An integration of TAM with usage barriers and ability to understand consumers intention to use SSTs

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ABSTRACT

This study examined the factors that influence consumers acceptance and use of self-service technology by integrating a ground theory model such as the technology acceptance model and the theory of innovation adoption. The variables that affect consumers attitudes and intentions were investigated. This included perceived usefulness, perceived ease of use, relative advantage, complexity, and knowledge. Further, the variables from the resistance theory, which consist of usage barriers and ability, were investigated. Interviews and surveys were conducted with two business operators that provide TVM services. Eight hundred online and offline consumers who experienced the TVMs were selected as a sample. The research model of this study was developed, and the correlations between the variables analyzed, using structural equation modeling. Our results confirm that the factors such as relative advantage, knowledge, perceived usefulness and perceived ease of use positively affected the attitude and intention toward using the TVM. Factors such as usage barriers and complexity negatively impacted the intention to use the top-up machine. These results can be used as baseline data for developing or designing self-service technology. Entrepreneurs should consider these factors to make technology continue to be recognized and encourage in the use of self-service technology.

Keywords: Vending Machine, Self-service Technology, Technology Acceptance Model, Diffusion of Innovation, Usage Barriers

1. INTRODUCTION

Self-service technology (SST) has become more actively used in the daily lives of consumers due to changing economic and social structures including the need for greater convenience [1]. Meuter, Ostrom, Roundtree and Bitner [2] defined this service as, technological interfaces that enable customers to perform tasks using technologies without direct personal assistance in the consumption context. There are many types of SSTs. In retail contexts, retailers have extended their range of SSTs to include self-checkout or self-checkout kiosks, whereby customers choose products and services and pay via self-checkout [3]. Among various types of SST, top-up vending machines (TVM) are classified as SST that help customers to top-up their account by allowing them to recharge their pre-paid account. The details of the TVM are presented in Appendix B.

According to Kearney and Intelligence [4], the global team of forward-thinking, mobile subscribers around the world accounts for approximately 3.9 billion people, which rapidly increased to 4 billion in 2018. In Thailand, there are around 110 million mobile phone subscribers, more than 80% are using mobile prepaid services [5]. In the past, there have been many ways to top up mobile prepaid services, such as purchase prepaid cards, top-up via calling to the service provider, and online banking by debiting from a deposit account. However, there are still many limitations and inconveniences with these top-up methods. For example, the top-up process has many steps, and it has a minimum setting for each re-fill [6]. Therefore, entrepreneurs have invented ways to reduce limitations by developed the TVM that helps facilitate convenience, smooth operation with service points covered, and it can provide 24 hour service. As we have seen, mobile prepaid numbers account for a relatively high number of consumers, and all of these groups will need to interact and use TVM. Hence, it is worth studying the factors and processes affecting and forecasting the user behavior and adoption processes toward the use of TVM.

Currently, the behavior of consumers when choosing or buying some products and services has changed. Consumers want convenience in buying products and services. To make products and services successful, manufacturers or entrepreneurs must analyze the factors that affect consumer adoption and use of technology [7, 8]. Some studies have combined the technology acceptance model (TAM) [9] with the diffusion of innovation theory [10] to investigate the factors influencing SST. The TAM has been used to analyze factors that affect the adoption of technology. In the past, researchers have used this theory to analyze factors that affect the adoption of SST in

a variety of contexts. For example, concerning the retail context, Wang, Harris and Patterson [3] proposed a conceptual framework for investigating the factors that affect consumers use of self-service payment kiosks. Vicini, Bellini, Rosi and Sanna [11] considered the factors that affect consumers acceptance and use of vending machines. Ernst, Hock and Rothlauf [12] proposed a conceptual framework to identify factors that influence slot machine usage. In the healthcare context, Zhang, Yu, Yan, Hu and Goureia [13] presented a conceptual framework for examining factors affecting the acceptance and use of a website for patients appointments. In the education context, Chang and Chang [14] proposed a conceptual model for examining the factors that influence students use of library self-issue and return systems.

As can be seen, the TAM provided by Davis, Bagozzi and Warshaw [9] can be used to describe the individual internal factors that influence the acceptance and intention to use information technology. However, there are still some limitations. For example, individual behavior may not occur if the behavior is complex, if it more complicated than the ability of the person to control, or if the attitudes and behaviors may cause errors [15]. To demonstrate this view, we combine factors from other theories as a supplement. Consequently, this study uses additional factors such as usage barriers [16] and ability [17] to describe the aspects of behavior change and the persistence of technology use when the technology is modified or changed from the original.

This paper is organized as follows: the next section presents the theoretical background including TAM [9] and resistance theory [18]. Following on, we present the proposed research model and hypothesis. The description of the methodology and analysis of results is then provided. Finally, we discuss the relevant findings of this research and the conclusion.

2. LITERATURE REVIEW

2.1 Technology acceptance model (TAM)

The technology acceptance model introduced by Davis, Bagozzi and Warshaw [9], is an information technology theory that is used to study the behavior or attitude of a consumer in terms of accepting the use of information technology. Moreover, the TAM is based on the theory of reasoned action (TRA) [15], which consist of an attitude toward behavior and subjective norms that have direct effects on behavioral intention. What is more, TAM is flexible in that it allows researchers to use external factors in predicting actual usage behavior. Drawing on the principles of information technology acceptance theory, this study will use technology acceptance theory as a base model to investigate the factors that influence the attitudes and intentions to use information technology. In essence, the TAM consists of five main factors: perceived usefulness, perceived ease of use,

attitude, behavior intention and external variables. The construct of the TAM is shown in Fig. 1.

As shown in Fig. 1, it is evident that the attitude toward and acceptance of technology will start from the external factors, while the behavior intention is derived from the attitude toward use. The TAM is different from the TRA in two respects: first, the TAM considers external factors and attitude before predicting the behavior intention. Second, personal norms are not taken into consideration. Taylor and Todd [19] have argued that the TAM can be used to predict behavior in accepting technology better than the theory of planned behavior (TPB), as TPB does not take external factors into consideration.

From Table 1, it can be seen that the technology acceptance model can be used as a fundamental theory for investigating acceptance and the intention to change behavior. The intention of the actual behavior of the individual should start with the right attitude [9]. The external factors that affect the behavior are flexible and are able to adapt to the varied context. Although, the technology acceptance model 2 (TAM2), Venkatesh and Davis [20], and the Unified Theory of Acceptance and Use of Technology (UTAUT) Venkatesh, Morris, Davis and Davis [21] can answer questions about the factors affecting the adoption of technology, these are fixed and are not flexible. It is difficult to adjust the factors or variables to find acceptance. Hence, this study uses the TAM as the basis for finding acceptance of the use of SST services.

The TAM has been used extensively to explain the adoption of information technology such as SST. Many researchers have adopted the TAM to explain the factors that affect the acceptance of the use of SST. For example, Curran and Meuter [22] proposed a comparison of SST in banking technology such as ATMs, and telephone and online banking, by using the essential factors from the technology acceptance theory. Lee, Cho, Xu and Fairhurst [23]explored the relationships between demographic factors and consumer traits to understand consumer behavior towards retail self-checkouts. Yang, Sheng Wen and May Ching [24] presented a review of factors affecting the use of SST services. The study of Elliott, Meng and Hall [25] proposed a conceptual framework for evaluating SST by integrated TAM and technology readiness such as perceived reliability and the perceived fun of using SST. Vicini, Bellini, Rosi and Sanna [11] presented factors that affect the acceptance of applications and purchases through vending machines, or vending machines that were used to create or change consumer behavior. Gelbrich and Sattler [26] proposed a conceptual model to test the impact of technology anxiety on the intention to use an SST in public. Kaushik, Agrawal and Rahman [27] extended the TAM to investigate antecedent beliefs in order to predict tourists attitudes towards SST.
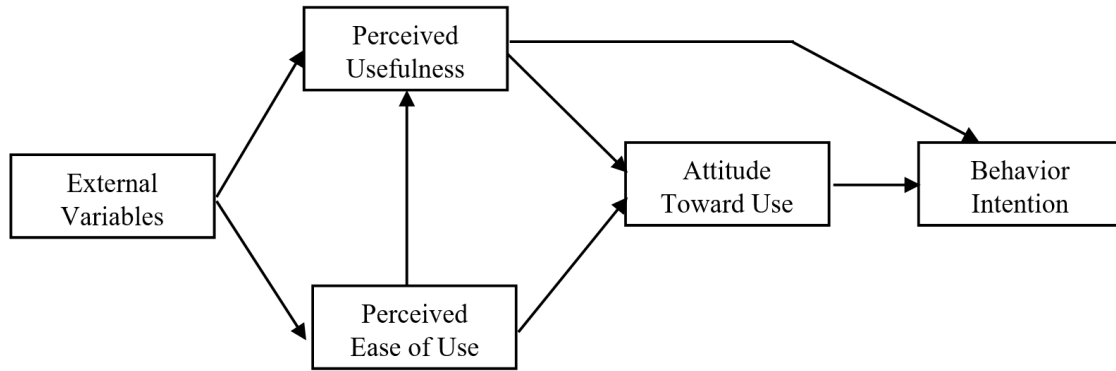
Fig.1: *Technology Acceptance Model: TAM [9].*

Ernst, Hock and Rothlauf [12] proposed a conceptual framework for investigating factors that affect the acceptance and use of the slot machine. Agag and El-Masry [28] presented an integration of DOI and TAM with trust to understand consumer intention to use online self-service recently, Demoulin and Djelassi [29] proposed a model to capture individual, system and situational drivers of customers intention to use self-service technologies.

2.2 Diffusion of Innovation Theory

Diffusion of Innovation Theory (DOI) has necessity method support for explaining consumer acceptance in several subjects, especially online shopping (e.g., Agag & El-Masry, 2016; Amaro & Duarte, 2015; Jensen, 2009; Kowatsch & Maass, 2010). According to Rogers [10], innovation is "an idea, practice, or object that is perceived as new by an individual or another unit of adoption". Diffusion, on the other hand, is "the process by which an innovation is communicated through certain channels over time among the members of a social system"[37, 38]. In the construction context, an innovation has been described as "the actual use of a non-trivial alteration in terms of enhancement in a system or working procedure that is new to the corresponding organization" [38].

Innovation is divided into the five following stages: identification, evaluation, commitments, preparation, and implementation [38]. In the retail context, innovation provides a set of factors that influence consumers intentions to adopt new technologies. These factors are: relative advantage, compatibility, complexity, trialability and visibility. Of these factors, relative advantage and complexity have provided the most constant explanation for consumer intention to adopt new technology [39]. Therefore, our study focuses on examining the influence of perceived relative advantage and complexity on consumers intentions to use TVM. The relevant reviewed on the DOI in SSTs is shown in Table 3.

2.3 Innovation Resistance Theory

Consumers will use SST when they are confident and able to use the technology by themselves [2]. Persistence in using this technology, if the technology is modified, depends on two main factors: usage barriers and ability to use the technology [18]. Factors and problems in using technology will occur when the technology has changed [18, 45, 46]. Usage barriers in the operation of technology are the main factors that affect the persistence of technology usage. Therefore, customers need to make greater efforts to learn and use innovation and technology [18]. In the past, researchers have investigated factors that are problematic and impede the persistence of innovation and technology [47]. Chudry [48] used usage barriers to study the acceptance and persistence of using service self-checkouts. Vicini, Bellini, Rosi and Sanna [11] used usage barriers to find the factors that influence customer acceptance and use of TVM.

In terms of the ability to use SST, this means having the necessary skills and confidence to use the service [49]. Ability refers to something that customers can do rather than what customers want or know how to do [50]. This is because the relationship between ability and barriers to work affect their perception of their skills and confidence needed to complete the assigned work [51, 52]. Abilities and attitudes are factors that directly influence customer behavior [51]. Previous studies have suggested that ability is an essential factor and is used as a critical factor in predicting consumer behavior related to the use of SST (e.g., Curran & Meuter, 2005; Maddux, Norton, & Stoltenberg, 1986). Curran and Meuter [22] also suggested that customers with high levels of ability (self-efficacy) in using SST tend to use it.

TAM is mostly used to understand how consumers accept technology. However, there are some limitations, such as not being able to explain behavior change or being unable to explain the persistent use of technology when it is modified or changed [45, 46]. Hence, to explain the view of change, this study combined the factors from theories of resistance intro-

Table 1: *The construct of intention based theories.*

Theory/Model	Core variables																
	Attitude	Effort expectancy	Experience	Facilitating conditions	Image	Job relevance	Output quality	Perceived ease of use	Perceived usefulness	Perceived behavior control	Performance expectancy	Result demonstrability	Social influence	Subjective norm	Voluntarism	Behavior intention	External variables
TRA Ajzen and Fishbein [15]	✓													✓		✓	
TPB Ajzen [30]	✓									✓				✓		✓	
TAM Davis, Bagozzi and Warshaw [9]	✓							✓	✓							✓	✓
TAM2 Venkatesh and Davis [31]			✓	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓	
SCT Bandura [32]								✓	✓							✓	
UTAUT Venkatesh, Morris, Davis and Davis [21]		✓	✓	✓							✓		✓		✓	✓	

Table 2: *Overview of the relevant literature on retail SST acceptance.*

Study	SST	Theory /Model	Methodology	Factors considered
Dabholkar, Bobbitt and Lee [33]	Self-scanning checkout	TAM	Survey	speed, ease-of-use, reliability, enjoyment, control, attitudes, and personal interaction
Lee, Cho, Xu and Fairhurst [34]	Self-checkout	TAM	Online survey	demographic factors, consumer traits
Elliott, Meng and Hall [25]	Self-checkout	TAM, TRI	Survey	usefulness, ease-of-use, reliability and fun, technology readiness
Wang, Harris and Patterson [3]	Self-kiosks	TAM, SCT	Longitudinal survey	habit, self-efficacy, and satisfaction
Hyun-Joo Lee [35]	Self-kiosks	TAM	Online survey	consumer characteristics and service quality dimension
Gelbrich and Sattler [26]	Self-service	TAM, SCT	Cross-sectional survey	technology self-efficacy, technology anxiety, perceived ease of use, intention
Demoulin and Djelassi [29]	Self-checkout	TAM, TPB	Survey	subjective norm, reliability, need for interaction, enjoyment, technology anxiety, social anxiety, self-efficacy, personal responsiveness, compatibility, perceived usefulness, perceived ease of use, perceived behavior control

duced by Ram and Sheth [18] as a supplement to explain the view of change.

Based on the literature, this study adopted a distinctive approach to investigate the determinants of acceptance and intention to use SST by proposing an integrated model with contributions from well-grounded theories, namely the TAM [9], the DOI [10] and the theory of innovation resistance [18], in order to investigate how consumers accept and persistent in using SST. The proposed research model of this study is shown in Fig 2.

3. HYPOTHESIS

Following a literature review, this study combined fundamental factors from the TAM Davis, Bagozzi and Warshaw [9] and the DOI Rogers [10] with Ram and Sheth [18], such as usage barriers and ability, to describe factors that influence the adoption of technology and the persistence in using this technology when it is modified or changed from the original. The hypotheses of this study are described next.

3.1 Attitudes

According to the TRA, introduced by Ajzen and Fishbein [15], the theory of social psychology can be used as a basis for studying human behavior. This theory explains the relationship between belief and attitude towards the behavior. Human behavior changes are the result of changing beliefs. People will show specific behavior because they think it is appro-

Table 3: *Instigated technology acceptance and diffusion of innovation in SSTs.*

Study	Innovation /SSTs	Theory/Model	Retail context	Aspects of consideration Acceptance	Adoption
Mallat, Rossi, Tuunainen and Öörni [40]	Mobile ticket service	TAM, DOI	×	✓	✓
Weijters, Rangarajan, Falk and Schillewaert [41]	Self-scanning	TAM, DOI	✓	✓	×
Aristeidis and Ioannis [42]	Internet banking	TAM, TPB, DOI	×	✓	×
Kowatsch and Maass [43]	Online store	TAM, TPB, DOI	✓	✓	×
Zhang, Yu, Yan, Hu and Goureia [13]	Online appointment	TAM, DOI	×	✓	×
Dash, Bhusan and Samal [44]	Mobile banking	TAM, DOI	×	✓	✓
Amaro and Duarte [39]	Online travel	TAM, TPB, DOI	×	✓	×
Agag and El-Masry [28]	Online travel	TAM, DOI	×	✓	×
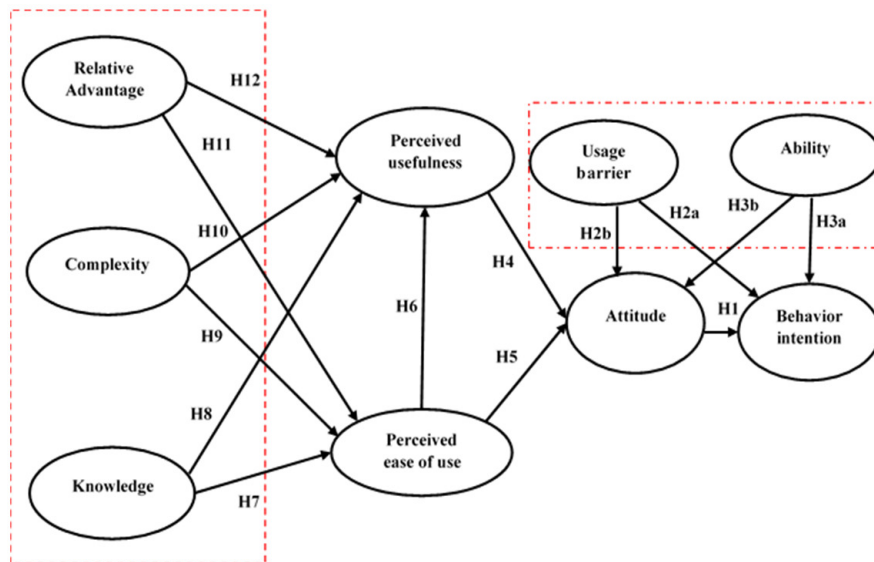
Fig.2: *Proposed research model.*

priate, and intention to show behavior is driven by attitude. Attitude means the opinions, perspectives and feeling towards one thing, which may be positive or negative thoughts or views of the mind that are not valid [15]. In the retail context, many researchers have presented a conceptual framework for investigating consumer attitudes towards accepting and using vending machines (e.g., Hampshire, 2017; Weijters, Rangarajan, Falk, & Schillewaert (2007); Wang, Harris, & Patterson, 2012). As we have seen, attitudes play an essential role in the intention or acceptance of using TVM. Therefore, from the definitions of Ajzen and Fishbein [15], this study uses attitude to examine changes in the behavior of consumers who have to accept the use of TVM. Based on the literature, we propose the following hypothesis:

H1: Attitude has a positive influence on consumers' intention to use SST.

3.2 Usage barriers

The idea of a usage barrier is derived from the theory of Ajzen [30]. They define a usage barrier as a major obstacle for consumers to use one thing in the context of using information technology[16]. Hasan [53] suggested that the past usage habits of consumers are important factors that affect the adoption of information technology and innovation. If information technology is a sophisticated technology that is difficult to understand, users will refuse or resist using it [54]. Usage barriers are another factor that will be involved in finding attitudes, intention and consumer usage behavior towards accepting and using SST. We,

therefore, propose the following hypotheses:

H2a: Usage barriers have a negative influence on consumers attitudes towards using SST.

H2b: Usage barriers have a negative influence on consumers behavior intention towards using SST.

3.3 Ability

Ability refers to the capability of using SST, such as having the required skills and the confidence to perform a particular assignment [22, 49]. The relationship between ability and effectiveness is symbiotic [51, 52]. Ability helps to build confidence in doing anything and influences the behavior of customers [51]. Customers with low abilities will feel that they do not dare perform complex tasks. In the past, research used ability factors to determine intentions or attitudes towards the use of SST. Curran and Meuter [22] proposed a conceptual framework to investigate consumer behavior towards the use of SST. Based on previous research studies, it can be seen that skills and abilities are one of the crucial factors that may affect the acceptance and use of SST. Therefore, this research will use these factors to understand consumer attitudes and intentions toward using SST. We, therefore, propose the hypotheses as follows:

H3a: The ability to use SST has a positive influence on consumers attitudes towards using SST.

H3b: The ability to use SST has a positive influenceon consumers behavior intention to use SST.

3.4 Perceived usefulness

Perceived usefulness, one of the factors from the TAM introduced by Davis, Bagozzi and Warshaw [9], is defined as the prospective user 's subjective probability that using the SST will perform their tasks efficiently and in a timely manner [41]. Hyun-Joo Lee [35] have suggested that perceived usefulness plays an important role in determining customers attitudes toward using SST. Ernst, Hock and Rothlauf [12] and Demoulin and Djelassi [29] also suggested that perceived usefulness plays an essential role in changing attitudes towards or accepting the use of SST. Therefore, based on the literature, we can propose the following hypothesis:

H4: Perceived usefulness has a positive influence on consumers attitudes towards using SST.

3.5 Perceived ease of use

Perceived ease of use is one of the constructs from the TAM. It refers to the degree to which the prospective user expects the target system to be free of effort [9]. This construct has been used in many studies

(e.g., Kim, 2016; Fernandes & Pedroso, 2017; Mallat, Rossi, Tuunainen, & Öörni, 2006; Zhang Xiaoren, 2013). It can be seen that this construct plays an important role in changing attitudes towards accepting the use of SST. Therefore, we propose two hypotheses as follows:

H5: Perceived ease of use has a positive influence on consumer attitudes towards using SST.

H6: Perceived ease of use has a positive influence on perceived usefulness.

3.6 Knowledge

Knowledge is another process that can create acceptance of innovation [55]. The process DOI on the theory of Rogers [10] is defined as "people have knowledge and understanding about innovation usage and also know how to use that innovation and how innovation works". Rogers [37] states that knowledge is a process that occurs before a persons decision to accept or reject the use of innovation. Therefore, we propose the hypotheses as follows:

H7: Consumer knowledge has a positive influence on perceived ease of use.

H8: Consumer knowledge has a positive influence on perceived usefulness.

3.7 Complexity

The complexity of using innovation is another factor from Rogers [10] theory of innovation that is commonly used to describe consumer behavior regarding using technology or innovation [56]. Complexity in the use of innovation means that innovation is complicated or complicated to use. For this study, complexity refers to the degree to which using SST such as TVM is perceived to be complicated. Several researchers have considered the use of complexity in using innovation (e.g., Agag & El-Masry, 2016; Amaro & Duarte, 2015; Lu, Yang, Chau, & Cao, 2011). As these studies have shown, the difficulty or complexity of innovative work is another crucial factor to describe the perspective of accepting or changing consumer behavior towards the use of technology or innovation. Based on the literature, we have selected complexity as an additional lens through which to examine the process of changing a persons behavior towards accepting TVM. As a consequence, the following hypotheses have been proposed:

H9: Complexity has a negative influence on perceived ease of use.

H10: Complexity has a negative influence on perceived usefulness.

3.8 Relative advantage

Relative advantage stems from Rogers [10] DOI theory. It is commonly used as a sociological theoretical basis to describe the perspective of dissemination or innovation distribution [56]. In this study, the perception of innovation can be defined as the use of SST making consumers receive greater benefits than the original method, such as being comfortable, low operating costs and reduced the time of the process, which makes it easy to use and fast. In the retail context, several researchers have considered the use of relative advantage as a pivotal factor to describe attitudes and changes in consumer behavior towards the use of technology or innovation (e.g., Aizstrauta, Ginters, & Eroles, 2015; Amaro & Duarte, 2015; Dash, Bhusan, & Samal, 2014; Lu et al., 2011). In this study, relative advantage is defined as the degree to which the use of SST provides a greater benefit to the consumer than the original method. Hence, we also propose the hypotheses as follows:

H11: Relative advantage has a positive influence on perceived ease of use.

H12: Relative advantage has a positive influence on perceived usefulness.

4. METHODOLOGY

4.1 Sampling and data collection

Based on the literature, this study used mixed methods, both qualitative and quantitative, as conducting mixed methods research will result in reliable and high quality data [57]. First, interviews were conducted to gain the data. We interviewed two business operators that provide a TVM service in Thailand. Second, we studied the use of the TVM in practice through a survey of the users who had experience with these services. The sample group in this study was selected using the purposive sampling method by considering the characteristics of the sample group that meets the criteria and objectives of the research. The sample group in this study was factory staff and students. The following section provides the results of the survey.

4.2 Questionnaire

The questionnaire in this study was divided into three parts. Part 1 had five sub-parts, which concerned general information about demographic characteristics. Part 2 had four sub-parts, which concerned general questions related to top-up behavior via TVM and factors affecting the decision to use the TVM. Part 3 had 11 sub-parts, which involved questions about the attitude of the respondents towards the acceptance and use of TVM.

5. RESULTS

This study was conducted based on the TAM of Davis, Bagozzi and Warshaw [9], relative advantage, complexity, knowledge from Rogers [10], along with constructs from Ram and Sheth [18], such as usage barriers and ability, to describe the perspectives related to use of SST. Partial least squares technique through the SmartPLS 3.0 software was applied to analyze the data collected. SmartPLS is rapidly becoming a widely-used tool to analyze structural equation modeling (SEM). The software is easy to use, uncomplicated and is able to support many variables; the results of the analysis are as follows:

5.1 Demographic characteristics

From the survey, both sample groups were made up of industrial workers and student groups. The results are shown in Table 4, which displays the gender of the respondents. Respondents were divided into 367 males and 432 females, representing 46% and 54% of the sample population, respectively. For the age group, most respondents were in the range of 21-30 years old, which represents 56% of the sample population. The age group of 50 years old and above answered the least number of questionnaires, which accounted for 0.5%of sample population.

In the education section, most respondents either had or would not finish with anything higher than a bachelors degree, which accounted for more than 95%. There was an even number of respondents between the employees of the factory and the students: 50.63% and 48.63%, respectively. Finally, income was an essential factor for choosing to use the service. It can be seen that groups with an income of less than 5,000 baht made most use of the services, which accounted for 42.5%.

5.2 Measurement model

The measurement model consists of the relationship between latent variables and observed variables. The measurement model is an examination to find reliability and the accuracy of variants within the model [58]. From the results shown in Table 5, it can be seen that all factors in the model are reliable, which is evident from the factor loadings. All factors are greater than 0.7 [58, 59]. Considering the acceptable threshold values for Cronbachs alpha, the values are higher than 0.7 [60].

Moreover, composite reliability is another statistical value that many researchers consider more suitable for PLS-SEM than Cronbach s alpha (e.g., Hair et all, 2011; Henseler et al., 2009), which was in the range 0.84 to 0.93 and exceed the recommended threshold value of 0.7 [61].

Discriminant validity is the degree to which the accuracy of the observed variables within the model can be checked. The measures of different observed

Table 4: *Sampling profiles.*

Variable	Categories	N	% of Responded
Gender	Male	367	46%
	Female	432	54%
	Total	**800**	**100**
Age	18-20	163	20.38%
	21-30	448	56%
	31-40	173	21.63%
	41-50	12	1.5%
	Over 50	4	0.5%
	Total	**800**	**100**
Education	High School	242	30.25%
	Diploma	206	25.75%
	Bachelor Degree	334	41.75%
	Master or doctorate	13	1.13%
	Other	5	0.63%
	Total	**800**	**100**
Occupational	Student	389	48.63%
	Factory staff	405	50.63%
	Other	6	0.75%
	Total	**800**	**100**
Income	<5,000	338	42.5%
	5,000-10,000	225	28.13%
	10,001-20,000	200	25%
	>20,000	37	4.63%
	Total	**800**	**100**

variables are related to latent variables in the same group rather than latent variables in another. This item was assessed by comparing the correlations between constructs with the square root of average extract variance (AVE) [62]. The results are shown in Table 4, which represent the square root of the AVEs. Each construct is higher than its correlations with any other construct [59]. Therefore, we achieved the desired discriminant validity.

5.3 Structural Model

Following the assessment of the measurement model, the structural model was then analyzed. The structural model was examined to assess the hypothesized relationship between the construct in the conceptual model [60]. The structural model in this study was evaluated using several measures based on the recommendations of Henseler, Ringle and Sinkovics [59]. Table 7 shows the results for the structural model. Attitude (H1) ($\beta = 0.33$, p <0.001) and usage barriers (H2a) ($\beta = 0.37$, p <0.001) were found to have a significant effect on behavior intention of using TVM. Usage barriers (H2b) ($\beta = 0.43$, p <0.001), ability (H3b) ($\beta = 0.40$, p <0.001), perceived usefulness (H4) ($\beta = 0.19$, p <0.001) and perceived ease of use (H6) ($\beta = 0.32$, p <0.001) were found to have a significant effect on attitudes toward the use of TVM. Ability (H3a) ($\beta = -0.08$, p = 0.18) and perceived ease of use were not found to have a significant effect on

attitude and behavior intention to use TVM.

Knowledge (H7) ($\beta = 0.55$, p <0.001, (H8) ($\beta = 0.35$, p <0.001) and relative advantage (H11, H12) ($\beta = 0.34$, p <0.001; $\beta = 0.26$, p <0.001) were found to have a significant effect on perceived usefulness and perceived ease of use. However, complexity (H9 and H10) factors ($\beta = -0.01$, p = 0.55; $\beta = -0.02$, p = 0.25) were not found to have a significant effect on perceived usefulness and perceived ease of use. Therefore, almost all hypotheses were supported with the exception of H3a, H5, H9 and H10.

The prediction power of the research model can be seen by observing the R^2 of an endogenous construct in the model. According to Chin [63], the acceptable R^2 must be at least 0.19. The R^2 value obtained from the analysis is shown in Table 8, which had values ranging between 0.43 and 0.73. Therefore, we can conclude that the model has high predictive value and can be explained by endogenous constructs in the model.

6. DISCUSSION

This study aimed to provide some insight into the acceptance and persistence in using SST, using a case study about TVM in Thailand. We proposed a conceptual model based on the integrated models of Davis, Bagozzi and Warshaw [9] in which attitude, perceived usefulness, and perceived ease of use. It also incorporated the theories of Rogers [10]: namely,

Table 5: *Measurement statistics of construct scales (cont.).*

Construct/Factors	Factors Loading	Average Variance Extracted[a]	Composite Reliability[a]	Cronbach s alpha a
Behavior intention		0.92	0.96	0.92
BI1	0.96			
BI2	0.96			
Attitude		0.89	0.96	0.94
ATU1	0.95			
ATU2	0.95			
ATU3	0.93			
Ability		0.91	0.97	0.95
ABI1	0.94			
ABI2	0.96			
ABI3	0.96			
Usage barrier		0.84	0.96	0.94
BAR1	0.92			
BAR2	0.94			
BAR3	0.90			
BAR4	0.92			
Perceived usefulness		0.86	0.95	0.92
PU1	0.93			
PU2	0.93			
PU3	0.93			
Perceived ease of use		0.92	0.97	0.96
PEOU1	0.97			
PEOU2	0.96			
PEOU	0.95			
Complexity		0.97	0.99	0.97
COM1	0.99			
COM2	0.99			
Knowledge		0.89	0.96	0.94
KN1	0.94			
KN2	0.94			
KN3	0.95			
Relative advantage		0.93	0.96	0.92
REA1	0.96			
REA2	0.96			

[a] *Factors loading >0.6, Cronbach's alpha >0.7, Composite reliability >0.7, Average variance extracted >0.5*

Table 6: *Discriminant validity of the constructs-correlations .*

Constructs	1	2	3	4	5	6	7	8	9
1. Ability	**0.95**								
2. Attitude	0.77	**0.94**							
3. Behavior Intention	0.51	0.61	**0.96**						
4. Complexity	0.19	0.13	0.10	**0.99**					
5. Knowledge	0.70	0.68	0.60	0.18	**0.94**				
6. Perceived Ease of use	0.69	0.70	0.65	0.16	0.81	**0.93**			
7. Perceive Usefulness	0.72	0.66	0.57	0.17	0.81	0.80	**0.96**		
8. Relative advantage	0.71	0.70	0.63	0.25	0.78	0.77	0.76	**0.96**	
9. Usage Barrier	0.78	0.78	0.63	0.14	0.75	0.78	0.77	0.76	**0.92**

Bold numbers represent the square roots of the AVE.

Table 7: *Structure estimate between constructs.*

Hypotheses	Relationship	Coefficient	t-value[b]	Results
H1	ATU → BI	0.33	6.11***	Supported
H2a	BAR → BI	0.43	7.20***	Supported
H2b	BAR → ATU	0.37	7.22***	Supported
H3a	ABI → BI	- 0.08	1.34	Not supported
H3b	ABI → ATU	0.40	8.78***	Supported
H4	PU → ATU	0.19	3.53***	Supported
H5	PEOU → ATU	- 0.07	1.35	Not supported
H6	PEOU → PU	0.32	6.53***	Supported
H7	KN → PEOU	0.55	13.05***	Supported
H8	KN → PU	0.35	7.53***	Supported
H9	COM → PEOU	- 0.01	0.60	Not supported
H10	COM → PU	- 0.02	1.15	Not supported
H11	REA → PEOU	0.34	7.61***	Supported
H12	REA → PU	0.25	6.30***	Supported

[b] *t-values were obtained with the bootstrapping procedure (5000 samples) and are significant at the level 0.001, *** $p < 0.001$*

Table 8: *Coefficient of determination (R^2).*

Constructs/Items	R^2	R^2 Adjusted
Attitude	0.69	0.69
Behavior intention	0.43	0.43
Perceived ease of use	0.70	0.70
Perceived usefulness	0.73	0.73

relative advantage, complexity and knowledge. Our model also ideas from Ram and Sheth [18], such as usage barrier and ability, to explain the causes of persistence and acceptance of using SST. The findings revealed that almost all of the constructs significantly affect the acceptance of using SST. Only three were not found to have a significant effect.

In this study, attitude, perceived usefulness, and perceived ease of use seem to be key determinants of consumers intention to accept and use TVM. Usage barriers and ability, the construct from Ram and Sheth [18], play an essential in modeling persistence of use TVM. As hypothesized, attitude (H1) and usage barriers (H2a) positively affect consumers behavior intention to use TVM. Ability (H3b), perceived usefulness (H4), and perceived ease of use (H5) were found to have a positive effect on attitude toward the use of TVM. Our results also indicate that usage barrier (H2b) was found to have a positive effect on attitude toward the use of TVM. On the other hands ability (H3a) was not found to have a significant effect on behavior intention. Perceived ease of use (H5) was not found to have a significant effect on attitude and behavior intention to use TVM.

Knowledge (H7) and relative advantage (H11, H12) were found to have a positive effect on perceived usefulness and perceived ease of use. Only complexity (H9 and H10) was not found to have a significant effect on perceived usefulness and perceived ease of use. Therefore, almost all hypotheses were supported with

the exception of H3a, H5, H9 and H10.

When entrepreneurs are confronted with an innovation to supplant conventional technological methods, they are more likely to be driven to accept and use it. Based on the literature, technology acceptance is crucially related to consumer behavior. It has become integrated into every aspect of work and living. Hence, entrepreneurs should consider these factors in order to make new technology be accepted and foster the continued use of this technology.

7. CONCLUSION

In this study, we extended the conceptual model of TAM and DOI, and combine it with resistance theories that were probable predictors of intention to acceptance and resistance in the use of SST. The results of our study indicate that attitude (p<0.001) and usage barriers (p<0.001) were significant predictors of the behavior intention to the use of TVM. Conversely, ability (p=0.18) was not found to have any significant effect on behavior intention in using TVM. Also the results of perceived usefulness (p<0.001), usage barriers (p<0.001) and ability (p<0.001) were significant predictors of attitude toward to the use of TVM. Surprisingly perceived ease of use (p=0.18) was not found to have a significant effect on attitude toward in using TVM.

Our study only focused on the factors that affect acceptance and the persistence of using SST in Thailand. We proposed the conceptual model that can be applied for future research on any SST. Researchers can perhaps look into the factors that drive consumers to change behavior in the usage of the technology and more comprehensive results should clearly explain the complete view of the various dimensions. Nevertheless, this study has concentrated only on factors that affect acceptance and persistence of using the technology. We expect that the findings of our study will provide some useful insights for en-

trepreneurs who search for understanding of the acceptance and persistence on using technology.

Appendix A: Questionnaire items

Behavior Intention

Item	
I intend to use top-up vending machine in the future	[21]
I would recommend the use of top-up vending machine to other consumers	[21]

Attitude

Item	
How good or bad do you feel about using the top-up vending machine?	[64]
I think using top-up vending machine is a good idea	[15]
I like the idea of using a top-up vending machine than buy top-up card from shop	[65]

Ability

Item	
I am fully capable of using self-service technology	[66]
I am confident in my ability to use self-service technology	[66]
In my opinion, using self-service technology is well within the scope of my abilities	[66]

Usage barrier

Item	
In my opinion, self-service technology is easy to use	[67-69]
In my opinion, the use of self-service technology is convenient	[69]
In my opinion, self-service technology is fast to use	[69]
In my opinion, progress in self-service technology is clear	[69]

Perceived Usefulness

Item	Source
Through top-up vending machine, I am more effective at making a top-up process	[22]
The top up vending machine is useful for doing my top up	[9, 70]
Using the top up vending machine improves the way in which I do my top up process	[71, 72]

Perceived Ease of Use

Item	Source
The top-up vending machine is easy to use	[9, 73]
Using top-up vending machine is clear and understandable	[9, 73]
The top-up vending machine does not take much effort	[74]

Relative Advantage

Item	Source
Top-up via top-up vending machine has easy payment procedures.	[75, 76]
Top-up via top-up vending machine is more convenient than regular shopping, as I can do it anytime and anywhere.	[75, 76]
Top-up via top-up vending machine makes me less dependent of opening hours.	[75, 76]

Complexity

Item	Source
I feel top-up procedures are not clear to me.	[9, 77]
I feel it is not easy to top-up via top-up vending machine	[9, 77]

Knowledge

Item	Source
I am knowledgeable in using self-service technology	[78]
Knowledge and understanding about the use of self-service technology are necessary for you.	[78]
Knowledge and understanding about the use of self-service technology, which gives you confidence in using services	[78]

Appendix B: Top-up vending machines (TVM)

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