
Identifying E-Commerce Processes Is Key to Sustainable Automation Using AI

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Abstract:

Purpose: This study focuses on the analysis of the transformation of e-commerce processes from the AS IS model to TO BE, in particular on the application of artificial intelligence (AI) and global identification standards such as GTIN. The study aims to identify key areas and data in e-commerce that have the potential to implement modern IT solutions supporting sustainable development. The work fills the gap in the literature, taking into account both the aspects of process automation and the challenges related to the transparency and ethics of AI in e-commerce.

Design/Methodology/Approach: The study is based on a qualitative research approach, including a systematic literature review and process analysis using BPMN 2.0 notation. The existing order and delivery process (AS IS) within the Allegro platform was analysed, identifying areas requiring improvement. Then, the TO BE model was developed, taking into account the use of AI and GTIN standards. The analysis process was supported by an expert method, which ensures the replicability of the results and their practical application in various e-commerce environments.

Findings: The study found that integrating AI and GTIN standards significantly improves operational efficiency and sustainability of e-commerce processes. AI supports the automation of key stages, such as generating quotes, optimizing inventory management, and dynamically adjusting prices, which shortens order fulfilment times and increases their accuracy. GTIN enables interoperability of systems, eliminating manual errors and streamlining the exchange of information between process participants. At the same time, challenges related to the ethical use of AI were identified, including the need to ensure transparency of algorithms and the protection of customer data.

Practical Implications: The results of the study have direct application in optimizing e-commerce processes, especially in the context of sustainable development. Automation and standardization of data can support companies in improving operational efficiency, increasing the quality of customer service and reducing costs. Recommendations on the responsible implementation of AI and transparency of algorithms can be valuable advice for

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decision-makers and industry practitioners.

Originality/Value: The study provides an innovative perspective on integrating AI into e-commerce processes, especially in the context of sustainable development. The combination of automation, global identification standards and an ethical approach distinguishes the work from existing studies. The results expand knowledge on the practical application of AI in e-commerce and emphasize the importance of sustainable and responsible strategies in a dynamically developing sector.

Keywords: E-commerce, business process, artificial intelligence, BPMN, sustainability.

JEL Codes: L81, O33, M15.

Paper Type: Research article.

1. Introduction

E-commerce is dynamically developing worldwide, becoming a dominant force shaping the future of retail. Forecasts indicate that by 2025, global sales in this sector will exceed 7 trillion dollars, accounting for 24-25% of total retail sales (Kovalchyk and Kovalchyk, 2021; Orzoł and Szopik-Depczyńska, 2023). In Poland, the e-commerce market also shows significant growth potential, with an estimated annual growth rate of approximately 8% by 2028, outpacing the overall retail market growth forecasted at 6% (Strategyand, 2024).

Alongside the growth of the e-commerce market, technologies and IT solutions are rapidly evolving, already finding applications or poised to be implemented in various areas of electronic commerce (Mandala *et al.*, 2023; Nayyar *et al.*, 2023). The sector's growth potential and increasing customer expectations drive the adoption of increasingly advanced technological solutions (Bawack *et al.*, 2022; Orzoł and Szopik-Depczyńska, 2023). These efforts are primarily motivated by the desire to improve operational efficiency, enhance competitiveness, and provide better customer service (Gupta *et al.*, 2024).

Moreover, the development of these technologies is driven by the need to automate processes, reduce costs, and minimize errors resulting from manual operations. Modern innovations, such as artificial intelligence, data analytics, the Internet of Things, and blockchain (Bawack *et al.*, 2022; Cui *et al.*, 2021; Kalkha *et al.*, 2023; Kovalchyk and Kovalchyk, 2021), enable companies not only to better manage resources but also to effectively address challenges related to sustainable development requirements, including carbon footprint reduction and supply chain optimization (Chen *et al.*, 2024; Criveanu, 2023; Fozooni *et al.*, 2024; Wu *et al.*, 2022).

Despite numerous studies on the dynamic development of e-commerce and the growing importance of new technologies, knowledge and application gaps remain in identifying e-commerce processes that can be optimized using modern IT solutions supporting sustainable development. In response to these challenges, this study focuses on analysing business processes using BPMN 2.0 notation and a literature review to identify key areas and data with the greatest potential for automation through artificial intelligence.

The adopted approach, combining a systematic literature review with process mapping and expert analysis, provides a solid foundation for developing conclusions useful in both theoretical and business practice contexts.

2. Literature Review

E-commerce is undergoing a dynamic transformation, driven by technological advancements and shifting consumer preferences and behaviours. In the face of growing competition, companies operating in the e-commerce sector must continuously adapt their strategies, invest in innovative solutions, and implement new business models that address evolving market needs (Adeniran *et al.*, 2024; Aljarboa, 2024; Kalkha *et al.*, 2023; Ma and Gu, 2024).

Recent studies highlight several key trends shaping the contemporary e-commerce landscape. Firstly, the rapid growth of mobile commerce is evident, fuelled by the increasing use of smartphones for online shopping. Social media also plays a pivotal role, not only facilitating product discovery and recommendations but also enabling consumers to interact actively with brands.

Another significant trend is the development of omnichannel strategies, where companies integrate online and offline channels to deliver consistent shopping experiences. Furthermore, personalization and automation supported by artificial intelligence significantly enhance user experiences, increasing customer satisfaction (Cui *et al.*, 2021; Kovalchyk and Kovalchyk, 2021; Malhotra, 2024; Nathalie *et al.*, 2024; Nayyar *et al.*, 2023; Sahoo *et al.*, 2023).

One of the fastest-growing segments of e-commerce is the marketplace platforms, such as Amazon and Alibaba. Marketplaces are becoming dominant online sales channels by aggregating offers and providing users with a wide selection of products in one place. Additionally, the Direct-to-Consumer (D2C) sales model, where manufacturers sell their products directly to consumers, bypassing intermediaries, is gaining traction.

This approach allows companies to establish closer relationships with customers, which is projected to become a key growth direction for the sector in the coming years. Concurrently, omnichannel strategies are gaining prominence, enabling businesses to merge online and offline sales into a cohesive whole, providing

customers with seamless shopping experiences across platforms (Bernovskis *et al.*, 2024; Kovalchuk and Kovalchuk, 2021; Nodirovna and Sharif o'g'li, 2024; Orzof and Szopik-Depczyńska, 2023).

Modern IT solutions, including artificial intelligence (AI), are transforming e-commerce primarily in two dimensions: customer experience (CX) and sustainability (Bernovskis *et al.*, 2024; Khrais, 2020; Raji *et al.*, 2023; Zhang and Xiong, 2024). The impact of AI on improving CX is particularly evident in areas such as:

- personalization – delivering relevant product or service recommendations based on an analysis of consumer purchasing behaviours, such as browsing history and demographic data, which enhances sales and user satisfaction (Gupta *et al.*, 2024; Krishna *et al.*, 2023; Necula and Păvăloaia, 2023; Rane *et al.*, 2024).
- customer support – providing immediate assistance, answering questions, and resolving issues through the use of chatbots (Khrais, 2020; Pundir *et al.*, 2024; Rane *et al.*, 2024).
- user engagement – giving customers a sense of control over their purchases while delivering personalized marketing messages, promotions, and recommendations (Khrais, 2020; Sheshadri *et al.*, 2024; Zhang and Xiong, 2024).

AI-driven solutions play a critical role in promoting sustainability in e-commerce, particularly through supply chain optimization. AI enables demand forecasting, inventory management, and logistics operations improvements, reducing costs, shortening delivery times, and enhancing customer service quality (Aljarboa, 2024; Chen *et al.*, 2024; Krishna *et al.*, 2023; Mishra and Dutta, 2024; Xiao *et al.*, 2024). Simultaneously, AI helps minimize waste by optimizing packaging and shipping processes, contributing to more efficient resource utilization and reducing environmental impact (Raji *et al.*, 2023).

In a broader context, artificial intelligence and big data analytics in e-commerce support the balance between operational efficiency and ecological responsibility. Integrating AI algorithms into operational management promotes environmentally friendly business models while minimizing energy consumption and environmental impact, aligning with sustainable development goals (Chen *et al.*, 2024; Fozooni *et al.*, 2024).

Multi-method data analysis systems and advanced algorithms can significantly improve data quality and usability while reducing processing costs, enabling more informed and sustainable operational decision-making (Anthoniraj *et al.*, 2022; Elzeheiry *et al.*, 2023).

In the context of product design, AI supports the circular economy by enabling real-

time data analysis, rapid prototyping, and testing. This approach reduces waste and energy consumption (Basingab *et al.*, 2024).

Additionally, AI technologies facilitate precise management of material and product information, enabling remote maintenance and promoting resource reuse and recycling (Ghoreishi and Happonen, 2020). These efforts combine to create harmony between operational efficiency and ecological responsibility in the e-commerce sector, establishing AI as a strategically significant tool for sustainable development (Bernovskis *et al.*, 2024; Criveanu, 2023; Deng and Guo, 2023; Kar *et al.*, 2022; Orzoł and Szopik-Decpzyńska, 2023). This area represents a knowledge gap that continues to require further research.

3. Research Methodology

The entirety of the actual research work was preceded by the identification of the cognitive and application gap. These activities allowed for setting the research goal formulated as: determining the areas and data in e-commerce that have the potential to implement modern IT solutions supporting sustainable development. In the first stage of the research, a systematic review of the literature was carried out relating to key words such as the future of e-commerce, trends in e-commerce, technologies in e-commerce.

In the further part of the study, the process analysis method was used. BPMN 2.0 notation was used (Ragin-Skorecka *et al.*, 2020) to map the existing typical process of ordering and delivering goods on the e-commerce platform. Expert analysis of the AS IS map in connection with the conducted literature analysis as the next stage of the study enabled the identification of areas and data with the potential for automation. Literature analysis, process mapping in accordance with the BPMN 2.0 standard and the expert method were carried out in accordance with the methodological approach, which ensures the replicability of the research.

4. Research Results

A systematic review of the literature allowed us to summarize key trends and areas of application of IT solutions in e-commerce. Based on the literature on the subject, the following tasks can be assigned to the technology (Bawack *et al.*, 2022; Bernovskis *et al.*, 2024; Deng and Guo, 2023; Fozooni *et al.*, 2023; He *et al.*, 2024; Valencia-Arias *et al.*, 2024):

- Artificial intelligence – product recommendations (personalization), customer service (chatbots), price optimization (based on market data and customer behavior), inventory management (demand prediction), sentiment analysis (analysis of customer opinions and reviews),
- Big Data – personalization (learning about customer behaviour and preferences), supply chain optimization (demand prediction and inventory

- management), market trend analysis,
- Internet of Things – tracking shipments (in real time), smart homes (ordering products using smart speakers or other home devices), collecting data about products and their users,
- Blockchain – transaction security, customer digital identity management, decentralization of e-commerce platforms.

From the point of view of sustainable development, research areas and market trends can be identified, presented in Table 1.

Table 1. AI research in e-commerce in the context of sustainable development

Research area	Description
Sustainable Logistics and Supply Chain	Optimizing delivery routes, warehouse management and reducing CO ₂ emissions and energy consumption
Waste Reduction	Minimizing waste through intelligent packaging processes and packaging design
Circular Economy	Promoting recycling and reuse of products throughout their life cycle
Energy Efficiency	Reducing energy consumption in e-commerce processes, especially in data centers and logistics
Sustainable Personalization	Personalizing products and services in a way that takes into account energy efficiency and waste minimization
Environmental Data Management	Collecting and analyzing data on the environmental impact of e-commerce processes
Supply Chain Optimization	Using AI to predict demand and manage inventory in an ecological way
Ethical and Transparent AI	Using transparent and responsible algorithms supporting sustainable development
Decentralization and P2P Economy	Creating trading platforms enabling exchange between users without intermediaries
Consumer Behavior Analytics	Examining customer preferences from an ecological perspective and the impact of purchasing decisions on the environment
Production Process Optimization	Minimizing waste and optimizing resource consumption in production
Green Logistics	Solutions supporting an ecological approach to deliveries and logistics in e-commerce

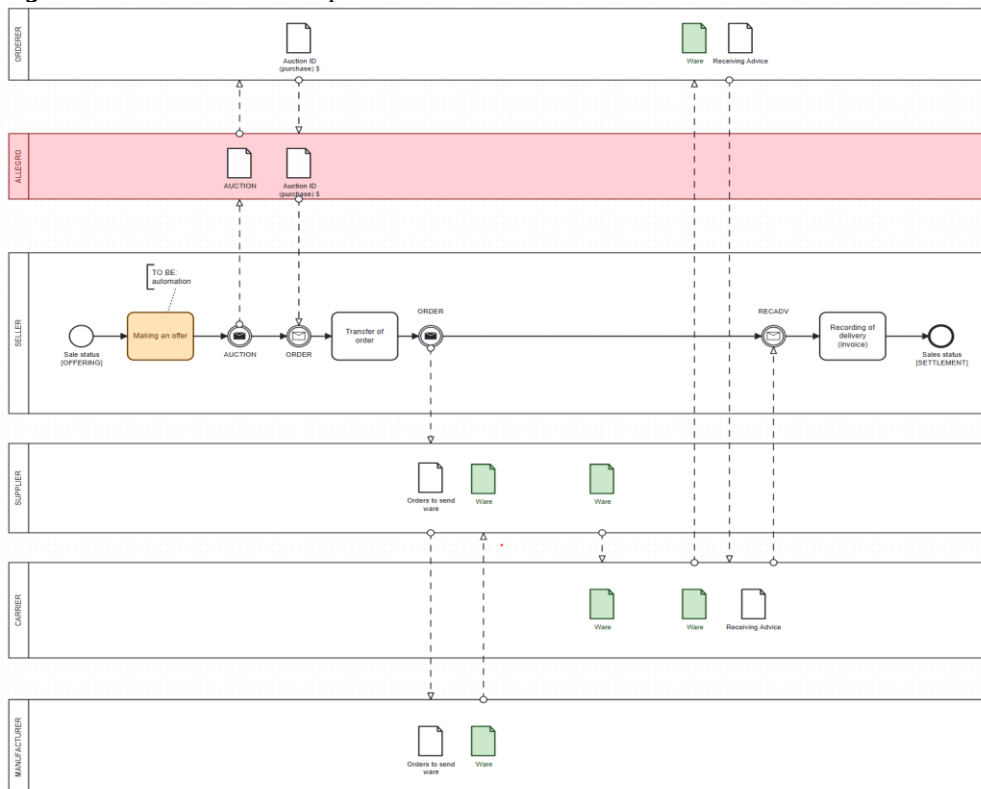
Source: Authors' calculations based on Bernovskis et al., 2024; Deng and Guo, 2023; Fozooni et al., 2023.

The applicability of the above solutions in e-commerce activities requires a process-based view of the e-commerce process implementation. Based on the authors' expert experience and the process presented by Mandala et al. (2023), an AS IS map was created using the BPMN 2.0 standard (Figure 1). The process is presented in BPMN 2.0 notation and describes the AS IS state of the execution of activities from order to delivery on the e-commerce platform. The AS IS map shows the classic model of ordering, sales, delivery and settlement, which involves many participants, such as:

- Orderer: the customer who initiates the purchase of goods,
- Allegro (marketplace, the largest Polish e-commerce platform): the intermediary of the platform on which the purchase is made,
- Seller: the participant responsible for developing the offer and selling the goods,
- Supplier: the entity that orders the shipment of the goods,
- Carrier: delivers the goods to the Ordering Party,
- Manufacturer: supplies the Supplier with the goods.

The process begins with the Seller, who prepares a sales offer. Then the offer is published on the Allegro platform. The Customer, as the Ordering Party, interacts with the platform by placing an order. After accepting the order, the Seller passes on the appropriate information to the Supplier, and the Supplier orders the shipment to the Carrier. The goods reach the Customer, and the Carrier informs about the delivery. The Seller records the delivery, and the process ends with the settlement of the sale. This process is time-consuming and requires manual actions on the part of each participant. There is a multi-stage exchange of information between entities, which increases the time needed to complete the order.

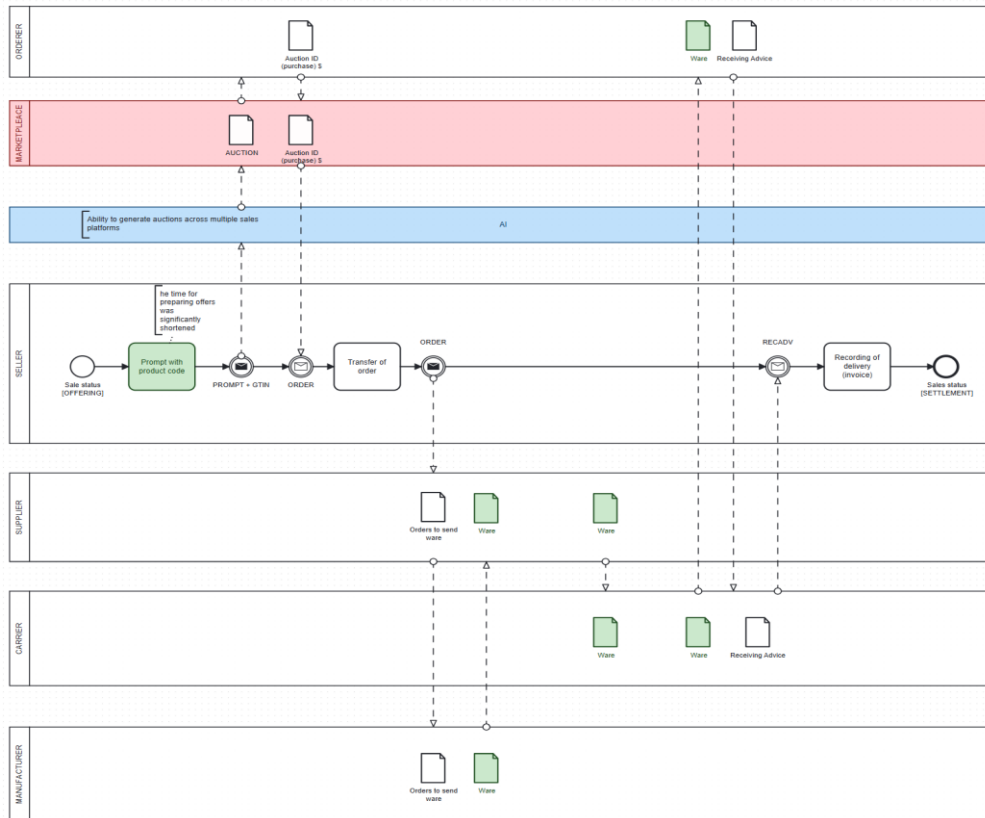
Figure 1. AS IS Process Map



Source: Authors' calculations.

Then the process was analysed in terms of complexity, duration and repeatability of individual activities. Particular attention was paid to stages requiring a lot of manual work, such as processing order data by the Seller or coordinating activities between the Supplier and the Carrier. The TO BE process presented in Fig. 2 introduces automation of many aspects of the operation and shortens the time for developing offers.

Figure 2. TO BE Process Map



Source: Authors' calculations.

A significant change presented in Figure 2 is the use of artificial intelligence and distributed auction generation mechanisms on various sales platforms. AI plays a key role in streamlining the preparation of sales offers by automating the processes related to their creation. The aim of these activities is not only to quickly generate auctions, but also to make optimized purchasing decisions and accelerate the flow of information between process participants.

In the target model (TO BE), artificial intelligence supports the seller by automatically generating offers based on product codes and market data. Thanks to this, the process of preparing and publishing offers on platforms such as Allegro or

Marketplace becomes more effective and less time-consuming. In addition, AI plays a significant role in the optimization of delivery orders. Automation of flows between the supplier and the carrier allows for immediate transfer of orders and information about their implementation, significantly reducing the need for manual intervention and minimizing errors.

5. Discussion

The conducted literature analysis and the mapping of the e-commerce process indicate the immense potential of artificial intelligence (AI) and big data in transforming the e-commerce sector, especially in the context of sustainable development. The application of AI in the TO BE model, which includes process automation, a multi-platform approach, and the use of identification standards such as GTIN (Global Trade Item Number), aligns with trends presented in the literature.

As noted by Fozooni *et al.* (2023), key applications of big data in e-commerce include supply chain coordination, product innovation, and business model optimization. The results of the analysis demonstrate that these areas can be effectively supported through automation and data integration on modern trading platforms.

One of the key aspects of process transformation is the use of AI-based recommendation systems. As highlighted by Necula and Păvăloaia (2023), such systems not only enhance customer experiences through offer personalization but also reduce shopping time and support purchasing decisions. The TO BE model, incorporating automated offer generation by AI, aligns with these trends, enabling dynamic price adjustments and inventory management optimization. However, according to the authors' remarks, it is necessary to further address ethical aspects such as algorithm transparency and customer data protection.

An important challenge emerging from the literature is the issue of AI ethics and transparency. As noted by Xiao *et al.* (2024), phenomena such as algorithmic discrimination can lead to negative customer experiences, such as the "kill-off phenomenon," where pricing algorithms set prices based on a user's payment capacity. In the TO BE model, a key challenge will therefore be ensuring transparency in AI-supported decision-making processes, which can be achieved through the use of Explainable AI (XAI) and standards such as blockchain to monitor interactions among process participants.

From an environmental perspective, the application of AI and big data in the TO BE model can also support sustainable development goals. Wu *et al.* (2022) emphasize that the operational carbon footprint of AI must be minimized through hardware and software optimization, which should be considered in the further implementation of this model. Additionally, Mohammed *et al.* (2023) and Reddy and Nalla (2023) point out that AI and big data can promote environmental sustainability in the

context of supply chain optimization, waste reduction, and environmental data management. The TO BE model incorporates these elements but requires further research into their full implementation and scalability.

The research findings underline significant benefits of incorporating AI and GTIN standards in e-commerce processes. Key stages such as offer generation, inventory management, and price optimization demonstrate marked improvements in efficiency and error reduction. The integration of GTIN standards facilitates seamless interoperability and information exchange among process participants, leading to higher operational precision. Furthermore, the TO BE model highlights the role of AI in enhancing supply chain logistics, which not only reduces costs but also contributes to sustainability goals through lower CO₂ emissions. These findings provide a strong foundation for implementing innovative solutions across the e-commerce sector.

6. Limitations of the Study

The study is limited by its focus on a single process mapped to a key e-commerce platform, which may limit the generalizability of the results to other platforms and business models.

Furthermore, ethical aspects such as data privacy and information security, which are indicated in studies such as Singh (2021) as key to responsible AI implementation in e-commerce, were not considered. Failure to address these issues may impact the full understanding of the risks associated with automation. The results should therefore be interpreted with these limitations in mind.

7. Conclusions

The transformation of the e-commerce process from AS IS to TO BE highlights the numerous benefits of AI and Big Data, both in the operational and environmental context.

However, the literature analysis and research findings indicate the need for greater consideration of ethical and environmental aspects, which remains an open field for further research and development of practices in this field. Future research should focus on developing mechanisms supporting the transparency, scalability and accountability of AI in the e-commerce sector.

References:

- Adeniran, A.O., Sidiq, O.B., Oyeniran, G.T., Adenira, A.A. 2024. Sustainability impact of digital transformation in e-commerce logistics. *International journal of Innovation in Marketing Elements*, 4(1).
- Aljarboa, S. 2024. Factors influencing the adoption of artificial intelligence in e-commerce

- by small and medium-sized enterprises. *International Journal of Information Management Data Insights*, 4(2), 100285.
- Basingab, M.S., Bukhari, H., Serbaya, S.H., Fotis, G., Vita, V., Pappas, S., Rizwan, A. 2024. AI-based decision support system optimizing wireless sensor networks for consumer electronics in e-commerce. *Applied Sciences*, 14(12), 4960.
- Bawack, R.E., Wamba, S.F., Carillo, K.D.A., Akter, S. 2022. Artificial intelligence in e-commerce: A bibliometric study and literature review. *Electronic Markets*, 32(1), 297-338.
- Bernovskis, A., Sceulovs, D., Stibe, A. 2024. Society 5.0: Shaping the future of e-commerce. *Journal of Open Innovation: Technology, Market, and Complexity*, 10(4), 100391.
- Chen, X., Guo, L., Islam, Q.U. 2024. Revolutionizing e-commerce logistics: AI-driven path optimization for sustainable success. *International Journal of Information Technologies and Systems Approach (IJITSA)*, 17(1), 1-15.
- Criveanu, M.M. 2023. Investigating digital intensity and e-commerce as drivers for sustainability and economic growth in the EU countries. *Electronics*, 12(10), 2318.
- Deng, Z., Guo, M. 2023. Research on the impact of the application of artificial intelligence technology on the sustainable development of mobile e-commerce. *Benchmarking: An International Journal*.
- Elzeheiry, S., Gab-Allah, W.A., Mekky, N., Elmogy, M. 2023. Sentiment analysis for e-commerce product reviews: Current trends and future directions.
- Fozooni, A., Nazari, S., Jamalpur, A. 2024. Prioritizing big data applications in E-commerce considering sustainable development indicators. *Journal of Future Sustainability*, 4(3), 169-178.
- Ghoreishi, M., Happonen, A. 2020. New promises AI brings into circular economy accelerated product design: a review on supporting literature. In: *E3S Web of Conferences*, 158, p. 06002. EDP Sciences.
- He, X., Liu, Y. 2024. Knowledge evolutionary process of Artificial intelligence in E-commerce: Main path analysis and science mapping analysis. *Expert Systems with Applications*, 238, 121801.
- Kalkha, H., Khiat, A., Bahnasse, A., Ouajji, H. 2023. The rising trends of smart e-commerce logistics. *IEEE Access*, 11, 33839-33857.
- Kar, A.K., Choudhary, S.K., Singh, V.K. 2022. How can artificial intelligence impact sustainability: A systematic literature review. *Journal of Cleaner Production*, 376, 134120.
- Khrais, L.T. 2020. Role of artificial intelligence in shaping consumer demand in E-commerce. *Future Internet*, 12(12), 226.
- Kovalchyk, O., Kovalchyk, I. 2021. Analysis of the main global trends for e-commerce. *Електронне наукове фахове видання "Соціально-економічні проблеми і держава"*, 2(25), 541-549.
- Krishna, I.M., Avinash, C.S.N., Jaganadham, R., Durga, A.J.L., Madhulika, Y., Rakesh, K. V.V.S. 2023. The impact of artificial intelligence effect on e-commerce: A framework for key research areas. In: *2023 IEEE International Conference on ICT in Business Industry and Government (ICTBIG)* (pp. 1-6). IEEE.
- Ma, X., Gu, X. 2024. New marketing strategy model of e-commerce enterprises in the era of digital economy. *Heliyon*, 10(8).
- Malhotra, G., Kharub, M. 2024. Elevating logistics performance: harnessing the power of artificial intelligence in e-commerce. *The International Journal of Logistics Management*. DOI:10.1108/ijlm-01-2024-0046. Corpus ID: 273739696.

- Mishra, A., Dutta, P. 2024. Return management in e-commerce firms: A machine learning approach to predict product returns and examine variables influencing returns. *Journal of Cleaner Production*, 477, 143802.
- Mohammed, M.A., Ahmed, M.A., Hacimahmud, A.V. 2023. Data-driven sustainability: Leveraging big data and machine learning to build a greener future. *Babylonian Journal of Artificial Intelligence*, 2023, 17-23.
- Nathalie, J., Jacqueline, G., Yusuf, N.A., Ming, L.W. 2024. Optimizing digital business processes through artificial intelligence: A case study in e-commerce systems. *ADI Journal on Recent Innovation*, 6(1), 89-98.
- Nayyar, J.S., Khosla, T., Saini, V.K. 2023. Trend analysis of e-commerce. *International Journal for Research in Applied Science and Engineering Technology (IJRASET)*, 11(5).
- Necula, S.C., Păvăloaia, V.D. 2023. AI-driven recommendations: A systematic review of the state of the art in e-commerce. *Applied Sciences*, 13(9), 5531.
- Nodirovna, M.S., Sharif o'g'li, A.S. 2024. E-commerce trends: Shaping the future of retail. *Academica One, Open Herald: Periodical of Methodical Research*, 2(3), 46-49.
- Orzoł, M., Szopik-Depczyńska, K. 2023. Development trends in e-commerce sector. *Procedia Computer Science*, 225, 4157-4166.
- Pundir, S., Garg, H., Singh, D., Rana, P.S. 2024. A systematic review of supply chain analytics for targeted ads in e-commerce. *Supply Chain Analytics*, 100085.
- Ragin-Skorecka, K., Nowak, F. 2020. Use of Google's ecosystem to improve efficiency of selected business processes. In: J. Duda, I. Skalna (Eds.), *Functioning and development of enterprises*, 29-35. AGH University of Science and Technology.
- Raji, M.A., Olodo, H.B., Oke, T.T., Addy, W.A., Ofodile, O.C., Oyewole, A.T. 2024. E-commerce and consumer behavior: A review of AI-powered personalization and market trends. *GSC Advanced Research and Reviews*, 18(3), 066-077.
- Rane, N., Choudhary, S., Rane, J. 2024. Artificial intelligence and machine learning in business intelligence, finance, and e-commerce: A review. *Finance, and E-commerce: A Review*.
- Reddy, V.M., Nalla, L.N. 2023. The future of e-commerce: How big data and AI are shaping the industry. *International Journal of Advanced Engineering Technologies and Innovations*, 1(03), 264-281.
- Sahoo, A.K., Gulavani, S., Manwal, M., Medidha, R., Bhaskar, T., Manohara, M. 2023. Faulty diagnostics model in e-commerce using AI. *Measurement: Sensors*, 25, 100634.
- Sheshadri, T., Shelly, R., Sharma, K., Sharma, T., Basha, M. 2024. An empirical study on integration of artificial intelligence and marketing management to transform consumer engagement in selected PSU Banks (PNB and Canara Banks). *Naturalista Campano*, (1), 463-471.
- Singh, R. 2021. A study of artificial intelligence and e-commerce ecosystem—a customer's perspective. *International Journal of Research in Engineering, Science and Management*, 4(2), 78-87.
- Strategyand. 2024. E-commerce w Polsce: Konkurencja i rosnące oczekiwania napędzają rozwój. PwC. <https://www.strategyand.pwc.com/pl/pl/publikacje/2024/e-commerce-w-polsce.html>.
- Valencia-Arias, A, Uribe-Bedoya, H, González-Ruiz, J.D., Santos, G.S., Ramírez, E.C. 2024. Artificial intelligence and recommender systems in e-commerce. Trends and research agenda. *Intelligent Systems with Applications*, 200435.

- Wu, C.J., Raghavendra, R., Gupta, U., Acun, B., Ardalani, N., Maeng, K, Hazelwood, K. 2021. Sustainable AI: Environmental implications, challenges and opportunities. arXiv preprint arXiv:2111.00364.
- Xiao, B., Tang, M. and Xiong, Y. Applications and ethical challenges of artificial intelligence technologies in e-commerce. *Applied mathematics and nonlinear sciences*, 2024, Sciendo, 9(1)
- Zhang, Q., Xiong, Y. 2024. Harnessing AI potential in E-Commerce: improving user engagement and sales through deep learning-based product recommendations. *Current Psychology*, 43(38), 30379-30401.