

# To M-Pay or not to M-Pay—Realising the potential of smart phones: conceptual modeling and empirical validation

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Received: 31 October 2011 / Accepted: 5 November 2012 / Published online: 17 November 2012  
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**Abstract** The variety of products and services available through Smart Phones is predicted to increase significantly over the coming years as the commercial potential of Smart Phones for M-Commerce is widely acknowledged. In fact, it is predicted that M-Commerce will achieve in the next three to four years, what E-Commerce has achieved in the last fifteen years. However, while Smart Phones present significant opportunities for organisations, the M-Commerce channel is entirely contingent on consumers' willingness to not only use these devices to engage in transactional tasks such as bookings, ticketing, and accessing information on products and services, but rather to actually make an M-Payment using the Smart Phone, and as such complete the M-Commerce transactional loop. Hence, M-Payments are a critical enabler of the true commercial value of the Smart Phone. Thus, gaining an understanding of consumers' perceptions of using Smart Phones to make M-Payments is

essential for theoretical explorations of the M-Payment phenomena, and in the practical implementation of M-Commerce services. This paper makes a number of contributions which are relevant to both academics and practitioners. The paper develops and empirically validates a conceptual model for exploring the impact of Vendor and Mechanism Trust on consumers' willingness to use Smart Phones to make M-Payments for both Push and Pull based products. The empirical findings of the developed Partial Least Squares model illustrate that a pull-based model (where consumers have high levels of control over the transaction process) is the model consumers are most likely to adopt, and most likely to use to make M-Payments. To realise the M-Payments vision, vendors need to clearly communicate to consumers how their data is secured and privacy protected. Furthermore, the findings illustrate the critical importance of ensuring that adequate legislation is in place pertaining to the protection of consumers, and that such legislation is communicated to consumers to maximise their willingness to make M-Payments.

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**Keywords** M-Payments · Trust · Smart phones · Smart mobile media services · PLS

**JEL classification** General (see [http://www.aeaweb.org/journal/jel\\_class\\_system.php#M](http://www.aeaweb.org/journal/jel_class_system.php#M))

## Introduction and theoretical grounding

Smart Phone devices have evolved rapidly to incorporate multiple applications and wide ranging functionality. This functionality enables direct delivery to consumers' personal Smart Phones, of a wide range of transactional push and pull-based M-Commerce products and services, including

highly individualised and location based Smart Mobile Media Services (O'Reilly and Duane 2010). Smart Mobile Media Services (SMMS) provide mobile network subscribers with “*permission and subscription based, dynamically profiled, location, context and task specific, mobile Internet applications, content, products, services and transactions for Smart Phones*” (O'Reilly and Duane 2010, p. 197). M-Commerce products and services are delivered using pull and push based approaches. Pull-based services are services sent to the subscriber upon request, with push-based services characterised as being non-request based (Unni and Harmon 2007). It is predicted the range of products and services available through Smart Phones will greatly increase over the coming years, as commercial entities realise the potential of M-Commerce. Indeed, the notion that Smart Phones could become critical business tools for the delivery of M-Commerce products and services, has long been touted by academics, professionals, and the media (Leppäniemi and Karjaluo 2005; Varshney and Vetter 2002).

While extant research (e.g. Matthews et al. 2009) illustrates that most consumers use their phones for SMS, MMS, and Internet access, few studies focus on consumers' perceptions of using Smart Phones for procuring products and services, and making M-Payments. In defining M-Payments, we utilise a definition by Dinez et al. (2011) who define M-Payments as “*payments made or enabled through digital mobility technologies, via handheld devices, with or without the use of mobile telecommunications networks. These payments are digital financial transactions, although not necessarily linked to financial institutions or banks*”. This lack of research is of concern, as the enormous commercial potential of Smart Phones for M-Commerce is entirely contingent on consumers' willingness to not only use these devices to engage in push and pull transactional tasks, such as bookings, ticketing and accessing information on products and services (Andreev et al. 2011), but to actually make M-Payments using Smart Phones, and as such complete the M-Commerce transactional loop. It is thus imperative to establish a clear understanding of consumers' willingness to use Smart Phones to make M-Payments, as well as their willingness to engage in push and pull transactional tasks. However, consumer reluctance to make M-Payments is understandable, as Smart Phones pose security and privacy risks creating uncertainty for consumers using the mobile Web and transacting with mobile Web vendors (Chen 2008).

It is quite clear, that although growth forecasts for M-Payment services are positive (Schierz et al. 2010), the reality is quite different, as consumer sentiment toward M-Commerce is influenced by trust and uncertainties regarding transactions and data transfers. Consequently, the potential of Smart Phones for M-Commerce will not be realised, until

the tangible benefits outweigh the intrusion and privacy concerns of consumers (Wei et al. 2010). Thus, there is an overwhelming need for research to understand and conceptualise consumer perceptions of making M-Payments using Smart Phones for products and services purchased over the mobile Web. Therefore, the purpose of this paper is to determine the associations between trust, consumers' willingness to engage in transactional push and pull-based Smart Mobile Media Services (SMMS), and willingness to make M-Payments using Smart Phones. Through investigating same, it contributes to the development of theory in the M-payments domain.

This paper contributes a conceptual model for exploring consumer's perceptions of M-payments. It explores variables that hadn't previously been investigated pertaining to M-payments. It demonstrates how the absence of transparent governance and legislation is contributing to the slow diffusion of M-Commerce and M-Payments. Furthermore, the findings illustrate that consumers' perceptions of legal frameworks and regulation have significant impact on their willingness to engage in transactional push and pull-based SMMS, and willingness to use Smart Phones to make M-Payments.

## A conceptual model

Schierz et al. (2010) state that while growth forecasts for M-Payment services have been very positive, the reality is quite different. Research by Google (Rao 2011) indicates that consumers are wary of using Smart Phones to make M-Payments, which are essential for realising the potential of Smart Phone based M-Commerce. This observation leads to the question as to why consumers do not fully adopt M-Payments. After an extensive review of the literature, a conceptual model based on technology adoption, trust, and behaviour models was developed. Junglas and Spitzmüller (2005) present a theoretical paper in which they argue that trust is a key factor impacting upon the adoption of push and pull location based Smart Mobile Media Services (SMMS). Similarly, O'Reilly and Duane (2010) illustrate that trust is a key inhibitor of both transaction and payment based M-Commerce services.

Yet, a review of the M-Commerce literature reveals that there is still much to be learned in relation to matters pertaining to trust. For example, Smith et al. (2011) note that the information privacy literature is still very much immature, with issues pertaining to meaning and conceptualisation still lacking. Furthermore, they call for further research, specifically stating that empirical studies have the potential to add the greatest value when they focus on actual outcomes. This is the primary reason why trust was selected as a key element of this paper. When considering the future

of M-Commerce and the realisation of the commercial potential of Smart Phones, the ability to understand consumers' perceptions of M-Commerce is of critical importance (Mallat 2007).

An analysis of the literature reveals the existence of two distinct SMMS models; the push model, and the pull model. With the pull-based model, consumers exercise greater control over the interaction: the decision to initiate contact with the service provider is volitional and location based information is provided only to complete the transaction requested (Xu et al. 2010). In push model SMMS, consumers exercise less control over their interaction with the service provider: push-based SMMS are automatically sent to consumers' Smart Phones (Xu et al. 2010). The differing characteristics of both models mean that these two M-commerce models are likely to impact differently on customer's willingness to M-pay.

The remainder of this section reviews and extends the extant literature on multiple facets of trust and consumers' willingness to engage in transactional push and pull-based Smart Mobile Media Services (SMMS) services, in order to explain consumers' willingness to make M-Payments using Smart Phones. In selecting relevant constructs to create the theoretical model, the immaturity of the M-Payments literature meant that choices had to be made by the researchers. Therefore, constructs and hypothesis were developed based upon emergent associations in the M-Commerce literature. Four constructs emerged, which theoretically are crucial in explaining consumers' perceptions of making an M-Payment. Relationships between the constructs were abstracted from the literature, enabling hypotheses to be developed. Each of the constructs, the relevant variables, together with the theories from which they are adopted are presented in the following section together with the eight hypothesis developed for testing.

### Vendor trust

Consumers' trust in an online vendor has significant effects on their decisions to purchase a product or service from a vendor's website (Chau et al. 2007). Consequently, vendor trust can significantly affect a consumer's intention to purchase online (Pavlou and Fygenon 2006). Applying this concept to M-Commerce, trust is crucial, given the anonymous buyer-seller interactions, and the lack of formal contractual agreements (Lie et al. 2010). Although, there are many ways to conceptualise the dimensionality of vendor trust, a review of extant literature identifies three dimensions of vendor trust; competence, benevolence and integrity (Table 1).

Lie et al. (2010) identify ability, benevolence, and integrity as key vendor characteristics in the context of an M-Commerce environment. However, these traditional

vendor trust dimensions and their descriptions are not sufficient in themselves to capture all facets of vendor trust in the context of M-Commerce. In M-Commerce, personal data as well as financial data is often required to be exchanged among the transacting parties to facilitate the purchase (Lie et al. 2010). Consequently, trust in the vendor is essential for the necessary disclosure of personal information in order to do business online (Treiblmaier and Chong 2007). More recent research identified the willingness to provide personal information online as an important antecedent that plays a mediating role between privacy, trust and the adoption of E-Commerce (Dinev 2006), and most likely M-Commerce also.

Through applying the concept of vendor trust to the two dominant M-commerce models and M-payments, three hypotheses are proposed for testing.

*Hypothesis 1* Consumers' trust in online vendors positively impacts upon their willingness to make M-Payments.

*Hypothesis 2* Consumers' trust in online vendors positively impacts upon their utilisation of push-based SMMS.

*Hypothesis 3* Consumers' trust in online vendors positively impacts upon their utilisation of pull-based SMMS.

Based on the social psychology perspective of trust (Lewicki and Bunker 1995), Cheung and Lee (2003) identified four trustworthiness factors specific to Internet vendors, namely: perceived integrity, perceived competence, perceived security control, and perceived privacy control. These four factors are of relevance to vendor trust with respect to M-Commerce also. Therefore, through integrating and applying extant literature on vendor trust to M-Commerce, a number of variables were designed for this study (Table 2).

### Trust mechanisms

Trust in the mechanism is also critical as it imposes a risk factor of its own (Treiblmaier and Chong 2007). Under mechanism trust, this study considers the infrastructure that enables transactions between users and providers of SMMS. Cheung and Lee (2003) recommend that in the highly impersonal domain of E-Commerce, an objective third party and the government should play important roles in establishing the Internet consumers' Bill of Rights. Similarly, in the context of an M-Commerce environment, this study proposes that it is particularly important that an independent objective third party and the government should play important roles in establishing legislation and standards of service to establish the legal rights of M-Commerce consumers. Thus as shown in Table 3, the

**Table 1** Traditional vendor trust dimensions

Dimensions	Description	Reference
Competence (Credibility)	Vendor is competent, honest, and reliable and will fulfil contractual requirements. Vendor is technically competent in role performance Vendor is technically able to secure consumers' private personal data.	(Dinev 2006; Pavlou and Dimoka 2006; Treiblmaier and Chong 2007)
Benevolence (Ethical and Fairly)	Vendor is interested in the buyer's welfare. Vendor is committed to managing consumers' private personal data in an ethical and responsible manner. Vendor has altruistic motives, is genuinely concerned with the buyer, and will act in a goodwill manner. Vendor will act fairly and stand behind its product, even if new conditions arise.	(Dinev 2006; Gefen 2002; Pavlou and Dimoka 2006; Treiblmaier and Chong 2007)
Integrity	Vendor provides assurance that promises will be kept.	(Gefen 2002)

Trust Mechanism must consider vendor compliance with legislation governing M-Commerce, the consumers' perceived robustness of this legislation, and the existence and independence of an objective third party regulator to protect M-Commerce consumers. This is also consistent with Cheung and Lee's (2003) notion of an "External Environment" consisting of "Third Party Recognition" and a "Legal Framework".

In applying the dynamics of Mechanism Trust to the two M-commerce models and M-payments, three further hypotheses are presented for testing.

*Hypothesis 4* Mechanism trust positively impacts upon consumers' willingness to make an M-Payment.

*Hypothesis 5* Mechanism trust positively impacts upon the adoption of push-based SMMS.

*Hypothesis 6* Mechanism trust positively impacts upon the adoption of pull-based SMMS.

### Willingness to engage

Consumers utilise Smart Phones to engage with a wide range of services, including generic services such as email, Internet search, and social networking, and more personalised location based Smart Mobile Media Services (SMMS) such as services provided by local businesses and groups, localised emergency or notification alerts, or localised and personalised product and service promotions, discounts, and special offers (O'Reilly and Duane 2010). Acknowledging the fact that two SMMS model exist (Xu et al. 2010), willingness to engage is subdivided into two constructs for the purposes of this paper; 1. Pull-Model SMMS pertaining to consumer's willingness to use services which they pre-select and 2. Push-Model SMMS relating to consumers intention to use unsolicited services. Table 4 provides an overview of these two constructs, their associated variables and unpinning literature.

Through applying the concept of willingness to engage to the M-commerce models and M-payments, two further hypotheses emerge for testing.

**Table 2** Vendor trust

Constructs	Variable	Literature
Vendor Trust	<i>Perceived Security Control</i> : M-Commerce consumers' perceptions of vendors' adequacy of security measures and their ability to secure personal private data	(Cheung and Lee 2003)
	<i>Perceived Privacy Control</i> : The M-Commerce consumers' perceptions of vendors' abilities and commitment to protect personal private data collected during registration, interaction, transaction and M-Payments from unauthorised use or disclosure	(Cheung and Lee 2003)
	<i>Perceived Integrity</i> : The M-Commerce consumers perceptions of vendors' honesty	(Cheung and Lee 2003; Gefen 2002)
	<i>Perceived Ethical Commitment</i> : The M-Commerce consumers' perceptions of vendors' commitment to being ethically responsible in the capturing, retaining, processing and management of personal data	(Dinev 2006; Gefen 2002; Pavlou and Dimoka 2006; Treiblmaier and Chong 2007)
	<i>Perceived Competence</i> : The M-Commerce consumers' perceptions of the technical expertise, resources and knowledge of the vendors to provide the product/service required.	(Dinev 2006; Gefen 2002; Pavlou and Dimoka 2006; Treiblmaier and Chong 2007)

**Table 3** Mechanism trust

Mechanism Trust	<i>Legal Framework</i> : The legislation in place to protect a consumers data & privacy	(Cheung and Lee 2003)
	<i>Regulatory Body</i> : An independent party responsible for enforcing legislation governing mobile consumers' data, and ensuring vendor compliance with same.	(Cheung and Lee 2003)

*Hypothesis 7* Consumers' willingness to utilise pull-based SMMS positively impacts upon their willingness to make M-Payments.

*Hypothesis 8* Consumers' willingness to utilise push-based SMMS positively impacts upon their willingness to make M-Payments.

Figure 1 provides a visual illustration of the developed conceptual model incorporating the eight hypotheses developed from the literature.

In operationalising the constructs in this study, the constructs' indicators were adopted from the literature in developing survey questions for the data-collection phase, and the construct items along with their associated survey statements are depicted in Table 5.

## Method

### Data collection

In operationalising the model (Fig. 1) an online survey instrument was developed. Following the generation of an initial iteration of the instrument as per Hair et al. (2006), the authors pre-tested the instrument with Smart Phone "experts" (active daily Smart Phones users) in order to

assess the semantic content of construct items. The authors retained those items that best fitted and reflected the definitions of the constructs, a process that facilitated the refinement and streamlining of the items included in this survey. The next phase of this research posted the survey online using a web based survey administration tool located at [www.SurveyMonkey.com](http://www.SurveyMonkey.com). The target population of users were informed of this survey by posting a survey notification and web link on an Irish Smart Phone users' discussion group located at [www.Boards.ie](http://www.Boards.ie). Responses were collected throughout June 2010. Irish Smart Phone users were selected as the target population as there had been no research conducted on M-Payments in Ireland to our knowledge, despite Ireland having one of the largest rates of mobile phone usage in Europe per head of population, with a 117.3 % penetration rate as of December 2010 (ComReg 2011). In fact, 1 out of every 2 mobile phones sold in Ireland in 2010 were Smart Phones (Vodafone Ireland 2010).

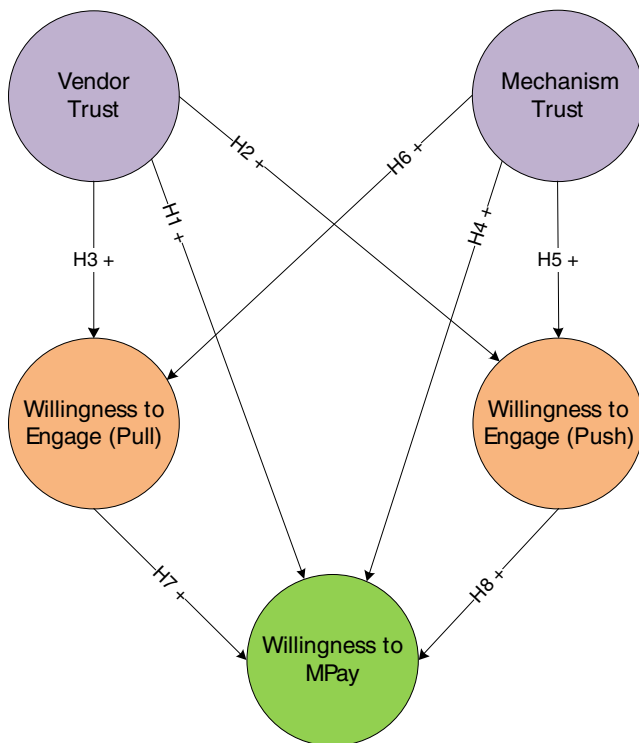
### Data analysis

The study employed the Partial Least Squares (PLS) approach, which uses component-based estimation, and is appropriate, since it allows simultaneous exploration of two models, the measurement (outer) model, relating the measurement variables (MV) to their latent variables (LV),

**Table 4** Willingness to engage constructs

Constructs	Variable	Literature
Willingness to Engage: Pull-Model SMMS	<i>GPS services</i> : Consumers' willingness to use GPS based services through their Smart Phone	Bruner and Kumar 2007; Tsang et al. 2004;
	<i>Information Services</i> : Consumers' willingness to use Smart Phones to find information on goods/services	Chang et al. 2009
	<i>Reservation Services</i> : Consumers' willingness to use Smart Phones for booking/reservation tasks	Ngai and Gunasekaranb 2007
	<i>Ticketing</i> : Consumers' willingness to use Smart Phones for ticketing tasks	Bruner and Kumar 2007; Tsang et al. 2004
Willingness to Engage: Push-Model SMMS	<i>Unsolicited Ads</i> : Consumers' perceptions of unsolicited generic advertisements	Bruner and Kumar 2007; Tsang et al. 2004
	<i>Personalised Advertisements</i> : Consumers' perceptions of receiving solicited advertisements customised to their specific interests/preferences	Leppäniemi and Karjaluoto 2005
	<i>Unsolicited Discounts</i> : Consumers' perceptions of receiving unsolicited discounts on their Smart Phones	Leppäniemi and Karjaluoto 2005
	<i>Unsolicited Location Based Messages</i> : Consumers' perceptions of receiving unsolicited advertisements specific to business products/services of interest to them near their location	Bruner and Kumar 2007; Tsang et al. 2004





**Fig. 1** Conceptual research model

and the structural (inner) model, relating the LVs to each other (Tenenhaus et al. 2005).

## Results

### Data statistics

The online survey collected data from 141 consumers with 82 of those being completed valid responses. Respondents originated from 12 of Ireland's 26 counties including large cities such as Dublin, Cork, and Waterford. This would indicate that the demographic attributes of a typical respondent to this survey is a person (Table 6): 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 per year.

Further analysis indicated that the mobile technology profile of a typical respondent to this survey is a person who accesses the Internet via their Smart Phone for less than an hour per day, talks on their Smart Phone for less than an hour per day, regularly uses their Smart Phone for SMS, but rarely for MMS or email, and, presently use their Smart Phone to purchase mobile services/applications.

### Model evaluation

PLS models with reflective constructs have well-defined and widely accepted validity techniques. The list of assessment criteria was first summarised and proposed by Chin (1998). The evaluation process of the PLS path model

**Table 5** Items and survey statements

Construct	Indicators	Survey Statement <sup>a</sup>
Mechanism Trust	LFCOMPLI	Compliance with SMMS legal frameworks is sufficiently enforced to protect consumers.
	LFROBUST	Legal frameworks for SMMS provision are sufficiently robust to protect consumers.
	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.
Vendor Trust	PCKNOW	I believe that SMMS providers have adequate knowledge to manage these services.
	PINTSINCER	I believe that SMMS providers act sincerely in dealing with consumers.
	PPCCONFPRIV	I am confident in the privacy controls of SMMS providers.
	PSCMPAY	I believe that all SMMS providers implement adequate security measures to secure M-Payments.
Wil_Engage (Pull)	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.
Wil_Engage (Push)	PUSHUNSOLICADS	I think receiving unsolicited advertisements on my Smart Phone is useful.
	PUSHUNSOLADLOC	I think receiving unsolicited advertisements specific to business product/service offerings near my location on my Smart Phone is useful.
	PUSHSOLICPREFS	I think receiving solicited advertisements customised to my specific preferences on my Smart Phone is beneficial.
	PUSHUNSOLICDISC	I think receiving unsolicited discount coupons for products/services on my Smart Phones is positive.
Wil to MPay	PPRSafe	I would like to make M-Payments, and I consider it safe to make M-Payments when using SMMS.

<sup>a</sup> A seven point Likert scale was used, ranging from Strongly Agree to Strongly Disagree.

**Table 6** Respondents descriptive statistics

Income		Age		Spend on SMM3 (month)		Education	
Prefer not to say	7.41%	18-21 yrs	3.70%	<€1.00	55.56%	Primary Level	0.00
< €20,000	12.35%	22-25 yrs	9.88%	€1.00-2.00	11.11%	2nd Level	3.70
€20,000-30,000	8.64%	26-30 yrs	13.58%	€2.01-5.00	16.05%	3rd Level Under-Graduate	28.40
€30,001-40,000	7.41%	31-35 yrs	20.99%	€5.01-10.00	7.41%	3rd Level Post-Graduate	56.79
€40,001-50,000	12.35%	36-40 yrs	32.10%	€10.01-20.00	3.70%	4th Level (PhD, Post-doc)	11.11
€50,001-60,000	17.28%	41-50 yrs	17.28%	€20.01-30.00	2.47%		
€60,001-70,000	7.41%	51-60 yrs	1.23%	€30.01-50.00	1.23%		
€70,001-80,000	9.88%	>60 years	1.23%	>€50.00	2.47%		
> €80,000	17.28%						

involves two steps. Step 1 necessitates the testing of the quality of the measurement (outer) models. If Step 1 is successful and latent constructs are reliable and valid, Step 2, which necessitates the assessment of the structural (inner) model, should be conducted (Henseler et al. 2009). The online survey resulted in a sample size of 82 complete and valid responses. Although 82 is a relatively small sample size, it is sufficient to get reliable PLS results. First, it meets a generally accepted “10 times” thumb rule, that defines the minimum sample size as 10 times the most complex relationships within the research model (Chin 1998). The most complex construct (Willingness to M-Pay) in the research model has four predictive constructs, necessitating a minimum sample size of 40 respondents.

### Assessment of measurement models

**Reliability** The first criterion of assessment of measurement models is reliability, which traditionally refers to internal consistency reliability and indicator reliability. Internal consistency reliability corresponds to testing either Cronbach's  $\alpha$ , which indicates estimation for the reliability assuming that all items are equally reliable, or composite reliability, where different items loadings are taken into account. Although these two reliability measures differ, either of them may be used. Table 7 shows that both parameters have high values (all values are above 0.825), 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. 2009).

**Table 7** Internal consistency reliability test

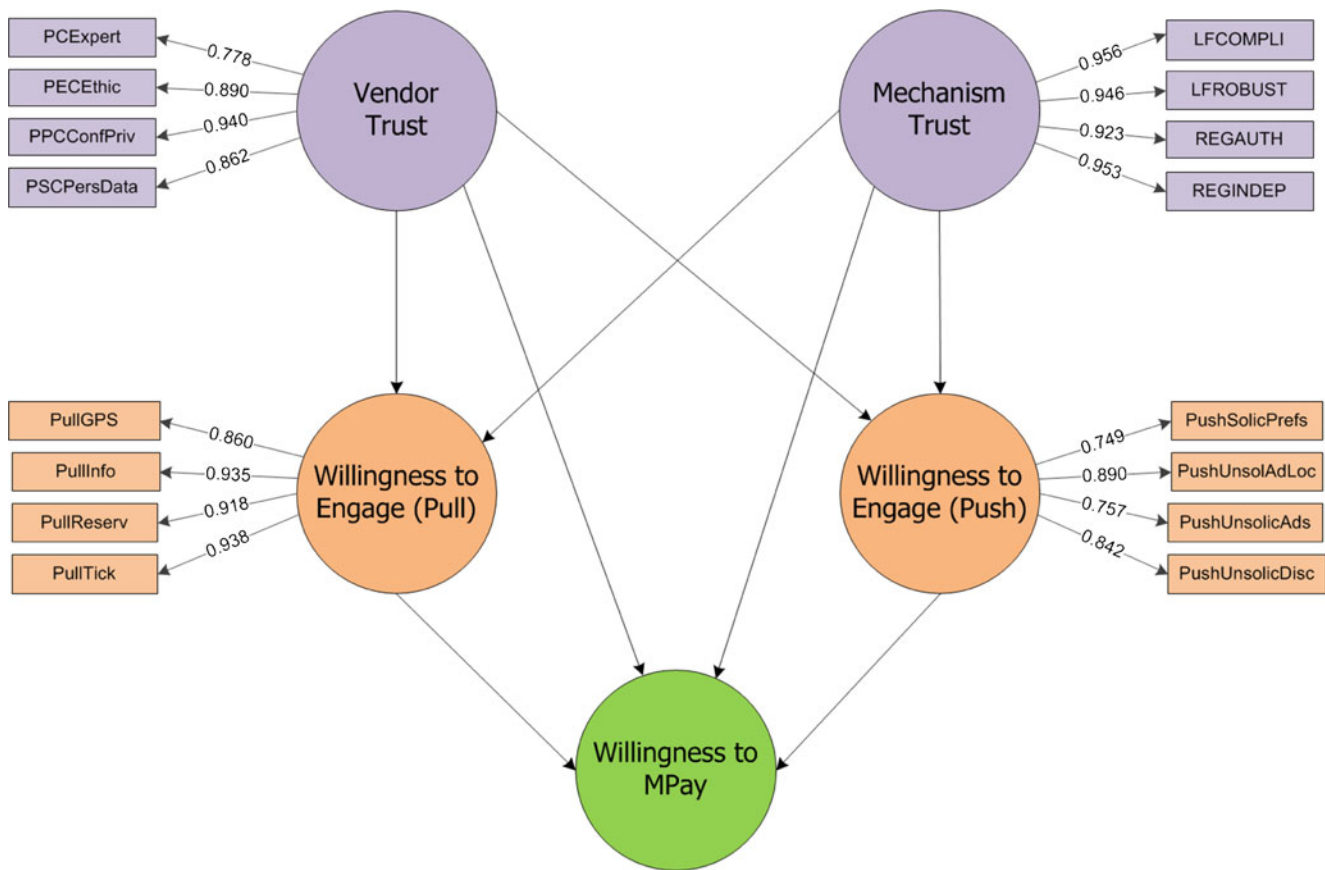
Construct	Composite Reliability	Cronbach's Alpha
Mechanism Trust	0.971	0.960
Vendor Trust	0.931	0.901
Wil_Engage (Pull)	0.953	0.934
Wil_Engage (Push)	0.885	0.825

Individual reliability of the indicators relies on the expectation that latent variable variance should explain at least 50 % of the indicator. In other words, loadings of manifest variables should not be less than 0.707 (Chin 1998). Figure 2 demonstrates that the magnitude of all indicators is higher than the required 0.707. Based on the two tests, the authors conclude that all indicators are reliable.

**Validity** The convergent validity and the discriminant validity examine the validity of five reflective constructs. The first column in Table 8 shows that the average variance extracted for all constructs is higher than 0.5, which indicates sufficient convergent validity, and means that each latent variable explains more than 50 % of their indicator variance on average. Discriminant validity refers to the appropriate patterns of inter-indicators of a construct and other constructs. First, the variance of a construct should be assigned more to their own indicators rather than to other constructs. For this purpose, the authors compared inter construct correlations and the square root of each construct's AVE. Table 8 shows all constructs have sufficient discriminant validity since the square root of each latent construct's AVE (values on the diagonal) is larger than the correlation of the specific construct with any other reflective constructs in our research model.

As shown in Table 8, the correlation between the Vendor Trust and Mechanism Trust constructs is 0.760, which is higher than the recommended maximum of 0.707. However, this high correlation was expected due to the common *trust* nature of these two constructs, and respondents' expectation of *vendor* responsibility. Moreover, the analysis illustrates that despite the cross-correlation between these trust constructs, the authors successfully separated them.

The authors also tested discriminant validity with a cross-loading test. Table 9 presents the results of the test, and demonstrates that any indicator of any specific construct has a higher loading on its own construct, than on the loading of any other construct (horizontal loading in Table 9). Thus, the high correlation in the previous cross-correlation test is also evident in the cross-loading analysis. The results of the



**Fig. 2** PLS results of measurement models

tests show that the manifest variables (indicators) presented in the research model are reliable and valid.

### Assessment of the structural model

In assessing the explanatory and predictive power of the structural model, the authors apply the recommendations made in PLS literature by Chin (1998) and Andreev et al. (2009).

*Explanatory power* Figure 3 presents an overview of the structural model evaluation results. The central criterion for

evaluating the structural model is the level of explained variance of the dependent construct Willingness to MPay, for which the  $R^2$  was 0.489. Thus, the model explained 48.9 % of the construct's variance. The variance of the construct was explained at the moderate level consistent with Chin's (1998) criteria.  $R^2$  values of 0.67, 0.33, or 0.19 for the endogenous latent variables are substantial, moderate, or weak respectively (Chin 1998 p.323). While explaining Willingness to Engage in Push SMMS and Willingness to Engage in Pull SMMS was not the objective of the study, the research model explains 17.3 % and 6.9 % respectively.

The effect size technique investigating the substantive impact of each independent construct on the dependent

**Table 8** Construct AVE analyses and inter construct correlations

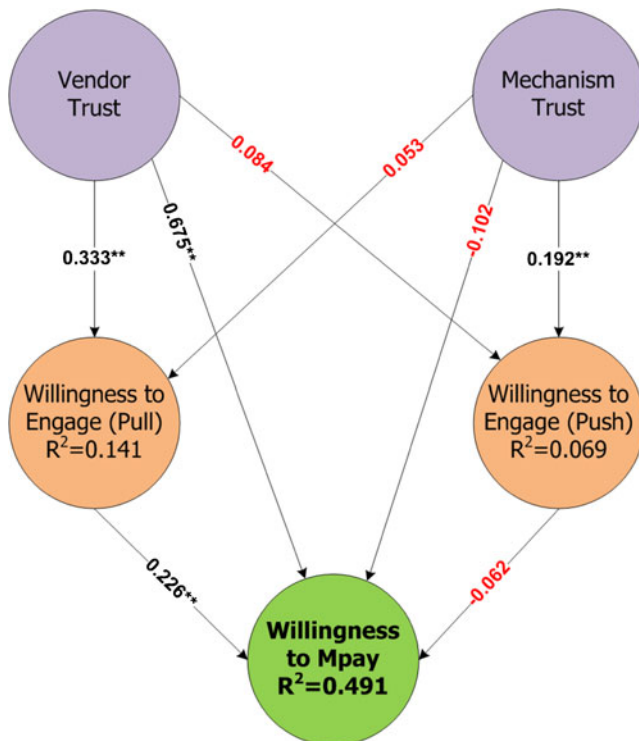
AVE	Construct	Mechanism Trust	Vendor Trust	Wil to MPay	WtE (Pull)	WtE (Push)
0.893	Mechanism Trust	<b>0.945</b>				
0.756	Vendor Trust	0.760	<b>0.878</b>			
1.000	Wil to MPay	0.471	0.676	<b>1.000</b>		
0.834	Wil_Engage (Pull)	0.308	0.415	0.430	<b>0.914</b>	
0.659	Wil_Engage (Push)	0.258	0.201	0.126	0.262	<b>0.812</b>



**Table 9** Cross loadings

Construct	Indicators	Mech. Trust	Vendor Trust	WtE (Pull)	WtE (Push)	Will_to_Mpay
Mechanism Trust	LFCOMPLI	0.956	0.766	0.263	0.191	0.489
	LFROBUST	0.946	0.777	0.284	0.263	0.487
	REGAUTH	0.924	0.631	0.272	0.238	0.367
	REGINDEP	0.953	0.692	0.340	0.278	0.429
Vendor Trust	PCKNOW	0.573	0.843	0.304	0.171	0.507
	PINTSINCER	0.702	0.907	0.448	0.133	0.563
	PPCCONFPRIV	0.740	0.911	0.349	0.234	0.583
	PSCMPAY	0.644	0.850	0.351	0.167	0.703
Wil to Engage (Pull)	PULLGPS	0.220	0.319	0.863	0.136	0.276
	PULLINFO	0.282	0.422	0.935	0.221	0.430
	PULLRESERV	0.279	0.313	0.917	0.318	0.363
	PULLTICK	0.328	0.437	0.938	0.269	0.464
Wil to Engage (Push)	PUSHUNSOLICADS	0.153	0.174	0.053	0.747	0.096
	PUSHUNSOLADLOC	0.172	0.171	0.153	0.888	0.137
	PUSHSOLICPREFS	0.243	0.165	0.400	0.758	0.097
	PUSHUNSOLICDISC	0.260	0.142	0.217	0.845	0.079
Will_to_Mpay	PPRSafe	0.471	0.676	0.430	0.126	1.000

constructs, was conducted by re-running four PLS estimations, excluding one of the explanatory latent constructs in



**Fig. 3** Evaluation of structural model. \*\*\* $p < 0.001$ , \*\* $p < 0.01$ . (Based on  $t(299)$ , The  $t$ -test for each path coefficient was conducted with 299 degrees of freedom, where is a number of subsample repetitions in bootstrapping procedure. 300 repetitions were chosen resulting 299 is degrees of freedom.), two-tailed test).  $T$ -value (0.001; 299)=3.315 ;  $t$  (0.01; 299)=2.58;  $t$ (0.05; 299)=1.96

each re-running. Table 10 summarises the quantitative results of the effect size test. Chin (1998) proposed using the effect size of PLS constructs, which similar to Cohen's implementation for multiple regression, may be small ( $f^2 = 0.02$ ), medium ( $f^2 = 0.15$ ), and large ( $f^2 = 0.35$ ).

The results of the effect size test (Table 10), show that while Willingness to Engage in Push SMMS and Mechanism Trust have no effect, Willingness to Engage in Pull SMMS has a small effect ( $f^2$  equal to 0.08), while Vendor Trust has a large effect ( $f^2 = 0.35$ ).

**Predictive power** The statistical significance of the path coefficients was tested using the bootstrapping re-sampling technique. Figure 3 presents the graphical output for the structural model evaluation. The study found that Vendor Trust (H1 supported with  $\beta = 0.674$  and  $p < 0.001$ ) and Willingness to Engage in Pull SMMS (H7 supported with  $\beta = 0.187$  and  $p < 0.001$ ) positively affect Willingness to MPay. Whereas, the impact of Mechanism Trust on Willingness to MPay was not found to be significant (H8 not supported).

**Table 10** Effect size test

Construct	$R^2$ incl	$R^2$ excl	$f^2$	Effect
Mechanism Trust	0.489	0.485	0.01	No
Vendor Trust	0.489	0.315	0.35	Large
Wil to Engage (Pull)	0.489	0.465	0.05	Small
Wil to Engage (Push)	0.489	0.488	0.00	No

**Table 11** Blindfolding test for predictive relevance

Construct	$\Sigma SO$	$\Sigma SE$	$Q^2$
Wil to MPay	81.0000	41.3292	0.4898
Wil to Engage (Pull)	324.0000	278.5437	0.1403
Wil to Engage (Push)	324.0000	310.9793	0.0402

Vendor Trust (H3 supported with  $\beta=0.429$  and  $p<0.001$ ) positively affects Willingness to Engage in Pull SMMS, but did not statistically affect Willingness to Engage in Push SMMS (H2 not supported). The opposite results were found for Mechanism Trust which positively affects Willingness to Engage in Push SMMS (H5 supported with  $\beta=0.249$  and  $p=0.001$ ), but does not have a statistically significant effect on Willingness to Engage in Pull SMMS. Finally, Willingness to Engage in Push SMMS (H8 not supported) does not have a statistically significant impact on Willingness to MPay.

The authors performed the Stone and Geisser  $Q^2$  test for the evaluation of the predictive relevance of the model. A positive  $Q^2>0$  provides evidence that the omitted observations were well-reconstructed and that predictive relevance is achieved, while a negative  $Q^2$  reflects an absence of predictive relevance. Table 11 shows that all values of  $Q^2$  were greater than zero, indicating predictive relevance for the endogenous constructs of the model.

## Discussion and conclusion

By exploring consumers' willingness to use Smart Phones to make M-Payments, this paper makes a number of significant theoretical and practical contributions of value to both researchers and practitioners alike. The research model developed in this study can be utilised to explore push and pull based SMMS and M-Payments by scholars, service providers, application designers, financial institutions, and retail organisations.

## Theoretical contribution

It is broadly accepted in the existing literature (Pavlou 2011; Smith et al. 2011) that the nature of the Internet has enabled individuals' personal information to be collected, stored, processed, and utilised. This is even more relevant in an M-Commerce scenario, where the widespread usage of mobile web-based applications is ubiquitous. As revealed in the literature, recent MISQ articles suggest that the IS information privacy literature is in a relatively immature state, with both Pavlou (2011) and Smith et al. (2011) calling for

empirical investigations to focus on outcomes. In response, this paper makes a number of contributions in enhancing the theoretical underpinnings of trust and privacy, as it relates to push and pull-based M-Commerce and M-Payment.

A conceptual model for exploring consumers' perceptions of M-Payments was developed by utilising, adopting and extending existing IS literature pertaining to trust and willingness to engage. Table 12 illustrates that 4 of the 8 research hypotheses were supported by the findings of our model estimations and data analysis in this study. The implications for theory will now be explored.

In developing the conceptual model, the authors applied numerous variables pertaining to vendor trust; many of which had never been previously applied to M-Payment related research. Variables such as perceived ethical commitment (Dinev 2006), perceived integrity (Cheung and Lee 2003) and perceived competence (Pavlou and Dimoka 2006) have never previously been included in a comprehensive model exploring consumers' perceptions of M-Payments. While our findings further illustrate Pavlou and Fygenon's (2006) suggestion that vendor trust affects consumers' intentions' to make purchases (our study illustrates this impact in the context of an M-Commerce environment), the findings suggest that such elements are of secondary importance to consumers, whose primary focus appears to be on data security and information privacy.

Existing literature (Wei et al. 2010) has documented in generic terms consumers' concerns with security and privacy when conducting M-Commerce. Pavlou et al. (2007) note that personal information is an economic good in markets with asymmetric information that relates to the agency problem of selection and moral hazard. Indeed, Pavlou (2011) notes that individuals do not know ex-ante which entities have appropriate information protection practices (adverse selection), and ex-post how their information will be appropriately used (moral hazard). Through empirical investigation, this study presents evidence of an association between privacy controls and security measures (Vendor Trust), and consumers' willingness to make M-Payments using Smart Phones. Theoretically this is significant, as it illustrates that when consumers engage in M-Commerce using push and pull-based SMMS and M-Payments, consumers are highly cognisant of the vendor with which they are interacting. Furthermore, analysis illustrates that consumers' perceptions of the security and privacy controls employed by Smart Phone service providers, are a critical element of their willingness to use Smart Phones to make M-Payments. This is also of theoretical value, as it suggests that at the current state of maturity, consumers are most concerned with the security and privacy issues pertaining to the protection and sharing of their data. Presently, consumers' fears over their data and privacy appear to outweigh their perceptions of the benefits of M-Commerce. The

**Table 12** Hypotheses testing outcomes

Hypotheses	Outcome	Values
Hypothesis 1: Consumers' trust in online vendors positively impacts upon their willingness to make M-Payments.	Supported	0.675
Hypothesis 2: Consumers' trust in online vendors positively impacts upon their utilisation of push-based SMMS.	Not Supported	–
Hypothesis 3: Consumers' trust in online vendors positively impacts upon their utilisation of pull-based SMMS.	Supported	0.333
Hypothesis 4: Mechanism trust positively impacts upon consumers' willingness to make M-Payments.	Not Supported	–
Hypothesis 5: Mechanism trust positively impacts upon the adoption of push-based SMMS.	Supported	0.192
Hypothesis 6: Mechanism trust positively impacts upon the adoption of pull-based SMMS.	Not Supported	–
Hypothesis 7: Consumers' willingness to utilise pull-based SMMS positively impacts upon their willingness to make M-Payments.	Supported	0.226
Hypothesis 8: Consumers' willingness to utilise push-based SMMS positively impacts upon their willingness to make M-Payments.	Not Supported	–

theoretical implications suggest that Pavlou's (2011) perspective of individuals' being willing to trade privacy for some perceived benefit is not founded, at least in the context of this study.

Extant literature illustrates that two SMMS models exist; the push and pull model (O'Reilly and Duane 2010). This paper extends our understanding of consumers' willingness to engage with push and pull models, complementing the extant, but predominately descriptive, literature focusing on these models. While existing literature (Unni and Harmon 2007) has focused on both of these models, the association between consumers' willingness to engage with both models, and make M-Payments, has not been previously explored in the extant literature. Theoretically this is of interest as consumers' willingness to make M-Payments is key if either model is to truly achieve commercial credibility. Indeed, extant literature (Mallat 2007) illustrates that consumers' lack of willingness to make M-Payments is the greatest barrier to the future growth of M-Commerce. Furthermore, Junglas and Spitzmüller (2005, p 7), in calling for further research on location based services state that "*understanding what the antecedents are that determine a user's intentions to use LBS is crucial*". In identifying such antecedents, the findings of this study illustrate that vendor trust and willingness to engage in pull-based SMMS positively impact on consumers' willingness to make M-Payments. However, while vendor trust positively affects willingness to engage in pull-based SMMS, it does not statistically impact on willingness to engage in push-based SMMS. This may mean that consumers are willing to make M-Payments for products and services they proactively search for and pull to their personal Smart Phones from trusted vendors, but are less likely to make M-Payments for products and services pushed to their Smart Phones by vendors, without being specifically requested to do so. This is most likely because consumers' perceive they have greater control over pull-based SMMS, as the decision to initiate contact with the vendor is volitional, and location based

information is provided only to complete the transaction requested. Theoretically this is significant, as it illustrates the importance placed by a consumer on control over SMMS, both in terms of service selection and provision of data. This perspective goes beyond Pavlou's (2011) theory that consumers are unconcerned with data privacy once they receive some benefit(s) for providing such data. It illustrates that at least in the context of M-Commerce and M-Payments, consumers are highly concerned with privacy and control over their data.

In a review of the M-Payments literature, Dinez et al. (2011) note that concepts pertaining to regulation and legislation have been overlooked in existing studies. Similarly, previous studies of SMMS (e.g. Junglas and Spitzmüller 2005), while focusing on matters pertaining to elements such as perceived usefulness, and benevolence, fail to address the influence of legal frameworks and regulation. An analysis of the results of this study illustrates that consumers' perceptions of legal frameworks and the independent regulation of these frameworks, have a significant impact on consumers' willingness to engage in push-based SMMS.

In terms of the push and pull based M-Commerce models, consumers appear to be more concerned with legislation and regulation as it pertains to push-based SMMS and vendor trust. This may indicate that while consumers are currently willing to engage in pull-based SMMS, they may be more willing to engage in push-based SMMS with vendors in the future, once consumers' perceive there is adequate legislation in place to protect their data and privacy, and if an independent party is responsible for the enforcement of the legislation governing M-Commerce. This reflects the findings of Xu et al. (2010), who assert that consumers exercise less control over their push-based interactions with mobile Web vendors, as they are tracked and triangulated, and automatically sent SMMS pertaining to their current location and preferences.

## Practical contribution and future research

In order to increase consumers' willingness to make M-Payments using Smart Phones, commercial entities need to communicate to consumers that they implement policies, and employ 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 the findings from this study are that a key step in getting consumers to make M-Payments is to ensure that adequate legal frameworks are in place. Furthermore, improving consumers' perceptions' that regulatory bodies have sufficient powers to take actions against mobile service providers who do not adhere to such frameworks, is a key issue in building consumer trust.

As established in this study, building consumer trust is essential to get consumers 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.

This paper is a response to calls for a better understanding of the emerging phenomenon of consumer utilisation of Smart Phones for M-Commerce, and more importantly, consumers' willingness to make M-Payments using these devices. Nevertheless, there are a number of limitations to this study and further research is necessary. Although the research sample size (82) is more than the minimum required, especially at large effect size (Vendor Trust), further study should employ a larger sample size to avoid underestimations at weak effect size (Willingness to Engage in Pull). Furthermore, this model should also be tested in a comparison study in an international context to determine if cultural or experiential factors impact on the results. One of the key limitations at present is the fact that data has only been gathered in an Irish context and sample size. Further research is required to examine the model in other geographical locations. Furthermore, a key limitation of this paper is that it doesn't assess actual M-Payment use. Thus, the authors call for further research to focus on actual M-Payment use and consumers opinions of the various M-Payment business models that exist.

**Acknowledgement** The authors wish to thank and acknowledge the efforts of the editor Roger Bons and the three anonymous reviewers for their work and contribution to this paper.

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