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## **The effect of awareness and perceived risk on the technology acceptance model (TAM): mobile banking in Yemen**

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**Abstract:** Mobile banking has the potential to outperform the internet banking, since, the usage of internet in Yemen is very limited. The purpose of this study is to examine the effect of perceived risk and awareness as external variables on the technology acceptance model (TAM) for a comprehensive understanding of intention to use mobile banking. A questionnaire was used to collect data, and 482 valid responses were received. The model explained 78% of the variance in intention. Results revealed that awareness reduces the perception of risk. In addition, perceived risk is a major attenuator for the perceived ease of use (PEOU), and perceived usefulness (PU). Awareness also had a significant impact on PU and PEOU. In addition, PU was found as a major predictor of the intention. The results of the current study will give additional insights into productive strategies to extend mobile banking in countries such as Yemen.

**Keywords:** mobile banking; TAM; technology acceptance model; perceived risk; awareness; intention to use mobile banking services.

**Reference** to this paper should be made as follows: Mutahar, A.M., Daud, N.M., Ramayah, T., Isaac, O. and Aldholay, A.H. (2018) 'The effect of awareness and perceived risk on the technology acceptance model (TAM): mobile banking in Yemen', *Int. J. Services and Standards*, Vol. 12, No. 2, pp.180–204.

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## 1 Introduction

The proliferation of telecommunications and the advancement of technology, especially mobile technology, have spurred the growth of mobile banking. Worldwide, the number of mobile phones exceeds the number of PCs, according to a recent consumer study by Gartner (2015) (see Table 1) who revealed that worldwide shipment of PCs are predicted to reach a total of 333 million units in 2016 (a 4.5% increase from 2014), while mobile phones are expected to lead overall device shipments to reach 1.969 billion mobile phones shipped in 2016 (an increase of 6.6% from 2014). The scenario in emerging markets is a low penetration of bank accounts but a high adoption of mobile phones (Sunil, 2013). In Yemen, mobile device usage has increased rapidly to 68.49% (see Figure 1) of the total population (BuddeComm, 2012; MADAR Research & Development, 2012; World Development Indicators, 2016; World Economic Forum, 2014). However, the 2,044,245 accounts opened in all financial institutions in Yemen, only represents about 8.1% of the Yemeni population (Central Bank of Yemen, 2014). Because internet adoption in Yemen is very poor, mobile banking has the potential to outperform internet banking, in a country where only 20% of the total population use the internet (World Development Indicators, 2016). The high adoption of mobile phones can be a catalyst for involving an under-served population in financial transactions.

**Table 1** Worldwide device shipments by segment, 2014-2016 (millions of units)

<i>Device type</i>	<i>2014</i>	<i>2015</i>	<i>2016</i>
PC (personal computer)	<b>318</b>	<b>321</b>	<b>333</b>
Tablet	216	233	259
Mobile phone	1.838	1.906	1.969
Other hybrids/clamshells	6	9	11
<b>Total</b>	<b>2.378</b>	<b>2.470</b>	<b>2.572</b>

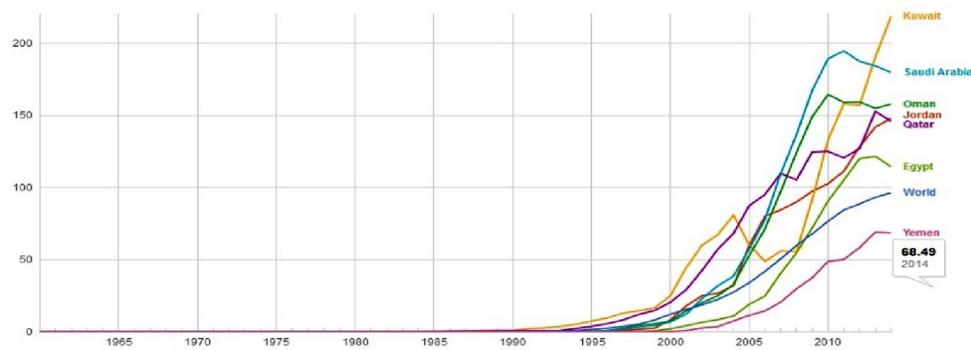
Other Hybrids/Clamshells include devices such as HP Pavilion 11, Lenovo Yoga 2 11 and Dell Inspiron 13.

*Source:* Gartner (2015)

Barnes and Corbitt (2003) and Turban et al. (2006) have defined mobile banking as “a banking channel whereby the customer interacts with a bank via a mobile device, such as a mobile phone or personal digital assistant”. This revolution may be one of the most

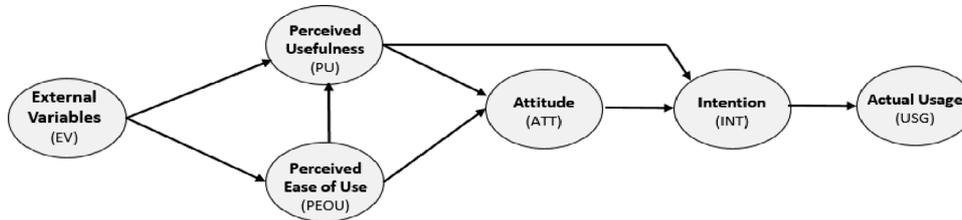
dramatic innovations to affect the industry because banking activities are easily digitised and automated (Bradley and Stewart, 2002). However, even though technology and applications for mobile banking are available, the usage rate worldwide is not as much as the level estimated by industry experts (Kleijnen et al., 2004; Laukkanen and Cruz, 2009; Luarn and Lin, 2005; Riivari, 2005; Suoranta and Mattila, 2004). In identifying the reasons for avoiding mobile banking, many different studies have been conducted to test expectations or explain the concept of adoption and use of mobile banking (Kim et al., 2007b; Laforet and Li, 2005; Luarn and Lin, 2005). Researchers found that a majority of people still resisting the adoption of mobile banking (e.g., Lee et al., 2013; Luo et al., 2010). Therefore, studies need to be undertaken in order to understand consumers' reluctance to use the new technology (Singh et al., 2010).

**Figure 1** Mobile phones subscriptions (per 100 people) (see online version for colours)



Source: World Development Indicators (2016), Last Update: 30 March, 2016

Due to the immense advancement of mobile technology and its inclusion in banking transactions and services, many researchers have tried to interpret and understand consumer behaviour towards the acceptance of such technologies. One of the models to explain this is the Technology Acceptance Model (TAM) which has been empirically and theoretically explained and justified (Huang et al., 2007). Over the years TAM has been validated and confirmed as robust by various applications and extensions, including Mobile Banking (Amin et al., 2008; Luarn and Lin, 2005; Norzaidi et al., 2011), Internet Banking (Al-somali et al., 2009; Guriting and Ndubisi, 2006; Nasri and Charfeddine, 2012; Wang et al., 2003), Mobile Payments (Schierz et al., 2010; Zhong et al., 2013), and Mobile Learning (Huang et al., 2007). These are also in line with Ignatius and Ramayah (2005), Leong et al. (2013), and Raman (2011) who extended TAM to different applications. However, the TAM model does not cover all the elements that influence the intention to adopt and the actual usage of a new technology. Davis (1989) in the original TAM model, suggested examining the effect of external variables on the main construct of TAM (see Figure 2 which depicts the original TAM model), namely perceived usefulness and perceived ease of use. While the original theoretical model of TAM included the attitude construct, however, based on empirical confirmation, the final model omitted this because it did not fully mediate the effect of perceived ease of use and the perceived usefulness of intention (Davis et al., 1989). A study by Kleijnen et al. (2007) indicates that customer attitude could not be a determining factor in the intent to adopt mobile services.

**Figure 2** Original TAM model by Davis (1989)

While the main constructs of TAM (usefulness and ease of use), may not entirely embrace all a client's reasons for adopting mobile banking services, there are other constructs that do address them. Laforet and Li (2005) report that perceived risk is important when a client decides to use new technology or services. Howcroft et al. (2002) state that clients are concerned about the risk that comes with mobile banking usage, being anxious about privacy and having concerns about the security of their financial information. Particularly in Yemen, such perceived risk may play a major part in determining the acceptance of mobile banking service. In addition, awareness, implying knowledge about a technology and its benefits, is a key factor in the voluntary use of systems. One of the hindrances to acceptance and adoption is the lack of awareness and understanding of the benefits that can be obtained by using mobile banking services (Laforet and Li, 2005). This lack can also lead to a higher risk perception among clients of e-service (Belkhamza and Wafa, 2009) and consequently influence the behavioural intention of such clients. This is in line with Lee et al. (2007) who revealed that non-users of mobile banking complained of a lack of information and guidance on how to actually to use the services. This could also be a determinant of client reluctance to adopt mobile banking services in Yemen.

In the view of many studies conducted in western countries on factors that affect mobile banking adoption, it was observed that these countries have different government policies, socio-economic condition, and varied industrial and cultural settings (Isaac et al., 2017a, 2017b; Norzaidi et al., 2011). Developing countries such were not given much attention, particularly in examining the banking industry. Western researches have limited applicability to developing countries (Norzaidi et al., 2011). The main objective of this research is to fill this gap by examining the external variables that could influence the main constructs of TAM in the context of mobile banking technology in Yemen. This model could give some answers to questions related to acceptance of mobile banking services. Moreover, it is essential for bank management to better understand how perceived risk and awareness play a role in the acceptance of mobile banking in Yemen.

This paper is structured in eight sections that are the introduction followed by the literature review. The methodology is discussed in details in Section 3, while Section 4 represents the analysis of data and results. Section 5 is the discussion, followed by the implication in Section 6. Limitations and suggestions and conclusion are shown in Sections 7 and 8. Appendices and references are placed at the end of the paper.

## **2 Literature review**

This part introduces the literature that has been done on TAM and the variables extended in this study to show the hypothesis building of each variable. Perceived risk, Awareness, TAM constructs (perceived ease of use, and perceived usefulness) are discussed below.

### *2.1 Perceived risk*

The theory of perceived risk was first proposed by Raymond Bauer in 1960 to determine the behaviour of customers and examine those factors that affect them when making decisions (Taylor, 1974). In more recent times, perceived risk definition has changed because of the change in client behaviour and the shift to online transactions. Originally, perceived risk was limited to fraud or product quality, but currently, the definition has changed to the potential for loss in the pursuit of the desired outcome while using an e-service (Featherman and Pavlou, 2003). They identified seven types of risk, namely performance risk, psychological risk, financial risk, privacy risk, time risk, social risk, and overall risk. They also said that it was important to enrich TAM with perceived risk because clients relate and value risk when assessing products/services for purchase/adoption, and this may be a cause of anxiety and discomfort. Several studies on the adoption of new technologies show that the perception of the individuals regarding perceived risk is an important factor in adopting that technology (Chen, 2013; Laforet and Li, 2005; Yang, 2009). Consumers may perceive great risk and uncertainty when they initially adopt mobile banking, so there is a strong necessity to build on trust in order to decrease perceived risk (Zhou, 2012). In their studies, Im et al. (2008) and Lee (2009) noted how perceived risk attenuates the perception of usefulness and ease of use, and consequently the intention to use. Since mobility increases the threat to security, the risk is considered to be a significant factor in the acceptance of mobile services. Several mobile banking adoption studies have shown that perceived risk was one of the main reasons that people refuse or were reluctant to use mobile banking (Dasgupta et al., 2011).

Consequently, the following two hypotheses are proposed:

**H1:** *Perceived Risk has a negative effect on perceived usefulness*

**H2:** *Perceived Risk has a negative effect on perceived ease of use*

### *2.2 Awareness*

Al-somali et al. (2009) have defined mobile banking services awareness as the awareness of the existence of a mobile banking system and its benefits. Amin et al. (2008), defined it as bank customer awareness of mobile banking services as represented by the amount of information they have about the services. Perceived risk is a powerful explanatory factor in consumer behaviour because individuals seem more likely to avoid uncertainty than to maximise the value and benefits of services (Mitchell, 1999). Behavioural perception and environmental control are likely to be influenced by the perceived risk associated with technological services (Pavlou, 2003), while reducing the level of perceived risk is likely to promote e-commerce applications (Belkhamza and Wafa, 2009). It is clear that awareness about the use and benefits of technology is most likely to reduce the level of the risk perceived. Regarding the acceptability of the internet banking

system, many researchers have conducted studies indicating that perceived usefulness and information on internet banking on a website were the main factors influencing bank customers (Al-somali et al., 2009; Howcroft et al., 2002; Pikkarainen et al., 2004). Al-somali et al. (2009) showed the direct effects of awareness about internet banking and its benefits on usefulness perception and ease of use. This factor is highly applicable to the mobile banking market in Yemen because it is a relatively new service and clients must thus be educated about its use and benefits. This implies that client adoption of mobile banking is highly dependent on how the banks market mobile banking services.

Consequently, the following hypotheses are proposed:

**H3:** *Awareness has a negative effect on perceived risk.*

**H4:** *Awareness has a positive effect on perceived usefulness.*

**H5:** *Awareness has a positive effect on perceived ease of use.*

### 2.3 TAM main constructs (perceived usefulness and perceived ease of use)

TAM is widely used to explain information system adoption and usage. One of its favourable characteristics is robustness (Venkatesh and Davis, 2000) and this has been responsible for its enormous popularity among information system studies and IT practitioners. Two fundamental determinants of TAM (perceived usefulness and perceived ease of use) affect user intention to adopt technology (Davis, 1989). Perceived ease of use is defined as the degree to which a person believes that using a particular system would be free of effort, whereas perceived usefulness is defined as the degree to which a person believes that using a particular system would enhance his or her job performance (Davis, 1989). These two main fundamental constructs of TAM are empirically confirmed to be significant as antecedents of user intention to adopt different technological applications and cultural contexts (AbuShanab and Pearson, 2007; Faqih, 2016; Liu and Min, 2009; Luarn and Lin, 2005; Norzaidi et al., 2011; Ramayah, 2006; Ramayah et al., 2005; Ramayah and Lo, 2007; Tan et al., 2016; Thakur and Srivastava, 2013; Zolait, 2010). Many studies on online banking, mobile banking and mobile payment report that perceived usefulness significantly affects the intention to use internet banking in such different countries as Malaysia, Oman, Australia, Denmark and Yemen (Cudjoe et al., 2015; Guriting and Ndubisi, 2006; Luo et al., 2010; Marcus, 2016; Riffai et al., 2012; Sarrab et al., 2016; Sathye, 1999; Sun et al., 2012; Wessels and Drennan, 2010; Zolait, 2010). In addition, the significant effect of perceived ease of use on behavioural intention has been intensively studied in the mobile banking context in Iran by Hanafizadeh et al. (2012), and Tanzania by Mawona and Mpogole (2013). Koksal (2016) in Lebanon reported the significance of the construct when studying M-learning along with Badwelan et al. (2016) in Saudi Arabia. Additional researches also reported on the importance of perceived ease of use on perceived usefulness, in different applications and different cultural contexts, such as mobile banking application in Malaysia, Korea, Yemen, and Turkey (Akturan and Tezcan, 2012; Amin et al., 2008; Gu et al., 2009; Mutahar et al., 2016; Tan et al., 2016), for online banking in Saudi Arabia (Al-somali et al., 2009), and in IT usage in the public sector in Yemen (Al-Haderi, 2012; Isaac et al., 2016), also M-learning in Yemen (Alrajawy et al., 2016).

Consequently, the following hypotheses are proposed:

**H6:** *perceived usefulness has a positive effect on the intention to use mobile banking services.*

**H7:** *perceived ease of use has a positive effect on perceived usefulness.*

**H8:** *perceived ease of use has a positive effect on the intention to use mobile banking services.*

### **3 Research method**

In this part methodology used in this article is discussed in details below, including the development of the instruments and data collection.

#### *3.1 Overview of the proposed research model*

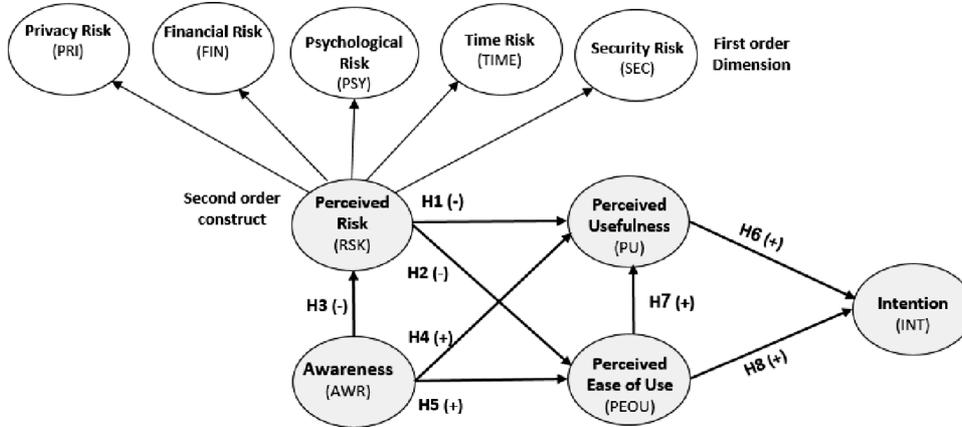
The underpinning theory of this research is the TAM by Davis (1989) to explain the adoption intention of mobile banking services among bank clients. The external variables of the main constructs of TAM (Usefulness and Ease of Use) to be tested are Perceived Risk and Awareness. Relationships between the independent variables and the dependent variable are depicted in Figure 3.

- Perceived risk will decrease the perception of usefulness and ease of use of mobile banking services (H1), and (H2), or in other words, it will negatively affect the PU and PEOU.
- Awareness about mobile banking services will reduce the perception of risk among clients (H3).
- (H4) and (H5) suggest that awareness will positively influence the two main variables of the underpinning theory, as the increase of awareness about mobile banking and its benefits will increase the perception of usefulness and ease of use of mobile banking and consequently the intention to use the services. Additionally, as the original TAM suggests, there is an increase of perceived usefulness as the ease of use perception increases.
- Furthermore, both perceived usefulness and perceived ease of use will improve the intention to use mobile banking services (H6), (H7), and (H8).

#### *3.2 Development of an instrument*

A survey questionnaire was used to collect data for this research, specifically designed to measure all the main factors of the proposed study model. It contained close-ended questions that were tested and translated into Arabic since the targeted respondents were from Yemen, and was divided into two parts. The first measures six core factors using the seven-point Likert scale ranging from 1 (strongly disagree) to 7 (strongly agree) as recommended of relevant studies (Isaac et al., 2017c, 2017d) (refer to Appendix A for the instruments), while the second covered the demographic profile of the respondents, measured using a nominal or ordinal scale.

**Figure 3** The Proposed research model



### 3.3 Data collection

For this study, the respondents were individuals who currently have an opened bank account at a bank in Yemen which provides mobile banking services, have a mobile phone but do not use mobile banking services. Snowball sampling, a non-probability sampling technique appropriate to use when the targeted population is difficult to reach (Al-Qeisi, 2009), was adopted to reach potential subjects among bank clients in the capital city Sana’a, 482 valid usable responses were received and analysed, the first part via multivariate analysis process using structural equation modelling (SEM) and analysis of moment structures (AMOS) software v. 21.0, because of its simplicity and technically advanced nature (Miles, 2000). It also offers a more precise assessment of the discriminant validity of an instrument than exploratory analysis (Bagozzi and Phillips, 1982). The second part was analysed using the Statistical Package for Social Sciences (SPSS) v. 22.0.

## 4 Data analysis and results

Data analysis are represented in this part including descriptive and the structural model and hypothesis testing.

### 4.1 Respondents demographics profile

Seven categories of the demographic characteristics of 482 respondents of this study were analysed, namely gender, marital status, age, education, occupation, income, and banking experience. Seventy-one percent of the respondents were male, while 29.0% were female. Three hundred of the respondents were married, leaving 127 still single. In terms of age groups, 13 respondents were less than 20 years old, 449 were between 20 and 49 years and 20 were 50 years old and above. For the banking experience, only 98 (20.3%) used banking services for a year, 275 (57.0%) had been bank clients for 2–7 years, and 109 (22.6%) had used banking services for more than seven years. Details of the demographic distributions are explained more in Table 2.

**Table 2** Respondents demographics profile

<i>Demographic Item</i>	<i>Categories</i>	<i>Frequency</i>	<i>Percentage</i>
Gender	1. Male	342	71.0
	2. Female	140	29.0
Marital Status	1. Single	127	35.7
	2. Married	300	62.2
	3. Divorced	9	1.9
	4. Widowed	0	0.0
	5. Others	1	0.2
Age	1. Less than 20 years	13	2.7
	2. 20–29 years	184	38.2
	3. 30–39 years	167	34.6
	4. 40–49 years	98	20.3
	5. 50–59 years	18	3.7
	6. 60 years and above	2	0.4
Education background	1. High School	69	14.3
	2. Diploma	64	13.3
	3. Bachelor degree	315	65.4
	4. Master degree	24	5.0
	5. PhD/DBA degree	8	1.7
	6. Others	2	0.4
Occupation	1. Student	114	23.7
	2. Government employee	257	53.3
	3. Private sector employee	73	15.1
	4. Business owner	15	3.1
	5. Unemployed	9	1.9
	6. Others	14	2.9
When did you Open your first account?	1. One year	98	20.3
	2. Two years	93	19.3
	3. 3–5 years	124	25.7
	4. 5–7 Years	58	12.0
	5. More than 7 years	109	22.6

#### 4.2 Descriptive analysis and measurement model assessment

Table 3 shows the mean and standard deviation of each core variable in this study. The results show that the level of perceived risk is moderate among respondents, which indicates that respondent's think that the mobile banking service is risky compared to other banking channels. The study shows the level of awareness of mobile banking services and their benefits is neutral, while the scores for perceived ease of use and perceived usefulness are high, showing that the respondents expect ease, flexibility, and usefulness if they adopt mobile banking services. Moreover, the intention of using mobile banking services in the future is good (4.77 out of 7).

**Table 3** Mean and standard deviation

<i>Construct</i>	<i>Dimension</i>	<i>Item</i>	<i>Loading (above 0.5)</i>	<i>M for variable</i>	<i>SD for variable</i>	<i>CR (&gt; 0.7)</i>	<i>AVE (above 0.5)</i>
RSK	PRI	PRI1	0.88	4.01	1.98	0.967	0.853
		PRI2	0.89				
		PRI3	0.92				
	FIN	FIN1	0.89	4.06	1.85		
		FIN2	0.91				
	PSY	PSY1	0.95	3.67	1.89		
		PSY2	0.95				
	TIME	TIME1	0.79	3.63	1.53		
		TIME2	0.81				
		TIME3	0.84				
	SEC	SEC1	0.90	3.98	1.80		
		SEC2	0.89				
SEC3		0.89					
AWR	AW1	0.88	3.50	1.81	0.916	0.785	
	AW2	0.98					
	AW3	0.79					
PU	PU1	0.95	4.72	1.80	0.963	0.868	
	PU2	0.95					
	PU3	0.90					
	PU4	0.92					
PEOU	PEOU1	0.85	4.94	1.76	0.887	0.723	
	PEOU2	0.87					
	PEOU3	0.78					
INT	INT1	0.93	4.77	1.88	0.964	0.899	
	INT2	0.95					
	INT3	0.82					

M = Mean; SD = Standard deviation.

The measurement used is seven-point scale ranging from 1 (strongly Disagree) to 7 (strongly Agree).

RSK: Perceived risk, PRI: Privacy risk, FIN: Financial risk, PSY: Psychological risk, TIME: Time risk, SEC: Security risk, AWR: Awareness, PU: Perceived usefulness, PEOU: Perceived ease of use, INT: Intention to use mobile banking.

Table 3 shows the mean and standard deviation of each core variable in this study. The results show that the level of perceived risk is moderate among respondents, which indicates that respondent's think that the mobile banking service is risky compared to other banking channels. The study shows the level of awareness of mobile banking services and their benefits is neutral, while the scores for perceived ease of use and perceived usefulness are high, showing that the respondents expect ease, flexibility, and usefulness if they adopt mobile banking services. Moreover, the intention of using mobile banking services in the future is good (4.77 out of 7). Absolute fit indices determine how well a priori model fits the sample data (McDonald and Ho, 2002). Based on the results of

Confirmatory Factor Analyses (CFA) (see Appendix B), the absolute fit indices show that the chi-square is not significant and this is justified because of the high sample size (Byrne, 2010). However, the model fit as represented by the RMSEA coefficient is 0.065, indicating a good fit. Sharma et al. (2005) recommended that this index should not be used because of its sensitivity and reduced popularity in recent years. Meanwhile, the Incremental fit indices indicate that both tests are fit since the normed fit index (NFI) and comparative-fit-index CFI obtained are 0.940 and 0.959 respectively. Finally, Parsimony fit indices also indicate fit, since the parsimony goodness of fit index (PGFI) is 0.711 and parsimony normed fit index (PNFI) is 0.827, thus the model fits well. In addition, Incremental fit indices indicate that both tests are fit since the CFI obtained was 0.959, thus according to Byrne (2010) and Kline (2011), the model fits well. The CFA model in this study, tested all variables simultaneously, not individually, because the hypothesised model integrates a small number of items for each of the latent variables. Generally, the goodness-of-fit statistics (see Table 4) support the integrity of the overall model. In this current study, the overall model fit reported in Table 4 shows that the overall fit indices for the CFA model are acceptable (Byrne, 2010; Hair et al., 2014; Kline, 2011) since Incremental fit indices and parsimony fit indices are fulfilled.

**Table 4** Goodness of fit indices for the measurement model

<i>Fit index</i>	<i>Cited</i>	<i>Admissibility</i>	<i>Result</i>	<i>Fit (Yes/No)</i>
$\chi^2$			859.201	
DF			286	
P value		>0.05	0.000	No
$\chi^2/DF$	Kline (2010)	1.00–5.00	<b>3.004</b>	<b>Yes</b>
<b>RMSEA</b>	Steiger (1990)	<0.08	<b>0.065</b>	<b>Yes</b>
NFI	Bentler and Bonnet (1980)	>0.80	0.940	Yes
PNFI	Bentler and Bonnet (1980)	>0.05	0.827	Yes
IFI	Bollen (1990)	>0.90	0.959	Yes
TLI	Tucker and Lewis (1973)	>0.90	0.954	Yes
<b>CFI</b>	Byrne (2010)	>0.90	<b>0.959</b>	<b>Yes</b>
PGFI	James et al. (1982)	>0.50	0.711	Yes

$\chi^2$ : Chi-square, DF: Degree of freedom, GFI: Goodness-of-fit, NFI: Normed fit index, IFI: the increment fit index, TLI: Tucker-Lewis coefficient index, CFI: Comparative-fit-index, RMSEA: Root mean square error of approximation, PNFI: Parsimony normed fit index, AGFI: Adjusted goodness of fit index.

The indexes in bold are recommended since they are frequently reported in the literature (Awang, 2014).

Convergent validity was tested on the CFA model before hypotheses testing. The convergent validity of the measurement model was tested by examining the factor loading, composite reliability and average variance extracted (AVE). High loadings (at least 0.50) on a factor indicate that the items converge on the same common point (Hair et al., 2014). The composite reliability is the same acceptable cut-off for the Cronbach's alpha (at least 0.70). High AVE values (greater than 0.5) show that the latent variables have high convergent validity (Hair et al., 2014). The results in Table 3 of

composite reliability demonstrate values greater than 0.7 and AVE values more than 0.5. Therefore, all variables have convergent validity (Hair et al., 2010).

There has long been a debate over the use and merits of EFA and CFA in organisational research, resulting in some extremely energetic exchanges on both the research methods and the structural equation modelling networks (Hurley et al., 1997). According to Hair et al. (2013), the distinction between EFA and CFA is not always as clear-cut as it seems. CFA is used when testing the hypotheses of existing theories and concepts, and EFA when searching in the data for latent patterns in case there is little or no prior knowledge about the factor structure and correlation (Hair et al., 2013).

Although Brannick (1995) and Stone-Romero et al. (1995) have mentioned that the use of CFA is increasing while the use of EFA is declining, using EFA, CFA or both in the validation process is still legitimate. According to Cabrera-Nguyen (2010), distinguishing between CFA and EFA is becoming increasingly unclear. Brown (2006) suggests using EFA in a CFA framework as an intermediate step between EFA and CFA. Worthington and Whittaker (2006) advised to start with EFA and follow with CFA but use a different sample, while Green et al. (2016) recommended not to conduct EFA and CFA on the same dataset. Kline (2010) mentioned that there is no need to use both techniques, use either EFA or CFA.

The Fornell-Larcker criterion is a more conservative approach to assessing discriminant validity. It compares the value of the AVE with the latent variable correlations. Precisely, AVE should exceed the correlation with any other construct (Hair et al., 2014). The Fornell-Larcker criterion for the current study in Table 5 shows that the AVE exceeds the correlation with any other construct.

**Table 5** Results of discriminant validity by Fornell-Larcker criterion

<i>Factors</i>		<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
		<i>RSK</i>	<i>AWR</i>	<i>PU</i>	<i>PEOU</i>	<i>INT</i>
1	RSK	<b>0.923</b>				
2	AWR	-0.333	<b>0.886</b>			
3	PU	-0.593	0.384	<b>0.931</b>		
4	PEOU	-0.517	0.271	0.711	<b>0.850</b>	
5	INT	-0.660	0.386	0.862	0.752	<b>0.948</b>

Diagonals represent the square root of the average variance extracted while the other entries represent the correlations.

RSK: Perceived risk, AWR: Awareness, PU: Perceived usefulness, PEOU: Perceived ease of use, INT: Intention to use mobile banking.

### 4.3 *Structural model and hypotheses testing*

All the hypotheses were examined through structural equation modelling using AMOS software v. 21.0 as shown in Figure 4. Table 6 shows the structural model fit, providing the indication for testing the hypotheses. The *p*-values associated with each standardised path estimate are used to determine significance at an alpha level of 0.05.

Figure 4 Research structural model results (see online version for colours)

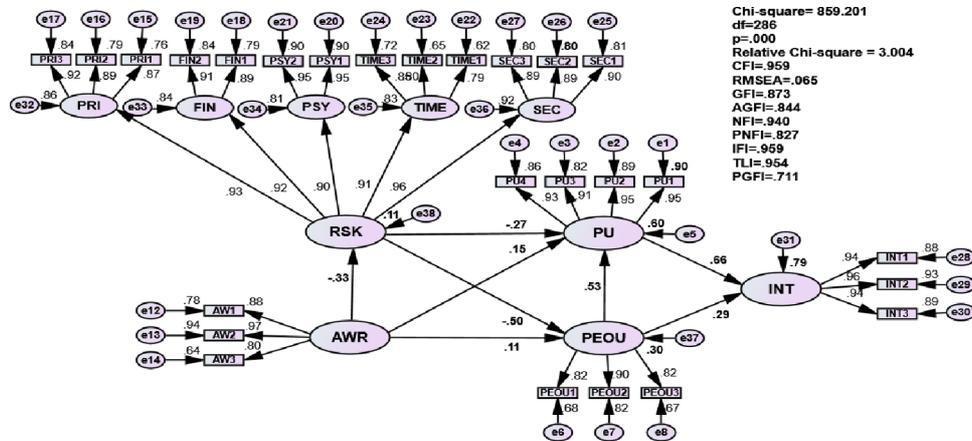


Table 6 Structural path analysis result

Dependent variables	Independent variables	Direction	Path coefficients –		C.R. t-value	Finding	
			beta values	S.E			
H1	PU	← RSK	Negative	-0.272	0.044	-6.533***	Supported
H2	PEOU	← RSK	Negative	-0.496	0.042	-9.821***	Supported
H3	RSK	← AWR	Negative	-0.332	0.047	-7.034***	Supported
H4	PU	← AWR	Positive	0.152	0.037	4.364***	Supported
H5	PEOU	← AWR	Positive	0.115	0.038	2.515*	Supported
H6	INT	← PU	Positive	0.659	0.041	16.424***	Supported
H7	PU	← PEOU	Positive	0.527	0.057	11.734***	Supported
H8	INT	← PEOU	Positive	0.288	0.052	7.268***	Supported

PU: Perceived usefulness, PEOU: Perceived ease of use, AWR: Awareness, RSK: Perceived risk, PV: Perceived value.

\* $p < 0.05$ ; \*\* $p < 0.01$ ; \*\*\* $p < 0.001$ .

S.E = Standard error.

C.R = Critical ratio.

Source: Survey

Table 6 shows the results of the seven hypotheses built for this study. The SEM analysis indicates that perceived risk significantly predicts perceived ease of use ( $\beta = -0.496, p < 0.001$ ) and also significantly predicts the perceived usefulness ( $\beta = -0.272, p < 0.001$ ), and hence H1 and H2 are supported. H3 is supported as well as awareness reduces the perception of risk with ( $\beta = 0.332$ ), H4 and H5 are also supported as awareness notably influenced the perceived usefulness and ease of use with beta values  $\beta = 0.152$  and  $\beta = 0.115$ , respectively. Perceived usefulness as well, considerably predicts intention to use mobile banking ( $\beta = 0.659, p < 0.001$ ), thus supporting H6. Likewise, H7 and H8 are supported as perceived ease of use was found to be an

important antecedent of perceived usefulness and intention to use mobile banking services with beta values  $\beta = 0.527$  and  $\beta = 0.288$ , respectively.

The coefficient of determination for the research proposed model shows that awareness explains 11% of the variance of perceived risk, while a perceived risk, awareness, and perceived ease of use explains 60% of the variance in perceived usefulness. Perceived risk and awareness explain 30% of the variance in perceived ease of use of using mobile banking services, while 79% of the variance of intention to use mobile banking is explained by perceived usefulness and perceived ease of use. According to Chin (1998), Cohen (1988), and Hair et al. (2013), the  $R^2$  of the intention to use mobile banking services in the current study is considered substantial.

## 5 Discussion

The main objective of this study was to examine the external variables (perceived risk, awareness) on the two essential factors of TAM and consequently determine the behavioural intention of using mobile banking services. The results of the current study show the following:

Perceived risk has a significant negative affect on the perceived ease of use ( $\beta = -0.496$ ,  $p < 0.001$ ), which means the higher the perception of risk the reduced ease of use perception by clients. In addition, perceived usefulness is also weakened when client perception of risk is high. ( $\beta = -0.272$ ) shows a notable negative effect of perceived risk on usefulness, and this is in line with earlier studies by Im et al. (2008) and Lee (2009) which revealed that perceived risk attenuates the usefulness and ease of use perception among clients. Therefore H1 and H2 are supported.

Awareness about mobile banking and its benefits was found statistically significant in influencing the perceived risk ( $\beta = -0.332$ ), perceived usefulness ( $\beta = 0.152$ ) and perceived ease of use ( $\beta = 0.115$ ). These results are in line with Laukkanen and Kiviniemi (2010) who found that the information and guidance offered by banks on mobile banking services had the most significant effect in reducing the usage barrier, value barrier and risk barrier respectively. Moreover, the results of this study confirm that the higher the awareness of mobile banking services (sufficient and concrete information), a corresponding decrease in the risk is perceived by clients. Therefore, H3 is supported.

According to Chin (1998), the moderate effect of awareness plays a role affecting a clients' intention to use mobile banking services through the main constructs of TAM. This is also consistent with the finding of Al-somali et al. (2009), who reported the important effect of awareness on usefulness and ease of use in the internet banking context. As a result, H4 and H5 are supported.

The original TAM proposed by Davis (1989) theorised that PEOU predicts the perceived usefulness, and both perceived usefulness and perceived ease of use are predictors of the behavioural intention to use new technology. In this study, PEOU was confirmed as a significant antecedent of PU with ( $\beta = 0.527$ ), and hence, the higher the perception of easiness of mobile banking services, the higher the perception of the usefulness of this technology application among banks clients. This is consistent with previous researches by Gu et al. (2009), Tan et al. (2016) and Mehrad and Mohammadi (2016) in a different context and application, reporting on the significant positive

influence of perceived ease of use on perceived usefulness. Potential users of the mobile banking system in Yemen perceive that when the mobile banking services system is easy to use, their perception of the usefulness of the same system is increased as well. This will consequently increase their intention to use mobile banking services. The results of this study are consistent with Kim et al. (2007a), Krogstie (2012), Amin et al. (2008) and Luarn and Lin (2005), all of whom showed empirically that perceived usefulness and ease of use have a positive influence on the intention to use mobile banking services. Based on the above, H6, H7, and H8 are supported through analysing the structural model of this study. The findings clearly show that ease of use and usefulness are important predictors of intention to use in the initial adoption stage of mobile banking services (Alalwan et al., 2016; Guriting and Ndubisi, 2006; Riffai et al., 2012; Sathye, 1999; Zolait, 2010). The variance in the intention to use mobile banking services is explained by 79% via perceived risk, awareness, perceived usefulness and perceived ease of use. Finally, the outcomes indicate that perceived risk and perceived usefulness are perceived by bank clients in Yemen as the core determinants of intention to adopt mobile banking services.

## **6 Implication**

The results of this study provide mobile banking services providers with several important factors that influence Yemeni clients to use mobile banking. The findings suggest that providers should concentrate more on risk, awareness, usefulness and ease of use to encourage the adoption of mobile banking. More precisely, marketers need to make sure that mobile banking services are more secure (such as financially, privacy), and are promoted as easier, and more useful than using traditional banking channels.

Perceived risk is analysed based on privacy risk, financial risk, time risk, psychological risk, and security risk. The higher the perception of breaches of these factors, the more questioning will be the clients' perception of the usefulness and ease of use of mobile banking service. They will be less expected to perceive the real easiness and usefulness of the mobile banking services if they uncomfortable or waste time. It is suggested that high-security features must be established to protect personal information such as personal identification or client bank account numbers and account information. The design and operational framework of mobile banking services platforms must have high-security features to protect customer information. To ensure a higher level of uptake of the service among the bank clients, practical use of mobile banking depends not only on the usefulness and ease of use but also the ability of that service to operate with a similar level of trust and efficiency as other banking channels.

There is a considerable potential market for mobile banking services but there are knowledge gaps regarding the service that prevents higher acceptance levels. To encourage more people to use mobile banking, practical action needs to be taken, such as having awareness campaigns, educating the public and conducting sensitisation initiatives. By reducing the perception of risk and increase the perception of its usefulness, there will be more uptake of mobile banking.

The underpinning theory in this current research is the TAM. Based on TAM, the conceptual model validates the role of perceived risk, and addresses awareness to drive the perceived ease of use and perceived usefulness, therefore affecting the behavioural intention to use mobile banking services. The results of the current study can be added to

the body of research on mobile banking in Yemen, complementing previous studies and including a significant source of influence in pre-adoption behaviour by highlighting the role of awareness and multi-dimension perceived risk in information systems (IS).

The findings of the current research have significant recommendations that will be very helpful for the banking sector and also beneficial for government-related authorities which should be aware of relatively important elements to be borne in mind when formulating strategies to promote mobile banking for greater take-up of the services.

## **7 Limitations and suggestions**

This study has limitations that need to be overcome in future researches. TAM was extended with perceived risk and awareness, but these should be integrated with other factors to provide a more comprehensive understanding of mobile banking and be more precise in predicting the intention to adopt. The sampling method may not have produced a sample that is representative of the whole population of the study, and using a different sampling method may produce a more representative result for the targeted population. Future work should also investigate the risk dimensions (privacy risk, financial risk, time risk, psychological risk, and security risk) on TAM main constructs separately. Finally, one limitation that is shared by many consumer adoption researches is that only behavioural intention is measured and not the actual behaviour and the extent of adoption or offering of mobile banking services in a particular country. It is suggested that future researchers should investigate the direct effect between intention to adopt and actual usage. Also, future research should investigate the influence of all proposed risks (privacy risk, financial risk, time risk, psychological risk, and security risk) separately.

## **8 Conclusion**

The primary objective of this study was to examine the external variables that could affect the main constructs of TAM (usefulness and ease of use) in the context of Yemen and the extent of that country's uptake of mobile banking services. Notwithstanding the limitations of this study, the results have shed some encouraging light on new variables of the intention to use mobile banking services in Yemen. In summary, perceived risk reduces the perceived ease of use and perceived usefulness of using mobile banking, since it negatively affects both TAM constructs. In addition, awareness of the benefits and value of using mobile banking services is essential to encourage clients to accept and adopt mobile banking services, and especially in the early stages, reduce the perception of its risk. Mobile banking services have to present something new to the bank clients to compete against services offered in the same category (e.g., e-banking services). Perceived usefulness has a great impact on the intention to use mobile banking services. As demonstrated by this study, after bank clients evaluate mobile banking services based on their perceptions of its ease of use, usefulness, associated perceived risk, and awareness, they make a decision toward intention to use mobile banking services or not. The study results clearly show that RSK and AWR are significant antecedents of PU and PEOU, and therefore good predictors of the intention to use mobile banking services.

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## Appendix A

### *Instrument for construct*

<i>Construct</i>	<i>Dimensions</i>	<i>Items</i>	<i>Source</i>
Perceived risk (RSK)	Privacy risk (PRI)	I think Mobile banking endanger my privacy by using my personal information without my permission	Thakur and Srivastava (2013)
		When using mobile banking, my personal data cannot be kept private.	Chen (2013)
		When using mobile banking, personal information may be stolen by others	Chen (2013)
	Financial risk (FIN)	When using mobile banking, I may lose money because my account information is hacked.	Akturan and Tezcan (2012)
		When using mobile banking services, the financial risk exists.	Chen (2013)
Perceived risk (RSK)	TIME risk (TIME)	I think I would spend too much time learning how to use mobile banking.	Akturan and Tezcan (2012)
		I think that mobile banking would not run fast and cause time loss, because of some problems in the operating system.	Chen (2013)
		I think using mobile banking service would lead to a loss of convenience for me because I would have to waste a lot of time fixing payments errors.	Lee (2009)
	Psychological risk (PSY)	Using mobile banking system makes me feel anxiety.	Chen (2013)
		Using mobile banking system makes me feel nervous.	Chen (2013)
	Security risk (SEC)	I would not feel totally safe providing personal privacy information over the mobile Banking.	Lee (2009)
		I am worried to use mobile banking because other people may be able to access my account.	Luo et al. (2010)
		I would not find mobile banking secure in conducting my transactions.	Koenig-Lewis et al. (2010)
Awareness (AWR)		I think that when needed, I will get enough guidance from the bank related to mobile banking services.	Al-somali et al. (2009),
		I have received enough information about the benefits of using mobile banking services.	Laukkanen and Kiviniemi (2010)
		In general, I know about mobile banking services.	

**Appendix A**

*Instrument for construct (continued)*

Construct	Dimensions	Items	Source
Perceived usefulness (PU)		I think using Mobile banking would enable me to accomplish more banking activities.	Akturan and Tezcan (2012)
		I think Mobile banking would enable me to improve the performance of utilising banking services.	Al-somali et al. (2009)
		In general, I would find mobile banking useful.	Akturan and Tezcan (2012)
		I think that Using mobile banking services will enhance my effectiveness in conducting my banking tasks.	Lee et al. (2012)
Perceived ease of use (PEOU)		I would find mobile banking easy to use	Yu (2012)
		Learning to use mobile phone banking would be easy	Hanafizadeh et al. (2012)
		I would find mobile banking services to be flexible to interact with.	Liu et al. (2008)
Intention (INT)		Assuming I have access to the mobile banking system, I intend to use it.	Venkatesh and Davis (2000)
		I would use the Mobile banking for my banking needs.	Nasri and Charfeddine (2012)
		If I have access to the mobile banking system, I want to use it as much as possible.	Al-Haderi (2012)

**Appendix B**

*Confirmatory factor analysis (CFA) (see online version for colours)*

