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RESEARCH ARTICLE

THE FUTURE STUDY OF UNMANNED CONVENIENCE STORE IN MALAYSIA

Ee Teck Rong[1], Nor Hazana Abdullah[1]*, and Azuraien Japper[2]

[1]Faculty of Technology Management & Business, Universiti Tun Hussein Onn Malaysia, Johor, Malaysia
[2]Department of Mechanical Engineering, Universiti Teknologi Petronas, Malaysia

ABSTRACT - Most conventional convenience stores in Malaysia face operation time and manpower problems, indicating the need for solutions such as unmanned convenience store. The unmanned convenience store is a retail outlet without service personnel or cashier. The technology of artificial intelligence and the Internet of Things are typically used to facilitate transactions in unmanned stores. However, whether unmanned convenience stores might replace conventional stores in the future has not been investigated. Therefore, this study aimed to identify the key drivers of the unmanned convenience store from merged issues, trends, and challenges and its future scenarios of the unmanned convenience store in Malaysia. This study used exploratory research design by using descriptive survey developed from the STEEPV analysis. Eight merged key drivers had been identified after the merging of all the drivers from STEEPV analysis. Descriptive questionnaires were distributed to the consumers who went to unmanned convenience stores. The technology readiness of unmanned convenience stores was also evaluated using Technology Readiness Index (TRI). The top two drivers that were identified which are "innovation of technology adoption" and "consumer preference" in impact-uncertainty analysis and were used for developing future scenarios of unmanned convenience store in the next 5 to 10 years. Four future scenarios discussed were "technology is at par with customer demand", "improvement is observed", "uses of technology are not welcome by customers", and "not fulfilling customer's demand". Consequently, this study may assist future researcher and developers to enhance their understanding of the unmanned convenience store in Malaysia.

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INTRODUCTION

The retail industry in general is facing many challenges. Margin pressure comes from various sources, including greater expenses to manage supply chains for e-commerce, increasing supplier expectations to pass on inflationary raw material costs, larger investments to keep up with the new competition, and continuously rising labour costs. As a result, retailers increasingly use automation to address margin pressure and escalating customer demands as they fight to adapt and survive.

In terms of convenience stores, aside from the above-mentioned issues, they also face operation time problems. Section 60A (1) of the Labor Code, states that maximum working hours are 8 hours per day or 45 hours per week. Although stores could opt for shift work, finding people willing to work late and face potential safety concerns (Danial, 2020) is still challenging. For example, New Straits Times news (2022, July 25) reported that a grocery store was robbed and set on fire in Felda Tersang 1 near Raub, leaving a foreigner injured, on July 23, 2022. Besides, the operation time of the convenience store is becoming an issue for the public as it does not allow customers to shop at any time that suits their needs and emergencies.

Another common issue faced in a convenience store is that customers need to queue and wait at the checkout counters. According to NACS magazine (2020), 63% of customers listed saving time by shopping at convenience stores' handy locations and short queues as their top priorities. Another 52% claimed that they chose to shop at convenience stores in addition to acquiring food and petrol since they could enter and exit quickly. With the advanced technology of unmanned convenience stores today, customers can choose products, collect products, and make payments by swiping their mobile phones; the user will save significant time (iNews, 2023).

One of the possible solutions is the adoption of an unmanned convenience store concept. It refers to a retail outlet without service personnel or cashiers. A mobile application or artificial intelligence is typically used to facilitate transactions in unmanned stores, allowing shoppers to make purchases without the traditional features of a store. A new era for unmanned retail stores ushered in with the launch of Amazon Go, the leading e-commerce company in the United States (Wang, et al. 2021). Many parts of the world, particularly Asia, have become accustomed to unmanned stores offering convenient and efficient shopping. For instance, China had an estimated 200 unmanned stores in 2017 (Murayama, 2019). Unmanned technology is becoming a new trend in the future as unmanned stores gain momentum throughout the world.

*CORRESPONDING AUTHOR | Nor Hazana Abdullah | ✉ hazana@uthm.edu.my

However, to what extent the unmanned store concept could replace conventional stores has not been explored empirically. Thus, there is a need to conduct future scenario analysis to anticipate its future needs and challenges. Thus, the aim of this study is to;

i) To identify the key drivers of the unmanned convenience store from merged issues, and challenges in Malaysia.

ii) To study the future image of the unmanned convenience store in Malaysia.

RESEARCH METHODOLOGY

A research methodology defines a systematic process of gathering, interpreting, and drawing conclusions based on the data collected. According to Murthy & Bhojanna (2009), research methodology is a study's blueprint. This research used an exploratory research design as the nature of the foresight study is descriptive. Although technology Foresight involves a wide range of activities such as panels, scenario workshops, brainstorming, consensus building, systematic looking ahead, forward-looking activities, strategic intelligence, futures research, or technology road mapping, this study focuses on horizon scanning, STEEPV analysis, impact-uncertainty analysis, and scenario building as shown in Figure 1.

The foresight process, usually called strategic foresight, is used in various industries, including marketing, to foresee and prepare for future developments and obstacles. It entails a methodical approach to data collection, analysis, and interpretation to spot future trends, opportunities, and risks that could impact a company or sector (Hirvensalo, 2023). In particular, the foresight process commonly starts with horizon scanning.

Horizon Scanning

Horizon scanning helps determine whether one is ready for potential changes or threats. Horizon scanning is valuable for getting specialists in many fields together to debate a problem and develop workable solutions. Each iteration of the cyclical actions of scanning, analysing, synthesizing, and disseminating information is a part of every horizon-scanning process (National et al. (US), 2020). The approach used in horizon scanning aims to facilitate scenario planning and identify specific issues. The scope of the horizon-scanning efforts envisioned can be either broad or narrow, with a horizon of 10–20 years in the future and the data being fed into the future-thinking process.

STEEPV Analysis

The next step involved STEEPV analysis which is recognized worldwide as a tool for conducting Technology Foresight brainstorming (Minhas et al., 2011). The theme STEEPV stands for S(Social), T(Technological), E(Economical), E(Environmental), P(Political), and V(Value). Organizations and industries use it to analyse and assess external factors that affect them (Meissner, 2013). By analysing these six dimensions, businesses can comprehensively understand the forces shaping their industry. Organizations can use STEEPV to discover opportunities, anticipate risks, and align their strategies with broader contexts. Using STEEPV analysis can help to obtain insight from the development of the external environment. In this study, this tool was used for identifying drivers and conducting a literature review. The drivers were then translated into a questionnaire to determine their respective impact and future uncertainties.

To distribute the questionnaires, the scope of the study was determined. There are only a few unmanned supermarkets in Malaysia. with Malaysia's first unmanned supermarket (Aye Smart Store) opened in April 2021 in UOA Glenmarie, Shah Alam. Thus, convenience sampling was used in collecting the data from respondents. Convenience sampling refers to respondents who are “convenient” to the researcher (Edgar & Manz, 2017). The researcher went to Mondo Smart Store, which is in MRT Ampang Park, Panas Express Lalaport 24 hours which is located in KL and Mondo Grocery located in Senai Airport, Johor for data collection.

Descriptive Questionnaire Survey

The questionnaire distributed had four sections: Section A, Section B, Section C and Section D. Section A is about the demographic respondents, and Section B is about the important factors in encouraging unmanned convenience stores in Malaysia. Section C is about the impact of implementing unmanned convenience stores in Malaysia. Section D is about the uncertainty of implementing unmanned convenience stores in Malaysia. The instrument was designed in the Likert scale style. The answer to the question given by the respondents with a five-scale ranging from (5) = Strongly Agree, (4) = Agree, (3) = Neutral, (2) = Disagree and (1) = Strongly Disagree. TRI was included in the survey to provide insight into the favourability of the technology. In this study, the primary data were collected through a descriptive questionnaire derived from STEEPV analysis results. The collected data was analysed in Microsoft Excel and leading drivers were identified for further impact-uncertainty analysis. Afterwards, the data were used for scenario-building analysis by the top two drivers.

Impact-Uncertainty Analysis

When analyzing impact uncertainty, impact refers to the degree to which each driver will influence the implementation of an unmanned convenience store, while uncertainty refers to the degree to which each driver will influence the implementation of an unmanned convenience store. A critical scenario area is selected based on drivers with the highest impact and uncertainty.

Scenario Building

Based on the impact uncertainty, the researcher identified two main drivers that have both high impact and high uncertainty. Based on the two drivers, the researcher then identified the scenario that will occur in the future as shown in Figure 1.

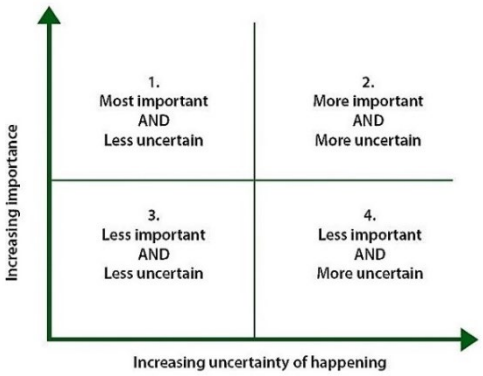

Figure 1. Impact-uncertainty analysis

LITERATURE REVIEW

This section focuses on identifying the issue and drivers, and of unmanned stores within Malaysia. The STEEPV analysis analyses issues and drivers, tabulates them into respective elements, and merges them from the keyword table.

Unmanned Technologies

Unmanned technologies, including unmanned autonomous systems and vehicles, have been advancing rapidly and introducing exciting new capabilities across various domains. These technologies have been driven by innovations in artificial intelligence (AI) and have found applications in diverse sectors, including retail.

According to Unmanned Systems Market Size & Share Analysis - Industry Research Report. The unmanned systems market has been experiencing significant growth, with a forecasted compound annual growth rate (CAGR) of 15.1% during the forecast period. The COVID-19 pandemic has positively impacted market growth, as there has been an increased demand for unmanned systems for various commercial and military applications.

Two key technologies are enabling unmanned convenience stores: the Internet of Things (IoT) and Artificial Intelligence (AI). AI uses bio payments, facial recognition, vision sensors, and deep learning to act as machines' eyes and brains. The idea of intelligent consumption is achieved through identity verification and automatic checkout, as well as the ability for customers to take away products directly. The Industrial Technology Research Institute has developed and tested an unmanned store based on the models of Amazon's "Amazon Go" and Hangzhou Wahaha Group Co., Ltd.'s "Take Go". IoT utilizes technologies such as Radio Frequency Identification (RFID) readers, barcode scanners, sensors, and others for check-out. RT-Mart and Auchan created the Bingo Box, an automated convenience shop where customers may select items using RFID tags, scan the product ID code, and make purchases. Payments are automatically collected (Gupta & Narayan 2020) (Ho et, al. 2020). These solutions enable efficient tracking and control of revenue and expenses while streamlining operations and saving time and effort for workers (Field Check, 2023).

Convenience Stores in Malaysia

The convenience store industry in Malaysia has been experiencing significant growth and presents promising potential for convenience store players (Markets, 2020). The number of convenience stores in Malaysia is anticipated to grow at a compound annual growth rate (CAGR) of 6% from 2016 to 2022 (Markets, 2020). This growth indicates the industry's expansion and development, which offers numerous opportunities for retail and convenience store businesses (Markets, 2020). Convenience stores are known for their extended operating hours, often catering to customers beyond the standard 9 to 5 times (ServiceChannel, 2022). While specific operating hours may vary between different convenience stores, many operate 24/7 or have hours extending well beyond regular business hours. This availability allows convenience stores to serve customers at any time of the day or night, meeting their immediate needs and providing convenience (ServiceChannel, 2022).

In Malaysia, several convenience store brands have made their presence felt. International brands such as Family Mart, CU Malaysia, and Circle K have established themselves alongside homegrown brands like KK Super Mart and 99 (Poon, 2022). These brands contribute to the growth and competition within the convenience store industry in Malaysia (Poon, 2022). Additional information about specific convenience store locations in Kuala Lumpur can be found on platforms like Yelp https://www.yelp.com/search?cflt=convenience&find_loc=Kuala+Lumpur.

Unmanned Convenience Store in Malaysia

Unmanned convenience stores, or independent retail stores, have been introduced in Malaysia, which the first outlet that was launched in Malaysia is Aye Smart Store which is planned to open at the end of April 2021 at UOA Glenmarie in Shah Alam. The store is aimed at bringing innovative concepts and transforming the traditional retail experience (Azman, 2021). These stores leverage advanced technologies, such as artificial intelligence (AI) and self-service kiosks, to enable customers to shop without cashiers or staff assistance.

These unmanned convenience stores offer 24/7 operating hours, allowing customers to shop at their convenience (John, 2018). The introduction of unmanned retail technologies in Malaysia disrupts the traditional retail landscape, providing new and innovative ways for customers to access products and services (Sharon & Sharon, 2020).

Furthermore, unmanned convenience stores have emerged in Malaysia, offering autonomous retail experiences powered by advanced technologies. Examples such as the Aye Smart Store and Irispay unmanned self-service convenience store have introduced new ways for customers to shop without cashiers or staff assistance. These concepts embrace AI, self-service kiosks, and mobile payments to provide convenience and accessibility to customers in Malaysia's retail landscape.

Besides, unmanned convenience stores fit well with current trends by incorporating cutting-edge technologies like artificial intelligence (AI) and the Internet of Things (IoT). These stores use facial recognition for admission, AI to track customer movements, and RFID to track merchandise. Such technologies allow for greater data analytics, individualized marketing plans, and superior product displays based on consumer preferences.

Advantages of Unmanned Convenience Stores in Malaysia

Unmanned Convenience Store is the new and growing trend of purchasing methods in this world. The purchase of goods in unmanned stores can offer several advantages. As Tan & Tan (2021) stated, when purchasing in unmanned convenience stores, customers may avoid long queues by tapping a bank card or using a mobile app to enter public transport instead of paying. During this automated payment method, cameras track customers as they select items from the shelves, and a single QR scan of the app tied to their payment method charges them for the items they pick up, simplifying the payment process (Azman, 2021).

Moreover, the advantage of unmanned convenience stores is about those safety and security concerns. According to the research of ControlTek (2021), shoplifting issues are common cases that often happen in grocery stores; for example, alcohol, top-shelf liquid, and other items are everyday items that will be stolen from grocery stores. Hence, with the innovative technology that unmanned convenience stores provide, it will track and record the customer's identity before entering the unmanned stores (Truck, 2023). Furthermore, collaboration with e-wallet allows for a seamless mobile payment experience using popular platforms like Alipay and WeChat (Sharon & Sharon, 2020). It can also reduce the risk of robbing cases in unmanned convenience stores.

Challenges of Unmanned Convenience Stores in Malaysia

While unmanned convenience stores in Malaysia offer numerous advantages, they also face several challenges that impact their widespread adoption and success. Technology is an advantage to unmanned convenience stores and convenience customers, but there is still some issue for safety concerns issue; unmanned store needs to ensure that they comply with new normal standard operating procedures to offer customers a safe and enjoyable shopping experience (Azman, 2021). Besides, unmanned stores heavily rely on backend networks of sensors and cameras to track and analyze the movement of shoppers and manage inventory in real-time (Tan & Tan, 2021). So, safety challenges will occur when the tracking system is facing problems. Thus, the safety challenges are the challenges during the operation.

In addition, technological integration and the acceptance level of customers also become a challenge to unmanned convenience stores. This is due to the concept of the unmanned store still being a new trend, so some individuals, especially senior citizens and villagers, need to be more experts at using this advanced technology. There are essentials to embracing self-checkout technology, which requires a shift in mindset and integrating new systems and processes (Wong, 2023). Consequently, it will cause those customers to choose traditional stores compared to unmanned convenience stores.

STEEPV Analysis

Table 1 shows the issues, challenges and drivers in detail. The first driver highlights how the adoption of unmanned convenience stores is significantly influenced by various technologies, each contributing to enhanced efficiency and customer experience. For example, Smart technology promotes energy efficiency and automation, enabling unmanned stores to optimize operations, control lighting based on occupancy, and enhance overall resource management (DMN Editorial Team, 2023) while Incorporating IoT and AI techniques enables real-time monitoring, predictive analytics, and intelligent decision-making, enhancing the overall functionality and efficiency of unmanned stores (Jiang et al., 2022).

Human-Technology Interaction: Improving the interaction between customers and technology is crucial. Understanding and refining this interaction can lead to user-friendly interfaces, making unmanned stores accessible and convenient for customers (Human-technology Interactions, 2022). On the other hand, the next driver focuses on the key

advantage of the technology which is convenience not only in terms of operating and managing the convenience store but also its implication to human resource/labour cost and customer preference. The third driver focuses on customer experience. The preference for unmanned convenience stores can be influenced by changing consumer demographics, including the increasing number of introverts. Research on AIoT-based unmanned convenience stores, such as X-Store, highlights the intersection of technology and consumer acceptance. Studies explore the impact of perceived risks and technological acceptance models on consumer acceptance of AIoT-based unmanned convenience stores, suggesting a growing interest and acceptance in technologically advanced retail environments (Wang et al., 2021). Additionally, factors such as experiential quality and psychological states in unmanned convenience stores have been explored, indicating the importance of consumer experience in these settings (Wu et al., 2019). While not explicitly mentioned, the shift toward autonomous and less socially demanding shopping experiences aligns with the preferences of introverted individuals who may find comfort in the autonomy and reduced human interaction offered by unmanned convenience stores. Other drivers include regulations and integration, environmental consideration, consumer safety, consumer technological inclination, and value creation and motivations.

Table 1. Drivers of emerged from issues, and challenges

No	Drivers related to merged issues, challenges, and trends	Merged issues and drivers
1.	Innovation in Technology Adoption	• Smart technology • Human-technology interaction • Self-service purchases • Self-checkout options • Internet of Things, and artificial intelligence techniques • 5G technology • Advanced technology
2.	Convenience	• Consumer convenience • Cost-effective items • Social dynamic • Smart retailing • Job displacement • Biometric readers • Reducing labor cost
3.	Customers experience	• Consumer shopping journeys • Enhancing customer interactions • Enhance customer experiences • Social norms • Delivering innovative retail services
4.	Regulation and integration	• Government regulation
5.	Environmental Consideration	• Reduced resource consumption • Market growth potential • Economic growth • Resource-saving model • Waste reduction • Real-time environmental monitoring • Environmental monitoring
6.	Consumer Safety	• Accuracy information • Customer safety • High level of technology readiness • Technology Acceptance Model (TAM) • Glorified vending machine
7.	Consumer Technological Inclination	• Win–win opportunities • Human-robot collaboration • Technical infrastructure • Mobile payment method

Table 1. (cont.)

No	Drivers related to merged issues, challenges, and trends	Merged issues and drivers
8.	Value Creation and Motivations	• Unique value • Create new value • Enhance profitability • Financial viability

RESULTS

This section discusses the results of the data collection of 105 respondents. The impact-uncertainty result was analyzed using Microsoft Excel. In terms of gender, there are more females with 61 out of 105 (58.10%) compared to the male respondent with 44 respondents (41.90%). Besides, most of the respondents are in the age range between 18-25 years old which is 56 out of 105 respondents (53.33%), and the lowest range respondent is in the range 32 years old and above which is 5 respondents (4.76%). Finally, most respondents' monthly income ranges between RM1500-RM2500 with 60 respondents (57.14%).

In addition, the majority of respondents prefer unmanned convenience stores which is 68 out of 105 respondents (64.76%). Most of the respondents spend 1-3 times a week on unmanned convenience stores which is 91 respondents (86.67%). This indicates that the majority of respondents prefer this type of store. This result is further enlightened by the Technology Readiness Index as shown in Table 2. Optimism has the highest mean score among the four attributes which is 4.57412. The second highest of the mean score is Innovativeness (4.47380), followed by discomfort (3.63333). Insecurity has the lowest mean score which is 3.640476. Overall, these four attributes have a high level of central tendency. Thus, the technology readiness of unmanned convenience stores was perceived as highly favourable in Malaysia.

Table 2. Technology readiness index

Attributes	Mean	Central of Tendency Level
Optimism	4.57142	High
Innovativeness	4.47380	High
Discomfort	3.63333	Medium
Insecurity	3.60476	Medium
Overall TRI	4.06750	High

Impact-Uncertainty Analysis

Table 3 indicates the comparison of mean value between the level of impact and level of uncertainty. All data are used to construct impact and uncertainty analysis as shown in Figure 4.1. The main objective of the analysis is to determine the highest outcome in terms of impact and uncertainty. Based on Figure 4.1, it is found that D1 (4.4514, 3.80953) and D7 (4.32380, 3.88571) which have been highlighted with a red colour circle in Figure 4.6. The decision of the top two drivers was made based on the highest mean scores of impacts and uncertainty. D1 and D7 represent the "innovation in technology adaptation" and "Consumer Preferences" respectively. These two key drivers will be used to generate the scenario-building analysis as shown in Figure 2.

Table 3. Mean score of impact and uncertainty drivers

Code	Drivers	Mean	
		Impact	Uncertainty
D1	Innovation in Technology Adoption	4.45714	3.80953
D2	Convenience	4.34285	3.67619
D3	Customers Experience	4.20952	3.74285
D4	Regulation and Integration	3.93333	3.64761
D5	Environmental Consideration	4.32809	3.74286
D6	Consumer Safety	4.30476	3.79809
D7	Consumer Preferences	4.32380	3.88571
D8	Value Creation and Motivations	4.40952	3.75238

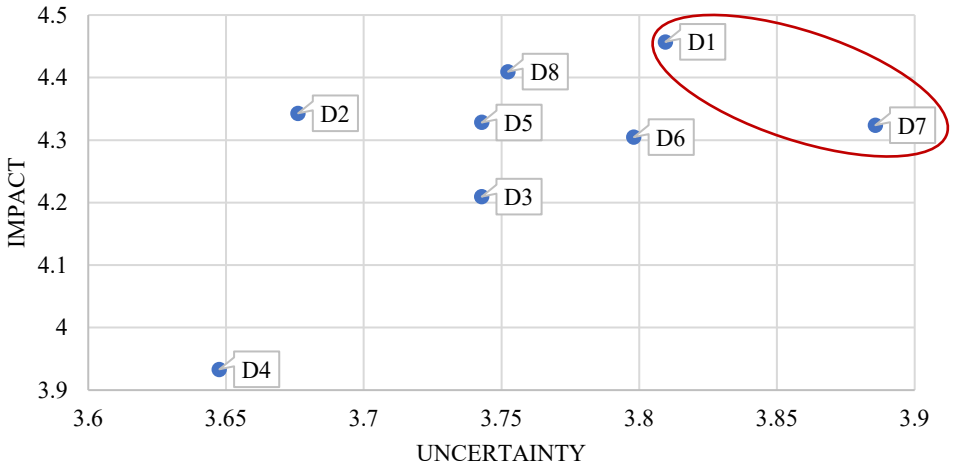

Figure 2. Mean score of impact-uncertainty drivers

DISCUSSION, RECOMMENDATION AND CONCLUSION

This section discusses the scenario building using the selected two drivers based on the impact-uncertainty analysis in the previous section. This chapter aims to create four distinct alternative scenarios that represent the future technology of unmanned convenience stores over ten years. The outcomes might be either beneficial or harmful. Impact uncertainty and scenario analysis are required to determine the top two that show high levels of impact and uncertainty to unmanned convenience stores.

The four-scenario analysis is illustrated in Figure 3. The four alternative scenarios were developed from two selected drivers which are “innovation in technology adoption” and “consumer preference.”

	High Innovation Technology Adoption		
Low Consumer Preference	Technology is not welcomed by customers	Technology is at par with customer demand	High Consumer Preference
	No improvement is observed	Not fulfilling customer’s demand	
	Low Innovation Technology Adoption		

Figure 3. Future Scenario of an unmanned convenience store in Malaysia

Scenario 1 “Technology is at par with customers demand”

Scenario 1 shows that technology is at par with customers' demand due to the high adoption of technology and consumer preferences. This scenario can fulfil customer demand and shopping experience through innovations like AI, IoT, and intelligent technologies (Sun et al., 2022). The innovative technology that applies in unmanned convenience stores may give them unlimited access to information and enable faster communication, allowing customers to select the products conveniently and efficiently (Alexa, 2023). Furthermore, combining intelligent technology and physical stores will replace the traditional cash transaction method with an e-payment method. Customers can make the payment by scanning the barcode for each product and make the payment without checking a cashier, or customers can even directly "take away" products (Wang et al., 2021). Moreover, based on the research, the sales of automated parts to unmanned convenience stores are improving by 11% compared to those with little or no automation (Nacs, 2023). Besides, through the AI and data analytics system, unmanned convenience stores can offer personalized promotions and recommendations to fulfil customer demand and experience; for example, with the increasing rate of handphone users in future, it might increase demand for digital advertising on platforms via smartphones and streaming video platforms (Karen, 2023). Consequently, with the high adoption of technology innovation and high preferences for unmanned convenience stores, it might show the idealistic scenario in the future; unmanned convenience stores, as a new trend shopping method in this generation, can easily satisfy the customer demand with the installation technology in store.

Scenario 2 “No improvement is observed”

The second scenario signifies stagnation, representing the most unfavourable outlook for unmanned convenience stores in Malaysia's future landscape. The imperative for enhancement arises from the dual challenges of inadequate technology adoption and diminished customer preferences. Insufficient technological integration in unmanned stores leaves them susceptible to security risks, including theft and fraud, as they heavily rely on intelligent systems like RFID for identity tracking (Turck, 2023), advanced checkout systems, and AI-powered inventory management (Wang et al., 2021). Such vulnerabilities compromise customer safety and satisfaction within these innovative retail spaces. Notably, Nair (2023) highlights that 77% of individuals are drawn to technology simplifying their daily lives. In an era dominated

by e-commerce and mobile payment systems, customers seek a seamless and tech-driven shopping experience. An unmanned convenience store lacking in technological adoption risks losing customers to traditional stores offering a more advanced and convenient shopping environment.

Scenario 3 "Technology is not welcomed by customers"

The third scenario arises when unmanned convenience stores embrace advanced technology extensively, yet face a challenge due to low consumer preference. This situation occurs when innovative unmanned stores, despite their technological prowess, are not optimized by a limited customer base. Consequently, this mismatch results in heightened operational challenges and costs without proportional revenue generation (Business Growth Report, 2023). Deploying cutting-edge technology in unmanned convenience stores incurs substantial initial costs, posing a significant investment for prospects. However, a lack of market demand can lead to financial stress if these costs cannot be justified. Additionally, slow consumer adoption of unmanned convenience stores, driven by factors like limited awareness and a preference for traditional stores, may hinder the expected return on technological investments. This, in turn, jeopardizes the store's ability to sustain operations and meet financial obligations (Mansor, 2022). Ultimately, even with advanced technology offering operational efficiencies, aligning with consumer preferences and market demand remains crucial to avoid financial strains.

Scenario 4 "Not fulfilling customer's demand"

The scenario of "Not fulfilling customer's demand" arises when there is high consumer preference for unmanned convenience stores but a sluggish adoption of innovative technologies. This issue is critical as it hampers operations, leading to potential errors and slowdowns, such as in tracking and managing inventory systems (Wang et al., 2021). Additionally, the combination of high consumer demand and low technology innovation can cause increased foot traffic, forcing unmanned stores to rely on manual processes, overwhelming the store's capacity and creating congestion at checkout points (Chen & Chang, 2023). This technological inefficiency extends to handling surges in demand manually, challenging the workforce and causing difficulties in efficiently fulfilling orders and restocking shelves. The lack of technology adoption directly impacts processes like payment systems, rechecking, and restocking, leading to delays and indirectly affecting the overall customer experience and safety.

Limitations of Study

This study incurred several limitations. First, the number of unmanned convenience stores in Malaysia is limited, so the availability of relevant and updated information is challenging to search. For example, the unmanned convenience store at Senai airport was facing bankruptcy due to a new area that had yet to be developed; this issue is making it challenging for researchers to find another unmanned convenience store for the data collection. Besides, the articles reviewed in this research are limited to searching the data related to unmanned convenience stores. Unmanned convenience stores might be a relatively new concept in Malaysia, and the industry could still be evolving, so the information can be found in databases such as Google Scholar, IEEE Xplore, Elsevier (Science Direct), Elsevier Scopus, and Springer-Link limited to assist researchers in completing the study. Lastly, there is a limitation about the number and selection of the sample size of respondents. Due to convenience sampling, the researchers must attend the unmanned convenience store to collect feedback and responses from respondents. This issue makes the researcher need to spend the cost and time to do this study.

Recommendations

The main objective of this research is to identify the future trend of unmanned convenience stores in Malaysia for the next ten years. Based on the TRI findings, insecurity is still low due to the unmanned convenience store being a new trend for shoppers. So, there are several recommendations to solve these limitations issues. First, future researchers may instead collect data from customers to developers because the data provided by developers may be more accurate than asking from customers. Besides, developers of unmanned convenience stores may also provide more detailed information about unmanned convenience stores to make it easier for the researcher to do the study. In addition, to collect more information about unmanned technology, researchers may also do research on other unmanned technologies or services, for example, the self-service dobi shop, self-service entertainment shop and others; this is one of the ways to receive more accurate information and can ensure that the data collected can be a benefit to more developers.

CONFLICT OF INTEREST

The author(s), as noted, certify that they have NO affiliations with or involvement in any organisation or agency with any financial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, jobs, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-financial interest (such as personal or professional relationships, affiliations, expertise or beliefs) in the subject matter or materials addressed in this manuscript.

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