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Typology of technologies in retail

Tipología de tecnologías en el comercio minorista

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Abstract

This article aims to classify and systematize the technologies used in the retail industry, addressing the growing need for a comprehensive framework to understand their integration. The study utilized a literature review and content analysis of academic papers, industry reports, and case studies, focusing on technology classifications based on functionality, impact on stakeholders, and implementation stages. The analysis resulted in a new classification system that categorizes retail technologies according to their application in online versus offline channels, the company's strategic approach, and the stage of the purchasing path. This framework provides a holistic understanding of how different technologies are utilized in retail, offering practical insights for retailers to enhance their technological integration strategies. The conclusion emphasizes the importance of adapting to technological advancements to maintain market leadership in the competitive retail landscape.

Keywords: Retail, Technology, Technology Classification, Economics, Stakeholders.

Resumen

Este artículo tiene como objetivo clasificar y sistematizar las tecnologías utilizadas en la industria minorista, abordando la creciente necesidad de un marco integral para comprender su integración. El estudio aprovechó una revisión de la literatura y un análisis de contenido de artículos académicos, informes de la industria y estudios de casos, centrándose en clasificaciones de tecnología basadas en la funcionalidad, el impacto en las partes interesadas y las etapas de implementación. El análisis dio como resultado un nuevo sistema de clasificación que clasifica las tecnologías minoristas según su aplicación en los canales en línea versus fuera de línea, el enfoque estratégico de la empresa y la etapa del proceso de compra. Este marco proporciona una comprensión holística de cómo se utilizan las diferentes tecnologías en el comercio minorista, ofreciendo conocimientos prácticos para que los minoristas mejoren sus estrategias de integración tecnológica. La conclusión enfatiza la importancia de adaptarse a los avances tecnológicos para mantener el liderazgo del mercado en el competitivo panorama minorista.

Palabras claves: Retail, Tecnología, Clasificación de Tecnologías, Economía, Stakeholders.

Introduction

The retail industry has undergone significant transformation over the past few decades, driven largely by technological advancements (Panasenko et al., 2023). From the early days of simple point-of-sale systems to the current era of artificial intelligence, big data analytics, and augmented reality, technology has become an integral part of retail operations (Abdullaev et al., 2023). These advancements have not only reshaped how retailers interact with customers but have also streamlined internal processes, improved supply chain management (Safiullin et al., 2024), and enhanced decision-making capabilities (Abdullayev et al., 2025; Balova et al., 2022). The digital revolution, accelerated by the widespread adoption of mobile devices and the Internet of Things (IoT), has made it imperative for retailers to integrate cutting-edge technologies to stay competitive (Gladilina et al., 2023). This evolution has led to various approaches in classifying retail technologies, which serve different functions depending on their target – be it customers, employees, or suppliers. Understanding and systematizing these technologies is crucial for retailers aiming to maintain their market leadership in this rapidly evolving landscape (Gladilina et al., 2023).

In the era of digitalization, the issue of technology implementation in retailing is becoming very relevant (Kiseleva et al., 2023; Voronina et al., 2023). There are many studies examining the directions of technology implementation by retail chains (Panasenko et al., 2022). Some authors classify technologies, depending on who their action is directed at - focused either on the buyer, or on employees, or on suppliers. Other authors classify technologies according to what action they are aimed at. For example, entertainment, training, and increased engagement. The third area of technology classification in retail is related to their chronological actual implementation in the activities of retail chains.

This article provides a comprehensive overview of approaches to technology classification in retail in order to develop our own approach to such classification.

Methodologies and Data

This study employed a comprehensive literature review and content analysis to explore and classify the various technologies utilized in the retail sector. Authors study existing academic papers, industry reports, and case studies focused on technology implementation in retail. Sources were selected based on their relevance, publication date (emphasizing recent studies), and contribution to the field.

The collected data was then analyzed to identify common themes and principles in the classification of retail technologies. Key categories were derived based on the functionality of the technologies, their impact on different stakeholders (customers, employees, suppliers), and their implementation stage within retail operations.

In addition to the literature review, the study also involved the creation of visual models to illustrate the classification frameworks. These models were designed to offer a clear and structured overview of how different technologies are applied in retail, based on the various criteria identified during the analysis.

Results and discussion

Shankar et al. (2021) identify areas of technology use in retailing. First, the authors consider two types of stakeholders – employees and buyers. From the point of view of employees, technology is aimed at improving their efficiency and productivity. From the buyers' point of view, technology affects their buying experience, purchase, satisfaction and loyalty. Secondly, the authors classify the technologies used by retailers themselves and those aimed at suppliers. Speaking about suppliers, the authors touch on online commerce and mention technologies that increase the speed of delivery. Retailers themselves use technology to increase sales, market share, and efficiency (Figure 1).

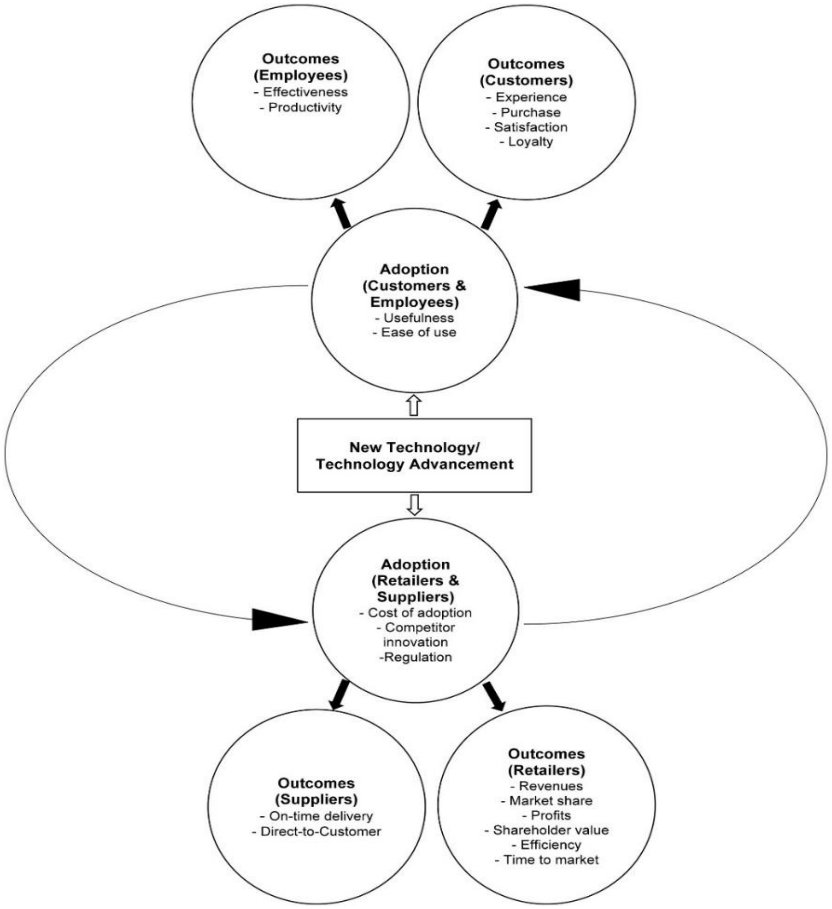

Figure 1. The usage of technology in retailing

The authors propose the following classification of technologies used in retail: customer-oriented, employee-oriented, and supplier-oriented technologies. These technologies are used by consumers and help retailers improve their interaction with goods, services or brands. Examples include mobile devices, wearables, smart speakers, augmented reality, virtual reality and MR systems, chatbots, smart mirrors and payment technologies. Examples of employee-oriented technologies include mobile devices, handheld scanners, price scanners, Internet of Things, RFID and augmented reality technologies, as well as smart mirrors. Work-from-home technologies (video calling services, instant communication tools, project management platforms and digital assistants) have gained momentum during the pandemic. Examples of vendor-oriented technologies include the Internet of Things, RFID, payments, and blockchain. Blockchain technology can improve contracts between supplier and retailer, inventory management and supply chain efficiency.

Har et al. (2022) give the following stage of the use of technology in retail (Figure 2).

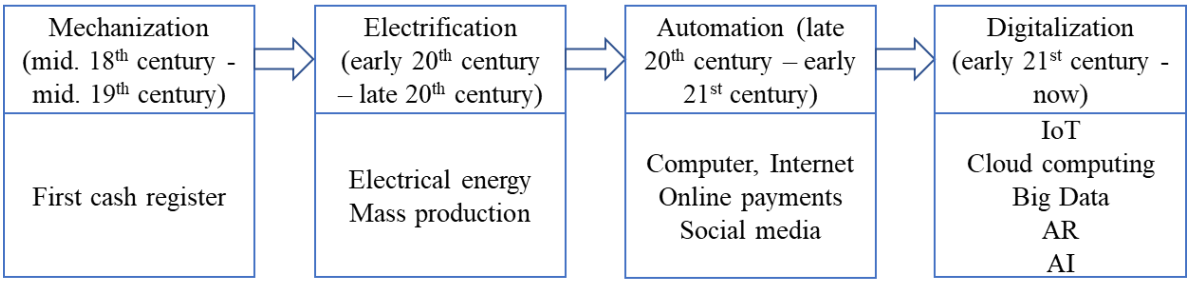

Figure 2. Technology implementation stages

- The Internet of Things (IoT) is a network of intelligent physical objects (sensors, computers, machines, real estate and products) that interact with each other, the Internet and applications, network architecture. IoT allows you to track, monitor and provide customers with real-time location data and order alerts. Virtual assistants such as Alexa, Siri and Google Assistant will inform you about the availability of goods in nearby stores; Smart beacons (Bluetooth radio transmitters) can detect when people are passing by a store and then send them notifications on their phones about it. In addition, IoT also allows you to predict, replenish and allocate resources, search for suppliers, manage orders and perform operations to fulfill them, as well as carry out logistics,

- RFID is a technology that uses radio waves to transmit data from an electronic chip, also known as an RFID tag or label, attached to an object, a reader to track and identify the object. RFID technologies are being widely implemented in supply chains in order to reduce the number of cases of absence of goods in stock, as well as accelerate the process of inventory turnover and replenishment.

- Big data analytics is a method of evaluating a huge amount of data, which allows you to make decisions based on their data, predict, and can be used in inventory management.

- Artificial intelligence (AI) is the ability of a machine to recognize, remember, learn and discover new things through data mining. For example, Alibaba's Cainiao network simplifies retailers' supply chains with an intelligent AI-enabled inventory system that connects online and offline stores, with physical storefronts acting as a distribution center.

- Augmented Reality (AR). According to a Deloite survey, most companies are currently using augmented reality technology to enhance the consumer experience.

- Cloud computing - refers to the provision of computing power, data storage resources, software and other information technology resources on demand via the Internet using the platform. Transaction data is analyzed based on customer movements online or in-store, and retailers gain a deeper understanding of consumer behavior and preferences.

- Machine learning consists of "methods or algorithms designed to study the underlying patterns of data and make predictions based on these patterns." In particular, training takes place during a training session to complete a task, and success is judged using certain performance indicators. The rapid development of machine learning has led to the need for human understanding and interpretation of information. Wang et al. We investigated how retailers can use machine learning at different stages of making a purchase. At the first stage of selecting suppliers and manufacturers and forming an assortment, machine learning can be used to analyze consumer activity on social networks to model customer needs. At the purchase stage (selection, ordering of goods), machine learning can determine what is being sold in real time for more effective forecasting. Machine learning algorithms allow retailers to identify the likelihood of customer churn using data from loyalty cards. Machine learning is used in retail to analyze customer feedback, analyze messages on online forums in order to identify factors in consumer decision-making and assess consumer sentiment.

Roggeveen et al. (2020) provide a different typology of technologies used in retail, based on the customer's path (Figure 3).

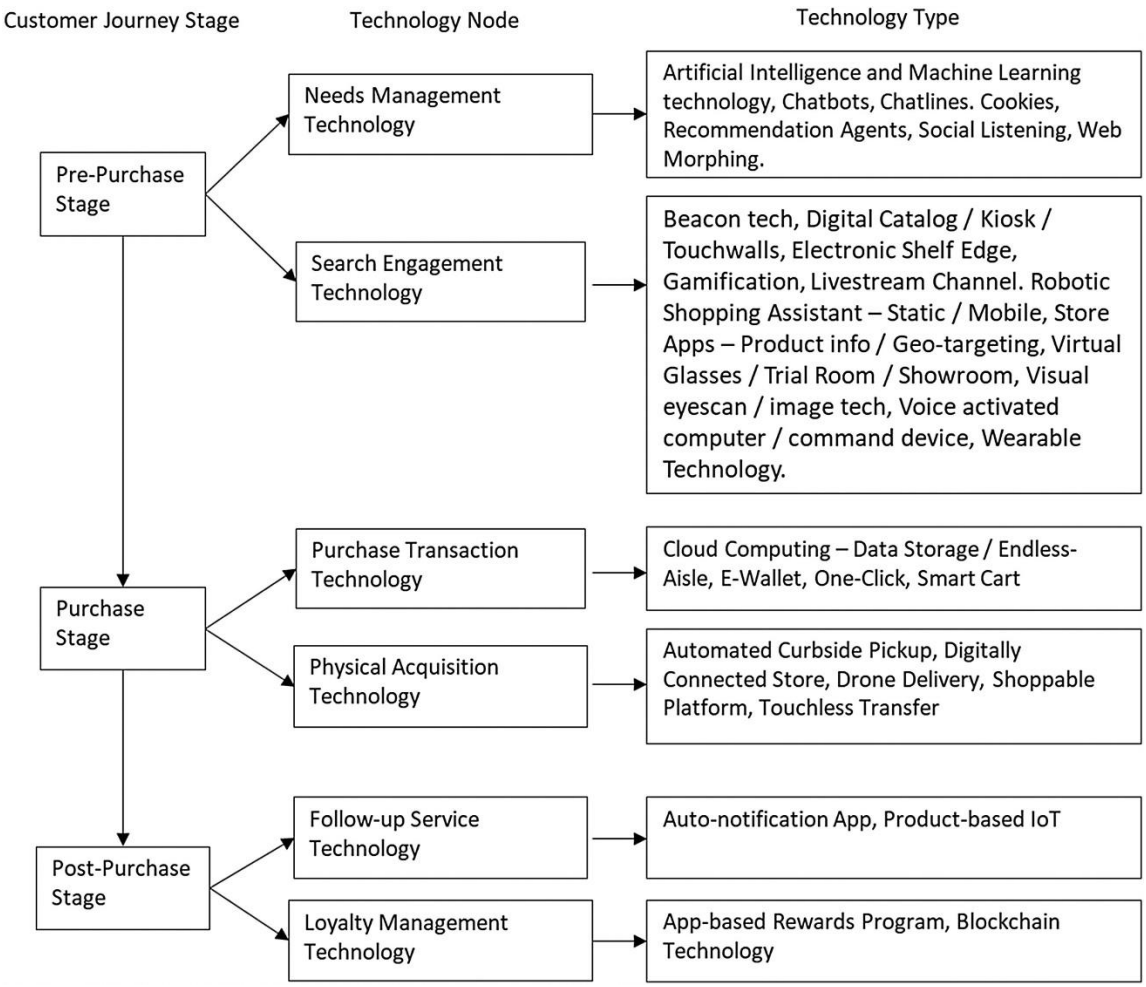

Figure 3. Classification of technologies used in retail

Tan et al. (2022), considering the use of augmented reality, suggests another principle of technology classification: to entertain, educate, evaluate, and increase engagement.

By entertainment, the authors understand the opening of new AR opportunities for marketers to create impressions. For example, Walmart placed special Marvel themed storefronts in its stores. AR is also an effective means of delivering content and information to customers, reflecting a learning function. For example, Toyota and Hyundai have used AR to showcase key features and innovative technologies in a vibrant and visually appealing way. Walgreen's and Lowe's have implemented navigation in stores through mobile apps, prompting

directions and telling about promotions. By evaluation, we mean an idea of what objects would look like in the real world. For example, the IKEA Place app uses augmented reality to provide customers with the opportunity to preview pieces of furniture in the house. Uniqlo and Topshop have virtual fitting rooms. BMW and Audi used augmented reality to demonstrate three-dimensional visual images of car models. Finally, augmented reality can be used to improve and rethink the perception of products after they are purchased (increasing engagement). For example, LEGO has recently released several sets of bricks that are specifically designed to combine physical and virtual gameplay.

Retail chains are developing different store formats, turning into integrated retailers focused on digital technology. Gauri et al. (2021) explore the technologies used in retail from the perspective of offline and online players and various retail formats (Figure 4).

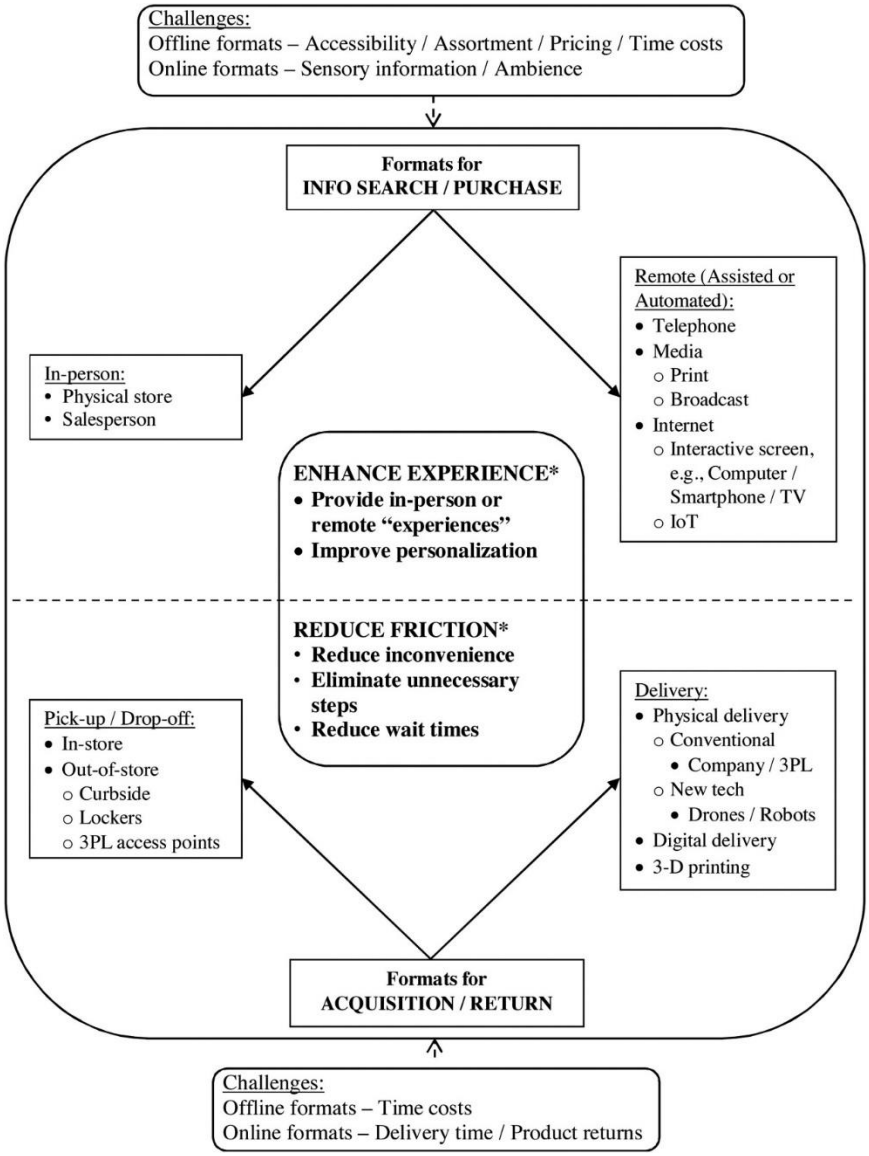

Figure 4. Technologies used by retail store formats

Based on the study of the theoretical foundations of the use of technologies in retail, the author of the article has compiled his own generalizing classification of technologies in retail (Figure 5).

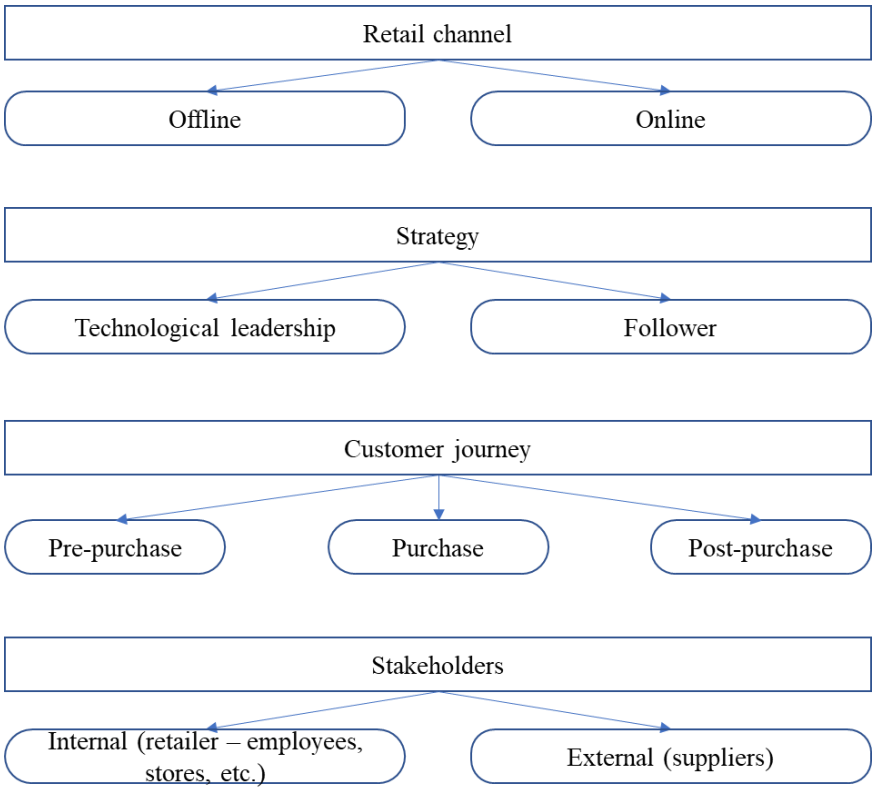

Figure 5. Typology of technologies in retailing

Source: compiled by the author

This classification assumes the following: firstly, retailers can use different technologies depending on which channel they work in – online or offline. Secondly, the introduction of technologies depends on the company's strategy – leading (the introduction of advanced technologies first and the availability of investments for this) or catching up (implementation after others). Thirdly, the use of technology differs at different stages of the purchasing path. The fourth factor is stakeholders, which can be internal (staff, shops) or external (suppliers, authorities).

Conclusion

This article provides an overview of theoretical approaches to the technologies used in retail, on the basis of which the author's classification of factors influencing the introduction of technology by retailers is compiled. Four components of technology implementation are highlighted: 1 - retailers can use different technologies depending on which channel they work in – online or offline; 2 - the

introduction of technologies depends on the company's strategy – leading (the introduction of advanced technologies first and the availability of investments for this) or catching up (the introduction after others); 3 - the use of technology differs at different stages of the purchasing path; 4 – stakeholders, which can be internal (staff, stores) or external (suppliers, authorities).

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