




Article

Investigating the Effect of Perceived Security, Perceived Trust, and Information Quality on Mobile Payment Usage through Near-Field Communication (NFC) in Saudi Arabia

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Abstract: This study aims to investigate the perceptions of near-field communication (NFC) usage for mobile payments in Saudi Arabia. In order to develop a mathematical framework for the acceptance of NFC quality of information for mobile payments, researchers have combined the technological acceptance model (TAM) and the idea of perceived risk. An online and physical study of 1217 NFC portable credit card holders in Saudi Arabia was conducted. Exploratory and confirmatory analyses were utilized to analyze the factor structure of the measurement items, and Smart PLS 2.0 from structural equation modeling (SEM) was used to assess the theories and hypotheses that had been put forth. The results show that (1) social influence, perceived element of risk, and subjective norms each have a negative influence on preconceptions of trust in online payment methods using NFC; (2) social influence, perceived element of risk, and social norms all have a positive effect on satisfaction with the security of electronic payment using NFC; (3) perceived ease of use has a negative effect on perceived confidence in digital payment using NFC; and (4) perceived ease of use has a negative effect on perceived trust in online payment using NFC. As a consequence of these findings, users' attitudes regarding the use of NFC and behavioral intentions to utilize NFC mobile payment can be revealed. This study created a unique approach for assessing perceptions, perceived trust, and NFC information quality in mobile payment uptake in Saudi Arabia. As a consequence, banks may find this research useful as they implement new strategies to attract more customers, such as perceived security, brand trust, and NFC information quality in mobile payment adaption.

Keywords: NFC; TAM; perceived security; perceived trust; NFC information quality; mobile payment structural equation modeling (SEM)

1. Introduction

Saudi Arabia's payment methods have changed dramatically during the last 15 years. The Saudi Arabian Monetary Agency (SAMA) [1] has contributed to the creation and ongoing management of an industrial payment system that promotes the development of

the Kingdom's economy. It achieves this with the help and guidance of financial companies. As a result of their close working relationship, banks and their customers have reaped major rewards in the form of a cost recovery system that is efficient, shared, and built on the most promising strategies now used in banking. Customers have profited from the ease of use and connectivity of modern payment methods such as credit cards, while banks have avoided making expensive competitive investments. In the past, shopping was frequently coupled with the payment of cash or a credit card. New types of payment have arisen within the digital payment theme as mobile phones become more advanced. "Payments for products, services, and bills via a mobile device such as a mobile phone, smart phone, or personal digital assistant by utilizing wireless as well as other communication technologies" is the general definition of mobile payment (MP) [2]. MP is viewed as a viable alternative to the typical credit card, regardless of definition. As mobile commerce becomes more widespread, MP will become more important in enabling payments between customers and sellers [3]. Because typical MP solutions are currently constrained, this paper considers mobile credit cards (MCCs) as a new form of MP. MCC refers to a rapid credit card payment performed using a smartphone using near-field communication (NFC) technology in this context. There is no need for a real link between the customer and the terminal reader in this situation because transactions may be performed with a simple touch or wave. Despite the fact that MCC adoption provides convenience and benefits to customers, it is still a minority activity [4]. Given the low adoption rate, there has been very little study on MP solutions from the perspective of NFC. The electronic card consists of a credit card linked to a local banking institution, as well as a debit card linked to a local institution [5]. According to certain writers, differences in key measurements such as age, gender, career, and financial status have been shown to contribute to variances in users' tendency to use a checking account [6,7]. Because of the benefits that card payments give, users prefer them to alternative payment methods such as electronic cash, e-money, or credit payments [8]. Users who are intelligent are worried not only about the advantages of having money in the bank, but also about the risk of financial loss [9,10]. Numerous empirical studies have also revealed that social groupings, such as families, friends, and coworkers, significantly affect customers' purchasing intentions [11–13]. Numerous studies show that a major obstacle to using e-services as intended is the sense of risk [14–17]. Similar to this, many individuals consider the perceived risk while deciding whether or not to use credit cards [18–23]. The impact of perceived risk on consumers' desire to use credit cards was either significantly positive, significantly negative, or had no effect, according to conflicting findings [24–28]. Credit cards are a type of technology that can be used to carry out the two basic functions of payment and credit on electronic devices [29–32]. Credit cards could be used to buy items and then use the bank's guarantee to pay for them later [33–36]. As a result, the financial institution pays the biller on behalf of the account holder, and the account holder is responsible for ensuring that all payments are returned in a timely and full manner [37–40].

Credit cards are becoming more commonly accepted and used in modern transactions around the world [41–43]. As a consequence, a conceptual approach with testable assumptions has been built, along with methods and data from Saudi customers. NFC is thought to be the direction in which MP services will evolve in the future [44–46]. The payment mechanism was initially used by the VISA and MasterCard PayPass programs [47–50]. NFC is an elevated wireless communication technique that can transmit files in both passive and active modes, according to [51]. The operating range is 10 cm in passive mode and 20 cm in active mode [52–54]. As a result, NFC technology has made it possible to conduct transactions by simply placing a phone within range of an NFC scanner. Thus, the U.S., Canada, Hong Kong, Korea, Japan, and Taiwan have all adopted the technology [55–58]. Therefore, this research develops a new model that measures perceived security, perceived trust, and NFC information quality in mobile payment adoption in Saudi Arabia.

Mobile payments are still in their infancy in Saudi Arabia. NFC technology has become one of the most exciting technologies in recent years due to the economic potential of its usage for mobile phones and the reliance on important features in the immediate term

beyond mobile payment [59–61]. M-commerce (mobile commerce) apps and new business models, such as mobile payments, are now flourishing [62–65]. On the market, there are a variety of solutions that use diverse approaches and technologies. They all utilize near-field communication (NFC), which is also known as contactless payment. As a result of this study's goal of building a new model of the acceptance of mobile payments and NFC information quality, users in Saudi Arabia must find them compatible with their system and must show acceptance toward their usage and a behavioral intention to use NFC mobile payment methods. Based on the above, this study aims to fulfil the following objective:

To investigate users' perceptions of near-field communication (NFC) usage for mobile payment in Saudi Arabia.

2. Literature Review

Near-Field Communication (NFC) Technology

Near-field communication (NFC) devices are developed based on radio frequency identification (RFID) technology combined with wireless communication; hence, NFC is considered as a subset of RFID technology. NFC based on RFID consists of several frequency bands, including ultra-high frequency, high frequency, and low frequency. Although NFC is a subset of RFID, NFC can use two-way communication between two devices, with effective security and confidentiality.

In recent years, NFC tools have achieved remarkable development in many fields, such as mobile payment, mobile banking, financial payment analysis, and others [66–69]. In addition, NFC technology is a promising tool for financial services, such as mobile payments with wireless connection, and fast and contactless data transfer [70–73]. NFC technology is now widely utilized in daily life and has become a great prospect for commercial applications using smartphone sensing [74–77].

NFC, with fast wireless communication and data transmission, offers new benefits for mobile payment, such as dynamic responses and real-time monitoring for financial transactions. NFC has been widely used for information transmission in mobile and smartphone devices. Moreover, NFC sensors can be utilized without batteries, unlike Bluetooth, which encourages their usage and adoption among clients in the mobile payment field. Based on the above motivations, this study aims to investigate the perceptions of near-field communication (NFC) usage for mobile payment in Saudi Arabia.

3. Research Model and Hypothesis Development

According to the literature review, there are several models that have been designed to analyze user intentions, actual behavior, and acceptance towards new technologies, such as UTAUT, TAM, TRA, DL&ML, and others. For example, a study conducted in [78] used the UTAUT model to study the adoption of mobile payment services. The study revealed that perceived trust is the primary factor motivating users to use mobile banking services. In the same way, a study [79] found that there is a positive relationship between perceived trust, perceived ease of use, and perceived usefulness with the adoption of mobile banking services in Spain. A study conducted in the UK [80] sought to investigate the impact of cybersecurity factors on mobile banking usage among users by extending the UTAUT model. They revealed that risk issues and privacy had significant effects on mobile banking usage. Therefore, the adoption of mobile payment services needs to be approached considering the security and trust factors.

To assess the usage and acceptance of mobile payment technology, several researchers have used the UTAUT model [81–85]. UTAUT has been considered as a comprehensive model for understanding the adoption of mobile payment, as well as having strong predictive power compared with other models [86]. Several studies have employed the UTAUT model to understand the main factors that impact the acceptance of mobile payment [87–90]. The UTAUT model has been employed in various fields, such as e-banking, e-commerce, and others, for which it can explain around 70% of the users' adoption and usage [91].

Although the UTAUT model has several benefits, it also has some limitations, such as a lack of factors related to security, privacy, and trust [91]. Thus, in our study, we compensate for this limitation by adding new external factors, such as perceived risk and perceived trust. Based on previous studies, several researchers have added perceived risk and perceived trust factors to the UTAUT model to assess the usage behavior of several technologies, such as e-banking [92], e-commerce [93], and mobile commerce [94]. Based on the above, this research established the proposed conceptual model based on the UTAUT model while adding perceived risk and perceived trust factors, as shown in Figure 1.

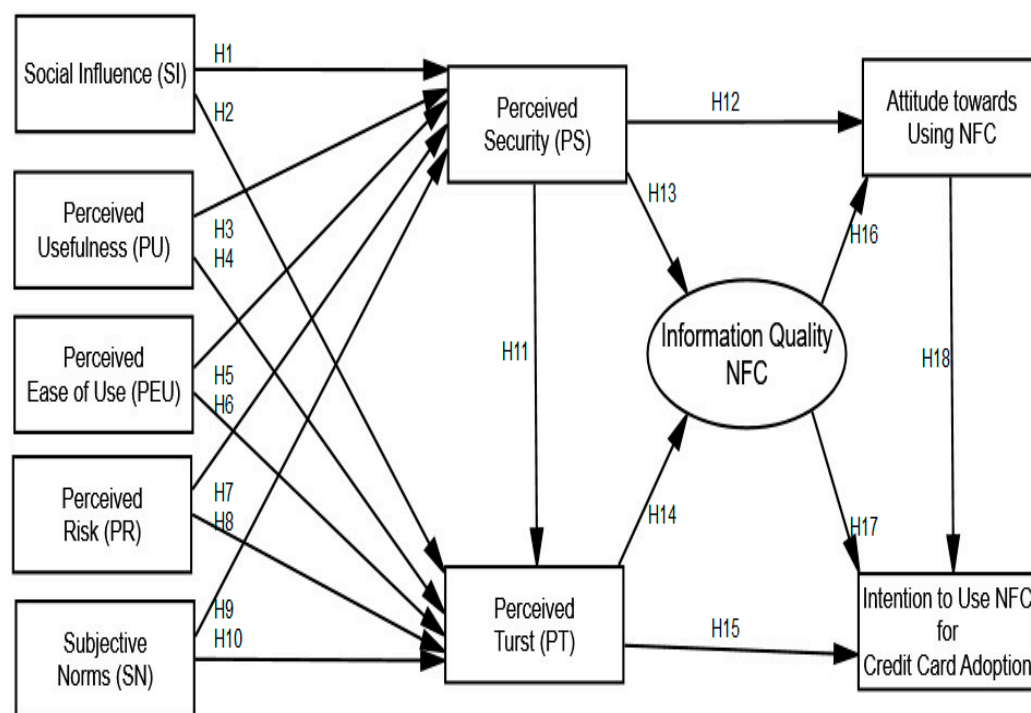


Figure 1. Hypotheses and model.

Many studies [95–97] looked at the factors that influence consumer appropriateness regarding mobile payment and the reasons that, despite the fact that mobile phones are already a common aspect of daily life, such services are still under-utilized. As of March 2012, there were more than 44 mobile telephone designs on the market with NFC technology, with over 20 more planned in the coming months. It was discovered that, in contrary to the initial TAM, perceived appropriateness was the primary factor motivating users to adopt mobile payment services [98]. Because NFC payment is a cutting-edge mobile technology that is expected to become a global trend in a few years, personal factors may have an impact on the expected use of NFC payments, in addition to the purported value and ease-of-use. Several research methodologies have been built over time to analyze client intentions and actual behavior. One of the most well-known theories is the theory of perceived risk (TPR) [99]. It investigates how customers' fears of potential losses impact their purchasing decisions in a variety of situations. In contrast, theories such as the unified theory of acceptance and use of technology (UTAUT), the hypothesis of intent action [100], the technology acceptance model (TAM) [100], the hypothesis of planning behavior [100], and others assert that consumers are logical and risk-averse [100]. Numerous studies on how consumers envision the use of e-services combine these ideas [100]. Therefore, in the current research, ten factors involved in NFC mobile payment adaption, via perceived security, perceived trust, and NFC information quality in mobile payment in Saudi Arabia, were analyzed. As shown in Figure 1, behavioral intention to utilize NFC mobile payment in Saudi Arabia includes perceived utility, perceived ease of use, social influence, perceived danger, subjective norms, perceived security, and perceived trust.

3.1. Social Influence

A customer's belief that influential people perceive that they can or cannot engage in a given activity is referred to as social influence [101]. Consumers must examine their credit card details carefully, and they grow irate when their friends and coworkers frequently discuss them [102]. Amin claims that customers frequently internalize and mimic the economic attitudes of their relatives [103]. Furthermore, readily available media have helped to raise consumers' knowledge of credit cards [104]. An empirical study found that a person's propensity to use credit cards is influenced by the judgments of their social groups [105]. According to [106], the social effect solely affects the planned use of credit cards due to their perceived utility and simplicity of use. A person's decision to use a mobile credit card will be positively influenced by social influence, a psychology science concept, according to [107]. Social impact is expected to favorably influence a consumer's willingness to adopt NFC due to its popularity.

3.2. Perceived Usefulness

Perceived utility measures the extent to which a person believes that employing a method would strengthen their position [108]. Credit cards can be used for both personal credit and non-cash purchases [109]. Consumers choose bank cards over cash because of the risk involved with storing cash [110] or access to special discounts from well-known companies [110]. They rely on traditional credit cards as a source of lines of credit [111]. If necessary, they can use debit cards to withdraw money [112]. Customers favor the simplicity of a credit card as a result, and they are more likely to use them for regular purchases [113]. For MCC to be accepted, it must offer more benefits than cash or credit card payment. One of the advantages of MCC, according to [114], is that it allows for faster checkout because no signature is necessary. Similarly, because the purchase is closed with a phone wave, the time-consuming step of inputting payment card information is removed [115].

3.3. Perceived Ease of Use

Perceived ease of use is defined as the degree to which a person believes that using a system is straightforward [116]. This perception is generated by a sophisticated system of perceived control [117]. Customers can quickly and simply register a bank card, according to [118]. According to [119], numerous electronic devices accept bank cards. Furthermore, because the card payment method is so simple to understand and regularly use, consumers do not have to invest much effort [120]. Multiple surveys demonstrate that credit card users value them and want to use them frequently as a result [121]. Because MCC actions are carried out with a single wave, the previous MP's limitations would be removed. Customers are likely to favor MCC if they perceive that it requires less mental effort to use. According to [122], location-based mobile services (such as NFC) may be difficult to use when moving about due to personalized dialogues. Because they lack the knowledge, skills, and capacity to use a technology when it is still in its early stages of development, the majority of customers may choose not to adopt it, according to [123]. A customer's perception of how convenient NFC mobile payments will be is the main aspect of TAM's perceived ease of use component [124].

3.4. Perceived Risk

A user's own expectation of financial loss in the event of an incident is referred to as perceived risk [125]. Users are given a credit line with which to transmit money, but in order to use it successfully, they must invest a great deal of time and [126]. There are occasionally operational or technological problems that cause payments to fail [127]. Users may be apprehended until the authorities establish stakeholder duties because private information and network security are perceived to be in danger [128]. People are consequently less likely to use credit cards when they are worried about their future prospects [129]. A customer's impression of the dangers associated with utilizing a payment method has little influence

on their adoption, according to numerous studies. Despite their reservations regarding the unexpected consequences of utilizing PayPal as a payment method, many use credit cards due to banks' marketing campaigns [130]. According to [131], public perception is the most crucial aspect in determining whether or not to use mobile phones for commercial activities such as purchasing in Australia. As a result, technological failure might have monetary or psychological ramifications. Moreover, 63% of American consumers are concerned about financial troubles as a result of MCC adoption [132]. Perceived risk is the degree to which a potential client views mobile payment to be dangerous [133]. When deciding whether to adopt a developing technology, a potential user will compare the level of (perceived) danger vs. the convenience that it delivers. In our research, consumers' security, privacy, and trust concerns have an influence on perceived risk. Customers' readiness to embrace new technologies is harmed as a result of this. Consumers are becoming increasingly aware of identity theft and hackers, raising concerns about the security of NFC mobile payments. Potential customers may be hesitant to use a new payment method whose security has yet to be established.

3.5. Subjective Norms

Because SN is active in new technology adoption studies, MCC adoption is likely to be influenced [134]. Image, on the other hand, refers to the extent to which an invention may improve a user's social standing [135]. By evaluating normative views, which are defined as a person's conviction that those who are significant to them believe that they should use a particular system or take a particular action, this method provides social context. Numerous studies have demonstrated the significance of the connection between normative beliefs and the desire to use a technology. The significance of the connection between subjective norms and beliefs regarding the use of mobile apps has also been shown in an additional study [136].

3.6. Perceived Security

Because perceived security is so essential in consumers' technology-linked activities, researchers have attempted to identify the factors that impact perceived security. According to a study, perceptions of security and privacy issues, as well as credit cards' "mobile payment" capabilities, are all obstacles to Internet-based transactions [137]. In terms of security concerns, the network security of digital payments and that of payment options such as credit cards is very similar [138]. More importantly, recent cryptographic advances have enabled all modern payment services, such as digital payments and smart credit/debit cards, to provide a better degree of financial safety [139], which is often supported by standard systems engineering security criteria [140].

3.7. Perceived Trust

Consumers' trust is crucial to a company's success, and a bank's high status is key to its position in the market. It demonstrates that clients have faith in banks. Many consumers are intrigued by the possibility of using credit cards [141]. Customers have faith in the financial industry because of the benefits that it delivers and because banks adhere to a set of norms. Trust and commitment, on the other hand, have an influence on client loyalty, particularly when banks' products and services are trusted [141]. On the other hand, unfavorable views of banks have a detrimental effect on how customers regard them, which lowers consumer loyalty and trust. Thus, employing TAM and the full theory, the authors of [142] created a model to ascertain whether a person's trust in mobile payments is likely to be impacted by his or her well-founded faith in Internet online payments. The model also looked at how these trust perceptions interact with both a customer's positive and negative attitudes to affect their uptake of mobile banking services. This model might account for 44.2% of the variation in intention to use digital payments [143].

3.8. NFC Information Quality

The excellent quality of NFC information during transactions might be considered as both a reward for using NFC and a reason to use NFC to manage transaction-related data. Visitors' judgments of the perceived benefits associated with NFC are based on the perceived achievements after using NFC, and the efforts required before using NFC define the perceived value of NFC [144]. According to previous studies, the higher the perceived value of knowledge, the higher the perceived worth. Because information quality is a measure of a product's or service's worth, when customers are passionate about a product's or service's information-related benefits, its value is seen to be higher. As a result, the higher the value of NFC, the higher the quality of the information that it provides, and the more people it attracts. Information quality may also be used as a criterion for measuring an information system's performance as an external motivation [145]. The quality of information is an important factor in determining enjoyment. The two components of NFC technology are the initiator, which initiates and sustains data and communication transfer, and the receiver, which responds to requests. According to various studies, this technology can offer enhanced functionality and transfer data to a user's bank via a chip, a cellular SIM card, or even a memory stick [146–148].

3.9. Attitudes towards Using NFC

Researchers have found that all of the aforementioned advantages are essential for maintaining NFC technology commitment [149]. Users' ongoing concerns about the privacy and security of their financial and personal information while using new mobile payment technology have a negative effect on their willingness to use the service. Several studies [150–152] have employed a variety of different subjective criteria to explain users' initial behavioral intentions and ongoing intentions regarding mobile payment systems. According to [153], there must be a connection between group norms and specific user suggestions in order for people to intend to use mobile payment services in the future. When examined how normative views affected mobile payment services, they found that it was a critical element in determining how likely consumers were to use mobile payments in the long run. Furthermore, [154] examined 323 US mobile payment users and discovered that social influence was the most critical element determining customers' propensity to continue using the service. The TAM model, which was the first to propose perceived benefits as a construct, has subsequently become the most commonly utilized construct in many technology acceptance theories. Consumer attitudes and actions are influenced by perceived usefulness. On the other hand, high perceived utility may influence consumer behavior and encourage the use of a service, such as mobile payments [154].

3.10. Consumer Intention to Use NFC for Credit Card

Based on the analysis of consumer habits and earlier studies on the intention to use credit cards, this paper proposes a theoretical model of intended credit card use. Customers' desire to continue using mobile payment services is positively and significantly correlated with perceived usefulness, according to [155]. These trust-based ecosystems encourage long-term technological engagement and influence willingness to use services such as contactless banking [155]. Perceived risk has long been acknowledged by researchers as an important factor in influencing users' behavioral intentions and influencing their pre- or post-purchase behavior. According to research, consumers' expected credit card usage is impacted by perceived utility. Regarding perceived risk, among the different approaches that employ perceived risk to assess consumers' intended usage of technology study are perceived danger and security, as well as privacy problems [155]. Consumer acceptance of e-services is generally viewed as a major barrier to the core idea of TPR, i.e., perceived risk. It has been demonstrated that e-services negatively affect behavioral intentions [155]. Peers' perceptions of the utility and ease of use of modern electronic services such as e-banking, e-shopping, and e-payment have been linked to customers' intentions to use them. According to empirical studies, perceived utility, which serves as a mediator between perceived

usefulness and perceived ease of use, influences credit card usage intentions directly or indirectly via perceived usefulness and ease of use [155]. Additionally, studies have demonstrated that social groups directly affect customers' behavior and intentions [155].

4. Methodology

This section includes the details of the study technique, such as the preparation of the measurement apparatus, the data collection procedure, sample characteristics, and data analysis methods. In order to assess theoretical models and assumptions, quantitative methods have been created. For this work, a quantification survey was used. The measurement scales were developed after performing extensive research and were intended to cover every step of the building process. The use of mobile payment systems based on NFC has been promoted by numerous organizations all over the world, including in Saudi Arabia. How closely connected a group of objects is can be determined by Cronbach's alpha, a measure of internal consistency [156]. It is frequently used as a scale accuracy indicator. In this study, Cronbach's alpha was calculated to be 0.914 using standardized items. According to the correlation value (Cronbach's alpha) for both the pilot and final test designs, all variables were confirmed to be correct and sufficient. For more details, see Table 1.

Table 1. Pilot and final test values for all variables.

No	Factors	Code	Pilot Test	Final Test
1	Social Influence	SI	0.704	0.856
2	Perceived Usefulness	PU	0.732	0.804
3	Perceived Ease of Use	PEU	0.801	0.890
4	Perceived Risk	PR	0.711	0.881
5	Subjective Norms	SN	0.782	0.889
6	Perceived Security	PS	0.716	0.865
7	Perceived Trust	PT	0.786	0.864
8	NFC Information Quality	NFCQ	0.792	0.927
9	Attitude towards Using NFC	ANFC	0.809	0.824
10	Intention to Use NFC	INFC	0.708	0.874

4.1. Measurement Instrument

The questions chosen in this study are based on research conducted with the conceptual method; to ensure the instrument's validity, each variable in the proposed model must be stated. The bulk of the materials had to be translated into Arabic before being utilized in the Saudi research because they were produced in English. The phrasing was changed in certain cases to fit the Saudi context of digital payment NFC systems. The goal of this study is to propose an initial NFC digital payment acceptance model due to a lack of empirical studies on the technology's mobile payment service. The measurements of the structures were performed in stages. All figures are based on the specified principles and are based on research. According to [154], who focused on mobile payment services, the TAM comprises perceived usefulness and ease of use, each with three components. Each of the three questions is used to examine attitudes toward and behavioral intentions to utilize NFC mobile payment. According to research on mobile banking services by the Federal Reserve, perceived security, perceived trust, and perceived risk all have three components [154]. Subjective norms were assessed using three questions from [154], and social influence was assessed using three questions from [154]. Finally, three criteria were utilized to evaluate the information quality of NFC [154].

4.2. Data Collection and Sample Size

The sample size in PLS is decided by one of the following rules [155]. Below, we describe the procedures used in the partial least squares (PLS) approach in this study. (1) Creating a Measurement Model. The latent and visible variables are connected via an exterior model called the measurement model. (2) Designing a Structural Model. (3) Creating a Flow Chart. We described the relationship between variables using a flow chart, which can be used to explain a series of causal interactions between concepts from the mathematical framework established in the first stage. (4) Creating an Equation from the Flowchart. University students from Saudi Arabia provided the information. The survey items were scored using a Likert scale with a maximum of seven points (1 being “strongly disagree”, and 7 being “strongly agree”). A brief overview of the NFC mobile banking system was provided on the questionnaire’s first page. Before continuing on to the following page, research participants were advised to read the explanation thoroughly. The 1217 responses were collected from people in Saudi Arabia’s major cities who had access to smartphone services. Male respondents represented 588 of the 1217 legitimate surveys, while female respondents represented 629. In addition, the respondents comprised 268 people between the ages of 26 and 30; 227 people between the ages of 31 and 35; 276 people between the ages of 36 and 40; and 230 people beyond the age of 40. Finally, the monthly average income of 305 respondents was between 3000 and 5000 Saudi Riyal; for 251, it was between 6000 and 8000 Saudi Riyal; for 227, it was between 9000 and 12,000 Saudi Riyal; for 220 (9.2%), it was is between 13,000 and 15,000 Saudi Riyal, and for 214, it was between 16,000 and 16,500 Saudi Riyal. See Table 2 for further information.

Table 2. Data collection and sample size.

Characteristics		Number
Gender	Male	588
	Female	629
Age	22–25 years old	216
	26–30 years old	268
	31–35 years old	227
	36–40 years old	276
	More than 40 years old	230
	3000–5000 Saudi Riyal	305
Monthly Average Income	6000–8000 Saudi Riyal	251
	9000–12,000 Saudi Riyal	227
	13,000–15,000 Saudi Riyal	220
	More than 16,000 Saudi Riyal	214

5. Results and Analysis

Analyzing the structure model (Inner Model), the R-squared (R^2) test and the relevance test using correlation and path estimations were employed to assess the structural equation model or SEM using PLS. The impact of a latent variable on a dependent latent variable is measured using the R-squared (R^2) value. [155] reported that the R^2 result ranged from 0.487 to 0.762, demonstrating the model’s suitability. Using structural equation modeling, the variables’ dependability and validity were evaluated (SEM). SPSS 23.0 and Smart PLS 2.0 were used to analyze the data.

5.1. Reliability and Validity of Measures

To evaluate the validity and reliability of each factor's measurement, coefficient alphas, composite reliabilities, and average variances were used (AVE). The reliability statistic that is most frequently used is Cronbach's alpha. The first step is to assess internal consistency using Cronbach's alpha. The confirmatory factor analysis (CFA) results were favorable, according to [155], because the loadings of 30 items were higher than 0.70 and their convergent validity varied from 0.862 to 0.953. The validity of the results was demonstrated by the Cronbach's alpha values, which varied from 0.824 to 0.927. R-squared values ranged from 0.487 to 0.762, while AVE values were between 0.675 and 0.872. Table 3 summarizes the findings.

Table 3. Factor analysis and factor loadings.

Factors	Items	Factor Loadings	Composite Reliability	Cronbach's Alpha	AVE	R-Squared
Attitude towards Using NFC	ANFC1	0.862	0.895	0.824	0.741	0.649
	ANFC2	0.919				
	ANFC3	0.798				
Social Influence	SI1	0.898	0.912	0.856	0.775	0.000
	SI2	0.880				
	SI3	0.862				
Intention to Use NFC	INFC1	0.890	0.922	0.874	0.798	0.487
	INFC2	0.887				
	INFC3	0.903				
Perceived Risk	PR1	0.901	0.926	0.881	0.808	0.000
	PR2	0.898				
	PR3	0.896				
Perceived Ease of Use	PEU1	0.846	0.876	0.890	0.702	0.000
	PEU2	0.868				
	PEU3	0.799				
Subjective Norms	SN1	0.834	0.876	0.889	0.703	0.000
	SN2	0.868				
	SN3	0.813				
Perceived Usefulness	PU1	0.865	0.885	0.804	0.720	0.000
	PU2	0.905				
	PU3	0.770				
Perceived Security	PS1	0.857	0.862	0.865	0.675	0.731
	PS2	0.792				
	PS3	0.816				
NFC Information Quality	NFCQ1	0.939	0.953	0.927	0.872	0.762
	NFCQ2	0.938				
	NFCQ3	0.924				
Perceived Trust	PT1	0.871	0.917	0.864	0.786	0.621
	PT2	0.917				
	PT3	0.871				

5.2. Measurement Construct Validity

The extent to which constructs express the idea for which they were developed is known as construct validity [155]. This was found after carefully examining a number of issues in the research that had obtained a great deal of confirmation. Table 4 shows the components that were included in the made-to-measure structure, as well as their corresponding loadings [155].

Table 4. Loadings and cross-loadings of items.

Factors	Items	ANFC	SI	INFC	PR	PEU	SN	PU	PS	NFCQ	PT
Attitude towards	ANFC1	0.862	0.539	0.599	0.617	0.522	0.543	0.630	0.716	0.657	0.670
	ANFC2	0.919	0.565	0.614	0.603	0.538	0.611	0.599	0.694	0.687	0.707
Using NFC	ANFC3	0.798	0.544	0.477	0.507	0.372	0.437	0.366	0.549	0.586	0.572
Social Influence	SI1	0.584	0.898	0.579	0.496	0.476	0.508	0.465	0.502	0.504	0.556
	SI2	0.613	0.880	0.557	0.516	0.426	0.509	0.429	0.535	0.570	0.539
	SI3	0.461	0.862	0.518	0.439	0.341	0.418	0.328	0.371	0.462	0.425
Intention to Use NFC	INFC1	0.592	0.537	0.890	0.657	0.566	0.602	0.624	0.584	0.528	0.576
	INFC2	0.541	0.517	0.887	0.558	0.509	0.532	0.533	0.528	0.554	0.527
	INFC3	0.628	0.625	0.903	0.680	0.530	0.623	0.548	0.607	0.599	0.605
Perceived Risk	PR1	0.631	0.532	0.668	0.901	0.532	0.604	0.625	0.764	0.650	0.609
	PR2	0.568	0.503	0.620	0.898	0.538	0.583	0.577	0.706	0.667	0.588
	PR3	0.612	0.452	0.623	0.896	0.518	0.556	0.573	0.665	0.587	0.582
Perceived Ease of Use	PEU1	0.401	0.362	0.510	0.436	0.846	0.508	0.467	0.436	0.408	0.414
	PEU2	0.511	0.446	0.539	0.530	0.868	0.608	0.632	0.617	0.517	0.512
	PEU3	0.484	0.381	0.453	0.503	0.799	0.647	0.434	0.495	0.423	0.484
Subjective Norms	SN1	0.526	0.434	0.540	0.504	0.635	0.834	0.592	0.555	0.448	0.484
	SN2	0.560	0.518	0.622	0.569	0.599	0.868	0.571	0.570	0.548	0.594
	SN3	0.473	0.423	0.487	0.554	0.543	0.813	0.424	0.536	0.561	0.527
Perceived Usefulness	PU1	0.517	0.319	0.510	0.544	0.521	0.546	0.865	0.658	0.478	0.528
	PU2	0.595	0.485	0.611	0.580	0.577	0.617	0.905	0.669	0.505	0.506
	PU3	0.483	0.397	0.495	0.559	0.474	0.432	0.770	0.563	0.390	0.405
Perceived Security	PS1	0.815	0.574	0.628	0.704	0.511	0.576	0.555	0.857	0.824	0.808
	PS2	0.508	0.417	0.482	0.609	0.492	0.565	0.668	0.792	0.464	0.449
	PS3	0.489	0.300	0.440	0.632	0.550	0.483	0.650	0.816	0.529	0.494
NFC Information Quality	NFCQ1	0.695	0.588	0.605	0.633	0.484	0.548	0.494	0.703	0.939	0.787
	NFCQ2	0.729	0.557	0.580	0.702	0.566	0.608	0.523	0.768	0.938	0.793
	NFCQ3	0.675	0.497	0.576	0.645	0.467	0.581	0.503	0.679	0.924	0.798
Perceived Trust	PT1	0.643	0.550	0.545	0.555	0.374	0.472	0.426	0.594	0.735	0.871
	PT2	0.695	0.470	0.611	0.564	0.527	0.569	0.503	0.643	0.792	0.917
	PT3	0.679	0.535	0.543	0.638	0.596	0.658	0.580	0.734	0.729	0.871

5.3. Measurement Validity of Construct

Discriminant validity describes differences between a set of concepts and related metrics. The study hypothesized that values greater than 0.50 and significance at $p = 0.001$ would support the discriminant validity of both concepts [155]. According to [155], the correlations between elements inside the constructs should be less than the AVE square root shared by concepts that represent a single notion; see Table 5.

Table 5. Discriminant validity.

No	Factors	1	2	3	4	5	6	7	8	9	10
1	Attitude towards Using NFC	1.000									
2	Intention to Use NFC	0.659	1.000								
3	NFC Information Quality	0.750	0.628	1.000							
4	Perceived Ease of Use	0.561	0.599	0.542	1.000						
5	Perceived Risk	0.672	0.710	0.707	0.589	1.000					
6	Perceived Security	0.764	0.643	0.768	0.626	0.794	1.000				
7	Perceived Trust	0.758	0.639	0.848	0.566	0.661	0.742	1.000			
8	Perceived Usefulness	0.628	0.636	0.543	0.619	0.659	0.745	0.569	1.000		
9	Social Influence	0.636	0.629	0.586	0.477	0.553	0.543	0.583	0.470	1.000	
10	Subjective Norms	0.621	0.658	0.620	0.706	0.648	0.660	0.640	0.632	0.549	1.000

5.4. Model Measurement Fit

As a result, the retrieval of five external factors, three mediator variables, and two endogenous variables was successful. Confirmatory factor analysis (CFA) and exploratory

factor analysis (EFA), as established by [155], were used to verify the multi-item scales' reliability, concurrent validity, and divergent validity. Despite the relevance of the chi-square value, these statistics were sensitive to the sample and model complexity (2.55). For evaluating the model's fit, other statistics such as the GFI (0.943), CFI (0.964), IFI (0.966), NFI (0.972), and RMSEA (0.051) are preferable [155].

5.5. The Analysis of the Structural Model

The structure model's global adjustment goodness-of-fit measurements were utilized to verify the model employed in this investigation. Since they had appropriate values for the absolute measures of adjustment determined during the model evaluation, such as GFI (0.934), CFI (0.955), IFI (0.951), NFI (0.959), RMSEA (0.959), and RMR (0.048), they were considered good according to the literature [155].

The study's assumptions were evaluated and correlations were established using Smart PLS 2.0. Figure 1 depicts the proposed theory, Figure 2 shows the results of the path coefficient, and Figure 3 shows the *T*-values.

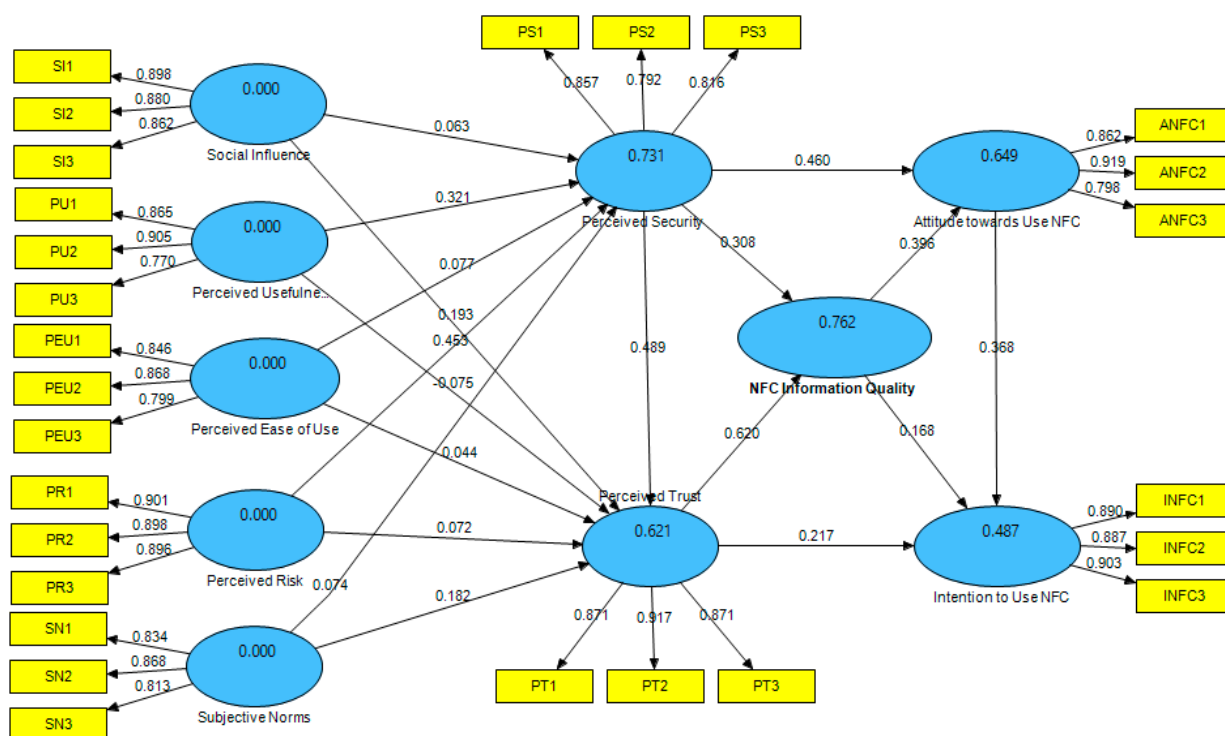


Figure 2. Results of path coefficient.

Table 6's findings show that seventeen hypotheses were confirmed, while one was rejected. The research model analyzes ten main factors and 30 research items. The first factor was the relationship between social influence and perceived security (0.063), and social influence and perceived trust (0.193); thus, both hypotheses were accepted. Due to the correlation between usefulness and trust (0.321) and perceived value and perceived security (0.321), both hypotheses were accepted (0.075). For the third component, the correlation between perceived ease of use and security was accepted (0.077), but the correlation between perceived ease of use and usefulness trust (0.044) was disregarded. Due to the fourth factor, which was the association among risk and perceived safety (0.453) and evaluated risk and brand trust (0.453), both hypotheses were confirmed (0.072). Both hypotheses were accepted because of the association between subjective norms and experienced security (0.074) and trust (0.182) in the fifth factor. The sixth factor was the relationship between perceived security and perceived trust (0.489), and perceived security and NFC information quality (0.308), as well as perceived security and attitude towards use

NFC (0.460); the three hypotheses were accepted. The seventh factor was the relationship between perceived trust and intention to use NFC (0.217), and perceived trust and NFC information quality (0.620); thus, both hypotheses were accepted. The eighth factor was the relationship between NFC information quality and attitude towards use NFC (0.396), and NFC information quality and intention to use NFC (0.168); thus, both hypotheses were accepted. Finally, the relationship between attitude towards using NFC and intention to use NFC (0.368) was accepted.

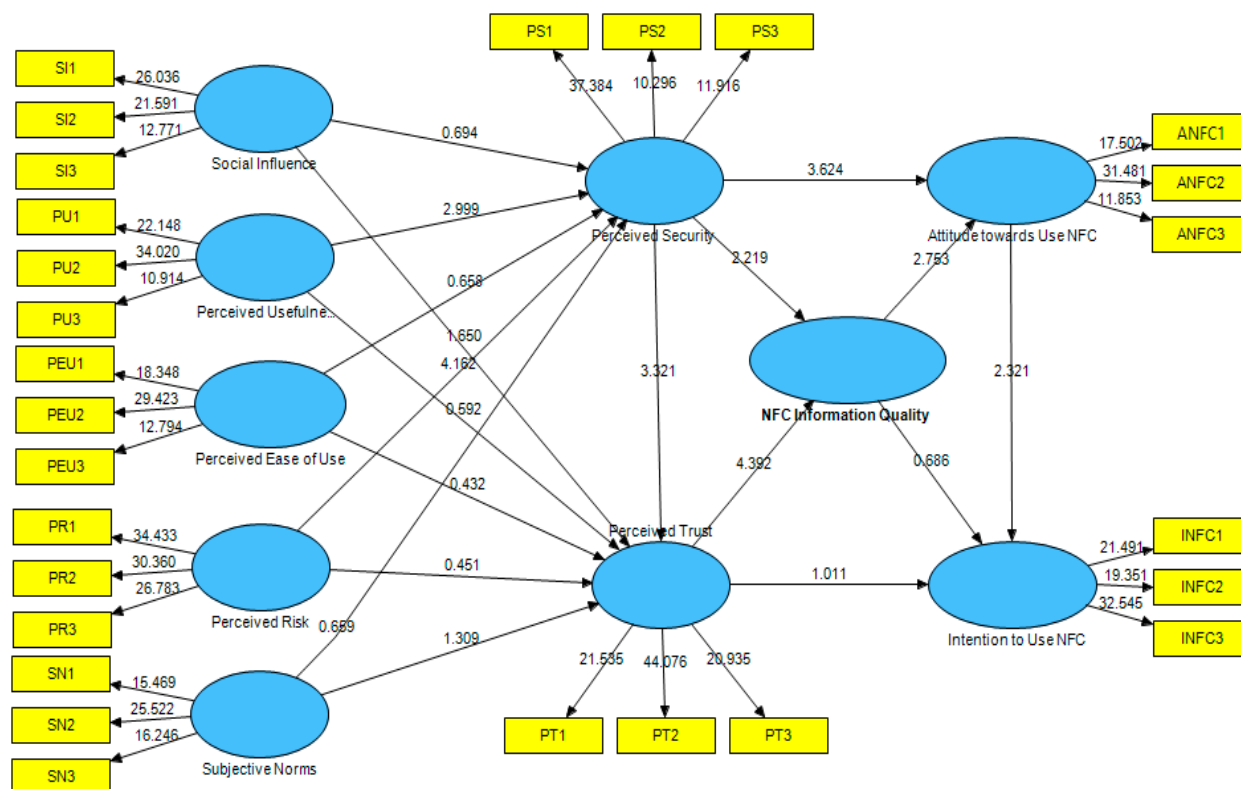


Figure 3. T-value results.

Table 6. Testing of hypotheses.

No	Hypotheses Links	Path Coefficient	Mean	S.D.	S.E.	T-Value	Results
1	Social Influence → Perceived Security	0.063	0.071	0.091	0.091	0.694	Accepted
2	Social Influence → Perceived Trust	0.193	0.171	0.117	0.117	1.650	Accepted
3	Perceived Usefulness → Perceived Security	0.321	0.330	0.107	0.107	2.999	Accepted
4	Perceived Usefulness → Perceived Trust	0.075	0.080	0.127	0.127	0.592	Accepted
5	Perceived Ease of Use → Perceived Security	0.077	0.098	0.117	0.117	0.658	Accepted
6	Perceived Ease of Use → Perceived Trust	0.044	0.051	0.101	0.101	0.432	Rejected
7	Perceived Risk → Perceived Security	0.453	0.443	0.109	0.109	4.162	Accepted
8	Perceived Risk → Perceived Trust	0.072	0.097	0.160	0.160	0.451	Accepted
9	Subjective Norms → Perceived Security	0.074	0.060	0.113	0.113	0.659	Accepted
10	Subjective Norms → Perceived Trust	0.182	0.176	0.139	0.139	1.309	Accepted
11	Perceived Security → Perceived Trust	0.489	0.489	0.147	0.147	3.321	Accepted
12	Perceived Security → NFC Information Quality	0.308	0.295	0.139	0.139	2.219	Accepted
13	Perceived Security → Attitude towards Using NFC	0.460	0.478	0.127	0.127	3.624	Accepted
14	Perceived Trust → Intention to Use NFC	0.217	0.186	0.215	0.215	1.011	Accepted
15	Perceived Trust → NFC Information Quality	0.620	0.634	0.141	0.141	4.392	Accepted
16	NFC Information Quality → Attitude towards Using NFC	0.396	0.383	0.144	0.144	2.753	Accepted
17	NFC Information Quality → Intention to Use NFC	0.168	0.213	0.245	0.245	0.686	Accepted
18	Attitude towards Using NFC → Intention to Use NFC	0.368	0.357	0.159	0.159	2.321	Accepted

6. Discussion and Academic Contribution

Mobile payments are still in their infancy in Saudi Arabia. Given that the mobile payment system requires the establishment of agreements among multiple players, this is understandable. Banks, technology companies, credit card companies, phone companies, startups, governments, businesses, customers, and other stakeholders must all work together to create a common interest and synergy. NFC might provide merchants with a means to interact with their consumers directly through products, applications, or mobile payments. When a customer inspects an NFC chip in a package, for example, the customer could send real-time data to the manufacturer, attempting to generate extremely valuable data, because the technology allows manufacturers to track both what happens to their products after they leave the shelves and their customers' purchasing habits [155]. For these reasons, we chose to investigate this technology. NFC technology has become one of the most exciting technologies in recent years due to the economic potential in its usage for mobile phones and the reliance on important features in the immediate term beyond mobile payment [155]. M-commerce (mobile commerce) apps and new business models, such as mobile payments, are now flourishing [155]. On the market, there are a variety of solutions that use diverse approaches and technologies. They all utilize near-field communication (NFC), which is also known as contactless payment. As a result of this study's goal of building a new model for accepting mobile payment and NFC information quality, people in Saudi Arabia must find them compatible with their systems and show acceptance toward their usage and behavioral intention to use NFC mobile payment methods. The study's conclusions have a large impact on the acceptance of NFC mobile payments [156]. This is one of the first studies to look at the factors influencing the consumer adoption of mobile payment services and the quality of NFC data. Based on theoretical considerations, we created a study model that outlines key components of behavioral control and attitudes toward usage for NFC mobile payment methods. Based on data from a comprehensive survey carried out in Saudi Arabia, Figure 1 provides empirical support for the proposed model. The most significant factors affecting the perceived safety of the adoption of mobile payments with NFC, according to Figures 2 and 3 and Table 4, are social influence, perceived usefulness, and perceived simplicity of use, risk involved, and subjective norms. The factors that had the greatest impact on people's perceptions of trust in NFC mobile payments were similar to those in earlier studies: social influence, perceived usefulness, perceived danger, and subjective standards [156]. Although it indicates that perceived ease of use has a negative influence on perceived trust in mobile payments utilizing NFC, this study varies from past research in that it finds that perceived ease of use has a positive impact on this perception [156]. Therefore, emphasizing the simplicity of NFC mobile payment is insufficient for the company's success; smartphone users must instead be made aware of its advantages. The ease of NFC payment, such as non-swiping cards and automated transactions utilizing short-range wireless technology, appears to be the major focus of NFC providers' marketing tactics in Saudi Arabia. According to the findings of this study, perceived ease of use without a strong sense of usefulness may be insufficient to drive smartphone users to employ NFC payment and its information quality capabilities. Perceived security also has the greatest impact on perceived trust, NFC information quality, attitudes toward using NFC, and the desire to use NFC for mobile payment. Similarly, perceived trust influences the quality of NFC information, attitudes toward adopting NFC, and willingness to utilize mobile payments with NFC. Finally, opinions toward NFC and the desire to utilize mobile payments with NFC are largely influenced by the quality of NFC information available. People must find mobile payment services and the NFC information quality to be consistent with their existing attitudes toward using NFC and their behavioral desire to use NFC mobile payment methods in order to contemplate adopting them. Acceptance researchers often disregard perceived security, perceived trust, and the caliber of NFC data because these are not addressed in the original TAM. We found that the elements that have the strongest effects on perceived security also have a strong positive and direct impact on perceived trust, the caliber of

the NFC information, and attitudes toward adopting NFC in the context of future NFC payment usage. According to the R-squared ($R^2 = 73\%$), perceived trust has a significant positive and direct impact on NFC information quality and the desire to use mobile payment methods. The NFC protocol was accepted. NFC information quality has a substantial favorable and direct influence on attitudes toward adopting NFC and intention to use mobile payment methods, according to the R-squared ($R^2 = 62\%$). The NFC protocol was accepted. NFC information quality has a substantial favorable and direct influence on attitudes toward adopting NFC and intention to use mobile payment methods, according to the R-squared ($R^2 = 76\%$). A person's attitude regarding the use of NFC has a major impact on whether or not they wish to use mobile payment methods. NFC was authorized by the R-squared ($R^2 = 66\%$), and the willingness to utilize mobile payment adaption NFC was accepted by the R-squared ($R^2 = 49\%$). This research will serve as a foundation for future empirical and conceptual research on mobile payment and NFC data quality. The results presented in this study offer additional research starting points, in addition to its overall contribution of attempting to identify, conceptualize, and operationalize pertinent acceptance drivers of mobile payments. They also offer a perspective on the perceptions of safety and perceived trust for particular intent-to-use factors influencing NFC. This research also looked at the overall acceptability of mobile payment services, as well as the accuracy of NFC data. Furthermore, we chose not to consider or categorize individual NFC-based mobile payment methods. As a result, a future study might expand on this structural model, adapting it to specific payment systems and NFC quality of information in turn, considering attitudes toward usage and behavioral control in using NFC mobile payment methods. Furthermore, the scope of our empirical study is restricted to the Saudi Arabian population. It will be intriguing to see if the findings are replicated in other countries. This would enable the data reported here to be examined for their worldwide generalizability and allow cultural aspects relevant to mobile payment acceptability to be investigated. This research has significant implications for mobile payment. It is one of the first of its type, delivering an experimental study to understand customers' behavior in the adoption of NFC mobile payments, due to the early stages of NFC mobile payment. Saudi Arabia has been a pioneer of NFC mobile payments, while the rest of the world lags behind. The mobile phone industry around the world is interested in whether Saudi consumers will adopt the new payment option. Because Saudi Arabia has a high and rapid acceptance rate for new technology such as smartphones and mobile internet, NFC mobile payment is projected to be successful. According to the conclusions of the present study, it is vital to underline the importance of employing marketing tools to establish targeted campaigns aimed at educating consumers on the benefits of mobile contactless payments, particularly those that use technologies such as NFC. Advertisements should also show how the new system can be integrated into their daily lives. It should also show that the instrument is safe for financial transactions by displaying perceived security, perceived trust, and NFC information quality safeguards such as security seals or even links to well-known financial security brands such as Visa or PayPal.

Research Contributions and Implications

This study makes several contributions to the mobile payment adoption literature. First, this work contributes to the body of knowledge on mobile payment adoption by establishing a new model that includes the important and significant drivers of the adoption of mobile payments among clients in Saudi banks. Second, this research will become a reference for many researchers for future empirical research on mobile payment adoption. Third, our findings can offer additional research starting points, in addition to our study's overall contribution in attempting to identify, conceptualize, and operationalize pertinent acceptance drivers of mobile payment. Fourth, they also offer a perspective on the importance of some factors related to perceived risk, perceived security and perceived trust, information quality, and subjective norms, and their effects on clients' intention to use mobile payments using NFC. Fifth, this work proves that the TAM model is a powerful tool

to predict the factors influencing users' adoption of mobile payment technology. Finally, the results of this research can assist Saudi banks in better understanding the security and privacy procedures of mobile payment using NFC.

7. Conclusions and Future Works

Identifying the factors that affect perceived security and trust, as well as how they affect NFC information quality, attitudes about utilizing NFC, and behavioral intentions to utilize NFC mobile payment, was the main objective of this study. The study's findings confirmed the associations that were expected, demonstrating that normative beliefs, value perception, usefulness and ease of use, perceived danger, and social power all significantly improve perceptions of security in the use of NFC mobile payments. Additionally, socializing, potential value, perceived danger, and subjective criteria all have a beneficial influence on perceptions of NFC and confidence in mobile payments. The one factor that seriously undermines confidence in near-field mobile payments is the perceived simplicity of use. The study's findings also unambiguously validated the connections between the perception of security, brand trust, and the quality of the NFC information, all of which significantly influenced Saudi Arabians' attitudes toward utilizing NFC and their behavioral intention to use NFC mobile payment. The study's conclusions have a variety of ramifications for academics investigating the application of NFC mobile payment technologies. Firstly, this research adds to our understanding of the aspects that determine NFC information quality, such as perceived danger, perceived security, and perceived trust, as well as its impact on attitudes toward NFC and behavioral intentions to use NFC mobile payment. The study's findings have significant theoretical significance for managers and practitioners developing mobile payment acceptance strategies in order to boost mobile payment acceptability and proliferation. Regarding the use of mobile payments, service providers should first thoroughly examine the risk, security, trust, and NFC information quality. Service providers should implement a strong security system while providing mobile payment services to customers in order to manage the potential risk, security, trust, and NFC quality of information associated with contactless banking. When completing operations that need authenticity and confidentiality, service providers should use a portable, cryptographically signed instruments and extremely secure passwords. It is crucial to educate consumers about safety each time they conduct a digital payment, before using NFC mobile payment technologies, or to provide prospective users with training and testing services. The second requirement is that users obtain a positive user experience. Mobile payments must be dependable, devoid of technological flaws, and extremely responsive to any problems that can arise as a result of the adoption of NFC mobile payments. Every study is certain to have issues. Firstly, this study only considers the perceived security and trustworthiness of mobile payment adoption NFC-related aspects that are theoretically linked to technology acceptance; other driving factors for mobile payment adoption are not included. Furthermore, because this study is based on information from only one Middle Eastern country, its generalizability is constrained. As a result, extrapolating these findings to a different culture should be performed with caution, and additional, prospective, cross-cultural research should be conducted to investigate the adoption of mobile payments utilizing NFC.

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