



Contents lists available at ScienceDirect

Electronic Commerce Research and Applications

journal homepage: www.elsevier.com/locate/ecra

Understanding consumer acceptance of mobile payment services: An empirical analysis

Paul Gerhardt Schierz^{a,1}, Oliver Schilke^{b,*}, Bernd W. Wirtz^{c,2}

^a The Boston Consulting Group, Ludwigstrasse 21, D-80539 Munich, Germany

^b Stanford University, Institute for Research in the Social Sciences, 450 Serra Mall – Building 370, Stanford, CA 94305, USA

^c German University of Administrative Sciences Speyer, Institute for Information and Communication Management, Freiherr-vom-Stein-Strasse 2, D-67346 Speyer, Germany

ARTICLE INFO

Article history:

Received 31 January 2009

Received in revised form 5 June 2009

Accepted 26 July 2009

Available online 3 August 2009

Keywords:

Mobile payment

Consumer mobility

Technology acceptance model (TAM)

Perceived usefulness

Perceived ease of use

Intention to use

Perceived risk

Subjective norm

Structural equation modeling

EQS

ABSTRACT

Mobile technology has become increasingly common in today's everyday life. However, mobile payment is surprisingly not among the frequently used mobile services, although technologically advanced solutions exist. Apparently, there is still a lack of acceptance of mobile payment services among consumers. The conceptual model developed and tested in this research thus focuses on factors determining consumers' acceptance of mobile payment services. The empirical results show particularly strong support for the effects of compatibility, individual mobility, and subjective norm. Our study offers several implications for managers in regards to marketing mobile payment solutions to increase consumers' intention to use these services.

© 2009 Elsevier B.V. All rights reserved.

1. Introduction

Driven by the increasing mobility of today's modern society, the number of mobile phone accounts has sharply increased in recent years and the mobile telephony industry has grown significantly. In line with these developments, mobile services have increasingly become a part of everyday life (Hwang et al. 2007). In particular, some growth forecasts for *mobile payment services* have been very positive. The management consulting firm Arthur D. Little, for example, predicted a growth of mobile payment services from US\$11.7 Billion in 2005 to US\$37.1 Billion in 2008 (Arthur D. Little 2004). This number would have accounted for about 8% of the total mobile services market in 2006. Despite these encouraging forecasts, however, the reality looks quite different, and the situation is often disappointing for those firms offering mobile payment services. In 2008, only 1% of all cellular users had used mobile payment services (Gartner Group 2009). Thus, the actual market

penetration of mobile payment services strongly deviates from previous predictions.

This observation leads to the question of why consumers have not adopted mobile payment services. Prior research has provided a rather limited understanding of the key drivers in consumer acceptance of mobile payment services. A comprehensive study about such factors offers the potential to derive important managerial implications regarding how mobile payment services could be marketed more effectively, thus leading to greater consumer acceptance. This is important because the number of firms already offering, or interested in, adopting mobile payment options has steadily increased, and guidance is needed on how managers can effectively boost the number of customers who choose this form of payment as an alternative to more traditional payment services. Given the high practical relevance and dearth of prior empirical work, the current research aims to develop and test an integrative model of factors determining consumers' acceptance of mobile payment services. For this purpose, we collected data from a representative sample of 1447 respondents and used the structural equation modeling software EQS to test a theory-based research model of mobile payment acceptance. Our results reveal major drivers of consumers' intention to use mobile payment services. Among the most important drivers are perceived compatibility

* Corresponding author. Tel.: +1 650 736 1137; fax: +1 650 725 6471.

E-mail addresses: schierz.paul@bcg.com (P.G. Schierz), schilke@stanford.edu (O. Schilke), wirtz@dhv-speyer.de (B.W. Wirtz).

¹ Tel.: +49 (0) 89 2317 4597.

² Tel.: +49 (0) 6232 654 296.

(the degree to which mobile payment is reconcilable with existing values, behavioral patterns, and experiences), individual mobility (the degree to which an individual pursues a mobile lifestyle), and subjective norm (the degree to which the social environment perceives mobile payment as desirable).

This article has two main contributions. From a conceptual viewpoint, we develop a model that is based on various theoretical fields which are relevant to the consumer motives for using mobile payment solutions. This allows us to draw a broader and more holistic picture of the drivers of consumer acceptance of mobile payment services compared to previous research. From an empirical viewpoint, we make a contribution by testing this model with a large sample, which enables us to conduct several stability tests in order to increase confidence in the findings. Providing reliable, confirmatory evidence regarding the relevance of various acceptance factors is particularly important since prior research on mobile payment has primarily been qualitative in nature.

The outline of the current article is as follows: First, we define the key terms used in our research and elaborate on the theoretical basis—the technology acceptance model (TAM), which provides the general structure for our research model. Subsequently, we review previous work on mobile payment acceptance. Building on theory and extant knowledge about the phenomenon of consumer acceptance, we present our hypotheses, specifying a set of factors that are proposed to directly or indirectly determine consumers' intention to use mobile payment solutions. In the section on methods, we describe the survey and discuss the validity and reliability of the empirical data. We then present our substantive results and stability checks. The paper closes with a summary of the key findings and a discussion of the implications of the research.

2. Conceptual foundations

2.1. Terminology

Mobile payment services can be considered a special form of the electronic handling of payments. Looking at existing definitions, we find several distinct commonalities and differences. Most conceptualizations emphasize the mobile device as the key characteristic distinguishing mobile payments from other forms of payment. Some authors focus on cell phones (e.g., Henkel 2002), while others include all mobile communication devices (e.g., Zmijewska and Lawrence 2006). Regarding the function of mobile payments, all definitions refer to the transfer of monetary value. Differences can be found when it comes to the phases of the payment process that are considered to be part of the mobile payment. Henkel (2002), for example, refers to the authorization and initiation of the payment process in his definition, and Dahlberg et al. (2008) also include this realization, i.e. the execution of the payment, in their definition. In the current study, we adopt a broad view of mobile payment services and examine all payments for goods, services, and bills authorized, initiated, or realized with a mobile device. However, since acceptance drivers in a B2B context may differ from consumer acceptance, we focus on consumers as the users of mobile payment services.

The second key term used in this research is *consumer acceptance*, which we define as the relatively enduring cognitive and affective perceptual orientation of an individual. Similar to previous work, we use the construct of intention to use as a proxy for consumer acceptance (Mathieson 1991; Venkatesh and Davis 2000). This is a particularly suitable concept since empirical findings underscore the idea that intention to use is an appropriate predictor of later usage (Sheppard et al. 1988).

2.2. Theoretical background

In the IT/IS literature, a variety of models have been advanced to explain innovation usage (Venkatesh et al. 2003). Among them, the *technology acceptance model* (TAM), proposed by Davis (1989), has evolved as the most popular (Chau and Hu 2001). It can be considered the most influential extension of the theory of reasoned action (TRA) and the theory of planned behavior (TPB), replacing variables related to attitude and behavioral control with technology acceptance measures (Bagozzi 2007).

The benefits of TAM include reliable instruments with excellent measurement properties, conciseness, and empirical soundness (Pavlou 2003). Moreover, TAM compares favorably with alternative acceptance models in explaining a substantial proportion of the variance in usage intentions (Venkatesh 1999). TAM also applies to a wide range of research questions, including wireless LAN usage (Yoon and Kim 2007), adoption of internet banking (Lee 2009), and attitude toward self-service solutions (Dabholkar and Bagozzi 2002). Therefore, even if TAM was originally intended to predict IT system use in the workplace, the TAM variables can also be employed to predict consumer acceptance in a variety of settings.

Although very useful in explaining behavioral intention, we posit that certain extensions to the model are required to explain the intention to use mobile payment services. It has been suggested that the TAM is too parsimonious and should be expanded by factors particularly relevant to the specific technology under investigation (Venkatesh and Davis 2000). Also, integrating variables from related theoretical perspectives can provide a better understanding of consumer acceptance (Nysveen et al. 2005). Thus, we regard the TAM as a starting point of our research and extend it with additional constructs important to mobile payment acceptance. In doing so, we heed the call for additional research that broadens and deepens TAM by introducing new variables, as well as explaining and reconceptualizing existing variables in the model (Bagozzi 2007).

2.3. Literature review

Reviewing the relevant literature, we find that only a rudimentary understanding exists about the drivers of mobile payment acceptance. There appear to be three groups of researchers that have published empirical work on this topic. In a survey-based study, Linck et al. (2006) asked consumers which characteristics of mobile payment applications they perceive as particularly relevant. The authors present an analysis of frequencies, indicating that consumers prefer simple, secure, and inexpensive payment services.

The work by Zmijewska, Lawrence, and Steele aims to develop a user-orientated taxonomy of mobile payment systems (Zmijewska and Lawrence 2006; Zmijewska et al. 2004a,b). They classify existing mobile payment systems, evaluating those systems based on a set of consumer-oriented criteria. Relevant classification dimensions include factors such as simplicity, security, and costs. An examination of the relative importance of those dimensions, however, was not included.

The work by Dahlberg, Mallat, and Öörni also needs to be noted (Dahlberg et al. 2003; Mallat 2004). Based on group interviews, they analyzed factors contributing to the acceptance of mobile payment systems. Their empirical study included 61 consumers within various age groups and from different professional backgrounds. The participants' comments during open discussion rounds were subsequently coded by the researchers, yielding three relevant factors related to mobile payment acceptance: perceived ease of use, perceived usefulness, and trust. The results were interpreted as confirming the general applicability of the technology acceptance model in the context of mobile payment services. However, given the nature of the data, no confirmatory test of this prop-

osition was employed. Therefore, the authors call for future research verifying their exploratory findings (Dahlberg et al. 2003).

These studies hint at a set of potentially relevant factors driving consumer acceptance of mobile payment solutions. At the same time, it is obvious that there is a research gap in regards to a lack of hypothesis-testing studies on mobile payment acceptance and in regards to developing an understanding of the relative importance and relationships of different acceptance drivers. This conclusion is in line with the literature review by Dahlberg et al. (2008, p. 179), who state: “Yet, we believe that more theory based empirical research is needed to enhance the current understanding of the mobile payment services markets. (...) to improve the quality and relevance of mobile payment research, we also recommend that researchers collect more empirical data backed by guiding theories (...).”

3. Hypotheses

Following the lead of Venkatesh and Davis (2000), we start our hypotheses section with the “core TAM” and incorporate additional constructs to extend the original theory. We begin by discussing eight hypotheses that are related to the technology itself. Subsequently, we will introduce a factor associated with the social context as well as a factor pertaining to an individual user characteristic.

The main dependent variable in studies building on the TAM is *intention to use* (van der Heijden 2003; Venkatesh et al. 2003), defined as the likelihood that an individual will use a technology. According to the TAM, the main antecedent—and key mediator of the influence of other variables on intention to use—is a person's *attitude towards using a technology* (Davis 1989; Davis et al. 1989), the degree to which using a technology is positively or negatively valued by an individual. A positive relationship between the two constructs—intention to use and attitude towards using a technology—has been found in a number of previous studies (Yang and Yoo 2004). We adopt this structure in our research model and hypothesize that attitude towards using mobile payment services serves as a determinant of the intention to use mobile payment services:

H₁: There is a positive relationship between the attitude towards using mobile payment services and the intention to use mobile payment services.

One of the main reasons for the slow diffusion of mobile applications in general and mobile payment in particular could be a failure in communicating a clear benefit to potential users. According to diffusion theory, users are only willing to accept innovations if those innovations provide a unique advantage compared to existing solutions (Rogers 1995). In the context of TAM, this view is reflected by the *perceived usefulness* construct. The TAM proposes that perceived usefulness is a central antecedent to the attitude towards using a technology (Davis 1989). Hence:

H₂: There is a positive relationship between the perceived usefulness of mobile payment services and the attitude towards using mobile payment services.

Given the technical limitations of mobile devices, ease of use becomes an imminent acceptance driver of mobile applications (Venkatesh 2000). This is especially true for mobile payment services, which compete with established payment solutions and thus need to provide benefits when it comes to ease of use. Important aspects related to mobile payment services ease of use include, for example, clear symbols and function keys, few and simple pay-

ment process steps, graphic display, and help functions (Pagani and Schipani 2005). Consequently, we incorporate *perceived ease of use* of mobile payment services in our consumer acceptance model. It is important to note that, especially for non-users, it is the perception of ease of use rather than actual system characteristics which underlie this construct (Venkatesh and Davis 1996).

H₃: There is a positive relationship between the perceived ease of use of mobile payment services and the attitude towards using mobile payment services.

Further, we follow prior research in proposing that the easier and more intuitive mobile payment services are perceived to be, the more positive the assessment of their usefulness (Venkatesh et al. 2003). The implied relationship is reflected by our fourth hypothesis:

H₄: There is a positive relationship between perceived ease of use of mobile payment services and perceived usefulness of mobile payment services.

Besides perceived benefits (i.e., perceived usefulness and ease of use), innovations usually also come with risks (Cho 2004). As such, the perceived risk associated with a product or service has gained significance in consumer research on innovations (Lim 2003; Mitchell 1999). In the context of electronic services, security risk, conceptualized as the likelihood of privacy invasion, has been found to be a particularly critical concern among consumers (Lwin et al. 2007). First, many people have not had any previous experience with new electronic services such as mobile payment systems (Bauer et al. 2005a). Second, services (as opposed to tangible products) are inherently more difficult to evaluate and are thus perceived as more risky (Gefen et al. 2003; Mitchell 1999). Finally, making a mobile payment is often associated with a relatively high loss potential—related to privacy, personal data, and the transaction itself (Bauer et al. 2005b)—further increasing the perceived risk of mobile payment services. Similar to previous research (Cho 2004), we thus propose a positive link between *perceived security* (i.e., low perceived risk) and the attitude towards using mobile payment services.

H₅: There is a positive relationship between perceived security of mobile payment services and the attitude towards using mobile payment services.

We further extend the original TAM by including the *perceived compatibility* of mobile payment services as an additional factor. In their comprehensive meta-analysis, Tornatzky and Klein (1982) find perceived compatibility to be a crucial innovation characteristic driving consumer acceptance. Thus, it can be assumed that perceived compatibility is a useful extension of TAM, increasing its predictive power. Perceived compatibility encompasses the reconcilability of an innovation with existing values, behavioral patterns, and experiences. Extant research shows positive effects of perceived compatibility on both the attitude toward using a technology and perceived usefulness (Hardgrave et al. 2003). Further, there is reason to believe that perceived compatibility has a direct impact on the intention to use a technology (Mallat et al. 2006). In view of these findings, we hypothesize the following:

H₆: There is a positive relationship between the perceived compatibility of mobile payment services and the perceived usefulness of mobile payment services.

H₇: There is a positive relationship between the perceived compatibility of mobile payment services and the attitude towards using mobile payment services.

H₈: There is a positive relationship between the perceived compatibility of mobile payment services and the intention to use mobile payment services.

When assessing the acceptance of technological innovations, the social context of the decision maker should not be neglected. If the social context is in favor of using a technology, this plays an important role in the decision process (Webster and Trevino 1995). This is particularly the case for products and services in an early stage of development or diffusion. Here, most users lack reliable information about usage details. Thus, the relevance of the social network opinions for individual attitude formation increases. Consistent with Fishbein and Ajzen (1975, p. 302), we incorporate the social context in our research model by including the factor of *subjective norm*, defined as a “person’s perception that most people who are important to him think he should or should not perform the behavior in question”. Accounting for the social context is also in line with the new product growth model put forward by Bass (1969), who emphasizes that innovation adoption is significantly influenced by the pressures of the social system. The importance of the subjective norm in regards to the attitude towards usage has previously been established in the context of mobile internet applications (Nysveen et al. 2005). Accordingly, we present a ninth hypothesis:

H₉: There is a positive relationship between the subjective norm and the attitude towards using mobile payment services.

The key feature and major advantage of mobile payment services is their ubiquity (Kleinrock 1996). Other than traditional payment solutions, mobile payment services can be used anytime and virtually anywhere (Dahlberg et al. 2003). While we currently observe a general trend toward an increasingly mobile society, there is still significant variance in the *mobility* of individuals. We propose that highly mobile persons will have a more positive attitude towards using mobile payment services and a higher intention to use them. Mobile services make an excellent fit with a mobile lifestyle, providing a means to pay for goods and services in virtually any life situation. Moreover, preliminary findings point to a positive link between individual mobility and

the perceived usefulness of mobile applications (Dahlberg et al. 2003). Thus:

H₁₀: There is a positive relationship between individual mobility and the attitude towards using mobile payment services.

H₁₁: There is a positive relationship between individual mobility and the intention to use mobile payment services.

H₁₂: There is a positive relationship between individual mobility and the perceived usefulness of mobile payment services.

The conceptual research model implied by our 12 hypotheses and empirically tested in the following section appears in Fig. 1.

4. Methods

4.1. Data

The *population* of the study comprises all persons in Germany who are able to use mobile applications. The information required for this study was not available in the form of secondary data, so we collected primary data through a survey. Based on data from the national census bureau (Statistisches Bundesamt 2006), a proportionate stratified sampling approach was followed. The goal was to generate a sample that is representative of the total population in terms of gender and age. The survey was conducted using a standardized online questionnaire, which was subjected to comprehensive pretesting prior to implementation. At the end of the data collection period, 1447 usable responses were received. We used χ^2 homogeneity tests to assess the representativeness of the sample (Hays 1973). Based on the results (gender: $\chi^2 = 1.32$, $df = 1$; age: $\chi^2 = 5.65$, $df = 4$), we conclude that there are no significant differences ($p \leq .05$) between the sample and the population with regard to gender and age. Table 1 summarizes the sample and population characteristics.

4.2. Measures

The measurement items were formulated as Likert-type statements anchored by a seven-point scale, ranging from 1 (“strongly disagree”) to 7 (“strongly agree”). Where possible, we adopted or

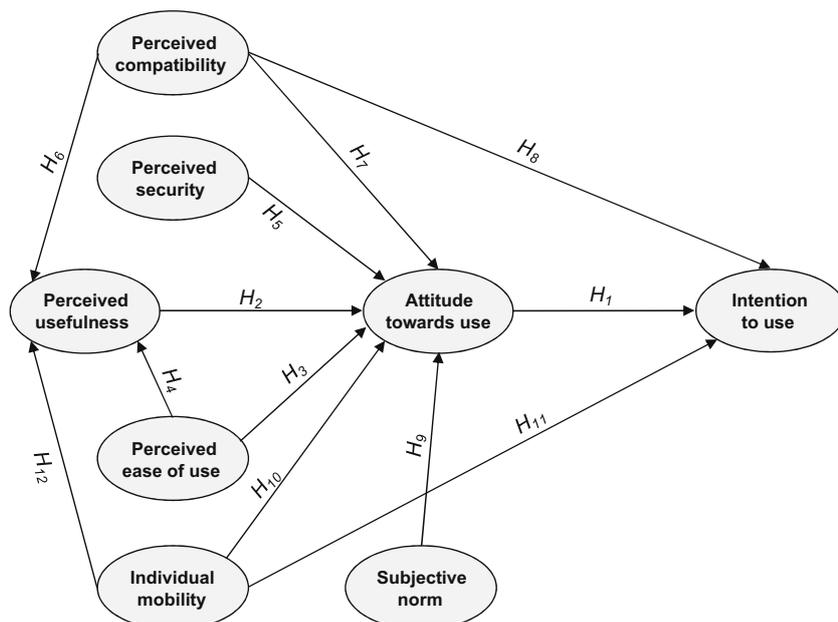


Fig. 1. Conceptual model.

Table 1
Sample and population characteristics.

Gender	Sample (%)	Population (%)
Female	45.3	51.1
Male	54.7	48.9
Age (years)		
≤29	28.2	31.9
30–39	20.9	14.8
40–49	18.9	16.1
50–59	14.0	12.2
≥60	18.0	24.9

modified existing measures for our study. Table 2 provides a list of all measurement items and their sources.

4.3. Estimation approach

To examine the latent variables within their causal structure, we applied *structural equation modeling* (SEM) using EQS 6.1 software (Bentler 1995) and the Maximum Likelihood (ML) procedure. We chose an SEM approach as it is a powerful generalization of earlier statistical approaches with the key benefit being that each explanatory and dependent variable is associated with measurement error in contrast to OLS regression, for example, that is based on the assumption that variables are measured perfectly (Bollen 1989). In addition, SEM allows for multiple indicators of latent variables which are a more realistic representation of the variables under study.

5. Results

We first conducted analyses separately for *each factor* and calculated coefficient alphas, composite reliabilities, and average variances extracted. The respective values are indicative of a reliable and valid measurement of the individual factors. All coefficient alphas exceed the recommended threshold of .7 (Nunnally 1978), composite reliabilities are greater than .7, and average variances extracted surpass values of .5 (Bagozzi and Yi 1988).

In an analysis based on Fornell and Larcker (1981), we subsequently assessed the discriminant validity of the factors. The results indicate that there are no problems with respect to discriminant validity; the average variance extracted by the measure of each factor is larger than the squared correlation of that factor's measure with all measures of other factors.

Moreover, we checked for the existence of common method bias in the data. Harman's one-factor test was employed, in which no single, general factor was extracted (Podsakoff and Organ 1986). In addition, we re-estimated our structural equation model with all the indicator variables loading on an unmeasured latent method factor (MacKenzie et al. 1993). For identification purposes, it was necessary to constrain factor loadings within constructs to be equal when estimating this model. The results showed that none of the individual path coefficients corresponding to relationships between the indicators and the method factor was significant. Moreover, the overall pattern of significant relationships was not affected by common method variance (i.e., all of the paths that were significant when common method variance was not

Table 2
Measurement items.

Construct	Items	References
Attitude towards using mobile payment services	Using mobile payment services is a good idea Using mobile payment services is wise Using mobile payment services is beneficial Using mobile payment services is interesting	Oh et al. (2003), van der Heijden (2003), Yang and Yoo (2004)
Intention to use mobile payment services	Given the opportunity, I will use mobile payment services I am likely to use mobile payment services in the near future I am willing to use mobile payment services in the near future I intend to use mobile payment services when the opportunity arises	Davis (1989), Gefen et al. (2003), Venkatesh and Davis (2000)
Perceived usefulness of mobile payment services	Mobile payment services are a useful mode of payment Using mobile payment services makes the handling of payments easier Mobile payment services allow for a faster usage of mobile applications (e.g., ticket purchase) By using mobile payment services, my choices as a consumer are improved (e.g., flexibility, speed)	Bhattacharjee (2001), Devaraj et al. (2002), van der Heijden (2003)
Perceived ease of use of mobile payment services	It is easy to become skillful at using mobile payment services The interaction with mobile payment services is clear and understandable It is easy to perform the steps required to use mobile payment services It is easy to interact with mobile payment services	Bhattacharjee (2001), Davis et al. (1989), Taylor and Todd (1995), Venkatesh and Davis (2000)
Perceived security of mobile payment services	The risk of an unauthorized third party overseeing the payment process is low The risk of abuse of usage information (e.g., names of business partners, payment amount) is low when using mobile payment services The risk of abuse of billing information (e.g., credit card number, bank account data) is low when using mobile payment services I would find mobile payment services secure in conducting my payment transactions	Luarn and Lin (2005), Parasuraman et al. (2005)
Perceived compatibility of mobile payment services	Using mobile payment services fits well with my lifestyle Using mobile payment services fits well with the way I like to purchase products and services I would appreciate using mobile payment services instead of alternative modes of payment (e.g., credit card, cash)	Moore and Benbasat (1991), Plouffe et al. (2001)
Subjective norm	People who are important to me would recommend using mobile payment services. People who are important to me would find using mobile payment services beneficial People who are important to me would find using mobile payment services a good idea	Taylor and Todd (1995), Venkatesh and Davis (2000)
Individual mobility	I could imagine having multiple jobs at a time I would like to be able to keep in touch everywhere I am I would like to be able to coordinate my daily tasks everywhere I am. I would like to be able to coordinate my daily tasks no matter what time it is	– (New measure)

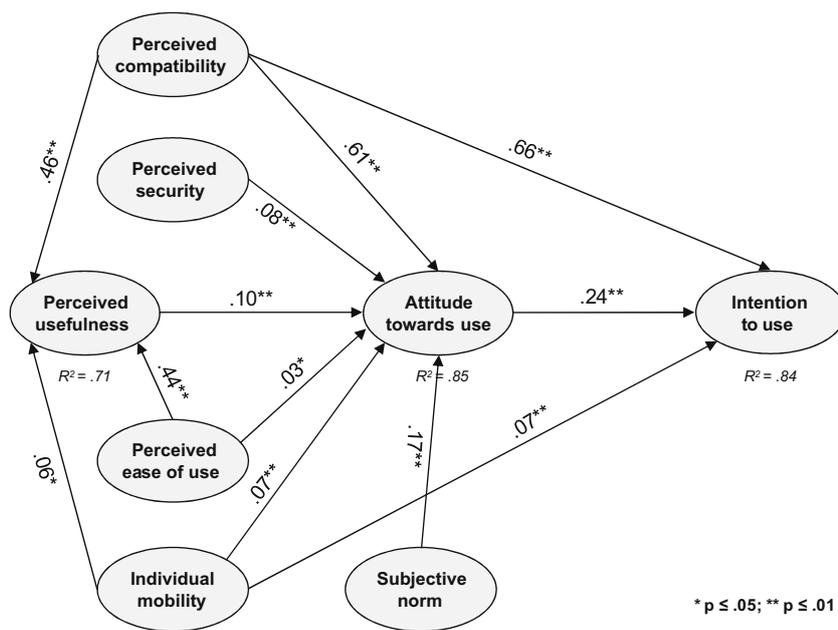


Fig. 2. Results of model estimation.

controlled remained significant even when common method variance was controlled). Overall, we conclude that common method bias does not seem to be a serious concern for this study.

After having gained confidence about the appropriateness of the measurement, the next step was to examine the structural model. The goodness of fit measures for the structural model show satisfactory values ($\chi^2/df = 2.41$; $GFI = .95$; $AGFI = .94$; $TLI = .99$; $RMSEA = .03$). Fig. 2 presents the standardized estimates. The significant path coefficients ($p \leq .05$) appear to support the proposed model.

In support of H_1 , we find a significant and positive relationship between the attitude towards using mobile payment services and the intention to use mobile payment services ($\beta = .24$; $p \leq .01$). Moreover, the path coefficient of .10, significant at a 1% level, points to a strong positive relationship between the perceived usefulness of mobile payment services and the attitude towards using mobile payment services. Thus, H_2 is supported. Further, the structural link from perceived ease of use to the attitude towards using mobile payment services is positive and significant ($\beta = .03$; $p \leq .05$), supporting H_3 . In addition, the relationship proposed in H_4 is confirmed; that is, perceived ease of use predicted the perceived usefulness of mobile payment services ($\beta = .44$; $p \leq .01$). The results also provide strong evidence for the effects of perceived security ($\beta = .08$; $p \leq .01$) and perceived compatibility ($\beta = .61$; $p \leq .01$) on the attitude towards using mobile payment services, in support of H_5 and H_7 . Similarly, perceived compatibility is found to predict perceived usefulness ($\beta = .46$; $p \leq .01$) and the intention to use mobile payment services ($\beta = .66$; $p \leq .01$), as hypothesized in H_6 and H_8 . Regarding the subjective norm factor, we found a significant link with the attitude towards using mobile payment ser-

vices ($\beta = .17$; $p \leq .01$). Therefore, H_9 is supported. Finally, the construct of individual mobility has significant relationships with the constructs of attitude towards using ($\beta = .07$; $p \leq .01$), the intention to use ($\beta = .07$; $p \leq .01$), and the perceived usefulness of mobile payment services ($\beta = .06$; $p \leq .05$), as proposed in H_{10} – H_{12} . In total, the high R^2 value of the key dependent variable “intention to use mobile payment services” (84%) indicates that the model highlights a comprehensive set of important factors that are associated with consumer acceptance of mobile payment services.

Because the correlations between the exogenous variables in our model are comparatively high, there is a potential risk that our results may not be stable with small changes in the data (Cohen et al. 2003). Thus, we reanalyzed our model with 20 different datasets, in which 5% of the cases had been removed randomly (Homburg et al. 2007). The results from the stability tests strongly suggest that the correlations between the exogenous variables do not compromise the validity of our results. For all datasets, the pattern of results is consistent with our hypotheses.

In addition, we assessed the stability of the results by splitting the entire sample into previous users of mobile payment services ($n_1 = 583$) and previous non-users of mobile payment services ($n_2 = 864$). All hypothesized relationships were supported in both subsamples ($p \leq .05$), which further underlines the robustness of our results.

Finally, we assessed the issue of multicollinearity by looking at the magnitude of the bivariate correlations between the exogenous variables (see Table 3). All correlations are far below the common cutoff value of .8 (Berry and Feldman 1985). Together with the results obtained from the stability tests, this indicates that multicollinearity is not a problem in our study.

Table 3
Correlations among the exogenous variables.

	Perceived compatibility	Perceived security	Subjective norm	Perceived ease of use	Individual mobility
Perceived compatibility	1.00				
Perceived security	.47	1.00			
Subjective norm	.53	.58	1.00		
Perceived ease of use	.25	.39	.41	1.00	
Individual mobility	.51	.46	.36	.40	1.00

Table 4
Total effects.

Factor	Total effect on intention to use
Perceived compatibility	.82
Individual mobility	.09
Subjective norm	.04
Perceived usefulness	.02
Perceived security	.02
Perceived ease of use	.02

6. Discussion

6.1. Academic contribution and future research

This study is among the first to empirically test determinants of the consumer acceptance of mobile payment services. Based on theoretical considerations, we derived a research model specifying key drivers of an individual's intention to use mobile payment. Using data from a large-scale survey conducted in Germany, we found empirical support for the proposed model.

Multiplying the coefficients along the paths (Bollen 1987) allows us to examine total effects and establish a ranking among the drivers of mobile payment acceptance (Table 4). To provide an example of calculating the total effects, the total effect of perceived ease of use on intention to use equals the indirect effect via perceived usefulness plus the indirect effect via attitude towards use ($.44 * .10 * .24 + .03 * .24 = .02$).

We find that perceived compatibility has the greatest impact on the intention to use mobile payment services. Thus, in order to consider adopting mobile payment services, people must find them to be reconcilable with their existing behavioral patterns. This is an important finding, since perceived compatibility is not part of the original TAM and thus is often not considered by acceptance researchers. The same is true for the second ranked factor. An individual's mobility is a key driver of mobile payment acceptance. One could interpret this finding as indicating that, with an increasingly mobile society, mobile payment services are likely to gain in significance in the future.

This study is intended to be a valuable source for further empirical and conceptual research on mobile payment services. Besides its general contribution of identifying, conceptualizing, and operationalizing relevant acceptance drivers of mobile payment systems, the results presented in this research result in further starting points for future investigations. This study focused on the acceptance of mobile payment services in general. We deliberately chose not to explore or classify single mobile payment solutions. Thus, continuative research work could build on the structural model presented here and modify it to fit specific payment solutions. Further, our empirical study is restricted to a German sample. It would be fruitful to test whether the results hold in other countries. In doing so, the global generalizability of the results presented here could be tested and/or cultural differences important to the process of mobile payment adoption could be explored.

6.2. Managerial implications

While this study has a confirmatory orientation and the primary intention is not to derive instrumental policy recommendations, several managerial implications can be drawn. Of particular importance to managers of firms providing mobile payment solutions or offering them as a mode of payment to customers is the question of how to effectively boost the number of users. The six factors summarized in Table 4 can serve as a guideline for increasing further market penetration of mobile payment services. As it turned out, a particularly important managerial task pertains to the perceived

compatibility of mobile payment services. Thus, industry players are challenged to develop and advertise mobile payment devices and solutions in a way that consumers regard them as well-suited to their individual behavioral patterns and prior experience. In addition to perceived compatibility, individual mobility is a key driver of the consumer acceptance of mobile payment services. While this consumer characteristic cannot be influenced by the firm, our finding can help managers in the segmentation and prioritization of potential customers. In the current early stage of the market, firms should focus on consumers who have a strong need to pay for goods and services in every life situation, as they are more likely to be interested in mobile payment services. If this group of people can be inspired to use such services, a critical mass effect may make even less mobile consumers interested in the service later on. Similarly, the factor subjective norm—another key driver of consumer acceptance—is unchangeable by the management. However, it can be implied that reference groups play an important role in the diffusion of mobile payments. Thus, firms need to identify early adopters and stimulate their usage of mobile payment services, so that they can serve as a reference facilitating broad diffusion in the future. Another managerially interesting insight can be gained from the relevance of the perceived security of mobile payment solutions. While we found a positive relationship of this factor with acceptance, the link was not as strong as perhaps suspected given the increasing importance of the perceived risk construct in consumer research. This implies that concerns related to risk may not be at center stage when launching mobile payment services. Rather, managers need to focus on the long-term strategic aspects highlighted above in order to make mobile payment services a mass market reality.

References

- Bagozzi, R. P. The legacy of the technology acceptance model and a proposal for a paradigm shift. *Journal of the Association for Information Systems*, 8, 4, 2007, 243–254.
- Bagozzi, R. P., and Yi, Y. On the evaluation of structural equation models. *Journal of the Academy of Marketing Science*, 16, 1, 1988, 74–94.
- Bass, F. M. A new product growth model for consumer durables. *Management Science*, 15, 5, 1969, 215–227.
- Bauer, H. H., Reichardt, T., Barnes, S. J., and Neumann, M. M. Driving consumer acceptance of mobile marketing: a theoretical framework and empirical study. *Journal of Electronic Commerce Research*, 6, 3, 2005, 181–191.
- Bauer, H. H., Reichardt, T., and Schüle, A. *User Requirements for Location Based Services*. University of Mannheim, Mannheim, 2005.
- Bentler, P. M. *EQS Structural Equations Program Manual*. Multivariate Software, Encino, CA, 1995.
- Berry, W. D., and Feldman, S. *Multiple Regression in Practice*. Sage, Beverly Hills, CA, 1985.
- Bhattacharjee, A. Understanding information systems continuance: an expectation confirmation model. *MIS Quarterly*, 25, 3, 2001, 351–370.
- Bollen, K. A. Total, direct, and indirect effects in structural equation models. *Sociological Methodology*, 17, 1987, 37–69.
- Bollen, K. A. *Structural Equations with Latent Variables*. Wiley, Toronto, 1989.
- Chau, P. Y. K., and Hu, P. J.-H. Information technology acceptance by individual professionals: a model comparison approach. *Decision Sciences*, 32, 4, 2001, 699–719.
- Cho, J. Likelihood to abort an online transaction: influences from cognitive evaluations, attitudes, and behavioral variables. *Information and Management*, 41, 7, 2004, 827–838.
- Cohen, J., Cohen, P., West, S. G., and Aiken, L. S. *Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences*. Lawrence Erlbaum Associates, Mahwah, NJ, 2003.
- Dabholkar, P. A., and Bagozzi, R. P. An attitudinal model of technology-based self-service, moderating effects of consumer traits and situational factors. *Journal of the Academy of Marketing Science*, 30, 3, 2002, 184–201.
- Dahlberg, T., Mallat, N. and Öörni, A. Consumer acceptance of mobile payment solutions. In G.M. Giaglis (ed.), *mBusiness 2003 – The Second International Conference on Mobile Business*, Vienna, 2003, 211–218.
- Dahlberg, T., Mallat, N., Ondrus, J., and Zmijewska, A. Past, present and future of mobile payments research: a literature review. *Electronic Commerce Research and Applications*, 7, 2, 2008, 165–181.
- Davis, F. D. Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13, 3, 1989, 319–340.
- Davis, F. D., Bagozzi, R. P., and Warshaw, P. R. User acceptance of computer technology. *Management Science*, 35, 8, 1989, 982–1003.

- Devaraj, S., Fan, M., and Kohli, R. Antecedents of B2C channel satisfaction and preference. validating e-commerce metrics. *Information Systems Research*, 13, 3, 2002, 316–333.
- Fishbein, M., and Ajzen, I. *Attributes, Attitude, Intention, and Behavior: An Introduction to Theory and Research*. Addison-Wesley, Reading, MA, 1975.
- Fornell, C., and Larcker, D. F. Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18, 1, 1981, 39–50.
- Gartner Group *Dataquest Insight: Mobile Payment, 2007–2012*. Gartner Group, Stamford, CT, 2009.
- Gefen, D., Karahanna, E., and Straub, D. W. Trust and TAM in online shopping: an integrated model. *MIS Quarterly*, 27, 1, 2003, 51–90.
- Hardgrave, B. C., Davis, F. D., and Riemenschneider, C. K. Investigating determinants of software developers' intentions to follow methodologies. *Journal of Management Information Systems*, 20, 1, 2003, 123–151.
- Hays, W. L. *Statistics for the Social Sciences*. Holt, New York, NY, 1973.
- Henkel, J. Mobile payment. In G. Silberer, J. Wohlfahrt, and T. Wilhelm (eds.), *Mobile Commerce*, Gabler, Wiesbaden, 2002.
- Homburg, C., Grozdanovic, M., and Klarmann, M. Responsiveness to customers and competitors: the role of affective and cognitive organizational systems. *Journal of Marketing*, 71, 3, 2007, 18–38.
- Hwang, R.-J., Shiau, S.-H., and Jan, D.-F. A new mobile payment scheme for roaming services. *Electronic Commerce Research and Applications*, 6, 2, 2007, 184–191.
- Kleinrock, L. Nomadicity – anytime, anywhere in a disconnected world. *Mobile Networks and Applications*, 1, 4, 1996, 351–357.
- Lee, M.-C. Factors influencing the adoption of internet banking: an integration of TAM and TPB with perceived risk and perceived benefit. *Electronic Commerce Research and Applications*, 8, 3, 2009, 130–141.
- Lim, N. Consumers' perceived risk: sources versus consequences. *Electronic Commerce Research and Applications*, 2, 3, 2003, 216–228.
- Linck, K., Pousttchi, K. and Wiedemann, D.G. Security issues in mobile payment from the customer viewpoint. In Proceedings of the 14th European Conference on Information Systems (ECIS 2006), Göteborg, 2006.
- Little, Arthur D. *Global M-Payment Report 2004*, Vienna, 2004.
- Luarn, P., and Lin, H.-H. Toward an understanding of the behavioural intention to use mobile banking. *Computers in Human Behavior*, 21, 6, 2005, 873–891.
- Lwin, M., Wirtz, J., and Williams, J. D. Consumer online privacy concerns and responses: a power-responsibility equilibrium perspective. *Journal of the Academy of Marketing Science*, 35, 4, 2007, 572–585.
- MacKenzie, S. B., Podsakoff, P. M., and Fetter, R. The impact of organizational citizenship behavior on evaluations of salesperson performance. *Journal of Marketing*, 57, 1, 1993, 70–80.
- Mallat, N. Theoretical constructs of mobile payment adoption. Paper Presented at the 27th Information Systems Research Seminar in Scandinavia (IRIS), Falkenberg, 2004.
- Mallat, N., Rossi, M., Tuunainen, V.K. and Öörni, A. The impact of use situation and mobility on the acceptance of mobile ticketing services. In Proceedings of the 39th Hawaii International Conference on System Sciences, Hawaii, 2006.
- Mathieson, K. Predicting user intentions: comparing the technology acceptance model with the theory of planned behavior. *Information Systems Research*, 2, 3, 1991, 173–191.
- Mitchell, V.-W. Consumer perceived risk: conceptualisations and models. *European Journal of Marketing*, 33, 1/2, 1999, 163–195.
- Moore, G. C., and Benbasat, I. Development of an instrument to measure the perceptions of adopting an information technology innovation. *Information Systems Research*, 2, 3, 1991, 192–222.
- Nunnally, J. C. *Psychometric Theory*. McGraw-Hill, New York, NY, 1978.
- Nysveen, H., Pedersen, P. E., and Thorbjørnsen, H. Intentions to use mobile services: antecedents and cross-service comparisons. *Journal of the Academy of Marketing Science*, 33, 3, 2005, 330–346.
- Oh, S., Ahn, J., and Kim, B. Adoption of broadband Internet in Korea: the role of experience in building attitudes. *Journal of Information Technology*, 18, 4, 2003, 267–280.
- Pagani, M., and Schipani, D. Motivations and barriers to the adoption of 3G mobile multimedia services. In P. C. Deans (ed.), *E-commerce and m-commerce technologies*, Idea Group, Hershey, PA, 2005, 80–95.
- Parasuraman, A., Zeithaml, V. A., and Malhotra, A. E-S-QUAL: a multiple-item scale for assessing electronic service quality. *Journal of Service Research*, 7, 3, 2005, 213–233.
- Pavlou, P. A. Consumer acceptance of electronic commerce. Integrating trust and risk with the technology acceptance model. *International Journal of Electronic Commerce*, 7, 3, 2003, 101–134.
- Plouffe, C. R., Hulland, J. S., and Vandenberg, M. Richness versus parsimony in modeling technology adoption decisions – understanding merchant adoption of a smart card-based payment system. *Information Systems Research*, 12, 2, 2001, 208–222.
- Podsakoff, P. M., and Organ, D. W. Self-reports in organizational research: problems and prospects. *Journal of Management*, 12, 4, 1986, 531–544.
- Rogers, E. M. *Diffusion of Innovations*. Free Press, New York, NY, 1995.
- Sheppard, B. H., Hartwick, J., and Warshaw, P. R. The theory of reasoned action: a meta-analysis of past research with recommendations for modifications and future research. *Journal of Consumer Research*, 15, 3, 1988, 325–343.
- Statistisches Bundesamt. *Statistisches Jahrbuch 2006*. Statistisches Bundesamt, Wiesbaden, 2006.
- Taylor, S., and Todd, P. A. Understanding information technology usage: a test of competing models. *Information Systems Research*, 6, 2, 1995, 144–176.
- Tornatzky, L. G., and Klein, K. J. Innovation characteristics and innovation adoption-implementation: a meta-analysis of findings. *IEEE Transactions on Engineering Management*, 29, 1, 1982, 28–45.
- van der Heijden, H. Factors influencing the usage of Websites: the case of a generic portal in The Netherlands. *Information and Management*, 40, 6, 2003, 541–549.
- Venkatesh, V. Creation of favorable user perceptions: exploring the role of intrinsic motivation. *MIS Quarterly*, 23, 2, 1999, 239–260.
- Venkatesh, V. Determinants of perceived ease of use: integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Information Systems Research*, 11, 4, 2000, 342–365.
- Venkatesh, V., and Davis, F. D. A model of the antecedents of perceived ease of use: development and test. *Decision Sciences*, 27, 3, 1996, 451–481.
- Venkatesh, V., and Davis, F. D. A theoretical extension of the technology acceptance model: four longitudinal field studies. *Management Science*, 46, 2, 2000, 186–204.
- Venkatesh, V., Morris, M. G., Davis, G. B., and Davis, F. D. User acceptance of information technology: toward a unified view. *MIS Quarterly*, 27, 3, 2003, 425–478.
- Webster, J., and Trevino, L. K. Rational and social theories as complementary explanations of communication media choices: two policy-capturing studies. *Academy of Management Journal*, 38, 6, 1995, 1544–1572.
- Yang, H.-D., and Yoo, Y. It's all about attitude: revisiting the technology acceptance model. *Decision Support Systems*, 38, 1, 2004, 19–31.
- Yoon, C., and Kim, S. Convenience and TAM in a ubiquitous computing environment: the case of wireless LAN. *Electronic Commerce Research and Applications*, 6, 1, 2007, 102–112.
- Zmijewska, A., and Lawrence, E. Implementation models in mobile payment. In Proceedings of the IASTED International Conference, Puerto Vallarta, 2006, 19–25.
- Zmijewska, A., Lawrence, E. and Steele, R. Classifying m-payments, Paper Presented at the third International Conference on Mobile Business, New York, 2004.
- Zmijewska, A., Lawrence, E. and Steele, R. Towards understanding of factors influencing user acceptance of mobile payment system, Paper Presented at the IADIS International Conference WWW/Internet, Madrid, 2004.