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Revolution of Retail Industry: From Perspective of Retail 1.0 to 4.0

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Abstract

When Industry 4.0 was first introduced in 2010, it also brought the retail industry into the fourth revolution. Retail 4.0, on the other hand, appears to be a novel concept for retailers worldwide. When Industry 4.0 technologies such as the Artificial Intelligent (AI), Internet of Things (IoT), Cloud Computing, Big Data Analytical (BDA), and Augmented Reality (AR) were implemented in the retail industry, the term Retail 4.0 arose from Industry 4.0. This paper examines Retail 4.0 technologies and their application in the retail industry. The retail industry's revolution is also discussed in this paper. The final section examines the extent of implementation of retail 4.0 technology in various nations.

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1. Introduction

Since the first industrial revolution, which took place in roughly 1760, a total of four industrial revolutions have occurred throughout human history. Each industrial revolution brings improvement in manufacturing and improves the human lifestyle in all aspects [1]. During the first industrial revolution, the invention of steam engines reduced the need for human labour and increased the efficiency of workflows. Consumers benefited from high-quality products at lower prices as electrification and mass production assembly lines were introduced in the Industry 2.0 revolution. Industry 3.0 then observed the rise of electronics, telecommunications, and computers, resulting in online shopping and globalization. However, Industry 4.0 altered humanity in profound ways and became more concerned about integrating physical objects with people through the internet. The industrial revolution ushered in dramatic changes to the retail industry [1].

Concerning the industrial revolution, the retail industry also evolved significantly. Firstly, in relation to Retail 1.0, as steam engines produced mass manufacturing items, department stores also started to pop up. Accordingly, consumers enjoyed low-cost products during the Retail 2.0, and consequently, more shopping malls were opened. Meanwhile, in Retail 3.0, consumers enjoy online shopping globally through the internet, and thus, purchasing behaviour has changed as we can now purchase anything without leaving the house. This is evidence that Retail 4.0 simplifies and improves our lives.

In general, Retail 4.0 technologies include Artificial Intelligent (AI), Internet of Things (IoT), Cloud Computing, Big Data Analytical (BDA), and Augmented Reality (AR) [4]. AI can replace employees in some routine jobs, while home and office applications can be managed via mobile apps thanks to IoT. Our recorded data using a self-service kiosk is then stored and analyzed in the cloud. Retail 4.0 is the integration of these technologies. When IoT works, data is then collected and analyzed to determine customer preferences. Then, through data analysis, AI would recognize the user and provide customized service. These technologies have also been applied to agri-food retailing and to enhancing the sustainability of the agri-food retailing supply chain.

Essentially, Industry 4.0 has started in 2010, but "Retail 4.0" is a new term for retailers worldwide. Therefore, the adoption of Retail 4.0 technologies is still low in developing countries. This scenario is even worse in the least developed countries. However, the COVID-19 pandemic sped up the adoption of these technologies [2]. People managed to do online shopping during coronavirus lockdown, and this shows that Retail 4.0 provides a seamless shopping experience that attracts customers. This left no choice to the retailers but to implement these technologies as well [3]. Hence, regarding the above explanation, it can be concluded that retail 4.0 can accommodate the new norm of requiring less contact with other people, making its adoption a must for retailers. This article discusses the retail industry's revolution, retail technologies and their impacts. The extent to which Retail 4.0 is being adopted in various nations has also been explored.

1.1. Revolution of the Retail Industry

For the fourth time in recorded history, the way the world works is changing. The same goes for the case of Industry 1.0, Industry 2.0, and Industry 3.0; their revolution has impacted all of humanity in terms of how they live, work, and play, not just how they do business [1]. Relatively, the retail industry also experienced a four times revolution as a result of the industrial revolution. The retail industry's revolution can be divided into three areas; namely Retail 1.0, Retail 2.0, Retail 3.0, and Retail 4.0. The revolution of the retail industry will be discussed in the following section.

1.1.1. Retail 1.0

The first retail disruption, or Retail 1.0, also known as mechanization, began in the mid-eighteenth century and ended in the mid-nineteenth century as electrification and mass production was introduced and the second industrial revolution happened [6]. Throughout most human history, individuals have worked exclusively with their hands. Each object utilized by humans, such as weapons, clothing, musical instruments, tools, and cooking utensils, was handcrafted with raw materials obtained or cultivated on the Earth by people. In the late 1700s, factories started to pop out, mass manufacturing items with steam-powered equipment and luring a new generation of workers to cities [1]. Before the late 1800s, neighbourhood merchants dominated retail, providing comprehensive services to clients, such as credit, repairs, and one-on-one assistance to explain the details and advantages of products to customers. Individuals were required to carry cash, and merchants were required to physically deposit cash and checks to keep the wheels of commerce turning. Nonetheless, technological advancements during the industrial revolution resulted in a significant rise in the availability of affordable, high-quality goods [5]. Department stores such as Bloomingdales, Sears and Macy's have started to appear in Chicago and New York City as more prosperous Americans develop broader preferences.

1.1.2. Retail 2.0

During the second industrial revolution, termed "Industry 2.0" or "mass production," low-cost products were manufactured on a vast scale [7], enabling automotive manufacturing to proceed at a rapid pace. With the widespread availability of automobiles, more people began to flee cities and commute from the suburbs [6], resulted in the clusterization of suburban shopping plazas and malls in discrete areas as the suburbs grew [1]. At this stage, data marketing, which was in its infancy a decade ago, evolved as retailers analysed transactions and conducted focus

groups to ascertain customers' thoughts and motivations [8]. Credit cards become handy for users and beneficial for businesses, as people prefer to spend more when they use their credit cards [9]. Additionally, there was a proliferation of loyalty cards that offered rewards for shopping and provided retailers with knowledge of their consumers' behaviour. The era of electrification, or Retail 2.0, which began in the early twentieth century, ended with the advent of automation in the late twentieth century.

1.1.3. Retail 3.0

The advent of widespread online buying is one of the most significant crises points in retail industry history. Retail 3.0 began with the creation of the Internet, which permitted the global production, marketing, and consumption of products and services and the global utilize of digital technologies [1].

In the 1990s, shoppers had practically limitless access to an incredible array of products, and their purchasing was less constrained by the physical store's location or hours of operation, as the Internet has altered how retailers and customers view the integration of product, place, price, and time [10]. The rise of digital competitors—platform players such as eBay, Taobao, Amazon, and Alibaba are upending traditional enterprises in virtually every industry [11]. With online technological and banking innovations, consumers have access to a wide range of goods from international retailers, often at lower prices than their local store [12].

Moreover, interstate highways allow no-frills self-service convenience stores, big-box businesses, or enormous stores that are served in far broader geographic areas [1]. These retailers, including Aeon, Tesco, Auchan, and Wal-Mart, provided a massive assortment of highly discounted items manufactured low-cost and efficiently throughout the world during the computerised, globalised Industry 3.0. Retail 4.0 began in the early twenty-first century, succeeding Retail 3.0, which started in the late twentieth century as automation gave way to digitalization.

1.1.4. Retail 4.0

Retail 4.0 is the fourth retail industry transformation, leveraging Industry 4.0 technologies, namely Artificial Intelligence (AI), Internet of Things (IoT), Cloud Computing, Big Data Analytics (BDA) and Augmented Reality (AR), to meet the customers' needs [4]. Therefore, it is said to be the integration of technology, innovation, and people, with massive advancements in production and data analytics technologies, with most of these advancements concentrated on AI techniques and digital manufacturing systems, converting systems to be intelligent and smart [13].

Over the last two years, the e-commerce market has seen a 45.8% surge in online sales worldwide. Compared to only 13.6% of sales made online in 2019, the figure is predicted to rise to 19.5% in 2021 [14]. Mobile e-commerce sales as a proportion of total e-commerce sales climbed from 52.4 % in 2016 to 72.9% in 2021 [15]. According to new statistics from IBM's United States Retail Index, the COVID -19 pandemic has hastened the shift away from physical businesses and toward online buying by around five years [16]. Both Walmart and Target have benefited from omnichannel fulfilment by offering grocery pickup and delivery options, increasing sales for both companies. [17]. Additionally, due to the COVID-19 pandemic, the IoT industry continues to rise. In 2020, there were more IoT connections (e.g., linked cars, smart home gadgets, and connected industrial equipment) than non-IoT connections (laptops and computers) [18].

Furthermore, retailers were also forced to implement self-service kiosks as a cost-effective approach to limit face-to-face interaction and protect customers from coronavirus [19]. Self-service kiosks enable users to administer various services independently of any representatives and increase consumer satisfaction by giving them more power over their purchase decisions [20]. Through the kiosks, customers can check out their purchases using self-checkout kiosks at any point within the store with their credit card, debit card, mobile phone, Apple watch, or gift cards thanks to a complex blend of technology solutions such as QR codes, RFID, and smartphone transactions [21]. These advancements assist the consumers in conducting their purchases regardless of crisis without noticing the difference between the online store and the retailer's physical locations, as various technologies have integrated the online and offline shopping experiences [22]. These dynamic changes in purchasing behaviour have also made the retailers aware that Retail 4.0 technologies can help in improving the business's performance and customer experience, allowing them to remain competitive [23]. Customers can move seamlessly between channels and receive integrated, uniform, and consistent service despite the channel (traditional store, online, or mobile) [24]. What is more, Retail 4.0 places a higher premium on digital marketing and social media while also managing customer data to provide a more personalized experience [22].

On the other hand, a business that offers a personalized experience will attract more customers and earn their loyalty [22]. Integrating such systems with IoT, AI, wireless sensor networking technologies, big data analytics, and cloud computing is the core of Retail 4.0 [25]. Businesses can obtain a competitive edge by leveraging the new digital technologies such as cloud computing, mobile, social, analytics, and the IoT [26]. The paradigm shift from Retail 3.0 to Retail 4.0 is evidence of the paradigm change from broad industrial digitalization to technologically advanced digitalization systems that integrate with smart objects and IoT, where products can determine production processes on their own [27]. Figure 1 shows the revolution of the retail industry.

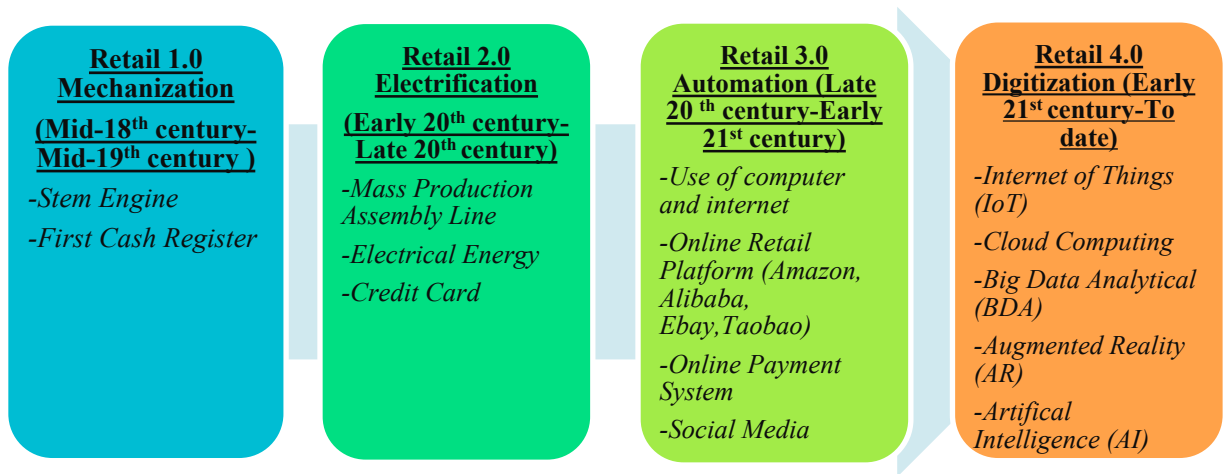


Fig. 1: The Revolution of the Retail Industry.

2. Retail 4.0 Technology

Retail 4.0 alters the supply chains into customer-centric organisations by enabling the rapid flow of items and information between channels while providing highly customised services to customers. Marketing intelligence is obtained in Retail 4.0 by collecting and analysing the user data in order to derive meaningful and valuable information about user behaviour and purchasing patterns for marketing purposes [28].

In other cases, Retail 4.0, also known as Omnichannel, combines many technological platforms to provide consumers with a seamless purchasing experience [1]. The integration of Retail 4.0 technologies allows us all to live a more convenient and accessible lifestyle. For instance, when an individual saw an advertisement on television that piqued his interest, he used his mobile phone to scan the QR code and peruse the product consultation, adding it to his shopping basket. Even though he has yet to complete the transaction, he could continue the purchasing process on the following day. Just place the order on the product's website and pick it up after work at the actual store. In this procedure, IoT enables him to access information by scanning a QR code and cloud computing to store his data, he can navigate seamlessly between mobile applications and websites. This appears to be so common now that it would have been unthinkable ten years ago or perhaps earlier.

Besides that, Retail 4.0 implements technologies such as AI and IoT in physical stores, providing customers with a better shopping experience. Retailers can now leave stores unmanned with the help of AI, saving a significant amount of money in labour costs [29]. Further, big data analytics (BDA) and cloud computing also save and analyse user data, allowing retailers to forecast user preferences and provide customized services [30]. These technologies also make the distribution value chain more flexible, efficient, and competitive [31].

2.1. Internet of Things (IoT)

IoT is a network of intelligent physical entities (sensors, computers, machines, properties, and products) that communicate with one another, the internet, and applications [32]. It is a network architecture that enables an object

to be connected to the internet via specified information sensing equipment and protocols to perform information and communication exchange [26]. Besides, IoT also enables tracking, monitoring, and providing customers with real-time location data and order alerts [33]. This makes monitoring and governing supplier efficiency easier with the availability of online tracking via IoT.

Today, almost all the new devices on the market include connectivity, indicating that the IoT is no longer a pipe dream but a reality [32]. Organizations will receive a continuous flow of data for decision-making purposes. Sensor technology advancements are critical, as these technologies are employed for data processing, sharing, and collection [25]. Virtual assistants such as Alexa, Siri and Google Assistant will tell users the nearby retailers provide the product they need if the retailer enters their store's location into the database [34]. Smart beacons, also known as Bluetooth radio transmitters, can detect when people walk by a store and then send them notifications on their phones about special deals, such as discounts or discount vouchers, in order to entice them to shop there [1].

According to [35], the IoT will be the future of data acquisition systems. It may also cultivate the soaring into its customer relationship management systems and reap the early entrants' first advantage [33]. Besides, IoT also enables forecasting, replenishment and allocation, sourcing, order management and order fulfilment operations, and logistics, which will be the future trends of the retail supply chain. This enables the achievement of customer satisfaction, which increases customer retention and loyalty [35]. A study by Jason [36] also revealed that when IoT is integrated into an Enterprise Resource Planning (ERP) system, it enables us to provide services to end customers, for example, order automation and product delivery to partner organisations as well as data storage, retrieval, and analysis—all of which fall under the area of traditional business intelligence.

Recently, order automation is overtaking the world's quick-service restaurant industry, with major chains such as McDonald's, Starbucks, and Panera introducing digital kiosks and smartphone ordering apps [37]. McDonald's has rolled out self-service kiosks worldwide since 2015 [38]. The kiosks enable customers to effortlessly customise their orders [39], which could avoid the counter and queue altogether, allowing them to place orders without a fuss [40]. By ordering at a kiosk rather than sending information to a person behind a till customers retain greater control over the contents of their order. There are no more embarrassing requests to remove tomatoes and pickles; customers may now customise their burgers straight at any McDonald's location. To avoid the line, customers can pay with credit, debit, or mobile payment systems at the kiosk. Additionally, customers can wait in line to pay with cash or a coupon [37].

According to [41], the Dodgers Stadium concession stands demonstrated a shift away from traditional point-of-sale systems toward new self-service kiosks, increasing in average order size of 20%. Apart from simplifying and expediting the ordering process, self-ordering enables restaurants to manage their cash flow and ingredient inventory better. By adding kiosks at its restaurants, staff can engage with customers and enhance their dining experience by working in customer service, such as concierges and table service [42].

In other matters, RFID is a technology that utilises radio waves to transmit data from an electronic chip, also known as an RFID tag or label, affixed to an object to a reader to track and identify the thing. RFID technologies have been widely implemented throughout Europe and the United States' supply chains, demonstrating their ability to ensure data accuracy, resulting in a reduction in bullwhip effect, a reduction in out of stock, out of shelf phenomena, and faster inventory turnover and replenishment routines [43].

2.2. *Big Data Analytics (BDA)*

BDA is the method of evaluating the mountains of data that a business already possesses (Lim et al., 2020). It enables data-driven decision-making, forecasting revenues, maintaining stable inventory levels, enhancing consumer relationships, and eventually increasing revenue and profit [44]. BDA goes beyond just looking at statistics to determine what happened; it also aims to explain why things happen and make recommendations for the next steps [45].

Additionally, BDA helps companies illustrate consumer behaviour, comprehend their preferences, construct suitable marketing strategies, identify sales transactions, and promote a long-term loyalty relationship [46]. This leads to complicated decision-making in situations where several parameters influence the company's decision-making process [47]. However, despite encouraging the companies to collect comprehensive data, businesses can control and attract customers by observing data growth and analysing it [48]. They also manage to prepare the forecast of

consumer loyalty using BDA to recognize loyal customers and increase profits, as a loyal customer generates an additional 25-100 % in revenue [49]

HappyFresh, a start-up online grocery platform, is attempting to offer supermarket delivery services such as Instacart, where users can buy products from big grocery stores around the city with a single click [50]. Thus, it has allocated a team to focus on personalization services using off-the-shelf Amazon Web Services (AWS), which extract the data and process it for analysis of customer shopping patterns to ensure customers see the products they are most likely to purchase and relevant promotions when they log on to the app [51]. Different teams analyse Happyfresh funnel performance quantitative data in detail, increasing the likelihood of identifying trends and understanding consumer behaviour [52]. This increased HappyFresh's new clients by 800 % in March 2020, posing another set of issues [53]. AWS then enables the company to scale to meet activity surges.

Finally, BDA was also used in stock management to ensure that the shelves were always filled and react to customer demands by connecting the central warehouse and the stores and allowing their access through cloud computing [31].

2.3. Artificial Intelligence (AI)

AI refer to a machine's ability to recognise, remember knowledge, learn, and discover new vision through data mining [54]. Intelligent automation driven by AI tools requires minimal manual intervention during routine operations. This organizational change enhances and supports human capacities, decreases human error, and increases efficiency while supporting digital operations and innovations [55]. With the intelligent use of valuable data produced at various points, AI-driven automation in retail will uncover numerous opportunities to improve operational efficiencies, the quality, and service levels of the customer experience [55]

As the technological transition continues, innovative technology solutions have expanded, the latest generation of virtual machines, dubbed intelligent vending machines (VMs), provide features such as voice and face recognition [56]. The aim is to increase machine intelligence through deep learning and machine learning techniques in order to attract more users [57]. The VM systems are equipped with an AI capable of determining consumer desires and actions to provide a visual interface with targeted promotions [58]. The VM and the decision support system (cloud infrastructure) work in tandem to process data to respond to the target customers in front of the machines with flexible pricing and intelligent product recommendations [58].

In China, JD.com Corporation offers unique AI vending machines that provide unattended access to fresh produce 24 hours a day. Customers can select products displayed on the transparent door of the machine and then scan a QR code with their mobile phones [59]. In COVID -19 pandemic, this form of contactless buying approach that does not involve physical touch is appreciated since consumer behaviour patterns have changed subtly, and they do not intend to visit a store [60]. Compared to large-scale supermarkets, the approach enables vendors to acquire fruit from wholesale marketplaces and save on rent and labour costs [61]. Through collaboration with the local government's poverty alleviation initiative, farm food from underprivileged parts of Ningxia and southwest China's Guizhou Province will soon be available [62]. In addition to providing customers with fresher and cheaper food, the company also helps farmers get better pay while improving the entire agri-food supply chain [61].

Alibaba's Cainiao network, for instance, facilitates retailers' supply chains with an AI-enabled smart inventory system that connects the online and offline retail worlds, with merchants' physical storefronts acting as a distribution hub [63].

2.4. Augmented Reality (AR)

For a long time, virtual reality (VR) and augmented reality (AR) held enormous promise; those promises are just now beginning to be realised. The emerging models of reality and devices based on technology improve sensory experiences [64]. According to a Deloitte survey, most businesses currently utilise augmented reality technology to enhance the consumer experience [65]. A vehicle, or game such as Pokémon GO, combines a quest with virtual creatures (Pokémon) and the users' real-world locales. This is made possible by the GPS functionality of a mobile device.

Nike Inc., a corporation that manufactures athletic footwear, clothing, and equipment, has created a system that allows consumers to design their shoes and purchase them in-store. Customers will design their Nike Presto X shoes using the latest automated system, called the Nike Maker Experience [66]. They simply put on blank Nike Presto X shoes and use voice activation to pick graphics and colours. The system displays the designed shoes to the customer

through augmented reality, object tracking, and projection systems. Suppose the customer has made their selections, the machine prints the pattern on the sneakers, which the customer will pick up in less than two hours [59]. Usually, customizations on a regular basis will take up to two weeks.

To address customer concerns and enhance the online shopping experience for lipstick and lip gloss, L'Oréal has launched an AR-powered tool partnered with Shopee. L'Oreal integrated the Shopee BeautyCam into the app, transforming Malaysia's beauty and skincare market with innovation and technology to improve users' online shopping experience [67]. As a result, users can find the perfect lipstick shade for their unique beauty needs [67].

2.5. *Cloud Computing*

Cloud computing is clarified as the on-demand delivery of computational power, data storage resources, software, and other information technology resources over the internet via a platform. Cloud computing is the pooling of computer resources so that they can be used concurrently by several processes. Additionally, cloud computing enables the enterprise's resources to be shared. Moreover, the system can be accessed from any location, regardless of the administrator's location [22]. The availability of real-time data via distant solutions connected through cloud computing and virtual infrastructure enables users to make sensible decisions based on solid facts [68].

Transaction data is analysed through client movements online or in-store, and retailers gain a deeper understanding of consumer behaviour and preferences [28]. The massive amount of data generated by Retail 4.0 must be kept, analysed, and shared throughout supply chains, which necessitates retailers investing in storage, and cloud computing is regarded as the best option due to its affordability and convenience [69]. A predictive manufacturing system uses big data analytics and cloud computing to enable self-aware machines and systems, and CPSs will be used in the future industry to increase efficiency and production [25].

Integrating cloud computing, networks, databases, and marketing management systems has established an interconnected cloud services platform in marketing management that combines e-commerce and traditional business models [70]. Cloud computing enables businesses to outsource portions of their information technology value chain, resulting in cost savings, flexibility, scalability, increased capacity utilisation, increased efficiency, and mobility [26].

According to [71], Indonesian farmers lack the logistics infrastructure necessary to sell directly to consumers, resulting in multiple intermediaries, an inefficient supply chain, and high waste; the supply chain from farm to table can involve as many as ten intermediaries. To address this demand, Rama Notowidigdo and his partners founded Sayurbox, a platform that connects Indonesia's traditional farmers (who account for a third of the population) to urban consumers via an innovative e-commerce solution based on digital supply chains to improve this process by managing its supply chain end to end [72]. In 2019, Sayurbox adopted cloud service provider AWS to help with monitoring and analytics activities performed in Sayurbox's operations and warehouse management systems to assess demand levels and match them to supply sources. Sayurbox grows to handle a 300% increase in daily order volume, accelerates deployment to enable 24-hour product delivery, saves consumers 30% on produce costs, assists farmers in earning 20% more for their crops, and decreases overhead through managed services [73].

3. **Adoption level of Retail 4.0 in Difference Countries**

According to a country's readiness index, the economies that are most prepared to use, implement, and adopt industry 4.0 technologies somewhat are North America and Europe [74]. Meanwhile, the least prepared are those in Sub-Saharan Africa and developing countries as developing countries must push toward universal internet access and provide an opportunity for all residents to acquire the skills necessary to succeed in frontier technologies [74]. According to the 2018 Annual Capital Expenditures Survey, in the United States, non-store retail was the third largest industry in terms of capital expenditures on robots [75]. These organizations adopted digitalization widely, with the highest adoption occurring among older, larger firms; nevertheless, cloud-based services were not as widely adopted [75].

The digital economy's economic geography is dominated by developed and developing countries: the United States and China, which hold more than 75% of the global public cloud market, 75% of all blockchain patents, and 50% of global IoT spending [76]. They also account for roughly 90% of the share value of the world's 70 major online platforms, with Microsoft leading the way, followed by Amazon, Apple, Facebook, Google, Alibaba, and Tencent,

which currently accounts for two-thirds of the total market value [76]. Since Jack Ma founded Alibaba in 1999, the firm has grown to become a market leader in China and globally, with 80% of China's internet market. In 2017, Alibaba launched New Retail, which combines AI-enabled smart inventory systems, cloud computing, data analytics, digital retail applications, and the Internet of Things to create an integrated buying experience suited to each customer [1]. The combination of digital consumer maturity and digitally supported supply chains has enabled China to become the world's largest digital buyer in 2021, accounting for 792.5 million (33.3% total); it will generate \$2.779 trillion in e-commerce sales (56.8%), and it has become the first nation in history to conduct more than half of its retail transactions digitally (52.1% of retail will be e-commerce) [77].

According to research, Russia, 3/4 of retailers in developing countries agreed that big data is necessary for creating a competitive marketing plan [75]. However, only 20% of retailers employ big data in their business, and 60% are unsure how valuable these data are for their operations [78]. Malaysia received a score of 2.0 to 3.0 in terms of Industry 4.0 technologies adoption, lagging below other ASEAN countries such as Singapore and Indonesia [4]. Only 15-20% of all businesses in Malaysia have adopted Retail 4.0 technologies, and one of the primary reasons for the slow adoption is a shortage of skilled workforce to meet Retail 4.0 needs [4].

Since Internet access is still confined to a small percentage of the Least Developed Countries (LDCs) population, LDCs have fallen behind in the global race for digital transformation [79]. LDCs risk falling further behind as the technical divide between them and more technologically advanced countries increases [79].

The UNCTAD-led eTrade for All initiative, which is currently sponsored by Estonia, the Netherlands, and Germany, is a global helpdesk that assists developing countries in bridging the knowledge gap in e-commerce information and resources. UNCTAD says it has more than 30 partners working together to raise awareness of opportunities and risks in developing countries and the least developed countries to overcome the constraints during the outbreak of the COVID-19 pandemic [75].

4. Conclusions

Even though the term "Industry 4.0" has been around since 2010, the term "Retail 4.0" is relatively new to most retailers worldwide. The retail revolution has given us a more convenient way of life. As the COVID -19 pandemic unfolds, forcing physical stores to close, Retail 4.0 represents an opportunity to assist retailers in surviving this pandemic. Retail 4.0 can deal with the new norm in the COVID -19 pandemic, which requires less contact.

The adoption of Retail 4.0, on the other hand, differs between the least developed countries, developing countries, and developed countries. The adoption level of Retail 4.0 is high in developed countries like the United States, the United Kingdom and Europe. However, in the least developed countries, with low internet access coverage, it seems challenging for them to adopt these technologies. Consumers and businesses are unable to take advantage of emerging e-commerce opportunities due to persistent bottlenecks and barriers, such as high-cost broadband services, over-reliance on cash, a lack of skilled workers among the populace, and government inattention.

Governments must prioritise national digital preparedness to enable more small companies to participate in the digital economy as producers, not simply consumers. Then, to maximise the value of digital commerce, digital entrepreneurship must become a primary focus. Future e-commerce trade norms should aim to facilitate the mobilisation of additional resources for financial and technical support for these countries in order to increase their capacity to participate in and profit from Retail 4.0.

This study contributes to the body of knowledge regarding Retail 4.0 technology and the revolution in the retail industry. Although our findings are confined to conceptual and theoretical notions, they can serve as a starting point for integrating the novel digital technologies associated with Retail 4.0 into customer service management. Examining the influence of Retail 4.0 adoption on e-loyalty may be an area for future research, as capturing and retaining consumer loyalty is extremely difficult in today's quickly expanding digital world, and research is absent in this area.

References

- [1] Reagan, J. R., & Singh, M. (2020). *Management 4.0: Cases and Methods for the 4th Industrial Revolution*. Springer Singapore.
- [2] Ernst & Young (2020, June 17). Digitalization key to helping Asian retailers emerge from Covid-19. *Retail News Asia*.
- [3] Richard Wright (2020, June 16). The challenges, the opportunities: past Covid-19 Lockdown retail trends. *Retail News Asia*.

- [4] Sakrabani, P., Teoh, A. P., & Amran, A. (2019). Strategic impact of retail 4.0 on retailers' performance in Malaysia. *Strategic Direction*.
- [5] Lumen Learning (2020). Introduction to retailing. The evolution of retail. Portland: Module of Retail Management.
- [6] Susan Meyer (2020). The history and evolution of retail stores: from mom and pop to online shops. *Ecommerce News*
- [7] Wang, Y., Ma, H. S., Yang, J. H., & Wang, K. S. (2017). Industry 4.0: a way from mass customization to mass personalization production. *Advances in Manufacturing*, 5(4), 311-320.
- [8] Ruth Yu (2017, April 16). Looking back on 40 years of retail- top tips for the future. *Ipsos Marketing*.
- [9] Tomas Diaz (2021). The evolution of retailing: a look back and a look ahead. *Flex Engage*.
- [10] Nöjd, S., Trischler, J. W., Otterbring, T., Andersson, P. K., & Wästlund, E. (2020). Bridging the valuescape with digital technology: A mixed methods study on customers' value creation process in the physical retail space. *Journal of Retailing and Consumer Services*, 56, 102161.
- [11] Apigee (2013). Are you where your customers are? Retail 3.0: digital transformation. San Jose: Apigee Corp.
- [12] Steel, W., Daglish, T., Marriott, L., Gemmell, N., & Howell, B. (2013). E-Commerce and its effect upon the Retail Industry and Government Revenue.
- [13] Kamble, S. S., Gunasekaran, A., Ghadge, A., & Raut, R. (2020). A performance measurement system for industry 4.0 enabled smart manufacturing system in SMEs-A review and empirical investigation. *International journal of production economics*, 229, 107853.
- [14] Keenan, M. (2021, May 13). Global Ecommerce: Stats and Trends To Watch (2021). Shopify Plus. <https://www.shopify.com/enterprise/global-ecommerce-statistics#5>.
- [15] O. (n.d.). Mobile Commerce Sales In 2021 [Feb 2021 Update] | Oberlo. Mobile Commerce Sales in 2021 [Feb 2021 Update] | Oberlo. <https://www.oberlo.com/statistics/mobile-commerce-sales>.
- [16] Wheeler, B. (2020, June 1). Post COVID-19, Self-service Kiosks Will Play a Bigger Role in Limited-Service Restaurants| Commentary | Kiosk Marketplace. www.kioskmarketplace.com. <https://www.kioskmarketplace.com/blogs/post-covid-19-self-service-kiosks-will-play-a-bigger-role-in-limited-service-restaurants/>.
- [17] Perez, S. (2020, August 18). Pandemic Helped Drive Walmart E-commerce Sales Up 97% In Second Quarter – TechCrunch. [TechCrunch. https://techcrunch.com/2020/08/18/pandemic-helped-drive-walmart-e-commerce-sales-up-97-in-second-quarter/](https://techcrunch.com/2020/08/18/pandemic-helped-drive-walmart-e-commerce-sales-up-97-in-second-quarter/).
- [18] Lasse Lueth, K. (2020, November 19). State Of the IoT 2020: 12 billion IoT Connections. IoT Analytics. <https://iot-analytics.com/state-of-the-iot-2020-12-billion-iot-connections-surpassing-non-iot-for-the-first-time/>.
- [19] Pendrill, K. (2020, September 17). Why Self Ordering Kiosks Are a Secret Weapon for Restaurants. TouchBistro. <https://www.touchbistro.com/blog/why-self-ordering-kiosks-are-becoming-the-secret-weapon-for-successful-restaurants/>.
- [20] Markets, R. A. (2021, April 16). Global Self-Service Kiosk Market Report 2021: Adoption Of. GlobeNewswire Newsroom. <https://www.globenewswire.com/en/news-release/2021/04/16/2211434/28124/en/Global-Self-Service-Kiosk-Market-Report-2021-Adoption-of-Self-Service-Kiosks-is-Witnessing-Huge-Growth-Due-to-COVID-19.html>.
- [21] Business Insights, F. (2021, June). Kiosk Market Size, Share & Growth | Global Report [2021-2028]. Kiosk Market Size, Share & Growth | Global Report [2021-2028]. <https://www.fortunebusinessinsights.com/industry-reports/kiosks-market-101374>.
- [22] Jayaram, A. (2017). Smart Retail 4.0 IoT Consumer retailer model for retail intelligence and strategic marketing of in-store products. *Proceedings of the 17th International Business Horizon-INBUSH ERA-2017*.
- [23] Sakrabani, P., & Teoh, A. P. (2020). Retail 4.0 adoption and firm performance among Malaysian retailers: the role of enterprise risk management as moderator. *International Journal of Retail & Distribution Management*.
- [24] Piotrowicz, W., & Cuthbertson, R. (2014). Introduction to the special issue information technology in retail: Toward omnichannel retailing. *International Journal of Electronic Commerce*, 18(4), 5-16.
- [25] Bayram, B., & İnce, G. (2018). Advances in Robotics in the Era of Industry 4.0. In *Industry 4.0: Managing the Digital Transformation* (pp. 187-200). Springer, Cham.
- [26] van Dyk, R., & Van Belle, J. P. (2019). Drivers and Challenges for Digital Transformation in the South African Retail Industry. In *Information Technology for Management: Current Research and Future Directions* (pp. 42-62). Springer, Cham.
- [27] Zaidi, M. F. A., & Belal, H. M. (2019). A PRELIMINARY STUDY TO UNDERSTAND THE SMES' READINESS ON IOT IN MALAYSIA. *International Journal of Accounting, Finance and Business (IJAFB)*, 4(19).
- [28] Zamil, A. M. A., Al Adwan, A., & Vasista, T. G. (2020). Enhancing customer loyalty with market basket analysis using innovative methods: a python implementation approach. *International Journal of Innovation, Creativity and Change*, 14(2), 1351-1368.
- [29] LamasaTech (2021). *What Mcdonald's self-order kiosks mean for fast food?* Newcastle
- [30] Richard Wright (2020, April 14). Covid-19: how retailers can take control and lessen the impact. *Retail News Asia*.
- [31] Taliaferro, A., Guenette, C. A., Agarwal, A., & Pochon, M. (2016). Industry 4.0 and distribution centers, Transforming distribution operations through innovation.
- [32] Yerpude, S., & Singhal, T. (2018). Customer service enhancement through on-road vehicle assistance enabled with internet of things (IoT) solutions and frameworks: A futuristic perspective. *International Journal of Applied Business and Economic Research*, 15(16), 551-565.
- [33] Yerpude, S., & Singhal, T. K. (2020). Value enablement of collaborative supply chain environment embedded with the Internet of Things: Empirical evidence from the Automotive Industry in India. *International Journal of Intelligent Information Technologies (IJIT)*, 16(3), 19-51.
- [34] Cate Trotter (2019, September 26). The automated personal assistant and the future of retail. *Insider Trends*
- [35] Jason Goldberg (2021, February 19). 2020: Not quite retail apocalypse, but great for e-commerce. *Forbes*.

- [36] Andreev, R., Svetozar, I., Chikalanov, A., & Petkov, Y. (2018). Conceptual Modeling of IoT Ecosystems: A Business-Oriented Approach. *Serdica Journal of Computing*, 12(1-2), 001p-022p.
- [37] Hollis Johnson (2018, July 27). We tried the kiosks that analysts say could help McDonald's win back \$2.7 billion in sales. Here's the verdict. *Insider*.
- [38] Kiosk Manufacturer Association. McDonald's kiosk facts and news. Westminster, CO
- [39] Brandon A Weber (2018, June 06). One big reason why McDonald's is adding self-serve kiosks in a hurry. *Big Think*.
- [40] Cheryl Bates (2017, October 26). McDonald's rolls out self-service kiosks in Malaysia. *Soya Cincau*.
- [41] Craig Witsoe (2017 January 25). Self-Ordering will be the new normal in fast food. *Linkedin*.
- [42] RJ Frometa (2020, March 26). Why self-ordering kiosks are becoming the secret weapon for successful restaurants? *Vents Magazine*.
- [43] Gulle, R. (2020). The Limitations of RFID Implementation in Retail Supply Chain in India A Case Study of the Hyderabad Region.
- [44] Sun, S., Hall, D. J., & Cegielski, C. G. (2020). Organizational intention to adopt big data in the B2B context: An integrated view. *Industrial Marketing Management*, 86, 109-121.
- [45] Ghani, N. A., Hamid, S., Hashem, I. A. T., & Ahmed, E. (2019). Social media big data analytics: A survey. *Computers in Human Behavior*, 101, 417-428.
- [46] Wassouf, W. N., Alkhatib, R., Salloum, K., & Balloul, S. (2020). Predictive analytics using big data for increased customer loyalty: Syriatel Telecom Company case study. *Journal of Big Data*, 7(1), 1-24.
- [47] Lim et al. (2021). *Senheng digital journey. The game, the rule, the way forward for businesses in digital economy*. Malaysia: Kaiyin Publications.
- [48] Salkin, C., Oner, M., Ustundag, A., & Cevikcan, E. (2018). A conceptual framework for Industry 4.0. In *Industry 4.0: managing the digital transformation* (pp. 3-23). Springer, Cham.
- [49] Griffin, J., & Herres, R. T. (2002). Customer loyalty: How to earn it, how to keep it (p. 18). San Francisco, CA: Jossey-Bass.
- [50] Jon Russell (2019, April 22). Resurgent HappyFresh raises \$20M for its online grocery service in Southeast Asia. *Techcrunch*.
- [51] Amazon Web Service. (2021). *HappyFresh personalizes onlineshopping at a lower cost with AWS*. Seattle
- [52] Campaign (2021, January 28). How Braze helped HappyFresh put their customers first. *Campaign Asia*.
- [53] Indian Retailer Bureau (2021, June 22). Winning in omnichannel: what you need to be doing and why. *Indian Retailer. Com*.
- [54] Weber, F. D., & Schütte, R. (2019). State-of-the-art and adoption of artificial intelligence in retailing. *Digital Policy, Regulation and Governance*.
- [55] Kapate, K., Pawar, Y. T., Principal, M. S. G., & Camp, M. Retail Intelligent Automation: An Overview.
- [56] Nick Yates (2017, October 21). Vending machines are getting smarter with machine learning and facial recognition. *Venture Beat*.
- [57] Paolanti, M., Pierdicca, R., Martini, M., Di Stefano, F., Morbidoni, C., Mancini, A., ... & Zingaretti, P. (2019, September). Semantic 3D object maps for everyday robotic retail inspection. In *International Conference on Image Analysis and Processing* (pp. 263-274). Springer, Cham.
- [58] Allegrino, F., Gabellini, P., Di Bello, L., Contigiani, M., & Placidi, V. (2019, September). The vending shopper science lab: deep learning for consumer research. In *International Conference on Image Analysis and Processing* (pp. 307-317). Springer, Cham.
- [59] Ling Cao & Tracy Yang (2020, February 21) JD's vending machines provide 24/7 "unmanned" access to fresh produce. *JD.com*
- [60] Guan Luanjun (2020, January 13). AI fruit vending machines open up new retail channels in the Chinese market. *FreshPlaza*.
- [61] Micheal Arnold (2020, January 15). Chinese fruit-vending machines driven by AI. *Inside Retail*.
- [62] HuaXia (2020, July 15). Discover China: fruits, veggie vending machines big hit in northwest China.
- [63] Lin, C. (2020, March 17). Delivery Technology Is Keeping Chinese Cities Afloat Through Coronavirus. *Harvard Business Review*. <https://hbr.org/2020/03/delivery-technology-is-keeping-chinese-cities-afloat-through-coronavirus>
- [64] Poncin, Ingrid and Mohamed Slim Ben Mimoun (2014), "The Impact of „E-atmospherics" on Physical Stores," *Journal of Retailing and Consumer Services*, 21 (5), 851–9.
- [65] Pangriya, R., & Singh, A. P. (2020). Automation in Retail: Modern Ways of Customer Engagement. *PalArch's Journal of Archaeology of Egypt/Egyptology*, 17(7), 10507-10533.
- [66] Kyle O'Brien (2017, September 6). Nike Maker Experience and W+K lodge promise custom sneakers in less than 90 minutes. *The Drum*.
- [67] Balqis Lim (2019, July 26). AR tool for your online makeup shopping. *New Straits Times*.
- [68] Karacay, G., & Aydın, B. (2018). Internet of things and new value proposition. In *Industry 4.0: Managing the Digital Transformation* (pp. 173-185). Springer, Cham.
- [69] Gawankar, S. A., Gunasekaran, A., & Kamble, S. (2020). A study on investments in the big data-driven supply chain, performance measures and organisational performance in Indian retail 4.0 context. *International Journal of Production Research*, 58(5), 1574-1593.
- [70] Galletta, A., Carnevale, L., Celesti, A., Fazio, M., & Villari, M. (2017). A cloud-based system for improving retention marketing loyalty programs in industry 4.0: a study on big data storage implications. *IEEE Access*, 6, 5485-5492.
- [71] Ivan Cossio Cortez (Ed.) (2020). *Investing in rural people in Indonesia*. Indonesia: International Fund for Agricultural Development.
- [72] Khamila Mulia (2021, May 12). Sayurbox is developing a sustainable agricultural supply chain in Indonesia. *KR-Asia*.
- [73] Amazon Web Service. (2021). *Sayurbox uses AWS to deliver fresh food faster*. Seattle.

- [74] United Nations (2021). *Technology and Innovation Report 2021*. New York: United Nations Publication.
- [60] Javier Miranda and Rob Sesmans. (2020, November 03). 2018 Data Measures Automation in U.S. Businesses. *United states Census Bureau*
- [75] United Nations (2019). *Digital economy report 2019. Value creation and capture: implications for developing countries*. New York: United Nations Publication.
- [76] Santalova, M. S., Lesnikova, E. P., Kustov, A. I., Balahanova, D. K., & Nechaeva, S. N. (2019). Digital technology in retail: reasons and trends of development. In *Ubiquitous Computing and the Internet of Things: Prerequisites for the Development of ICT* (pp. 1071-1080). Springer, Cham.
- [77] Cramer-Flood, E. (2021, January 13). Global Ecommerce Update 2021 - Insider Intelligence Trends, Forecasts & Statistics. Insider Intelligence. <https://www.emarketer.com/content/global-ecommerce-update-2021>.
- [78] United Nations (2021). *Technology and innovation report 2021. Catching technologies waves, Innovation with equity*. New York: United Nations Publication.
- [79] UNCTAD (2021, March 15). How COVID-19 triggered the digital and e-commerce turning point. *United Nations Conference on Trade and Development*.