Consumer Behavioral Intension for Using Mobile Payment for E-commerce in Taiwan

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Abstract

With the rise of the Internet, the popularity of e-commerce has been promoted. With the advent of this financial technology and the rapid growth of smart device applications, consumer payment methods have also changed dramatically, e-commerce has evolved to mobile commerce. Due to the characteristics of mobile commerce, it brings convenience in terms of location and personal needs. The purpose is to make modern people's lives smoother, and consumers can complete transactions without any money. However, people in Taiwan are less willing to use mobile payments than in other countries. Therefore, this paper is based on technology acceptance model (TAM) and fuzzy Delphi method (FDM) is used to development evaluative framework. Next, the fuzzy analytic hierarchy process (FAHP) is used to understand consumer's preference factors for mobile payment. Finally, the results of this paper can provide reference for the relative business mobile payment service and further increase user usage of mobile payments.

Keywords: Fintech, mobile payment, Technology Acceptance Model (TAM), Fuzzy Delphi Method (FDM), Fuzzy Analytic Hierarchy Process (FAHP)

1 Introduction

With the rise of the Internet, the popularity of e-commerce has been promoted. Payment [30] is a key business process in financial technology. As McAuley [29] mentioned about financial technology (Fintech) is business that use technology to make financial services more efficient. In recent years, the popularity of smart phones has gradually grown in Taiwan, and almost all users can use the internet. This booming business opportunities in turn derived from "mobile payment" bring a lot of convenience to our lives. The biggest attraction of mobile payments is that with the increasing popularity of smart phones, consumers can provide a time-saving method when paying. Even through the consumption model of the mobile payment platform, the industry has a very large business opportunity for sending coupons and even advertising messages in the customer group. It not only attracts the attention of traditional financial institutions such as banks and credit card companies, but also attracts the attention of emerging companies such as mobile network operators, mobile phone manufacturers and software platform vendors. However, whenever a new product goes on the market, the consumer's willingness to use is a topic that the service provider cares about. Chang [9] discusses that mobile payment will become an important payment mod-el in the future. Mobile payment services in many countries have been in existence for a long time, but in Taiwan is still in its infancy. Therefore, this study is based on the technology acceptance model (TAM), together with convenience and risk to formulate guidelines for initial influence on willingness to use. Through expert interviews, construct an evaluation framework that affects the willingness to mobile payment. Using AHP theory to analyze what factors that influence consumers about the willingness to use mobile payment.

2 Literature Review

2.1 Mobile Payment

A mobile payment is a money payment made for a product or service through a mobile device such as a tablet computer or smart phone. Herzberg [17] pointed out that the integration of payment systems and mobile devices is feasible, and mobile devices are effective, secure and convenient payment tools that can be used not only in mobile commerce, but also in e-commerce and physical sales. Lin [4] mentioned that mobile payment refers to the core transaction of the mobile bank. Kang [31] discussed mobile Fintech payment services must meet and security challenges that future and present mobile Fintech payment services. It is expected to integrate the traditional wallet, credit card

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and other related financial payment services into the smart hands, so as to complete the agreed/non-contracted transfer, bill payment/tax payment, physical store/Accounting transactions such as mobile consumer deposits in virtual online stores.

Technology Acceptance Model (TAM) is a theory that describes the consumer's willingness to use technology. It mainly provides a simple, effective predictive and theoretically based model to explain the user's acceptance of information system. This theory was proposed by Davis [16]. It is mainly used to explain why people accept this computer information system through TAM research. However, in order to better predict and explain the user's acceptance, Davis must know more about the reasons why the user accepts or rejects the system. In addition to predicting the user's behavior, it can be used to explain user behavior. Therefore, the purpose of TAM is to simplify the theory of rational action, and to focus specifically on explaining the use of information technology and to analyze the influencing factors affecting users' acceptance of new information technology. The model is shown in Figure 1.

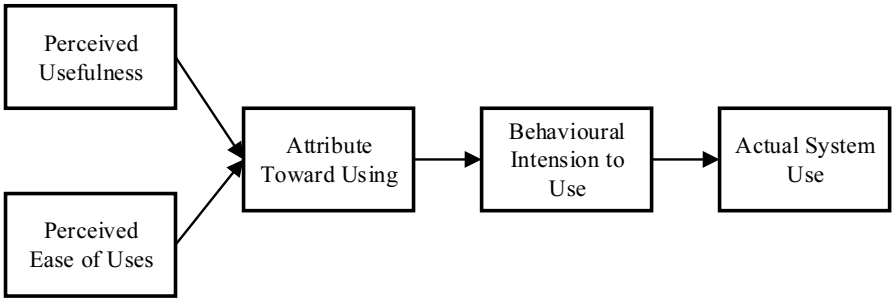

Figure 1. Technology Acceptance Model (TAM)

2.3 Convenience

Brown [14] found that convenience is not the nature or attributes of a product, but the time and effort of a consumer when purchasing a product. In the era of the Internet, websites can systematically store consumer information to simplify the consumer ordering process and facilitate the convenience of consumers to shop. If you want to retain customers, you must establish more convenience in the service. Conversely, Keaveney [19] discussed that if consumers feel inconvenience in the process of consumption, it will result in the transfer behavior of consumers. Therefore, convenience can be defined as a multi-faceted combination, which can reduce the energy consumed by consumers in shopping time, location, information, finance and shopping management, and enable consumers to use the service to save more effort and obtain more convenient benefits.

3 Research Method

3.1 Fuzzy Delphi Method

The Delphi method was proposed by Dalkey and Helmer [15]. It is a procedural method that systematically expresses the opinions of expert groups. Its main purpose is to obtain the consensus of experts and seek experts in a repeated way. Consistent opinion on specific forecasting objects. Fuzzy Delphi Method (FDM) is proposed by Ishikawa et al. [18], which is developed by the traditional Delphi method combined with fuzzy set theory. It mainly uses the preference of each participant. Con-struct a personal fuzzy preference to make the best choice for the group's preferences.

Fuzzy numbers are used to express semantic variables, which are variables with values or phrases in natural language, whose characteristics are close to the human mind's thinking mode when evaluating problems that proposed by Zadeh [27]. Klir and Folger [20] introduced the generalized average model into the Delphi method, and establish a triangular fuzzy function based on the evaluation value of the expert questionnaire. The correspondence between the semantic variables and the triangular fuzzy values is shown in Table 1.

Table 1. Correspondence between semantic variables and triangular fuzzy numbers

Evaluation scale	semantic variable	Triangular fuzzy number
1	Not Important	(0.1, 0.1, 0.3)
2	Slightly Important	(0.1, 0.3, 0.5)
3	Moderately Important	(0.3, 0.5, 0.7)
4	Important	(0.5, 0.7, 0.9)
5	Very important	(0.7, 0.9, 1.0)

3.2 Fuzzy Analytic Hierarchy Process

The Analytic Hierarchy Process (AHP) was proposed by Professor Saaty [25] which applies to prioritization decisions, resource planning, allocation, and portfolio. Later, a complete methodology was proposed to systematically simplify complex problems. Zadeh [26] proposed the fuzzy set theory in 1965. He believes that hu-man beings have subjective ideas, inferences and cognition of the surrounding things. They have a

considerable degree of ambiguity, so they describe things with fuzzy logic concepts. The advantages and disadvantages and circumstances to compensate for the shortcomings of traditional binary logic (non-zero or 1 concept) to describe things. A fuzzy set is used to represent a collection of things of a specific nature whose boundaries or boundaries are not distinct, Zimmermann [28], and a membership function to describe the extent to which an element belongs to a set, and its value is between 0 and 1.

In view of the fact that AHP method cannot overcome the shortcomings associated with the ambiguity in decision-making, Van Laarhoven and Pedrycz [22] evolved the hierarchical analysis method and developed the Fuzzy analytic hierarchy process (FAHP). It directly substitutes the triangular fuzzy number into the pairwise comparison matrix to prevent the ambiguity problem generated in the process of measuring and judging the criteria. FAHP replaces the traditional AHP's value with interval value, allowing experts to evaluate problems on a more human scale in decision-making and give evaluation items comparison values. Wang [1] introduced the main steps of the FAHP method as follows:

(1) Establish a hierarchical structure
(2) Designing a questionnaire
(3) Establishing a fuzzy positive reciprocal matrix
(4) Group integration
(5) Calculating the fuzzy weight value
(6) Defuzzification
(7) Formalization
(8) Hierarchical cascade

4 Empirical Analysis

4.1 Phase 1- Fuzzy Delphi Method Questionnaire and Hierarchical Structure Establishment

This study refers to relevant literature, [2-3, 5-8, 11, 13, 16, 24, and concludes the factors that affect consumers' willingness to mobile payment. By these researches, we divided them into four major dimensions and 21 criteria, shown in Table 2. And then, the fuzzy Delphi method is used to determine the appropriate criteria through expert opinions, making the selection of evaluation criteria more representative. The experts that reviewed questionnaires included academic and industry experts. These experts are come from Min-jiang University, Fujian Jiangxia University, Xiamen University of Technology, National Quemoy University, and Vanung University, Alibaba, Tencent, Industrial and Commercial Bank of China Limited and Xiamen Bank (one professor or supervisor respectively). Three professors from Fujian University of Technology are participated in the selection process. The principle of selection of experts interviewed must be in the field of e-commerce, finance, or information and computer science.

Table 2. Fuzzy Delphi method questionnaire items

Dimension	variable	value
Convenience	Easy payment	0.95
	Eliminate the inconvenience of carrying cash or credit card	0.92
	Simplify the payment process	0.79
	Make checkout faster	~~0..68~~(delete)
	More places to use	0.85
	Easy to understand operation interface	~~0.61~~(delete)
Easy to use	The function list is very clear	0.82
	Easy operation	0.79
	Interactive presentation is clear and easy to understand	~~0.67~~(delete)
	Can support multiple devices	0.81
	Easy to learn	~~0.56~~(delete)
Transaction Security	High system quality stability	~~0.55~~(delete)
	User identity recognition	0.86
	Transaction security certification	0.91
	Confidential personal data	0.87
	Provide instant payment message	0.80
Personal Cognition	Use new technology products or services	~~0.65~~(delete)
	Improve living efficiency	0.90
	Change payment habits	0.83
	Personalized service	0.79
	It doesn't take too much effort on the use.	~~0.58~~(delete)

The questionnaire was conducted from the beginning of March 2017 to the end of May 2017. A total of 12 questionnaires were issued, and the effective questionnaire was 10 copies. The assessment is based on the assessment scale of Table 1 to reflect the extent to which the respondents value each assessment criterion. The criterion for taking the threshold value is 0.7. The factor criteria are choosing depends on the

threshold value. The results of the four dimensions are as follows: "Convenience" dimension has a total of 6 evaluation factors, and the index values of items 4 and 6 are less than 0.7, which are deleted. The dimension of "Easy to use" contains 5 evaluation factors, the indicators of items 9 and 11 are not up to 0.7 that are deleted. There are 5 evaluation factors in the "Transaction Security" dimension, the index value of the 12th item is less than 0.7 which is deleted. There are five evaluation factors for the "Personal Cognition" dimension, and the 17th and 21st evaluation factors are not up to 0.7 which are deleted. The results are shown in Table 2. The criterion "It doesn't take too much effort on the use" reflect the consumers' cognition rather than "Easy to use" dimension focus on mobile payment systematic function. Fuzzy numbers are used to express semantic variables, which are variables with values or phrases in natural language, whose characteristics are close to the human mind's thinking mode when evaluating problems that proposed by Zadeh [27]. Klir and Folger [20] introduced the generalized average model into the Delphi method, and establish a triangular fuzzy function based on the evaluation value of the expert questionnaire. The correspondence between the semantic variables and the triangular fuzzy values is shown in Table 2.

4.2 Phase 2- Fuzzy AHP Questionnaire Survey Analysis

The phase 2 of the questionnaire was conducted from July 10 to August 31, 2017. It was filled out using the online questionnaire, and 132 copies were collected. 41 questionnaires failed the consistency check and were deleted as invalid questionnaires. Therefore, the 91 questionnaires passed the consistency check will be used for subsequent analysis. Among the 91 questionnaires, there was active mobile payment, male, 31-40 years old group, education level for master's degree, occupation for in-formation industry, and income from 40,000 to 50,000 NT dollars for the majority, as shown in Table 3. The questionnaire is designed according to the content of Table 2, then the weights of the two levels are compared according to the hierarchical structure. In the case of a pairwise comparison between the evaluation criteria, the assessment scale uses Table 4, then each of the questionnaires is calculated using steps (3)-(8) in Sec 3.2. Finally, using the method of post-integration, the relative weights of the overall dimensions and criteria are obtained. The results are shown in Table 5.

Table 3. Basic information of respondents to valid questionnaires (N=91)

background		number	Percentage (%)
Experience	Have used electronic payment	53	58.2
	Unused electronic payment	38	41.8
gender	male	61	67.0
	Female	30	33.0
age	Below 20	17	18.7
	21-30	26	28.6
	31-40	30	33.0
	41-50	13	14.3
	Above 50	5	5.4
education	Some high school	8	8.8
	Some college	15	16.5
	University degree	21	23.1
	Master(Doctorial) degree	47	51.6
job occupation	student	13	14.3
	public employees	5	5.4
	Service industry	21	23.1
	Information industry	31	34.1
	Financial insurance industry	12	13.2
	other	9	9.9
Monthly salary (NTD)	<= 20,000	6	6.6
	20,001-30,000	18	19.8
	30,001-40,000	10	11.0
	40,001-50,000	27	30.0
	50,001-60,000	11	12.1
	>= 60001	19	20.5

Table 4. Fuzzy AHP evaluation scale and fuzzy semantics variable

semantics variable	value	Fuzzy scale
Not Important	1	(1, 1, 2)
Between the two	2	(1, 2, 3)
Slightly important	3	(2, 3, 4)
Between the two	4	(3, 4, 5)
Moderately Important	5	(4, 5, 6)
Between the two	6	(5, 6, 7)
Important	7	(6, 7, 8)
Between the two	8	(7, 8, 9)
Very important	9	(8, 9, 9)

Table 5. Weight values and overall rank of the evaluation criteria

Dimension	Evaluation criteria	normalization Weights	FAHP weight	rank
Convenience (0.267)	Easy payment	0.271	0.072	8
	Eliminate the inconvenience of carrying cash or credit card	0.292	0.078	5
	Simplify the payment process	0.236	0.063	10
	More places to use	0.201	0.054	12
Easy to use (0.224)	The function list is very clear	0.216	0.048	14
	Easy operation	0.406	0.091	2
	Can support multiple devices	0.378	0.085	3
Transaction Security (0.301)	User identity recognition	0.251	0.076	6
	Transaction security certification	0.313	0.094	1
	Confidential personal data	0.274	0.082	4
	Provide instant payment message	0.162	0.049	13
Personal Cognition (0.208)	Improve living efficiency	0.347	0.072	8
	Change payment habits	0.359	0.075	7
	Personalized service	0.294	0.061	11

A two-level hierarchical structure shows that influences consumer behavioral intension to use mobile payment. The weight shows in Table 5, four dimensions of the first level that are marked as “Transaction Security” (0.301), “Convenience” (0.267), “Easy to use” (0.224) and “Personal Cognition” (0.208). This result shows that the most important thing about whether consumers are willing to use mobile payments is “Transaction Security”, which is consistent with the results of Chan [10], Lai [12], Gbongli et al. [21] and Osmani et al. [23]. The weight of “Transaction Security” and “Convenience” dimensions has exceeded 55 percent that indicating the influence that the consumer behavioral intension for using mobile payment. The result is same as Elizabeth et al. [32] that most consumers are concerned that their online activities are intercepted by fraudulent users, which may result in the loss of financial data or theft of sensitive personal information. Therefore, how to ensure the security and convenience of online transactions [33], and enhance consumers’ confidence in the mobile payments, will not cause doubts and inconveniences in security.

In the evaluation criteria weight value and ranking analysis of the second layer after the transitive computing. Table 5 shows that the top six evaluation criteria that are most valued by consumers are: “Transaction security certification” (0.094), “Easy Operation” (0.091), “Can support multiple devices” (0.085), “Confidential personal data” (0.082), “Eliminate the inconvenience of carrying cash or credit card” (0.078), “User identity recognition” (0.076). Among the top six assessment criteria, three criteria are included in “Transaction Security” dimension, with a coverage rate of up to 83%. Two criteria are included in “Easy to use” dimension with a coverage rate of 78%. One criterion is included in “Convenience” dimension.

In addition to the evaluation criteria for “Transaction security certification”, “Easy operation” and “Can support multiple devices” are factors that consumers pay more attention. Therefore, the industry must design a highly supportive software that al-lows consumers to seamlessly connect to each mobile device. Finally, there is no need to carry the inconvenience of carrying cash or credit cards, and this is also a convenience to use mobile payments.

In addition, the evaluation criteria that consumers pay less attention to, include “Personalized service” (0.061), “More places to use” (0.054), “Provide instant payment message” (0.049), “The function list is very clear” (0.048). This shows that when the consumer uses the mobile payment, the function list is very clear or there is no important consideration for providing the consumption message. It’s also com-mon to have a message to inform the consumer record, and usually

only pay for the money. In addition, the criteria for personalized service and location are the goals that the industry has to work hard. Mobile payment can provide dividend redemption services through a cross-industry alliance, but there are not many operators interested in alliances. And this is also lacking the main point of the incentive. At the same time, the number of stores that use mobile payment is still relatively small. Although the government and related industry have been vigorously promoting and promoting, only by making up the deficiencies or improving incentives can promote consumer use mobile payment.

5 Conclusion

The main purpose of this study is to understand the consumer behavioral intension to use mobile payments. Therefore, through the consolidation of relevant literatures and the factors that influence consumers' willingness to use mobile payment. The fuzzy Delphi method is used to construct the evaluation framework, and the analysis is carried out through FAHP method to find out the key factors for the relevant industry. From the results of this study, it is found that "Transaction Security" and "Convenience" are most important. The six evaluation criteria are respectively attributed to the three dimensions of "Transaction Security", "Convenience" and "Easy to use". No criteria included in "Personal Cognition" dimension that means consumers pay less attention to the factors in "Personal Cognition" dimension. It is speculated that it may be an advancement in network technology, which makes most consumers think that mobile payment can promote the convenience of consumers, so less consideration is given to the difference between this factor and the present.

According to the weighting and ranking of the evaluation criteria, it can be seen that "Transaction Security" is the most important dimension for consumers when using mobile payment. This means that mobile payment can bring payment convenience, you don't need to carry cash or credit card to pay. However, because you need to fill in personal basic information and credit card information, consumers are worried that the capital will be leaked, and even the mobile device will be infected a virus. This will inevitably lead consumers to doubt about the mobile payment [6, 10]. On the management side, it is recommended that the industry can implement the new financial system with Block-chain technology, and strengthen transaction security, ensuring the security of data transmission throughout the process to gain consumer confidence. In addition, "Convenience" and "Easy to use" are also considerations that consumers' focus. As mobile payment is the future trend, it is recommended that vendors to reduce amount of time and effort in use mobile payment. To make the operation simple and clear, so that it can change the consumer's payment habits and enhance the user's willingness to use.

Our research is mainly based on the behavioral intention of mobile payment in Taiwan. Compared with the most mature China market for mobile payments, the number of people who use mobile payments at least once every six months has been growing rapidly, from 35% in 2015 to more than 67% in 2018 [36]. WeChat Pay and Alipay are the two main mobile payment services in China, enabling users to download their applications to any type of mobile phone. Phuah et al. [37] shows that security is less important than convenience. In the United States, credit and debit cards have been the most popular transaction methods for many years. If you want to use mobile payment services, it will be compatible with certain types of phones. For example, users using Android-based phones cannot use Apple Pay, and users using Apple iPhones cannot use Google Pay. In the United States, the popularity of mobile payment is not as good as in other parts of the world such as Western Europe and Asia. The intention of American consumers to use mobile payment depends largely on their perceptions of performance expectations, social influence, compatibility, knowledge and trust [38].

In the future research, since this study only summarizes the factors that affect the willingness to mobile payment based on literatures. These considerations may be considered insufficiently. Therefore, it is recommended to use expert interviews or focus group to include all factors. Finally, the study was limited by the number of samples and it was not possible to distinguish between consumers with or without electronic payment for all respondents. The evaluation factors and the degree of emphasis considered by the two groups in the use of mobile payment may be different, which may result in a slight difference in the weighting value and ranking of the factors. Therefore, it is suggested that the future study can be used as the research topic for the two groups respectively (with or without electronic payment). In order to be able to truly understand the consumer's consideration factor and its relative weight value. Another research direction is to combine big data analysis and data mining technology to explore the consumer habits of using mobile payment. Ma and Fildes [34] help millions of small businesses improve their operations by providing professional customer flow prediction based on third-party payment data that bring potential additional benefits. Lee et al. [35] use two-stage analysis and emerging artificial intelligence deep learning analysis to prove that the link between mobile usability and behavioral intention is supported.

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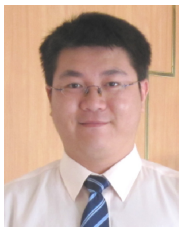

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