Augmenting Retail Reality, Part A

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Augmenting Retail Reality, Part A

Blockchain, AR, VR, and the Internet of Things

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Preface

In an era marked by unprecedented technological advancements, the retail industry is at the forefront of a transformative journey. *Augmenting Retail Reality, Part A: Blockchain, AR, VR, and the Internet of Things* delves into the dynamic interplay between cutting-edge technologies and the evolving landscape of retail commerce. This book serves as a comprehensive guide for retailers, researchers, students, and technology enthusiasts, exploring how innovations such as the internet of things (IoT), blockchain, robotics, augmented reality (AR), virtual reality (VR), and other emerging technologies are reshaping the retail sector.

The genesis of this book is rooted in the recognition that technology is not merely an auxiliary component but a fundamental driver of change in retail. As the digital revolution continues to accelerate, retailers must navigate a complex and rapidly evolving environment where customer expectations are constantly shifting, and new opportunities for growth are continually emerging. This publication is a response to the urgent need for an in-depth examination of how these technologies are transforming customer experiences, operational efficiencies, and business models within the retail industry.

Our journey begins with an exploration of the IoT's role in linking supply and demand in retail. This foundational chapter sets the stage for understanding how IoT enables a seamless integration of customer touchpoints, thereby enhancing the shopping experience and optimising supply chain operations. The subsequent chapters delve into the transformative power of blockchain and cryptocurrencies, fortifying payment gateway security, and the rise of Industry 4.0 technologies that are driving the future of smart retail.

AR and VR take centre stage as we examine their profound impact on creating immersive shopping environments and enhancing customer engagement. We explore the dynamic relationship between employees and artificial intelligence (AI)-powered service robots, highlighting the collaborative potential and operational efficiencies that these technologies bring to retail settings. Additionally, this book addresses the convergence of IoT and over-the-top platforms, offering insights into how digital content distribution is being revolutionised.

The narrative is enriched by practical examples, success stories, and best practices from industry leaders. Each chapter provides a detailed analysis of current trends, challenges, and opportunities, offering readers a holistic understanding of the technological landscape in retail. By bridging the gap between theoretical insights and real-world applications, this book empowers readers to make informed decisions and drive innovation within their own spheres of influence.

Augmenting Retail Reality: Blockchain, AR, VR, and the Internet of Things is not just a compilation of technological insights; it is a beacon guiding retailers towards a future where technology and commerce seamlessly merge. As we stand at the cusp of this new era, it is imperative to embrace the possibilities that these technologies offer. This book is dedicated to all those who seek to understand, navigate, and lead in the ever-evolving world of retail technology.

We extend our deepest gratitude to the ***contributors*** whose expertise and insights have made this publication possible. Their dedication to exploring the frontiers of retail technology has been instrumental in shaping the comprehensive and forward-looking narrative presented in these pages. We hope that this book will serve as an invaluable resource, inspiring innovation and fostering a deeper understanding of the transformative potential of technology in retail.

Welcome to the future of retail.

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Chapter 1

Linking Supply and Demand in Retail Through the Internet of Things (IoT)

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Abstract

The development of Internet of Things (IoT) is revolutionising the retail sector with innovation. With the help of IoT, retailers can now offer shoppers a personalised, interactive shopping experience, making it easier for them to find what they need and discover new products. Consequently, this is generating fresh prospects and propelling the sector's expansion. The distribution chain in retail provides the products and information that enable customers to learn about products through various channels other than the ones they use to buy them. Keeping up with the rapidly changing demand and supply necessitates a sophisticated inventory and supply chain operation, in addition to the integration of all customer touchpoints. Because it enables businesses to rebalance supply and demand, the IoT has the potential to be a key component of channel integration. This chapter offers a strategic framework for classifying IoT initiatives on an opportunity map and differentiating them according to their primary area of impact and value creation. This chapter uses the enabling capabilities of the IoT to support adoption.

Keywords: IoT; retailing; eshop; supply; demand; retail; linking supply and demand

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1. Introduction

The IoT has transformed the retail sector, enhancing the overall shopping experience for consumers and merchants alike. Fig. 1.1 represents the several IoT-driven solutions in retail (Elizabeth, 2023). The IoT is significantly reshaping the dynamics of supply and demand. Retailers' business operations and customer interactions have been completely transformed by IoT technologies, characterised by interconnected devices and sensors. The potential for IoT integration to enhance transparency and efficiency in supply chain management has garnered attention. The use of IoT-enabled sensors for real-time tracking and monitoring of goods throughout the supply chain helps minimise stockouts and overstock scenarios, reduces delays, and improves logistics while enabling predictive analytics for inventory management. The potential applications and business implications of blockchain technology often lead to debates. Min (2019) explains how blockchain technology can make supply chains more resilient during periods of heightened risk and uncertainty. The IoT will consist of billions of devices equipped with sensors, actuators, and possibly even voices. This integration allows for the identification, capture, collection, and management of continuous data from billions of connected devices, supporting a range of applications such as corporate, human-driven, modern, and natural monitoring applications (Kaur et al., 2022). The ability of IoT to help businesses adjust supply and demand makes it a key component of channel integration (Felipe et al., 2019; Verma & Tandon, 2022). The findings highlight how retailers can use these data to predict trends, optimise pricing strategies, and generally improve customer satisfaction. Wang et al. (2019)

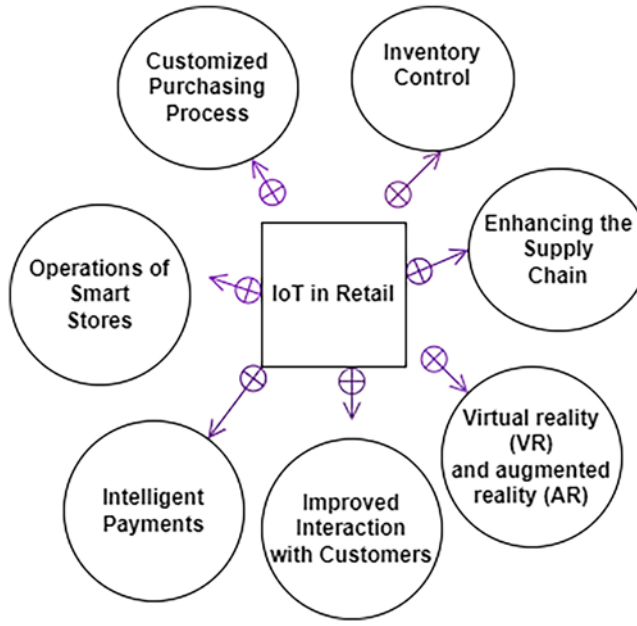

Fig. 1.1. IoT-Driven Solutions in Retail. *Source*: Authors' representation.

examine how physical stores have evolved into smart retail spaces. The study explores how IoT technologies, such as smart mirrors and interactive displays, enhance the immersive and customised shopping experience. This not only affects consumer behaviour but also the overall demand for goods and services. Effective inventory management is crucial for supply chain optimisation. Ensuring the reliability and security of IoT systems in retail is essential. Picot-Coupey et al. (2023) investigate livestreaming shopping as a novel retail concept. As digital technology has changed consumer expectations and behaviour, businesses are being forced to develop creative customisation tactics to meet customers' increasingly individualised needs (Xin et al., 2024). The systematic review on retail and supply chain is explored by Taj et al. (2023).

IoT technologies are changing the way traditional retail paradigms are applied, from supply chain optimisation to demand forecasting and the development of smart retail environments. Table 1.1 depicts the IoT-driven solutions in retail (Onomondo, 2023). To fully realise the potential of IoT in retail and ultimately create more customer-focused and efficient operations, it is imperative to address issues such as security and trust. Businesses hoping to stay competitive and meet customers' ever-changing demands will need to understand and leverage IoT's capabilities.

Table 1.1. IoT-Driven Solution Shopping Experience.

IoT Driven Solution	Shopping Experience
Customized Purchasing Process	**Customer Insights:** Information about consumer behavior, preferences, and demographics is gathered by Internet of Things devices like beacons and sensors. Retailers can offer tailored promotions, discounts, and suggestions using this data to create individualized shopping experiences.
Inventory Control	**RFID tags and smart shelves:** Retailers can monitor and manage inventory in real-time with the use of RFID tags and real-time by the Internet of Things. This guarantees that popular products are always available and minimizes stockouts and overstock situations.
Enhancing the Supply Chain	**Supply Chain:** IoT devices make it possible to track assets in real-time along the entire supply chain. This enhances the overall efficiency of the supply chain, minimizes delays, and optimizes logistics.
Improved Interaction with Customers	**Interactive Displays:** By offering more product details, enabling virtual try-ons, and promoting an interactive shopping experience, interactive displays and smart mirrors with IoT capabilities can interact with customers in-store.
Intelligent Payments	**Contactless Payments:** The Internet of Things makes contactless payment methods possible, which speeds up and simplifies customer transactions. This includes mobile wallets and NFC (Near Field Communication) technology.

(*Continued*)

Table 1.1. (*Continued*)

IoT Driven Solution	Shopping Experience
Operations of Smart Stores	**Energy Management:** By regulating lighting, heating, and cooling systems in response to in-store foot traffic and outside variables in real-time, IoT can be used to optimize energy consumption within stores. Predictive maintenance is made possible by IoT sensors that track the condition of appliances and HVAC systems, cutting down on downtime.
Virtual reality (VR) and augmented reality (AR)	**Virtual Try-Ons:** Augmented reality (AR) and virtual reality (VR) technologies improve the shopping experience for customers by enabling virtual try-ons of apparel and accessories, which aids in better decision-making.

Source: Authors' compilation.

2. IoT in Retail

Like any other technological breakthrough, the development of a successful IoT strategy must be motivated by the production of economic value. Fig. 1.2 shows the retailing with IoT. This simple structure can assist senior management in creating a good demand and supply chain. Because enabling IoT capabilities are based on the company's current operations, identifying them is simple and boosting the sales. IoT capabilities should be arranged according to their primary impact area, which might be supply, demand, or both (Felipe et al., 2019). Customers can feel secure in their purchasing selections when they are equipped with provenance knowledge, which comprises details regarding the products' origin, production, changes, and custody (Montecchi et al., 2019). With the goal of locating and resolving causes of contamination in the global food supply chain, tracking and authenticating the food chain to comprehend provenance is essential (Galvez et al., 2018). Cycle time and preservation cost optimisation guide supply chain decisions (Goswami & Verma, 2024; Iqbal & Kang, 2024). In the process of achieving sustainable operations, the retail industry has utilised IoT technology extensively. However, this has brought to light a number of operational challenges, including security and privacy. So, a more methodical, in linked domains, theoretical analysis must be carried out (Ma et al., 2022).

IoT devices collect data from the consumer behaviour using the preferences and demographics. Marketing efforts and product help to create a personalised shopping experience. IoT helps the retailers to understand the trends and inventory patterns accordingly. IoT helps to identify the payments and smart cards, to streamline the checkout process. Use of cameras linking them to IoT helps to monitor the customers movements and ensure the high safety to enhance the shopping experiences. Figs. 1.3 and 1.4 show the enhanced focus on consumer behaviour and experiences in the retail (Chawla et al., 2024; Jiang et al., 2024; Zheng et al., 2024).

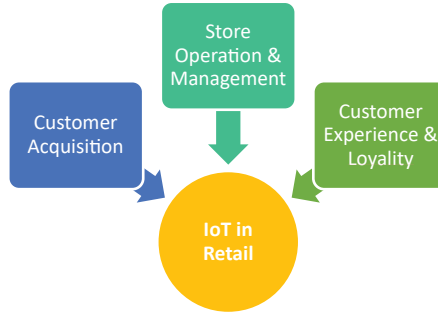

Fig. 1.2. Retailing With IoT. *Source*: Authors' representation.

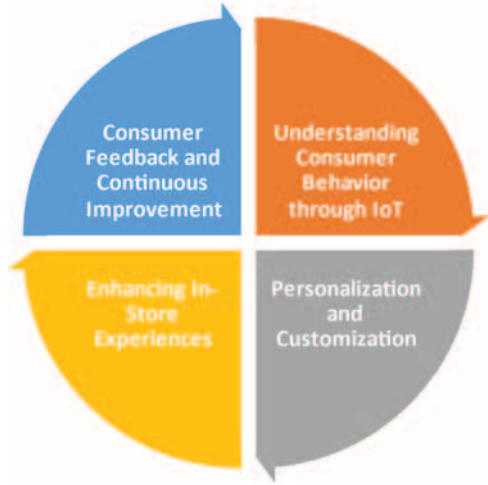

Fig. 1.3. Enhanced Focus on Consumer Behaviour and Experiences in Retail. *Source*: Authors' representation.

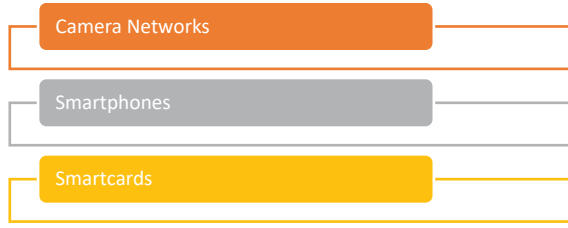

Fig. 1.4. IoT Options in Demand Side. *Source*: Authors' representation.

The basic idea is to rank any possible IoT opportunity based on its associated capabilities and value-adding mechanism. Capabilities can be enhanced or enabled; these are two distinct concepts. Although an IoT endeavour may entail some combinations of these capabilities, it will be helpful to treat each one independently. By enabling the firm to do existing tasks more efficiently, an enabling capability creates value. Motion sensors, for instance, can execute traffic counts more effectively than humans, while radio frequency identification (RFID) tags can essentially automate inventory counts. Many multinational companies are working on effective technology for supply chain management. Employee-focused connected platforms are made possible by IoT. Smart glasses are one tool that warehouse employees can utilise to receive continuous instruction, so they spend less time finishing tasks. Furthermore, IoT raises awareness in resource and labour management by gathering data linked to efficiency. Supply chain managers will guarantee that every party engaged in the delivery performs to the best of their abilities because of technology.

3. IoT Options in Demand Side

The disparity between client demand and supply is addressed by an IoT-based demand side management. Demand-side IoT possibilities are primarily divided into three categories as shown in Fig. 1.4.

3.1. Camera Networks

Retailers have embraced these networks for inventory management. Camera networks collect information about conversion rates, length of visits, frequency of visits (sometimes using facial recognition software), patterns of entrances and exits, and interactions between sales representatives and clients. To describe the movement and activity of clients, a daily study is carried out. Typically housed on the cloud, software analytics leverage data that are communicated and saved to enhance store layouts and facilitate effective mobile marketing through interacting with customers through personalised offers displayed on display screens or through 'chatbots'.

3.2. Smartphones

This method offers far less information regarding in-store customer behaviour and the entire shopping experience, although being less expensive than a camera network. Customers are offered Wi-Fi access, and if they accept, the system follows them using a network of wireless access points.

3.3. Smartcards

This is the least expensive method of recording the frequency of client visits and their purchasing preferences when paired with information on the actual

transactions made by the consumer. However, the card technology does not record the activity of customers while they are in the store; instead, it can only identify the purchasing habits of customers over time.

4. IoT Options in Supply Side

RFID technology and IoT-enabled smart shelves support real-time inventory tracking. The positive effects on demand fulfilment, decrease stockouts, and helps to enhance process related to inventory. Most clothing businesses need a high device density because they carry anything from thousands to hundreds of products. Therefore, the IoT solution the retailer uses to track every item out for the supply and monitor inventory will depend on the required device density. Passive RFID tags operating at ultra-high frequencies are the most frequently used IoT device for a high-density environment.

5. Enhancing Capabilities in IoT-Based Supply and Demand Linking in Retail

IoT can play a vital role in channel integration because it enables businesses to restore supply and demand equilibrium. Compared to closed systems, connected platforms are quicker and simpler to use. Businesses may make sure that everyone involved in the supply chain lifecycle has access to pertinent data and can quickly resolve issues by implementing a cloud-based IoT system. Additionally, tools for various users (workers, managers, operators, and consumers) on the web and mobile platforms enable them to engage with the insights and utilise the data gathered to create strategies and various scenarios that are pertinent to their jobs and needs.

Like any technology, the production of business value must be the driving force behind the development of a successful IoT strategy. To assist top management in developing such a plan, this chapter offered a basic structure. The overall concept is to classify every potential IoT opportunity according to the capabilities it is associated with and the value it adds. The two types of capacities that are represented to identify are enabling and enhancing.

5.1. Analytics in Supply

Analytics in supply cleverly integrate IoT devices connected via Bluetooth or Wi-Fi. These devices can track their retail environment, offer smooth in-store navigation, and help customers locate requested items. The data collected for supply including item state, sales rate, in-store product placement, availability of goods, stores, and location are gathered via IoT sensors placed in the location.

The following strategies are taken into account for effective linking of supply and demand.

The supply chains are made ready.

- A gateway device receives the gathered data and processes it before forwarding it to the central IoT, which serves as a central hub for managing and monitoring IoT devices.
- The chosen Azure service is then used to export the data, where strong analytics capabilities are ready to extract insightful information.
- Cloud storage services effectively store structured data, enabling smooth data administration.
- Retail operations may now make well-informed decisions and streamline procedures by using business tools like Power BI, which query the data and produce useful insights.
- Navigation of the supply products is much improved with IoT deployment, enabling quick product searches and building a strong shopping environment with better product choices and store layouts.
- This game-changing strategy transforms how consumers engage with retailers, resulting in a smooth and pleasurable buying experience.

5.2. Beacon-Based Targeted Alerts

Beacons are Bluetooth devices that are used to send out smartphone notifications to prospective suppliers in proximity about special discounts, offers, and events based on the demands.

5.3. Smart Carts

Shopping carts with sensors enable retailers to see customers' flow based on preferences for different categories and subcategories, so opening up new growth potential. Insightful path analysis, trend analysis, and streamlined checkout procedures are made possible by technology. These smart carts can precisely track wheel movements and log the distance travelled within the store thanks to connectivity protocols. The gathered information is safely transferred to a cloud server, where it becomes an invaluable tool for thorough analysis that eventually yields actionable insights. Retailers can successfully accommodate client preferences with this creative strategy, increasing customer loyalty.

5.4. Inference

It is predicted that the number of IoT devices in the world would nearly double from 15.1 billion in 2020 to over 29 billion by 2030 (Lional, 2023) as shown in Fig 1.5. In 2030, the biggest number of IoT devices will be found in China with roughly 8 billion consumer devices. IoT-based technology will therefore help businesses and customers when used in logistics and business.