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TOWARDS UNDERSTANDING OF FACTORS INFLUENCING USER ACCEPTANCE OF MOBILE PAYMENT SYSTEMS

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ABSTRACT

M-payments, which refer to payments over a mobile device, have not taken off as fast as predicted. Their slow adoption rates raise many questions about what drives consumer behaviour. The aim of this study is to find out what influences the user acceptance of a new system. The user is seen here as the key to acceptance of a new m-payment procedure, hence the focus on understanding their motivations and attitudes. To predict acceptance, Technology Acceptance Model (TAM) has been extensively used in information systems. This study is based on the belief that TAM needs to be expanded and customized to suit specific characteristics of mobile payments. This paper draws from prior studies that used TAM in fields related to mobile payments. Extensions of TAM in related fields are depicted. Analysis of suitability of various acceptance factors for mobile payments follows. The result of the analysis is a set of factors that are believed to influence the user acceptance of mobile payments: perceived ease of use, usefulness, mobility, cost, trust, and expressiveness. To measure each of these factors, multi-item scales using specific criteria are proposed. Further research will involve pilot study and possible improvement of the measuring scales, as well as further empirical validation of the model. The proposed model illustrates the level of fulfilment of each of the six acceptance factors in an m-payment system, and therefore predicts its adoption, as well as indicates areas of improvement.

KEYWORDS

Mobile payments, mobile commerce, TAM, user acceptance, user-centric approach, acceptance factors

1. INTRODUCTION

Mobile commerce refers to conducting business over a mobile device. E-commerce has already been revolutionary in the way it allowed consumers to shop without leaving home, at any time of day or night. It is often referred to as shopping 'anytime, anywhere'. This 'anywhere' however has a catch: it requires access to a stationary computer at home, work, or an Internet café. M-commerce overcomes this limitation. Consumers can now shop wherever they can take their mobile phone. M-commerce cannot exist without payment systems. For any transaction to take place there must be a way for consumers to pay. Therefore, m-payments refer to payments over a mobile device.

Despite high expectations, m-commerce has not taken off as fast as predicted. Existing m-payment solutions seem to be troubled by weaknesses. The Japanese i-mode system remains the only truly widespread

mobile payment solution. Outside Japan though, the story is very different. New solutions keep appearing but none has reached a considerable customer base.

Because of this obvious gap between what m-commerce can become, and where it is now, numerous questions have been asked about the reasons for this slow adoption. Why are consumers not using new systems? What would make them accept a new way to pay? How is it possible to win customer's acceptance? Only when these questions are answered, can new systems be devised that consumers will be willing to use. This paper will outline consumers' motivations and attitudes towards using mobile payments. Its aim is to identify and explain factors influencing the user acceptance of m-payment systems.

Section 2 highlights the role of the user in the adoption process of any new m-payment system. Section 3 discusses the previous uses of acceptance models in fields related to mobile payments. The methodology is explained in Section 4. Section 5 proposes user acceptance factors for mobile payments, while Section 6 proceeds to present detailed criteria that measure each of the factors. Further research and conclusions are discussed in Sections 7 and 8 respectively.

2. MOBILE USER-CENTRIC APPROACH

There are many conditions that influence the success or failure of a new m-payment system, including available technologies, competition, and business models. This paper focuses on user acceptance as the crucial success factor. It is based on a belief that the most important component in mobile payments systems is the user (Bradford, 2003). Kreyer et al. (2002) use the example of credit cards to support the key role of the customer in the process of acceptance of a new payment method. Credit cards spread in Europe due to strong consumer demand, even though merchants were forced to pay 3-5% fees. Amberg et al (2003) similarly see the user acceptance as a critical success factor for mobile services. If eventually this is the user who decides whether or not a new system is accepted, user adoption behaviour deserves thorough analysis and discussion.

3. TECHNOLOGY ACCEPTANCE MODEL AND M-PAYMENTS

To understand what influences user acceptance of mobile payment systems, it seems logical to consider the use of some already established and tested acceptance models. Davis's (1989) Technology Acceptance Model has been extensively used to analyse customer's acceptance of various information systems. It is based on the belief that individual factors affecting the user's decision whether to accept or reject a system can be identified and measured. TAM sees perceived ease of use and perceived usefulness as fundamental determinants of user acceptance. These two variables influence intention to use a system, which, in turn, correlates with actual use. The model uses measurement scales for both ease of use and usefulness. TAM has been successfully applied in many fields of study and, because it has been tried and verified in numerous studies, it is likely to benefit the analysis of mobile payments, too.

TAM has been since expanded by Vekatesh et al. (2003) in their Unified Theory of Acceptance and Use of Technology (UTAUT). The new model integrates eight of the most established acceptance models, including TAM. Although it has already been validated in previous studies, UTAUT does not seem to be easily adapted to mobile payments. The model is best used to measure technology acceptance in companies. Two of its six variables rely heavily on the technology being introduced in an organization. Some of the criteria suggested to measure 'social influence' include help of the senior management, and organizational support for the new technology. 'Voluntariness of use' measures whether technology is compulsory in the job, to what extent it is required by the boss, or expected by supervisors. As mobile payments remain in the everyday life domain, the use of TAM to predict user acceptance in this field seems more appropriate.

When used in new fields of study, TAM often needs to be adapted or expanded to suit the characteristics of the specific service. According to Serenko & Bontis (2004), the major advantage of TAM is that it can be used as the basis for building acceptance frameworks in very narrow areas. It can be extended by using domain-specific constructs when used with newer technologies.

Discussion of mobile payments acceptance factors is likely to benefit from prior research in related fields of study. TAM was already used in electronic commerce by Lee et al. (2001) in their e-Commerce Adoption Model (e-CAM), as well as extended by Gefen et al. (2003). TAM was also adapted to mobile services as

Compass Acceptance Model (CAM) by Amberg et al. (2003). Furthermore, it was applied to mobile portals by Serenko & Bontis (2004). To explain the adoption of mobile parking, Pedersen (2003) used the Theory of Planned Behavior (TPB) along with TAM. On each occasion, new categories were proposed to suit the particular field, but the two original dimensions, ease of use and usefulness, were not questioned.

M-payment is yet another phenomenon, hence the model needs to be adapted again to suit its characteristics. Dahlberg et al. (2003) suggest one new category to be used in analysis of mobile payments adoption. The view proposed here however is that to suit mobile payments, TAM needs to be extended and customized more than just by adding one acceptance factor.

Table 1 sums up the adaptations of TAM to suit various services related to mobile payments.

Table 1. Adaptations of TAM in fields related to mobile payments

Model	Author	Application	Proposed user acceptance factors				
			<i>ease of use</i>	<i>usefulness</i>	<i>Perceived</i>		
					<i>trust</i>	<i>expressive-ness</i>	<i>others</i>
TAM	Davis	Any IS	√	√			
e-CAM	Lee et al.	Electronic commerce	√	√			<i>risk</i>
TAM	Gefen et al.	Electronic commerce	√	√	√		
CAM	Amberg et al.	Mobile services	√	√			<i>mobility, cost</i>
TAM	Serenko & Bontis	Mobile portals	√	√	√	√	<i>value</i>
TAM/TPB	Pedersen	Mobile parking	√	√		√	<i>enjoyment</i>
Trust-enhanced TAM	Dahlberg et al.	Mobile payments	√	√	√		

This study will draw from the previous TAM applications to identify user acceptance factors in mobile payments. The factors presented in Table 1 will be analysed for their suitability to mobile payments. Defining acceptance factors however is only the beginning of the TAM process. The next step involves developing multi-item scales to measure the factors. Various services may require different individual criteria to measure each factor, hence the need for a customized set of indicators for m-payments. Dahlberg et al. (2003) have already linked TAM with mobile payments; however, the use of TAM was to group the findings from their focus group interviews into categories (ease of use, usefulness, and trust). Specific criteria, and the way to measure m-payments acceptance with TAM have not been proposed yet. Consequently, after the acceptance factors are identified, this paper will proceed to complete the next stage of the TAM process, and propose specific indicators for each factor.

Alberg et al. (2004) divide the use of their acceptance model into four steps:

- Adaptation of structure to the specific characteristics of the service
- Design of acceptance criteria
- Analysis and evaluation using a survey
- Visualization of evaluation results

This study focuses on the first two steps, as well as presents an example of possible visualization of results. Further research will require use of a survey to perform analysis and evaluation.

4. METHODOLOGY

The initial literature review focused on acceptance models used in fields related to mobile payments. Based on those models, as well as existing research and industry literature, customer acceptance factors in mobile payments were identified. Subsequently, specific criteria measuring each of the factors were devised using:

- the authors' previous research which identified the features used to classify m-payments from the customer's point of view;
- adaptation of some criteria used in the related studies (these studies are listed in Table 1);
- analysis of features of other payment systems, including credit cards, cash, and cheques;
- the results of some empirical studies on customers' preferences in mobile payments (Dahlberg et al., 2003; Pousttchi, 2003).

5. PROPOSED MOBILE PAYMENTS ACCEPTANCE FACTORS

5.1 Perceived Ease of Use

Davis (1989) defines 'perceived ease of use' as the degree to which the user believes that using a system would be free of effort. Numerous empirical studies have already validated TAM, and proved the relationship between ease of use and user acceptance in various fields. Studies of mobile payments also suggest that ease of use is an important success factor. In Pousttchi's (2003) study on conditions for acceptance of m-payment procedures, 93% of the respondents found easy handling important, and 81% indicated that the ease of learning about a system is important. According to Dahlberg et al. (2003), in their focus group interviews issues related to ease of use were frequently brought up. It is therefore assumed that when consumers perceive an m-payment procedure as easy to use, they will be more likely to accept it.

5.2 Perceived Usefulness

According to Davis (1989), 'perceived usefulness' is the degree to which the user believes that using a system would enhance their job performance. 'Job' can be replaced with 'everyday life' in regards to m-payments. As with ease of use, the influence of usefulness on user acceptance has also been extensively validated in various studies of TAM. It is important that a mobile payment system offers the user numerous benefits. For example, in Pousttchi's (2003) study, 91% of the respondents found fast processing important. A faster way to pay therefore is one possible benefit. Systems may increase the effectiveness and efficiency of the user's life by offering many applications, including paying for digital content, Point of Sale (POS) payments, virtual POS, vending machines, topping up pre-paid mobile accounts, or person-to-person payments. Useful systems will also be widely available, will allow various kinds of payments, and offer additional benefits such as localization or loyalty schemes.

5.3 Perceived Cost

'Perceived cost' was proposed by Amberg et al. (2003) in their analysis of mobile services acceptance. It seems to be an important predictor of use of m-payments, too. Not having to purchase a new mobile phone was rated as 'very important' or 'important' by 83% of respondents in Pousttchi's (2003) survey. In the same study, only 8.5% of the respondents were willing to accept more than €5 as a yearly fee. Only one third of respondents accepted the use with a transaction fee of €0.10. 'Perceived cost' category can also include non-monetary costs such as health hazards. Some health risks that may be believed to result from mobile phones use include microwave radiation thermal effects, and the greater risk of accidents while driving and using a mobile phone (Maier et al., 2000).

5.4 Perceived Mobility

Mobility is a category proposed by Amberg et al. (2003) that is specific to mobile services. Mobility is also a unique feature of mobile payments comparing to other types of payments. This factor may not be satisfied if there are not enough network coverage areas, the device discharges too fast, or there is not enough operators offering the service. Furthermore, Krueger (2001) predicts a demand for 'payment roaming', and the pressure from users for co-operative solutions. Such payment roaming includes both the user wanting to make

payments while travelling outside of their network coverage, or to make payments to other networks' customers. Buhan et al. (2002) point out that the good solutions will be able to interact with other solutions to create a global payment network. Perceived mobility therefore is proposed as another factor that makes users accept the system.

5.5 Perceived Trust

Trust was introduced as another construct of TAM by Gefen et al. (2003) in their study of e-commerce adoption. As with any payment system, trust is of high importance in mobile payments. In Pousttchi's (2003) study, 96% of the respondents indicated that confidentiality of data is important to them. Confirmation of payment and possibility of cancellation were considered important by 89% and 86% of the participants respectively. Dahlberg et al. (2003) also enhance TAM with trust dimension, as they believe that perceived security and trustworthiness of different parties significantly affect consumers' perception of a mobile payment system. According to Egger (2001), trust in any payment system is influenced by anonymity, security, reliability, the amount of control that users have, and the reputation of the entity that introduces the system. Perceived trust, built on these criteria, is believed to be another determinant of user acceptance in mobile payments.

5.6 Perceived Expressiveness

Expressiveness refers to ability to express individuals' emotions or identity. This dimension was proposed in the mobile parking (Pedersen, 2003), and mobile portals (Serenko & Bontis, 2004) acceptance models. Some systems let the user express who they are. They express the consumer's identity both in social networks and to oneself. This category seems important in the analysis of mobile payments because of the nature of mobile phones. They often allow the owner to express their personality with various designs, tones, and other customisable features. What is more, as Leung and Wei (2000) point out, fashion and status often serve as a gratification of a mobile phone use.

5.7 Dimensions Not Included in the Model

There are three more dimensions that have been included in the user acceptance models in the related fields: 'perceived value', 'perceived enjoyment', and 'perceived risk' (see Table 1). These factors are not believed to greatly influence the user adoption of m-payment systems.

Enjoyment is considered instrumental of services primarily designed for entertainment (Leaung and Wai, 2000), which does not apply to mobile payments. Mobile payments are not likely to be performed just for the sake of doing it. Enjoyment can instead be included as one criterion measuring ease of use.

The inclusion of 'perceived value' by Serenko & Bontis (2004) in their mobile portals analysis was justified by the fact that mobile portals always involve the user paying for airtime, and so there must be enough value gained from it. Costs are not so obvious in mobile payments, and perceived usefulness seems to provide enough value. Perceived value would parallel perceived usefulness so its use as a new acceptance factor is not justified.

Criteria that deal with 'perceived risk', such as health hazards or loss of privacy, are already included in 'perceived trust' and 'perceived cost' dimensions, and therefore there is no need for a separate category.

5.8 Acceptance Factors Representation

After the level of satisfaction of acceptance factors is measured for a specific system, the results can be represented as in the fictitious example in Table 2. Such visualization of the results would depict which areas are strengths of the new payment solution, and which need to be improved. The higher the bars, the more likely it is that consumers will accept the system.

Table 2. Example of representation of acceptance factors fulfilment in an m-payment system

Satisfaction of acceptance condition	<i>Ease of use</i>	<i>Usefulness</i>	<i>Cost</i>	<i>Mobility</i>	<i>Trust</i>	<i>Expressiveness</i>
↑ <i>Satisfied</i>						
<i>Neutral</i>						
<i>Not satisfied</i>						

6. MEASURING CRITERIA FOR THE ACCEPTANCE FACTORS

The preceding section identified the factors affecting the acceptance of m-payment systems. If the conditions are fulfilled, users are likely to accept the new system. However, an obvious question arises: how to measure the abovementioned factors? How can we know that the system satisfies the ease of use, usefulness, cost, mobility, security, and expressiveness conditions? In his TAM study, Davis (1989) proposed using separate measuring indicators for each factor. These measuring criteria are specific features of the system that make the system easy to use, useful or secure, for example. Different services may need to have their own criteria invented. A set of criteria to measure the factors proposed in the preceding section is attempted next.

Some criteria, such as ease of set up, can be adapted from other fields. Others will need to be highly specific to mobile payments. Network reliability is one example of such a new criterion. The extent to which the network offering payments is available is likely to influence the adoption of a payment system.

The scale must also be decided upon at this stage. Davis's (1989) original measurement scales for perceived usefulness and perceived ease of use included seven levels, ranging from 'extremely likely' to 'extremely unlikely'. In his mobile parking study, Pedersen (2003) also had the subjects indicating their agreement using seven-point scales, ranging from 'strongly disagree' to 'strongly agree'. The same seven-point scale was used by Serenko & Bontis (2004) in their mobile portals survey, and by Lee et al. (2003) in the distance learning TAM survey. The proposed model will follow the convention since it has been validated in previous studies.

Table 3 presents criteria that can be used to measure the user acceptance factors in m-payment systems.

Table 3. Criteria measuring acceptance factors in mobile payments

		<i>Strongly Agree</i>	<i>Neutral</i>	<i>Strongly Disagree</i>
		+3	0	-3
PERCEIVED EASE OF USE	It is easy to register for the system	○ ○ ○ ○ ○ ○ ○ ○		
	It is easy to set up the system	○ ○ ○ ○ ○ ○ ○ ○		
	It is easy to start the transaction	○ ○ ○ ○ ○ ○ ○ ○		
	It is easy to receive the transaction details	○ ○ ○ ○ ○ ○ ○ ○		
	There are few steps required to complete the transaction	○ ○ ○ ○ ○ ○ ○ ○		
	The screen size is appropriate to make payments	○ ○ ○ ○ ○ ○ ○ ○		
	Documentation or instructions are helpful and clear	○ ○ ○ ○ ○ ○ ○ ○		
	Customer service is easily available	○ ○ ○ ○ ○ ○ ○ ○		
	I enjoy using the system	○ ○ ○ ○ ○ ○ ○ ○		
PERCEIVED USEFULNESS	There are a high number of available applications	○ ○ ○ ○ ○ ○ ○ ○		
	The number of accepting points is high	○ ○ ○ ○ ○ ○ ○ ○		
	Transaction time is shorter than other types of payment	○ ○ ○ ○ ○ ○ ○ ○		
	The range of payment values available is adequate	○ ○ ○ ○ ○ ○ ○ ○		
	Loyalty scheme is rewarding	○ ○ ○ ○ ○ ○ ○ ○		
	There is new value added (e.g. no queues or changing money)	○ ○ ○ ○ ○ ○ ○ ○		
	Services offered change with location	○ ○ ○ ○ ○ ○ ○ ○		

PERCEIVED COST	The cost of upgrading a device is adequate	O O O O O O O O
	The registration fee is adequate	O O O O O O O O
	The transaction cost is adequate	O O O O O O O O
	There are no health hazards while using this system	O O O O O O O O
PERCEIVED MOBILITY	Many mobile operators offer this system	O O O O O O O O
	Roaming services within this system are adequate	O O O O O O O O
	I can carry the payment device with me all the time	O O O O O O O O
	The device is constantly available	O O O O O O O O
	The network is constantly available	O O O O O O O O
PERCEIVED TRUST	The system provider is trustworthy	O O O O O O O O
	Transactions can be easily refunded	O O O O O O O O
	Errors can be easily reversed	O O O O O O O O
	I believe that data sent is confidential	O O O O O O O O
	I get immediate confirmation of the transaction	O O O O O O O O
	Nobody else could accept the transaction as me	O O O O O O O O
	I have no privacy concerns using the system	O O O O O O O O
	It is easy to recover from theft or loss of the device	O O O O O O O O
Past transactions record can be easily accessed	O O O O O O O O	
PERCEIVED EXPRESSIVENESS	I can personalize the system	O O O O O O O O
	Using this system improves social interaction	O O O O O O O O
	Using this system gives me status	O O O O O O O O
	It is fashionable to use the payment system	O O O O O O O O

7. FURTHER RESEARCH

The authors intend to assess the measuring criteria in a pilot study. After this step a subsequently reworded or improved survey based on the feedback gathered will be administered to further validate the model. It is also important to note that not all of the criteria matter equally to the user. Consumers may be willing to accept non-fulfilment of some criteria, but reject the system based on lack of even one specific feature. Empirical research, where the criteria will be rated on their importance, will reveal which of the indicators matter most to consumers. The weighting will then be assigned to each criterion. The final step will involve devising benchmarks to be able to specify to what extent each of the six factors is fulfilled, based on participants' responses. Finally, the results for various systems can be visualized using the example presented in Table 2. All the steps outlined in this section involve empirical studies.

8. CONCLUSIONS

TAM is seen as a suitable user acceptance model to analyse m-payments adoption, however it needs to be expanded and customized to address their specific characteristics. Perceived ease of use, usefulness, mobility, cost, trust, and expressiveness have been proposed as the main user acceptance factors. Multi-item scales to measure each of these factors have been proposed, which now need to be validated in empirical study.

The advantage of this research is that its focus is on the user, who is the key to acceptance of a new system. Furthermore, it is based on TAM, which has been validated in numerous studies. It also takes into consideration unique characteristics of mobile payments, such as mobility or expressiveness, to expand TAM. The measuring criteria have been designed specifically for this narrow field of study.

Such user acceptance models can be used by system providers to predict the adoption of their new solutions. In the design stage such evaluations can be used to identify and address user requirements, and therefore shape a new system. Systems already deployed may be improved. Information gathered in the survey can be used to better understand users' preferences, and the reasons for lack of acceptance of some m-payment systems. The scales will not only indicate which of the factors are fulfilled overall, but analysis of responses to each criterion may be useful to identify very specific areas of improvement. Moreover, it enables meaningful comparisons of various systems.

The limitation of TAM in general is that it is best used with existing systems. The questionnaire concerns users' opinions about their use of a payment procedure, which calls for some experience with the system. This limitation can be overcome by use of prototypes. In Davis's study (1989), the participants were given one hour of hands-on experience with a new system. The model therefore can be applied in various stages of the system life cycle. Forthcoming empirical study will help improve and validate the mobile payment acceptance model proposed in this paper.

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