# International Journal for Development of Science and Technology (IJDST)

## Data-driven retail transformation: The integrative role of artificial intelligence

REVIEW

*Rakshitha[1] , Vijaya Ramineni[2], Prakash Kuppuswamy[3*]*

**Abstract**

The tender of Artificial Intelligence (AI) in the retail sector is covered in this study. It centers on the process of determining the significance and function of AI in retail enterprises. It highlights significant flaws in current approaches that cannot handle the unique characteristics and complexity of a retail setting. This study suggests using some of the current Fuzzy Complex to analyze a manufacturing-based approach that provides an accurate understanding of the issue and application flexibility. Around 400 publications published during have been subjected to bibliometric analysis by the research. It provides keyword co-occurrence analysis in addition to bibliometric analysis. Six key research highlights consumer behavior, AI in retail marketing, corporate performance, sustainability, supply chain management, and trust are shown by this investigation. The study focuses on how artificial intelligence is altering how retail companies operate. It offers data-driven insights on topics including target marketing, customer experience, and operational effectiveness. But it also highlights the obstacles to AI adoption, including worker competence, cost, and managerial opposition. It carries on the conversation about how AI's function in retail may be maximized by evaluating current approaches and offering customized strategies for future research avenues that are expected to further investigate the evolution of AI technologies in retail environments. Because of this, methodological advancement is thought to be required to rise the efficacy of AI applications and ultimately promote innovation and competition in the retail sector.

**Keywords:** *Retail 4.0, artificial intelligence, ai-enabled supply chain, technological integration, ai and consumer behaviour.*

## 1. Introduction

The retail industry is the part of the economy that involves selling goods and services directly to consumers. It includes a variety of businesses, such as shops, supermarkets, department stores, discount stores, warehouse stores, and online retailers [1].

[1] Affiliation: GM University, Davanagere, Karnataka, India.

[2] Affiliation: DVR & Dr Hs MIC College of Technology, Vijayawada, Andhra Pradesh, India.

[3] Affiliation: GM University, Davanagere, Karnataka, India.

* Corresponding Author: prakashcnet@gmail.com

It includes both offline stores and online platforms [2]. The retail industry plays an important role in the supply chain. Retail is not only buying and selling the product and providing the services but also making a good relationship between the manufacturer and consumer [3]. As the times changed consumer preferences and technological developments also transformed over the years. Factors such as e-commerce growth, changing shopping behaviour of customers, and the increase in the importance of customer experience and feedback have changed the way how retailers operate [4]. Nowadays the retail industry is facing a lot of competition in the market so it is now a requirement of businesses.

To innovate continuously and adapt to new market trends, such as AI, Data analysis, and IoT to fulfill the diverse demands of consumers [5]. In recent years, Artificial Intelligence (AI) has played a very important role in innovation across businesses & industries, with its ability to predict consumer behaviour, automate processes, and optimize business operations. AI can enhance business competitiveness and efficiency without negotiating ethical principles, such as data privacy [6]. AI is changing the way of thought companies towards consumers, consumer preferences, and behaviours [7].

## 1.1. Retail 4.0

Retail 4.0 is the next upgradation of the Revolution in the Retail industries after Retail 3.0, where industries focused only on expanding their stores, scaling their businesses, and integrating online and offline stores, is now shifting toward the integration of advanced technologies such as artificial intelligence, Big Data, the Internet of Things (IoT), and automation, enabling companies not only to optimize their operations but also to deliver a highly personalized and efficient customer experience [8]. In Retail 4.0, a new term known as marketing intelligence is introduced in which the companies collect and analyse user data to extract significant and beneficial insights regarding consumer behaviour and purchasing trends for marketing applications [9]. The Merkle Report, 76% of Customers Are Comfortable Sharing Their Data for Personalization; in this sense, Retail 4.0 leverages the power of data to analyse the buyer's journey and offer tailored experiences in real-time [10]. Additionally, Retail 4.0, often referred to as Omnichannel means, a business strategy that aims to provide a consistent customer experience across all channels, including physical stores, mobile, and online, Retail That is not all, ads and recommendations of the same item are also visible on social media. This lets us know how user data is being used in real time for personalization purposes. Here, IoT sensors enable real-time interaction with the store environment, while cloud computing ensures [11]. This is a very common example the customers experience in daily life.

Furthermore, Retail 4.0 incorporates technologies such as artificial intelligence (AI), for enhancing the shopping experience for consumers. With the integration of Artificial intelligence, Retailers are now manage to avoid understaffing or overstaffing conditions, which leads to increased productivity and cost savings [12]. Also, big data analytics (BDA) and cloud computing enable the storage and analysis of consumer data, with the help of a large amount of user data, retailers precisely predict the consumer's preferences and offer customizable services [13]. These technological innovations also enhance the flexibility, efficiency, and competitiveness of the distribution value chain (Figure 1).

## 1.2. Artificial Intelligence

Artificial Intelligence is a set of technologies that focuses on creating an intelligent machine that thinks like a human. Nowadays AI is used in problem solving, decision-making, and language understating. Examples of AI applications are making predictions, natural language processing (NLP), expert systems, speech recognition, and machine vision [14]. AI has many benefits like it Reduce human error, increasing productivity, reduce operation costs [15]. AI has revolutionized many sectors like healthcare, Education, Smart cities, and many more. On the other hand, AI is also adopted by Retail businesses to find AI-driven solutions in logistics, to improve user experience, personalized recommendations, and customer relationship management (CMR) [16]. Tools such as advanced AI-based inventory systems and chatbot, assistance optimize both back-end and front-end operations by reducing human interaction and helping in cost and labor reduction [17]. AI helps retailers in making their marketing strategies by analysing large data sets of users. At the time of the COVID-19 pandemic, all the supply chains across the world were disturbed, many people lost their jobs, and industries of all sectors faced too much loss.

Learning from this Industries started adopting AI technology right from the onset of Covid 19, if we talk about contactless delivery or AI-powered customer assistance, somewhere AI was also used. Nowadays industries are looking at AI-based solutions to learn about user behavior and understand the market [18]. For example, in China company named JD.com's introduce an AI vending machine that provides features like QR codes for purchases and contactless payments. This approach is appreciated during the COVID-19 pandemic. This AI-driven system reduces costs for the vendors. Another example is Alibaba's Cainiao network who integrate AI with an inventory system to connect both online and offline retail, by doing this they also use their physical store as a distribution hub. These innovations show how AI transforms customer experiences and supply chains in retail industries.

### 1.3. Before the implementation of Artificial Intelligence

*Manual Operations:* Retail operations like inventory management, sales tracking, and customer support mainly depended on manual processes. This led to human errors.

*Poor Data Analysis and Prediction:* Retailers had limited tools for analyzing customer data, so they faced difficulty in understanding consumers' behaviour and pattern of buying products.

*Poor Customer Experience:* Customer service like customer care support depends upon the staff's knowledge and availability. Each time you try to contact customer care different staff suggest different ideas, leading to poor shopping experiences.

*Inventory Challenges:* Retailers face difficulty with stock management, most of the time they face issues like overstocking or out-of-stock, which affect total sales and customer satisfaction.

### 1.4. After the Implementation of Artificial Intelligence

*Automation of Processes:* AI has automated many retail operations, like inventory management, and sales tracking.

It helps in reducing human error and increases efficiency.

*Advanced Data Analytics:* Retailers can use AI to collect and analyse large amounts of customer data and make predictions, by which retailers know about the buying patterns and preferences of consumers.

*Personalized Customer Experience:* Recommendation engines detect the keywords of the user data and analyse them with the help of AI tools. It provides useful data that is used further in personalized shopping.

*Optimized Inventory:* AI algorithms predict the demand and supply of the items more accurately. It helps retailers in maintaining a stock level of items. This led to reduced waste, which is produced when the item expires. By adopting this they improve overall supply chain efficiency. Now retailers also use the predicted data before introducing the discount on the items.

*Target Marketing:* AI enables target marketing in which the company figures out that they should introduce which item to which customers. This helps in increasing engagement of consumers and conversion rates (Figure 2).

## 2. Background study

### 2.1. Ahasanul Haque and Naznin Akther

They researched "Artificial Intelligence in Retail Marketing: Research Agenda Based on Bibliometric Reflection and Content Analysis". Integrating artificial intelligence with the retail market opens a new door of ideas. It enhances the way of doing business with consumer and managing their operations. A detailed analysis of all the articles published between 2000 and 2023 highlights six key consumer behavior, AI in retail, business performance, sustainability, supply chain management, and consumer trust. The methodology used by the author is bibliometric analysis and keyword co-occurrence analysis [19].

## 2.2. Kim Oosthuizen and Elsamari Botha

This research titled "Australasian Marketing Journal" demonstrates that the traditional retail value chain is facing dramatic changes through digital disturbance.

This trend makes retailers adapt to those changes to remain go-ahead, but there is so little literature that guides these managers on how to positively respond to this transformation.
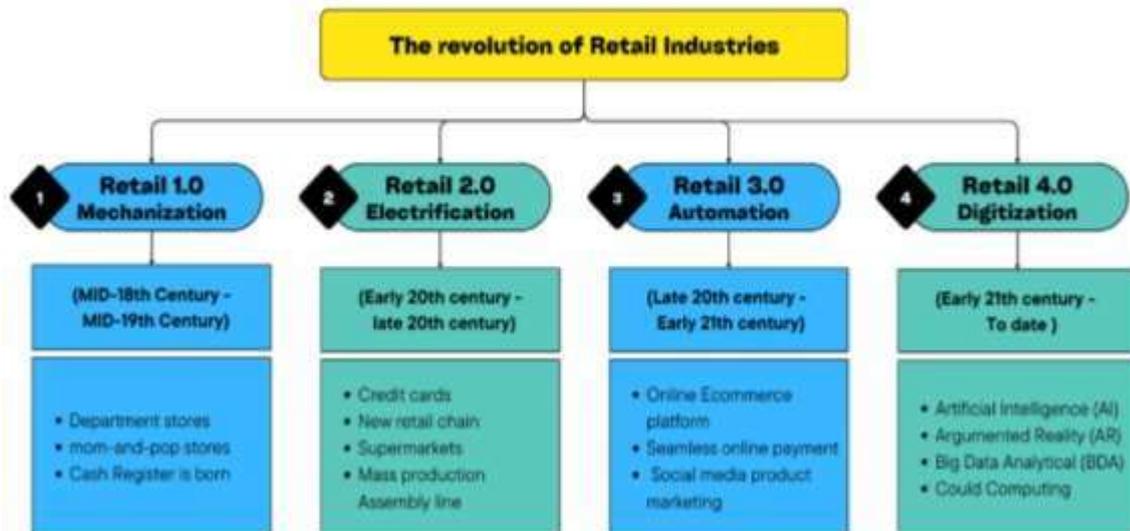


**Figure 1:** Revolution of retails industries

Increasingly, more retailers welcome varying digital technologies, especially the application of AI, with an aim to increase engagement between customers and the sellers themselves. This is essential if the retailers are to become competitive in the fast-shifting market. The paper reviews recent AI technologies and conceptualizes four key dimensions of the application of AI in a retail value chain: knowledge management and insight, inventory, operations optimization, and customer engagement. These dimensions form a basis for understanding in which ways AI can be applied to ensure retail operations [20].

## 2.3. Loh Li Hara and Umi Kartini Rashida

This study demonstrates Retail 4.0 and how the retail industry has been transforming from Retail 3.0. New technologies like AI, IoT, Cloud Computing, BDA, and AR technologies are introduced in Retail 4.0. These technologies improve operational efficiency as well as customer engagement.

The study thus suggests that the relationship between the adoption of Retail 4.0 technologies and e-loyalty needs further research, as the challenge of consumer loyalty is becoming very difficult to maintain in the digital era [21].

## 2.4. Helen Murdoch

This paper discusses the implications of Artificial Intelligence in the retail industry, especially focusing on methodologies for selecting the problem. The paper identifies an inadequacy in traditional methodologies for selecting problems that may be suitable for Intelligent Knowledge-Based Systems in the case of the retail sector because of the unique characteristics presented by the retail environment which are not addressed by more traditional approaches. The paper concludes that analysing the degree of structure in a problem would be useful in identifying potential problems. It advocates for the FuzzylComplex analysis as being the most appropriate methodology in the retail sector because of the manufacturing origin, clarity of purpose [22].
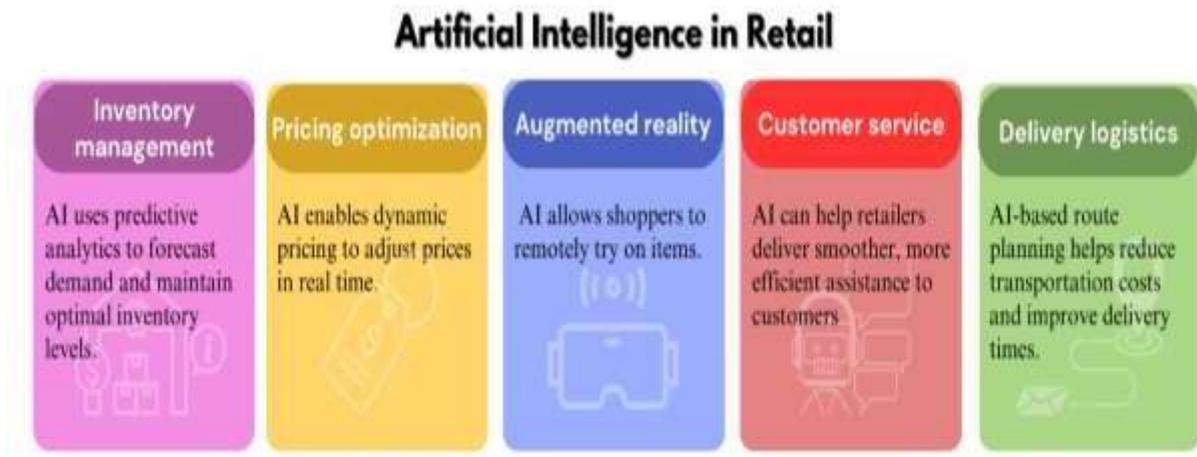
**Figure 2:** AI in retail business

These tools include Big Data, IoT, chatbots, and robotics to improve stock management within the stores, assist customers in purchasing, and market the products more effectively. AI offers personalized shopping experiences both online and in stores by analyzing the behaviour and preferences of its customers. However, it also brings with it high costs, resistance from management, and a lack of skilled workers. The paper underlines that future technologies like augmented and virtual reality and drone deliveries will play an important role in helping retailers remain competitive and meet the needs of customers.

### 2.5. Venus Kaur, Vasvi Khullar and Neha Verma

This paper carried out the study on "Artificial Intelligence with Retailing Sector". AI changed the way of the retail industry. Businesses understand their customers better, making smarter decisions. These tools include Big Data, IoT, chatbots, and robotics to improve stock management within the stores, assist customers in purchasing, and market the products more effectively. AI offers personalized shopping experiences both online and in stores by analyzing the behaviour and preferences of its customers. However, it also brings with it high costs, resistance from management, and a lack of skilled workers. The paper underlines that future technologies like augmented and virtual reality and drone deliveries will play an important role.

In helping retailers remain competitive and meet the needs of customers [23].

## 3. Methodology

This research paper discusses the role of Artificial intelligence in the data-driven retail industry. AI comes with new advancements in analysis and prediction. This study employs research based on the journal, related research paper, and article. The bibliometric analysis of more than 400 articles published from 2000 to 2023 behaviour, and transformation of the retail from the traditional method to the modern method. This shows the various roles of AI in retail industries. This paper also consists of the analysis of various retail companies in terms of their income or profit, and how the AI implementation raises the income of companies such as Amazon. ACI corporation, Starbucks, and Druva. The methodology culminates in the identification of six primary research streams: consumer behaviour, AI in retail marketing, business performance, sustainability, supply chain management, and trust. The paper also concludes the existing Fuzzy Complex analysis as a suitable methodology for addressing the unique challenges faced by the retail sector. The Fuzzy Complex analysis approach is relevant due to its origin in manufacturing.

The study critically examines the existing methodologies for selecting problems suitable for Intelligent Knowledge-Based Systems (IKBS) in retail. It helps in identifying the inadequate way in traditional approach in the retail industry which has to be updated with modern AI-driven solutions. All these research and methodologies are adopted in such a way that leads to a better understanding of AI and its role in the retail industry and the benefits of using AI (Table 1).

# 4. Retail

AI integration in retail is still in its early stages. Retailers test AI with their businesses but face difficulty in getting benefits from it. A 2019 Gartner report suggests that the key AI technology is expected to grow in the next five years. Those technologies are speech recognition, chatbots, and analysis and prediction of a large set of data. Many retailers are beginners so they are confused about which technology is useful. In many developing countries, people are still not so educated to understand the concept of AI and apply it in their businesses. AI has multiple benefits like improving inventory and customer support. For a better understanding of the potential of AI in retail, researchers suggest focusing on identifying the most effective way like Clayton Christensen's "jobs-to-be-done" approach.

## 4.1. Personalization and Consumer Engagement

Artificial intelligence is also used the predict the data which helps in the personalization of the consumer. It collects, and analyse the data of the user preferences and makes marketing strategies that are specific for the individual consumer, it helps in engaging the consumer and wins customer loyalty. AI-driven tools detect and collect user preferences and are used to show the recommendations in the app. For example, if the user wants to buy a mobile phone, he/she searches on the search engine, the data is collected by AI-driven tools and tries to predict the features and recommend the same type of mobile phone to the consumer. Nowadays we see that our search items are also recommended in the social media marketplace. This is all possible with the AI analysis.

## 4.2. Supply Chain Management

AI is enhancing supply chain management by improving inventory management, logistics, and sales forecasting. AI helps in the real-time monitoring of the items and risk management which is very crucial for the industries. Like in the food supply chain, real-time monitoring is very important. In the logistics part, the AI predicts and suggests the route, it detects all the other parameters and helps retailers in the supply chain. After the pandemic, many businesses chose AI for their convenience. Others also benefit if they integrate AI with their businesses.

## 4.3. In-Store Experience Enhancement

AI has the ability to process data, make predictions, and adapt in real-time, greatly enhancing AR experiences. For the simulation in the garments stores or accessories store the AR has vast scope in the market. Users get one more option to try the items in the store using the AR so they are also satisfied. By engaging the AR in physical stores return and replacement of the items after the purchasing is reduced.

## 4.4. Fraud detection

AI is also used in fraud detection in the retail industry. It analyses data to identify anomalies and prevent fraud activities. Many times we hear that the consumer orders some item from e-commerce and then after receiving the order they claim that the actual product is missing, this leads to a loss for the company. So here the AI integrates with the system and if any unusual pattern is found it detects and informs the retailer. In this way, the retailer can minimize financial losses, enhance security, and save the customer trust (Figure 3).

# 5. Scope of the research

## 5.1. Technological Integration in Retail

This study explores the implementation of artificial intelligence into the retail sector.

Along with other hi-tech advancements like cloud computing, big data analytics (BDA), the Internet of Things (IoT), and lastly Augmented reality. Nowadays each and every sector integrates with the latest technology and does so well. So this paper examined the need to update from the traditional retail method to the modern retail method which is Retail 4.0. The use of these technologies brings various benefits improving the customer experience, boosting operational effectiveness, and improving the supply chain

## 5.2. Impact on Operational Efficiency

This study points out how AI is important in the day-to-day operations of the retail business, from maintaining stocks, predicting customer demands, optimizing the supply chain, and then identifying fraud.

This analysis tells us about the complex problem in the retail environment, and also about the effective tools for solving the specific issue [24, 25]. The book further discusses how predictive analytics, machine learning, and AI-driven automation have been used to eliminate errors carried out by humans, make informed decisions, and enhance productivity across retail operations. By adopting AI, retailers will find better ways to maintain appropriate levels of stock, eliminate wastage. Predict consumer preference, and develop supply chains that are agile with market changes.
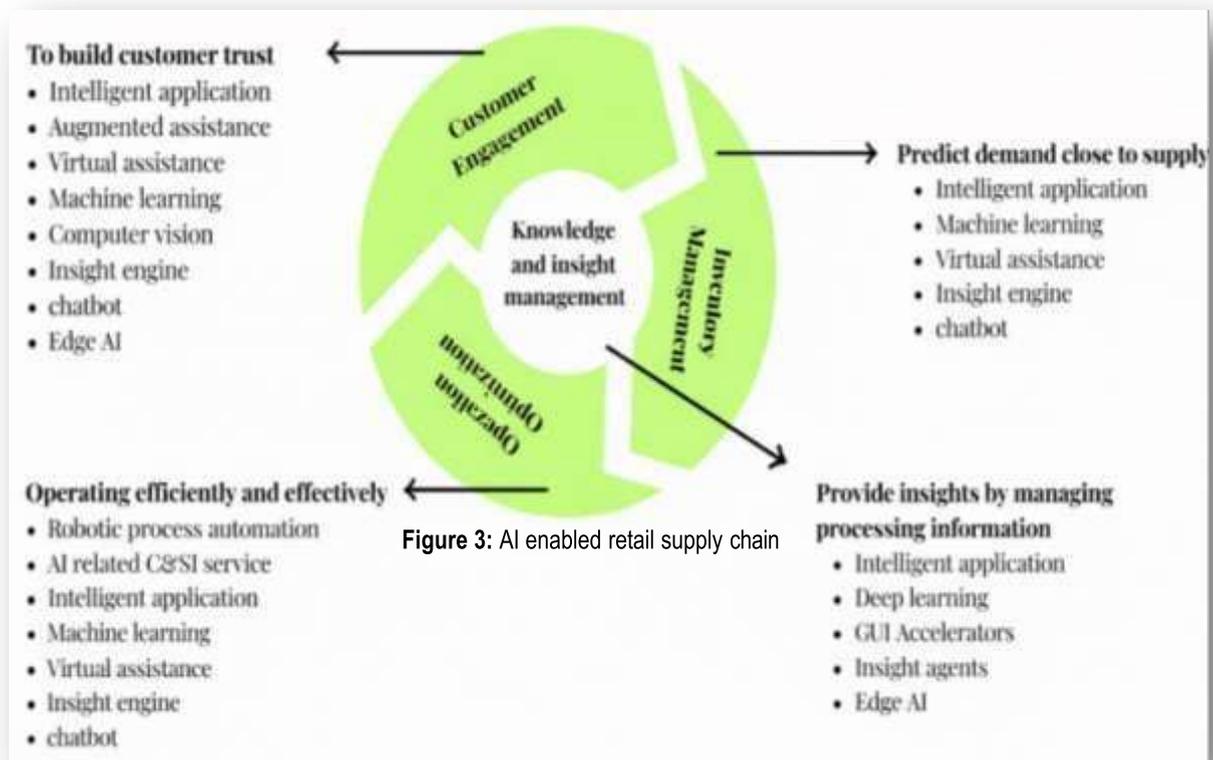


**Figure 3:** AI enabled retail supply chain

**Figure 3:** AI enabled retail supply chain

**Table1:** Impact of artificial intelligence on retail and enterprise decision making

| Name | Before AI | AI Implemented | After AI |
|---|---|---|---|
| Amazon | Lacked advanced personalization and AI-based cloud services | Recommendation engines, natural language processing (NLP), speech recognition, and cloud- based machine learning | Enhanced personalized homepage; launched Alexa and Echo, increasing engagement; AWS became the leader in cloud services with 47% market share in 2018 |
| Anheuser-Busch InBev (AB InBev) | Largest global beer brewer with challenges in sustainable farming, supply chain, and operational efficiency | AI for supply chain optimization, predictive analytics, sustainable farming (Smart Barley), and machinery maintenance | Improved supply chain and reduced shipping/fuel costs; optimized beer filtration; improved sustainability; revenue growth of 4.8% in 2018 |
| ACI Corporation | Struggled with low sales conversion rates (~5%) and difficulty in acquiring leads | Real-time sales assistance using speech-to-text, AI-driven analysis, and personalized sales prompts | Sales conversions increased from ~5% to 6.5%; qualified leads rose from 45.5% to 64.1%; enhanced product knowledge from 24% to 34.6%; improved customer satisfaction and sales |
| Starbucks | Vast network of stores with data from 90 million transactions but lacked targeted marketing and personalization | AI for personalized marketing, customer behavior analysis, and virtual assistants in the mobile app | Enhanced targeted advertising and decision- making; seamless order placement via app; increased user engagement and loyalty with 17 million app users |
| Druva | Sales training relied on lengthy live sessions and time- consuming video creation processes | AI video solutions with avatars, voices, and templates for streamlined and engaging sales training content | Training videos reduced from 2 hours to under 30 minutes; improved feedback loop; concise and relevant training materials; enhanced skill development and knowledge retention |

## 5.3. Enhancing the Customer Experience

This paper discussed how new AI technologies, like chatbots, recommendation engines, and personalized marketing, help retailers. It focuses on how AI tracks customer behavior, preferences, and history of purchases to deliver relevant products and adjust pricing strategies toward customer interaction. The study will also address ethical considerations, particularly data privacy, and consent, in AI-driven personalization, where the need for transparency and consumer trust has to be established with these technologies. It will also discuss balancing personalization with respect to individual privacy.

## 5.4. Application in Retail Market

This research will describe how AI changes the retail market with the help of performing analyses like predictive analytics and customer sentiment analysis. AI gives real-time insight into consumer behavior, preferences, and emotions. Such insights help retailers design campaigns that are more effective and targeted. The study will also examine how AI supports ultra-personalized marketing, including customized promotions and content. This results in increased customer satisfaction, loyalty, and conversion rates.

These AI-based strategies support retailers in getting closer to their customers and increasing their sales. This leads to higher conversion rates and repeat business. These AI-based strategies help retailers connect with customers on a deeper level, making their marketing more relevant and impactful. As a result, retailers are able to build long-term relationships with their customers and significantly increase sales.

### 5.5. AI's Role in Retail 4.0 Transformation

This paper will study the shift from traditional retail to Retail 4.0, which focuses on creating seamless experiences using AI technology. It will explore how AI and other emerging technologies are connecting online and offline platforms. The paper will show how these technologies provide smooth and connected experiences for customers. This makes it easier for customers to interact with retailers in a more convenient, personalized, and efficient way across multiple touchpoints [26].

## 6. Conclusion

In conclusion, this research demonstrates the influence of artificial intelligence in data-driven retail decision-making. Still, Artificial intelligence has a great future in the retail industry. The benefits of the AI are undeniable. This analysis highlights the benefits and scope of the Artificial intelligence in the retail industries. From automation of the inventory to offering a personalized shopping experience, AI has great use. AI is not only helping the retailers but also improving customer relationships with retailers. As technology gets advanced day by day, AI has a great demand in the future whether for predictive analysis or making strategies. Many of the big giants in the retail industry understand the importance of AI and use it to improve their supply chain. This will maximize the profit by reducing the human interaction and the human error. AI adoption is not just about the innovation of new things but also about creating a profitable, positive, and responsible future for the industry.

## References

1. Bhatia, Suresh Chander, Retail management Book Atlantic Publishers. 2008, 3(1):407-508

2. Gauri DK, Jindal RP, Ratchford B, Fox E, Bhatnagar, A, Pandey A, et. al. Evolution of retail formats: Past, present, and future. Journal of Retailing. 2021, 97(1): 42-61

3. Kumar N, The power of trust in manufacturer-retailer relationships, Harvard Business Review. 1996, 74(6):92-106

4. Johnson N, Purwanegara MS, Mulyono NB, Examining e-commerce shopping behavior: Investigating the influence of customer decision-making. Kurdish Studies. 2024, 12(2):2093-2113. doi.org/10.58237/ks. v12I2.2093

5. Sorescu A, Frambach RT, Singh J, Rangaswamy A, Bridges C, Innovations in retail business models. Journal of Retailing. 2011, 87(1):3-16. doi.org/10.1016/i.jretai.2011.04.005

6. Adanyin A, Ethical AI in retail: Consumer privacy and fairness. 2024, 5(3):1-15

7. Dias T, Goncalves R, Da Costa R L, Pereira LF, Dias A, The impact of artificial intelligence on consumer behaviour and changes in business activity due to pandemic effects. Human Technology. 2023, 19(1):121-148. doi.org/10.14254/1795-6889.2023.17-1.7

8. Mukhopadhyay S, Singh RK, Jain T, Developing big data enabled Marketing 4.0 framework. International Journal of Information Management Data Insights. 2024, 4(1):100214.doi.org/10.1108/978-1-80382-640 620231004

9. Kumari R, Singh VP, Industry 4.0 technologies: Managing the future of smart retail augmenting retail reality, part A: Blockchain, AR, VR, and the internet of things. Emerald Publishing Limited. 2024, 1(1):59-82. doi.org/10.1108/978-1-80382-640-620231004

10. Pandey P, Hasmukh G, Bhavin JS, Determining optimal workforce size and schedule at the retail store considering overstaffing and understaffing costs, Computers Industrial Engineering. 2021, 161(1):107656. doi.org/10.1016/j.cie.2021.107656

11. Swami P, Personalization and customization of products and services in e-commerce through big data augmenting customer retention through big data analytics, Apple Academic Press. 2025,1(1):1-21

12. Chatterjee R, Fundamental concepts of artificial intelligence and its applications. Journal of Mathematical Problems, Equations and Statistics. 2020, 1(2):13-24

13. Javaid M, Haleem A, Singh RP, Suman R, Artificial intelligence applications for industry 4.0: A literature-based study, Journal of Industrial Integration and Management. 2022, 7(1):83-111. doi.org/10.1142/s2424862221500057

14. Zhang S, The role of artificial intelligence in enhancing online sales and the customer experience. 2024, 1(1):1-67

15. Avula M, Thandiwe S, Artificial intelligence's potential to improve operational efficiency and customer experience in the hospitality and tourism sectors impact of AI and tech-driven solutions in hospitality and tourism. IGI Global. 2024, 1(1):351-382

16. Haleem A, Javaid M, Qadri MA, Singh RP, Suman R, Artificial intelligence (AI) applications for marketing: A literature-based study. International Journal of Intelligent Networks. 2022, 2(1):119-132

17. Haque A, Akther N, Khan I, Agarwal K, Uddin N, Personalization artificial intelligence in retail marketing: Research agenda based on bibliometric reflection and content analysis. 2024, 11(4):74-87. doi.org/10.3390/Infomatics11040074

18. Oosthuizen K, Botha E, Robertson J, Montecchi M, Australasian Marketing Journal. 2020, 1(1):15-25. doi.org/10.1016/j.ausmj.2020.07.007

19. Loh Li, Rashid K, Te Lee C, Seah Choon Sen Y, Loh X, Revolution of the retail industry: From perspective of retail 1.0 to 4.0. 2022, 3(1):353-369. doi.org/10.1016/j.procs.01.362

20. Kaur V, Khullar V, Verma N, Review of artificial intelligence with retailing sector. Journal of Computer Science Research. 2020, 2(1):1-7. doi.org/10.30564/jcsr.v2i1.1591

21. Gambo I, Massenon R , Lin C, Ogundokun RO, Agarwal S, Pak W. Enhancing user trust and interpretability in AI-driven feature request detection for mobile app reviews: An explainable approach, IEEE Access. 2024, 14(1):650-658

22. Baryannis G, Supply chain risk management and artificial intelligence: State of the art and future research directions. International Journal of Production Research. 2019, 57(7):2179-2202

23. Devagiri S, Augmented reality and artificial intelligence in industry: Trends, tools, and future challenges. Expert Systems with Applications. 2022, 207(1):118002

24. Gayam SR, AI-Driven fraud detection in e-commerce: Advanced techniques for anomaly detection, transaction monitoring and risk mitigation Distributed Learning And Broad Applications in Scientific Research. 2020, 6(2):124-151

25. Vijaya R, Saeed QY, Khalidi Al, Optimizing a deep learning model to develop a threshold based framework for threat detection proceedings of the International Conference on Modern Sustainable Systems CMSS. 2025, 2(2):12-14

26. Prakash K, Mohd DA, Mohan M, Sayed QY, Data mining for predictive analytics, intelligent techniques for predictive data analytics, Wiley IEEE Publication, Book Chapter. 2024, 3(1):1-15