International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

The Journey of Artificial Intelligence in E-Commerce: An Annual Insights

Shivani Anand[1], Mahesh Chandra Prasad[2]

[1]Research Scholar, Department of Applied Economics and Commerce, Patna University
[2]Professor, Department of Applied Economics and Commerce, Patna University

Abstract

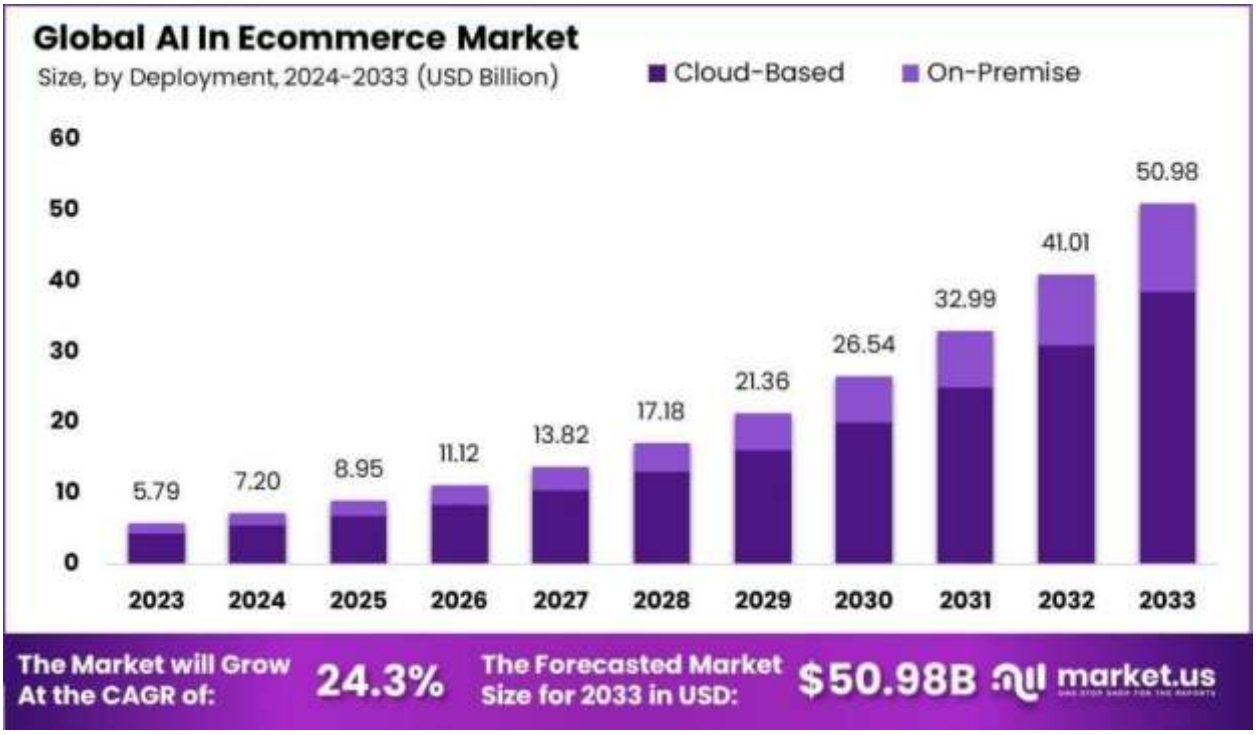
This study examines the evolution of artificial intelligence (AI) in the e-commerce industry, tracing its progression in three phases, namely, the **early adoption phase (2000-2010)**, the **rapid growth phase (2011-2015)** and the **maturity & innovation phase (2016-present)**. The early phase has laid the foundation for AI to flourish in the e-commerce industry. The next phase has improved recommendation systems and machine learning and has accumulated vast customer data to train AI models. More sophisticated AI techniques, such as generative AI, are used in the current phase.

This study investigates the remarkable milestones in integrating artificial intelligence into e-commerce, focusing on key innovations and challenges that have shaped the industry. It is based on secondary data, and findings are derived from the thematic analysis of qualitative data. This comprehensive analysis provides valuable insights for businesses, policymakers, and researchers seeking to understand the evolution of artificial intelligence in e-commerce to make more advanced strategies and policies in the rapidly evolving market. The study concludes by discussing the future trends and potential challenges of integrating AI into e-commerce.

Keywords: Artificial Intelligence, Innovation, Challenges, E-Commerce.

Introduction

The speedy transformation of **artificial intelligence (AI)** has significantly evolved the outlook of e-commerce, revising how businesses operate and interconnect with consumers. As e-commerce platforms amplify globally, AI has surfaced as a significant technology, pushing innovation and propelling operational efficiencies. From customised shopping experiences to advanced supply chain management, artificial intelligence's role in e-commerce is complex, composite, and evolving daily. Incorporating AI into e-commerce has paved the way for more responsive systems that serve the ever-changing demands of online consumers. The global AI in e-commerce market size is expected to be worth around **USD 50.98 billion by 2033**, from **USD 5.79 billion in 2023**, growing at a **CAGR of 24.3%** during the forecast period from **2024 to 2033**(market. us,2024).



Source- market.us (2024)

The advent of artificial intelligence in e-commerce can be traced to the early 2000s when basic algorithms were first involved in recommending products to consumers based on their buying behaviour. After that, improvements in machine learning, natural language processing and data analytics have led to the evolution of highly developed AI systems that anticipate customers' needs, estimate the optimal price of products and even self-operate customer services like chatbots and virtual assistants. This progression is a testament to technological advancements and reflects the growing reliance on AI to sustain competitive advantage in an increasingly crowded marketplace **(Kumar, 2021).**

Comprehending the timeline of the progression of artificial intelligence in e-commerce is essential for understanding its influence and future potential. Every phase of the development of artificial intelligence has introduced new potentiality, from increasing user experiences with customised recommendations to smooth-running operations through predictive algorithms. These developments have transformed consumer behaviour and prompted businesses to rethink their strategies, often leading to increased efficiency, customer satisfaction and profitability **(Smith & Anderson, 2019).**

This study will investigate the remarkable milestones in incorporating AI in the e-commerce industry, underlining key innovations and challenges that have shaped the industry. By inspecting this timeline, the paper aims to provide a comprehensive overview of how AI has transformed the e-commerce sector, contributing insights into the current state of the technology and its possible future path. The analysis will extract existing literature to map out the progression of AI implementation in e-commerce, eventually contributing to a deeper understanding of how this transformative technology continues to examine the digital marketplace repeatedly.

Literature Review

Literature 1- Personalised Customer Experience

Artificial intelligence (AI) has transformed the way businesses deal with customers, and due to this, custo-

mers are also changing their buying patterns. AI-powered recommendation systems analyse customer data to offer personalised product suggestions, enhancing customer satisfaction and driving sales. **Li, Zhang, and Liu (2019)**, in their research study **"The impact of personalised recommendation on customer satisfaction in e-commerce: A meta-analysis,"** found that personalised recommendations significantly impact customer satisfaction in e-commerce. Customers are also highly attracted to customised shopping.

Literature 2- AI-Driven Supply Chain Optimisation

The complications of modern supply chains require intelligent solutions. Artificial intelligence is changing supply chain management by improving inventory levels, predicting demand, and developing logistics efficiency. **Chen, Lee, and Simchi-Levi (2018),** in their study **"The impact of AI on supply chain management,"** highlighted the capability of Artificial Intelligence to transform supply chain management by increasing forecasting, inventory management, and transportation upgrades.

Literature 3- Chatbots and Customer Service

AI-powered chatbots have become indispensable in customer service. These AI-powered assistants respond immediately to customers' enquiries, improving their response times and customer satisfaction. **Huang and Chen (2020)**, in their study **"The impact of chatbot technology on customer satisfaction in e-commerce: A literature review,"** investigated the influence of chatbot technology on customer satisfaction in e-commerce, emphasising its potential to improve the customer experience.

Literature 4- AI and Fraud Detection

E-commerce fraud is a significant challenge. AI-powered fraud detection systems analyse transaction data to identify suspicious patterns and prevent financial losses. **Deng, Zhang, and Li (2019),** in their research work titled **"Artificial Intelligence in Fraud Detection for e-commerce: A Review,"** reviewed the application of Artificial Intelligence in fraud detection for e-commerce and focused on its significance in safeguarding e-businesses.

Literature 5- AI-Driven Innovation

In the **2020s**, the role of AI in e-commerce has expanded with the arrival of computer vision, deep learning and AI-driven **customer relationship management (CRM)** systems. These technologies allow more refined consumer perceptions and automated decision-making processes, from visual search capabilities to voice-activated shopping **(Grewal et al., 2021).** In their study, titled **"The future of retailing"**, the authors explored that AI-driven technologies such as voice search or camera(visual) search lead to more nuanced decision-making and rational online shopping.

Literature 6- Ethical Considerations

As AI's influence grows, concerns about data privacy, algorithmic bias and AI's ethical implications also increase in e-commerce. **Raji et al. (2020),** in their study titled "Closing the AI accountability gap: Defining an end-to-end framework for internal algorithmic auditing," discussed that researchers and industry leaders are constantly demanding a fair, transparent, and accountable AI system to ensure that the benefits of Artificial Intelligence are dispersed equally. Every technology comes with some pros and cons. As AI is bringing so much ease into our lives, it is also causing many concerns about data privacy and fraud.

Literature gap—There is a lack of comprehensive timeline studies that investigate the evolution of AI technologies and their applications in different e-commerce fields. Existing research often concentrates on specific AI techniques or particular e-commerce sectors, but a holistic timeline analysis is missing.

3. Research Objectives

- To analyse the **year-wise progression** of artificial intelligence in the e-commerce industry from 2000 to the present.
- To identify **critical achievements and challenges** in each phase.

4. Research Methodology

The study is based on secondary data. Various authentic and reliable reports have been published, and much literature is present to understand the transformation of artificial intelligence in the e-commerce industry. Thematic analysis of qualitative data is used to identify comprehensive themes in AI evolution.

Data Collection: Secondary Data Sources-

- Academic Journals- Scholarly articles providing in-depth analyses of e-commerce and AI trends.
- Online Databases- Utilising online databases such as Statista, market.us, Wikipedia, etc.

Ethical Considerations-

- Ensuring all data comes from credible and reliable sources and respecting copyright and intellectual property rights.
- Proper citation of sources is provided to avoid plagiarism, and credit is given to the original authors.

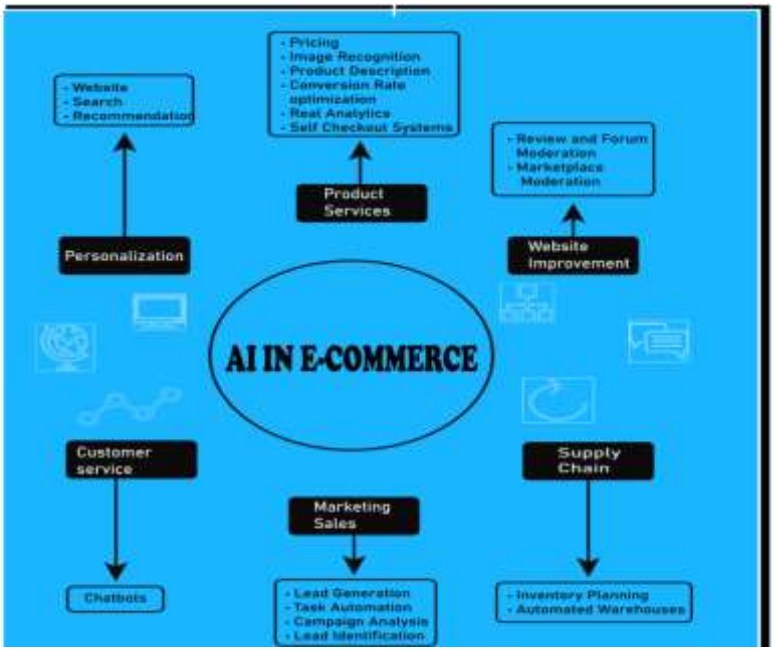
Limitations-

- Dependency on the availability and accuracy of secondary data sources.
- There is a lack of real-time data, as the analysis is based on historical information.

A Timeline Study on the Year-wise Progression of AI in E-commerce

This study discusses the year-wise progression of artificial intelligence in the E-commerce industry. E-commerce has witnessed a dramatic evolution in the last few decades, and one of the reasons is the arrival of artificial intelligence into the e-commerce industry. This timeline has been divided into **three phases,** namely-

1. **Early Adoption phase (2000-2010)**
2. **Rapid Growth phase (2011-2015)**
3. **Maturity and Innovation phase (2016- present)**



Source- AI Multiple

Early Adoption Phase (2000-2010)

The early adoption phase of artificial intelligence (AI) in the e-commerce industry, stretching from **2000 to 2010,** marked an age of discovery and the start of developments. While artificial intelligence was still in its initial stages, new e-commerce companies began experimenting with its potential to improve customer experiences and better performance. However, in **1996, Amazon** launched its online bookstore, introducing collaborative filtering algorithms to recommend products. However, after **2000**, more adoption of artificial intelligence in e-commerce platforms has been seen.

- **2001** marked a significant milestone for **eBay** as it started incorporating machine learning into its operations. This early adoption of AI technology allowed eBay to improve search results, optimise recommendations, detect fraud, and enhance pricing. The incorporation of machine learning in **2001** laid the foundation for eBay's continued growth and success as an online marketplace.
- In **2003**, **Amazon** took a crucial step forward in e-commerce by launching its personalised recommendation system. It introduced its personalised recommendation system, significantly increasing sales by suggesting products based on user behaviour. Innovative features like collaborative and content-based filtering have become a cornerstone of Amazon's success.
- In **2006**, Google acquired YouTube, a popular video-sharing platform. This acquisition marked a historic move for Google to expand its reach. Over the years, Google has leveraged its advanced AI potential to increase YouTube's functionality significantly. Ultimately, Google's acquisition of YouTube and subsequent integration of AI have considerably impacted the e-commerce outlook.
- In 2007**, Flipkart** was founded, marking the beginning of modern e-commerce in India. Initially, the role of AI was minimal, focused on search algorithms and recommendation engines, similar to global counterparts, as AI was still in its initial stages. Flipkart primarily used AI for search algorithms, recommendation engines, and other AI-powered attributes. These attributes helped Flipkart provide customers with a more customised and efficient shopping experience.
- In **2009**, Indian e-commerce retailers began to experiment with AI-powered dynamic pricing. This innovative approach allowed companies to adjust product prices in real-time based on various factors such as demand, competition, inventory levels, seasonal trends, etc. Data collection and analysis, predictive modelling, and price optimisation are some of the ways of enabling dynamic pricing.
- In **2010, Snapdeal** was launched, and other companies like **Myntra(2007-2008)** and **Jabong(2012)** entered the scene. This period has marked a significant expansion in the Indian e-commerce market. With the launch of Snapdeal and the entry of other players like Myntra and Jabong, the competition intensified, leading to a surge in innovation and the adoption of advanced technologies. AI-driven personalised recommendations and customer segmentation start gaining traction. These technologies offered many advantages like enhanced customer experience, more customer engagement, etc.

Key Achievements

- **Recommendation Systems-** Some of the earliest applications of AI in e-commerce were recommendation systems. Amazon was a pioneer in this area, introducing its personalised recommendation engine in the early 2000s,
- **Search Engine Optimisation (SEO)-**AI-powered search algorithms were developed to improve product search results on e-commerce platforms.
- **Chatbots and Virtual Assistants:** Basic chatbots and virtual assistants began to appear on e-commerce websites, offering customer support and answering queries.

- **Fraud Detection:** AI algorithms were employed to detect fraudulent activities on e-commerce platforms, such as credit card fraud and identity theft.

Challenges

- **Data Limitations:** Limited data availability and quality hindered the early adoption of AI in e-commerce. E-commerce companies lacked the vast datasets to train and improve AI models effectively.
- **Computational Power:** AI algorithms were computationally expensive, requiring significant processing power that was often beyond the reach of many e-commerce businesses.
- **Scalability:** Scaling AI applications to handle the growing volume of data and transactions in the e-commerce industry was a significant challenge.
- **Consumer Trust:** Building consumer trust in AI-powered systems was crucial for their adoption—Concerns about privacy, security, and the potential for algorithmic bias needed to be addressed.

Despite these challenges, the early adoption phase of AI in e-commerce laid the groundwork for future innovations. The successes achieved during this period demonstrated AI's potential to transform the industry and paved the way for more widespread adoption in the years to come.

Rapid Growth phase (2011-2015)

Artificial Intelligence (AI) has revolutionised e-commerce, transforming how businesses interact with customers and operate. From personalised recommendations to efficient supply chain management, AI has become an indispensable tool for online retailers. This phase explores the progression of AI in e-commerce, focusing on the period between **2011 and 2015**, a phase marked by rapid growth and significant advancements. The period between **2011 and 2015** marked a pivotal phase in the progression of AI in e-commerce. The advancements during this time laid the foundation for the widespread adoption of AI technologies in the industry and continue to shape how we shop and do business online today.

The years between 2011 and 2015 witnessed a surge in AI adoption within the e-commerce sector. Several key achievements and opportunities emerged during this time:

- In **2011**, **Apple** launched **Siri**, indicating a notable advancement in voice recognition technology and opening new opportunities for voice commerce.
- In **2014,** Amazon introduced the Echo device with **Alexa**, transforming voice-assisted shopping and home mechanisation.
- In **2015**, Facebook introduced AI-driven dynamic ads, allowing businesses to spontaneously show essential products to potential customers based on their activity and purchase history.

Key achievements

- **Personalised Recommendation Systems-** AI-powered recommendation engines have become more sophisticated, delivering highly tailored product suggestions to customers based on their browsing history, purchase behaviour, and preferences.
- **Natural Language Processing (NLP) Advancements-** NLP technologies have made significant strides, enabling e-commerce platforms to understand and respond to customer queries more naturally and humanistically.
- **Image and Visual Search-** AI-driven image and visual search capabilities emerged, allowing customers to search for products using pictures instead of text.

- **Intelligent Chatbots-**AI-powered chatbots began to gain traction, providing automated customer support and answering common queries.

Opportunities

- **Data-Driven Insights:** The increasing availability of customer data presented opportunities for e-commerce businesses to leverage AI for data-driven decision-making.
- **Supply Chain Optimisation:** AI algorithms offer the potential to streamline supply chain processes, improving inventory management, demand forecasting, and logistics.
- **Fraud Detection:** AI-based fraud detection systems have emerged as valuable tools in combating online fraud and protecting businesses and customers from financial losses.
- **Personalised Marketing:** AI-enabled e-commerce companies deliver highly targeted and personalised marketing campaigns, increasing the effectiveness of their promotional efforts.

Maturity and Innovation Phase (2016- present)

The 2016-present period constitutes a phase of maturity and innovation in applying Artificial Intelligence (AI) within the e-commerce industry. Due to the advancements made in the previous years, AI technologies have become increasingly advanced and consolidated into numerous aspects of online retail. This timeline study investigates the key achievements and opportunities that have characterised this phase. Artificial intelligence has been having an impact on marketing for years, and will continuously grow. The impact of AI has become more apparent, and noticeable in 2017 (Wikipedia,2024)

The 2016-present period has witnessed a significant acceleration in the application of AI within the e-commerce industry. We can expect even more innovative and transformative applications as AI technologies evolve and mature. By 2025, at least 90 billion US dollars will be added to consumer goods and AI technologies (Statista, 2024).

- In **2016,** AI became popular in Indian e-commerce with investments in AI by major players like **Flipkart and Amazon India** aggressively adopting machine learning for logistics, supply chain optimisation, and personalised marketing. In **2016, Google** launched **Google Assistant** in India, marking a significant step in AI-driven voice commerce.
- In 2017 **Reliance Jio** launched its e-commerce platform, using AI for hyper-customisation and predictive analytics. In **2017, Flipkart** acquired **Liv.ai**, an AI startup concentrating on speech recognition, to amplify voice-based shopping experiences.
- In **2018, Walmart** acquired a 77% stake in Flipkart, leading to further investment in AI technologies for logistics, customer experience and fraud prevention. **Amazon India** also launched **Alexa-powered voice shopping**, remarkably boosting voice-based e-commerce.
- In **2019, Myntra** introduced **Myntra Insider**, an AI-powered loyalty program that personalises rewards and recommendations.
- **2020:** The COVID-19 pandemic acted as a catalyst in the adoption of AI in e-commerce. Companies like **BigBasket** and **Grofers** rely heavily on AI for distribution chain management, forecasting demand rise and ensuring efficient delivery. The same year, **Amazon India** expanded its AI potential by introducing **Amazon SageMaker** to enable real-time data analysis for personalised shopping experiences.
- In **2021, Tata Digital** acquired a significant share in **BigBasket** and planned to upgrade AI-driven functioning in the grocery section.

- In **2022, Flipkart** launched **Flipkart Labs**, focusing on developing and incorporating AI technologies like immersive commerce and the metaverse into its platform. AI-powered voice assistants and chatbots have become ubiquitous in customer service.
- In **2023**, **ONDC (Open Network for Digital Commerce)** was rolled out across India, focusing on modifying e-commerce. AI plays a crucial role in logistics, dynamic pricing, and personalised recommendations on the web. Myntra also launched the MyFashionGPT search feature powered by ChatGPT to enhance customers' shopping experiences and drive higher engagement on its app.
- In **2024,** the emergence of **Generative AI** in Indian e-commerce, with companies like **Meesho** and **Nykaa** exploring AI-generated content, including product descriptions, marketing materials, and even virtual fashion models.
- In **2025**, Myntra's flagship feature **AI-Powered "MyStylist"** is an advanced AI fashion advisor that analyses your past purchases, browsing history and even your body type (if you choose to provide that data via their new AR body-scanning tool) to deliver hyper-personalised style recommendations. It can compile entire looks for specific occasions, like a "Goa beach party" or a "formal office meeting," acting as a true digital personal shopper. The feature of **Virtual Try-On** has now expanded to a wider range of apparel too. Using the mobile's camera, the augmented reality (AR) feature can now realistically drape selected dresses on your live video feed, greatly reducing return rates.

Key Achievements

- **Voice Commerce:** AI-powered voice assistants like Amazon Alexa and Google Assistant have become integral to e-commerce, enabling customers to shop hands-free through voice commands. This has opened up new avenues for product discovery and purchase.
- **Computer Vision and Augmented Reality (AR):** Advancements in computer vision have led to the integration of AR into e-commerce platforms. Customers can now visualise products in their spaces, enhancing the shopping experience and reducing return rates.
- **Predictive Analytics:** AI-driven predictive analytics have become more accurate, allowing e-commerce businesses to anticipate customer needs, optimise inventory levels, and personalise marketing campaigns.
- **Hyper-Personalisation:** AI algorithms have become capable of delivering highly personalised experiences, tailoring product recommendations, content, and pricing to individual customers based on their preferences, behaviour, and context.
- **AI-Driven Supply Chain Management:** AI has revolutionised supply chain operations, enabling more efficient demand forecasting, inventory management, and logistics. This has resulted in reduced costs and improved customer satisfaction.

Opportunities

- **Ethical AI:** As AI becomes more pervasive, addressing ethical concerns such as bias, privacy, and transparency becomes crucial. Developing ethical frameworks and guidelines will be essential for responsible AI adoption in e-commerce.
- **AI-Powered Customer Service:** AI-powered chatbots and virtual assistants can provide round-the-clock customer support, improving response times and reducing costs. However, ensuring these systems can handle complex customer inquiries and maintain a human-like touch remains challenging.

- **AI-Enabled Product Development:** AI can analyse customer feedback, market trends, and product data to inform the development of new products and features. This can lead to more innovative and customer-centric offerings.
- **AI in Sustainability:** AI can contribute to sustainable e-commerce practices by optimising logistics, reducing waste, and enabling more efficient resource utilisation.

Findings

Early Adoption Phase (2000-2010)

- **Initial AI Applications:** Early AI applications in e-commerce were primarily focused on recommendation systems and personalisation.
- **Limited Capabilities:** AI capabilities were relatively limited during this phase, with recommendation systems often relying on simple rule-based approaches.
- **Data Limitations:** The availability and quality of customer data were constraints, hindering the development of more sophisticated AI models.

Rapid Growth Phase (2011-2015)

- **Advancements in Machine Learning:** Significant advancements in machine learning algorithms and intense learning fueled the growth of AI in e-commerce.
- **Improved Recommendation Systems:** Recommendation systems became more accurate and personalised, leveraging techniques like collaborative filtering and content-based recommendations.
- **The emergence of NLP and Computer Vision:** Natural Language Processing (NLP) and computer vision technologies started to be applied in e-commerce, enabling features like customer support chatbots and image search.
- **Increased Data Availability:** The accumulation of vast amounts of customer data provided fuel for training more powerful AI models.

Maturity and Innovation Phase (2016-Present)

- **Integration of AI Across E-commerce:** AI has become deeply integrated into various aspects of e-commerce, from product discovery and personalisation to supply chain management and customer service.
- **Sophisticated AI Applications:** Developing more sophisticated AI techniques, such as generative AI and reinforcement learning, has led to innovative applications like virtual try-ons, predictive analytics, and autonomous delivery.
- **Ethical Considerations:** The increasing use of AI has raised ethical concerns about bias, privacy, and transparency. Addressing these concerns is crucial for responsible AI adoption in e-commerce.
- **Continuous Innovation:** The e-commerce industry remains a hotbed for AI innovation, with new AI-powered features and solutions emerging regularly.

Conclusion

The progression of AI in the e-commerce industry has been remarkable, with each milestone leading to significant advancements. From early expert systems to cutting-edge deep learning applications, AI has transformed how consumers shop, and businesses operate. As AI technology continues to evolve, we can expect even more innovative and personalised experiences in the future.

References-

1. Chen, Y., Lee, H. L., & Simchi-Levi, D. (2018). The impact of AI on supply chain management. Supply Chain Management Review, 22(1), 31-43.
2. Deng, Y., Zhang, Y., & Li, K. (2019). Artificial intelligence in fraud detection for e-commerce: A review. Expert Systems with Applications, 123, 187-199.
3. Grewal, D., Roggeveen, A. L., & Nordfält, J. (2021). The future of retailing. *Journal of Retailing*, 97(1), 5-17.
4. Huang, L., & Chen, H. (2020). The impact of chatbot technology on customer satisfaction in e-commerce: A literature review. Journal of Retailing and Consumer Services, 55, 102-150.
5. Kumar, A. (2021). *Artificial Intelligence in E-Commerce: Revolutionizing Online Retail*. Journal of Technological Advances, 8(2), 45-59.
6. Li, C., Zhang, Y., & Liu, Y. (2019). The impact of personalised recommendation on customer satisfaction in e-commerce: A meta-analysis. Information Systems Research, 30(4), 1107-1126.
7. Raji, I. D., Smart, A., White, R. N., & Mitchell, M. (2020). Closing the AI accountability gap: Defining an end-to-end framework for internal algorithmic auditing. *Proceedings of the 2020 Conference on Fairness, Accountability, and Transparency*, 33(4), 33-44.
8. Smith, J., & Anderson, P. (2019). *AI and the Future of E-Commerce: A Comprehensive Overview*. International Journal of Digital Commerce, 15(3), 102-118.

websites-

1. https://market.us/report/ai-in-ecommerce-market/?hl=en-GB
2. https://www.statista.com/
3. https://www.statista.com/statistics/1299067/india-data-and-ai-economic-value-add-by-sector/#:~:text=By%202025%2C%20at%20least%2090,billion%20dollars%20to%20India's%20GDP
4. https://en.m.wikipedia.org/wiki/Artificial_intelligence_marketing