An integrated framework for the adoption and continuance intention to use mobile payment apps

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Abstract

Purpose - The purpose of this study is to develop and test an integrated model of the modified technology readiness index (TRI) with the extended expectation confirmation model, in the context of information technology (EECM-IT) to explain the adoption and the intention to continue to use mobile payment applications (apps).

Design/methodology/approach - Data was collected from 426 users of mobile payment apps across South Africa. A confirmatory factor analysis was performed to validate the factor structure of the measurement items while structural equation modelling (SEM) was employed to validate the proposed model and testing the hypotheses.

Findings - The overall model explained 81% of variance in adoption and 78.5% in the intention to continue to use mobile payment services. "Drivers" were better predictors of adoption than "inhibitors" while satisfaction emerged as the strongest predictor of continuance intentions.

Originality/value - To the best knowledge of the authors, this study is the first to empirically test an integrated modified TRI and E-ECM-IT model to supplement the paucity of research on the topic. The results show that the integrated model provides an enhanced way to understand the factors that influence adoption and continuance intention toward mobile payment apps. The results also add to existing knowledge of mobile technology literature.

Keywords: Mobile payment apps, adoption, continuance intention, technology readiness, expectation-confirmation theory.

Paper type: Research paper

1 Introduction

Mobile payments have become one of the technological revolutions of modern times, and they have disrupted and dominated markets in both the developing and the developed world. In 2014, it was estimated that global mobile payment services would have 450 million users by 2017 (Slade *et al*., 2014), and now the future projections point to an estimated 720 million subscribers by 2020 (GSMA, 2016).

While it is believed that mobile payments are the key to driving economic development in developing countries, mobile payments continue to create opportunities to earn money, and even to create new business ventures, thus empowering the general populations in developing countries (GSMA, 2016). South Africa is one of the three largest markets in Africa in terms of mobile subscribers (GSMA, 2016) so that understanding the usage of South African users of mobile payment apps is important, in order to grow the mobile payment market. Furthermore, research shedding light on the reasons for the slow uptake and more importantly, how to enhance the uptake of mobile payment apps is very sparse.

There is abundant literature examining the factors that impact on the initial adoption of information technology services (Liebana-Cabanillas *et al*., 2015; Mallat, 2007; Pham and Ho, 2015; Slade *et al*., 2014). The majority of these adoption studies have been conducted in developed countries, with little evidence to suggest mobile payment adoption studies focusing on developing countries. Similarly, there also seems to be growing academic attention being paid to consumer's continued use of information technologies (Kim and Crowston, 2011; Mouakket and Bettayeb, 2015), including mobile payment apps (Lu *et al*., 2017; Zhou, 2011), but only in developed countries. Both Greenland and Kwansah-Aidoo (2012)'s argument support the notion that international academic journals still neglect research in emerging markets, especially in the less developed countries of Sub-Saharan Africa.

There have also been conflicting reports in the adoption of mobile payments between developing and developed countries. Some reports indicate that mobile payments gained more traction in developed nations because of plentiful possibilities to shop on mobile phones (Statistica, 2018). Yet, Flood *et al*. (2013) reported that mobile payments initiated by short message service (SMS) occurred in developing countries well ahead of developed countries because the mature payment systems eroded the need for payments initiated by SMSs. On the other hand, Kshetri and Acharya (2012) reported that mobile payments in developing countries spread rapidly due to limited alternatives to cash, such as credit cards and cheque accounts as well as due to the fact that mobile payment apps may be the panacea for the financially excluded communities in Africa (Makina, 2017). Yet, Gupta and Garg (2015) indicated that South African consumers are not ready to adopt mobile payments because of the sophisticated banking industry.

Despite these inconsistent reports, experts tend to agree that the future of traditional payments such as cash, debit and credit cards, is on the demise and as a result banks, retailers, and mobile network operators are entering the mobile payment space to facilitate the mobile based consumption of their services (Shrier *et al*., 2016), often with limited information, as little attention has been paid to understanding the factors that predict the adoption and the intention to continue to use the ensued mobile payment apps.

Furthermore there seems to be a lack of consensus among researchers regarding a clear distinction between the factors that influence adoption and the intention to continue to use various mobile technologies. Previous adoption studies have studied consumers' continued use of various information technologies (Kim and Crowston, 2011). Constructs such as perceived cost, perceived risk, perceived ease-of-use and perceived usefulness have been studied to examine both consumers' adoption and intention to continue to use various new technologies

(Cho, 2016; Hung *et al*., 2012; Liebaña-Cabanillas *et al*., 2015; Makanyeza and Mutambayashata, 2018; Parasuraman, 2000; Setterstrom *et al*., 2013; Venkatesh *et al*., 2003).

Nevertheless, other scholars, such as Eriksson and Nilsson (2007), argue that researchers need to clearly delineate between the adoption and the continuance factors because consumer adoption and the intention to continue to use any new technology are influenced by different factors. Support for this argument is offered by Schuster *et al*. (2015), who reported that consumers' attitudes and perceptions change after experiencing a service. These contradictions require further research to provide a better understanding of the extent to which factors that lead to adoption can also lead to the continued use of the new technology.

Since adoption can be viewed as the initial step for continued use to take place, this suggests that the two phenomena should be studied collectively. However, a review of the literature shows that studies examining the initial adoption and the continuance intention have been conducted separately, thereby leading to a siloed or compartmentalised approach for doing research and this in turn, leads to a fragmented view instead of a more integrated and holistic perspective.

From a business perspective, examining user adoption and the intention to continue to use is important because "the irregular and ineffective long-term use of new technologies often contributes to corporate failure" (Bhattacherjee, 2001, p.352). Thus, until the continued usage of an information technology, such as mobile payments can be established, one cannot classify its adoption as a success (Thong *et al*., 2006).

To supplement the dearth of empirical studies on the topic, and to provide a more integrated approach, this study examines both the initial adoption and the continued use of mobile payment apps concurrently in a single study, and in the context of an emerging economy, which researchers believe has not been covered in depth to date. Drawing on the technology readiness

index (TRI) (Parasuraman, 2000) and the extended expectation-confirmation model in the context of information technology (E-ECM-IT) (Thong *et al*., 2006), this study proposes and empirically tests a conceptual model using structural equation modelling (SEM) to predict the adoption and the intention to continue to use mobile payment apps.

Firstly, the integration is intended to build a theoretical framework that can enhance the understanding of the factors that impact on adoption and continuance intention. Secondly, the study aims to empirically validate the proposed integrated model in the context of mobile payment apps. Thirdly, and from a practical perspective, the study may help service providers such as banks to appropriately invest the required resources in the development and provision of mobile payment services (Kim, Mirusmonov and Lee, 2010) that not only attract new users, but also retain existing ones for the realisation of their financial investments. Lastly, "a combination of theories can collectively provide a better and more comprehensive understanding of consumer behaviour regarding their IT usage than when each theory is considered alone" (Chong, 2013, p.24).

In the light of the above, there seems to be sufficient motivation to create a hybrid model. Hence, the TRI and E-ECM-IT constructs have been integrated to ground this study, in order to better explain and broaden this sparsely researched perspective.

Liebaña-Cabanillas *et al.* (2015) describe mobile payments as a convenient, safe and simplified payment transaction that uses a mobile device. From a consumer's perspective, mobile payments refer to purchases that are instigated and processed via a mobile phone (Schierz *et al*., 2010). Dahlberg *et al*. (2008) describe mobile payments from a device point of view as the payments that use a mobile phone or a tablet that utilises wireless communication technologies.

Based on the above conceptualisations, mobile payments are described in the context of this study, as a payment form that utilises an app-enabled mobile phone instead of cash, cheque or bank card to pay for goods and services.

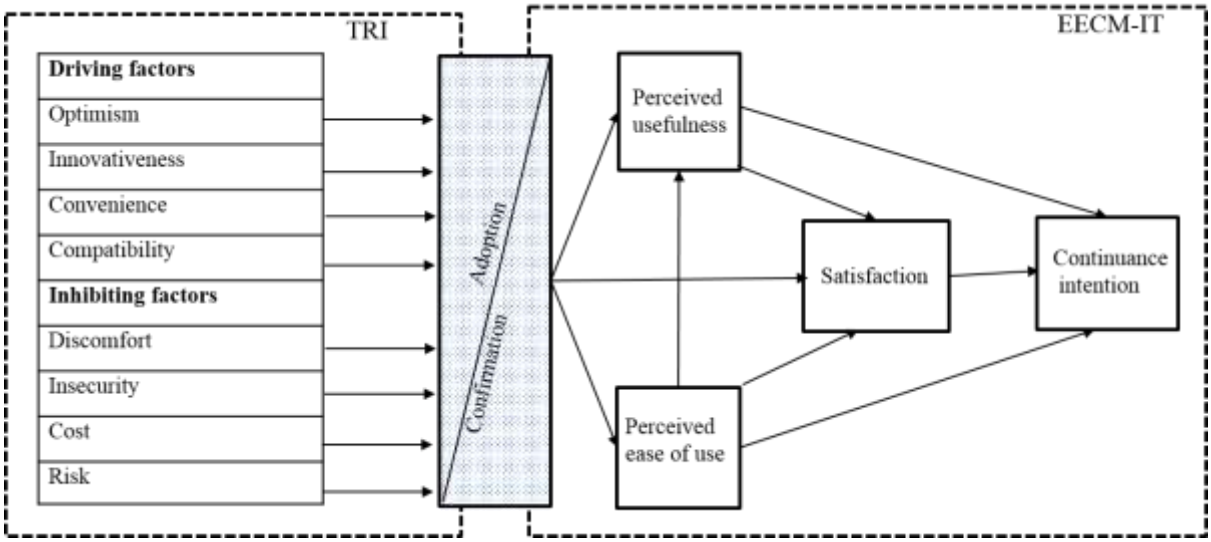
2 Development of a theoretical framework

The technology readiness index (TRI) (Parasuraman, 2000), was used as theoretical underpinning for adoption because it relates to an individual person's predisposition to use new technology, as well as the general thoughts and feelings about the new technology, and it is especially relevant to marketing settings (Lin *et al*., 2007). Furthermore, the TRI considers the individual differences between the drivers and the inhibitors of technology adoption (Parasuraman, 2000), which is congruent with our study that seeks to determine the factors that influence an individual to adopt mobile payment apps.

The E-ECM-IT, on the other hand, is suited to further our understanding of the continued use of mobile payment services as it examines the salient factors that affect the user's post-adoption usage of a new technology. It uses consumers' affective and cognitive beliefs experienced during consumption in order to predict satisfaction and the intention to continue to use the new technology. The model is applicable to a wide range of information systems service repurchasing and continuance and it has gained widespread acceptance in the literature to predict satisfaction and continuance intention (Hsu *et al*., 2006).

As noted earlier, the proposed framework for this study is a combination of two perspectives of the TRI and the E-ECM-IT in order to provide a holistic explanation of adoption and continuance intention behaviour in the context of mobile payments, as depicted in Figure 1.
It is therefore hypothesise that consumers' technology readiness significantly influences their cognitive and affective evaluations of mobile payment apps.

Figure 1 Technology readiness and extended expectation-confirmation measurement model in the context of mobile payments



2.1 Technology readiness to adopt mobile payment apps

Parasuraman and Colby (2015) describe technology readiness as the degree to which users embrace and use the new technology to accomplish their personal goals. Before a consumer adopts a new technology such as a mobile payment app, they must be ready to embrace such a new technology. Given the significant changes in the mobile technological developments and their impact on people's lives, the updated 16-item TRI 2.0 has become a relevant theoretical basis to understand consumers' reactions to the new technologies. In streamlining the original TRI, Parasuraman and Colby (2015) concluded that the TRI 2.0 has wider applicability because it is concise and thus makes it more robust for use across different contexts. More so, the TRI 2.0 can be used to assess technology readiness within a particular demographic group and is useful in understanding consumer dynamics behind technology adoption (Parasuraman and Colby, 2015). The TRI comprises four constructs: optimism and innovativeness as drivers and discomfort and insecurity as inhibitors of adoption (Parasuraman, 2000). To reflect the changing landscape and specific factors pertaining to the mobile payment context to improve the predictive ability of the TRI, four additions were made to the TRI: convenience, compatibility, perceived cost and perceived risk. Prior studies have reported positive

relationships between convenience (de Kerviler *et al*., 2016; Liao *et al*., 2012) as well as compatibility (Kwasawneh and Irshaidat, 2017; Liebana-Cabanillas *et al*., 2015) and the adoption of mobile banking. In a similar fashion, perceived risk and cost have also been identified as significant inhibitors of new technology adoption (Chong *et al*., 2012; Mallat, 2007; Pham and Ho, 2015).

2.1.1 Drivers of the technology readiness

Optimism refers to a positive attitude and the confidence that the new technology will improve users' personal lives (Parasuraman and Colby, 2015), while *innovativeness* is a consumer's predisposition to try out new information technologies rather than remain using previous choices (Kim *et al*., 2010). Prior studies have shown that both optimism and innovativeness positively influence the adoption of new technologies (Parasuraman, 2000; Kim *et al*., 2010).

The ability of mobile payments to eradicate multiple cards (Tan *et al*., 2015), making payment transactions, viewing balances, initiating and authorising transactions, regardless of time and location (Herzberg, 2003), makes mobile payments more *convenient* when compared with the traditional forms of payment. Another possible driver of adoption is the *compatibility* of the new technology (Kwasawneh and Irshaidat, 2017). If users perceive a technology as being consistent and in harmony with their behaviour, habits, values and needs (Liebaña-Cabanillas *et al*., 2015; Mallat, 2007), this would enhance their adoption levels.

In the light of the above, it can be hypothesised that:

$H_{1\text{-}4}$: *Drivers (optimism, innovativeness, convenience and compatibility) have a positive effect on the adoption of mobile payment apps.*

2.1.2 Inhibitors of technology readiness

Insecurity, described by Parasuraman and Colby (2015) as the suspicions that consumers have regarding the new technology, in terms of its possible failure to deliver the expected benefits and its possible harmful effects, could inhibit the adoption of mobile payment apps. Additionally, *discomfort*, the perceived feeling of uneasiness regarding whether the consumer would be able to use and control the new technology to their advantage (Parasuraman and Colby, 2015), could also slow down the adoption of an innovation.

Users who experience discomfort in using the new technology feel overwhelmed by the use thereof (Walczuch *et al*., 2007) so that they would be less receptive of new technology. Several studies have found a negative relationship between high levels of discomfort and insecurity and the adoption of the new technology (Walczuch *et al*., 2007; Parasuraman, 2000).

In a study done by Mallat (2007), the *cost* of using mobile payments negatively impacted consumers' willingness to adopt mobile payments. The results of their study indicated that consumers resent mobile payments that transfer the transaction costs to consumers, without any added advantages. In the same way, the probability of a loss or injury *(perceived risk)* that might be caused by the use of the new technology (Pham and Ho, 2015), could also jeopardise the chances of adopting the new technology.

Prior studies have considered the perception of risk as a deterrent factor in the adoption of mobile payments (Mallat, 2007, Pham and Ho, 2015). Consequently, we hypothesise that:

H $_{5\text{-}8}$ *Inhibitors (discomfort, insecurity, perceived cost and perceived risk) have a negative effect on the adoption of mobile payment apps.*

2.2 Adoption vis-a-vis confirmation

Adoption theory explains why an individual accepts or rejects an innovation (Straub, 2009). Adoption thus takes place if the mobile payment app is appropriate for the task at hand in terms of convenience and compatibility with user values, beliefs and lifestyle, and whether their pre-

use expectations are met or confirmed. If a consumer encounters obstacles, such as cost, risk, insecurity or discomfort in mobile payment app transactions, this could lead to disappointment, resulting in the rejection of the mobile payment app.

In a similar fashion, confirmation of expectations are realised if the product meets or exceeds the consumers' prior expectations, but when the product or service falls short of expectations, there would be disconfirmation, leading to rejection of the product or service (Oliver, 1980).

This study describes confirmation as the perception of consistency between the drivers and inhibitors in using the mobile payment app and in the actual adoption thereof. From the above, it can be observed that the conceptualisation between confirmation (the performance of the product as expected) (Bhattacherjee, 2001) and adoption (a choice to accept or reject an innovation) (Straub, 2009) suggests that confirmation and adoption are terms that can be used interchangeably because both of these measure consumers' experience after using a new technology.

In other words, both adoption and confirmation take into account the actual experience of using the mobile payment app to confirm/adopt, or refute the initial expectations of the service. As a consequence, we argue that the modified TRI predicts adoption. The adoption of the new technology reflects the confirmation of expectations that serve as an antecedent (indirectly through satisfaction) to the continued use thereof.

2.3 Continuance intention to use mobile payment apps

The E-ECM-IT proposes that confirmation, perceived ease-of-use and perceived usefulness, positively predict satisfaction and the intention to continue to use mobile payment apps. The impact of confirmation (adoption) on satisfaction, perceived ease-of-use, and on perceived usefulness has been reported in various contexts, such as online banking (Bhattacherjee, 2001),

general information-technology behaviour (Hong *et al*., 2006) and smartphone-banking services (Susanto *et al*., 2016). Each of these constructs will now be discussed in detail.

Davis (1989, p.320) defines perceived usefulness as "the belief that using a particular innovation or technology would improve one's job performance". In the context of our proposed model, perceived usefulness represents the practical benefits that an individual experiences when using mobile payment apps. Hong *et al*. (2006) reported that user's perceived usefulness of a new technology is a key determinant of satisfaction and continuance intention. Many studies have pointed to the direct effects of the perceived ease-of-use on perceived usefulness (Cho, 2016; Kim *et al*., 2010; Liebaña-Cabanillas *et al*., 2015). A new technology regarded as being easy to use facilitates the accomplishment of more individual tasks than a new technology with lower perceived ease-of-use (Ashraf *et al*., 2014). According to these authors, systems that are easy to use are more accessible and they would influence the perceived usefulness. It stands to reason that mobile payment apps that are easy to use will be more accessible and therefore, they would influence the perceived usefulness thereof.

Given that user satisfaction is a type of an emotion, if mobile payments are considered easy to use, consumers' level of satisfaction with the new technology would be enhanced (Thong *et al*., 2006). Prior studies have also indicated that the perceived ease-of-use can have an indirect effect on the continuance intention through usefulness (Cho, 2016). This implies that when an individual realises that few resources are needed to learn a new mobile technology, he or she may perceive the technology as being useful, which leads to the continued use thereof. Satisfaction is one of the positive emotions experienced by the consumer from using the mobile payment app. Satisfied customers can provide not only an effective channel to attract new users via word-of-mouth communications (Thong *et al*., 2006), but they can also act as a steady and reliable source of revenue, resulting from repeated business (Hong *et al*., 2006). However, more importantly, previous studies have demonstrated that satisfaction is a fundamental driving

force for continued use (Eriksson and Nilsson, 2007; Mouakket and Bettayeb, 2015; Thong *et al*., 2006). Continuance intention can be defined as the degree to which an individual currently using a mobile phone to purchase products or services has developed conscious plans to continue using it in the future (Setterstrom *et al*., 2013). Consumers' continuance intentions are determined by their satisfaction with prior use and this association has been corroborated in previous studies (Chen *et al*., 2012; Hong *et al*., 2006).

Based on the above, it can be hypothesised that:

H_9 *Adoption of mobile payment apps has a positive effect on satisfaction*.

H_{10} *Adoption of mobile payment apps has a positive effect on usefulness.*

H_{11} *Adoption of mobile payment apps has a positive effect on ease-of-use.*

H_{12} *Perceived ease-of-use of mobile payment apps has a positive effect on usefulness.*

H_{13} *Perceived ease-of-use of mobile payment apps has a positive effect on satisfaction.*

H_{14} *Perceived ease-of-use of mobile payment apps has a positive effect on continuance intention.*

H_{15} *Perceived usefulness of mobile payment apps has a positive effect on satisfaction.*

H_{16} *Perceived usefulness of mobile payment apps has a positive effect on continuance intention.*

H_{17} *Satisfaction with mobile payment apps has a positive effect on continuance intention.*

3 Methodology

The participants of the survey were adults aged 18 years and older, who had downloaded a mobile payment app prior to participating in the study. Convenience sampling was used to distribute a self-administered questionnaire via an online South African consumer panel hosted by an international research firm, resulting in a sample of 426 respondents. Existing scales

were adopted from literature and slightly adapted to reflect the mobile payment app content and 7-point Likert scales points were used with 1 (strongly disagree) and 7 (strongly agree).

The questionnaire consisted of three sections. Section A pertained to mobile payment app usage while section B contained statements measuring the extent of adoption and the continuance intention to do so. Section C pertained to the demographic information of the respondents. The 4-item scales measuring optimism, innovativeness, discomfort, and insecurity, were all adapted from Parasuraman and Colby (2015). Scales measuring convenience (4 items) and perceived ease-of-use (5 items) were adapted from Kim *et al*. (2010). Perceived cost (3 items) were adapted from Kim (2010) while compatibility (3 items) were adapted from Schierz *et al.* (2010). Perceived risk consists of three scale items and were taken from Ramos-de-Luna *et al.* (2015). Adoption, continued intention and perceived usefulness scales were adapted from Bhattacherjee (2001), while the four-item satisfaction scale were taken from Susanto *et al*. (2016). The questionnaire was pre-tested before it was distributed.

4 Results

4.1 Descriptive statistics

From a total of 426 respondents, 213 were males (51.2%) and 203 were females (48.8%) representing an almost equal gender distribution. The age distribution of the respondents ranged from 18 to 71. Most of the respondents were aged 20-29 years (35.8%) and 30-39 years (30.3%). Of the 86% of respondents who preferred to answer the question relating to household income, 33% earned below R15 000 per month, 43% earned up to R45 000, while 10% earned R47 000 and higher, thus representing low, middle and high-income brackets in South Africa (SAARF, 2012). Snapscan was the most used mobile payment app among the respondents (35%), followed by Zapper (17%).

4.2 Measurement model

To assess the reliability and validity of the proposed measurement model, confirmatory factor analysis (CFA) was conducted (Pallant, 2016), using AMOS Version 24 software. Based on the initial results, 42 out of 47 indicator items were retained for further processing. Five items with factor loadings below 0.5 (Hair *et al.,* 2006) were identified and excluded from further analysis (C1 related to optimism, C7 related to innovativeness, C9 related to discomfort, C16 related to insecurity and C37 related to usefulness). The obtained fit indices of Chi-square (χ^2) (741) =1335.293 (p=0.00), Chi-square/degrees of freedom (χ^2/df.)=1.802, adjusted goodness-of-fit index (AGFI**)** =0.841, comparative fit index (CFI**)** =0.941, Tucker Lewis Index (TLI**)** =0.923, and root mean square error of approximation (RMSEA**)** =0.44, indicate acceptable model fit.

4.3 Reliability and validity

4.3.1 Convergent validity

Convergent validity was assessed by inspecting the values and significance of the factor loadings and the average variance extracted (AVEs) (Fornell and Larcker, 1981). The results in Table 1 indicate that all the constructs had good internal consistency as the composite reliability (CR) and Cronbach's Alpha values were all greater than the recommended threshold of 0.7 (Nunnally, 1978). Furthermore, all the factor loadings were significant and equal to or greater than 0.5 (Hair *et al*., 2006).

The AVE also meets or exceeds the cut-off point of 0.5 (Hair *et al*., 2006), which seems to suggest that the scale items used are representative of each construct and support convergent validity.

Table 1 Factor loadings, CR, Cronbach's Alpha and AVE values

Construct	Items	Factor loadings	CR	Alpha	AVE
Optimism	Optim. C2	0.742	0.756	0.722	0.512
	Optim. C3	0.805			
	Optim. C4	0.582			
Innovativeness	Innov. C5	0.631	0.745	0.738	0.500
	Innov. C6	0.772			
	Innov. C8	0.701			
Convenience	Conven. C21	0.743	0.799	0.775	0.500
	Conven. C22	0.743			
	Conven. C23	0.615			
	Conven. C24	0.718			
Compatibility	Compat. C25	0.828	0.833	0.825	0.624
	Compat. C26	0.787			
	Compat. C27	0.753			
Discomfort	Discom. C10	0.732	0.738	0.738	0.500
	Discom. C11	0.672			
	Discom. C12	0.682			
Insecurity	Insec. C13	0.613	0.767	0.760	0.529
	Insec. C14	0.865			
	Insec. C15	0.681			
Cost	Cost C28	0.675	0.847	0.838	0.651
	Cost C29	0.876			
	Cost C30	0.854			
Risk	Risk C31	0.755	0.869	0.866	0.690
	Risk C32	0.887			
	Risk C33	0.845			
Adoption	Adopt C34	0.766	0.776	0.776	0.536
	Adop C35	0.745			
	Adop C36	0.683			
Usefulness	Use C38	0.816	0.791	0.791	0.654
	Use C39	0.801			
Ease-of-use	Eou C40	0.763	0.877	0.873	0.589
	Eou C41	0.798			
	Eou C42	0.763			
	Eou C43	0.817			
	Eou C44	0.690			
Satisfaction	Sat C48	0.879	0.909	0.908	0.714
	Sat C49	0.779			
	Sat C50	0.868			
	Sat C51	0.850			
Continuance intention	CI C45	0.915	0.936	0.935	0.830
	CI C46	0.927			
	CI C47	0.890			

Note: All the factor loadings were significant at the 0.05 level

4.3.2 Discriminant validity

Discriminant validity was assessed by using the Fornell and Larcker (1981) criterion, in which the square root of the AVE should exceed the shared correlations between each pair of constructs in order to confirm that the constructs are unique. The results in Table 2 show that most diagonal values exceed the inter-construct correlations and thereby confirm the discriminant validity.

Table 2. Results of discriminant validity

	Opt	Inno	Disco	Insec	Conv	Com	Cost	Risk	Ado	Use	EOU	Sati	Cont
Opt	**0.716**												
Inno	0.441	**0.707**											
Disc	-0.077	-0.077	**0.707**										
Insec	-0.313	-0.136	0.352	**0.728**									
Conv	0.663	0.450	-0.011	-0.101	**0.707**								
Com	0.572	0.535	-0.047	-0.148	0.850	**0.790**							
Cost	0.234	0.306	-0.209	-0.112	0.344	0.398	**0.807**						
Risk	0.424	0.354	-0.002	-0.128	0.394	0.415	0.393	**0.831**					
Ado	0.566	0.494	-0.130	-0.236	0.729	0.734	0.574	0.553	**0.732**				
Use	0.612	0.378	-0.062	-0.182	0.784	0.840	0.404	0.396	0.756	**0.809**			
EOU	0.423	0.440	-0.177	-0.134	0.613	0.551	0.390	0.360	0.606	0.692	**0.767**		
Satis	0.543	0.409	-0.083	-0.215	0.745	0.738	0.407	0.427	0.782	0.813	0.691	**0.845**	
Cont	0.513	0.373	-0.035	-0.221	0.696	0.733	0.351	0.349	0.688	0.731	0.542	0.890	**0.911**

Note: The diagonal elements in bold represents the square roots of the average variance extracted (AVE). The off-diagonal elements represent the correlation coefficients.

However, a few constructs that showed weak discriminant validities were subjected to further testing. Shiu *et al.* (2011) cites that one of the limitations of the Fornell and Larcker (1981) criterion is that the procedure is a rule-of-thumb, in which the researcher does not take sampling errors into consideration. Against this backdrop, this study applied three additional procedures to determine discriminant validity for those constructs showing weak validities with the Fornell and Larcker (1981) criterion.

Table 3 Procedures estimating discriminant validity

	Chi-square difference tests					**Confidence intervals**		**Correlation coefficients**
	Constrained CFA model		Unconstrained CFA model		Chi-square diff			
Constructs	Chi-square	Df	Chi - square	Df		BBCI Lower	BBCI Upper	Estimate
Satisfaction & Continuance intention	199.3	14	51.9	13	52.2 (*df* =1)	0.835	0.939	0.890
Satisfaction & Usefulness	193.9	14	59.9	13	134 (*d*f =1)	0.666	0.885	0.789
Satisfaction & Adoption	156.1	14	63.4	13	92.7 (*df* =1)	0.680	0.864	0.783
Usefulness & Adoption	118.5	9	21.1	8	96 (*df* =1)	0.621	0.831	0.736
Usefulness & Compatibility	102.2	9	21.7	8	97.4 (*df* =1)	0.735	0.891	0.840
Convenience & Compatibility	113.7	14	51.2	13	62.5 (*df* =1)	0.769	0.912	0.840
Convenience & Adoption	163.1	14	67.0	13	96.1 (*df* =1)	0.599	0.818	0.719
Convenience & Satisfaction	249.2	20	93.6	19	155.6 (*df* =1)	0.631	0.824	0.739
Convenience & Usefulness	168.1	14	61.5	13	106.6 (*df* =1)	0.654	0.861	0.761

Note: Df= degrees of freedom

The difference in the Chi-square values between the unconstrained CFA model and the nested CFA model was greater than the threshold value of 3.84. This indicates that a pair of constructs is distinct (Bagozzi and Phillips, 1982). Additionally, the confidence intervals for the estimated correlations between the pairs of constructs (Bagozzi *et al*., 1991) were examined. Here, a 95% confidence interval for the correlations between the two constructs that do not contain unity indicates that discriminant validity is established. Lastly, the criteria of Hair *et al*. (1998) stipulate that the correlation coefficients between a pair of constructs, which is less than 0.9, is indicative of discriminant validity.

From the results shown in Table 3, it is evident that discriminant validity was confirmed and all the constructs were retained for further analysis**.**

4.4 Structural model

The hypothesised paths were tested using SEM, due its ability to test both the relationships and the overall fitness of the research model (Hair *et al*., 2006). The results of the goodness-of-fit of the structural model X^2 (790) =1594.417 (p=0.00) are reported in Table 4. It is evident from the results that an acceptable model fit was achieved.

Table 4 Structural model fit statistics

Fit indicators	**Overall model**	**Recommended thresholds**	**Recommending authors**
X^2/df	2.018	≤5.00	Hooper *et al.* (2008)
CFI	0.920	≥0.90	Hair *et al*. (2006)
TLI	0.913	≥0.90	Hair *et al*.(2006)
IFI	0.921	≥0.90	Hair *et al*. (2006)
RMSEA	0.050	≤0.06	Hu and Bentler (1999)

4.4.1 Hypothesis testing

It is evident from Table 5 and it can be seen in Figure 2, that the results of the path analyses provide support for twelve out of the seventeen hypotheses tested in this study.

Table 5 Results of the hypotheses testing

H	**Hypothesised Path**	**SRW**	**P value**	**Remark**
H1	Optimism-->Adoption	0.072	0.246	*Not supported*
H2	Innovativeness-->Adoption	0.009	0.866	*Not supported*
H3	Convenience-->Adoption	0.407**	0.000	Supported
H4	Compatibility-->Adoption	0.401**	0.000	Supported
H5	Discomfort-->Adoption	-0.014	0.755	*Not supported*
H6	Insecurity-->Adoption	-0.098**	0.024	Supported
H7	Cost-->Adoption	-0.239**	0.000	Supported
H8	Risk-->Adoption	-0.152**	0.000	Supported
H9	Adoption-->Satisfaction	0.499**	0.000	Supported
H10	Adoption-->Usefulness	0.704**	0.000	Supported
H11	Adoption-->ease of use	0.631**	0.000	Supported
H12	Ease-of-use-->Usefulness	0.213**	0.000	Supported
H13	Usefulness-->Satisfaction	0.245**	0.019	Supported

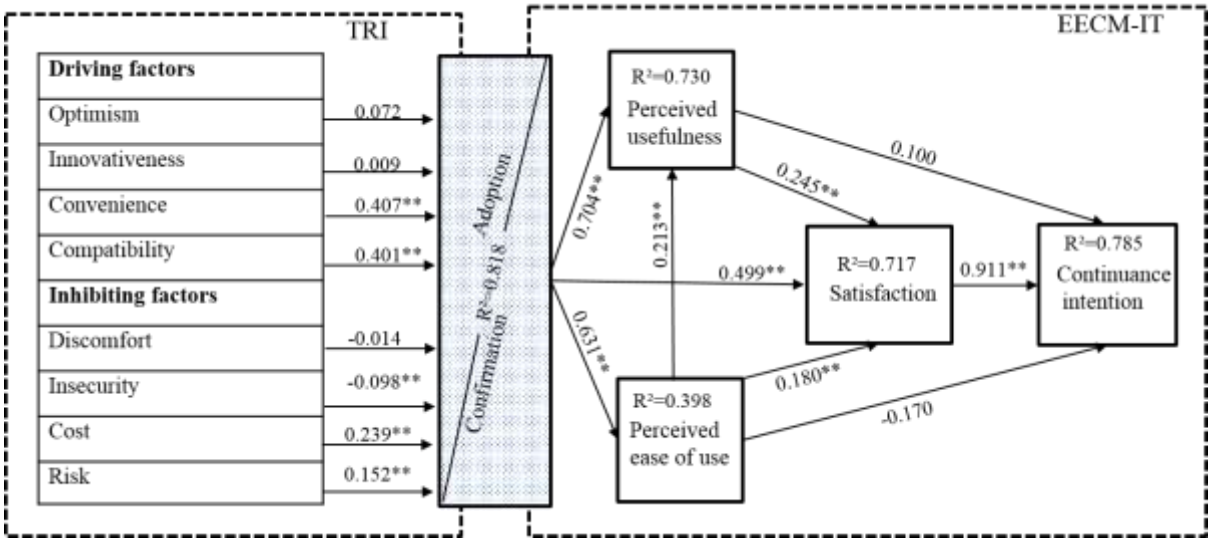
H14	Ease of use-->Satisfaction	0.180**	0.001	Supported
H15	Usefulness-->Continued Int	0.100	0.171	*Not supported*
H16	Ease of use-->Continued Int	-0.170**	0.000	*Not Supported*
H17	Satisfaction-->Continuance Int	0.911**	0.000	Supported

Note: H = Hypothesis; SRW = Standardized regression weight; ** = Significant at p<0.05

Five of the eight factors hypothesised as predictors of mobile payment app adoption were significant: convenience (β=0.407, p<0.05), compatibility (β=0.401, p<0.05), insecurity (β=-0.098, p<0.05), cost (β=0.239, p<0.05) and risk (β=0.152, p<0.05). Thus, there is support for H3, H4, H6, H7, and H8, respectively. Contrary to our expectations, optimism (β=0.072, p>0.05), innovativeness (β=0.009, p>0.05) and discomfort (β=-0.014, p>0.05), showed non-significant relationships with adoption. Consequently, H1, H2 and H5 were not confirmed.

Overall, the presence of drivers seem to be stronger predictors of the adoption of mobile payment apps than do the absence of inhibitors. As shown in Figure 2, the driving and inhibiting factors accounted for 81.8% of the variance explained in the consumer readiness to adopt mobile payment apps.

Figure 2 Path diagram and relationships between constructs



** = Significant relationship at p <0.05

With regard to the E-ECM-IT, adoption (β=0.499, p<0.05), usefulness (β=0.245, p<0.05) and ease-of-use (β=0.180, p<0.05) were positive predictors of consumer satisfaction, to show

support for H9, H13, and H14, explaining 71.7% of the variance in satisfaction. Both the adoption of mobile payment apps (β=0.704, $p<0.05$) and the ease-of-use (β=0.213, $p<0.05$) positively predict the usefulness, thereby confirming H10 and H12, and this explained 73% of the variance in perceived usefulness. The results also show that adoption (β=0.631, $p<0.05$) has a positive effect on ease-of-use, showing support for H11.

In terms of predicting the intention to continue to use mobile payment apps, usefulness (β=0.100, $p>0.05$) did not reach the level of significance while ease-of-use (β=-0.170, $p<0.05$), although significant, showed an inverse relationship that is contrary to the set hypothesis. Therefore, H15 and H16 were not supported. Satisfaction (β=0.911, $p<0.05$) emerged as the strongest predictor of the intention to continue to use mobile payment apps, and showing support for H17. Overall, Figure 2 shows that the model explained 78.5% of variance in consumers' intention to continue to use mobile payment apps.

This result (78.5% of variance explained) is thus better compared to similar studies as the model explains more variance. Hong *et al*. (2006), reported only 67% of the variance explained in their e-services study, and the study of Hsiao and Chang (2014), reported only 54% of variance in a mobile advertising study, both of which only employed the E-ECM-IT in isolation to predict continued technology usage behaviour. The improved variance explained could be due to the combination of the TRI and EECM-IT into one comprehensive model, further indicating the importance of investigating adoption as the first step in the intention to continue to use mobile payments.

5 Discussion

Previous studies on mobile payment services have not fully investigated both the factors that influence consumers' intention to adopt and the continuance use of various mobile payment

apps in a single study. This study attempts to fill this research gap, by introducing a new integrated model, combining the constructs derived from the modified TRI and the E-ECM-IT.

Firstly, the results challenge some of the basic dimensions of the TRI as several of the original TRI relationships were not confirmed in our context. Optimism, innovativeness and discomfort were insignificant in predicting the adoption of mobile payment apps in South Africa. These unforeseen results are contrary to the findings of previous studies in developed countries (Gupta and Garg, 2015; Meng *et al*., 2009; Walczuch *et al*., 2007).

A plausible explanation could be the fact that the TRI was developed from an American perspective (Meng *et al*., 2009) such that it requires further testing in other Sub-Saharan countries as individuals could differ in their personality traits and their acceptance of a new technology. The result suggests that some of the American/Western theories are not always significant in the context of developing countries (Duh, 2015), thereby highlighting the importance of conducting research, such as that of our study to test the applicability of Western theories in the context of Africa. Despite that, the results are supportive of the majority of hypotheses and they provide a better understanding of what influences consumers to initially adopt mobile payment apps as indicated in the variance explained (81.8%) in the adoption of mobile payment apps.

The overall indication is that banks and other service providers should focus more on the driving factors than on the inhibiting factors. Convenience and compatibility emerged as strong contributors to the adoption of mobile payment apps. This implies that consumers' perception of convenience and compatibility with their life style enhances their intention to adopt and use mobile payment apps (Mallat, 2007). Thus, the convenience of being able to use mobile payment apps anytime and in any situation, and the execution of mobile payment services befitting consumers' purchase behaviours are important considerations.

A key measure of success of a mobile payment service is its adoption by the intended users (Makanyaza and Mutambayashata, 2018). Therefore, service providers ought to craft tangible solutions based on the fundamental driving forces affecting the adoption of mobile payment apps if they are to realise the economic value that can be derived from mobile payments. This is important, particularly in developing countries experiencing growth in the ubiquity of mobile phones and broadened financial access, from which mobile payments are expected to create more opportunities for financial inclusion.

This study corroborates the findings of Kalan (2016), who underscored the impact of risk as a deterrent to the adoption of mobile payment apps in South Africa. Our study revealed that the perception of apps being risky and costly, reduces consumers' propensity to embrace them. Unless service providers can reduce the transaction costs and improve the transparency of mobile payment transactions, consumers' perception of the high costs associated with mobile payments would hinder the adoption process (Zhou, 2011). This finding was also corroborated by Chong (2013), who cautioned service providers against pricing their services beyond those of the competition as some of the competitors offer the services without requiring any payment at all.

In terms of the intention to continue to use mobile payment apps, the findings validate the majority of the hypothesised paths of the E-ECM-IT, except H15 and H16, challenging previous studies (Hong *et al*., 2006; Thong *et al*., 2006). However, they corroborate other previous studies (Bhattacherjee, 2001, Hsu *et al*., 2006) indicating that confirmation (adoption) exerts a strong effect on satisfaction. Thus, meeting or exceeding users' expectations such as accurate billing and transaction records in mobile payments are crucial elements in effecting high satisfaction levels. Ease-of-use was a significant predictor of satisfaction and the intention to continue to use mobile payment apps but it showed an inverse relationship. This result

warrants further investigation, in order to determine whether indeed the importance of ease-of-use diminishes with experience.

Usefulness was also found to be a significant predictor of satisfaction but it was not found to directly affect the intention to continue to use mobile payment apps. It seems as if usefulness could have a more indirect effect through satisfaction on the intention to continue to use the mobile payment apps. Although not expected, this result supports the findings by Hung *et al.* (2012), who reported that consumers are not motivated by past benefits, but rather by future benefits. No matter how good the mobile payment system was in the past, its future use is based on the expectations of future benefits. Therefore, the motivation to continue using mobile payment apps is dependent on the anticipated future benefits rather than on the usefulness thereof.

Satisfaction emerged as the strongest predictor of the intention to continue to use mobile payment apps. It is important to ensure that customer experiences are consistent in order to strengthen their continuance intention; because satisfaction is a result of meeting customers' expectations of the service (confirmation/adoption), as well as the usefulness and the ease-of-use of the app.

The emphasis should be placed on important issues, such as reliable connectivity and security to bring about a sense of satisfaction that would lead to the continued use of mobile payment apps. Since the majority of the E-ECM-IT relationships were confirmed, this suggests that the model could be suitable for use in the African context. Overall, the results thus provide empirical evidence for the proposed integrated model's predictive capabilities in terms of mobile payment app adoption and continued use, and they suggest that it is generic enough to apply to various new technology adoption and continuance intention studies.

6 Implications of the study

6.1 Theoretical implications

The first theoretical contribution of this study is the development of a synthesised model, based on the TRI and E-ECM-IT in order to explain users' the adoption and their intention to continue to use mobile payment apps. The study theorised that technology readiness significantly influences continuance intention through the direct and indirect effects of ease-of-use, usefulness and satisfaction. And indeed, the findings of this study show that mobile payment readiness significantly influences consumers' intention to continue using the mobile payment apps.

Our second contribution lies in the expanding of the original TRI by including four additional constructs taken from the existing literature, namely convenience, compatibility, cost and risk, which are found to be useful in the context of mobile payments. Because some of the relationships in the original TRI were not confirmed, the modified TRI 2.0 might be a more applicable model for investigating the adoption of mobile payment apps in developing countries, than the original one.

Overall, the model explained 78.5% of the variance in the intention to continue to use mobile payment apps, a percentage much higher, when compared with the variance explained in previous related studies (Bhattacherjee, 2001; Hong *et al*., 2006), thereby signifying the robustness of the proposed integrated model. The results indicate that the proposed model is suitable enough and it now needs validation through additional research, in order to confirm its ability to predict the adoption and the intention to continue to use new technologies.

Thirdly the study contributes to the growing body of literature on mobile payments, and specifically on payment apps in Sub-Saharan economies, as not much had been done in the

context of emerging economies, such as that of South Africa, where local market factors are conducive to mobile payment systems.

6.2 Managerial implications

It emerged that ease-of-use and usefulness are prerequisites for customer satisfaction, and ultimately the intention to continue using mobile payment apps. Ease-of-use plays a vital role in customers' interaction with a mobile payment app, and is regarded as an important 'moment of truth' to cement the foundation for a lasting relationship. For any mobile payment experience to be memorable, not only has it to be compatible with users' lifestyle but should also be more convenient and safer (less risks and insecurity) than traditional payment methods. However, for consumers to continue to use mobile payment apps, compatibility and convenience may not be enough. Service providers should craft sustainable and distinct value propositions based not only on convenience and compatibility, but also emphasising the ease-of-use, and usefulness benefits of the safe, single payment method offered by mobile payment apps. Unfortunately, currently marketing communications depicting these benefits of mobile payments apps in South Africa are scarce. Proactive marketing communications creating awareness of these benefits as well encouraging downloads of these apps using special discounts, friend referrals, encouragement by retailers and assistance for first time users, are needed to enhance adoption. Furthermore, marketing strategies such as customer alerts, notifications, reminders via tailored messages to customers and loyalty rewards could enhance the intention to continue to use mobile payments apps.

It is also evident that the key obstacles to adoption revolve around the issue of security and risk involved in the download and first time use of mobile payment apps. One way to address the problem is to provide training and assistance to first time users of mobile payment apps to demonstrate how to use the app and showcase the safety features. This could be facilitated via

short YouTube videos or instructions on mobile service providers and banks' websites, step-by-step instructions printed on invoices or retail staff such as waiters. Due to an increase in mobile payment options, consumers store their personal details on a variety of mobile payment platforms, which increases the risks of hacking and fraud. Therefore, security features such as encryption, biometrics, and authentication should be given due consideration, as they offer safety benefits to consumers and merchants (Delloite and Touche, 2015). More importantly, service providers need to offer consumers sufficient payment documentation and avoid any transaction errors that may arise during the process. Security is especially relevant to South Africans as they are considered to be risk averse (Babin and Harris, 2014), which could result in the slow adoption of unfamiliar technologies. To prevent any scepticisms about mobile payments, service providers must provide greater amounts of mobile payment app information and educate consumers on how value is obtained by using these apps. The banking sector could play an important role in reducing the insecurity of users by more publicly supporting mobile payments apps and even work more closely with mobile payment app developers.

The relationship between satisfaction and the intention to continue to use mobile technology has long been proven (Singh *et al*., 2017). If consumers prefer doing transactions via mobile payments apps and are satisfied with the service, their usage will increase over time. Thus, service providers should constantly measure the satisfaction level of users with short surveys via the app, to identify and rectify service failures.

In South Africa, popular mobile payment apps such as SnapScan and Zapper are not linked to debit cards but are compatible with credit cards. This can lead to a loss of customers due to transaction costs associated with the use of credit cards, as well as excluding the unbanked population. Therefore, service providers should devise mobile payment apps that are compatible with multiple bank cards or no cards at all to ensure that more consumers can utilise mobile payment apps. South Africa is reflective of other developing economies because it is

estimated that 7 million people in South Africa are on payrolls yet they do not own any bank account (Vodacom, 2015). With this sizeable unbanked population that depend on cash, mobile payments are expected to fill an important gap. Mobile payment apps could provide an opportunity for the unbanked population to 'leapfrog' past the 'card stage' directly to mobile payment apps.

Convincing consumers to convert from traditional payment methods to mobile payment apps requires the collaboration of several role-players. Although the customer is an important role-player, other stakeholders such as government, financial institutions such as banks, mobile providers and merchants' collaboration is needed. Government, banks and network operators need to provide and enabling environment to push mobile payment apps while merchants need to pull customers towards mobile payment adoption and use, creating a seamless customer experience.

7 Limitations and direction for future research

The primary objective of this study was to test the applicability of the proposed integrated model in the context of a developing country. As mobile technology continues to advance and diffuse into society, it is hoped that the findings reported in this study have contributed to the understanding of the mobile technology adoption and the continued use thereof.

This research has limitations worth noting such as a single country context and the convenience sampling technique which was employed to collect data. Due to the fact that not all hypotheses in the study were confirmed, future replication studies are needed to determine whether similar results would be obtained, and whether a more parsimonious model exists.

In conclusion, we argue that mobile payment apps are becoming more prevalent and possibly they hold the key to unlocking economic growth in Africa. We urge other researchers to explore

future research avenues across different cultures, in order to increase the momentum in the uptake of mobile payment apps to ensure economic growth in Africa.

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