



# Understanding user acceptance of QR code mobile payment systems in Turkey: An extended TAM

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## ARTICLE INFO

### Keywords:

Technology Acceptance Model  
Mobile payment systems  
User acceptance  
Technology acceptance  
QR code mobile payments

## ABSTRACT

With the contactless payment feature, QR code mobile payment systems (MPS) has been increasingly popular among consumers, particularly during the COVID-19 pandemic. These systems enable consumers to shop from their mobile devices and complete payment transactions quickly. This research aims to explain the user acceptance of QR code MPS and identify the causal relationships between the factors affecting the acceptance. An extended Technology Acceptance Model (TAM) was proposed to achieve this. The research data was obtained from 485 QR code MPS users in Turkey using an online survey.

The remarkable findings of the research showed that the most crucial determinant of the intention to use (IU) is perceived trust (PT), followed by perceived compatibility (PC) and perceived usefulness (PU). Although some of the variables included in the current study were also included in some past studies, no study in the area of QR code mobile payment adoption includes all our variables. In addition, the proposed model explains 65 % of the variance in intention to use QR code MPS (a higher value than the past studies). Therefore, it is expected that the results of this study will be useful in making inferences for countries with similar characteristics.

## 1. Introduction

Mobile commerce offers consumers the chance to shop online by removing time and space limitations and facilitating consumers' lives (Coursaris and Hassanein, 2002). Clarke (2001) defines mobile commerce as transactions involving monetary value over mobile networks. With the growth of the mobile market, online banking transactions and online product or service purchases have become possible with mobile devices (Ngai and Gunasekaran, 2007). The emergence of MPS enabled consumers to purchase from their mobile devices and complete payment transactions within seconds. Mobile payment, an alternative solution to the reduced use of cash at points of sale (Mallat, 2007), is defined as a form of payment used to initiate, authorize and approve a financial value change in return for goods or services in transactions performed over a mobile device (Pousttchi, 2003; Karnouskos, 2004).

QR code mobile payment is a popular Near Field Communication (NFC) MPS. This type of payment requires a QR code and a reader. QR code systems were developed by Denso Wave. They are two-dimensional barcode systems that can be read with a particular reader or intelligent mobile devices (Finžgar and Trebar, 2011; Liébana-Cabanillas et al.,

2015). QR code MPS is a remarkable phenomenon that allows smartphones to be used as digital wallets in more and more places (Pham and Ho, 2015).

This study seeks answers to the following questions, "Why do Turkish people accept QR code MPS?" and "Which factors influence IU?" Hence, this study attempts to determine factors affecting IU and reveal the relationship between the factors by a helpful model including original TAM constructs and PT, SN, PC, and PS constructs.

One of the pioneering papers (Liébana-Cabanillas et al., 2015) in the area of QR code MPS adoption suggested future research in other countries with a larger sample. This suggestion was a good starting point for this paper. The number of publications in this area is limited (Zhong and Moon, 2022; Tu et al., 2021; Indriasari and Jayadi, 2021; Sueb-timrat and Vonguai, 2021; Yan et al., 2021; Liébana-Cabanillas et al., 2015; De Luna et al., 2019; Raza et al., 2019; Ibrahim et al., 2019) and these publications have a focus on a few countries. Turkey is a developing country experiencing an early stage of QR code mobile payment as in many undeveloped or developing countries. For example, a legislative Regulation regarding the usage of QR code MPS of the Central Bank of the Republic of Turkey has recently entered into force (T.C. Official

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<https://doi.org/10.1016/j.techfore.2022.121968>

Received 4 January 2022; Received in revised form 21 July 2022; Accepted 13 August 2022

Available online 19 August 2022

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Gazette, August 21, 2020).

Considering the lack of literature and the rising importance of the contactless payment feature being a promising phenomenon, particularly during the COVID-19 pandemic, this paper is expected to contribute to the literature and reveal the motivations behind using QR code payment in a developing country and provide inferences for countries with similar characteristics.

The remaining parts are as follows: The study's theoretical background and the related literature are presented in Section 2. Section 3 provides the research method. Section 4 addresses the research outcomes. Section 5 includes the discussion and conclusions. The last section provides limitations and suggestions.

## 2. Literature review

This section presents the past studies dealing with the acceptance of QR code MPS, research model, and hypotheses formulation.

### 2.1. QR code mobile payment systems adoption

Although there are many studies on mobile payment acceptance, a limited number of studies focus on the acceptance of QR code MPS adoption. Table 1 presents the past studies' information and findings in a comparative way. The studies' similarities and differences were discussed in detail in the discussion and conclusions section.

A major study by Liébana-Cabanillas et al. (2015) aimed to explain user behavior in QR code MPS based on the data collected from 128 Spanish users. They found that attitude, innovation, and subjective norms are essential antecedents of IU. After that, several papers examining QR code MPS adoption in different countries such as Spain (De Luna et al., 2019), Pakistan (Raza et al., 2019), Malaysia (Ibrahim et al., 2019; Yan et al., 2021), Thailand (Suebtimrat and Vonguai, 2021), China (Zhong and Moon, 2022; Tu et al., 2021), and Jakarta (Indriasari and Jayadi, 2021) were published.

**Table 1**  
Past studies' information and their findings.

Sources information	Country	Sample	Supported hypotheses <sup>a</sup>	Rejected hypotheses <sup>a</sup>	R2 of IU (BI)
Sources					
Zhong and Moon (2022)	China	289 QR-Code MPS users			Not shared
Tu et al. (2021)	China	248 QR-Code MPS users	PB - > BI SI - > PB		0.428
Indriasari and Jayadi (2021)	Jakarta	401 daily passengers of MRT using QR code MPS			0.579
Suebtimrat and Vonguai (2021)	Thailand	1800 QR code MPS users	C - > BI	PT - > BI	Not shared
Yan et al. (2021)	Malaysia	333 QR code users in the retail industry	MU - > BI	MEOU - > BI	0.257
Liébana-Cabanillas et al. (2015)	Spain	168 QR MPS users	PEOU - > PU PC - > PU SN - > IU		0.640
De Luna et al. (2019)	Spain	287 SMS users, 287 NFC users, 168 QR code users	PU - > IU SN - > IU	PS - > IU	0.574
Raza et al. (2019)	Pakistan	Not specified			Not shared
Ibrahim et al. (2019)	Malaysia	485 smartphone users	SN - > IU PU - > IU PEOU - > IU PS - > IU		0.547
The current paper	Turkey	485 QR code MPS users in Turkey	PU - > IU; PT - > IU; PC - > IU; PS - > IU; PEOU - > PU; SI - > PU; PC - > PU; PS - > PU; SI - > PEOU; PC - > PEOU; SI - > PT; PC - > PT; PS - > PT	PEOU - > IU; SI - > IU; PT - > PU; PS - > PEOU; PEOU - > PT	0.650

<sup>a</sup> It shows only the hypotheses established with the variables included in the current study. Perceived Benefit = PB; Social Influence = SI; Behavioral Intention = BI; Compatibility = C; Perceived Trust = PT; Mobile Usefulness = MU; Mobile Ease of Use = MEOU; Perceived Ease of Use = PEOU; Perceived Compatibility = PC; Perceived Usefulness = PU; Subjective Norms = SN; Perceived Security = PS; Intention to Use = IU.

## 2.2. Research model and hypotheses formulation

This paper attempts to reveal causal relationships between the factors affecting the acceptance of QR code MPS with the help of a comprehensive model. The model consists of the three constructs of the original TAM (PEOU, PU, and IU) and the other four constructs (PT, PC, PS, and SN). As seen in Table 2, although some of the variables included in our study were included in some past studies, no study includes all our variables in the area of QR code mobile payment adoption.

### 2.2.1. Technology acceptance model

Davis et al. (1989) put forward the TAM to explain why users adopt or reject new technologies drawing from the Theory of Reasoned Action (TRA) introduced by Fishbein and Ajzen (1975). The TRA proved that behavioral intention successfully explains and predicts a specific behavior. (Davis et al., 1989). The TAM handles beliefs, intentions, and behaviors in a logical order (Sun and Zhang, 2006). The model's primary purpose is to track how internal elements such as individuals' beliefs and intentions are affected by external factors. According to the TAM, the use of technology can be determined by behavioral intention. (Davis et al., 1989). The TAM helps to understand the exploratory power of PEOU and PU over intention (Venkatesh, 2000). Ease of use and usefulness are the critical determinants of actual system usage, and they are the factors that system designers have some control over (Taylor and Todd, 1995).

Many researchers revised the TAM by stating that people's perceptions of various technologies may change depending on user characteristics, organizational factors, and technology development processes (Szajna, 1996). Another reason for the revision and expansion of the TAM is that system designers generally receive feedback on PEOU and PU; however, such feedback is not enough to take action on essential aspects of information technologies (such as flexibility and integration) (Wixom and Todd, 2005).

### 2.2.2. Intention to use

IU reflects a person's desire to use a particular technology (Ajzen,

**Table 2**  
Articles on the acceptance of QR Code MPS.

Source	Zhong and Moon (2022)	Tu et al. (2021)	Indriasari and Jayadi (2021)	Suebtimrat and Vonguai (2021)	Yan et al. (2021)	Liébana-Cabanillas et al. (2015)	De Luna et al. (2019)	Raza et al. (2019)	Ibrahim et al. (2019)
Used frameworks	TAM, UTAUT2	SLT, UTAUT	TAM, DIT	TAM, DIT	TAM, UTAUT, DIT	TAM, DIT	TAM	DIT, UTAUT2	TAM, DIT
Constructs included in the current study									
Perceived ease of use	✓		✓	✓	✓	✓	✓		✓
Perceived usefulness (perceived benefit)	✓	✓	✓	✓	✓	✓	✓		✓
Perceived compatibility			✓	✓		✓		✓	
Subjective norms (social influence)		✓		✓		✓	✓	✓	✓
Perceived trust			✓	✓				✓	
Perceived security	✓					✓	✓		✓
Intention to use (behavioral intention)		✓	✓	✓	✓	✓	✓	✓	✓

Note: SLT: Social Learning Theory; DIT: Diffusion of Innovation Theory; UTAUT: Unified Theory of Acceptance and Use of Technology.

1991). According to the TRA and TAM, IU is the most critical antecedent of actual behavior, and all other factors indirectly affect the actual behavior through IU (Davis et al., 1989).

2.2.3. Perceived usefulness

PU is the degree of believing that using technology will develop an individual's job performance (Davis, 1989). Robey (1979) stated that a technology that does not contribute to job performance will not be accepted with satisfaction regardless of other system attributes. The benefits users will gain in return for using technologies are essential in positively welcoming the system.

Past research outcomes reported a significant impact of PU on IU (Venkatesh and Davis, 2000; Gefen et al., 2003; Wu and Wang, 2005; Benbasat and Wang, 2005; Tung et al., 2008; Kim et al., 2010). Recent studies on the adoption of QR code MPS (Ibrahim et al., 2019) and P2P MPS (Liébana-Cabanillas et al., 2021) also reported a direct impact of PU on the IU. The current paper, therefore, suggests that:

H<sub>1</sub> : PU has a positive effect on IU.

2.2.4. Perceived ease of use

PEOU refers to the belief in the difficulty level in using a particular technology (Davis, 1989). In other words, PEOU can be explained as the consumers' perception of the complexity of new technology (Mallat, 2007). Wu and Wang (2005) studied mobile commerce adoption and revealed that PEOU affects behavioral intention. Tsai et al. (2011) investigated mobile technologies adoption and claimed that PEOU is a critical antecedent of IU. Many other studies also reported a significant impact of PEOU on IU (Venkatesh and Davis, 2000; Gefen et al., 2003; Benbasat and Wang, 2005; Tung et al., 2008; Kim et al., 2010; Joo and Sang, 2013). Therefore, this paper posits the hypothesis below:

H<sub>2</sub> : PEOU has a positive effect on IU.

Venkatesh (2000) revealed that the easier the technology is to use, the more PU increases. Many past studies on the TAM confirmed that PEOU is a critical antecedent of PU (Chen et al., 2002; Gefen et al., 2003; Kleijnen et al., 2004; Benbasat and Wang, 2005; Tung et al., 2008; Kim et al., 2010). Hence, this study assumes that:

H<sub>3</sub> : PEOU has a positive effect on PU.

2.2.5. Perceived trust

PT refers to the belief that technology providers act toward consumers' expectations (Pavlou and Gefen, 2004; Gefen and Straub, 2004). Trust is a key consideration in the technological e-commerce

environment where uncertainty and the lack of one-to-one human interaction exist (Pavlou, 2003). The relationship between PT in online transactions and IU has been the subject of many studies (Benbasat and Wang, 2005; Tung et al., 2008; Al-Saedi et al., 2020). Pavlou (2002) concluded that trust, directly and indirectly, affects online transaction intention. Gefen et al. (2003) revealed that the lack of physical interaction of individuals in online purchasing behaviors leads to differences in perception of trust. The current study, therefore, posits the hypothesis:

H<sub>4</sub> : PT has a positive effect on IU.

Gefen et al. (2003) reported a significant relationship between PT and PU. Other studies (Benbasat and Wang, 2005; Tung et al., 2008) also indicated an important relationship between PT and PU. Hence, this paper assumes that:

H<sub>5</sub> : PT has a positive effect on PU.

Benbasat and Wang (2005) proved that people who consider using a website easy may trust the website providers more. This study, therefore, assumes that:

H<sub>6</sub> : PT has a positive effect on PEOU.

2.2.6. Subjective norms

Subjective norms (SN) can be described as the degree to which individuals perceive that people who are important to them believe that they should use a specific technology or take action (Venkatesh and Bala, 2008; Altay and Okumus, 2022). Individuals tend to interact with their social environment through consultation and comparison during adopting innovation to decrease the uncertainty anxieties arising from the acceptance of innovation (Karahanna et al., 1999). Many past articles reveal that SN is an essential factor in explaining the intention to use various technologies (Taylor and Todd, 1995; Venkatesh and Davis, 2000; Venkatesh and Bala, 2008) and mobile payment technologies (Liébana-Cabanillas et al., 2015; De Luna et al., 2019; Ibrahim et al., 2019).

Hence, this paper suggests that:

H<sub>7</sub> : SN has a positive effect on IU.

Venkatesh and Davis (2000) confirmed that SN affects behavioral intention through PU. This study, therefore, assumes that:

H<sub>8</sub> : SN has a positive effect on PU.

López-Nicolás et al. (2008) examined mobile service acceptance and

found that social influence affects PEOU. Park (2009) studied the adoption of electronic learning systems and supported the finding of López-Nicolás et al. (2008). Therefore, this paper claims that:

**H<sub>9</sub>** : SN has a positive effect on PEOU.

Kelman (1958) defines the relationship between performing the behavior and counseling others as an adaptation effect. Social impact reveals this adaptation and internalization effect. Li et al. (2008) investigated the relationship between SN and the intention to trust new technology and found that SN positively influences the intention to trust. Another study (Hwang and Lee, 2012) examined the perception of online trust with its three sub-dimensions (the providers keeping their promises, doing their job well, and observing the users' interests). It concluded that SN affects all dimensions of online trust. Hence, this study assumes that:

**H<sub>10</sub>** : SN has a positive effect on PT.

### 2.2.7. Perceived compatibility

PC is defined as the consistency between the values, experiences, and needs of people who are more inclined to adopt a new product (Moore and Benbasat, 1991; Taylor and Todd, 1995). Wu et al. (2007) concluded that PC positively influences the intention to use a mobile health system application. Another study (Schierz et al., 2010) expanded the TAM by addressing the compatibility perception in the DIT and claimed that PC directly affects the IU. Later, Yang et al. (2012) found that PC influences intention to use mobile payment services. Therefore, this paper assumes that:

**H<sub>11</sub>** : PC has a positive effect on IU.

PC is considered an essential determinant of PU too. Chau and Hu (2001) examined the adoption of mobile devices and revealed a positive effect of PC on PU. Another study on mobile payment acceptance (Liébana-Cabanillas et al., 2018) confirmed that PC significantly affects PU. Hence, this study claims that:

**H<sub>12</sub>** : PC has a positive effect on PU.

Agarwal and Karahanna (1998) state that compatibility beliefs are one of the factors explaining PEOU. Escobar-Rodriguez and Monge-Lozano (2012) revealed that students who find electronic learning platforms compatible with them perceived the platform as easy. Another study (Ozturk et al., 2016) on acceptance of mobile hotel booking proved that PC positively affects PEOU. Hence, this paper posits the hypothesis below:

**H<sub>13</sub>** : PC has a positive effect on PEOU.

Williams et al. (2017) studied the adoption of mobile payments and concluded that PC positively affects trust. Therefore, this study argues that:

**H<sub>14</sub>** : PC has a positive effect on PT.

### 2.2.8. Perceived security

PS is the degree of transaction security in the system perceived by the consumer regarding authentication, confidentiality, non-refusal, and data integrity when performing a transaction on the system (Amoroso and Magnier-Watanabe, 2012). Park and Kim (2014) researched mobile cloud systems adoption and found that PS significantly affects the adoption.

Payment transactions via mobile devices require the transfer of personal data. Therefore, consumers' security perceptions are considered to affect their usage intentions for mobile payments (Shin, 2009; Oliveira et al., 2016). Lee and Kim (2020) found that trust significantly affects the intention to use a system while the security risk affects it negatively. Therefore, this paper suggests that:

**H<sub>15</sub>** : PS has a positive effect on IU.

As stated before, mobile payments require sharing sensitive data such as card information, addresses, and account balances. A study (Featherman et al., 2010) on e-service adoption revealed that consumers' security concerns regarding the disclosure of user data affect their perceived benefit. Therefore, this study claims that:

**H<sub>16</sub>** : PS has a positive effect on PU.

Qureshi et al. (1970) studied online banking in developing countries and reported a significant relationship between PEOU and PS. Later, Lin and Kim (2016) confirmed the relationship between users' anxiety about the privacy of their information and PEOU. Hence, this paper claims that:

**H<sub>17</sub>** : PS has a positive effect on PEOU.

Consumers who share personal data while shopping online expect to protect their information and verify their passwords. When consumers make financial transactions, they expect the seller to protect their data consistent with these expectations. Chellappa (2008) revealed that consumers associate data protection in e-commerce transactions with the fulfillment of the promises made by the seller. This research suggested that PS may affect PT. Another study (Yousafzai et al., 2010) on internet banking behavior confirmed that the first step of building online trust is strengthening consumers' security perceptions. They claim that users can establish trust and perform online transactions once they ensure their security. Therefore, this study argues that:

**H<sub>18</sub>** : PS has a positive effect on PT.

Fig. 1 shows the research model and expected relations to analyze the determinants affecting QR code MPS adoption.

## 3. Method

This part provides the details of measurement and data collection. The model's constructs were measured with a five-point Likert scale using the scales of two previous studies (Schierz et al., 2010; Chandra et al., 2010) for content validity. The scales are provided in Table A in the Appendix. The research data was collected from Turkish QR code MPS users between March 14–21, 2019, employing various survey websites to achieve random sampling. After the first evaluation, eighty-six responses were eliminated because of the invariance in the answers. Hence, the remaining 485 responses were used.

The socio-demographic characteristics of the participants are demonstrated in Table 3. The gender weights of the respondents are almost equal. Most respondents have an income below 4001 ₺ (67 %) and are younger than 35 (86 %). A sample structure generally consists of young people when QR code mobile payment is a relatively new activity (Kalinčić et al., 2019). Since, for Turkey, this phenomenon is a relatively new activity, the sample includes many young people. The total number of participants with undergraduate and graduate degrees constitutes nearly 60 % of the sample. Private-sector employees (39 %) and students (40 %) are predominant in the sample. Lastly, the sample consists of more single (80 %) than married (20 %) people.

## 4. Results

SEM was performed to establish a theoretical causal model and test the proposed hypotheses. For this aim, the measurement model was first evaluated and developed as a precursor to the structural model tests. After getting good results on confirmatory factor analysis, the structural model was assessed.

### 4.1. Measurement model

To develop the measurement model, internal consistency, discriminant validity, and convergent validity tests were performed. Table 4 demonstrates the CFA results. The model's reliability was assessed using

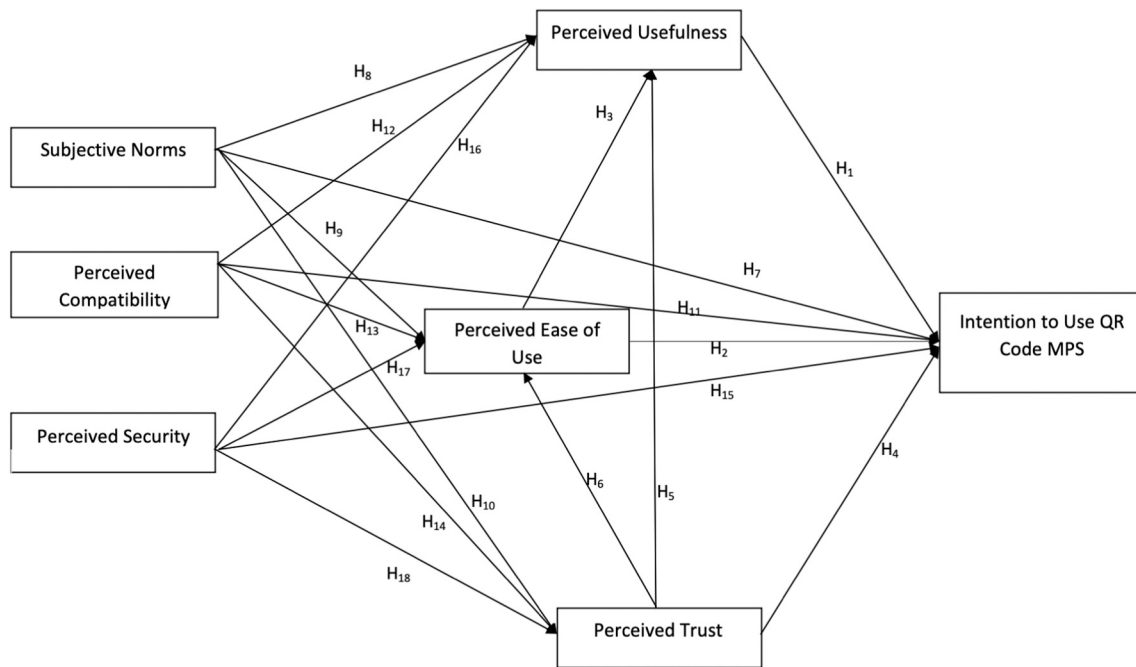


Fig. 1. Research model.

Table 3  
Demographic characteristics of the participants.

Variable	Level	Percentage (%)	Variable	Level	Percentage (%)
Gender	Female	52.16	Occupation	Private sector employee	39.59
	Male	47.84		Public sector officer	10.72
Marital status	Single	79.59		Self employed	2.89
	Married	20.41		Student	40.41
Income	2000 ₺ or below	40.00		Worker	0.82
	2001 ₺ - 4000 ₺	27.22		Retired	1.24
	4001 ₺ - 6000 ₺	18.14	Business owner	1.65	
	6001 ₺ - 8000 ₺	7.01	Unemployed	2.68	
	8000 ₺ or above	7.63	Age	18-24	42.06
Education	High school	32.58		25-34	44.33
	Associate	7.22		35-44	9.07
	Undergraduate	35.87		45-54	3.71
	Graduate	24.33		55 or above	0.83

Cronbach's alpha (CA) and composite reliability (CR) tests. CA and CR values should be 0.7 or higher (Barcelay et al., 1995). All CA and CR values of the constructs exceed 0.7, suggesting high reliability. Each item should have a factor loading of at least 0.5 to achieve convergent validity for each construct in the model. Since all loadings had a higher value than the minimum threshold (0.5) and were significant at the 0.001 level, convergent validity was achieved. Convergent validity can be tested by also checking the constructs' Average Variance Extracted (AVE) value. As seen in Table 4, all AVE values exceed the minimum requirement (0.5) (Hair et al., 2010).

Finally, discriminant validity analysis was performed before testing the measurement model's fitness. The discriminant validity of the measurement model can be achieved only where all latent variables' maximum shared variances (MSV) are lower than the AVEs (Hair et al., 2010). As seen in Table 5, all latent variables' MSVs are lower than the AVEs, implying no cross-loading among the factors, and the discriminant validity was achieved.

Upon good convergent and discriminant validity results, the model's fitness was assessed by various indices. Table 6 shows model fit and recommended values (Hair et al., 2010). The model fit results indicate that the measurement model properly fits the data.

#### 4.2. Structural model

The structural model was assessed to reveal the causal relationships between the proposed model's constructs. Fig. 2 shows the analysis results.

Table 7 shows the hypotheses test results, the significance of the relationships, and standardized path coefficients. Accordingly, H<sub>2</sub>, H<sub>4</sub>, H<sub>8</sub>, H<sub>14</sub>, and H<sub>15</sub> hypotheses are rejected, while the others (H<sub>1</sub>, H<sub>3</sub>, H<sub>5</sub>, H<sub>6</sub>, H<sub>7</sub>, H<sub>9</sub>, H<sub>10</sub>, H<sub>11</sub>, H<sub>12</sub>, H<sub>13</sub>, H<sub>16</sub>, H<sub>17</sub>, and H<sub>18</sub>) are supported. PT is the most critical determinant of the intention to use QR code MPS among latent variables with the standardized effect of 0.33, followed by PC (0.29) and PU (0.28).

The model's explanatory power was calculated by the determination coefficient (R<sup>2</sup>), which corresponds to a value between 0 and 1. An R<sup>2</sup> value higher than 0.10 indicates an acceptable predictive accuracy for a model (Hair et al., 2010). The R<sup>2</sup> of the "IU" was 0.65. This value proves that the proposed model explained the high amount of IU variance. The R<sup>2</sup> values of the PU (0.74) and PT (0.75) are very close. Among the endogenous variables, PEOU had the lowest R<sup>2</sup> value (0.61).

**Table 4**  
Convergent validity and reliability.

	Item	Standardized factor load	AVE	CR	CA
Intention to use	IU1	0.913	0.894	0.952	0.941
	IU2	0.921			
	IU3	0.937			
	IU4	0.916			
Perceived usefulness	PU1	0.859	0.810	0.908	0.884
	PU2	0.829			
	PU3	0.882			
	PU4	0.876			
Perceived ease of use	PEOU1	0.888	0.889	0.959	0.937
	PEOU2	0.931			
	PEOU3	0.939			
	PEOU4	0.912			
Perceived trust	PT1	0.887	0.864	0.945	0.933
	PT2	0.932			
	PT3	0.943			
	PT4	0.936			
	PT5	0.747			
Subjective norms	SN1	0.922	0.896	0.948	0.923
	SN2	0.946			
	SN3	0.926			
	SN3	0.926			
Perceived compatibility	PC1	0.926	0.893	0.935	0.921
	PC2	0.944			
	PC3	0.918			
Perceived security	PS1	0.911	0.890	0.945	0.938
	PS2	0.935			
	PS3	0.937			
	PS4	0.887			

**5. Discussion and conclusions**

This study investigated the factors affecting user adoption of QR code MPS, drawing from the data obtained from 485 Turkish users. According to the research findings, PU, PT, and PC positively and significantly affect IU, while PS has a negative and significant impact. The research outcomes indicated that the strongest predictor of IU is PT. Trust is considered an essential need rather than a comparative advantage in MPS, especially when financial risks are high (Eze et al., 2008). Hence, one of the most critical priorities of QR code MPS providers should be gaining users' trust.

Although attitude is a central construct in the original TAM, it was not included in TAM2, TAM3, UTAUT, and UTAUT2 models. Some prominent studies (Liébana-Cabanillas et al., 2015; De Luna et al., 2019) on QR code MPS acceptance incorporated this construct into their model, while some did not. For example, De Luna et al. (2019) expected many determinants affect IU through attitude. However, only PU

**Table 5**  
Discriminant validity.

Construct	AVE value	Construct						
		IU	PU	PEOU	PT	SN	PC	PS
IU	0.894	<b>0.946*</b>						
PU	0.810	0.735	<b>0.900*</b>					
PEOU	0.889	0.671	0.717	<b>0.943*</b>				
PT	0.864	0.723	0.719	0.647	<b>0.929*</b>			
SN	0.896	0.639	0.771	0.591	0.666	<b>0.947*</b>		
PC	0.893	0.749	0.726	0.757	0.770	0.613	<b>0.945*</b>	
PS	0.890	0.601	0.698	0.592	0.836	0.649	0.676	<b>0.944*</b>

Note: Values on diagonal indicate AVEs' square roots.

**Table 6**  
Measurement model fit indices and recommended values.

Fit indices	$\chi^2/df$	RMSEA	NFI	NNFI	CFI	GFI	RMR
Recommended	<3	<0.05	$\geq 0.90$	$\geq 0.90$	>0.90	>0.90	$\leq 0.05$
Measurement model	2.383	0.053	0.987	0.991	0.992	0.901	0.028

specified by the proposed model was found as a determinant of attitude. The current study has not included attitude in the proposed model drawing from the literature review and in-depth interviews with five experts.

As seen in Table 1, unlike other studies, this paper reveals a significant positive effect of perceived trust on intention to use QR code MPS. In addition, past studies determined the antecedents of PU as PEOU and PC (Liébana-Cabanillas et al., 2015). The current paper found the third antecedent and revealed the effect of PS on PU.

This paper revealed the effect of SN and PC on PEOU different from other studies. These findings imply that if individuals perceive a system to be compatible with their habits and experiences or other people around them suggest using QR code MPS, they will tend to perceive the use of the system to be easier and less complex.

Lastly, this research indicated that PS, SN, and PC positively and significantly influence PT. The research results showed that the strongest predictor of PT is PS. This notable finding implies that QR code MPS should be free of severe security gaps to ensure consumers trust these systems.

Regarding the rejected hypotheses, this paper did not find a significant and positive effect of SN different from three past studies (Liébana-Cabanillas et al., 2015; De Luna et al., 2019; Ibrahim et al., 2019). This finding implies that only thoughts and suggestions of the social environment are insufficient for Turkish people to show their intention to use QR code MPS. Parallel to the outcomes of another research (Yan et al., 2021), the current paper did not confirm a direct effect of PEOU on IU.

Although some of the variables included in our study were also included in some past studies, no study includes all our variables in the area of QR code mobile payment adoption. In addition, our model explains 65 % of the variance in intention to use QR code MPS. Compared to the past studies (Tu et al., 2021; Indriasari and Jayadi, 2021; Yan et al., 2021; Liébana-Cabanillas et al., 2015; De Luna et al., 2019) on QR code MPS, the proposed model indicates a stronger explanatory and predictive power. Therefore, it is expected that the results of this study will be useful in making inferences for countries with similar characteristics.

**6. Limitations and future research**

This research has some limitations. First, the current research collected data from participants, most of them aged lower than 35 years old. Other age groups in the sample may have different perceptions of QR code MPS. Second, although various mobile payment methods are available, this study investigated only QR code MPS. The predictive

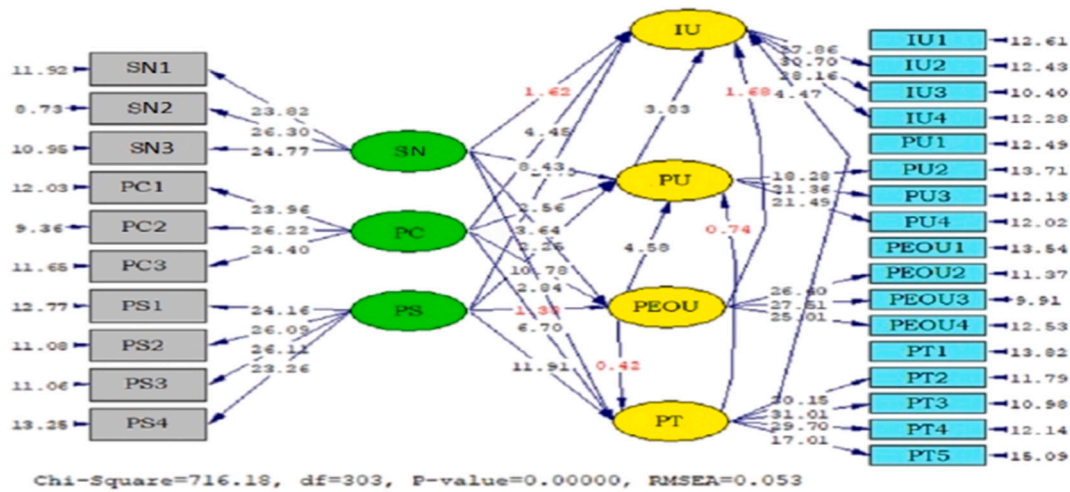


Fig. 2. Structural model results.

Table 7  
Hypotheses tests summary.

Hypothesis	Path	t-Value	Path coefficients	Result
H1	PU → IU	3.83*	0.28	Supported
H2	PEOU → IU	1.68	0.09	Not supported
H3	PT → IU	4.47*	0.33	Supported
H4	SN → IU	1.62	0.09	Not supported
H5	PC → IU	4.45*	0.29	Supported
H6	PS → IU	-2.70*	-0.17	Supported
H7	PEOU → PU	4.58*	0.24	Supported
H8	PT → PU	0.74	0.05	Not supported
H9	SN → PU	8.43*	0.41	Supported
H10	PC → PU	2.56*	0.16	Supported
H11	PS → PU	2.25*	0.14	Supported
H12	SN → PEOU	3.64*	0.18	Supported
H13	PC → PEOU	10.78*	0.60	Supported
H14	PS → PEOU	1.38	0.07	Not supported
H15	PEOU → PT	0.42	0.02	Not supported
H16	SN → PT	2.84*	0.11	Supported
H17	PC → PT	6.70*	0.33	Supported
H18	PS → PT	11.92*	0.53	Supported

\* p < 0.001.

factors for the acceptance of other mobile payment methods might differ.

Third, Park and Ohm (2014) suggest that certain mobile technologies are more widespread in developed countries compared to less developed countries. Hence, consumers' perceptions of QR code MPS might differ

Appendix A

Table A  
Measurement constructs and items.

Constructs	Codes	Modified items	Original scale items
Intention to use	IU1	I consider using QR code mobile payment services	Given the opportunity, I will use mobile payment services
	IU2	I am likely to use QR code mobile payment services in the near future	I am likely to use mobile payment services in the near future
	IU3	I am willing to use QR code mobile payment services	I am willing to use mobile payment services in the near future
	IU4	I intend to use QR code mobile payment services	I intend to use mobile payment services when the opportunity arises (Schierz et al., 2010)
Perceived usefulness	PU1	QR code mobile payment services are a useful mode of payment	Mobile payment services are a useful mode of payment
	PU2	Using QR code mobile payment services makes the handling of payments easier	Using mobile payment services makes the handling of payments easier
	PU3	QR code mobile payment services allow for a faster usage of mobile applications (e.g., ticket purchase on mobile applications)	Mobile payment services allow for a faster usage of mobile applications (e.g., ticket purchase)
	PU4	By using QR code mobile payment services, my choices as a consumer are improved (e.g., flexibility, speed)	By using mobile payment services, my choices as a consumer are improved (e.g., flexibility, speed) (Schierz et al., 2010)

(continued on next page)

when these services become more reachable in more developed countries.

Overall future studies can be conducted with the same set of variables for other existing mobile payment methods or with new model structures in line with the characteristics of the payment systems.

CRediT authorship contribution statement

Cansu Türker: Conceptualization, Data curation, Methodology, Visualization, Writing – first draft.

Burak Can Altay: Conceptualization, Data curation, Methodology, Writing – reviewing, editing, and revisions.

Abdullah Okumus: Methodology, Empirical results, Supervision, Writing – reviewing and editing.

Declaration of competing interest

The authors declare no conflicting interests.

Data availability

The authors do not have permission to share data.

Acknowledgment

This paper was derived from Cansu Türker's master thesis.

Table A (continued)

Constructs	Codes	Modified items	Original scale items
Perceived ease of use	PEOU1	It is easy to become skillful at using QR code mobile payment services	It is easy to become skillful at using mobile payment services
	PEOU2	The interaction with QR code mobile payment services is clear	The interaction with mobile payment services is clear and understandable
	PEOU3	It is easy to perform the steps required to use QR code mobile payment services	It is easy to perform the steps required to use mobile payment services
Perceived trust	PEOU4	It is easy to use QR code mobile payment services	It is easy to interact with mobile payment services (Schierz et al., 2010)
	PT1	I trust QR code mobile payment systems to be reliable.	I trust mobile payment systems to be reliable.
	PT2	I trust QR code mobile payment systems to be secure.	I trust mobile payment systems to be secure.
	PT3	I believe QR code mobile payment systems are trustworthy.	I believe mobile payment systems are trustworthy.
	PT4	I trust QR code mobile payment systems.	I trust mobile payment systems.
Subjective norm	PT5	Even if the QR code mobile payment systems are not monitored, I'd trust them to do the job correctly.	Even if the mobile payment systems are not monitored, I'd trust them to do the job correctly (Chandra et al., 2010)
	SN1	People who are important to me would recommend using QR code mobile payment services.	People who are important to me would recommend using mobile payment services.
	SN2	People who are important to me would find using QR code mobile payment services beneficial	People who are important to me would find using mobile payment services beneficial
Perceived compatibility	SN3	People who are important to me would find using QR code mobile payment services a good idea	People who are important to me would find using mobile payment services a good idea (Schierz et al., 2010)
	PC1	Using QR code mobile payment services fits well with my lifestyle	Using mobile payment services fits well with my lifestyle
	PC2	Using QR code mobile payment services fits well with the way I like to purchase products and services	Using mobile payment services fits well with the way I like to purchase products and services
Perceived security	PC3	I would appreciate using QR code mobile payment services instead of alternative modes of payment (e.g., credit card, cash)	I would appreciate using mobile payment services instead of alternative modes of payment (e.g., credit card, cash) (Schierz et al., 2010)
	PS1	The risk of an unauthorized third party overseeing the payment process is low when using QR code mobile payment services	The risk of an unauthorized third party overseeing the payment process is low
	PS2	The risk of abuse of usage information (e.g., names of business partners, payment amount) is low when using QR code mobile payment services	The risk of abuse of usage information (e.g., names of business partners, payment amount) is low when using mobile payment services
	PS3	The risk of abuse of billing information (e.g., credit card number, bank account data) is low when using QR code mobile payment services	The risk of abuse of billing information (e.g., credit card number, bank account data) is low when using mobile payment services
	PS4	I would find QR code mobile payment services secure in conducting my payment transactions	I would find mobile payment services secure in conducting my payment transactions (Schierz et al., 2010)

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