[1] Raed Shujaa Alotaibi

An Empirical Study to Measure Impact the Dimensions of Perceived Risks on Continual Usage M-Commerce Applications: Saudi Arabia as a Case Study

Abstract: - In recent years, the use of mobile commerce (M-commerce) applications has significantly increased. This study aims to examine the impact of various dimensions of perceived risk on the continued usage (IU) of M-commerce applications in Saudi Arabia. Data were collected using a questionnaire distributed among Saudi citizens. The study also investigates whether there are significant differences in IU of M-commerce applications across gender and age groups. Structural equation model (SEM) analysis revealed that functional risk, information risk, privacy risk, physical risk, delivery risk and social risk do not have a significant negative impact on IU of M-commerce applications in Saudi Arabia. In contrast, financial risk was found to have a negative impact on IU. Furthermore, the results indicated no significant difference in IU between younger and older participants. Also, the results indicated no significant difference in IU between Males and Females participants. These results provide valuable insights for service providers seeing to enhance user engagement with M-commerce applications in the Saudi context.

Keywords: M-commerce; Perceived Risk; Saudi Arabia; Structural equation model (SEM).

I. INTRODUCTION

Mobile commerce (M-commerce) applications have become increasingly popular, due to the widespread adoption of smartphones. These applications now play important roles in users' daily lives by facilitating the purchase of goods and other shopping activities [1]. In 2023, global e-commerce retail sales reached USD 5.7 trillion, reached over USD 6 trillion in 2024, and are projected to reach over USD 8 trillion in 2027 [2, 3] (Figure 1).

In Saudi Arabia the e-commerce market is also expanding rapidly. It is expected to reach USD 27.96 billion in 2025 and USD 49.49 billion by 2030 [4]. According to Saied [5], Saudi citizens have a high level of awareness and trust in using online payment systems, which is considered a key factor driving the increased adoption of e-commerce in the Saudi market. A recent report revealed that 72% of Saudi citizens made online payments for e-commerce purchases in 2023 [5]

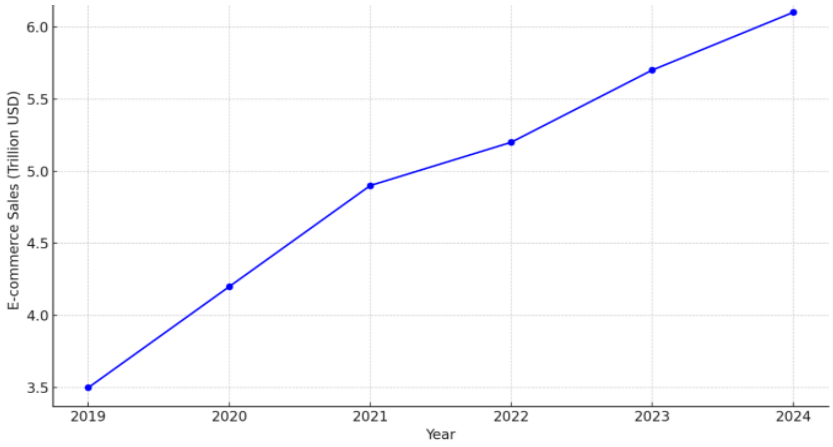

Figure 1 Growth of global e-commerce sales [2]

In recent years, researchers have increasingly explored the rapid adoption of M-commerce applications by consumers across various domains. These areas include consumer behavior in online shopping [6, 7], online

1 1Applied college, Shaqra University, Shaqra, 11961, Saudi Arabia; Alhafi@su.edu.sa.

*Corresponding author: Alhafi@su.edu.sa.

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banking [8, 9] and mobile commerce itself [10-15]. Many previous studies have highlighted that perceived risk has a significant impact on consumers' purchase decisions [16-18].

According to Gough [19], perceived risk is defined as "the individual or group, judgment or valuation of the magnitude and likelihood of the possible 'bad' outcomes which may result from an action". Similarly, perceived risk is identified the negative perceptions customers form about goods and services, which can influence their behaviour when using new technologies [20]. The concept of perceived risk was first introduced in the context of consumer behaviour by Bauer [21] who stated that uncertainty plays an important role in consumers' purchasing behaviour and decisions. He explained that customers must balance the uncertainty and risks involved in making a purchase by obtaining information about the brands to facilitate their decision-making [21, 22]. Bauer further noted that a lack of information is a primary source of uncertainty, which strongly impacts purchasing behaviour and decisions. Cox and Rich [23] later expanded on Bauer's concept of perceived risk to include four different elements: (1) uncertainty regarding the purchase of goods and services, (2) the financial and psychosocial consequences of purchase decisions, (3) uncertainty associated with buying methods and service providers, and (4) other situational uncertainties faced by customers when they decide to purchase. Therefore, customers need to use other methods to reduce uncertainty, which in turn can decrease the potential financial and psychosocial consequences associated with their purchase decisions [24]. For example, to measure perceived risk Bettman [25] analyzed the concept of risk by distinguishing between inherent risk and handled risk. Inherent risk includes all risks intrinsically associated with a product or service, while handled risk refers to the mitigating impact of information related to the product or brand. According to this concept, when customers lack information about a product or brand, the perceived level of risk will be high. Conversely, customers have prior knowledge and experience about the product or brand, perceived risk may be low even if the inherent risk associated with the product is high [26]. Manida [27] recently reported that high levels of perceived risk are associated with low levels of trust, leading to low adoption of e-commerce. Similarly, Farhat, Yang [28] found that perceived risk has a negative impact on customers' intention to purchase on new e-commerce platforms. Therefore, this study aims to measure the impact of various dimensions of perceived risk on continued usage (IU) of m-commerce applications in Saudi Arabia. It also aims to determine whether there are differences in IU across different gender and age groups.

II. LITERATURE REVIEW

A. Dimensions of perceived risks

Cox [29] categorized the perceived of risk into several dimensions which were broadly divided into two dimensions: psychosocial risk and performance risk. Psychosocial risk includes all social and psychological uncertainties associated with a purchase decision, while performance risk includes the uncertainty about a product's ability to meet performance expectations [23, 29]. Cunningham [30] expanded the concept of performance risk into four areas: safety risk, financial risk, performance risk and opportunity risk, while retaining the original psychosocial risks proposed by Cox and Rich [23]. Perceived risk has been the focus of significant research attention as researchers have sought to identify additional sources of uncertainty that may influence consumer purchase decisions. For example, studies have identified physical risk [31-34], time risk [30, 33, 35, 36], functional risk [36], overall risk [35, 37] and service risk [13] as important contributors to consumers risk perception during the purchase process. Stone and Grønhaug [38] identified six sources of affecting customer purchase decisions: psychological risk, physical risk, financial risk, social risk, time risk and performance risk. Martins, Oliveira [35] confirmed the influence of performance risk, privacy risk, time risk and financial risk on customer decision-making. In the recent study by Qi, Xie [39], perceived risk was categorized into four dimensions: service risk, quality risk, appearance risk and functional risk. Zaheer, Mumtaz [40] identified financial, psychological, functional, and physical risks as major dimensions influencing customer purchase intentions.

This study incorporates the risk dimensions described above and additional risk factors to assess the impact of perceived risk on IU of M-commerce applications in Saudi Arabia. These risk dimensions are described in more detail below:

1) Functional risk:

According to Mitchell [41], functional risk is defined as "the product does not perform up to expectations". One of the keys disadvantages of online purchasing is that customers are unable to physically inspect or test products prior to purchase [42], leading to increased uncertainty about product quality and functionality which may impact negatively on purchase decisions [43]. Additionally, some studies have shown that there are concerns among customers about the risk of purchasing fake products online [44-47]. The degree of functional risk perceived by

customers can vary depending on the product category, brand, and mode of purchase [48]. For example, Aldás‐Manzano, Lassala‐Navarré [49] found that financial services and other products and services that permit refunds or trial periods are often associated with greater perceived functional risk. The majority of previous studies in this field have shown that functional risk significantly influences consumers' decisions to buy [7, 13, 32, 50]. A recent study found that functional risk has a negative effect on satisfaction with using mobile payment services [51]. Based on this evidence, the following hypothesis is proposed:

H1: Functional risk has a negative impact on the continued usage of M-commerce applications in Saudi Arabia.

2) Information risk

The process of disseminating information is closely linked to information uncertainty [26]. According to Soto, Jose [52], online customers often encounter information uncertainty during their online shopping experience, such as too much information, insufficient information, and disorganized or conflicting information. These factors complicate the information search process and contribute to decision-making difficulty [53]. Several studies have shown that information risks have a major direct impact on online purchasing through increased risk complexity [44, 54] as well as indirect impacts [46, 52, 55]. Alrawad, Lutfi [26] been found that information risk negatively impacts customers' intention to use online shopping services. Therefore, the hypothesis will be:

H2: Information risk has a negative impact on the continued usage of m-commerce applications in Saudi Arabia.

3) Privacy risk

According to Zhang, Tan [47] privacy risk is defined as the "potential loss of control over personal information when the information is used without permission." This type of risk leads to concerns among customers that their personal and financial data may be misused by third parties or inadequately protected by online stores, leaving them vulnerable to data breaches and cyberattacks [22, 43, 48, 56, 57]. Many previous studies have highlighted the key role of privacy in influencing customer acceptance and adoption of e-commerce [58-61]. Privacy concerns have also been shown to have a negative impact on customers' engagement with and intention to use online banking [62]. Singh, Dash [63] recently reported that privacy risk negatively impacts customer attitudes toward online shopping assistants during e-commerce interactions. The recent study by Malik, Khan [64] confirmed that privacy risk has a negative effect on customers' intentions to shop online in Pakistan. Therefore, the hypothesis will be:

H3: Privacy risk has a negative impact on the continued usage of m-commerce applications in Saudi Arabia.

4) Physical risk

According to Mitchell [41], physical risk is defined as a risk that, "captures individuals' concerns that the online purchased item or services may cause a mental and physical threat to their health and wellbeing." Many previous studies have found that physical risk has a negative impact on customers' purchasing decisions [7, 31, 46, 65]. Therefore, the hypothesis will be:

H4: Physical risk has a negative impact on the continued usage of M-commerce applications in Saudi Arabia.

5) Delivery risk

Delivery risk refers to the uncertainty associated with the process of delivering items to customers which include many issues related to delivery outcomes and product condition [26]. Several factors contribute to delays or failures in product delivery, such as issues in logistics or warehousing systems, non-delivery of the product, and damage to the product during delivery [6, 66, 67]. Many previous studies have shown that delivery risk negatively affects customers' experiences with online shopping [6, 46, 65, 67, 68]. A recent study found that delivery risk has a negative impact on customers' ratings and online purchasing behavior in e-commerce contexts [69]. Therefore, the hypothesis will be:

H5: Delivery risk has a negative impact on the continued usage of m-commerce applications in Saudi Arabia.

6) Financial risk

According to Hassan, Kunz [70], financial risk is defined as "an individual's concern over any financial loss that might be incurred because of online shopping." This risk refers to customers losing their money when shopping online, potential loss of money due to defective products, or finding the same product cheaper somewhere else [26, 41, 71]. Additionally, customers may be deterred by unexpected charges, such as high taxes and delivery fees, which can increase the total cost of purchase [71, 72]. Numerous studies have shown that financial risk has a negative effect on customers when they are using online shopping [44, 46, 62]. Handoyo [73] found that increased

trust in e-commerce can reduce perceived financial risk, thereby facilitating customers' purchase decisions. Therefore, the hypothesis will be:

H6: Financial risk has a negative impact on the continued usage of M-commerce applications in Saudi Arabia.

7) Social risk

Social risk is the perceived risk associated with how a customer's purchasing decision may be viewed by others, potentially affecting their social image and/or reputation [26]. In this context, customers may feel embarrassment or social judgment from friends, family or peers because of shopping online. In other words, social risk links to the effects of customers' purchasing decisions on their position in society [37]. Previous studies have consistently found that social risk has a negative effect on customers when they are using online shopping [47, 50, 65, 74]. A recent study by Hasan, Amin [75] found that social factors have a significant impact on consumers' purchase intentions towards online shopping. Therefore, the hypothesis will be:

H7: Social risk has a negative impact on the continued usage of M-commerce applications in Saudi Arabia.

Based on the literature review, the proposed model for this study is presented in Figure 2.

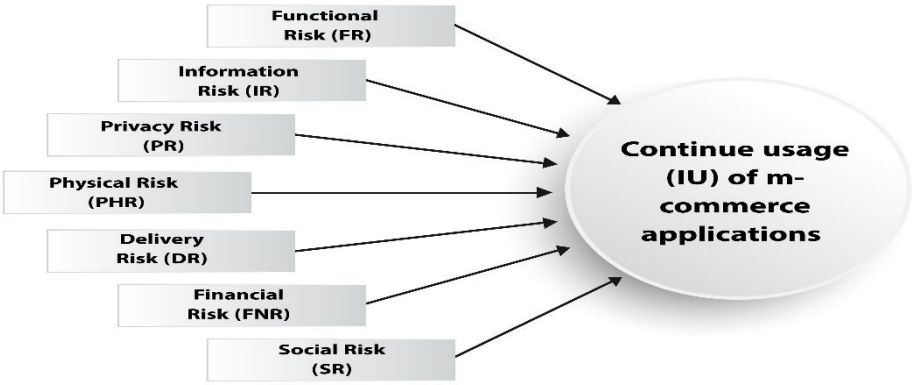

Figure 2. Proposed Model for this study

III. METHODOLOGY

A questionnaire was used in this study to collect data from participants who were all Saudi citizens. A snowballing technique was used initially shared with the researchers' relatives and friends who were then asked to forward the link to their own social networks. This approach is grounded in social network theory, which states that individuals are connected through various social ties and relationships [76]. As the target participants were native Arabic speakers, the questionnaire was professionally translated into Arabic by experts in translation to ensure linguistic accuracy.

The questionnaire consisted of three sections. Part one provided general information about the research, its aims, instructions for participants and an informed consent statement addressing ethical concerns. Part two collected demographic data from participants. Part three contained items related to the dimensions of perceived risk as outlined in the proposed research model. These items were measured using a five-point Likert-type scale (5 = strongly Agree, 4 = Agree, 3 = Neutral, 2 = Disagree and 1 = Strongly Disagree). More than 150 questionnaires were distributed, of which 112 were received and included in the analysis.

To examine the relationship between perceived risk dimensions and the continued usage (IU) of M-commerce applications, the data were analyzed using Structural Equation Modeling (SEM) with the Maximum Likelihood Estimation (MLE) method. The standardized path coefficient (β) was used to assess the strength and direction of relationships between variables. Additionally, independent sample T-tests were conducted to identify potential differences in continued usage across gender and age groups.

IV. RESULTS

A. Demographic Data

The demographic data is summarized in Table 1. The participants in this study were 50% (56) males and 50% (56) females. Most participants were young people (89.3%, 100) while older people comprised 10.7%.

Table 1. Demographic data summary.

Group		Number of participants	Percentage of sample
Gender	Male	56	50
	Female	56	50
	Total	112	100
Age	Young (18-40 years)	100	89.3
	Old (over 40 years)	12	10.7
	Total	112	100

B. Reliability

The reliability values were divided into four groups: excellent reliability (>0.90), high reliability (0.70 to 0.90), moderate reliability (0.50 to 0.70), and low reliability (<0.50) [77]. Based on the results (Table 2), all values are above 0.60, and the overall reliability for this instrument was excellent (0.904). Therefore, the results of this study can be considered reliable in the Saudi M-commerce context.

Table 2. Reliability Analysis

Section	Number of items	Cronbach Alpha reliability
Functional Risk (FR)	4	0.661
Social Risk (SR)	3	0.758
Delivery Risk (DR)	4	0.770
Financial Risk (FNR)	3	0.623
Information Risk (IR)	4	0.736
Privacy Risk (PR)	3	0.731
Physical Risk (PHR)	3	0.688
continued usage (IU)	3	0.791
Total	27	0.904

C. Assessment of the Hypotheses

This study employed Structural Equation Modeling (SEM) using the Maximum Likelihood Estimation (MLE) method to test the proposed hypotheses. The standardized path coefficients (β) and significance levels (p-values) are presented in Figure 3 and Table 3. The results revealed that most of hypothesized relationships were non-significant negative impact: FR→IU, H1: Rejected (β = 0.006, P-value = 0.945), IR→IU, H2: Rejected (β =0.27, P-value=0.001), PR→IU, H3: Rejected (β = 0.059, P-value=0.486), PHR→IU, H4: Rejected (β =0.323, P-value=0.000), DR→IU, H5: Rejected (β = 0.259 and P-value=0.002), SR→IU, H7: Rejected (β = 0.209 and P-value=0.014), Only H6 was supported indicating a significant negative relationship between financial risk and IU of M-commerce applications: FNR→IU (β = -0.839, P-value <0.001)

Table 3. The results for each hypothesis

Hypothesis	Path	B	P-Value	Overall Result
H1	FR →IU	0.006	0.945	Rejected
H2	IR →IU	0.279	0.001	Rejected

H3	PR →IU	0.059	0.486	Rejected
H4	PHR→IU	0.323	0.000	Rejected
H5	DR→IU	0.259	0.002	Rejected
H6	FNR→IU	-0.839	0.000	Supported
H7	SR→IU	0.209	0.014	Rejected

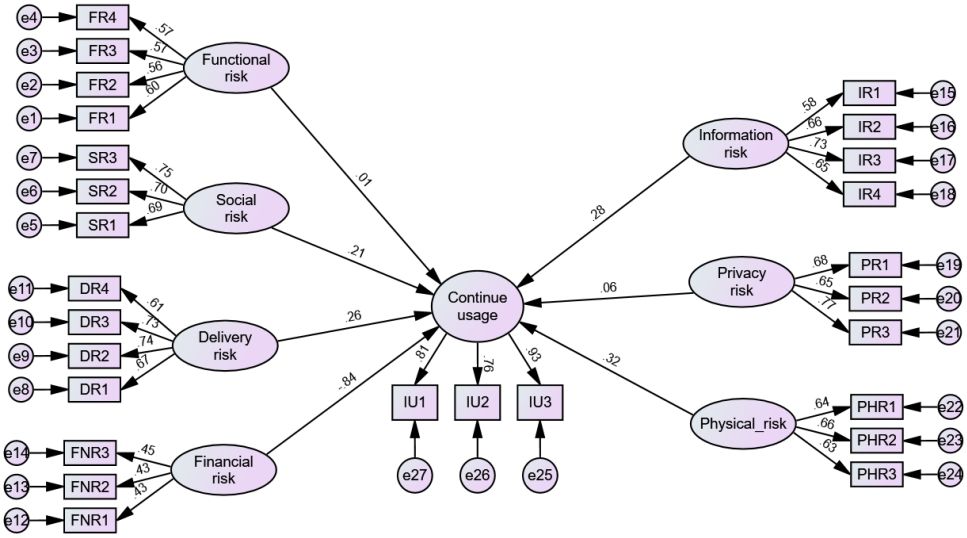

Figure 3. SEM Analysis Result Summary

D. Comparison between gender and age groups in the Continue usage (IU) of M-commerce

An independent samples t-test was conducted to examine differences in the continued usage (IU) of M-commerce applications across gender and age groups. The results in Table 4 reveal that although the male mean IU of M-commerce score was higher than for females, this difference was not significant. There was also no significant difference in IU of M-commerce between younger and older participants.

Table 4. T-Test Analysis

Group		N	Mean	SD	T	P
Gender	Male	56	3.78	0.810	0.877	0.383
	Female	56	3.64	0.843		
Age	Young	100	3.71	0.851	-0.171	0.098
	Old	12	3.75	0.606		

V. DISCUSSION

Based on the SEM results, functional risk (FR) was found to have no significant negative impact on the continued usage (IU) of M-commerce applications in Saudi Arabia. Therefore, H1 is rejected. This result contradicts those of several prior studies that found functional risk has a significant negative impact on customers' decisions in online shopping such as Ha, Tran [51] who found that functional risk negatively affects customer

satisfaction with mobile payment services. However, this finding is consistent with Alrawad, Lutfi [26]. One possible explanation is that users in Saudi Arabia trust the functionality of M-commerce applications when they buy goods and services, and have sufficient experience with them, reducing concerns relating to product performance of usability.

The results also revealed that information risk and privacy risk do not have a significant negative impact on the continued usage (IU) of m-commerce applications in Saudi Arabia. These unexpected results contradict results of several previous studies such as [26, 64]. One possible explanation is that participants may not be particularly concerned about privacy and information risks due to their trust in these applications. Most online stores in Saudi Arabia operate under government oversight which may enhance user confidence. These results may also indicate that M-commerce applications in Saudi Arabia provide all necessary information that customers need, thus alleviating their concerns related to privacy and information security.

Similarly, results revealed that delivery risk, physical risk and social risk do not have a significant negative impact on the continued usage of M-commerce applications. Again, these unexpected results contradict those of prior studies such as [66, 69], although they are consistent with Alrawad, Lutfi [26]. These results may indicate that customers generally do not experience significant delivery issues when shopping online, reducing the relevance of this risk. Social risk may also be less influential, possibly because online shopping via M-commerce applications is widespread across Saudi society, thereby normalizing such behavior and reducing any associated negative connotations. In the same line, one possible explanation is that participants may not be particularly concerned about physical risk due to their trust in these applications.

Conversely, financial risk was found to have a significant negative impact on the continued usage of m-commerce applications in Saudi Arabia. This result is consistent with many previous studies such as [26, 46, 73]. This result suggests that most customers remain concerned about the potential for financial loss during online shopping. Negative past experiences, such as monetary loss or fraudulent activity, may contribute to this perception. Given the importance of financial considerations, any perceived risk in this dimension is likely to deter continued usage. Furthermore, recent increased threats and prevalence of cyberattacks may exacerbate these concerns and reinforce customers' fears regarding their financial security in M-commerce environments.

Finally, the results revealed that no significant differences in the continued usage (IU) of M-commerce applications between age groups (younger vs. older participants) or gender groups (female vs. male). This finding contradicts many previous studies. For example, Windasari and Albashrawi [78] reported gender-based differences in loyalty toward m-banking, while Mkpojiogu and Hashim [79] identified significant age-related differences in user satisfaction with m-banking services. However, the present results are consistent with other studies, such as Kolsaker and Payne [80], who found no significant gender differences in online shopping behavior. Similarly, Alotaibi [81] reported no significant differences in M-commerce customer loyalty across gender, age, and experience groups. These findings may indicate that both age and gender groups have similar intentions to continue using M-commerce applications, likely due to similar perceived benefits and satisfaction with these applications. The widespread adoption of M-commerce in Saudi Arabia may have contributed to a normalization of online shopping behavior across demographic groups. Many users may prefer the convenience of online shopping over traditional retail experiences, such as visiting physical malls. Additionally, the consistent quality of experience and effectiveness of services offered by M-commerce platforms may explain the uniformity in continued usage across the different groups.

VI. CONCLUSIONS

This study aims to examine the impact of various dimensions of perceived risk on the continued usage of M-commerce applications in Saudi Arabia. The dimensions assessed included functional risk, information risk, privacy risk, physical risk, delivery risk, financial risk and social risk. The SEM analysis revealed that functional risk, information risk, privacy risk, physical risk, delivery risk and social risk do not have a significant negative impact on continued usage of m-commerce applications in Saudi Arabia. In contrast, financial risk was found to have a significant negative impact on continued usage. Finally, the results indicated no significant difference in continued usage of M-commerce applications between age groups (younger vs. older participants) or gender groups (female vs. male).

This study contributes to practical knowledge by addressing and acknowledging the dimensions of perceived risk affecting the continued usage of M-commerce applications in Saudi Arabia and by exploring the differences

in usage between younger and older participants as well as between males and females. It also advances theoretical knowledge by proposing and empirically testing a model that measures the impact of perceived risk dimensions on continued M-commerce usage. The findings may offer valuable insights for provider services seeking to improve customer experience and increase the adoption of M-commerce applications. Furthermore, the proposed model can be adapted and applied in other national contexts to assess the influence of perceived risks on the continued usage of m-commerce applications. Future research, we recommend conducting exploratory studies to investigate the unexpected findings in greater depth, particularly from the perspective of users.

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