Can Unmanned Supermarkets Become Leaders in the New Retail Era: Industry Status and Improvement Measures

Tingxuan Zhao *
Capital University of Economics and Business, Beijing, China
* Corresponding Author Email: 1910571236@mail.sit.edu.cn

Abstract. In the trend of rapid growth in the Internet of Things industry and new retail industry, automated and manual retail services such as unmanned retail and unmanned supermarkets have come to people's attention. With the development of emerging technologies, face recognition, artificial intelligence, big data, and 5G industries, the popularity of smart phones and the convenience of online payment have made people accustomed to using payment tools anytime and anywhere, and mobile payment has also provided convenience for businesses, consumers, and some public services; Big data credit reporting covers a wide range, and is more convenient and younger than the traditional retail model. This to some extent allows the public to experience the application of intelligent technology in daily life, improving happiness and convenience, but there are also problems and hidden dangers in this process. In view of this, this article conducts in-depth research on the market of unmanned supermarkets and concludes that unmanned supermarkets need to improve and innovate in multiple aspects in order to become a long-term retail form in the future.

Keywords: Unmanned supermarket; new retail; unmanned retail.

1. Introduction

Due to the short-term decline in global retail sales in 2020 due to the impact of the epidemic, retail e-commerce sales continued to grow in the following years, and offline physical store sales rebounded. With the development of Internet+ and AI intelligent technology, traditional retail faces many challenges: from an internal perspective, the market is becoming saturated and competition is becoming increasingly fierce. From an external perspective, people's lifestyles and consumption habits have changed, and most physical retailers transfer business risks to brand owners through joint ventures or booth rentals. Their procurement and operation are completed by third parties, and the investment of enterprises in retail operations is very limited. Especially in supermarket stores, they do not have a complete product procurement supply chain and often use joint ventures to collect discounts and channel fees, unable to obtain the low-cost advantage in product circulation.

In order to solve the problems facing the retail industry today, Yun Ma proposed the term "new retail" at the Alibaba Cloud Habitat Conference in October 2016: "In the next ten or twenty years, there will be no e-commerce, only new retail."

Since 2016, the American e-commerce giant Amazon opened its first unmanned retail convenience store, Amazon Go, in Seattle [1]. Disrupting the traditional operation mode of convenience stores and supermarkets, using computer vision, deep learning, and sensor touch-pad technology, completely bypassing the traditional checkout process and sparking the wave of unmanned supermarkets, in 2017, Anhui Jiuling Yougou opened the first chain self-service convenience store in China, with the development of stores centered around Anhui and steadily expanding nationwide. Subsequently, multiple new enterprises such as Zhongju Intelligence, Jian24, Bingguo Box, Take Go, Taocoffee, Convenience Bee, Xiaoe Micro Store, and F5 Future Store entered the Chinese market, making unmanned supermarkets enter a popular field.

The core of this article is to focus on unmanned supermarkets. In the context of the development of intelligent technologies such as Internet+, AI, and cloud computing after the epidemic, what is the current development status in the market, how to distinguish and impact it from traditional supermarkets, and analyze the problems existing in unmanned supermarkets and propose future countermeasures and suggestions. The argument in this article has certain practical significance,
guiding more and more consumers to understand and become familiar with the "sense of technology" of unmanned supermarkets.

2. Literature Review

2.1. Current Research Status Abroad

2016 was the first year of exploration in the field of "new retail" and "unmanned supermarkets". For research in this field, scholars both domestically and internationally have started at the same time. Based on the development of some core technologies such as artificial intelligence, the Internet of Things, and AR technology, they promote the transformation and upgrading of the traditional retail industry, so as to better meet the growing demand level of consumers.

Since the rise of unmanned retail in the Chinese market in 2017, foreign scholars have also evaluated some companies. Audrey Guo (2017) proposed the emergence of the "bingo box", allowing users to experience the application of emerging technologies such as recognition and machine learning to intelligent and convenient shopping experiences. Artificial intelligence has played a new advantage in the field of unmanned supermarkets. Yujie Zhang (2019) proposed new insights into the development trend of new retail. It is believed that theory should be combined with practice, and research on online and offline shopping models should be integrated to better promote the development of the new retail era.

2.2. Domestic Research Status

The relevant research on "new retail", "unmanned retail", and "unmanned supermarkets" in China has increased with the continuous increase in the number of unmanned supermarkets in China, so the total number of studies is much higher than that of foreign countries.

Firstly, Hongmei Zhao, Hao Zhu, Yao Chen, Xiaolin Chen summarize the concept of "unmanned supermarkets", market status, government policy support, and other external environmental factors [2-5]. Xiaoli Bai summarized the current types of unmanned supermarkets in China [6]. Miaoyi Wang analyzed the changes in sales of traditional convenience stores and found that the epidemic has promoted the rapid development of unmanned supermarkets [7]. Yan Sun applied marketing theories such as "STP theory" and "4Ps theory" to conduct internal and external environmental analysis on Y Company and AI products [8]. In terms of the application of Internet and artificial intelligence technology, Hao Zhu proposed machine vision technology unmanned store and RFID technology unmanned store, both of which use technologies in many fields such as deep learning algorithm, sensor fusion technology, convolutional neural network, biometrics and so on.

Secondly, scholars such as Hongmei Zhao and Wenhao Deng compared traditional supermarkets with "unmanned supermarkets" to explore whether this "unmanned supermarket" in the new retail era can replace traditional supermarkets [2, 9]. Through the comparison of sales data in recent years, they analyzed the impact of traditional supermarkets and believed that unmanned supermarkets will be the mainstream shopping trend in the new retail era but will not affect the traditional retail industry.

Furthermore, from a consumer perspective, according to Shaohan Wang, it was concluded through a survey questionnaire that in traditional retail models, the "store location factor" is the key factor affecting consumer behavior tendencies [10]. According to Xiaoli Bai, through questionnaire surveys, semi-structured user interviews, and observation methods, it was found that after unmanned supermarkets entered the public eye, the consumer group who chose unmanned supermarkets for shopping had a younger tendency and higher consumption ability. From the perspective of shopping habits, most consumers go to convenience stores or supermarkets every day. Most of them are students or office workers who often buy three meals at their doorstep or downstairs of the company or school. They avoid long queues in order to save time. Therefore, it seems that no one's supermarket is favored by this group and has high enthusiasm for this new retail form, and greatly recognize the convenient and fast near field retail model of unmanned supermarkets, but consumers have high food safety requirements for processed food.
Overall, most scholars at home and abroad believe that the research in the field of unmanned supermarkets and unmanned retail has future prospects and a bright future. Most scholars provided a clear explanation and introduction of new terms from a qualitative perspective before the epidemic era, or analyzed the current market situation and proportion of the retail industry. There is relatively little research on quantitatively analyzing and proving the development prospects and improvement measures of unmanned supermarkets. Therefore, the highlight of this article is to propose future policy recommendations based on existing data after the impact of the epidemic, which has great historical significance and theoretical value.

3. Current Situation of New Retail Industry

3.1. New Retail Definition

The so-called new retail refers to the upgrading and transformation of the production, circulation and sales process of goods, and the deep integration of online services, offline experience and modern logistics by enterprises relying on the Internet and using big data, artificial intelligence and other technical means. It can also be summarized as the transformation of retail form driven by big data through the development of new technology and upgrading of user experience. Unmanned vending machines, unmanned supermarkets, etc. are all carriers of new retail.

3.2. The Rise of Unmanned Retail Industry

3.2.1. Definition of unmanned retail

Based on the research of multiple scholars, the author summarizes that unmanned retail is proposed in the context of the new retail market. By using machine vision, deep learning algorithm, sensor fusion and other technologies, consumers only need to enter the store to scan the code and confirm their identity, select their favorite products and put them in shopping bags, and then directly go out of the supermarket to complete the purchase. Consumers’ mobile devices will automatically pay for the total cost of shopping through third-party payment channels, without the need for queuing and waiting for checkout. Compared with traditional forms, this shopping method greatly saves consumers the time and cost of queuing and waiting, while also increasing their shopping experience and enthusiasm.

3.2.2. Market status of unmanned retail

With the rapid development of China's economy and driven by technological innovation, unmanned retail, as a new retail model in the unmanned economy industry, has also developed rapidly. In order to standardize and promote the healthy development of China's unmanned retail industry, relevant national departments have also successively introduced a series of relevant policies, creating a good policy environment for China's unmanned retail industry.

Unmanned retail, as a new business model combining China's retail industry with artificial intelligence, Internet of Things and other technologies, will also usher in broad development space under the background of China's growing consumption scale. According to data, the total retail sales of consumer goods in China reached 44082.32 billion yuan in 2021, a year-on-year increase of 12.5%. The total sales revenue of the unmanned retail market in 2022 will reach 34.821 billion yuan.

From the perspective of the structure of the unmanned retail market, the current unmanned retail market in China is mainly dominated by vending machine retail. In 2021, the retail market share of vending machines in China was 95.9%, while the market share of other unmanned retail markets was 4.1%. A vending machine refers to an automated retail machine that includes machines operated using coins, payment cards, tokens, or other cashless payment methods to sell products at unmanned points of sale. In recent years, the retail sales of vending machines in China have shown a growing trend. In 2021, the retail sales of vending machines reached 27.124 billion yuan, and it is expected to increase to 33.526 billion yuan by 2022. From the distribution of unmanned retail demand scenarios in China,
residential areas and communities have the highest proportion of unmanned retail demand, accounting for 24%; Next are office buildings, subways, and train stations, both accounting for 21%.

In recent years, with the intensification of China's aging population and the continuous increase in labor costs, labor will become extremely precious, especially in labor-intensive retail industries. Unmanned retail, a new retail format that basically does not require labor costs, will also usher in good development prospects against the backdrop of continuously increasing labor costs. According to data, in 2021, the average salary of employees in the wholesale and retail industries of urban private units in China reached 58071 yuan, a year-on-year increase of 9.5%.

### 3.2.3. New retail industry changes in the post epidemic era

As shown in Figure 1, influenced by the COVID-19, the "non-contact economy" has sprung up. According to the Research Report on Business Model Innovation and Investment Opportunities in China's New Retail Industry issued by the Prospective Industry Research Institute, 121.6 new retail investment events still occurred in 2020 under the influence of the capital winter, with an investment amount of 4.5 billion yuan. On the whole, new retail will become the darling of capital in 2020.

According to Figure 2, in terms of the annual number of new retail financing events, the peak was 102 in 2017, and the following years showed a significant downward trend, and from January to February 2021, the number of financings plummeted only three times due to the impact of the epidemic.

![Fig 1. Financing amount of new retail industry (Photo credit: Original).](image1)

![Fig 2. New retail financing events (Photo credit: Original).](image2)
3.3. Analysis of Current Situation of Unmanned Supermarkets

3.3.1. Current situation abroad: taking Amazon Go as an example

In 2016, the Amazon go concept was first announced. The developer advocated the slogan of "just walk out" and used three technologies similar to driver-less cars: computer vision, deep learning algorithm and sensor fusion. Therefore, a new retail mode that is different from the traditional supermarket has been realized. Let the concept of unmanned supermarket become a reality, which has aroused global discussion. In 2019, the first Amazon go in New York officially opened in Manhattan. It was widely loved by consumers, and then the unmanned supermarket expanded to more than 20 regions in the United States. However, in April 2023, Amazon announced that it had closed eight unmanned supermarkets Amazon go, accounting for about 28% of the total number of stores in the United States. The reason is that Amazon go's extremely expensive vending machine and the application of high-tech technology have far exceeded the expected cost, and the sales volume is not large enough to enable the store to operate. In addition, in terms of technology, the technology that can be fully applied to the situation of unmanned supermarket needs to be innovated and improved. There may be errors and omissions of face recognition and RFID technology of commodity recognition, which will damage the overall operation of the whole store. On the other hand, Amazon may be restructuring its retail strategy to invest more resources in online retail and express business rather than unmanned convenience stores. Closing these stores can release capital and human resources for Amazon to support the growth of its online retail and express business.

In general, although Amazon go is the first unmanned supermarket enterprise to attract the attention of consumers in China, there are still some problems, such as imperfect technology, low consumer popularity and inappropriate business strategy. Therefore, the field of unmanned supermarkets still needs innovation.

3.3.2. Current domestic situation

With the gradual maturity of emerging technologies such as artificial intelligence and machine vision, as well as the domestic and global leading trend of mobile payment, the new retail represented by unmanned retail has attracted the attention of major e-commerce platforms and well-known brands. The unmanned store has become a new trend in the global retail industry. Traditional retail giants such as Alibaba have begun to try the unmanned store model, and some small and medium-sized start-ups have also emerged with their industry-leading AI technology. After sharing bicycles, the unmanned store is expected to become the next explosive emerging business. According to Figure 3, the scale of the domestic unmanned retail market (including vending machines) in 2017 was close to 21.8 billion yuan, and it is expected to exceed 65 billion yuan in 2020, with a three-year compound growth rate of about 44.4%. In 2017, the overall market size of vending machines was about 18.8 billion. It is expected that the market size will exceed 45 billion in 2020, with a compound growth of 37.1%.

![Fig 3. Size of China's unmanned retail market (Photo credit: Original).](image)
According to Table 1, At present, there are over a hundred unmanned supermarkets in China, most of which are located in cities with rapid economic development in the first and second tier, while the number of unmanned supermarkets in small and medium-sized cities is relatively small. There are mainly Take Go, Xiaoe Micro Store, Yishi Box, Bingguo Box, Lawson, JD Unmanned Supermarket, Convenience Bee, etc. Each brand's unmanned store has its own characteristics.

**Table 1. Overview of unmanned supermarkets in China.**

<table>
<thead>
<tr>
<th>Store Name</th>
<th>Start Time</th>
<th>Characteristic</th>
<th>Square</th>
<th>Shopping Process</th>
<th>Product Category</th>
<th>Payment Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Take Go</td>
<td>2017.2</td>
<td>Unattended Smart Store</td>
<td>unlimited</td>
<td>Sweep hand into the store, take it and leave, automatic deduction</td>
<td>daily necessities</td>
<td>Free of payment</td>
</tr>
<tr>
<td>Small e-store</td>
<td>2016</td>
<td>Unattended, automated supermarkets, automated shelves</td>
<td>Open Shopping Cabinet</td>
<td>Scan the phone code to open the container, scan the code for payment, and close the container</td>
<td>Snacks and beverages</td>
<td>Scan payment</td>
</tr>
<tr>
<td>Yishi Box</td>
<td>2017</td>
<td>Unmanned self-service supermarket</td>
<td>35 square meters</td>
<td>Register an account with a mobile phone and upload facial photos. Enter the supermarket through a dual door, scan the QR code or swipe the face for payment, and leave the store with facial recognition</td>
<td>Snacks, alcohol, Water, daily necessities, etc</td>
<td>Scan code or swipe face payment</td>
</tr>
<tr>
<td>Binguo Box</td>
<td>2017.6</td>
<td>Unmanned intelligent convenience store</td>
<td>Two sizes, 12.48 and 15.6 square meters</td>
<td>Scan the code to pick up the goods at the store, automatically scan the goods at the checkout counter, and check out</td>
<td>Beverages, daily necessities, snacks, etc</td>
<td>Scan payment</td>
</tr>
<tr>
<td>Lawson</td>
<td>2016.12</td>
<td>Unmanned convenience store</td>
<td>Convenience store size</td>
<td>Automatic scanning for pickup, automatic packaging, and check-out</td>
<td>Breakfast, bento, afternoon tea, snacks, etc</td>
<td>Scan payment</td>
</tr>
<tr>
<td>JD Unmanned Supermarket</td>
<td>2017.10</td>
<td>Unmanned supermarkets and intelligent shelves</td>
<td>Over 100 square meters</td>
<td>Bind a JD account before entering the store, activate password free payment, swipe face to enter the store, select products, swipe face to settle, and leave the store</td>
<td>Snacks, beverages, daily necessities, fruits, etc</td>
<td>Face-scan payment</td>
</tr>
<tr>
<td>Convenient Bee</td>
<td>2017.2</td>
<td>Unmanned convenience store, manned</td>
<td>Convenience store size</td>
<td>Entering the store to select goods, self-service checkout, and leaving the store</td>
<td>Snacks, drinks, sandwiches, bread, etc</td>
<td>Scan payment</td>
</tr>
<tr>
<td>711 Under testing</td>
<td></td>
<td>Intelligent convenience store</td>
<td>Convenience store size</td>
<td>Shopping, conveyor belt, self-service scanning of products, check-out</td>
<td>Breakfast, bento, afternoon tea, snacks, etc</td>
<td>Scan payment</td>
</tr>
</tbody>
</table>
3.4. Characteristics of Unmanned Supermarkets

3.4.1. Lower labor costs
Reduce labor costs: Compared with traditional supermarkets, unmanned supermarkets can save a large part of labor wages. With the rapid development of the times and the improvement of people's quality, labor costs will continue to increase. If a part of the payment is reduced, businesses will gain more revenue under the same Ceteris paribus.

3.4.2. Rich consumption data
Convenient for merchants to obtain consumer information: Some unmanned supermarkets enter by registering an account first or scanning the QR code and face, so that merchants can record user information, such as age, gender, number of visits to the supermarket, frequently purchased products, and so on. Through the personal information of these users, businesses can analyze the personal preferences and needs of each consumer, which is conducive to increasing contact with consumers and better meeting their shopping needs. This not only benefits consumers, but also increases the profits of merchants.

3.4.3. Immersive shopping experience
Innovate different shopping experiences: Strolling traditional supermarkets will experience social and emotional interactions and connections with shopping guides and staff, promoting emotional communication between people. Unlike unmanned supermarkets, they effectively prevent consumers from being promoted and interfered with by shopping guides, even though forced marketing. This can create an "immersive" shopping experience for consumers and experience the joy of selecting products.

4. Limitation and Feasible Solution

4.1. Problems in Unmanned Supermarkets

4.1.1. Limited consumer base
According to the consumption situation of unmanned supermarkets in China, the target audience is mostly young people. And the elderly is overly concerned about technological innovation. However, in China, the degree of aging is increasing, and the proportion of middle-aged and elderly people is increasing, with strong purchasing power. This will lead to increasing restrictions on the audience of unmanned supermarkets. Therefore, the unmanned supermarket industry needs to propose specialized service channels for the elderly population in order to attract more consumers.

4.1.2. Inaccurate recognition system
Unmanned supermarkets still have shortcomings in sensor recognition and security technology. For example, when the traffic is high, it can easily lead to inaccurate camera recognition system judgment; Goods are identified through RFID tags attached to them, and if consumers tear or damage the tags, there is a high risk of theft.

4.1.3. High operating costs
It is reported that the Gross margin of an unmanned convenience store accounts for 30% -40%, even if the rental cost and labor cost are zero, its investment payback period is less than one year. In addition, the high cost of high-tech procurement, operation, and maintenance can lead to a business crisis for unmanned supermarkets. Secondly, the scale of each unmanned supermarket varies, and there is no fixed rental cost and budget, so cost management is still a problem that needs to be solved.

4.1.4. Insufficient user experience
In traditional supermarkets, customers may have emotional communication and connections with familiar guides or salespeople, which increases the transmission and exchange of emotions between
people. However, unmanned supermarkets lack this, which increases the difficulty of capturing user preferences and may affect users' shopping experience and merchants' profits.

4.2. Future Improvement Measures and Guidance Suggestions

4.2.1. Services for the elderly

From field surveys and questionnaire surveys, it can be seen that unmanned supermarkets are mostly used by young people, but for elderly people who cannot flexibly use their phones, it has become a problem. Therefore, online client merchants can establish an "elderly mode" in mobile apps, simply set some necessary operating steps in it, enlarge the font, and form a very simple desktop. This can to some extent reduce the troubles of the elderly. In offline physical stores, businesses can open several windows and channels for the elderly, or develop Boot flag for the elderly, which will also play a role.

4.2.2. Vision technology

The information recognition of unmanned supermarkets mainly relies on computer vision technology and sensor technology. Merchants need to enhance visual technology through technology and expand the detection of adult body parts. When displaying images of partial faces, there will be images from another angle of the face, which are combined with multiple images to distinguish body parts. If this technology is applied to the unmanned supermarket scenario, it will greatly improve the safety of the store.

4.2.3. Cost control

In order to effectively reduce the cost of unmanned supermarkets, unmanned supermarkets can have multiple chains or franchises, allowing brands and suppliers to share data, exchange information between both parties, and reduce the dividends of intermediaries. Alternatively, establishing preferential policies between chain stores can promote multiple stores to increase sales and achieve greater profits.

4.2.4. Service satisfaction

In order to better enhance the consumer experience, merchants should optimize and upgrade the overall service process, improve the design of online and offline contact points, and meet the needs of various consumers to the greatest extent. Specifically, merchants can promote popular and new products through both online and offline channels from pre-sales, allowing consumers to have a general understanding of the products before making a purchase. Set up a dedicated after-sales manual customer service column online, and set up a dedicated window at the offline entrance to handle return and exchange disputes. This can reduce the time and cost spent by consumers in the return and exchange process, allowing them to experience a more reassuring consumption experience. At the same time, businesses need to improve the reliability of technology. In unmanned supermarkets, consumers will focus more on product information descriptions, shopping lists, and settlement bills. Therefore, during the product introduction and payment process, merchants need to make multiple confirmations to reduce consumer concerns. Strengthen the accuracy and speed of scanning and identifying products, and reduce consumers' concerns about unfamiliar devices. In addition, it also need to use artificial intelligence to record the personalized consumption tendency of each shopping consumer, so that people can push the product information of the favorite fields to consumers through Big data, which will help increase the sales of businesses. On the other hand, merchants can interact in a timely manner based on consumer behavior through multi sensory scene interactions. For example, consumers can directly input the desired product on an artificial intelligence service robot, and the robot display can immediately display the specific location of the desired product, and even make a sound. This stimulates consumers' purchasing behavior through visual, auditory, and tactile stimuli.
5. Conclusion

As a carrier in the context of new retail, unmanned supermarkets have been widely loved by domestic and foreign consumers, enriching their diverse consumption patterns and shopping experiences, and thus having the foundation of some consumer groups. However, during its implementation, there were still some issues that needed to be addressed, such as user group, technology, experience and cost. Therefore, corresponding solutions have been proposed based on these issues. Not only does it require strong financial and technological support, but the government should also encourage and actively promote the use of unmanned supermarkets in public life. Such unmanned supermarkets can also develop in the long run.

References