced cash + cards; PhonePe/Paytm captured 80% transactions from traditional banking networks.
2. Jio Telecom Revolution - Free data destroyed incumbent telcos (Airtel/Vodafone); 400M users acquired in 6 months.
3. Quick Commerce (Blinkit/Zepto) - 10-minute delivery killed Swiggy/Instamart's 30-min model; kirana stores disrupted.
4. Ola/Uber Ride-hailing - Ended taxi + auto meter pricing; GPS + surge pricing created ₹50K Cr mobility market.
5. Flipkart/Amazon E-commerce - Physical retail erosion; 500M online shoppers vs traditional bazaars.
6. Paytm Digital Wallet - Demonetization accelerator; replaced cash for small transactions across unbanked India.
7. BYJU'S Edtech - Offline coaching (FIITJEE) → app-based learning; ₹10K Cr valuation peak.
8. Zomato Food Delivery - Dhabas + restaurants forced into aggregator model; dine-in revenue declined 30%.
9. Nykaa Beauty Retail - Disrupted multi-brand outlets; omnichannel model captured premium beauty market.
10. BigBasket Grocery - Traditional sabzi mandis + kiranas lost 20% urban market share to online slotted delivery.

Positive Impacts of Business Disruptions in India

1.Job Creation: Digital disruptions (UPI, e-commerce) created 50M+ jobs in delivery, tech support, and digital services.

2.Consumer Choice: Ride-hailing, OTT platforms offer 10x variety vs traditional cable/TV; prices dropped 30-50%.

3.Efficiency Gains: Quick commerce cut delivery from 2 days → 10 minutes; fintech reduced loan processing from weeks → minutes.

4.Financial Inclusion: Paytm/UPI banked 500M unbanked Indians; digital credit reached rural MSMEs.

5.Global Competitiveness: Flipkart/Zomato models exported to SEA/LATAM, creating $100B+ market cap companies.

Negative Impacts of Business Disruptions in India

1. Job Displacement: 20M taxi/auto drivers compete with Ola/Uber; kiranas lost 15-20% urban revenue.

2. Monopoly Power: Jio → 45% telecom market share crushed competition; limited consumer choice.

3. Data Privacy Risks: Frequent breaches (Paytm 2024); unregulated surveillance capitalism concerns.

4. Urban Inequality: Benefits concentrated in Tier 1 cities; rural India lags digital infrastructure.

5. MSME Debt Trap: Quick commerce forced kiranas into debt for speed matching; 30% closures in metros.

Net Effect: Disruptions accelerated India's GDP growth 2x faster than peers but widened inequality gaps requiring policy intervention

Current Status of AI-Driven Business Models in India (2026)

Rapid Scaling Phase: 91% of enterprises have moved beyond GenAI pilots, with 47% running multiple use cases and 21%+ of POCs reaching production. India scores 2.45/4 on NASSCOM AI Adoption Index, with 87% actively deploying solutions.

Infrastructure Momentum: IndiaAI Mission delivers 40K GPUs and ₹10K Cr funding. IT giants commit $6-7B to 1GW AI data centers. Startups pivot from infra to applications—voice AI, SMB intelligence, Bharat commerce.

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Sector Leaders: BFSI (loan disbursals via AI agents), manufacturing (predictive maintenance), quick commerce (non-linear journeys). HCLTech, TCS secure multi-billion AI transformation deals

Future Trends of Business Disruptions: -

Agentic AI & Autonomous Commerce: Multi-agent systems will execute end-to-end business processes—procurement, customer service, logistics—without human intervention. Voice-first commerce in Tier 2/3 cities will disrupt linear e-commerce.

Deep Tech Explosion: Semiconductors, biotech, climate tech, and advanced manufacturing will create $100B+ categories. India Semiconductor Mission drives domestic chip design/manufacturing.

Climate & Sustainability Mandates: Carbon tracking, waste-to-value, clean mobility solutions become mandatory. Climate tech attracts $50B+ investments by 2030.

Tier 2/3 City Entrepreneurship: Indore (agritech), Surat (textiles tech), Jaipur (handicraft digitization) emerge as startup hubs. Reverse migration + digital infra fuels localized innovation.

Hyperautomation of SMBs: AI-first ERPs/CRMs serve 50M+ MSMEs, automating accounting, inventory, compliance. Kiranas become data-driven enterprises.

Bharat-First Platforms: Multilingual AI + UPI/ONDC powers non-linear commerce for price-sensitive consumers. Social commerce scales 10x via reseller networks.

Defense & Sovereign Tech: Indigenous AI hardware, drone swarms, cybersecurity platforms gain priority. Atmanirbhar mandates create new B2G markets.

Programmable Money & Governance: CBDC + AI agents enable micropayments, automated compliance, outcome-based procurement.

Global Supply Chain Realignment: PLI schemes + AI manufacturing position India as China+1 hub for electronics, pharma, auto components.

Workforce Multipliers: AI coworkers expand enterprise capacity 2-3x without headcount growth, creating premium AI fluency jobs while reskilling informal workers.

CONCLUSION

To conclude the current research article AI-powered business models revolutionize global and Indian markets, generating vast opportunities amid urgent adaptation needs. Worldwide, AI drives flexible value transformation—via customization, forecasting analytics, and automation—yielding fresh income channels, evident in Amazon's algorithmic supremacy and fintechs reaching billions. Research validates 2-3x growth in prospects through streamlined operations and untapped segments.

India's UPI ecosystem accelerates this: PhonePe, Meesho, and Blinkit onboarded 400M+ users, fueling $500B digital expansion, 9M jobs by 2030, and Tier 2/3 innovation. Studies underscore efficiency surges, $957B GDP uplift, and strategic leads, even with skill shortages. Impact of these disruptions created 50M+ jobs while displacing traditional intermediaries, mirroring global patterns but accelerated by India's digital leapfrogging.

In essence, AI disruption rewards nimble data pioneers. Legacy firms face decline; trailblazers seize trillion-dollar realms. India's strengths—mobile-savvy users, policy support—prime it for AI leadership, contingent on parallel ethical progress.

Emerging Hotspots such as Automotive/EV: ADAS, battery management, autonomous features In Agriculture-Kisan e-Mitra, yield prediction (30% improvements). In Telecom sector -Network optimization, 5G deployment. Almost 91% enterprises scaling AI; BFSI leads adoption while manufacturing sees highest ROI from PdM implementations.

Economic Projection: $1.7T GDP addition by 2035 via productivity across sectors. Strategic infrastructure + localized innovation positions India for global AI leadership by 2047.

REFERENCES

1. Aldoseri, A., Khalifa, K. N. A., & Hamouda, A. M. (2024). AI-Powered Innovation in Digital Transformation: Key Pillars and Industry Impact. *Sustainability*, *16*(5), 1790. mdpi. https://www.mdpi.com/2071-1050/16/5/1790

2. Dey, L. (2026, January 12). *OPINION | What AI Still Cannot Do: The limits that will matter most in 2026*. Moneycontrol. https://www.moneycontrol.com/news/opinion/what-ai-still-cannot-do-the-limits-that-will-matter-most-in-2026-13768331.html
3. Iansiti, M., & Lakhani, K. R. (2020). *Competing in the Age of AI*. Harvard Business Review. https://hbr.org/2020/01/competing-in-the-age-of-ai
4. Jorzik, P., Klein, S. P., Kanbach, D. K., & Kraus, S. (2024). AI-driven business model innovation: A systematic review and research agenda. *Journal of Business Research*, *182*, 114764–114764. https://doi.org/10.1016/j.jbusres.2024.114764
5. Lamba, N. (2025, December 18). *Top Generative AI Trends in 2026: The Definitive Guide for Business Leaders*. Daffodilsw.com; Daffodil Unthinkable Software Corp. https://insights.daffodilsw.com/blog/top-generative-ai-trends-in-2026-the-definitive-guide-for-business-leaders
6. Marcin Kapuściński. (2026). *AI Solutions for Business in 2026: Opportunities, Challenges, and Industry Examples | TTMS*. TTMS. https://ttms.com/ai-solutions-for-business-in-2026-opportunities-challenges-and-industry-examples/
7. Mehta, R. (2025, November 6). *7 AI Myths Holding Your Business Back in 2026 (+ What Actually Works)*. Online Skill Assessment | Online Exam Software | Eklavvya.com; Online Skill Assessment | Online Exam Software | Eklavvya.com. https://www.eklavvya.com/blog/ai-myths-corporates/
8. Mike Paul. (2025, February 10). *How AI is Disrupting Business and the Global Economy: Must-Read Books for the Future*. Mike Paul. https://mikepaul.com/how-ai-is-disrupting-business-and-the-global-economy-must-read-books-for-the-future/
9. Patt, D. (2025, November 24). *Spotlight on Startups: How AI-First Companies Are Disrupting Traditional Industries*. EvinceDev Blog. https://evincedev.com/blog/how-ai-first-companies-are-disrupting-traditional-industries/
10. Press Information Bureau of India [PIB]. (2025). *Transforming India with AI*. Pib.gov.in. https://www.pib.gov.in/PressReleasePage.aspx?PRID=2209737®=3&lang=1
11. Prof. Pasunuri Amaraveni, & K. Chandana. (2025). Artificial Intelligence in Indian Businesses: Adoption Rate, Impact, and Challenges. *International Journal of Informative and Futuristic Research*, *13*(1), 164–174. https://doi.org/10.64672/ijifr/25.09.13.01.017
12. Putu Putra, A., & Made Risma M., A. (2024). *Artificial Intelligence and Business Models from the Perspective of Innovation and Operational Efficiency of Companies: Systematic Literature Review - International Journal of Research and Innovation in Social Science*. International Journal of Research and Innovation in Social Science. https://rsisinternational.org/journals/ijriss/articles/artificial-intelligence-and-business-models-from-the-perspective-of-innovation-and-operational-efficiency-of-companies-systematic-literature-review/
13. Rohin Dharmakumar. (2026, January 10). *AI, 2026, and balancing loops*. The Ken. https://the-ken.com/columns/zero-shot/ai-2026-and-balancing-loops/
14. RVIM Journal of Management Research. (2025). *Welcome To Zscaler Directory Authentication*. Rvimjournal.com. https://www.rvimjournal.com/index.php/rvim/article/view/306
15. Sanjit Sarkar, M. (2025). A Study Of Artificial Intelligence (Ai) In Commerce: Opportunities, Challenges And Future In India. *International Journal of Creative Research Thoughts (IJCRT) Www.ijcrt.org |*, *13*(1), 2320–2882. https://www.ijcrt.org/papers/IJCRT2501360.pdf
16. Soni, H. (2026, January 2). *How Traditional Business Models Are Evolving with AI Software in 2026*. BMV System Integration. https://systemintegration.in/blog/how-ai-based-software-is-transforming-traditional-business-models-in-2026/
17. Wong, E. (2025, October 20). *Gartner 2026 Tech Predictions Implications*. Ibm.com. https://www.ibm.com/think/insights/gartner-2026-tech-predictions-implications
18. Zetamicron, India. (2025, April 22). *How AI is Disrupting Traditional Business Models (And How to Adapt)*. Zetamicron. https://www.zetamicron.com/how-ai-is-disrupting-traditional-business-models/
19. Prediction Machines: The Simple Economics of Artificial Intelligence (Agrawal, Gans, & Goldfarb, 2018)

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20. Applies economic theory to show AI reduces prediction costs, transforming business models from fixed strategies to dynamic ones. Enables new revenue via hyper-personalization and automation, creating opportunities in predictive services across industries like retail and finance.
21. Competing in the Age of AI (Iansiti & Lakhani, 2020)
22. Details AI's shift to data-centric firms (e.g., Amazon), where algorithms replace hierarchies. Unlocks scalable opportunities by redefining value capture, fostering network effects and rapid experimentation for global market dominance.
23. The AI Republic: Building the Nexus Between People and Technology (Lee, 2020) Explores AI-driven models like AI-as-a-Service, impacting jobs and economies. Highlights opportunities in ethical AI ecosystems, workforce reskilling, and inclusive growth through democratized tech access.
24. AI-Driven Business Model Innovation (Khokhar, 2025) Examines AI's integration into Indian business practices across HR, customer service, and management. Highlights how AI fosters agile, scalable models via business intelligence and digital tech, creating new revenue streams and competitive opportunities for organizations in a digital economy.
25. Management in the Age of AI: Strategic Synergies Across Industries (Som & Tiwari, Eds.) Focuses on AI's strategic applications in Indian sectors like manufacturing and services. Demonstrates how AI redefines business models for efficiency and innovation, unlocking market expansion and profitability through data-driven decision-making.
26. AI for Managers (Cengage, 2024) Provides Indian managers with insights into AI's business transformation. Covers automation, personalization, and predictive tools that overhaul traditional models, generating fresh opportunities in operations, customer engagement, and growth strategies.

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A STUDY ON AI ANIMATION IN MAHABHARAT: EK DHARMAYUDH AND ITS ROLE IN TRANSFORMING THE ANIMATION INDUSTRY

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ABSTRACT
The animation industry is undergoing a significant change with the incorporation of artificial intelligence (AI), transforming content creation and viewer interaction. This study investigates viewer perceptions of animation quality characteristics, particularly emotional expressiveness and motion smoothness, in the AI-created series Mahabharat: Ek Dharmayudh compared to traditional human-animated content. Additionally, it examines how viewer demographics and levels of expertise affect their preferences for AI versus human animation in epic storytelling contexts. Data were collected through a structured survey from 276 participants in the Mumbai Metropolitan Region (MMR), surpassing the minimum sample size established by a power analysis (Faul et al., 2009). Chi-square tests evaluated the relationships between animation type and emotional expressiveness, motion fluidity, and viewer expertise with animation preference. Ratings reveal substantial disparities in emotional expressiveness and motion fluidity between AI and human animation, with human animation typically receiving higher scores. The level of expertise had a substantial effect on animation preference, with experts preferring human animation and those with less experience being more receptive to AI-generated content. These results highlight the transformative potential of AI animation in the industry, emphasising the necessity for the strategic integration of AI tools to complement traditional animation techniques. This research helps in knowing how the audience perceives AI animation in culturally significant storylines and offers practical advice for animators and content creators working in this evolving field.

Keywords: *AI animation, Mahabharat: Ek Dharmayudh, viewer perception, emotional expressiveness, motion fluidity, strategic integration.*

INTRODUCTION
The animation industry is undergoing a substantial change, primarily due to improvements in artificial intelligence technologies, which are redefining traditional animation workflows and creative opportunities (Smith & Jones, 2021). AI-generated animation, characterised by automation and generative models, provides new avenues for increased efficiency, cost reduction, and novel visual effects, thus challenging the conventional dominance of human animation (Lee et al., 2020). A prominent example is the Indian mythological series Mahabharat: Ek Dharmayudh, which was created using AI animation methods and made available on platforms like Jio Hotstar. This series combines ancient storytelling customs with the latest technology advancements, echoing industry-wide shifts toward incorporating AI technology to boost production quality and audience interaction (Patel & Kumar, 2022).

The perception of viewers is a vital factor in the acceptance and success of content generated by artificial intelligence. Convincing emotional expression and the smoothness of animated movements are key quality attributes that impact audience engagement and satisfaction (Chen & Wang, 2019). Previous research indicates that human-animated content typically excels in these areas due to the refined artistic skill and manual control involved. (Garcia & Silva, 2018). Rapid advancements in AI animation have been made possible by the use of machine learning algorithms to generate emotional cues and realistic motion, demanding empirical research into audience perceptions of these attributes in AI versus human animation (Zhang et al., 2021).

Demographic factors and the level of viewer expertise also influence preferences for animation. Individuals with formal training or extensive experience in animation techniques may have more stringent expectations or a bias towards traditional human animation, whereas newcomers may be more receptive to innovative AI-produced content (Ramirez & Lee, 2020). Understanding these dynamics is crucial for animators and studios wanting to tailor their content to various audience groups and to strategically adopt AI technologies without losing the loyalty of their core viewers (Singh & Das, 2023).

The development of AI animation has substantially transformed the employment scene for animators. According to numerous reports, a large number of animators have experienced prolonged periods of unemployment resulting from the use of AI driven automation that has taken over traditional manual animation tasks (Brown, 2022). Increasingly, the advertising sector is relying on fully AI-generated content, resulting in decreased demand for human animators (Clark, 2023). Several well-known animation studios have reduced their workforce, resulting in the firing of skilled animators, while smaller studios have been compelled to close down altogether because they cannot match the efficiency and cost-effectiveness of AI animation (Evans,

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2023). This shift highlights the significant economic and career challenges posed by AI integration in the animation industry, emphasising the pressing need for strategies to balance technological progress with workforce stability (Miller, 2024).

A researcher conducted interviews with few professional animators, who stressed that AI animation falls short of the level of precision and emotional depth attained by human animators. These animators believe that AI is capable of creating or animating characters, but it lacks the ability to infuse genuine emotions into them. The researcher's findings in AI animation for Mahabharat: Ek Dharmayudh are consistent with their observations, which noted less nuanced emotional expressiveness compared to human animation. The findings of these insights provoked the researcher to explore audience perceptions of emotional expressiveness and fluid motion in AI-generated animation compared to human animation, with the goal of quantitatively evaluating the qualitative distinctions and viewer response to AI-created content within culturally important stories. This study focuses on viewers from the Mumbai Metropolitan Region (MMR), a culturally rich and demographically diverse area, in order to capture relevant audience responses in the Indian context.

STATEMENT OF THE PROBLEM

The incorporation of AI in animation, as seen in the series Mahabharat: Ek Dharmayudh, has brought about considerable changes in animation quality and industry dynamics. Despite the potential of AI animation for efficiency and innovation, there are ongoing concerns about its capacity to equal human animation in emotional expressiveness and motion fluidity. The growth of AI animation has also led to employment disruption for animators, with reported job losses and studio closures. This investigation aims to explore viewer perceptions of AI versus human animation quality characteristics and determine how viewer familiarity affects animation preferences, filling the knowledge gap regarding AI animation's effect on audience response and the wider animation sector.

SCOPE OF THE STUDY

This study focuses on examining viewer opinions and tastes associated with the AI-generated animation series Mahabharat: Ek Dharmayudh, accessible on the Jio Hotstar platform. The study compares this series to traditional human-animated content in order to assess differences in animation quality attributes like emotional expressiveness and motion fluidity. The scope is confined to the animation industry, concentrating on how AI integration is transforming content creation and audience reception within this specific sector. The geographical focus is the Mumbai Metropolitan Region (MMR), selected for its diverse population and substantial audience base for digital streaming platforms. The research only focuses on particular genres, platforms, and geographic areas but not on technical production processes beyond viewer perception metrics.

REVIEW OF LITERATURE

For the present study, the researchers examined various published research articles and journals related to the integration of artificial intelligence into animation workflows, as well as viewer perceptions of animation quality and emotional expressiveness, motion fluidity, expertise-based preferences, and cultural applications in mythological storytelling.

Smith and Jones (2021), this study, published in the International Journal of Digital Arts, sought to assess the impact of AI on animation production workflows. Through a qualitative analysis of 15 global studios and expert interviews, the authors found that AI automation reduced production timelines by 40% and enabled new generative effects but also impacted traditional skill sets. Research indicates that AI has the potential to enhance creativity, but also stresses the importance of collaboration between humans and AI in order to maintain artistic control.

Lee et al. (2020), published in *Computer Graphics Forum*, aimed to assess viewer engagement metrics for AI-generated versus human-created animations. The methodology consisted of an experimental design, incorporating eye-tracking and surveys, where 250 participants viewed short video clips. Findings indicated that AI animations received higher scores for visual originality (mean=7.2/10) yet lower scores for emotional connection (mean=5.8/10), suggesting ongoing disparities in audience engagement.

Chen and Wang (2019), research, published in the Journal of Animation Studies, aimed to determine the fundamental perceptual elements influencing viewer satisfaction in animated media. Using a mixed-methods methodology that combined factor analysis of Likert-scale surveys (involving 180 participants) with qualitative focus groups, the research identified emotional expressiveness and motion fluidity as the primary dimensions, which explained 68% of the variance in viewer ratings.

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Garcia and Silva (2018), work, published in Animation Practice and Theory, compared quality perceptions across different production methods. A study using perceptual experiments with blinded clip evaluations involving 120 animation professionals found that human-animated sequences surpassed their AI equivalents in emotional expressiveness, with an effect size of d=1.2, due to the precision of manual keyframing.

Zhang et al. (2021), published in IEEE Transactions on Visualization and Computer Graphics aimed to improve AI methods for character animation. Deep learning models, specifically GANs and RNNs, were trained on motion-capture datasets and evaluated through user studies involving 300 participants. The results showed AI-generated movements reaching 85% human-likeness ratings, thereby substantially reducing the disparity in quality between human and artificial performances in terms of fluidity and cue simulation.

Ramirez and Lee (2020), published in the Journal of Visual Culture, examined expertise as a factor influencing technology preferences. Results from an analysis of variance on survey data from novices and experts (n=400) found that experts rated human animation 25% higher ($p<0.01$), whereas novices had no significant inclination towards AI innovations.

Singh and Das (2023), published in the Journal of Media and Entertainment Studies, examined audience segmentation for the adoption of AI content with a focus on demographic differences. A hierarchical cluster analysis of a survey of 500 Indian viewers revealed four distinct audience segments, with younger viewers aged 18-25 displaying a 30% higher acceptance of AI-generated mythological animations.

Patel and Kumar (2022), published in the South Asian Media Journal**,** explored AI's suitability for cultural narratives. The analysis of 20 Indian animated series and interviews with relevant parties revealed that AI excels at large-scale productions (e.g., epic battles) but has difficulty with culturally sensitive expressions, suggesting the integration of both approaches as the most effective solution.

JUSTIFICATION FOR THE STUDY

While prior studies document AI animation's technical advancements and general perceptual differences from human work (Zhang et al., 2021; Lee et al., 2020; Garcia & Silva, 2018), there remains a lack of empirical research comparing these approaches within culturally significant mythological storytelling contexts. The influence of viewer expertise and demographics on quality perceptions, particularly emotional expressiveness and motion fluidity, stays underexplored in the Indian market, with no quantitative analysis of landmark cases like *Mahabharat: Ek Dharmayudh* or chi-square testing among Mumbai Metropolitan Region (MMR) audiences. This study addresses these gaps by providing viewer survey data from diverse MMR respondents, testing associations between animation type, expertise levels, and key quality attributes to inform both industry practice and academic understanding of AI's role in epic narratives.

LIMITATIONS OF THE STUDY

This research has certain limitations. The study concentrates solely on the Mahabharat: Ek Dharmayudh series on Jio Hotstar, thereby restricting the potential for broad applicability to other AI-animated content or platforms. The geographic scope is limited to the Mumbai Metropolitan Region, which may not accurately reflect viewer perceptions across various cultural or regional contexts. The data collection process relied on individuals' own reports, encompassing self-assessed expertise levels and perception ratings, which may lead to subjective bias. The questionnaire evaluated emotional expressiveness and motion fluidity but failed to incorporate other possibly significant animation quality aspects such as character design or narrative engagement. Interview with animators bring in qualitative information, but were constrained by a small sample size and narrow focus, hindering the formation of more comprehensive industry-wide conclusions.

OBJECTIVES

1. To assess viewer perceptions of animation quality attributes (emotional expressiveness, motion fluidity) in AI-generated *Mahabharat: Ek Dharmayudh* relative to human-animated mythological content.
2. To explore associations between viewer demographics or expertise and preferences for AI versus human animation in epic storytelling.

HYPOTHESES

1. H1: Animation type (AI vs. human) is significantly associated with emotional expressiveness ratings.
2. H2: Perceived motion fluidity ratings are significantly associated with animation method.
3. H3: Viewer expertise level (novice vs. expert) significantly relates to preference for animation type.

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RESEARCH METHODOLOGY

The research methodology must be strong to minimise errors in data collection and analysis. Therefore, researchers have selected a survey or structured questionnaire method for data collection.

It is described in the following **Table 1**:

Type of Data	Primary & Secondary
Sampling Method	Convenience & Snow Ball Sampling
Sample size	To determine the sample size for the study, power analysis was conducted using the G*Power software (Faul et al., 2009). At a significance level of 0.05 and power of 0.95, the required minimum sample size was of 220. Finally, 276 complete responses received were analysed for the study which were greater than the minimum requirement.
Research tool	Structured Questionnaire
Research Method	Descriptive
Data Collection method	Survey
Survey Area	Mumbai Metropolitan Region
Tools to analyse data	Chi-square for hypothesis testing.

ANALYSIS, INTERPRETATION OF DATA & FINDINGS

DEMOGRAPHIC PROFILE OF THE RESPONDENTS: Table 2

Demographic Variable	Category	Frequency (n)	Percentage (%)
Gender	Female	146	53%
	Male	130	47%
Expertise Level	Novice	235	85%
	Expert	41	15%
Age Group	18–30 years	152	55%
	31–45 years	83	30%
	Above 45 years	41	15%
Education Level	Undergraduate	210	76%
	Postgraduate	41	15%
	Diploma in Animation	25	9%
Total		**276**	**100%**

Interpretation:

The demographic characteristics of the participants (N=276) are summarised in Table 2. The sample was relatively balanced in terms of gender, with females representing 53% (n=146) and males 47% (n=130). The age distribution indicates a young participant base, as a majority (55%) fell within the 18–30 age group. Regarding expertise in animation, the group was predominantly comprised of novices (85%), though a small portion (15%) identified as experts. Additionally, the educational profile was largely skewed toward undergraduate students, who made up 76% of the total sample size.

RELIABILITY ANALYSIS: Table 3

Statistics	Value
k	5
sum of item variances	4.750
Variance of Total Scores	13.820
Cronbach's Alpha	0.82

Interpretation:

The scale's internal consistency reliability was measured using Cronbach's Alpha (Hair, 2019), based on 90 responses. The alpha coefficient of 0.82 obtained from the data signifies high internal consistency among the items measuring animation quality attributes. This implies that the set of items consistently measures the underlying construct, and the instrument is suitable for further analysis.

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STATISTICAL ANALYSIS AND HYPOTHESIS TESTING RESULTS: Table 4

Sr. No.	Relationship Tested	Degrees of Freedom (df)	p value (α = 0.05)	Decision (α = 0.05)
1	Association between Animation Type and Emotional Expressiveness Ratings	2	0.002	Reject H0
2	Association between Animation Type and Motion Fluidity Ratings	2	0.001	Reject H0
3	Association between Viewer Expertise Level and Animation Preference	1	0.002	Reject H0

Interpretation:
The three chi-square tests collectively present a clear and consistent picture, viewers are able to meaningfully differentiate between AI and human animation, and this distinction is not coincidental. Human animation is rated significantly higher in emotional expressiveness and motion fluidity, suggesting that audiences still perceive a qualitative advantage in how human animators convey feeling and movement. Professionals and novices have differing views on AI output, with experts being far more critical and beginners being more accepting, implying that technical knowledge enhances awareness of AI's current shortcomings. To conclude, these findings demonstrate that human-directed animation remains the standard for emotional and aesthetic excellence, particularly in the opinion of knowledgeable observers.

RECOMMENDATIONS & SUGGESTIONS

The following recommendations & suggestions are primarily aimed at animation studios, content developers, and industry decision-makers who are integrating or testing AI within their production workflows. This study's findings indicate that different viewer groups, comprising novices, experts, and various demographic segments, perceive AI and human animation uniquely, ultimately influencing audience acceptance, brand reputation, and the long-term viability of AI-based projects.

- Animation studios should consider appealing to inexperienced viewers with AI-generated content, as this demographic is more open to pioneering animation techniques.
- Improving the emotional expressiveness and motion fluidity in AI animation may enhance its acceptance among experts and increase its appeal to a wider audience.
- Animation training programs could incorporate AI technology, yet prioritise the development of traditional animation skills to reconcile creativity with high standards.
- Content creators should utilize viewer demographic insights to customise their marketing strategies and platform distribution, especially in diverse markets such as the MMR.

SIGNIFICANCE OF THE STUDY

This study provides empirical evidence on how AI animation is viewed relative to human animation within the culturally relevant context of Mahabharat: Ek Dharmayudh. The analysis reveals the distinct viewing preferences of various audience groups, providing valuable information for animators, producers, and marketing teams. Grasping these dynamics is vital for the future of animation, with AI technologies persisting to evolve and redefine creative sectors. The research backs the strategic use of AI tools that work alongside human imagination, leading to lasting growth and audience involvement in the animation industry.

CONCLUSION

Research findings confirm that the type of animation has a significant impact on viewer perceptions of emotional expressiveness and motion fluidity, with human animation generally preferred for these qualities. The level of viewer expertise also influences their animation preferences, highlighting the need for audience segmentation in content creation. Full audience satisfaction with AI animation is contingent on further improvement and refinement to unlock its full transformative potential. This study focuses on the changing dynamics between technology and skill in animation, especially within the context of Indian mythological storytelling.

AREA FOR FURTHER RESEARCH

Future research could enhance the geographic scope beyond the MMR to encompass a variety of cultural settings. Enhancing the study by incorporating physiological measures of emotional response and examining further animation quality attributes, including character design and narrative engagement, may provide a more

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comprehensive understanding. Qualitative studies examining the viewpoints of animators and producers would complement research focused on viewers in order to inform comprehensive industry strategies.

REFERENCES

1. Brown, L. (2022). *Automation and the creative workforce: The case of digital animation*. Creative Industries Press.
2. Chen, Y., & Wang, H. (2019). Emotional expressiveness in character animation: A review of techniques and audience perception. *Journal of Animation Studies, 12*(2), 45–62.
3. Clark, R. (2023). AI in advertising: From concept art to full-stack content generation. *International Journal of Media Technology, 8*(1), 21–39.
4. Evans, D. (2023). Surviving the AI wave: Small animation studios under pressure. *Media Economics Review, 15*(3), 73–89.
5. Garcia, M., & Silva, P. (2018). Human touch in motion: Why hand-crafted animation still matters. *Animation Practice and Theory, 6*(1), 1–19.
6. Lee, S., Kim, J., & Park, H. (2020). Generative models in animation production: Opportunities and challenges. *Computer Graphics Forum, 39*(7), 101–115.
7. Miller, J. (2024). AI and labour in the screen industries: Risks, regulation and resilience. *Journal of Cultural Economics, 48*(2), 199–218.
8. Patel, R., & Kumar, S. (2022). Mythology meets machine: AI-enabled storytelling in Indian digital media. *South Asian Media Journal, 4*(1), 55–70.
9. Ramirez, T., & Lee, A. (2020). Expertise, bias and technological adoption in digital animation. *Journal of Visual Culture, 19*(3), 287–305.
10. Singh, V., & Das, P. (2023). Audience segmentation and technology adoption in Indian animation studios. *Journal of Media and Entertainment Studies, 11*(4), 133–149.
11. Smith, J., & Jones, K. (2021). Artificial intelligence and the future of animation. *International Journal of Digital Arts, 5*(2), 10–28.
12. Zhang, L., Chen, Q., & Yu, X. (2021). Learning to move and feel: Machine learning approaches to emotional character animation. *IEEE Transactions on Visualization and Computer Graphics, 27*(11), 4150–4163.
13. Chen, Y., & Wang, H. (2019). Emotional expressiveness in character animation: A review of techniques and audience perception. *Journal of Animation Studies, 12*(2), 45–62.
14. Garcia, M., & Silva, P. (2018). Human touch in motion: Why hand-crafted animation still matters. *Animation Practice and Theory, 6*(1), 1–19.
15. Lee, S., Kim, J., & Park, H. (2020). Generative models in animation production: Opportunities and challenges. *Computer Graphics Forum, 39*(7), 101–115.
16. Patel, R., & Kumar, S. (2022). Mythology meets machine: AI-enabled storytelling in Indian digital media. *South Asian Media Journal, 4*(1), 55–70.
17. Ramirez, T., & Lee, A. (2020). Expertise, bias and technological adoption in digital animation. *Journal of Visual Culture, 19*(3), 287–305.
18. Singh, V., & Das, P. (2023). Audience segmentation and technology adoption in Indian animation studios. *Journal of Media and Entertainment Studies, 11*(4), 133–149.
19. Smith, J., & Jones, K. (2021). Artificial intelligence and the future of animation. *International Journal of Digital Arts, 5*(2), 10–28.
20. Zhang, L., Chen, Q., & Yu, X. (2021). Learning to move and feel: Machine learning approaches to emotional character animation. *IEEE Transactions on Visualization and Computer Graphics, 27*(11), 4150–4163.

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- **Unpublished dissertation/ paper:**

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- **Article in newspaper:**

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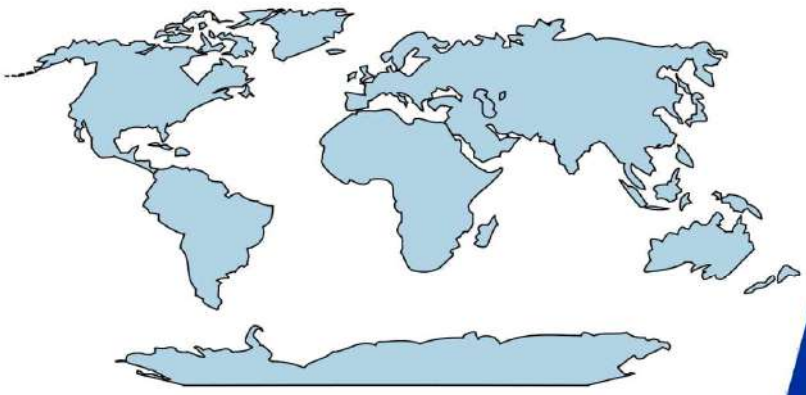

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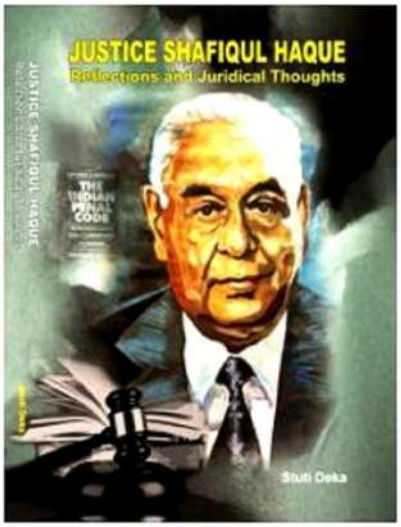

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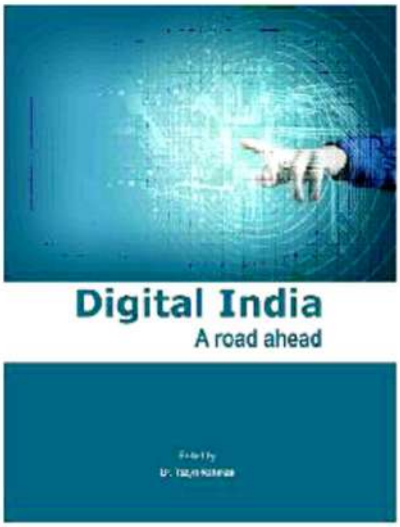

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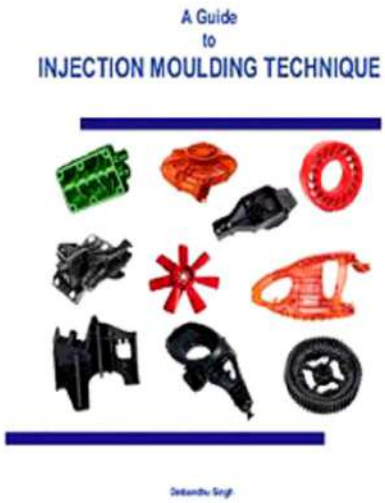

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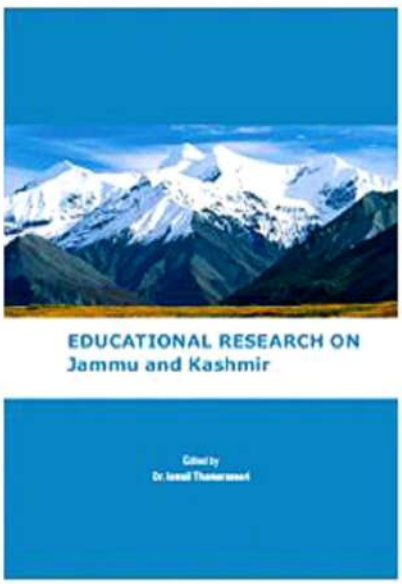

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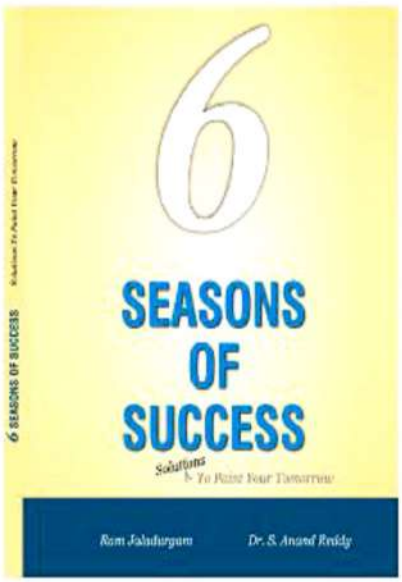

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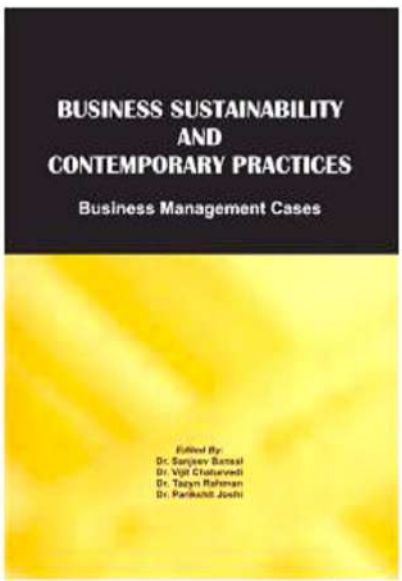

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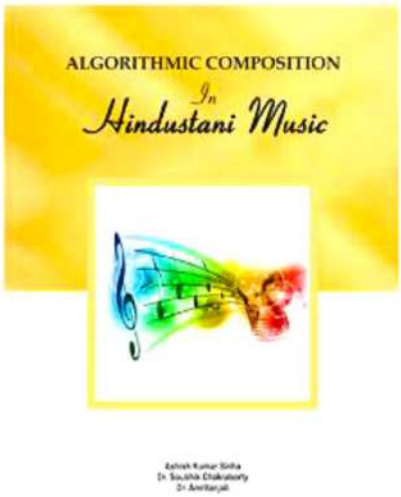

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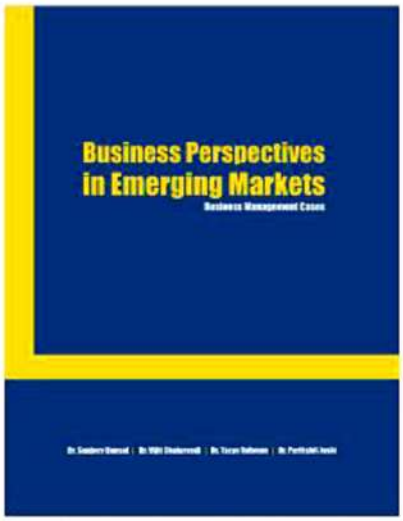

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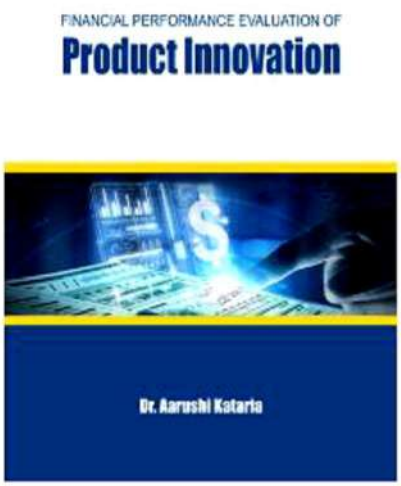

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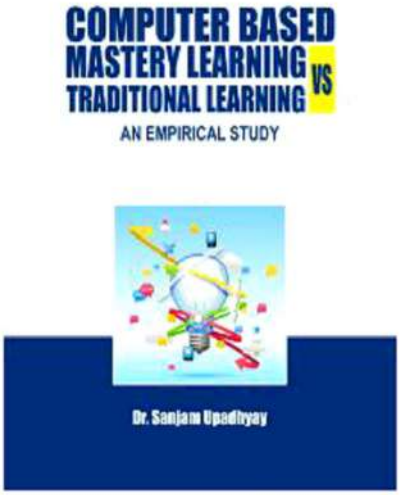

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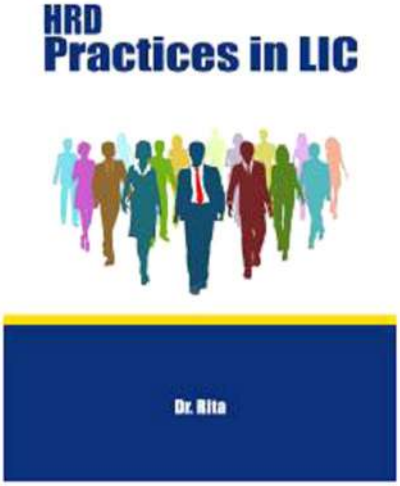

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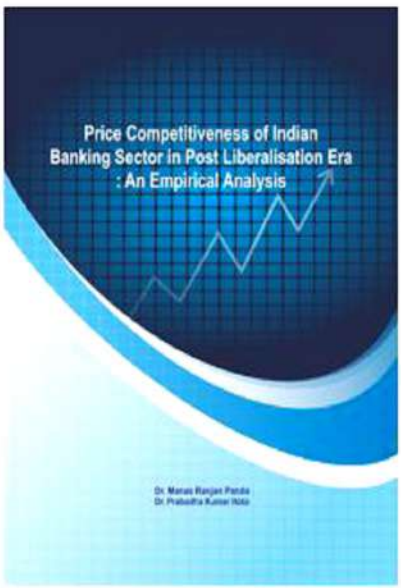

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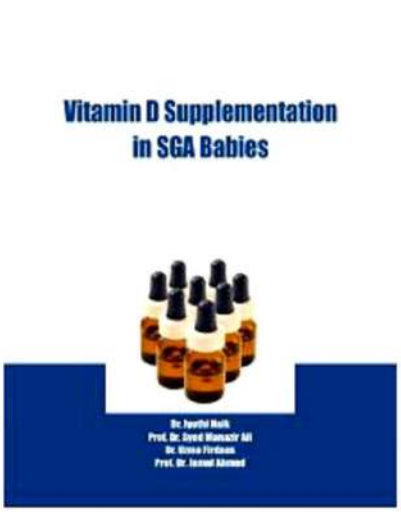

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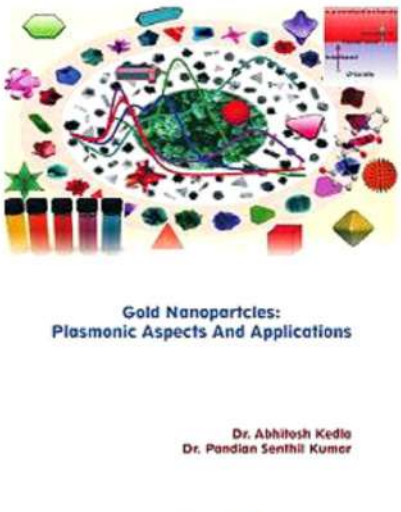

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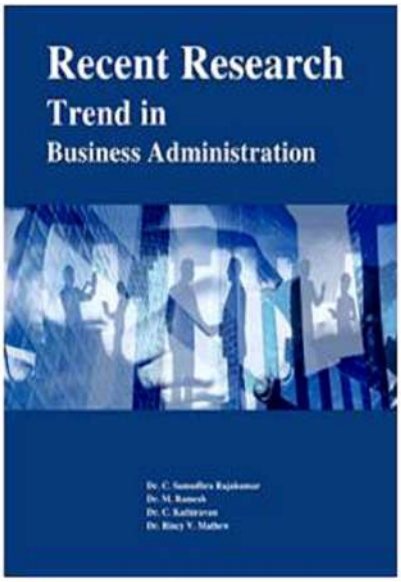

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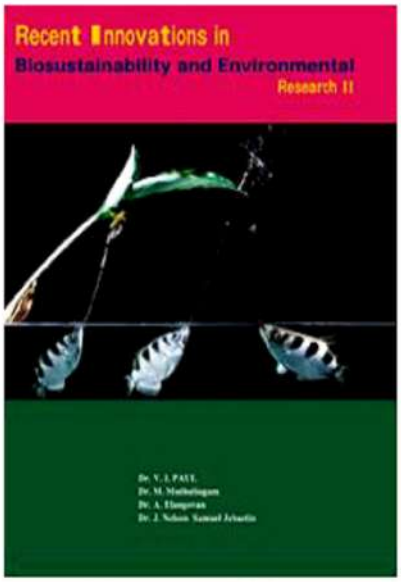

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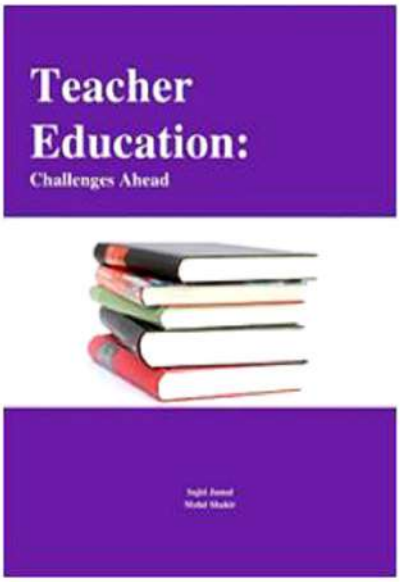

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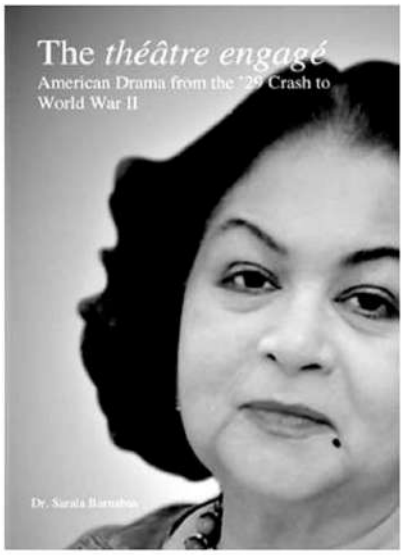

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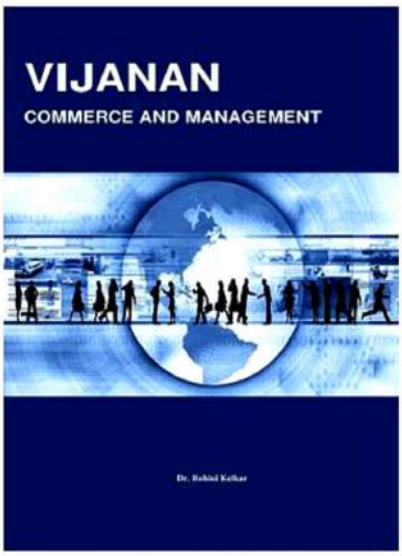

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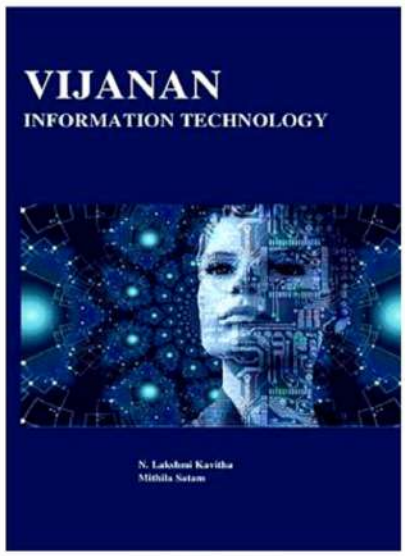

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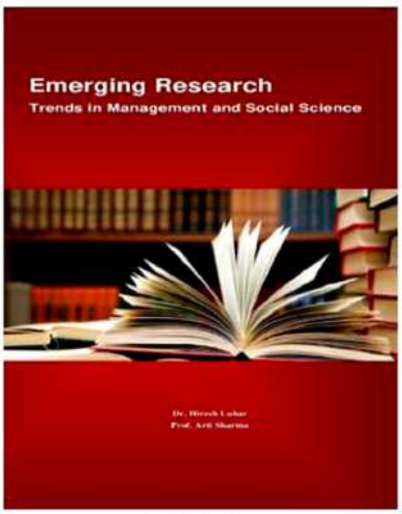

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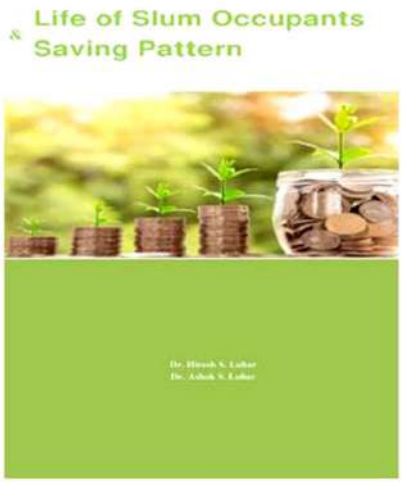

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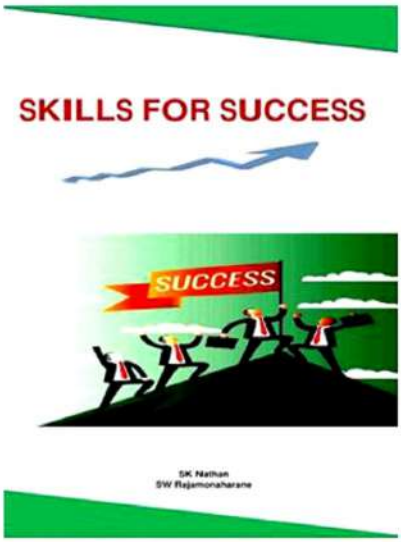

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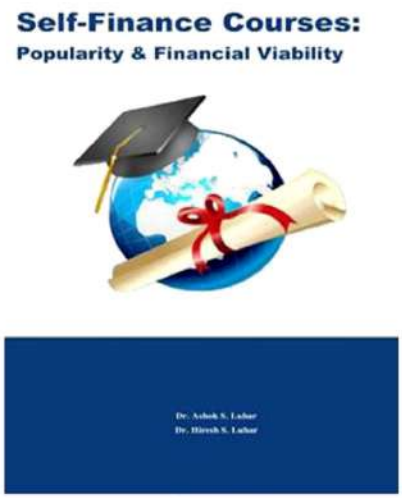

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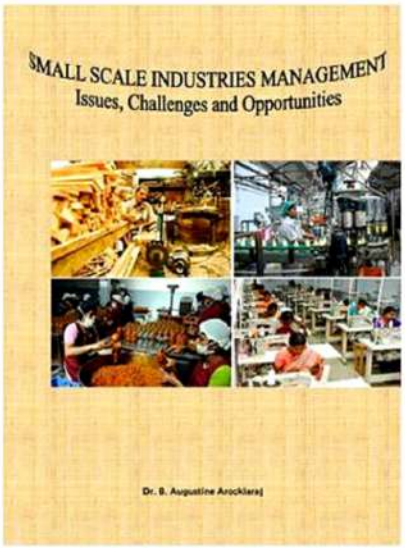

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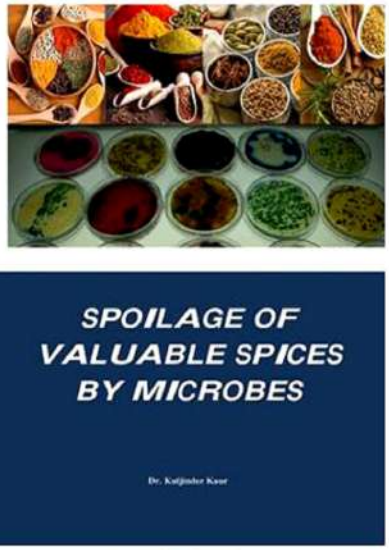

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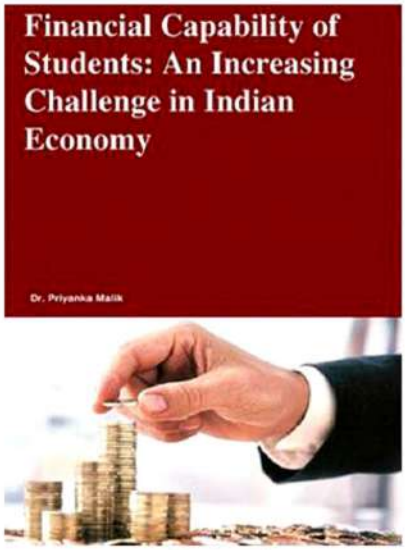

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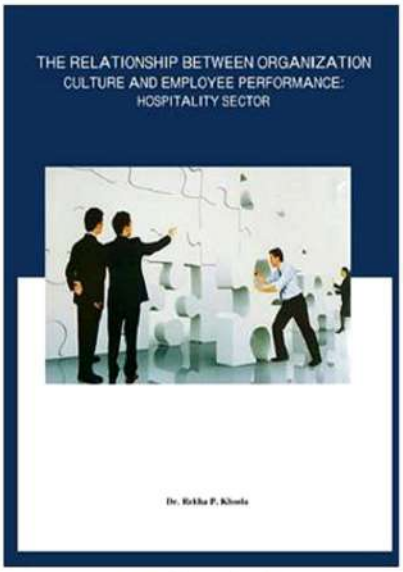

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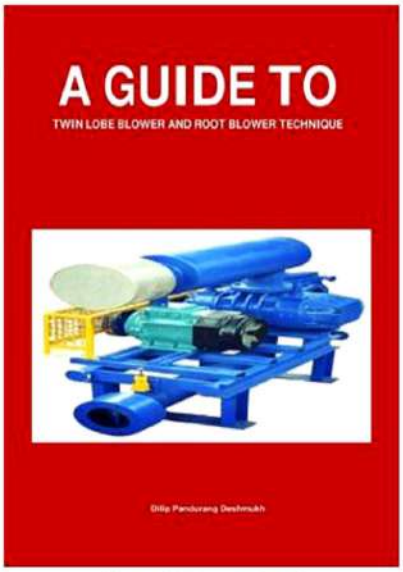

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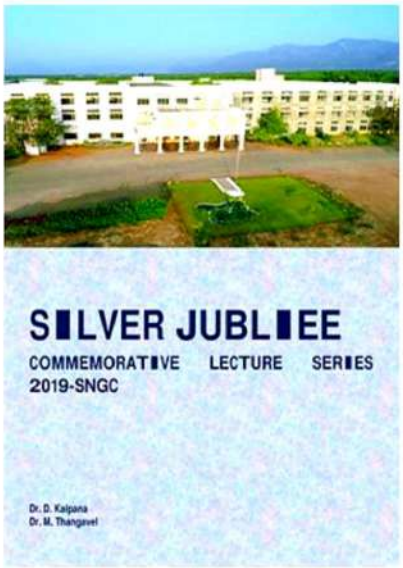

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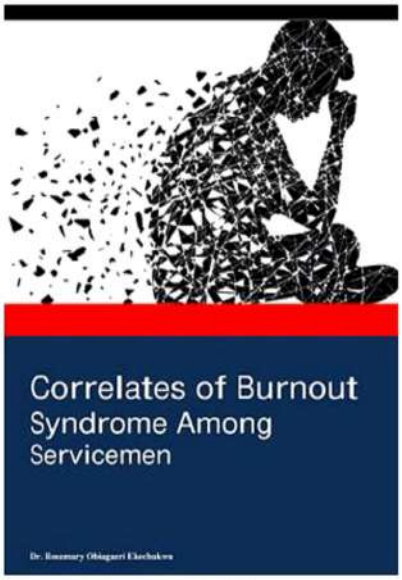

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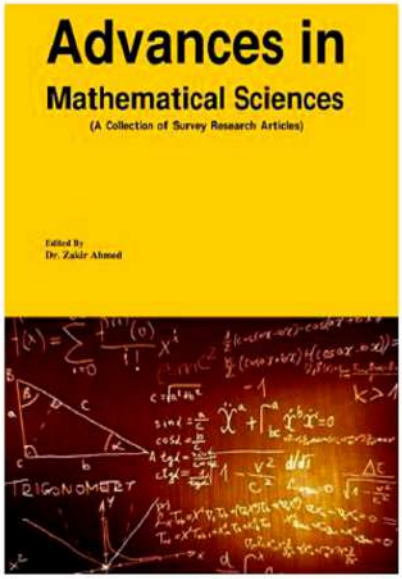

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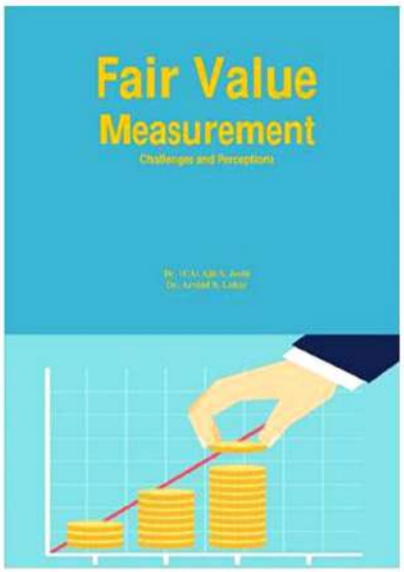

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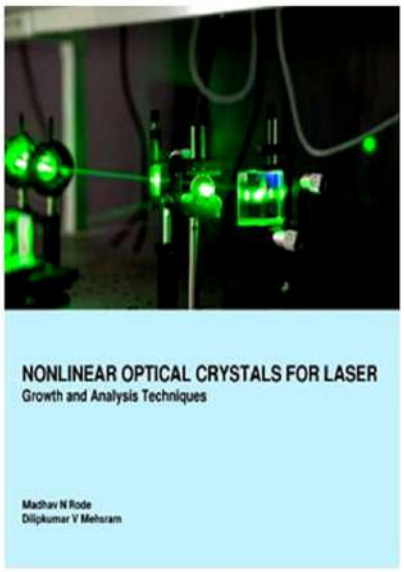

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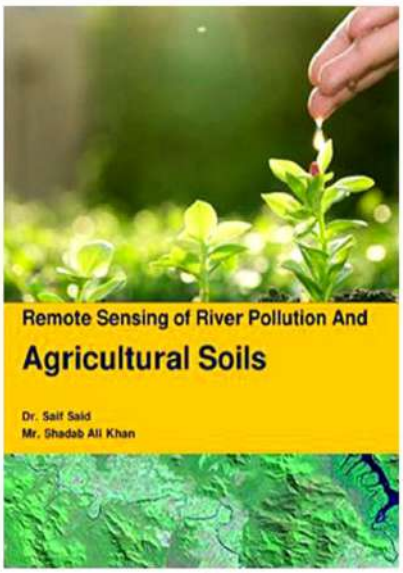

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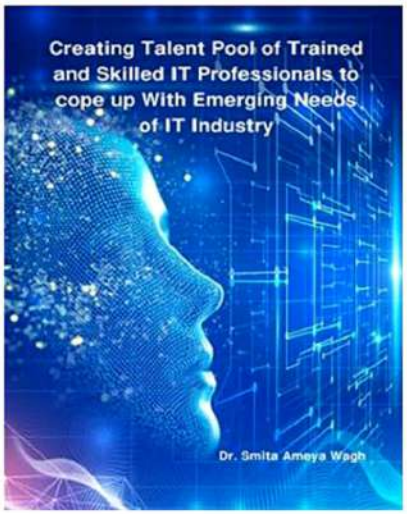

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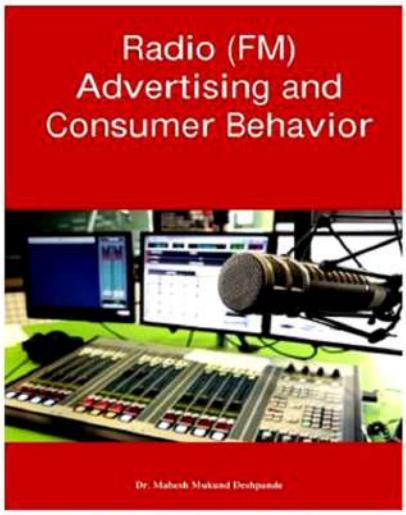

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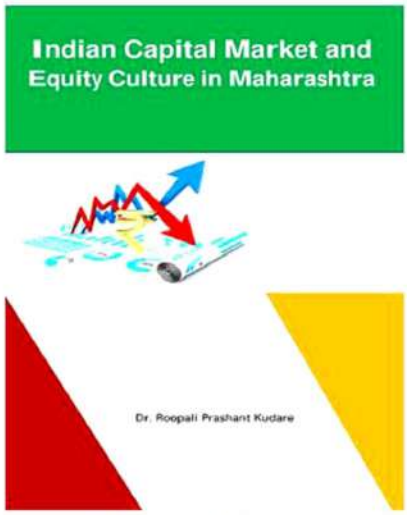

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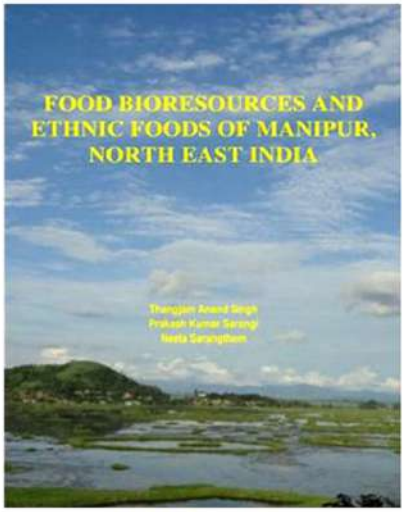

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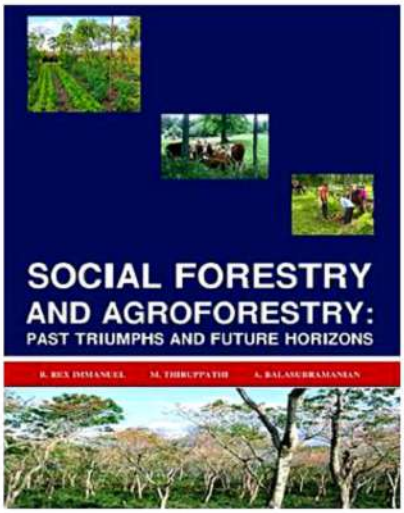

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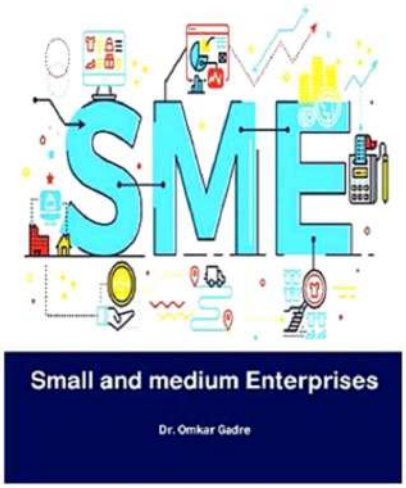

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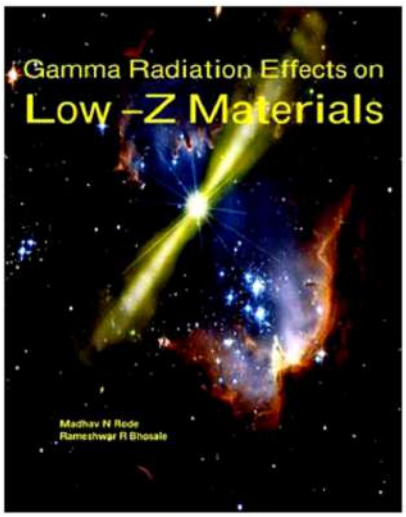

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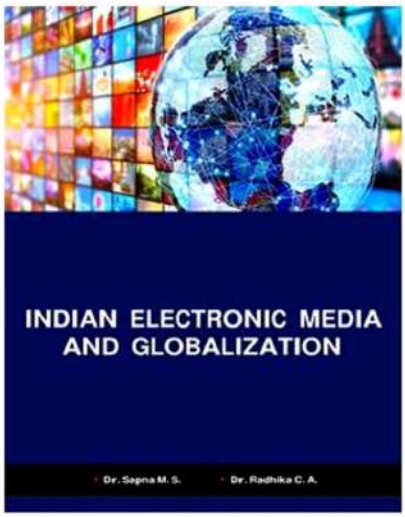

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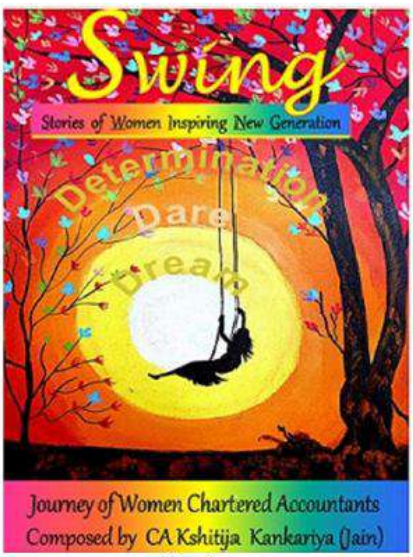

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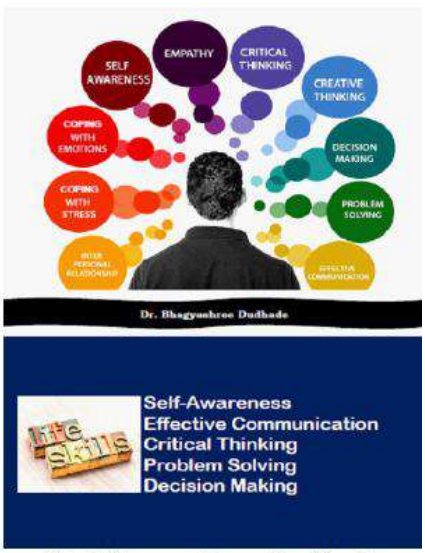

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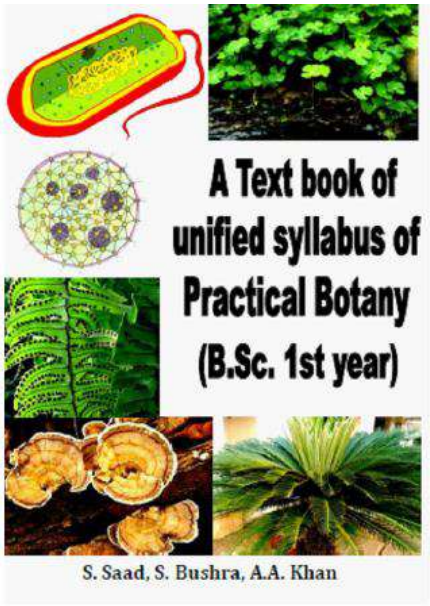

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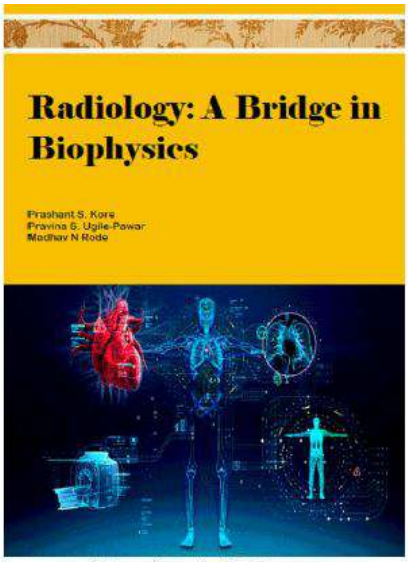

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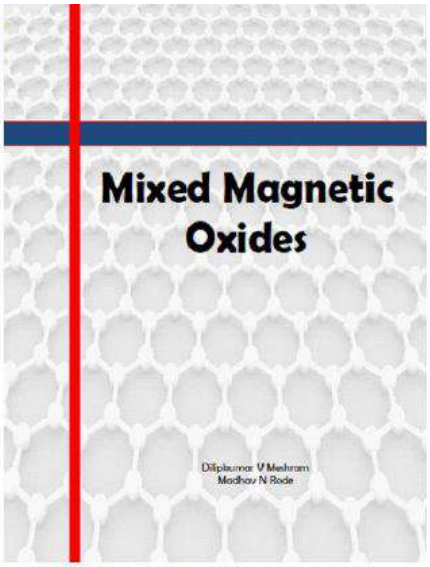

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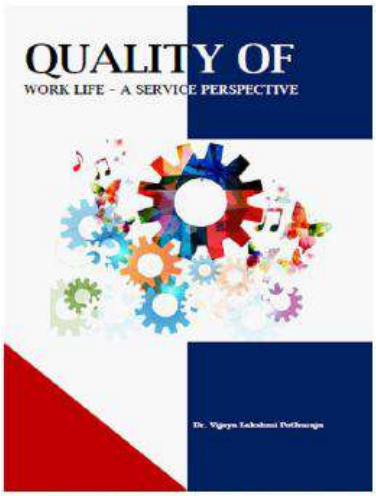

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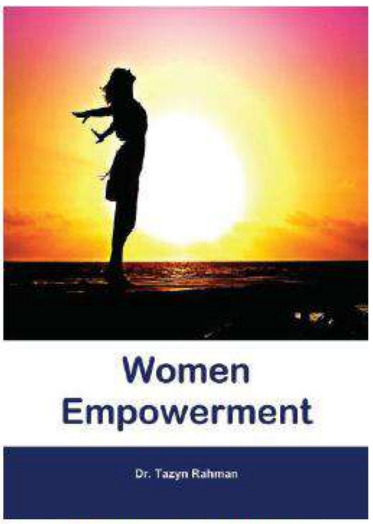

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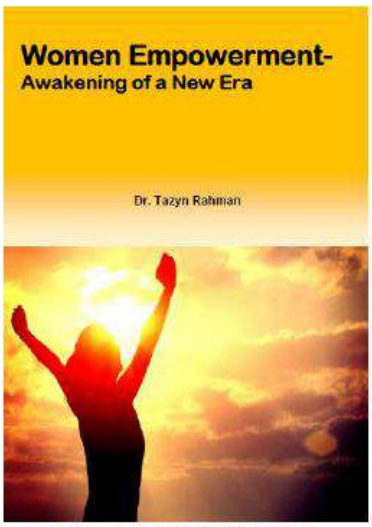

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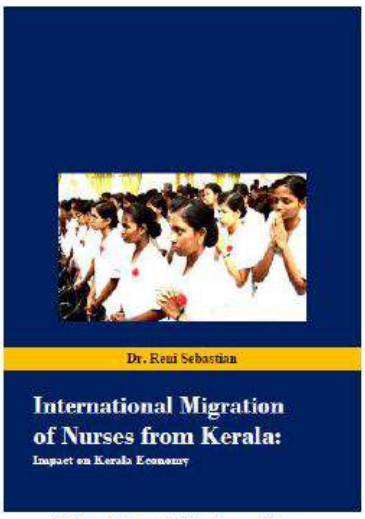

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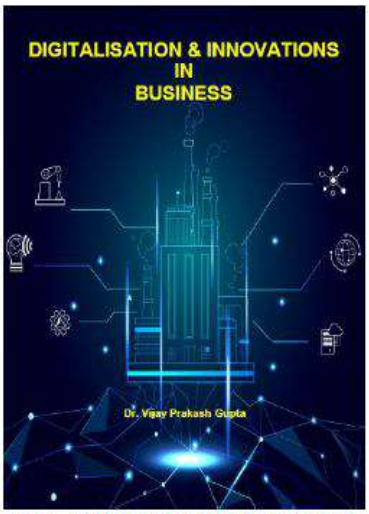

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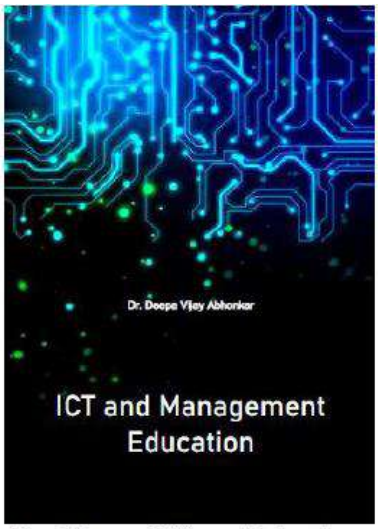

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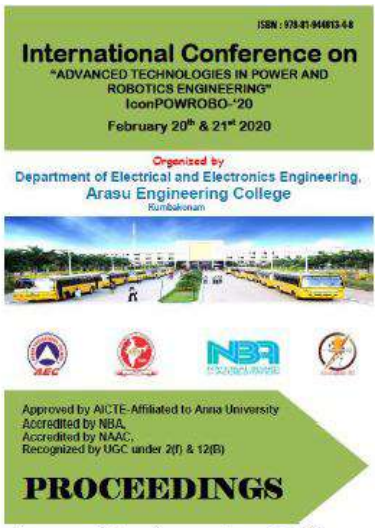

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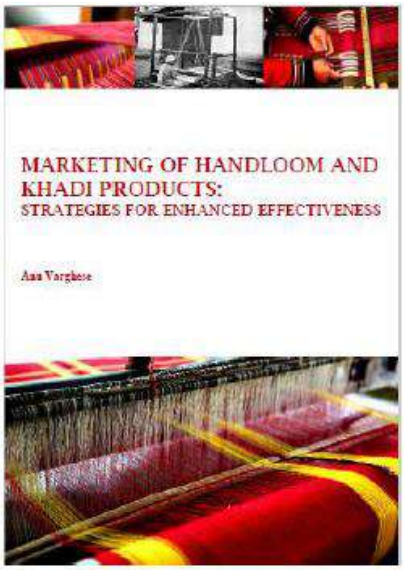

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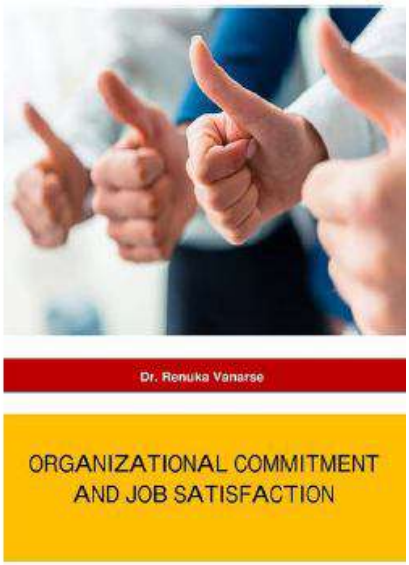

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