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Abstract. Consumer adoption of smart phones is growing globally at an exponential rate presenting significant commercial opportunities for all organizations. The percentage of the population using mobile phones in Ireland is the largest in Europe, with market revenue of €2 billion in 2009, and 117.3 percent penetration. However, the commercial growth potential of smart phones is being hindered by an industry failure to adopt an accepted m-payment model to facilitate the widespread adoption of m-payments. Furthermore, previous research has shown there is a lack of a willingness among consumers to make m-payments. However, little is known about consumers' perceptions of m-payments using a smart phone or what factors impact upon these perceptions. In response, this paper develops a theoretical smart phone m-payment model, and applies it using an online survey, to explore Irish consumers' perceptions of making an m-payments for products/ services using their smart phones. The empirical findings of the developed PLS model, illustrate that respondents display a strong willingness to transact using m-commerce but trust is the key factor in explaining consumer's willingness to make an m-payment for products/ services using their smart phones. Another significant finding for m-payment companies is that respondents considered using a secure and trusted third-party payment company as the preferred method of making an m-payment for products/ services. Significant levels of concern regarding perceived privacy control, together with the authority and independence of regulatory bodies and the robustness of the legislative frameworks governing m-commerce, were also very evident from the empirical findings.

Keywords: Smart phones, m-payment adoption, trust, consumer perceptions

[1]All authors contributed equally to this paper.

1 Introduction

Smart phones have developed and evolved to incorporate multiple applications and wide ranging functionality, including SMS, MMS, mobile web, GPS navigation, photo, and video camera. Such functionality is an enabler of a wide range of commercial products and services. Indeed, the notion that smart phones could become valuable and critical business tools for the delivery of electronic products and services has long been touted by academics, professionals, and the media (Bauer et al. 2005; Gao and Küpper 2006; Hsu and Kulviwat 2006; Leppäniemi and Karjaluoto 2005; Varshney and Vetter 2002). From a commercial perspective, smart phone strategies are being adopted by major global organizations, and these organizations are eager to explore the personal, interactive, and ubiquitous features of smart phones to increase the effectiveness of their service provision and product commercialization beyond the use of traditional media channels. Furthermore, the growth of smart phones is phenomenal with global shipments of smart phones growing 50 percent each year, reaching 54 million units in the first quarter of 2010 (Evans 2010). The percentage of the population using mobile phones in Ireland is the largest in Europe, with market revenue of €2 billion in 2009, and 117.3 percent penetration based on a population of 4,459,300 people (ComReg 2009). In 2010, one out of every two mobile phones sold in Ireland were smart phones (Vodafone Ireland 2010).

However, the realization of the remarkable commercial potential of smart phones is contingent on consumer willingness to employ these devices for transactional tasks, such as bookings, ticketing tasks, accessing GPS services, and gathering information on and purchasing products/services. Inherently, these tasks require a secure, efficient and reliable m-payment system. An m-payment may be defined, in the context of this paper, as any electronic payment where a smart phone is used to initiate, authorize, and confirm exchange of financial value in return for products and services.

While growth forecasts for m-payment services have been very positive, the reality is quite different with a study by the Gartner Group illustrating that in 2008, only 1 percent of all mobile phone users had used m-payment services. This observation leads to the question of why consumers have not adopted m-payments. Mallat (2007) notes that there is considerable evidence that users perceive significant risks and uncertainty in transacting with Internet vendors through computers, an issue yet to be explored in relation to smart phones. McKnight et al. (2003) argue this issue is compounded by extensive media coverage about privacy, security, and fraud on the Internet. While such research issues have been examined in the realm of computers, they are yet to be explored for smart phones.

The absence of standardized, interconnected, and widely accepted payment procedures, crucial for the successful diffusion of m-payments, is also a significant growth inhibitor of the commercialization of smart phones (Zhong 2009). This may be a consequence of the significant number of potential stakeholders and vested interests in the area of m-payments including banks, mobile network operators, credit card companies, and third-party payment companies, which all have proposed various models aimed at streamlining the m-payment market. Essentially, these proposed

m-payment models center on (1) mobile network operator led, (2) bank and financial institution led, and (3) third-party led models, or numerous variations/combinations of these (Turner 2009). Despite these efforts, an accepted m-payment model to facilitate the widespread adoption of m-payments has not been adopted. Consumers will play a key role in determining the "winning" model as without consumer buy-in, any proposed m-payment model will not succeed.

While extant research (Matthews et al. 2009) illustrates that most users utilize the phone, SMS, MMS, and Internet services of the mobile phone, little is known about consumers' perceptions of m-payment using a smart phone or what factors impact their perceptions. Therefore, gaining insight into consumers' perceptions of m-payments using a smart phone is crucial as, within the extant literature, there remains a lack of insight into consumers' perceptions of m-payments. It is the objective of this paper to begin to bridge this gap in understanding by developing and applying a theoretical smart phone m-payment model to explore Irish consumers' perceptions of making a m-payments for products/services using their smart phones. The smart phone m-payment model is applied using an online survey hosted on www.SurveyMonkey.com, an online subscription based surveying tool. The target population of Irish mobile phone users were informed of this survey by email and through a private Irish mobile phone users' discussion group on www.Boards.ie. This paper also answers the call for research by Dahlberg et al. (2008, p. 178), who state

> Yet, we believe that more theory based empirical research is needed to enhance the current understanding of the m-payment services markets....to improve the quality and relevance of m-payment research, we also recommend that researchers collect more empirical data backed by guiding theories.

2 Conceptualization of Consumers Perceptions of M-Payment

Consumers' lack of willingness to make an m-payment is a significant barrier to m-payment adoption, and it is very much influenced by their assessment of the risk involved (Mallat 2007). Viehland and Leong (2007) state that in order for m-payments to succeed, they must be secure (consumer perception), convenient, and easy to use. Therefore, perceived payment reliability—a consumer's perception of the reliability of making an m-payment using a smart phone—and ease of use are important issues if smart phones are to realize their true commercial potential. Thus far, m-payment services have failed to entice consumers and several m-payment companies and initiatives in the EU have failed or have been abandoned (Mallat 2007; Dahlberg and Oorni 2007). With many and varied payment models proposed (Turner 2009), gaining an understanding of consumers' perceptions of making m-payments using smart phones is thus required in order to develop m-payment services successfully (Dahlberg and Oorni 2007).

In order to develop a model to explain consumers' willingness to make m-payments using smart phones, literature in the areas of trust and consumer behavior (including the theory of planned behavior, decision theory, and the theory of reasoned

action) were reviewed. Several studies (Chen and Barnes 2007; Gefen et al. 2003; Jarvenpaa et al. 2000; Vewrhagen et al. 2006) have found that trust is a significant determinant influencing consumers' willingness to conduct e-commerce transactions and a key obstacle to vendors succeeding on the Internet, as a lack of trust discourages consumers making an e-commerce transaction. Similar studies (Mallat 2007; Siau et al. 2004; Xu and Gutierrez 2006) indicate that trust is also a significant determinant of consumers' willingness to make m-commerce transactions and m-payment. Trust is a significant factor for m-commerce transactions because of the spatial and temporal separation between buyers and sellers when buyers are required to provide personal and payment data to suppliers (Grabner-Kräuter and Kaluscha 2003).

In the context of e-commerce, as illustrated in Table 1, Cheung and Lee (2000) captured a significant set of trust antecedents by synthesizing the literature on consumer trust including perceived security control, perceived privacy control, and perceived integrity.

Table 1. Trust Antecedents for E-Commerce (adapted from Cheung and Lee 2000)

Trust Antecedents	***Description***
Perceived Security Control	User's perception of Internet vendor's ability in fulfilling security requirements, such as authentication, integrity, encryption, and non-repudiation.
Perceived Privacy Control	User's perception on the ability of Internet vendor's in protecting consumers' personal information collected from electronic transactions, from unauthorized use or disclosure.
Perceived Integrity	Refers to the perception of Internet users on the honesty of Internet vendors. For instance, whether it has consistent actions, whether its' actions are congruent with its own words and whether its transactions are fair.

Similar trust antecedents emerge from the literature on m-commerce. Shortcomings in security and privacy controls reduce people's trust in m-payment systems and hinder the emergence of these systems (Chou et al. 2004). Consumers' concerns about the privacy and security of m-payments as they relate to authentication and confidentiality, and privacy and ethical issues relating to concerns about third-party use and unauthorized access to payments and user data (Dewan and Chen 2005), are notable in previous research. Thus, consumer trust in legal frameworks and independent regulatory bodies to protect and regulate their transactions and data, are also essential to reduce consumers perceived risks of m-commerce and making an m-payment (Cleff 2007). Regulation of data protection often clashes with commercial practices to maximize m-commerce activities via mobile technologies (Cleff 2007). Critically, Mallat (2007) found that trust in merchants and in m-payment and mobile network service providers was essential to encourage consumers to engage in m-commerce transactions and to reduce consumers perceived risks of m-payments. Trust has a positive impact on consumer loyalty and satisfaction towards m-commerce (Lin and Wang 2006) and it is, therefore, a critical component of any model seeking to explain consumers' willingness to transact in an m-commerce environment and to make an m-payment.

Reviewing these trust antecedents as they relate to consumers' willingness to engage in electronic commercial transactions and willingness to perform an m-payment, results in the identification of several trust measures, presented in Table 2, and the generation of two specific hypotheses:

Hypothesis 1a: Consumer trust in the ethical, privacy, and data protection controls of service providers, and perception that the legal and regulatory frameworks are sufficiently robust and independent, positively impact consumers' willingness to engage in m-commerce transactions using a smart phone.

Hypothesis 1b: Consumer trust in the ethical, privacy, and data protection controls of service providers, and perception that the legal and regulatory frameworks are sufficiently robust and independent, positively impacts upon consumers' willingness to make m-payments using a smart phone.

Table 2. Trust Measures Utilized for this Study

Element	***Literature***
Legal Frameworks: The perception by consumers that the legal frameworks governing transactions and payments using smart phones are sufficiently robust to protect consumers.	Cleff 2007; Johanssen 2003
Ethical Commitment: Consumers perception that service providers act ethically when capturing, retaining, processing, and managing my personal data.	Mallet 2007; McKnight et al. 2003; Chou et al. 2004; Dewan and Chen 2005; Johanssen 2003
Providers Perspectives on Consumer Privacy: Consumers perceptions that service providers are concerned with consumers' privacy.	Mallet 2007; McKnight et al. 2003; Chou et al. 2004; Dewan and Chen 2005; Johanssen 2003
Privacy Controls of Service Providers: Consumers confidence in the privacy controls of Service Providers.	Mallet 2007; McKnight et al. 2003; Chou et al. 2004; Dewan and Chen 2005; Johanssen 2003
Transfer of Consumer Data to Third Parties: Consumers beliefs that service providers will not divulge consumers' personal data to third parties.	Mallet 2007; McKnight et al. 2003; Johanssen 2003
Power of Regulatory Bodies: Consumers perceptions that regulatory bodies for service provision are sufficiently authoritative to regulate smart phone Service Providers.	Clef 2007; Johanssen 2003
Independence of Regulatory Bodies: Consumers perceptions that the regulatory bodies for service provision are sufficiently independent to regulate smart phone service providers.	Clef 2007; Johanssen 2003

Kim and Zhang (2009) state that an individual's rationale for adopting smart phone services is under-investigated in the extant literature. Indeed, Kim and Zhang note that there can be numerous factors influencing people's adoption of smart phone services. The technology acceptance model (TAM) proposed by Davis (1989) has been a widely cited model for predicting and explaining user behavior and IT usage through focusing on perceived usefulness and perceived ease of use. Perceived usefulness refers to one's tendency of using or not using an application to the extent that the person believes it will help them perform their tasks better (Davis 1989) Perceived ease of use is defined "as the degree to which a prospective user expects the target system to be free of effort" (Davis 1989, p. 321). Extant research has illustrated that perceived ease of use has a direct effect on perceived usefulness, and that both determine the consumer's attitude toward use (Viehland and Leong 2007).

TAM has previously been utilized to explore m-payments. Viehland and Leong (2007) examined perceived usefulness and perceived ease of use on consumers' willingness to use m-payment services for retail point-of-sale payments. Given the technical limitations of mobile devices, ease of use becomes an imminent acceptance driver of mobile applications. Schierz et al. (2010) note that this is especially true for m-payment services, which compete with established payment solutions and thus need to provide benefits when it comes to ease of use. Therefore, one of the main reasons for the slow diffusion of m-payments, in particular, could be a failure in understanding the perception among consumers of the ease of use of m-payments using smart phones.

Utilizing the logic inherent in extant research on TAM (Davis 1989; Venkatesh and Davis 1996), a system must be both easy to learn and easy to use. Applying this logic to smart phones, we hypothesize that the perceived ease of use of smart phones in relation to (1) transaction-based services and (2) m-payments will impact upon utilization of both of these categories of services on smart phones. These concepts can be incorporated into our model in order to determine the relationships between the perceived ease of use/usefulness of smart phones and their association with consumers' willingness to transact using a smart phone and consumers' willingness to make an m-payment for products/services using a smart phone. The supporting literature upon which these are based is outlined in Table 3. This leads to the generation of two additional hypotheses:

Hypothesis 2a: The perceived ease of use of services available through smart phones positively impact consumers' willingness to engage in m-commerce transactions using smart phones.

Hypothesis 2b: The perceived ease of use of services available through smart phones positively impact consumers' willingness to make an m-payment for products/services using a smart phone.

Kim et al. (2010) note that there is a certain amount of empirical evidence in the mobile technology literature regarding users' intention to use mobile technology, with users using m-payment systems when they find the system to be useful for their transaction needs. From a commercial perspective, it would be beneficial to understand if there is an association between consumers' willingness to use smart phones for m-commerce transactions and consumers' willingness to make an m-payment for products/ services using a smart phone. This enables the generation of one final hypothesis:

Table 3. Perceived Ease of Use Measures

Element	*Literature*
Ease of Use: Consumers' perceptions of the overall ease of use of smart phones for transactional and payment purposes .	Viehland and Leong 2007; Kim and Zhang 2009; Davis 1989
Knowledge: Consumers' perceptions that the use of smart phones does not require a lot of knowledge.	Viehland and Leong 2007; Davis 1989; Kim et al. 2010
Technical Skills: Consumers' perceptions that the use of smart phones does not require a lot of technical skills.	Viehland and Leong 2007; Davis 1989

Hypothesis 3: A consumer's willingness to engage in m-commerce transactions through their smart phone will positively impact their perceptions of making smart phone m-payments.

By combining these hypotheses, we can present a smart phone m-payment model (Figure 1).

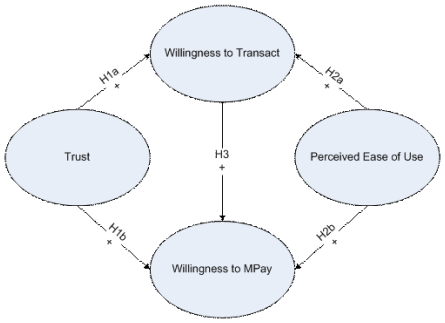

Figure 1. A Smart Phone M-Payment Model

In operationalizing the constructs in this study, indicators from the literature were adopted enabling questions to be developed for the data collection aspect of the study. These indicators and their associated questions are outlined in Appendix A, Table A1.

3 Method

3.1 Data Collection

In operationalizing the model (Figure 1), a survey instrument was developed. A number of previous studies (e.g., Verhagen et al. 2006; Davis 1989) have utilized a number of the constructs documented in this study. We adopted these reflective constructs to smart phones to generate candidate items for each construct. Manifest

variables representing these constructs were measured using a seven-point Likert scale. Once an initial iteration of the instrument documented in Appendix A was generated, as per Hair et al. (2006), we pre-tested the instrument with targeted smart phones "experts" (people who all possessed and actively utilized smart phones as part of their daily lives) in order to assess the semantic content of the items. Those items that best fit and reflect the definitions of the constructs were retained, a process that facilitated the refinement and streamlining of the items included in this survey. The next phase of this research involved posting the survey live on the web using www.SurveyMonkey.com, a subscription-based online surveying tool. The survey was posted live for a one month period in June 2010 with Irish mobile phone users specifically being targeted in order to eliminate environmental and cultural issues. Irish consumers were informed of the survey by email and through a private online mobile phone users' discussion group on www.boards.ie.

3.2 Data Analyses

Structural equation modeling, a second generation[2] model testing tool, was used for the data analysis and hypotheses testing. Choosing the partial least squares (PLS) approach, which uses component-based estimation, is appropriate since it allows simultaneous exploration of both the measurement and the structural models. In addition, the PLS approach, compared to covariance-based SEM, allows testing the relationships in the model with less restrictive requirements. Another reason of choosing PLS is that this tool is considered to be appropriate for testing theories at earlier stages of development (Fornell and Bookstein 1982). PLS model might be described from the perspective of two models (Chatelin et al. 2002; Diamantopoulos 2006; Tenenhaus et al. 2005), the measurement (outer) model, relating the measurement variables (MV) to their latent variables (LV), and the structural (inner) model, relating the LVs to each other.

4 Results

4.1 Data Statistics

A total of 82 valid responses to the survey were received. Respondents originated from 12 of Ireland's 26 counties, including the 3 most densely populated cities of Dublin, Cork, and Waterford which, when combined, accounted for 68 percent of respondents. Of the respondents, 57 percent were in the 30–50 years age bracket,

[2]The term *second generation* refers to the differentiation of classes of data analyses techniques rather than to a discrete point of time. This term has been used in IS research (and in other disciplines). For example, according to Gefen et al. (2000, p. 55), "*Second generation data analysis techniques*: Techniques enabling researchers to answer a set of interrelated research questions in a single, systematic, and comprehensive analysis by modeling the relationships among multiple independent and dependent constructs simultaneously."

while 23 percent were between 18 and 30 years of age. In all, 85 percent of respondents were employed, with student respondents only accounting for 13 percent; 68 percent of respondents were educated to third (i.e., graduate diploma, master's) and fourth level post-graduate level (i.e., post-doctorate, Ph.D.) including 11 percent at post-doctorate and Ph.D. level, while 32 percent were educated to undergraduate third level (i.e., degree, diploma, certificate). Income levels of respondents included 46 percent with an annual salary between 40,000 and 80,000 Euros, while 17 percent earned more than 80,000 Euros per year. A total of 85 percent of respondents already owned a store loyalty smart card and 76 percent had registered for electronic or paperless billing/statements.

This would indicate that the demographic attributes of a typical respondent to this survey is a person

- between the ages of 30-50 years,
- living in a large Irish city,
- educated to a post-graduate level,
- in full-time employment earning between 40,000 and 80,000 Euros per year, and
- already using smart cards and electronic billing/statements.

A total of 62 percent of respondents use the Internet for more than 2 hours per day, but 83 percent of respondents access the Internet using their mobile phone for less than 1 hour a day. In all, 90 percent of respondents talk on their phone for less than an hour per day, while 40 percent send more than 10 SMS messages per day. However, 78 percent of respondents never send an MMS from their mobile phone while 56 percent never send an email from their mobile phone. Of the respondents, 27 percent spend between 1 and 5 Euros per month on mobile phone services/applications, while 15 percent spend between 5 and 50 Euros per month.

This would indicate that the mobile technology profile of a typical respondent to this survey is a person who

- accesses the Internet via their mobile phone for less than an hour per day,
- talks on their mobile phone for less than an hour per day,
- regularly uses their mobile phone for SMS but rarely for MMS or email, and
- is currently using their mobile phone to purchase mobile services/applications.

On average, respondents indicated that they perceived smart phone services to be easy to use, and not requiring a lot of knowledge or technical skills to use. Respondents also displayed a strong willingness to transact, particularly to use smart phones for pulling information, ticketing, bookings/reservations, and using GPS functionality. Interestingly, respondents considered using a secure and trusted third-party payment company as the most preferred method of payment for products/services using their smart phone, while using their existing mobile network operator (MNO) to pay for products/services was also rated highly. Respondents displayed significant levels of concern regarding perceived privacy control and the authority and independence of regulatory bodies, and in the robustness of the legislative frameworks governing m-commerce.

4.2 Model Evaluation

Chin (1998) proposed the list of criteria to assess PLS models with reflective constructs. These criteria are highly accepted and adopted by researchers from different research fields (e.g., Gefen et al. 2000; Henseler et al. 2009; Tenenhaus et al. 2005). The evaluation process of the PLS path model results involves two steps. Step 1 necessitates the testing of the quality of the measurement (outer) models. As Step 1 was successful and latent constructs were found reliable and valid, Step 2, which necessitates the assessment of the structural (inner) model, was conducted (Henseler 2009). SmartPLS 2.0 M3 was employed for the PLS model assessment.

4.2.1 Assessment of Measurement Models

Reliability. The first criterion of assessment of measurement models is reliability, which is traditionally tested by internal consistency reliability and indicator reliability. Internal consistency reliability might be tested either by Cronbach's α, which indicates an estimation for the reliability assuming that all items are equally reliable, or by composite reliability, where different item loadings are taken into account. Although these two reliability measures differ, either of them may be used. As can be seen in Table 4, both parameters have high values (all values are above 0.91), while the requirement value should be above 0.7 at the earlier stage of the research and above 0.8–0.9 in the advanced stages (Henseler et al. 2005).

Table 4. Internal Consistency Reliability Test

Construct	***Composite***	***Cronbach's***
Per Ease of Use	0.9451	0.9127
Trust	0.9558	0.9461
Willingness to MPay	0.9665	0.9535
Willingness to Transact	0.9528	0.9341

Individual reliability of the indicators relies on the expectation that latent variable variance should explain at least 50 percent of the indicator. In other words, loadings of manifest variables should be not less than 0.707 (Chin 1998; Gefen et al. 2000; Henseler et al. 2009).

Figure 2 demonstrates that magnitude of all indicators is higher than required the 0.707, with the lowest value of 0.807. Based on the two tests, we can conclude that all indicators are reliable.

Validity. The convergent validity and the discriminant validity are employed to examine the validity of four reflective constructs. The first column in Table 5 shows that the average variance extracted (AVE) for all constructs is higher than 0.5, which indicates sufficient convergent validity and means that each latent variable explains more than 50 percent of their indicator variance on average. Discriminant validity

refers to the appropriate patterns of inter indicators of a construct and other constructs. First, variance of a construct should be assigned more with their own indicators than with other constructs. For this purpose, construct cross-correlation and the square root of each construct's AVE were compared. As can be seen in Table 5, all constructs have sufficient discriminant validity since the square root of each latent construct's AVE (values on the diagonal) is much larger than the correlation of the specific construct with any other reflective constructs in our research model. We also tested discriminant validity with cross-loading test. Results of the test presented in Table 6 demonstrate that an indicator of any specific construct has higher loading on its own construct than on any other constructs. The results of the tests show that manifest variables (indicators) presented in the research model are reliable and valid.

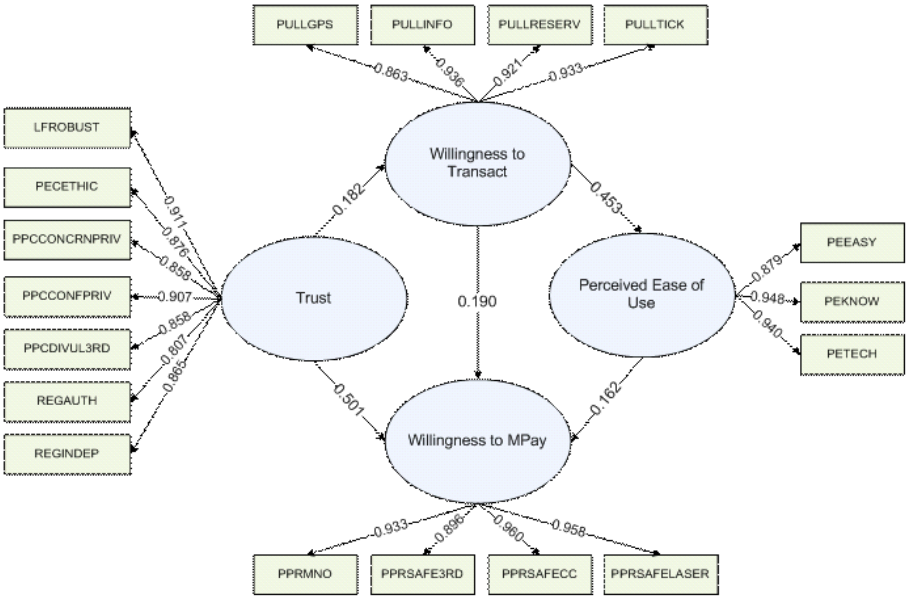

Figure 2. PLS Results of Measurement and Structural Models

Table 5. Construct Cross-Correlation Matrix and AVE Analyses

AVE	*Construct*	*Per Ease*	*Trust*	*Wil to*	*Wil to*
0.8517	Perceived Ease of Use	**0.9229**			
0.7558	Trust	0.3324	**0.8694**		
0.8782	Willingness to MPay	0.4261	0.6183	**0.9371**	
0.8348	Willingness to Transact	0.5138	0.3323	0.4398	**0.9137**

Table 6. Cross Loadings

Construct	*Items*	*Per Ease of*	*Trust*	*Wil to*	*Wil to*
Perceived Ease of Use	PEEASY	**0.8793**	0.285	0.4119	0.526
	PEKNOW	**0.9483**	0.302	0.394	0.4378
	PETECH	**0.9395**	0.334	0.3676	0.4475
Trust	LFROBUST	0.2838	**0.9109**	0.5394	0.2823
	PECETHIC	0.3189	**0.876**	0.5498	0.2636
	PPCCONCRNPRIV	0.2924	**0.858**	0.6147	0.2985
	PPCCONFPRIV	0.3241	**0.907**	0.6264	0.3461
	PPCDIVUL3RD	0.3549	**0.8576**	0.5137	0.2067
	REGAUTH	0.2079	**0.8072**	0.3921	0.2705
	REGINDEP	0.2246	**0.8646**	0.4741	0.3395
Willingness to MPay	PPRMNO	0.414	0.6083	**0.9332**	0.3931
	PPRSAFE3RD	0.3431	0.5043	**0.8958**	0.4294
	PPRSAFECC	0.4564	0.5969	**0.9602**	0.4312
	PPRSAFELASER	0.3766	0.6013	**0.9578**	0.3981
Willingness to Transact	PULLGPS	0.4215	0.2262	0.258	**0.8628**
	PULLINFO	0.5481	0.3255	0.4232	**0.936**
	PULLRESERV	0.4779	0.2846	0.4085	**0.9214**
	PULLTICK	0.4203	0.36	0.4843	**0.9326**

4.2.2 Assessment of the Structural Model

In assessing the explanatory and predictive power of the structural model, we employed a number of recommendations (Andreev et al. 2009; Chatelin et al. 2002; Chin 1998; Gefen et al. 2000; Henseler et al. 2005).

Explanatory Power. An overview of the structural model evaluation results is presented in Figure 3. The complete evaluation, containing both structural and measurement models, can be seen in Figure 2.

The central criterion for evaluating the structural model is the level of explained variance of the dependent construct *Willingness to MPay*, for which the R-square was 0.463. Thus, the model explained 46.3 percent of the construct's variance. The variance of the construct was explained at the moderate level according to Chin's (1998) criteria. R^2 values of 0.67, 0.33, or 0.19 for endogenous latent variables are described as substantial, moderate, or weak (Chin 1988, p. 323). The *Willingness to Transact* was explained at 29.3 percent by *Trust* and *Perceived Ease of Use*.

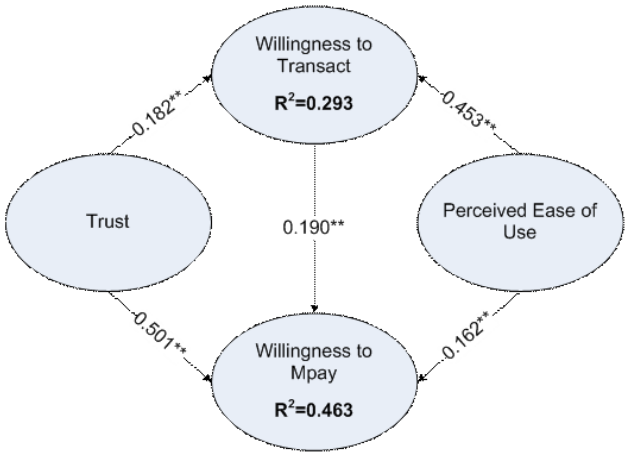

Figure 3. Evaluation of Structural Model

Changes in R-square were explored to investigate the substantive impact of each independent construct on the dependent constructs, carrying out the effect size technique by rerunning three PLS estimations, excluding in each run one of the explaining latent constructs. PLS estimations of each model can be found in Appendix B.

Chin (1998) proposed using the effect size f^2 of PLS constructs, which is similar to Cohen's implementation for multiple regression and might be small ($f^2 = 0.02$), medium ($f^2 = 0.15$), or large ($f^2 = 0.35$).

Table 7. Effect Size Test

Construct	*R^2excl*	*R^2incl*	*f^2*	*Effect*
Perceived Ease of Use	0.446	0.463	0.03	small
Trust	0.248	0.463	0.40	large
Willingness to Transact	0.439	0.463	0.04	small

The results of the effect size test presented in Table 7 show that while *Perceived Ease of Use* and *Willingness to Transact* have small effects (with f^2's equal to 0.03 and 0.04, respectively), *Trust* has a large effect with magnitude of $f^2 = 0.4$.

Predictive power. The statistical significance of the path coefficients was tested by employing the bootstrapping re-sampling technique, using the SmartPLS software, with the graphical output for the structural model evaluation presented in in Appendix A, Figure A1. All path coefficients were found to be highly significant.

Willingness to MPay, as expected, was found to be positively affected by *Trust* (H1b supported with β = -0.637 and $p < 0.001$), *Willingness to Transact* (H3 supported with and $p < 0.001$), and *Perceived Ease of Use* (H2b supported with β = -0.193 and $p < 0.001$).

Willingness to Transact was found to be positively affected by *Trust* (H1a supported with β = -0.637 and p < 0.001), and *Perceived Ease of Use* (H2a supported with β = -0.193 and p < 0.001).

Our analysis revealed that all hypotheses were supported. For the evaluation of the *predictive relevance* of the structural model, the Stone and Geisser Q^2 test was performed using the blindfolding procedure, for which Chin (1998) stated that Q^2 reflects an index of goodness of reconstruction by model and parameter estimations. A positive Q^2 provides evidence that the omitted observations were well-reconstructed and that predictive relevance is achieved, while a negative Q^2 reflects absence of predictive relevance. As can be seen in Table 8, all values of Q^2 were greater than zero, indicating predictive relevance for the endogenous constructs of the research model.

Table 8. Blindfolding Test for Predictive Relevance

Construct	ΣSO	ΣSE	Q^2
Willingness to MPay	324	43.7389	0.865
Willingness to Transact	324	63.1417	0.8051

5 Discussion and Conclusions

Consumers' perceptions of using smart phones for m-transactions and m-payments is of scientific and practical interest. Smart phones present organizations with a vast potential for commercial opportunities. For commercial organizations, an understanding of consumer's perceptions of smart phones is of paramount importance. Yet, in an academic context, the extant literature is still immature. This paper, by exploring consumer's willingness to m-pay using smart phones, makes a number of contributions, which are of value to researchers and practitioners alike. A smart phone m-payment model is developed from a thorough analysis of the literature from a variety of fields including trust, consumer behavior (incorporating the theory of planned behavior, decision theory, and the theory of reasoned action).

Extant literature (Malat 2007; Viehland and Leong 2007) illustrates that users perceive significant risks associated with m-payment. Indeed, Mallat (2007) noted that consumer's unwillingness to make (conduct) m-payments is the greatest barrier to further adoption of this phenomenon. Extant literature (e.g., Viehland and Leong 2007) states that consumer's willingness to make an m-payment using a smart phone is an issue impacted by perceived ease of use and trust. However, both factors are treated the same in the extant literature with no differentiation being made between these factors in relation to their impact upon consumer's willingness to use m-payment. In explaining consumer's willingness to use smart phones for m-payment, this study presents a conceptual framework and provides empirical evidence that trust, willingness to transact, and perceived ease of use are key factors in explaining consumer's willingness to make an m-payment, with trust having the largest explanatory power.

Perceived ease of use has widely been documented in the literature (Venkatesh and Davis 1996) as having a key influence on the adoption and use of new technologies. However, the findings of this study, illustrate that while causation exists between perceived ease of use and willingness to make an m-payment, the association is relatively weak. This illustrates that perceived ease of use of the technology is not a key determinant of consumers' willingness to make an m-payment using a smart phone. Therefore, this study contradicts the findings of Schierz et al. (2010) and illustrates that although perceived ease of use is important, it is not actually a key factor in explaining the slow diffusion of m-payments using smart phones. However, respondents did have a high level of education, which may also be a factor in determining their perceptions of the ease of use of smart phone services. However, perceived ease of use is a key determinant in explaining a consumer's willingness to utilize smart phones for transactional tasks, such as bookings, ticketing, accessing GPS services, and pulling information on products/services. In interpreting these findings and trying to understand why perceived ease of use is a key determinant of a consumer's willingness to transact but yet has much less of an influence on consumer's willingness to make an m-payment, a possible explanation may be the current state of diffusion of the respective services, with consumers being much more familiar with, and having greater access to, transaction-based services. Furthermore, the findings illustrate that willingness to transact via a smart phone is a limited predictor of willingness to make an m-payment.

The findings of this study present conclusive evidence of the association between trust and consumer's willingness to make an m-payment using a smart phone. By exploring trust in detail, our analysis illustrates that consumer's perceptions of legal frameworks and the regulation of these frameworks are integral parts of trust. Analysis also revealed that consumer's perceptions of the privacy controls employed by smart phone service providers is a critical element of trust. This analysis would be of interest to practice.

In order to increase consumer's willingness to make an m-payment using smart phones, commercial entities need to communicate to consumers that they implement policies and utilize the latest technologies to protect the privacy and data of consumers. For government and commercial entities who wish to develop an m-payment culture, the implications of our findings are that a key step in getting consumers to utilize m-payment is to ensure that adequate legal frameworks are in place. Furthermore, the belief among consumers that regulatory bodies have sufficient powers to take actions against service providers who do not adhere to such frameworks is a key issue in building trust among consumers in order to get them to make m-payments using smart phones. Presently, among Irish consumers at least, this is not the case, with our findings illustrating that consumers perceive that regulatory bodies are not sufficiently authoritative or independent to regulate smart phone service providers. We are currently conducting a comparative study in an international context which will examine this further.

This paper is a response to calls for a better understanding of the emerging phenomenon of consumer utilization of smart phone m-payments and it represents a suitable response to the call for research by Dahlberg et al. (2008) and Kim and Zhang

(2009). Nevertheless, there are a number of limitations to this study. The study is limited by its sample size with findings based on 82 respondents participating in the study. Therefore, further research needs to be conducted to reexamine the model with a larger sample size. This model also needs to be tested on a younger population as the majority of respondents to this survey were between 30 and 50 years of age. The authors are currently engaged in an international study, specifically examining the perceptions of a younger population of mobile phone users.

In testing this smart phone m-payment model, we examined all possible products/ services without differentiation. Further research is in progress to investigate the explanatory power of the model for different socio-demographic groups and for specific products/services. Such research may provide further insight on the impact of ease of use of m-payments. As Mallet (2007) states, trust is a multi-object construct. Therefore, we call for further scientific investigation of trust as it pertains to m-payment using smart phones.

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Appendix A. Re-sampling Test of Coefficient Significance

Table A1. Indicators Description

Construct	*Item*	*Survey Statement*
Perceived Ease of Use	PEEASY	Overall, I find SMMS easy to use.
	PEKNOW	Use of SMMS does not require a lot of knowledge.
	PETECH	Use of SMMS does not require a lot of technical skills.
Trust	LFROBUST	Legal frameworks for SMMS provision are sufficiently robust to protect consumers.
	PECETHIC	I believe that SMMS providers will act ethically when capturing, retaining, processing, and managing my personal data.
	PCCONCRNPRIV	I believe that SMMS providers are concerned with consumers' privacy.
	PPCCONFPRIV	I am confident in the privacy controls of SMMS providers.
	PPCDIVUL3RD	I believe that SMMS providers will not divulge consumers' personal data to 3rd parties.
	REGAUTH	Regulatory bodies for SMMS provision are sufficiently authoritative to regulate SMMS providers.
	REGINDEP	Regulatory bodies for SMMS provision are sufficiently independent to regulate SMMS providers.
Willingness to MPay	PPRMNO	I consider it safe to make an m-payment through my mobile network operator when using SMMS.
	PPRSAFE3RD	I consider it safe to make an m-payment through a third party payment company when using SMMS.
	PPRSAFECC	I consider it safe to make an m-payment with my credit card when using SMMS.
	PPRSAFELASER	I consider it safe to make an m-payment with my laser card when using SMMS.
Willingness to Transact	PULLGPS	I intend to use SMMS to access GPS services
	PULLINFO	I intend to use SMMS to find information on products/services.
	PULLRESERV	I intend to use SMMS for booking or reservation tasks
	PULLTICK	I intend to use SMMS for ticketing tasks

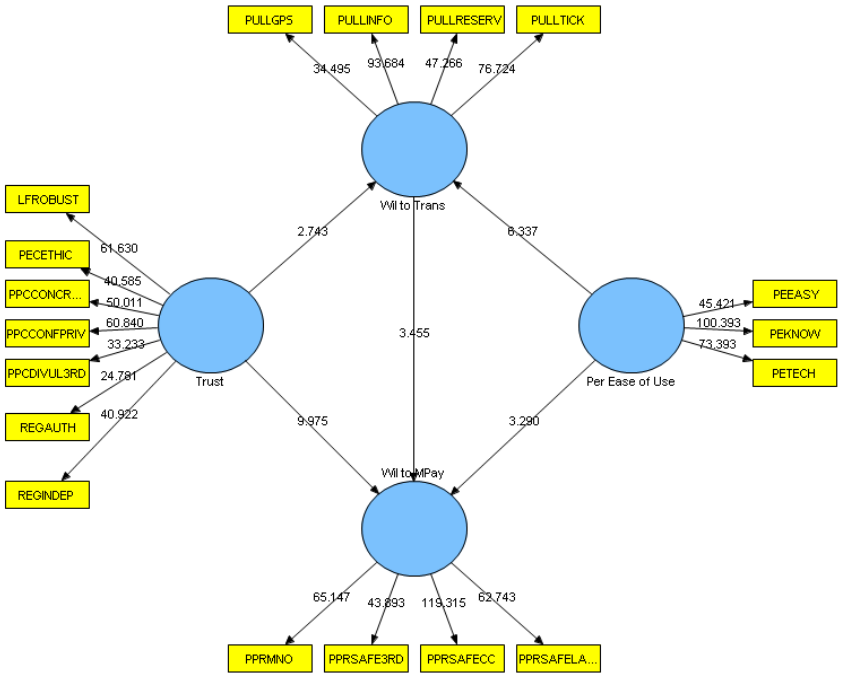

Figure A1. Bootstrapping

Appendix B. Effect Size Test

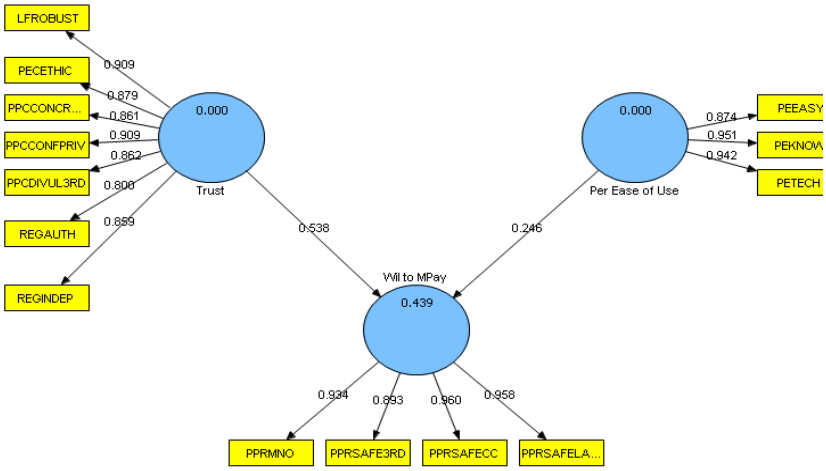

Figure B1. Effect Size Test: Willingness to Transact Is Excluded

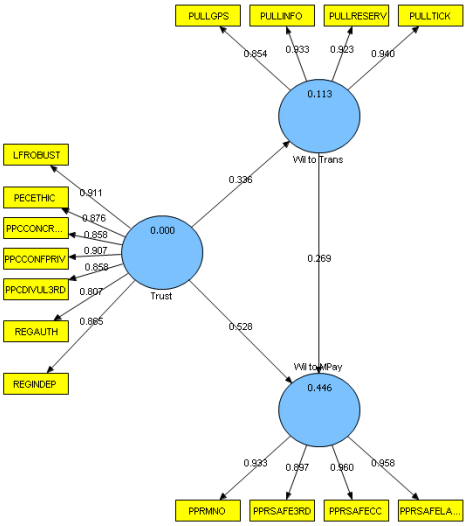

Figure B2. Effect Size Test: Perceived Ease of Use Is Excluded

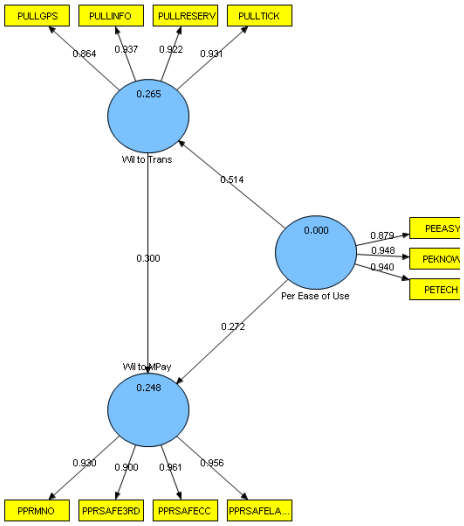

Figure B3. Effect Size Test: Trust Is Excluded