

Research Article

Evaluate the Consumer Acceptance of AIoT-Based Unmanned Convenience Stores Based on Perceived Risks and Technological Acceptance Models

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As the Artificial Intelligence Internet of Things (AIoT)-based unmanned convenience stores stand out in an increasingly challenging market, the consumer experience is more important than ever (CustomerThink, 2018). By employing new technologies, 7-Eleven, a leading chain convenience store in Taiwan, launched X-Store in 2018. While AIoT-based unmanned technology can help solve the problem of manpower shortages in the future, a question arises: will people accept this new technology for shopping? In view of this and based on the technology acceptance model (TAM), this study adds perceived risk as another variable to explore the impact of perceived usefulness, perceived ease of use, and attitudes toward using unmanned technology etc. factors on the purchase intentions of consumers in unattended convenience stores. The study further employs SPSS software for reliability and validity analyses, descriptive statistics, multivariate analysis of variance (MANOVA), and structural equation modeling (SEM) in order to explore the causal relationship among the variables herein. The main empirical findings show that consumers' perceived ease of use and perceived usefulness positively affect consumers' attitudes toward making purchases in X-Store, and via the moderating effect, perceived usefulness and attitudes toward X-Store consumption impact consumers' behavioral intention of purchasing products in X-Store. In addition, perceived risk has a significant moderating effect on attitudes toward using X-Store and behavioral intentions. The empirical results also reveal that male consumers have significantly greater perceived usefulness, perceived ease of use, attitudes toward using, and behavioral intentions in comparison with female consumers. Finally, this study presents conclusions and recommendations based on the research results as reference for unattended convenience store operators and follow-up researchers.

1. Introduction

With the decline of the fertility rate and human needs for innovative development, smart technology is becoming increasingly advanced. According to the Statistics Department of the Ministry of Economic Affairs in 2019, there were 11,465 convenience stores in Taiwan, ranking second in the world in density, with one convenience store for every 2,058 people on average. In addition, the turnover of convenience stores hits TWD 331.6 billion NTD in 2019. It not only maintains a positive growth for 20 consecutive years but also expects to reach a new high this year [1]. At the end of 2016,

Amazon [2], the leading e-commerce company in the United States, predicted a possible new look of retail stores in the future; it launched "Amazon Go," which ushered in a new era for unmanned stores. As the development of unmanned stores gathers momentum throughout the world, unmanned technology has become a new trend in the future [3–6].

The consumption experience that combines smart technology with physical stores has already emerged; traditional cash transaction is transformed into online electronic payment with cash replaced by virtual currency. In this context, the study aims to explore consumer behaviors toward AIoT-based unmanned convenience stores and the

factors that influence consumers to use them. Considering unmanned convenience stores as a new technological model, the study uses the technology acceptance model (TAM) as its theoretical basis for it is widely accepted [7–10]. In addition, the promotion of AIoT-based unmanned convenience stores in Taiwan is slow in comparison with some countries. Therefore, the variable perceived risk is added to this study in order to explore whether consumption intentions of consumers in Taiwan are affected by the aforementioned factors when they are in AIoT-based unmanned convenience stores.

A majority of Taiwanese consumers are highly dependent on services of convenience stores. With the help of innovative technology, AIoT-based unmanned convenience stores are introduced by the leading convenience store chain 7-Eleven. Traditional convenience stores are still booming, but the rise of X-Store seems to mark the transition of Taiwan's convenience stores. In this context, whether new technology is accepted by the public when buying at convenience stores remains a question to be explored.

People must have perceived risks when they avail of the convenience and the service provided by the rising X-Store. Under this circumstance, it is unsure whether the existence value of X-Store can be recognized by Taiwan's consumers. Therefore, this study employs TAM and the variable of perceived risk. To be more specific, the objectives of this study are as follows:

- (a) To help investors figure out important concerns of Taiwan's customers that influence their behaviors toward X-Store, the TAM is adopted to find out whether customers' feelings of the new technology service provided by X-Store have a positive influence on their attitude towards X-Store. It can be a reference for the future development of other unmanned stores and help reduce potential resistance.
- (b) This research aims to find out the extent to which Taiwanese customers recognize AIoT-based unmanned convenience stores after they gained an understanding of the service provided by such stores through watching a video.
- (c) Which risks are the biggest concerns of Taiwanese consumers? If these perceived risks exist, will they influence the behaviors of Taiwanese consumers toward unattended convenience stores?

2. Literature Review

2.1. Perceived Risk. According to Chen and Chen [11] and Chen et al. [12], the quality of experience refers to the psychological consequences produced by consumers' participation in purchasing activities. It not only involves the attributes of services provided by suppliers, but also the psychological perception brought by consumers. Bauer [13] first proposed the concept of perceived risk in 1990. He believes that unpredictable results may occur when consumers make purchases, which are often negative. Cox further explained that perceived risk may be derived from customers' failure in meeting their

expectations. In addition, risks increase as the Internet is widely used in marketing. Online selling can do better than the traditional way of providing product descriptions to meet customers' visual and auditory satisfaction. It is also a new way of virtual retailing. Information asymmetry, inability to experience the product, and having no direct feeling of a product and its features increase uncertainty and make customers doubtful about shopping websites. Therefore, shopping online generates higher perceived risks compared with traditional shopping at physical stores.

In addition, Akaah and Korgaonkar [14] pointed out that when shopping situation changes, the perceived risks of customers also change. Stone and Grønhaug [15] define perceived risks as "possible losses in pursuit of a desired outcome." Swaminathan et al. [16] proposed that the most important thing in online shopping is transaction security. Higher transaction security produces a lower level of perceived risks and makes consumers more willing to make purchases. Therefore, the perceived risk is defined as "the risks that consumers feel in transactions when they shop online." Forsythe and Shi [17] define the perceived risk of online shopping as the expected loss of an online shopper when he/she making a decision.

Based on the viewpoints of the above scholars, this study defines the perceived risks of online shopping as the risk assessment made by shoppers in order to pursue expected results when they decide to shop online. That is to say, people change their decision based on their subjective cognition of potential loss and risk. Risks mainly consist of six types, namely, financial risk, performance risk, physical risk, psychological risk, social risk, and time risk.

2.2. Unmanned Store. Thanks to the rapid growth of high-end technologies such as the Internet of Things (IoT) and artificial intelligence (AI), unmanned stores that feature "Low-Touch Service" are brought to our daily lives [18]. The technologies applied to the most commonly seen unmanned stores can be classified into two categories: AI and IoT. AI employs technologies such as biopayment, facial or biological recognition, vision sensor, and deep learning to function as machines' eyes and brains. Intelligent consumption is achieved through identity confirmation and automatic checkout, and customers can even directly "take away" products. This model is followed by "Amazon Go" by Amazon, the intelligent convenience store "Take Go" by Hangzhou Wahaha Group Co., Ltd. and DeepBlue Technology (Shanghai) Co., Ltd., and the unmanned store that is being tested and developed by the Industrial Technology Research Institute. The second kind is IoT utilizes Radio Frequency Identification (RFID) readers, barcode scanners, sensors, and other technologies to check out. For example, the Bingo Box, an unmanned convenience store developed by RT-Mart and Auchan uses RFID technology; customers choose products with RFID tags in the Bingo Box, after which they can scan the product identification code, pay for the products that they have chosen, and collect payments automatically [19, 20].

AI and IoT are two core technologies, and the third kind of interactive use that integrates AI with IoT has emerged. Taiwan's X-Store and NEC mainly use the third technology. They combine the third type of technology with the intelligent identification system that can be used to identify humans and items without much-complicated calculation or installing a number of sensors. The combination makes this technology connect humans, items, and consumption easily and manage the whole shopping process.

In addition, vending machines have existed in the market for a long time. Take the F5 Future Store as an example; it is similar to a large vending machine. Robotic arms are used to pick up items, and the biggest selling point is that it sells fresh food products. Located in Wanhua District, Taipei of Taiwan, the "O2O Unmanned Convenience Store" of Green Taste also uses many vending machines to sell beverages and foods and customers are required to use Easy Cards for recognition. In brief, unmanned convenience stores mainly rely on AI and IoT technologies such as vision sensors, facial or biological recognition, deep learning, and RFID. The fundamental task is to integrate and link various intelligent terminals and AI platforms for data analysis and cloud solutions.

2.3. Technology Acceptance Model. The technology acceptance model (TAM), first proposed by Fred Davis [21] on the basis of the theory of reasoned action, discusses the technology acceptance of a single consumer. It hopes to explore the influences of external variables on users' internal beliefs, attitudes, and intentions with TAM and predict whether intentions can change an individual's behavior toward new technology. In other words, the TAM holds that those who insist that certain technology can improve work efficiency and performance believe the technology is easy to operate, and then their attitude toward using the technology will be more favorable and positive. As a result, users' willingness to use the technology will be improved. Therefore, numerous studies have applied the technology acceptance model (TAM) to the fields of information, finance, consumption, research and development, etc. and have received remarkable outcomes [22–26].

3. Research Method

3.1. Research Framework. This research centers on X-Store which embodies a new technology concept of AIoT-based unmanned convenience stores and uses the technology acceptance model (TAM) as the theoretical basis to explore users' acceptance of emerging technology applications. This study means to find out whether there are factors that affect consumers' decision-making. To answer this question, this study collected data about moderating variables which may affect people's final decisions based on the literature; previous studies have revealed that perceived risks exert an impact on users' behavioral intentions and attitudes. Consequently, this study sets perceived risk as the moderating variable that influences consumers' attitudes and behavioral intentions to find out whether the variable would affect

people's final decision-making. In addition, this study aims to investigate consumers' attitudes toward using X-Store and their acceptance of it after they understood its overall operation. The research framework is shown in Figure 1.

3.2. Research Hypothesis. Based on the research motivation and objectives, the literature review, and research framework, this study proposes hypotheses shown as follows.

3.2.1. The Effect of Perceived Ease of Use on Perceived Usefulness. Benbasat and Dexter [27] and Davis and Venkatesh [28] pointed out that consumers' perceived ease of use for technology products increases their perceived usefulness. Shih [29] and Van der Heijden [30] also found that when consumers think that a technology product is easy to use, they will increase their recognition for the product. Accordingly, the first hypothesis is proposed as follows:

H1: the higher the perceived ease of use is, the higher the perceived usefulness will be.

3.2.2. The Impact of Perceived Ease of Use on Attitudes toward Using X-Store. Dishaw and Strong [31]; Moon and Kim [32]; and Van der Heijden [30] pointed out that if consumers find it easy to use a technology product, they will maintain a positive attitude toward using it, which leads to the following hypothesis:

H2: the higher the perceived ease of use is, the more positive the attitudes toward using X-Store consumers will have.

3.2.3. The Impact of Perceived Usefulness on Attitudes toward Using X-Store. Perceived usefulness means that if users' actual performance improves after using new technology, they will generate a sense of recognition for it. According to the studies of Hu et al. [33]; Dishaw and Strong [31]; and Bruner II and Kumar [34], if users feel that their work efficiency improves or they achieve better performance after using a technology product, they will recognize its usefulness. This also has a positive impact on their attitudes toward using it. In this respect, a hypothesis is proposed as follows:

H3: the higher the degree of perceived usefulness of X-Store, the more favorable the attitude toward using X-Store consumers will have.

3.2.4. The Effect of Perceived Usefulness on Behavioral Intentions. According to the studies of Hu et al. [33]; Dishaw and Strong [31]; and Bruner II and Kumar [34], if users feel that what they expected to do improves after using a technology product, their intentions to use this product will also be improved. In this aspect, the following hypothesis is proposed:

H4: the higher the perceived usefulness users have for X-Store, the higher their behavioral intentions to visit it again.

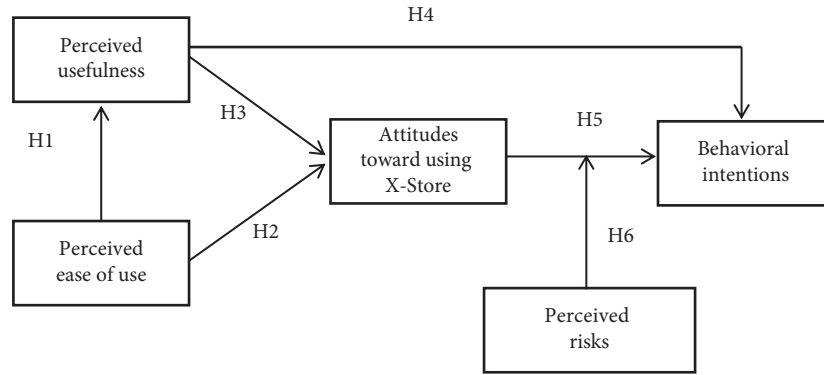


FIGURE 1: Research framework.

3.2.5. The Impact of Attitudes toward Using X-Store on Behavioral Intentions. According to the studies of Hu et al. [33]; Moon and Kim [32]; Van der Heijden [30]; and Bruner II and Kumar [34], if users have a positive feeling toward what they expect to do after using a technology product, they will use the product more in the future, which leads to the following hypothesis:

H5: the more positive the attitudes toward using X-Store users take, the higher their behavioral intention will be.

3.2.6. Moderating Effects of Perceived Risks, Attitude toward Using X-Store, and Behavioral Intentions. Featherman and Pavlou [35] pointed out in their e-commerce research that perceived risk has a negative effect on perceived usefulness. In addition, Sönmez and Graefe [36] found that perceived security and risk (perceived risks) push people to avoid traveling rather than planning another tour. The following hypothesis is proposed accordingly:

H6: the perceived risk has a moderating effect on users' attitudes toward and behavioral intentions of using X-Store.

4. Data Analysis

According to the research framework and research hypotheses proposed in previous sections, this study adopted a questionnaire survey to collect data and used SPSS, descriptive statistical analysis, and the MANOVA for reliability and validity analysis. Moreover, the SEM was used to analyze the causal relationship between variables in the research framework.

4.1. Questionnaire Collection. This study used the convenience sampling method to collect important data from online questionnaires. The research participants were consumers who had gone to convenience stores in Taiwan. The questionnaires were measured by a five-point Likert scale. The higher score respondents provide also means a higher degree to which they agree with the items. In order to ensure that the respondents were all Taiwanese consumers and the items were definite, this research used the Google online questionnaires that were distributed in private groups of the application Line. The data were collected from February 1, 2019, to March 28, 2019. During this period, a total of 249

copies were issued with 249 valid questionnaires returned. The effective questionnaire recovery rate was 100%. The collected data are sufficient for the required samples to be tested in this study.

4.2. Reliability and Validity Analysis of Formal Survey. In order to guarantee the questionnaire reliability and validity, this study conducted the reliability and validity analysis on 249 valid questionnaires. In this study, the questionnaire reliability and validity are evaluated with Cronbach's α value and exploratory factor analysis. According to Hair et al. [37], if Cronbach's α value is greater than 0.7, it indicates the high internal consistency which can be called as high reliability. Kerlinger [38] proposed that the correlation coefficient of item to total is required to meet the decision criteria of being greater than 0.5. This study results show that Cronbach's α value and correlation coefficients of all dimensions meet the criteria; as a result, the overall questionnaire reliability of this study is good (see Table 1).

As for validity analysis, the exploratory factor analysis (EFA) was used to verify the questionnaire convergent validity. The factors with the characteristic values greater than 1 are extracted by the principal component analysis. By the varimax rotation analysis, it is learnt that the variables under the 5 dimensions, such as perceived ease of use, perceived usefulness, perceived risks, attitudes toward using X-Store, and behavioral intentions, can be classified into the same factors. The factor loadings of all variables in all the factors are larger than 0.5, and the cumulative explained variances of all the factors are larger than 50%, which indicates that all the questionnaire dimensions have the convergent validity (see Table 1).

This study evaluated the reliability and the validity based on the two indexes which are the composite reliability (CR) of latent variables and the average variance extracted (AVE) of latent variables. The decisions are made on the principle that the CR value is greater than 0.6 and the AVE value is greater than 0.5 [39]. The values of composite reliability (CR) of latent variables in all factors are between 0.911 and 0.944 and larger than 0.6, indicating that all the dimensions of this study have good internal consistency. The average variance extracted (AVE) of latent variables is ranged from 0.598 to 0.848, which is larger than 0.5 and meets the ideal value,

TABLE 1: Reliability and validity analysis of formal survey ($n = 249$).

Construct	Measurement items	Item-to-total correlation coefficient	Factor loading	Eigenvalue	Cumulative explained variation %	Cronbach α value	Component reliability (CR)	Average variance extracted (AVE)
Perceived ease of use	I think shopping at the X-Store would not expend much of my energy	0.880	0.947					
	I think shopping at the X-Store can be easy	0.878	0.946	2.676	89.210	0.940	0.940	0.838
	I think the facilities and services at the X-Store are easy to use	0.865	0.940					
Perceived usefulness	Using X-Store can improve my shopping convenience	0.898	0.955					
	Using X-Store can improve my shopping efficiency	0.877	0.946	2.693	89.767	0.943	0.944	0.848
	Shopping in the X-Store is good for me	0.868	0.941					
Perceived risks	I have no confidence in the operation of the facilities or services provided by the X-Store	0.833	0.889					
	I am concerned that the products or services provided by the X-Store are not meeting my expectations	0.786	0.855					
	I may feel uneasy about making purchases in an X-Store without clerks	0.787	0.854					
	I would worry that the value of the product or service provided by the X-Store is not in line with my expectations	0.775	0.842	4.672	68.023	0.921	0.911	0.598
	I would worry that the services provided by the X-Store would not work properly and cause financial losses	0.719	0.790					
	I would worry that the facial recognition system of X-Store would not work properly and make me not be able to enter and exit the store smoothly	0.697	0.775					
	I would worry about the property loss caused by theft of data or passwords when using the X-Store's automatic checkout system	0.683	0.760					
Attitudes toward using X-Store	I like the concept of X-Store	0.870	0.944					
	I think using X-Store is a good idea	0.836	0.927	2.602	86.734	0.923	0.925	0.803
	I think making purchases at X-Store is a wise decision	0.828	0.923					
Behavioral intentions	The shopping experience provided by X-Store will increase my willingness to make purchases in it	0.883	0.951					
	I may use X-Store frequently in the future	0.823	0.921	2.591	86.369	0.921	0.939	0.838
	If I have the opportunity, I will use X-Store	0.814	0.916					

indicating that all the dimensions have the convergent validity (see Table 1).

4.3. Narrative Statistics of Taiwanese Consumers' Perceived Ease of Use, Perceived Usefulness, Perceived Risks, Attitudes toward Using X-Store, and Behavioral Intentions. The first question that this study aims to explore is the important factors affecting Taiwanese consumers' behaviors in the X-Store. In Table 2, to collect data about the Taiwanese consumers' perceived ease of use, perceived usefulness, perceived risks, attitudes toward using the store, and behavioral intentions of consumer behaviors in the X-Store, SPSS was used to perform descriptive statistical analysis. According to the averages of the intention, a higher score represents more attention.

- (1) How Taiwanese consumers feel whether the facilities in X-Store are easy to operate is shown in Table 2, the mean for the item "I think shopping at the X-Store can be easy" is the highest 3.8313 ($SD = 1.1197$) while the item "I think the facilities and services at the X-Store are easy to use" had the lowest mean 3.6426 ($SD = 1.1309$). It can be seen that most Taiwanese consumers had not found it relaxing and easy to use the facilities at the X-Store and their attitudes toward using its services remained relatively neutral.
- (2) Taiwanese consumers' views on whether the facilities at the X-Store are useful are shown in Table 2. The mean of the item "using X-Store can improve my shopping convenience" is the highest 3.6225 ($SD = 1.1154$) while the item "shopping in the X-Store is good for me" had the lowest mean 3.5422 ($SD = 1.1213$). It can be seen that most Taiwanese consumers do not particularly enjoy the convenience of shopping at the X-Store nor do they have a strong feeling of assistance given by the devices at the store.
- (3) How Taiwanese consumers feel about the potential risks when they make purchases at the X-Store is shown in Table 2. The mean of the item "I would worry about the loss of property caused by theft of data or passwords when using the X-Store's automatic checkout system" is the highest 3.7791 ($SD = 1.1826$), and the mean of the item "I have no confidence in the operation of the facilities or services provided by the X-Store" is the lowest 3.0522 ($SD = 1.1576$). It can be seen that most Taiwanese consumers pay much attention to financial security and maintain a relatively neutral attitude toward the services provided by X-Store.
- (4) Whether the facilities and services provided by the X-Store have a positive impact on Taiwan consumers' attitudes toward using X-Store is shown in Table 2. The item "I think using X-Store is a good idea" has the highest mean 3.8353 ($SD = 1.0930$) while the item "I think spending at X-Store is a wise decision" 3.5542 ($SD = 1.0463$) has the lowest mean. It can be seen that although most Taiwanese

consumers thought that the X-Store idea is good, most consumers did not significantly feel that X-Store makes their life more convenient.

- (5) In terms of whether the facilities and services provided by the X-Store have a positive impact on the behavioral intentions of Taiwanese consumers, as shown in Table 2, the item "if I have the opportunity, I will use X-Store" has the highest mean 3.9398 ($SD = 1.1361$) while the item "I may use X-Store frequently in the future" has the lowest mean 3.5181 ($SD = 1.1573$). It can be seen that most consumers are less willing to use the services provided by the X-Store or do not intend to use X-Store frequently in the future. The mean of the item "if I have the opportunity, I will use X-Store" has the highest mean. This may happen because most consumers are willing to have a try before actually experiencing shopping in the X-Store.

4.4. Multivariate Analysis of Variance. The second question that this study aims to explore is how many Taiwanese consumers recognize AIoT-based unmanned convenience stores after learning about the latest technological services provided by such stores. As shown in Table 3, to figure out the differences from the perspective of gender, this study uses multivariate analysis of variance (MANOVA) to know the means and significance between different factors to analyze the degree to which consumers recognize perceived ease of use, perceived usefulness, perceived risk, attitude toward using, and behavioral intention between male and female research participants.

4.4.1. Perceived Usefulness. As shown in Table 3, the P values of the following factors are all less than 0.05, which suggests a level of significance. According to the means for gender, male participants' means of perceived usefulness are all greater than those of female respondents. The research result shows that male respondents have a higher level of recognition for the services provided by X-Store than female participants.

4.4.2. Perceived Ease of Use. As shown in Table 3, the P values of the following factors are all less than 0.05, which indicates a level of significance. According to the means of male and female participants, the averages of male perceived ease of use are all greater than those of female respondents. The study result shows that male respondents tend to find X-Store devices relatively easier to use than female participants.

4.4.3. Perceived Risk. As shown in Table 3, most of the means of male perceived risk are less than those of female participants. The study result suggests that men relatively care less about the potential risks of shopping at the X-Store than women. The P value of male perceived risks is less than 0.05, which indicates a level of significance.

TABLE 2: The mean value and standard deviation of measurement items.

Construct	Measurement items	Mean value	Standard deviation
Perceived ease of use	I think shopping at the X-Store would not expend much of my energy	3.7912	1.1019
	I think shopping at the X-Store can be easy	3.8313	1.1197
	I think the facilities and services at the X-Store are easy to use	3.6426	1.1309
Perceived usefulness	Using X-Store can improve my shopping convenience	3.6225	1.1154
	Using X-Store can improve my shopping efficiency	3.5462	1.1738
	Shopping in the X-Store is good for me	3.5422	1.1213
Perceived risks	I have no confidence in the operation of the facilities or services provided by the X-Store	3.0522	1.1576
	I am concerned that the products or services provided by the X-Store are not meeting my expectations	3.1847	1.1350
	I may feel uneasy about making purchases in an X-Store without clerks	3.2530	1.2461
	I would worry that the value of the product or service provided by the X-Store is not in line with my expectations	3.2932	1.2042
	I would worry that the services provided by the X-Store would not work properly and cause financial losses	3.5020	1.2152
	I would worry that the facial recognition system of X-Store would not work properly and make me not be able to enter and exit the store smoothly	3.5783	1.1618
	I would worry about the property loss caused by theft of data or passwords when using the X-Store's automatic checkout system	3.7791	1.1826
Attitudes toward using X-Store	I like the concept of X-Store	3.8273	1.0991
	I think using X-Store is a good idea	3.8353	1.0930
	I think making purchases at X-Store is a wise decision	3.5542	1.0463
Behavioral intentions	The shopping experience provided by X-Store will increase my willingness to make purchases in it	3.6546	1.1748
	I may use X-Store frequently in the future	3.5181	1.1573
	If I have the opportunity, I will use X-Store	3.9398	1.1361

4.4.4. Attitude toward Using. As shown in Table 3, the P values of the following factors are all less than 0.05, indicating a level of significance. The means of male respondents' attitudes toward using X-Store are all greater than those of female respondents. The study result suggests that the degree to which men recognize X-Store is relatively higher than that of women.

4.4.5. Behavioral Intention. As shown in Table 3, the P values of the following factors are all less than 0.05, which indicates a level of significance. The means of male respondents' behavioral intentions are all greater than those of female respondents. The study result suggests that men are relatively more willing to revisit X-Store in the future than women.

4.5. Structural Equation Modeling. The third aim of this study is to find out what kinds of potential risks Taiwanese consumers regard the most important. If these perceived risks exist, it is worth to explore whether they will have an effect on the consumption behaviors of Taiwan consumers towards unattended convenience stores. In this section, the structural equation modeling (SEM) is used to test hypothesis 1 to 6.

4.5.1. Offending Estimates Verification. The measured values of the structure model of this study are shown in Table 4. The

standard error is between 0.065 and 0.316, and there is not much standard error; the error variance of measurement is between 0.133 and 0.895, and there is no negative error variance. In addition, the standardized regression coefficient value in the model is between 0.059 and 0.943, and none exceeds 0.95, indicating that the structural model of this study does not violate the estimation.

4.5.2. Confirmatory Factor Analysis. In order to confirm the efficiency of measuring dimensions, this study carried out the confirmatory factor analysis (CFA) with AMOS software on the measurement models of 5 dimensions such as perceived ease of use to AIoT-based unmanned convenience stores, perceived usefulness, perceived risk, attitude to use, and behavioral intentions. According to the model proposed by Carmines and MacIver [40], the fit indicators shall meet the ideal standard; thereinto, the ratio between chi-square value and degree of freedom is no more than 3, RMSEA is less than 0.05, and the values of GFI, AGFI, NFI, RFI, and CFI are greater than 0.9 [41, 42]. The results show that, among the fit indicators of the measurement model, the value of χ^2/df is 1.960, the value of GFI is 0.902, the value of AGFI is 0.983, the value of NFI is 0.949, the value of RFI is 0.937, the value of CFI is 0.974, and the value of RMSEA is 0.059, except for the chi-square value affected by the sample size, indicating that the fitness of all the measurement models reaches the acceptable range. Therefore, in this study, the fitness of the measurement model is good, representing

TABLE 3: MANOVA for perceived ease of use, perceived usefulness, perceived risks, attitudes toward using, and behavioral intentions.

Item	Factor	Gender		<i>F</i> value	<i>P</i> value
		Male <i>N</i> = 88	Female <i>N</i> = 161		
Perceived ease of use	Pillai's trace = 0.046 Wikls' lambda = 0.954	4.0568	3.6000	3.959	0.009
	It will not take me much time to shop at the X-Store	4.1250	3.6708	9.691	0.002
	It is easy for me to shop at the X-Store	4.0795	3.6635	9.646	0.002
	Overall, the devices and services at the X-Store are easy to use for me	3.9659	3.4658	11.601	0.001
Perceived usefulness	Pillai's Trace = 0.036 Wikls' lambda = 0.964	3.8296	3.4286	3.012	0.031
	X-Store can improve my shopping convenience	3.8523	3.4969	5.890	0.016
	X-Store can improve my shopping efficiency	3.8182	3.3975	7.499	0.007
	Overall, shopping at the X-Store is good for me	3.8182	3.3913	8.496	0.004
Perceived risk	Pillai's trace = 0.071 Wikls' lambda = 0.929	3.2490	3.3931	2.624	0.013
	I do not have much confidence in the normal operation of X-Store's facilities and services	3.4091	3.5528	0.795	0.373
	I worry that the products and services at the X-Store do not meet my expectation	3.4545	3.2050	2.459	0.118
	I may feel nervous when shopping at self-service X-Store that has no clerk	3.6477	3.8509	1.685	0.196
	I worry that the value of the products and services in the X-Store do not meet my expectation	3.2386	3.2609	0.018	0.893
	I worry about financial losses because the services at the X-Store may not work well	3.1364	3.2112	0.246	0.620
	I worry that I cannot enter and exit the store freely due to the potential failure of the store's facial recognition system	3.0114	3.0745	0.169	0.681
	I worry about financial losses because my data and password may be stolen when I am using the automatic checkout system at the X-Store	3.5455	3.5963	0.108	0.742
Attitude toward using X-Store	Pillai's trace = 0.045 Wikls' lambda = 0.955	3.9583	3.5652	3.853	0.010
	Overall, I like the idea of X-Store	4.2386	3.7764	9.752	0.002
	I think it is a good idea to shop at the X-Store	3.8636	3.5404	4.366	0.038
	I think it is a wise decision to shop at the X-Store	3.7727	3.3789	6.742	0.010
Behavior intention	Pillai's trace = 0.038 Wikls' lambda = 0.962	3.9773	3.6087	3.196	0.024
	The consumption experience provided by X-Store will increase my willingness to make purchases from the store	4.0568	3.7143	5.694	0.018
	I will probably visit X-Store frequently in the future	3.7614	3.4410	5.429	0.021
	I would like to shop at X-Store if I get a chance	4.1136	3.6708	9.556	0.002

that this measurement index has the construct validity and the measurement efficiency (as shown in Table 5).

4.5.3. Linear Structure Model Analysis. In this study, AMOS software was used to analyze the linear structural relationship model, in order to understand the causality and correlation between variables. According to Forza and Filippini [43], the good model should meet the following: GFI, RFI, AGFI, NFI, and other indicators should be greater than 0.8, CFI value should be greater than 0.9 [44], RMSEA value should be less than 0.05 [45], the measurement standard of $\chi^2/df \leq 3$ [46] is used as the criterion for checking the suitability of the model.

The analysis results show that this study χ^2 is 255.277, the degree of freedom is 138, *P* value is 0.00, χ^2/df is 1.850, GFI is 0.903, AGFI is 0.986, NFI is 0.950, RFI is 0.938, CFI is 0.976, and RMSEA is 0.059. Except that the chi-square value affected by the sample size does not meet the adaptation

standard, this result meets the good model standard proposed by scholars, so the structural model suitability is better (as shown in Table 5).

4.5.4. Hypothesis Testing. Through the overall model parameter estimation analysis, as shown in Table 4, the verification results of each hypothesis are as follows:

- (1) H1: perceived ease of use has a positive impact on perceived usefulness with a standardized coefficient of 0.928 and *T* value greater than 1.96 (*T* value = 9.588), which supports H1. Therefore, if consumers feel that new technology products are easy to use, they will recognize their usefulness.
- (2) H2: perceived ease of use has a positive impact on the attitude of X-Store users with a standardized coefficient of 0.535 and *T* value greater than 1.96 (*T* value = 3.654), which supports H2. Therefore, if

TABLE 4: Overall model parameter estimation table.

Path			Standardized regression coefficient	Standard error	T value	P value	Error variance	Squared multiple correlation
H1: perceived usefulness	<---	Perceived ease of use	0.928	0.260	9.588	***	0.153	0.861
H2: attitudes toward using X-Store	<---	Perceived ease of use	0.535	0.272	3.654	***	0.256	0.711
H3: attitudes toward using X-Store	<---	Perceived usefulness	0.323	0.101	2.222	*		
H4: behavior intention	<---	Perceived usefulness	0.175	0.065	2.930	**	0.133	0.881
H4: behavior intention	<---	Attitudes toward using X-Store	0.788	0.171	7.170	***		
H4: behavior intention	<---	Perceived risks	-0.059	0.082	-2.078	*	0.548	0.000
I think shopping at the X-Store would not expend much of my energy	<---	Perceived ease of use	0.912	0.245	18.572	***	0.211	0.831
I think shopping at the X-Store can be easy	<---	Perceived ease of use	0.921	0.240	18.893	***	0.184	0.848
I think the facilities and services at the X-Store are easy to use	<---	Perceived ease of use	0.914	0.247	18.660	***	0.209	0.836
Using X-Store can improve my shopping convenience	<---	Perceived usefulness	0.938	0.150	11.675	***	0.150	0.880
Using X-Store can improve my shopping efficiency	<---	Perceived usefulness	0.909	0.156	11.380	***	0.239	0.826
Shopping in the X-Store is good for me	<---	Perceived usefulness	0.915	0.146	11.596	***	0.201	0.838
I have no confidence in the operation of the facilities or services provided by the X-Store	<---	Perceived risks	0.616	0.316	10.457	***	0.895	0.380
I am concerned that the products or services provided by the X-Store are not meeting my expectations	<---	Perceived risks	0.778	0.291	14.517	***	0.582	0.606
I may feel uneasy about making purchases in an X-Store without clerks	<---	Perceived risks	0.618	0.310	10.517	***	0.860	0.382
I would worry that the value of the product or service provided by the X-Store is not in line with my expectations	<---	Perceived risks	0.838	0.290	16.065	***	0.459	0.703
I would worry that the services provided by the X-Store would not work properly and cause financial losses	<---	Perceived risks	0.900	0.253	18.020	***	0.245	0.809
I would worry that the facial recognition system of X-Store would not work properly and make me not be able to enter and exit the store smoothly	<---	Perceived risks	0.924	0.253	18.686	***	0.194	0.855
I would worry about the property loss caused by theft of data or passwords when using the X-Store's automatic checkout system	<---	Perceived risks	0.675	0.297	11.773	***	0.732	0.455
I like the concept of X-Store	<---	Attitudes toward using X-Store	0.864	0.158	14.343	***	0.302	0.746
I think using X-Store is a good idea	<---	Attitudes toward using X-Store	0.901	0.149	15.255	***	0.207	0.811
I think making purchases at X-Store is a wise decision	<---	Attitudes toward using X-Store	0.923	0.157	15.523	***	0.178	0.852
The shopping experience provided by X-Store will increase my willingness to make purchases in it	<---	Behavioral intentions	0.943	0.162	10.088	***	0.140	0.889

TABLE 4: Continued.

Path			Standardized regression coefficient	Standard error	T value	P value	Error variance	Squared multiple correlation
I may use X-Store frequently in the future	<---	Behavioral intentions	0.878	0.148	10.623	***	0.310	0.772
If I have the opportunity, I will use X-Store	<---	Behavioral intentions	0.924	0.164	9.901	***	0.190	0.853

TABLE 5: The goodness-of-fit of the measurement and structural model.

Fit indices		Criteria	Measurement model	Structural model
Absolute fit index	χ^2	The smaller the better ($P \geq \alpha$ 值)	278.104 ($P = 0.004$)	255.277 ($P = 0.000$)
	χ^2/df	<3, 1~5	1.960	1.850
	CFI	>0.9	0.902	0.903
	AGFI	>0.9	0.983	0.986
	RMR	<0.08	0.037	0.010
	SRMR	<0.08	0.074	0.074
	RMSEA	<0.08	0.067	0.059
Incremental fit index	NFI	>0.9	0.925	0.950
	NNFI	>0.9	0.958	0.971
	CFI	>0.9	0.962	0.976
	RFI	>0.9	0.937	0.938
	IFI	>0.9	0.970	0.976
Streamline and adapt indicators	PNFI	>0.5	0.765	0.767
	PGFI	>0.5	0.674	0.656

consumers feel that new technology products are easy to use, they will hold a positive attitude toward using them.

- (3) H3: perceived usefulness has a positive impact on the attitude of X-Store users toward using it with a standardized coefficient of 0.323 and T value greater than 1.96 (T value = 2.222), which supports H3. Therefore, if consumers feel that new technology products have a positive impact on the way they finish a task, they will take a positive attitude towards using them.
- (4) H4: perceived usefulness has a positive impact on the behavioral intention of X-Store users with a standardized coefficient of 0.175 and T value greater than 1.96 (T value = 2.930), which supports H4. Therefore, if consumers feel that new technology products exert a positive impact on the way they finish a task, they are more likely to use them again.
- (5) H5: the attitude of X-Store users has a positive effect on their behavioral intention with a standardized coefficient of 0.788 and T value greater than 1.96 (T value = 7.170), which supports H5. Therefore, if consumers take a positive attitude towards new technology products, their behavioral intention will also be positive.
- (6) H6: perceived risk has a disturbing effect on X-Store users' attitudes and behavioral intentions. The path coefficient of perceptual risk on usage attitude and behavioral intention is -0.059 , and the t value is -2.078 reaching a significant level. This result

supports H6, showing that perceptual risk has a negative impact on behavioral intention. In other words, the higher the perceived risk, the lower the consumer's intention to act on this new technology product.

5. Conclusions and Suggestions

5.1. Research Found. This study aims to explore the relationship between Taiwan consumers' perceived usefulness, perceived ease of use, perceived attitude, behavioral intention, and perceived risk for using X-Store. The study finds that the means for most of the factors and items are less than 4.0 while the means of the factors and items for female respondents are all less than 4.0. Regarding the payment, the most common payment method is cash payments for 178 respondents (71.5%), followed by i-cash cards for 27 respondents (10.8%), credit cards for 16 participants (6.4%), mobile payments for 24 participants (9.6%), and other methods of payment for 4 participants (1.6%).

Moreover, research results show that consumers' cognitive process towards X-Store conforms to the technology acceptance model. The perceived ease of use and perceived usefulness of consumers do have a positive effect on their attitude toward using the X-Store; the perceived usefulness and attitude toward using the X-Store of consumers have a positive impact on their behavioral intention of shopping at X-Store. Also, the perceived usefulness and perceived ease of use of consumers can also positively influence the behavioral intention of consumers visiting X-Store through their attitude toward using X-Store.

Furthermore, the study finds that the perceived risk has a significant moderating effect on consumers' behavioral intention of visiting X-Store. Male consumers have a lower extent to which they recognize perceived risks in comparison with female consumers, but they have significantly greater perceived usefulness, perceived ease of use, attitude toward using, and behavioral intentions than female consumers.

5.2. Research Limitations. There are only two X-Stores in Taiwan, and they are both located in Northern Taiwan. Under this circumstance, it is difficult to interview those who have visited X-Store. That is why research participants were required to watch a video before answering the questionnaires to know more about the services provided by X-Store. This is a limitation of this research.

5.3. Suggestions for Future Management. Based on the conclusions of this empirical study, the following suggestions are proposed for reference of unattended convenience store operators and future research.

5.3.1. Promote the i-cash 2.0 Card or Develop Other Electronic Payment Methods. Most of the study participants are female consumers. Research results show that most consumers are accustomed to paying in cash (70%) while those who use i-cash 2.0 cards only account for around 10%. Therefore, if X-Store is promoted in the future, i-cash 2.0 cards should be popularized or other electronic payment methods should be developed. In addition, in order to popularize the electronic payment and make consumers accept it, the diversity and security of i-cash 2.0 cards or the development of other electronic payment methods should be considered, so that it can attract more consumers.

5.3.2. Diversifying Payment Methods. Taiwan's citizens have been used to various services provided by convenience stores and cash payments. If only i-cash cards are accepted, consumers without i-cash cards will not be able to make purchases. This problem can be solved by diversifying payment methods such as mobile payment and cash payment.

5.3.3. Rolling Out New Services. If we want to promote AIoT-based unmanned convenience stores, we cannot simply offer a few basic services. At present, the services provided by X-Store are far fewer than those provided by current convenience stores. Without improving its services, consumers' willingness to shop at X-Store will definitely decline.

Data Availability

The questionnaire survey data used to support the findings of this study are available from the authors upon request.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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