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Effects of behavioural intention on usage behaviour of digital wallet: the mediating role of perceived risk and moderating role of perceived service quality and perceived trust

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Abstract

In today's digital economy, digital wallets are becoming increasingly significant. Various factors influence digital wallet's usage behaviour, e.g. consumer attitudes and views of digital wallets, the perceived benefits and hazards of using digital wallets, and the ease of use and reliability of digital wallet services. This study empirically examines the usage behaviour of digital wallets, with a particular focus on the role of perceived risk as a mediator and role of perceived trust and perceived service quality as moderators. This quantitative and primary data-based study used survey approach to collect data using structured questionnaires from 450 digital wallet users, and data were analyzed using PLS-SEM (Smart PLS 4.0). The findings show that behavioural intention positively and significantly impacts digital wallet usage behaviour, and perceived risk mediates the proposed relationship, while perceived trust and service quality showed strong moderating effects on the relationship between perceived risk and digital wallet usage behaviour. The study adds to the literature on digital wallet adoption and usage by emphasizing the complex relationship between behavioural intention, perceived risk, perceived trust, and perceived service quality. The findings can help digital wallet service providers to build successful strategies to increase its' acceptance and usage.

Keywords Behavioral intention, Digital wallet, Perceived risk, Perceived ease of use

Introduction

Digital wallets are gaining wider acceptability as payment methods for online purchases. Digital wallets have evolved as a viable alternative to traditional payment methods in response to the expansion of e-commerce. Flinders ([1], p. 1) stated that *".... more than 5 billion people will be using digital wallets by 2026 as 'super apps' drive adoption in developing countries; further, it is estimated that the value of digital wallet payments will be more than $12tn in 2026"*, whereas Juniper [2] reported that *"total number of digital wallet users will exceed 5.2 billion globally in 2026, up from 3.4 billion in 2022; representing strong growth of over 53%"* (p. 1). While, in the perspective of Pakistan, State Bank of Pakistan (SBP) reported that (a) *"E-banking—defined as transactions conducted* via *electronic channels (including ATMs, mobile banking, internet banking* etc.*) grew by 12% and 16%, respectively, in Q1-FY22 over the same quarter of FY21 with higher adoption in internet and mobile banking option....The number of mobile banking users grew by 4% on quarter over quarter (QoQ) basis, reaching a total of 11.3 million with a total number of transactions conducted* via *mobile banking channels was 79.1 million with a value of around PKR 2.2 tn, showing a QoQ growth of 29% by volume and 36%*

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by value… and during the quarter, 12.7million ecommerce related transactions amounting to PKR 22.3 billion were conducted using digital payment channels" [3]. However, several factors including behavioural intent, perceived risk, perceived trust, and perceived service quality drive the adoption and usage of digital wallets, while behavioural intent is an essential component in accepting and utilizing digital wallets. According to the theory of planned behaviour, behavioural intention is a crucial factor in determining actual behaviour, and it is affected by beliefs, normative beliefs, and perceived levels of behavioural control [4]. While discussing digital wallets, the behavioural intention is to utilize and use digital wallets for online transactions.

Another major factor in accepting and using digital wallets is risk perception. Perceived risk relates to the potential bad outcomes that users associate with digital wallet usage, such as fraud, data theft, and unauthorized transactions [4–6]. Risk perception can operate as a barrier to the adoption and use of digital wallets, and reducing risk perception can boost digital wallets' acceptance and usage. In the perspective of digital wallets, a customer uses four characteristics: positivism, originality, tolerance for discomfort, and a willingness to take risks; while offering a safe and easy to use interface helps in reducing consumers' perceived risks and safety issues [7]. Similarly, to Aldammagh et al. [8], less perceived risk has been shown to promote usage behaviour that significantly enhances the acceptance of digital wallet services. Honggo et al. [9] found that an individual's perception of risk or loss can considerably influence their behavioural intentions and use behaviour of digital wallet services to perform monetary transactions. Thus, it can be said that if individuals perceive high level of risks associated with using a digital wallet, they may be less likely to form the intention to use it and may also be less likely to use it, which could influence the individual's intention to use the digital wallet and their actual usage. Moreover, threat aversion can mediate the relationship between intended behaviour and actual usage. A high degree of desire to use a digital wallet does not always indicate actual usage behaviour; if the perceived risk or loss is high [10, 11].

Perceived trust and perceived service quality are significant variables in digital wallets' acceptance and usage, because perceived trust relates to the perception that digital wallets are trustworthy, reliable, and secure [6, 8, 12], and perceived service quality can be referred to the perception of the quality of digital wallet providers' services, such as customer assistance and usability [5, 13, 14], while, perceived trust and service quality have been shown to promote usage behaviour that increases the acceptance of digital wallet services [8].

According to Pillai et al. [7], an individual's level of self-perceived trust is an important factor that strengthens the interrelationship between behavioural intention and actual use; whereas, in terms of digital wallets, it can be said that if an individual's level of perceived trust concerning digital payment is an essential aspect that directly influences one's behavioural intentions of technology. Hanaysha [15] demonstrated that trust is a fundamental and relevant precondition for using electronic wallets; thus, it can be said that those with higher levels of trust are likely to accept and utilize electronic wallets (e-wallets). Therefore, behavioural intention of using e-wallets for digital payments is favourably impacted when there is confidence and trust between the parties. Compared to customers with a lower level of trust, those with a higher level of trust are more likely to carry out the associated intents [11, 16]. Here, the quality of the service that is being provided is operationalized as the overall quality of digital wallets. Tian et al. [12] also found that consumers' perceptions of the service quality they actually receive have a favourable impact on their interests in using mobile banking and digital payment services. As per Uzir et al. [17], service quality significantly influences the perceived risk to continue using digital payment services including mobile payment options [17]. Thus, perceived service quality can be considered as an important factor that may influence consumers' acceptance of e-wallet option [17].

Previous studies have examined the determinants that impact the usage and utilization of digital wallets; however, there is a lack of knowledge of the interaction among behavioural intention, perceived trust, perceived risk and perceived service quality in the setting of digital wallets, so there exists a gap in the literature on the said topic. For instance, some studies have investigated the impact of perceived risk on the usage and adoption of digital wallet services; whereas, others have investigated the relationship between the adoption and usage of digital wallets and behavioural intentions [18]. Some studies have investigated perceived trust's role in adopting and using digital wallets [12, 14, 19]; while, other studies have focused on perceived service quality's impact on decision making [20–22]. Although some studies, for instance, Ajina et al. [23], investigated the reasons for and against mobile-wallet adoption in Pakistan; Panhwer et al. [24] studied the awareness and reason towards slow adoption of e-payment system and Zafar et al. [25] studied the cashless revolution in Pakistan using enterprise integration in the perspective of e-wallets; however, studies examining the relationship among behavioural intention, perceived risk, perceived trust, and perceived service quality regarding digital wallets and how these influence the adoption and utilization of digital wallets, particularly

in the context of Pakistan, remained understudied and underexamined. Therefore, this study aims to fill this gap by investigating the impact of behavioural intention on the usage behaviour of digital wallets; moreover, this study also emphasizes on perceived risk's role in mediating the relationship between behavioural intention and usage behaviour, along with the moderating effects that perceived trust and perceived service quality play in the context of Pakistan.

Theoretical background and hypotheses development

Technology acceptance model (TAM) by Davis [26] is well recognized and widely used in new technological innovation-based research studies [19, 27, 28], and this is also considered a robust model based on theoretical grounds to understand determinants regarding intentions of new technology [19, 29]. Moreover, this model has also been one of the significant and important theories regarding acceptance of technology comprising dimensions that influence an individual's intention regarding usage of new technology: (a) perceived ease of use (PEU) and (b) perceived usefulness, i.e. PU [30–33]. Here, PEOU can be referred to as "the amount of effort required to effectively use a technology" (Davis [26], Cited in [34] and PU is known as the "extent to which a technology is expected to improve a potential user's performance" (Davis, [26], p.1, cited in [34]. To many researchers (i.e. [8, 12, 32]), TAM is considered as an important and significant model regarding acceptance of technology (including e-wallets), because Davis [26] stated that this model is effective and helpful for collecting information system's related information. Moreover, many studies (e.g. [14, 19, 27, 35–37] used TAM model to study intentions to use mobile and e-wallets.

Another model "Unified Theory of Acceptance and Use Technology" (UTAUT) is also well-known framework that measures a consumers' willingness to use or adopt modern technology [38, 39], Venkatesh et al. [40]; further, it states that behavioural intentions determine the actual technology use, and the perceived likelihood of technology adoption depends on following dimensions: social influence, effort expectancy, performance expectancy and facilitating conditions [38, 40]. Moreover, Venkatesh et al. [41] proposed an extension of UTAUT model that is known as UTAUT2 [38, 42] by introducing three new dimensions in the original UTAUT model to adapt it to the context of consumer's use of technology. To Venkatesh et al. ([43], p.1), "such an approach offered a new theoretically justified mechanism for predicting technology acceptance, which was encouraged and endorsed by prior research". However, in order to broadening the scope of the UTAUT2 model, Sarfraz et al. [44]

included the variables of innovative behaviour, perceived risk, disposition, and social impacts in their research and found that the perceived usefulness, innovativeness, perceived ease of use, and social influence of the UTAUT and UTAUT2 concepts have substantial impact on the acceptance of digital wallets in Asian countries [45, 46].

Perceived Usefulness (PU)

It is referred to the "extent to which a technology is expected to improve a potential user's performance" (Davis, [26], p.1, cited in [34, 47]; while, to Hunte et al. ([48], p. 479), PU is termed as the "users' confidence that adopting a digitalized technology will enhance the quality of their activity or performance." Consumers believe utilizing new financial technologies enables them to achieve their monetary objectives that will increase the efficiency level in their transactional process [49]. Previous research has shown a relationship between consumers' expectations of usefulness of e-wallet and their intentions to utilize such service [49, 50]. In the perspective of mobile/smartphone payments, Alassafi [51] studied the factors that impact users' behavioural intention to utilize mobile payments and found that users' behavioural intentions are significantly predicted by their perception of mobile payments' utility [52, 53]. Similarly, another study found that customers are more likely to adopt e-wallets if they see a favourable relationship between their utility and the benefits they actually receive by utilizing such service [12]. The hypothesis proposed is:

H1: Perceived usefulness has a significant and positive effect on the behavioural intention.

Perceived ease of use

Perceived ease of use is defined as "the amount of effort required to effectively use a technology" (Davis [26], Cited in [34, 49]. According to researchers (e.g. [34, 54]), perceived ease of use liberates the technology from its complex state, thus making it more user-friendly. As users would be reluctant to utilize any service/option related to financial technology, if they encountered any difficulty or perceive it difficult to utilize [34, 55, 56]; whereas, some researchers (e.g. [12, 57, 58]) stated that safe, secure, reliable, and easy to use system for digital payments make it easier to carry out monetary transactions, thus, further contributing to a greater likelihood of intentions to use mobile payment system. Therefore, this feature impacts user's intention to use mobile payment system [9, 12, 58]. Moreover, some researchers (e.g. [12, 46, 59]) also showed that perceived ease of use impacts behavioural intention to use e-wallets. The proposed hypothesis is as follows:

H2:   Perceived ease of use has a significant and positive effect on the behavioural intentions.

Perceived compatibility

Perceived compatibility can be referred to as "an individual's perception of how relevant the technology is to one's job" ([60], p. 34). It can also be viewed as a person's evaluation of how an innovation or new mechanism/system can assist in complicated tasks related to work; whereas, here, to what extent digital wallets can accommodate consumers' lifestyles is referred to as the compatibility [55, 61]. Further, it was found that consumer experiences with a digital product are linked to their compatibility with that product e.g. the widespread adoption of mobile payment systems. An individual's propensity to adopt mobile/smartphone payment system is correlated with the degree to which their social circle supports this new purchase method [62, 63]. Moreover, consumers' experiences with a digital product are linked to their compatibility with that product. If a person's values, needs, and experiences with similar technologies are all met, they are more inclined to experiment with the technology. One example is the rise of mobile payment systems. An individual's propensity to adopt mobile payment systems is also correlated with the degree to which their social circle supports this new and innovative option of making monetary transactions [63, 64]. So, compatibility is a factor which will affect the innovation's effectiveness according to the intended use of digital wallet [63, 65]. Thus, the proposed hypothesis is as under:

H3:   Perceived compatibility has a significant and positive effect on behavioural intentions.

Perceived social influence

As per many researchers (e.g. [63, 66, 67]), adopting new technologies sometimes is result of social pressure or perceived social influence, which is necessary for survival in today's competitive era; thus, adopting new and modern technologies in general and financial technologies in particular are greatly influenced by their social influence. Therefore, the extent to which prospective users value the services of their respective social networks has also been shown to impact their interests and use of mobile payment systems [68]. The concept of social influence is primarily centred on how the process of technological acceptance is greatly focused and concerns the characteristics of the people around the users [69, 70]. It was the most influential factor in people's decisions to take action, followed by their expectations for how they would perform and their disposition. Yet, the strongest factor

in shaping future conduct was the impression of others' approval. Users of a service can learn about the opinions of other users by talking to those users and those users can also consider the opinions of their peers by looking at social media [69]. Consumers now have the opportunity to scrutinize these data. Studies have demonstrated that peer pressure is the most reliable indicator of future actions. Thus, the hypothesis proposed is as under:

H4:   Perceived social influence has a significant and positive effect on behavioural intentions.

Behavioral intention and use Behavior

To many researchers (e.g. [4, 12, 71]), behavioural intention can be termed as "the degree to which a person is intended to use a certain technology". It can also be referred to as a person's propensity to use technology or to maintain current level of technology use in the perspective of different factors or determinants that may impact technology use [4]. This study uses customers' stated intentions to predict their usage patterns, while some researchers (e.g. [51]) indicated that customers' behavioural intentions have impacts on their actual actions. Even though there are substantial number of studies (e.g. [38, 72]), utilization of financial technology and mobile payment were less emphasized [62], Hu et al. [11]. Thus, the hypothesis proposed is as under:

H5:   Behavioural intention has a significant and positive effect on the user behaviour of digital wallets.

Perceived risk

To Bauer [73], "*consumer behavior involves risk in the sense that any action of a consumer will produce consequences which he cannot anticipate with anything approximating certainty, and some of which are likely to be unpleasant*" (p. 390); while perceived risk in the perspective of technology adoption can be referred to as *"a consumer's expectation of loss associated with making a mobile payment transaction, which includes personal information leakage as well as the loss of funds"* ([74], p.134). Moreover, there have always been some factors—for instance, perception of risk due to privacy concerns [75]—that prevent customers from adopting new technologies such as digital wallets. Consumers' interest in mobile payment services directly relates to the digital wallet service provider. Conversely, consumers' scepticism may hinder this payment method's widespread adoption ([76], [6, 12]). To Tian et al. [12], issues of confidence and privacy for companies offering and participating in the mobile wallet transactions-based

operations are a major concern for users. Users understand that providing the sensitive information to digital wallet service providers is necessary for utilizing digital wallets services to make financial transactions. When talking about digital wallets, a customer uses four characteristics: positivism, originality, tolerance for discomfort, and a willingness to take risks; as offering a safe and easy to use interface helps in reducing consumers' perceived risks and safety issues [7]. Thus, less perceived risk and trust have been shown to promote usage behaviour that enhance the acceptance of digital wallet services [8]. Thus, hypothesis proposed is as under:

H6: Perceived risk has a significant and negative effect on the usage behaviour of digital wallets.

Perceived risk as a mediator

The level at which a person believes that one's use of a specific product or service may result in any unfavourable consequences or outcomes is referred to as their perceived risk of utilizing that particular product or service [7, 11]. Concerns regarding safety, privacy, dependability, and user-friendliness can all fall under the "perceived risk" category in the context of digital wallets. To Ajzen ([77], p. 23), "behavioural intention represents a persons' readiness to perform a given behaviour and is the primary predictor of actual behaviour" and in the perspective of digital banking, it refers to a person's likelihood and rationale to use digital wallet services to conduct financial and monetary transactions [7, 11, 78, 79]. Whereas, studies found that individuals' perceptions of risk or loss can considerably influence their behavioural intentions and use behaviour of digital wallet services to perform monetary transactions [9]. Thus, it can be said that if individuals perceive high level of risks associated with using a digital wallet service, they may be less likely to form the intention to use it and may also be less likely to use it, which could influence individuals' intentions to use the digital wallet and their actual usage. Moreover, threat aversion can mediate the relationship between intended behaviour and actual usage. A high degree of desire to use a digital wallet does not always indicate actual usage behaviour, if the perceived risk or loss is high [10, 11]. This is particularly more relevant, if the individual is more concerned about compromised personal information. As a result, it is essential for organizations/service providers to provide digital wallet services to properly address and reduce the impact of any perceived risks to enhance the adoptability, acceptance and customer engagement with their such digital offerings. This could include implementing industry's acceptable standards and measure for security and privacy,

improving the user interface and experience, and providing clear and transparent information regarding the advantages and disadvantages of utilizing a digital wallet. The hypothesis developed is as under:

H7: Perceived risk mediates the relationship between behavioural intention and usage behaviour of digital wallets.

Perceived trust as a moderator

The concept of trust can be referred to the positive anticipation that an individual has, in which that individual has belief and faith in the words, acts, and judgments of others [12, 80]. As per Gefen ([81], p.735), trust can be defined as the *"users' intention towards an expected outcome brought by technology and their faith that the service provider will fulfill their responsibility"*; while, to many researchers (e.g. [6, 11, 82]), trust can be defined as a user's purpose toward a desired outcome brought by technology. According to Pillai et al. [7], an individual's level of self-perceived trust is an important factor that strengthens the interrelationship between behavioural intention and actual use; and in terms of digital wallets, it can be said that if an individual's level of perceived trust concerning digital payment is an essential aspect that directly influences one's behavioural intentions of technology. Hanaysha [15] demonstrated that trust is a fundamental and relevant precondition for using e-wallets; thus, it can be said that those with higher levels of trust are likely to accept and utilize e-wallets. Therefore, behavioural intention of using e-wallets for digital payments is favourably impacted when there is confidence and trust between the parties. Compared to customers with a lower level of trust, those with a higher level of trust are more likely to carry out the associated intents [11, 16]. Moreover, perceived trust has critical importance and it also influences customers' behavioural intentions to use e-wallets for making e-payments. This research draws on empirical information from previous authors and proposes hypothesis as under:

H8: Perceived trust positively moderates the relationship between behavioural intention and the user behaviour of digital wallets.

The moderating role of perceived service quality (PSQ)

Gefen ([81], p. 737) defined PSQ as "the subjective comparison of consumers between the expected quality of service and the actual service quality they get" and to Tian et al. [12], perceived service quality results

from consumers comparing the level of service they expected to receive and the quality of service they actually received. According to Zameer et al. [83], PSQ is the judgment of the consumers between the expected and received service levels. In the context of digital payment systems, it was described as customers' perceptions of the quality of new payment services and the features they offer [84]. In this study, the quality of the service that is being provided is operationalized as the overall quality of digital wallets. Tian et al. [12] also found that consumers' perceptions of the service quality they actually receive have a significant and favourable impact on their interests in using mobile banking and digital payment services. According to the findings of another study, service quality significantly influences the perceived risk to continue using digital payment services including mobile payment options [17]. Thus, perceived service quality can be considered as an important factor that may influence consumers' acceptance of an e-wallet [17]. Hypothesis proposed is as under:

H9:   Perceived service quality positively moderates the relationship between perceived risk and use behaviour of digital wallets.

Conceptual framework

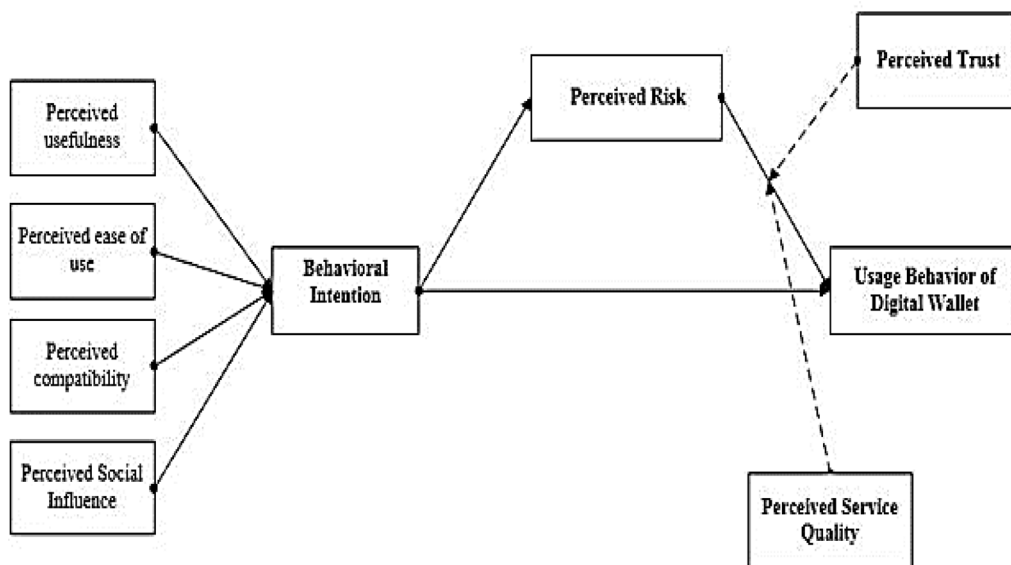The conceptual framework of the present study is as under (Fig. 1):

Methodology

Research instrument

The research instrument consists of ten sections: section A that contains demographic information; section B that addresses perceived usefulness; section C addresses perceived ease of use; section D addresses perceived compatibility; section E addresses perceived social influence; section F addresses behavioural intention; section G addresses perceived risk; section H addresses perceived trust; section I addresses perceived service quality; and section J addresses use behaviour. Demographic characteristics (i.e. age, gender and academic qualifications) were considered to acquire information about the participants. The purpose of this question was to identify respondents who have previous experience with using digital wallet payment options. Verified structured questionnaires were adopted to collect data of other constructs on 1–5 Likert scale (where 1 = strongly disagree and 5 = strongly agree). Three items adapted from Senali et al. [65] were used to measure the construct of perceived usefulness. Four items for perceived ease of use were adapted from Venkatesh et al. [42]; while three items adapted from the study of Shetu et al. [6] were considered to measure perceived compatibility. Scale of perceived social influence was borrowed from the study of Shetu et al. [6] that was measured on three items; while three items from the study of Tian et al. [12] were used to assess behavioural intentions. Four items adapted from the study of Pavlou and Fygenson [85] were used to assess perceived trust. Three items from the study of Tian et al. [12] were used to assess perceived service quality;

Fig. 1 Conceptual framework. *Source:* Author's proposed model

while three items were borrowed from the research study of Aldammagh et al. [8] to assess perceived risk and four items were adopted from the study of Sivathanu [86] to assess use behaviour.

Sampling and data collection

Between December 2022 and February 2023, a quantitative, cross-sectional, and survey-based study was conducted that used online survey method as a technique for collecting primary data. The study emphasized on following social media platforms: Facebook, Instagram, Telegram, WeChat, and YouTube. Tian et al. [12] also emphasized that the utilization of the services offered by social media platforms would be acceptable and efficient for the collecting of data. In this study, purposive sampling technique was employed (focusing on Pakistani individuals using digital wallet payment services) to collect required data from 500 respondents. These respondents also had experience using digital wallet options during the most recent three months. Out of this total, 450 questionnaires were deemed suitable for the data analysis. It is also likely that such respondents are using mobile phones and digital wallet payment systems, which is the logic behind selecting such individuals.

Data analysis tools and technique

The researchers used software SPSS to analyze the respondents' demographic data. In addition, to confirm the suggested conceptual model of this study and to determine the significant constructs and moderating and mediating role regarding the adoption of digital wallets, PLS-SEM using software Smart PLS 4.0 was employed; and considering the sample size of 500 and the PLS-SEM through a multivariate statistical technique applied for testing the structural model [87].

Results

Demographic information

Out of 450 questionnaires, the data analysis showed that 58.5% were men and 41.5% were women. Regarding their academic qualifications, 24% had postgraduate degrees, 47% had undergraduate degrees, 22% had higher secondary school certificates/A levels, and 7% had high school certificate/O levels.

Assessment of measurement model

Figure 2 shows the measurement model. The usage of SmartPLS 4.0 allowed the evaluation of both reliability and validity. A cut-off of value of 0.6 was applied as a criterion to determine the factor loadings of the items
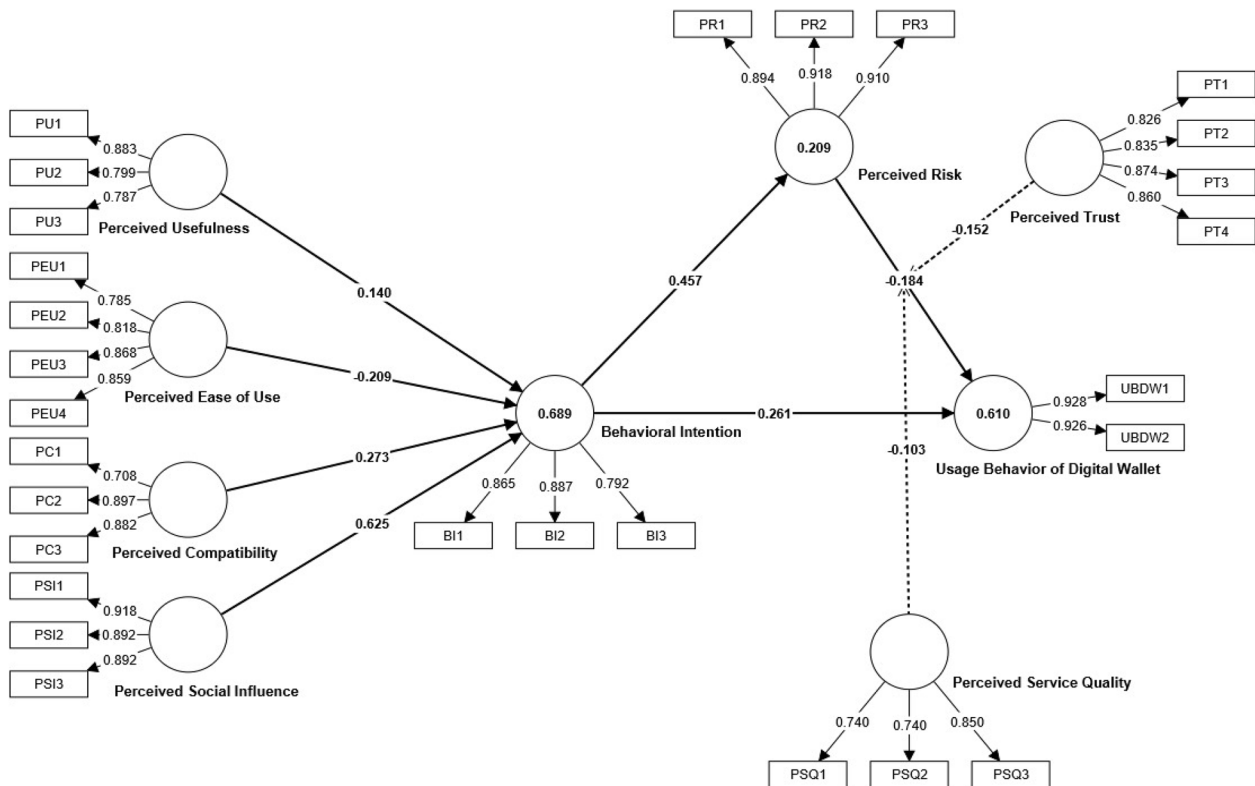

Fig. 2 Measurement model. *Source:* Based on author's computation

[88]. In addition, composite reliability (CR), Cronbach's alpha and average variance extracted (AVE) were examined, and the cut-off values for each of these measures were determined as 0.7, 0.7, and 0.5, respectively (Hair et al. [89]). The Fornell–Larcker criteria model investigated the square root of AVE to quantify the possibly overlapping conceptions that were used to create discriminant validity. Measuring model's results are presented in Table 1. The estimated value for Cronbach's alpha varies from 0.728 to 1.0 that indicated the reliability of the data; whereas, all of the composite reliability values were greater than the threshold value of 0.7 that ensured their reliability as these values varied from 0.839 to 1.0. At the end of the study, the computed average variance extracted of every tested construct was greater than the 0.5 threshold value. The validity of the components was also proven by the study's estimated findings, which ranged from 0.637 to 1.0.

Discriminant validity
By comparing the outer and the inner variance inflation factor values, the researchers looked into the discriminant validity (VIF). Discriminant validity can be evaluated using the Fornell–Larcker criterion model and cross-loadings [90]. According to the data analysis, the values of the highest outer VIF and highest inner VIF were found as 4.036 and 7.326, respectively; these numbers were less than 10.0, serving as the statistical significance threshold; thus, there is no evidence of multicollinearity in the data (Nawaz and Pangil [91]). The models developed by Fornell and Larcker may be found given in Table 3. The researchers also analyzed the degree of correlation among each latent variable and related it with the square root of the AVE value obtained from the correlation test. As the correlation values of other constructs across the plane and the vertical sides are lower than the AVE's square roots, as shown in Table 2, it is evident that there were not any issues with the study's capacity to distinguish between the various constructs. The square root of the AVE is presented in bold.

In addition, the Heterotrait/Monotrait ratio of correlations (HTMT) was analyzed to determine whether or not the constructs possessed discriminant validity. According to Zaman et al. [92], the value of HTMT should not be greater than 0.85 or 0.9 when comparing different constructs. The results of the analysis showed that none of the HTMT values between the constructions were larger than 0.85. Because of this, discriminant validity has been established.

Structural model analysis
Initially, regression analysis was used to evaluate the proposed hypotheses. SmartPLS4.0 was used to enter the regression analysis findings into Table 3. R-square values for behavioural intention, perceived risk, and digital wallet usage behaviour were 0.689 (69.9%), 0.209 (20.9%), and 0.610 (61.0%), respectively. The R^2 values showed the dependent constructions' interpretative power.

Test of hypotheses
The results of the PLS-SEM analysis to assess the significance of the suggested hypothetical model are provided in Table 4. Table 4 displays the direct findings that were obtained from the route analysis. These findings pertain to perceived utility, ease of use, compatibility, social impact, behavioural intention, and perceived danger. A statistical analysis suggests that H_1 is backed up by the information, proving that a boost in perceived utility massively increases behavioural intention to use digital wallets ($t = 2.486$, $p = 0.006$). This conclusion was reached after the research analysis of statistical data. Users' behavioural intentions to adopt digital wallets are highly impacted by their opinions of how simple it is to use them ($t = 3.742$, $p = 0.000$); thus, H2 is statistically significant. Perceived compatibility significantly impacted users' desire to take action ($t = 4.367$, $p = 0.000$), thus, H_3 was strongly backed. Users' desire to act is greatly influenced by their estimation of the social consequences of their actions ($t = 14.688$, $p = 0.000$), thus, H_4 is supported. It is further supported by the fact that consumers' behavioural intention to adopt digital wallets significantly affects their usage intent ($t = 5.207$, $p = 0.000$). In addition, H_6 is supported by the fact that users' risk aversion increases when they are aware of the potential dangers associated with using a digital wallet ($t = 4.945$, $p = 0.000$).

Testing mediation effects
The authors investigated the function of perceived risk as a mediator in the relationship between behavioural intention and usage behaviour of digital wallets to understand the dynamics of this relationship better. According to the findings, an individual's perception of risk significantly and negatively affects the link between behavioural intention and usage behaviour of digital wallets ($p = 0.000$), supporting H_7. The results of the mediation analysis are presented in Table 5.

Moderation test
This study reveals that trust and service quality perceptions substantially moderate the relationship between behavioural intention and actual digital wallet usage ($t = 2.823$, $p = 0.002$; $t = 2.250$, $p = 0.012$). Hence, both H8 and H9 can be considered as accepted. Table 6 and Fig. 3 show that users' opinions of the reliability and security of a digital wallet have a major impact on their propensity to make purchases using that wallet.

Table 1 Construct reliability and validity

	Items	Outer loading	Cronbach alpha	CR	AVE
Behavioural intention (BI)	[BI1] Using digital wallets improves the course of my daily life	0.865	0.805	0.885	0.721
	[BI2] Using digital wallets in my everyday life increases my productivity	0.887			
	[BI3] Using digital wallets enhances the effectiveness of my daily life	0.792			
Perceived compatibility (PC)	[PC1] Using digital wallets fit well with my lifestyle	0.708	0.777	0.871	0.695
	[PC2] Using digital wallets does well with the way I like to purchase products and services	0.897			
	[PC3] I would appreciate using digital wallets instead of traditional modes of payment	0.882			
Perceived ease of use (PEU)	[PEU1] The payment process with mobile apps is clear and understandable	0.785	0.853	0.901	0.694
	[PEU2] The payment process with mobile apps does not require a lot of mental effort	0.818			
	[PEU3] I find it convenient to pay digitally	0.868			
	[PEU4] It is easy to follow all the steps to using the mobile payment system	0.859			
Perceived risk (PR)	[PR1] There is a risk of losing money or making unintended purchases when using a digital wallet	0.894	0.893	0.933	0.824
	[PR2] I am concerned about the reliability and security of the technology behind digital wallets	0.918			
	[PR3] Using a digital wallet may lead to errors or mistakes that could negatively impact my finances	0.910			
Perceived social influence (PSR)	[PSI1] People who are important to me think that I should use digital wallets	0.918	0.885	0.928	0.811
	[PSI2] People who influence my behaviour think that I should use digital wallets	0.892			
	[PSI3] People whose opinions I value prefer that I should use digital wallets	0.892			
Perceived service quality (PSQ)	[PSQ1] Digital wallet payment service provider anticipates and responds promptly to my needs as a user	0.740	0.716	0.821	0.606
	[PSQ2] Digital Wallet meets my expectations	0.740			
	[PSQ3] Digital wallet instils confidence in users by reducing uncertainty	0.850			
Perceived trust (PT)	[PT1] I think that Alipay will keep its promises and commitments	0.826	0.873	0.911	0.720
	[PT2] Digital wallet is trustworthy	0.835			
	[PT3] I would consider digital wallet to be honest	0.874			
	[PT4] I think that digital wallet is responsible	0.860			
Perceived usefulness (PU)	[PU1] Using digital wallets improves the course of my daily life	0.883	0.765	0.863	0.679
	[PU2] Using digital wallets in my everyday life increases my productivity	0.799			
	[PU3] Using digital wallets enhances the effectiveness of my daily life	0.787			
Usage behaviour of digital wallet (UBDW)	[UBDW1] I will frequently use the digital wallets platform	0.928	0.836	0.924	0.859
	[UBDW2] I will continue to use my digital wallets apps	0.926			

Discussion

The results of this study supported the first hypothesis that hypothesized that perceived usefulness had a considerable and favourable influence on behavioural intention. Research in various contexts has repeatedly substantiated the positive relationship between perceived usefulness and behavioural intention. Research has supported the positive correlation between a person's perceived

Table 2 Discriminant validity

	BI	PC	PEU	PR	PSQ	PSI	PT	PU	UBDW
Behavioural intention	**0.849**								
Perceived compatibility	0.707	**0.833**							
Perceived ease of use	0.433	0.683	**0.833**						
Perceived risk	0.457	0.497	0.528	**0.908**					
Perceived service quality	0.663	0.684	0.582	0.599	**0.778**				
Perceived social influence	0.803	0.754	0.571	0.480	0.684	**0.901**			
Perceived trust	0.743	0.715	0.552	0.545	0.687	0.661	**0.849**		
Perceived usefulness	−0.608	−0.755	−0.707	−0.438	−0.659	−0.656	−0.604	**0.824**	
Usage Behavior of digital wallet	0.667	0.633	0.468	0.357	0.715	0.650	0.691	−0.596	**0.927**

Table 3 R^2 values

	R-square	Adjusted *R^2*
Behavioural intention	0.689	0.686
Perceived risk	0.209	0.207
Usage behaviour of digital wallet	0.610	0.605

Source: Based on author's computation

Table 4 Path coefficient

	Original sample	*T* values	*P* values	Decision
PU→BI	0.140	2.486	0.006	Accepted
PEU→BI	0.209	3.742	0.000	Accepted
PC→BI	0.273	4.367	0.000	Accepted
PSI→BI	0.625	14.688	0.000	Accepted
BI→UBDW	0.261	5.207	0.000	Accepted
PR→UBDW	−0.184	4.945	0.000	Accepted

Source: Based on author's computation

Table 5 Mediation analysis

	Original sample	*T* values	*P* values
BI→PR→UBDW	−0.084	4.548	0.000

Source: Based on author's computation

Table 6 Moderation analysis

	Original sample	*T* values	*P* values
PT × PR→UBDW	−0.152	2.823	0.002
PSQ × PR→UBDW	−0.103	2.250	0.012

Source: Based on author's computation

usefulness and their inclination to engage in a certain action. According to the findings of a study conducted by Zielonka and Rothlauf [93], the perceived utility of a technological tool or innovation, such as a decision support system, significantly impacts a person's behavioural intention to use that particular system or tool. Similarly, Tian et al. [12] found that perceived usefulness was positively associated with behavioural intention to use mobile payment services. This was shown to be the case in mobile payment services. Hence H_1 is supported. The findings of the study's second hypothesis stated that ease of use has a significant and positive impact on behavioural intention. According to Zia and Alzahrani [94], users are more likely to accept a technology if they believe it is simple. The perceived usefulness of a technology is positively related to its' easiness and simplicity of use, which enhances the propensity to utilize it; hence, H_2 is supported. The findings of the third hypothesis of the study stated that perceived compatibility has a significant and positive impact on behavioural intention. According to Becker and Jaakkola [95], perceived compatibility strongly predicts behavioural intention. They proposed that if consumers do believe technology to be congruent with their beliefs, security and safety concerns, and requirements, they are more likely to accept and adopt it. Similarly, Acikgoz et al. [96] found that perceived compatibility was positively related to intention to use e-services. They also found that if users view e-services as aligned with their wants and values, they are more inclined to adopt them; hence, H_3 is supported. The findings of the fourth hypothesis of the study stated that perceived social influence has a significant and positive impact on behavioural intention. Cahigas et al. [69] stated that perceived social influence impacts the purpose to use online purchasing services. They found that if consumers believe that their peers or family members like or prefer to buy in online context, they are more likely to have a favourable attitude toward it that enhances their intention to utilize it. Moreover, Shetu et al. [6] stated that perceived social influence significantly and favourably impacts the intention to utilize
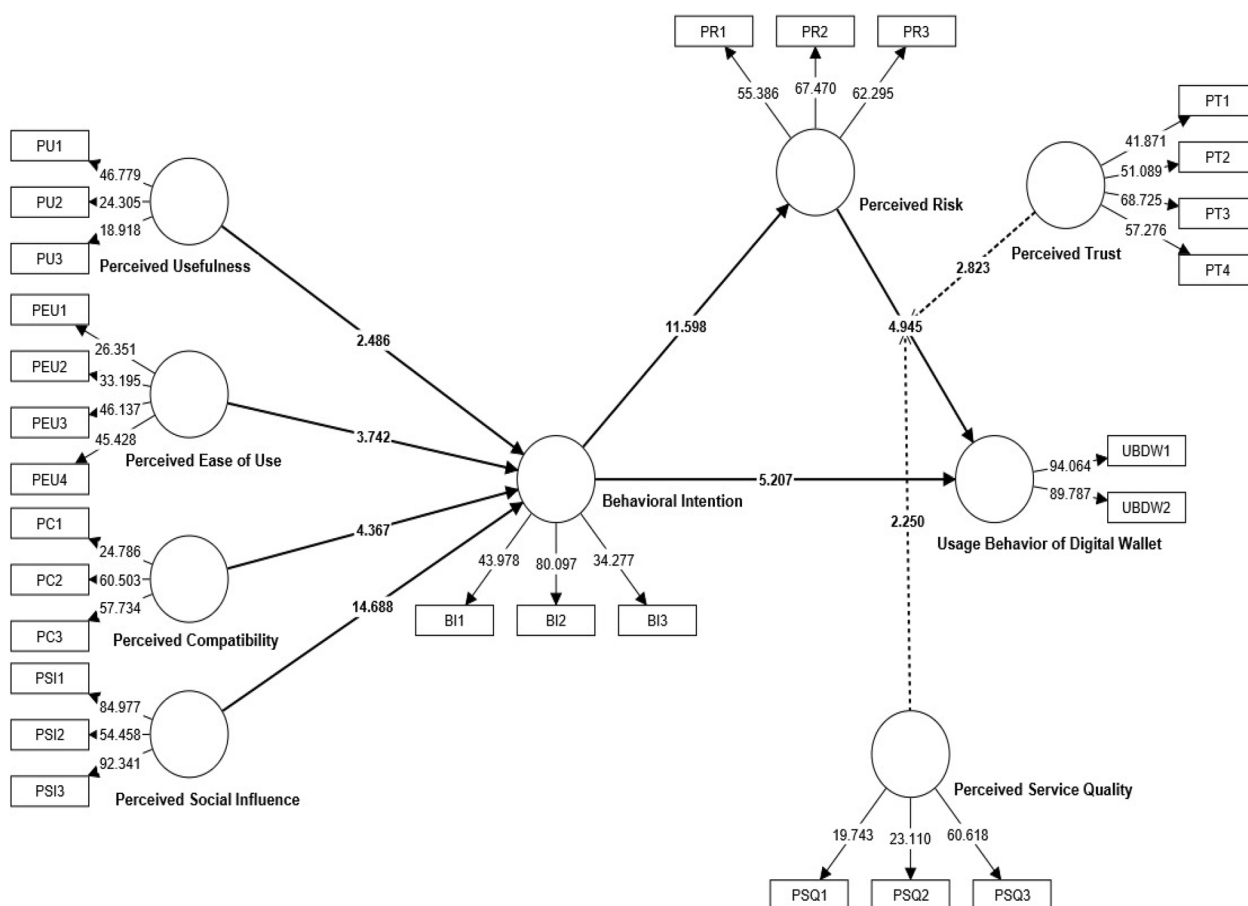
Fig. 3 Structural model. *Source:* Based on author's computation

digital wallet payment services. They hypothesized that if consumers believe their social network encourages to adopt mobile payment system, they are more inclined to utilize them; hence, H_4 is supported. The findings of the fifth hypothesis of the study stated that behavioural intention has a significant and positive impact on the usage behaviour of digital wallets. According to studies, there is a correlation that can be considered both positive and significant between behavioural intentions and actual usage patterns of digital wallets, for instance, a study conducted by Alam et al. [97] found that the frequency with which consumers used digital wallets was directly proportional to the degree to which they had the behavioural intention to use digital wallets. Similarly, a study conducted by Senali et al. [65] found that behavioural intention was the most powerful predictor of the usage behaviour of digital wallets among customers; hence, H_5 is supported. The findings of the sixth hypothesis of the study stated that perceived risk has a significant and negative impact on the usage behaviour of digital wallets. A

study by Zia and Alzahrani [94] indicated that perceived danger/risk was the most significant obstacle to adopting digital wallets among consumers; hence, H_6 is supported. The findings of the seventh hypothesis of the study stated that perceived risk significantly mediates the relationship between behavioural intention and usage behaviour of digital wallets. The behavioural intention of an individual to use a digital wallet will be reduced, if the individual considers a significant level of risk to be linked with utilizing a digital wallet. Furthermore, an individual's actual usage behaviour of a digital wallet is determined by their level of perceived risk, even if the individual intends to use a digital wallet; hence, H_7 is supported. The findings of the eighth hypothesis of the study stated that perceived trust moderates the relationship between perceived risk and usage behaviour of digital wallets. Customers may be hesitant to utilize the technology due to concerns about the potential adverse outcomes, making perceived trust an important aspect in the acceptance and usage of digital wallets [98]. Consumers who have trust in the service

provider's reliability are more inclined to utilize the service and also suggest it to others; hence, H$_8$ is supported. The findings of the ninth hypothesis of the study stated that perceived service quality moderates the connection between perceived risk and usage behaviour of digital wallets. Previous research shows that service quality can function as a buffer against perceived risk's potentially detrimental influence on consumption behaviour [86]; thus, H$_9$ is supported.

Implications

Theoretical and practical implications

This study has several different theoretical implications. First, it sheds a light on the various aspects that play important role in the widespread use of digital wallet services. Past research has demonstrated that perceived utility, ease of use, and compatibility are crucial elements that promote behavioural intention [12]. Yet, the current research emphasizes the significance of perceived risk as a mediator component in this relationship. Moreover, it seems to imply that users may perceive a higher level of risk connected with digital wallets, which may lead to lower usage behaviour. Second, this study underlines the significance of perceived trust and reported service quality as moderating variables. This is an important finding of this study having important implication. Past research has indicated that trust and service quality can favour the use of digital wallets [80]. Based on the study's results, these factors may also be considered to create and strengthen the relationship between behavioural intention and usage behaviour. This study also has some practical applications. It proposes that suppliers of digital wallet services should focus on controlling the risks (of different types including monetary, data) associated with using e-wallet services. This can be accomplished by giving clear information about the security aspects of the digital wallet and by taking concrete steps to secure users' information. Two-factor authentication, encryption, and biometric authentication are examples of such techniques and security measures. The study also indicates that digital wallet providers should prioritize establishing customer trust and delivering high-quality services. This can be achieved by delivering superior customer service, enacting fair and transparent pricing rules, and offering a seamless user experience. Such methods can aid in fostering confidence and improving the perceived service quality of the digital wallet, which can increase usage rates.

Limitations and future directions

This study has some limitations: first, the data utilized in the study were self-reported, which means they may be prone to biases and social desirability effects. In the subsequent studies, various methodologies, such as data on behaviour, may be utilized to provide additional support for the conclusions. Second, the research was conducted on a particular group in one specific setting, which may restrict the potential to generalize the findings to other groups and settings. Third, the study did not consider other aspects that could influence how people use digital wallets, such as social pressure and routine. There are many potential directions for further research based on the current study's limitations: first, the current study's findings can be further validated by using various approaches, such as behavioural data, in follow-up research studies in the future. For instance, researchers may evaluate transactions-based data provided by digital wallet providers to investigate the relationship between behavioural intention and digital wallet usage behaviour, as well as the variables that mediate and moderate the relationship. Second, additional research can also assess the generalizability of the findings by replicating the study with a variety of participants in various settings. For instance, researchers can investigate how social influence and habit interact with the mediating and moderating variables identified in the present study to influence the usage behaviour of digital wallet services. This can be done by examining how social influence and habit interact with the mediating and moderating variables identified in the present study.

Conclusions

This study sheds light on the importance of perceived risk, perceived trust, and perceived service quality in the relationship between behavioural intention and usage behaviour of digital wallets. In conclusion, the findings of this study have thrown light on the importance of these factors. There are certain effective techniques for improving the adoption and usage of digital wallets, such as lowering the perceived risk, building perceived trust, and increasing the perceived quality of the service. In addition, the research provides further insights on the significance of these factors mediating and moderating roles in the relationship between behavioural intention and usage behaviour. Having said that, the study does have some restrictions to it. These limitations can be addressed in a subsequent study, which can also provide the use of a variable that drives the acceptance and utilization of digital wallets. In particular, cross-cultural, longitudinal, and multi-dimensional studies can provide valuable insights into the relationship between various factors and their impacts on the usage behaviour of digital wallets. Other studies may include multi-dimensional studies, which look at multiple dimensions simultaneously. Overall, the current research helps the expanding literature on the

adoption and digital wallet usage and provides valuable insights that digital wallet providers can use to develop effective strategies to increase the adoption and usage of their products. In addition, the research contributes to the existing literature on the proliferation of digital wallet usage and its applications.

Abbreviations

SEM	Structural equation modelling
TRA	The theory of reasoned action
TAM	Technology acceptance model
UTAUT	Unified Theory of Acceptance and Use Technology
PSQ	Perceived service quality
VIF	Variation inflation factor
CR	Composite reliability
AVE	Average variance extracted
BI	Behavioural intention
PC	Perceived compatibility
PEU	Perceived ease of use
PR	Perceived risk
PSQ	Perceived service quality
PSI	Perceived social influence
PT	Perceived trust
PU	Perceived usefulness
UBDW	Usage Behavior of digital wallet
HTMT	Heterotrait/monotrait ratio of correlations

Availability of data and materials
The data supporting the results presented in the paper can be shared upon reasonable request.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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