

Users' Perception of NFC Technology in Digital Payment Transactions in Indonesia



Saripudin

Perbanas Institute, Jakarta, Indonesia

ABSTRACT: Near Field Communication (NFC) technology is growing and starting to be used on mobile devices such as smartphones. However, there are still differences in the factors of user perception and acceptance of the use of the NFC system in previous studies. Therefore, this study aims to analyze the influence of factors such as Actual System Use, Attitudes Toward Use, Behavioral Intentions, Perceived Ease of Use, Perceived Safety, Perceived Benefits, and Subjective Norms on user acceptance of the NFC system on smartphone users in Indonesia. In this study, a quantitative approach was used with the online survey method which was conducted on 150 respondents who use smartphones in Indonesia. Respondents taken are smartphone users who have used NFC technology. The collected data were analyzed using the Structural Equation Modeling (SEM) method. The results of the study show that the user's perception of the ease of use and the benefits and safety of using the NFC system has a significant influence on the user's acceptance of using it. However, the subject norm for NFC technology does not have a significant effect on user acceptance. The implication of this research is the importance of paying attention to the factors that influence user perceptions in developing and promoting the use of the NFC system among smartphone users in Indonesia.

KEYWORDS: NFC, Attitude Toward, Behavioral Intention, Perceived Ease of Use, Perceived Security, Perceived Usefulness

I. INTRODUCTION

The increasing popularity of mobile phones has led to the development of products that aim to improve productivity while providing increased security. The growing demand for convenience and the need to reduce ownership costs are expected to continue to shape industry developments. The adoption of NFC technology has encouraged consumers to make small and large payments using their mobile devices. The widespread use of mobile payments, including digital wallets and apps, has attracted non-payment technology companies to enter the payment landscape, further driving market growth. Additionally, the increasing penetration of smartphones in developing countries has led to technological advancements. (researchandmarkets, 2023).

The increased penetration of NFC-enabled mobile phones in the Asia Pacific region has significantly contributed to growth from 2016 to 2024. The NFC-based market in the Asia Pacific is expected to remain the key revenue-generating region, with a market share of over 20% in 2015. The increasing penetration of smartphones and tablets is expected to be the reason behind the adoption of NFC technology. The rapid diversification of mobile payment services has accelerated collaboration among industry participants resulting in technological advancements. International banks have been enthusiastically investing in building mobile payment networks, which are expected to increase application in collaborations between financial service providers and retailers. NFC (Near Field Communication) is a wireless technology that enables data exchange between electronic devices in close proximity. NFC payments are a convenient way to pay in person at a store or compatible terminal by simply bringing your mobile device close to the terminal. NFC technology has several advantages, including its wide availability and ability to be implemented on existing mobile devices with the installation of a chip. It also has a wide range of applications, is easy to use, and provides added value services. NFC payments are secure because they require manual activation or proximity to the receiver, which encourages proactive behavior from the user. Additionally, NFC is based on open standards, making it economically attractive for users who do not have to pay licensing fees. Overall, NFC technology is a versatile and secure way to make payments and receive services (Grassie 2007).

NFC has been introduced in Indonesia and is being used in several applications. Examples of NFC usage in Indonesia include digital payments, smart cards such as e-KTP and e-Passport for identity verification, public transportation systems such as MRT Jakarta for ticketing, and IoT applications like Smart Home and Smart City for device interaction. However, the use of

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NFC in Indonesia is still limited and not fully integrated into daily life. The NFC market has been growing steadily in recent years. According to a report by Market sand Markets, the NFC market is expected to grow at a CAGR of 18.9% between 2020 and 2025. The increasing use of NFC is driven by factors such as the growing demand for fast and easy digital payments, the widespread adoption of smartphones equipped with NFC technology, and increased investment in IoT technology. Additionally, NFC technology is being adopted in various industrial sectors such as transportation, logistics, and manufacturing. In the transportation sector, NFC is used to facilitate ticket purchases and access to stations or vehicles, while in the logistics and manufacturing sectors, NFC is used to track and manage inventory. In the coming years, the use of NFC in various industrial sectors is expected to increase, especially with the widespread adoption of IoT technology and the increasing complexity of customer needs. This will drive innovation and the development of NFC technology, enabling more applications and wider usage in the future (Asia 2017).

Several studies have been conducted to analyze the factors that influence the adoption of NFC-based mobile payments. (J. Kim and Lee 2012) conducted an empirical study in China to investigate the factors that influence the adoption of NFC-based mobile payments. They found that the perceived usefulness, perceived ease of use, and compatibility of the technology were significant factors that influenced the adoption of NFC-based mobile payments. In Malaysia, (Aris, Ismail, and Mohezar 2022), conducted a study on the adoption of NFC technology for mobile payment transactions. The study aimed to analyze the influence of factors such as security, ease of use, and infrastructure availability on the adoption of NFC technology for payment transactions. The study found that the perceived usefulness, perceived ease of use, and perceived trust were significant factors that influenced the adoption of NFC-based mobile payments. In Saudi Arabia, (Almaiah et al. 2022) conducted a study to investigate the effect of perceived security, perceived trust, and information quality on mobile payment usage through NFC. The study aimed to provide insights into the factors that influence the adoption and use of NFC technology for mobile payments. The study found that perceived security and perceived trust were significant factors that influenced mobile payment usage through NFC. Based on previous research in these 3 countries, researchers are interested in analyzing user acceptance of NFC technology for mobile payment transactions in Indonesia. This study aims to analyze the influence of security factors, ease of use, and availability of infrastructure on the application of NFC technology for payment transactions. In addition, this study aims to provide recommendations for NFC developers and service providers to increase the acceptance and use of NFC technology for mobile payment transactions.

LITERATURE REVIEW

The Technology Acceptance Model (TAM) is a theoretical model that explains how users accept and adopt new technologies. The model was initially proposed by Davis (Davis 1986) in 1986 and later modified by Venkatesh and Davis in 2000 (Venkatesh and Davis 2000b) to include Perceived Usefulness and Perceived Ease of Use as key factors influencing user behavior. Mobile TAM, or mTAM, is a variation of TAM that specifically focuses on the acceptance and adoption of mobile technologies. Mobile TAM includes the same key factors as TAM but also takes into account additional factors that are unique to mobile technologies, such as mobility, location-based services, and context awareness .Mobile TAM proposes that users' attitudes and intentions to use a mobile technology are primarily influenced by their perceived usefulness and perceived ease of use. Additionally, social influence factors, such as subjective norm and image, can also affect users' intentions to use mobile technologies. Mobile TAM has been applied in various studies to investigate users' acceptance and adoption of different mobile technologies, such as mobile banking, mobile learning, and mobile healthcare. The model has been found to be useful in predicting user behavior and identifying factors that influence user acceptance and adoption of mobile technologies (Park 2009). Attitude toward using is an individual's evaluation or attitude towards the use of a technology or system. The theories that support the relationship between attitude toward using and behavioral intention usage are the Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB). Both theories state that an individual's attitude towards a behavior influences their intention to perform that behavior(Ajzen and Fishbein 1980). Behavioral intention usage is an individual's intention to use a technology or system. The theory that supports the relationship between behavioral intention usage and actual system use is the Technology Acceptance Model (TAM). This theory states that an individual's intention to use a technology influences the actual use of that technology (Davis 1989). Perceived ease of use is an individual's perception of how easy it is to use a technology or system. The theory that supports the relationship between perceived ease of use and attitude toward using is the Technology Acceptance Model (TAM). This theory states that the easier it is to use a technology, the more positive an individual's attitude towards using that technology will be(Davis 1989). Perceived usefulness is an individual's perception of how useful a technology or system is. The theory that supports the relationship between perceived usefulness and actual system use is the Technology Acceptance Model (TAM). This theory states that the more useful a technology is, the higher the actual use of that technology will be (Davis and Davis 1989). Perceived security is an individual's perception of how secure the use of a technology or system is. The theory

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that supports the relationship between perceived security and actual system use is the Protection Motivation Theory (PMT). This theory states that the more secure a technology is, the higher the actual use of that technology will be (Rogers 1975). Subject norm is the social pressure perceived by an individual to perform a behavior. The theories that support the relationship between subject norm and attitude toward using are the Theory of Reasoned Action (TRA) and the Theory of Planned Behavior (TPB). Both theories state that the social pressure perceived by an individual influences their attitude towards using a technology (Ajzen and Fishbein 1980).

HYPOTHESES DEVELOPMENT

Attitude toward using has a significant positive influence on the intention to use technology. In his study, Davis introduced the Technology Acceptance Model (TAM) which emphasizes that the perceived usefulness and perceived ease of use of a technology are the primary determinants of an individual's attitude toward using that technology. Davis found that when users perceive a technology to be more useful and easier to use, they are more likely to have a positive attitude toward using it, which in turn increases their intention to use it (Davis 1986), (Gefen, Karahanna, and Straub 2003). The study by (Almaiah et al. 2022) found that the attitude towards using NFC technology in Saudi Arabia was positive and had a significant positive influence on the intention to use NFC technology, While research Teo and Lim (2000) investigated the relationship between attitude toward using and intention to use technology. Specifically, they examined whether attitude toward using has a significant influence on intention to use technology, which is the opposite of the hypothesis stated in H1. They used the Theory of Planned Behavior (TPB) as their theoretical framework, which suggests that attitudes, subjective norms, and perceived behavioral control all influence behavioral intention. Their study involved a survey of 324 undergraduate students, and they found that attitude toward using did not have a significant influence on intention to use technology. However, they also noted that subjective norms (i.e., the perceived social pressure to use technology) and perceived behavioral control (i.e., the perceived ease of use and ability to use technology) were significant predictors of behavioral intention (Teo and Lim 2000).

H1: Attitude toward using has a significant positive influence on the intention to use NFC technology.

Based on the article "Factors affecting consumer intention to use NFC mobile phone payments" by Lu and Hsiao, the authors concluded that perceived usefulness, perceived ease of use, perceived trust, and perceived cost are significant factors that influence the behavioral intention of consumers to use NFC mobile phone payments. The study found that consumers are more likely to use NFC mobile phone payments if they perceive it to be useful, easy to use, trustworthy, and cost-effective. Additionally, the study found that the age and gender of consumers also have an impact on their behavioral intention to use NFC mobile phone payments. Overall, the authors suggest that companies should focus on improving the perceived usefulness, ease of use, trustworthiness, and cost-effectiveness of NFC mobile phone payments, and consider the demographic characteristics of their target consumers to encourage adoption of this technology. 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 (Almaiah et al. 2022).

H2: Perceived behavioral intention has significant positive influence on action to use NFC technology.

According to (Venkatesh and Davis 2000), (J. Kim and Lee 2012), (Aris, Ismail, and Mohezar 2022), perceived ease of use has a significant positive influence on attitude toward using technology. In their study, they extended the Technology Acceptance Model (TAM) by including the construct of perceived ease of use. They conducted four longitudinal field studies across different contexts and found that perceived ease of use is a significant predictor of attitude toward using technology. They also found that perceived usefulness and subjective norm (i.e., social pressure) are important determinants of attitude toward using technology. Overall, their findings suggest that the perceived ease of use of a technology is an important factor that influences an individual's attitude toward using it. In Hong and Tam's (2006) study, they investigated the adoption of mobile data services and examined the factors that influence an individual's attitude toward using them. They found that while perceived usefulness and perceived ease of use were significant predictors of attitude toward using mobile data services, perceived ease of use had a weaker impact on attitude than perceived usefulness. However, they also noted that perceived ease of use is still an important factor that affects an individual's attitude toward using technology, albeit to a lesser extent than perceived usefulness. Overall, their findings support the hypothesis that perceived ease of use has a significant positive influence on attitude toward using technology.

H3, H4: Perceived ease of use has significant influence on attitude toward using NFC technology

Perceived usefulness is a concept in information systems that refers to the degree to which an individual believes that a technology or system will enhance their job performance or make their life easier. In the context of Near Field Communication

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(NFC) technology, perceived usefulness refers to users' perceptions of the potential benefits of using NFC for various purposes, such as mobile payments, data transfer, and access control. Several researchers have studied users' perceptions of NFC technology and its perceived usefulness. For example, (J. Kim and Lee 2012) found that users' perceived usefulness of NFC technology was a significant factor in their intention to use it for mobile payments. They also found that the perceived ease of use of NFC technology was a significant predictor of perceived usefulness. Similarly, (Kesharwani and Bisht 2016) conducted a study on users' perceptions of NFC technology for mobile payments and found that perceived usefulness was a significant predictor of users' intention to adopt NFC-based mobile payments. Overall, the perceived usefulness of NFC technology appears to be an important factor in users' adoption and use of NFC for various purposes.

H5: Perceived Usefulness has significant influence on attitude toward using NFC technology

Perceived security is an important factor in users' adoption and use of Near Field Communication (NFC) technology. Several studies have investigated the relationship between perceived security and users' attitudes towards using NFC technology. For example, (Huang, Shen, and Liao 2013) found that perceived security significantly influenced users' adoption intentions for mobile payments using NFC technology. Similarly, (J. Kim and Lee 2012) found that perceived security was a significant predictor of users' intention to use NFC technology for mobile payments.

In addition, (Kesharwani and Bisht 2016),(Liébana-Cabanillas, de Luna, and Montoro-Ríosa 2017) found that users' perceived security was a significant predictor of their intention to adopt NFC-based mobile payments. They also found that the perceived security of NFC technology had a significant impact on users' perceived usefulness of the technology. Overall, the research suggests that users' perceived security is an important factor in their attitudes towards using NFC technology, particularly for mobile payments.

H6: Perceived security has significant influence on attitude toward using NFC technology

Subject norm is a factor that influences users' intentions and behaviors in adopting NFC technology. Several studies have been conducted to investigate the relationship between subject norm and NFC technology adoption. For example, (Xu and Bai 2014) found that the influence of subject norm on NFC adoption intentions primarily comes from those who are close to the user, such as family, friends, and colleagues. The influence of subject norm from those who are not close to the user, such as celebrities or public figures, does not have a significant effect. Another study conducted by (Li and Li 2017) showed that subject norm obtained from reference groups can influence users' intentions and behaviors in using NFC. They also found that subject norm can moderate the relationship between perceived usefulness and NFC adoption intentions. Overall, subject norm can influence users' intentions and behaviors in using NFC technology, especially when it comes from reference groups that are close to the user.

H7: Subject norm has significant influence on attitude toward using NFC technology

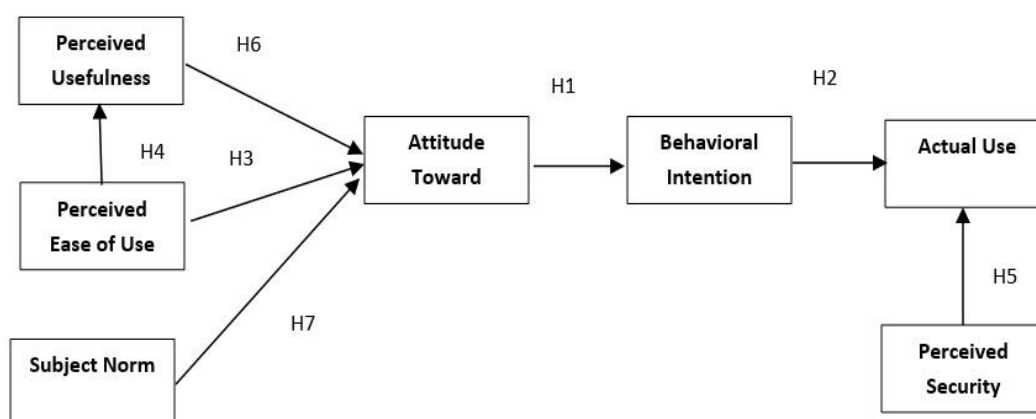


Figure 1. hypothesis framework

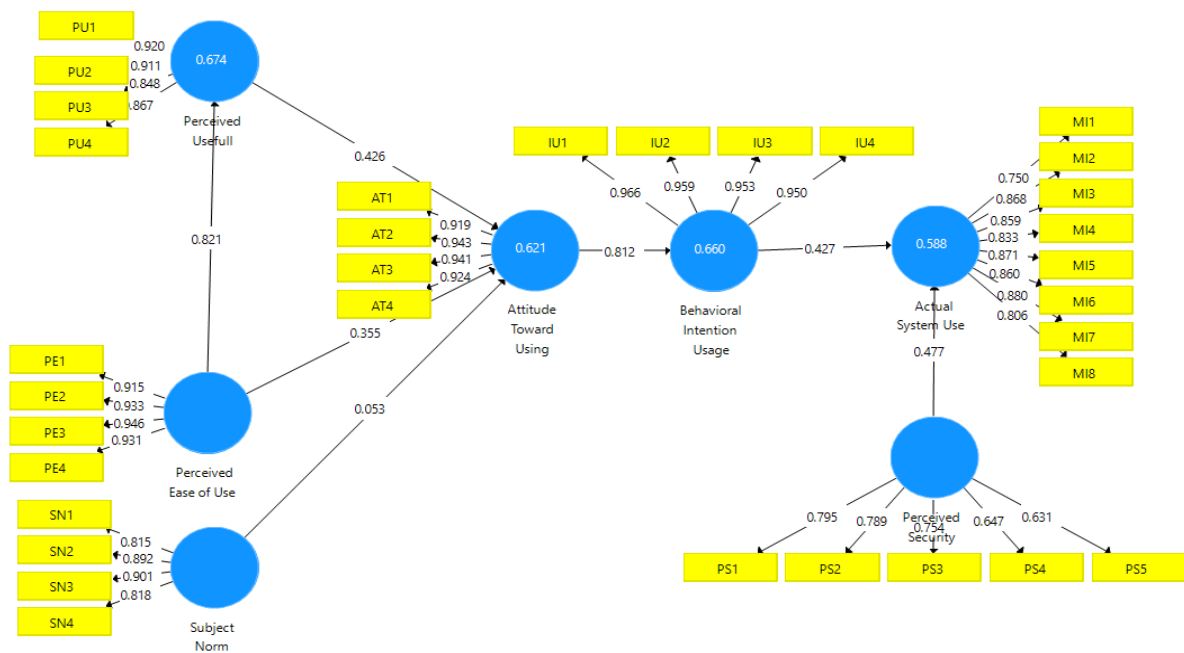
RESEARCH METHODOLOGY

This research utilized an online survey method using a questionnaire as a data collection instrument. The sample consisted of 150 smartphone users in Indonesia. The collected data was analyzed using Structural Equation Modeling (SEM) to examine the influence of factors such as Actual System Use, Attitude Toward Using, Behavioral Intention, Perceived Ease of Use, Perceived Security, Perceived Usefulness, and Subject Norm on user acceptance of NFC system in smartphone users in Indonesia. This

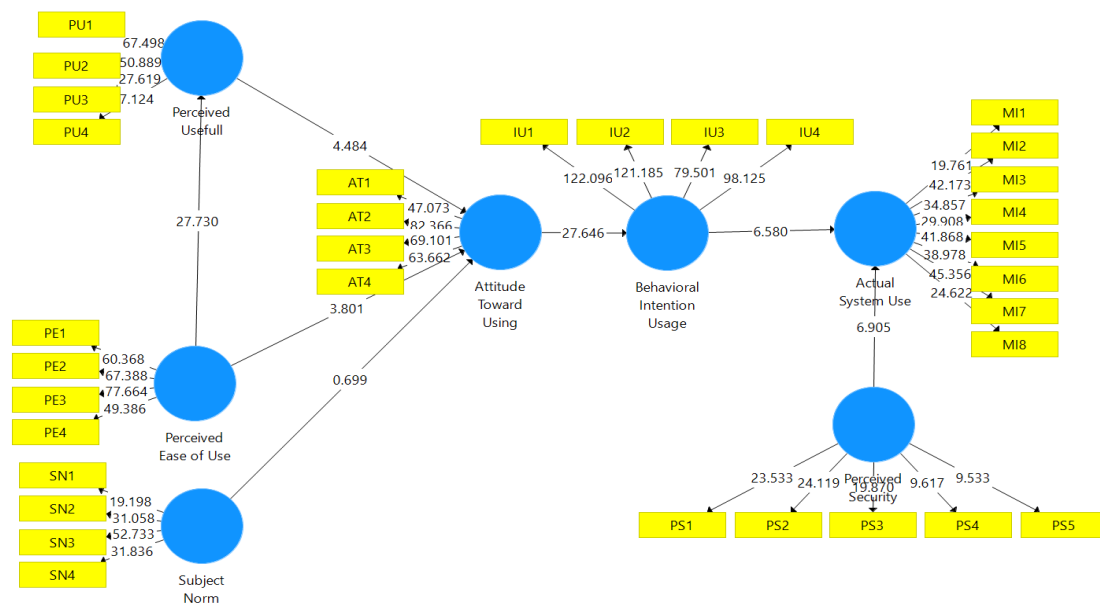
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study employed an online survey method utilizing a questionnaire as the data collection instrument. Sampling Technique The sample for this study was drawn using a convenience sampling technique, where respondents were selected based on their accessibility and willingness to participate in the study. The target population was smartphone users in Indonesia who were at least 18 years old and had experience using NFC technology. The online survey was distributed through various social media platforms and email, targeting individuals who met the eligibility criteria. The survey was conducted over a period of two weeks, with a total of 150 respondents completing the survey. Data Collection Instrument The data collection instrument used in this study was a structured questionnaire, consisting of closed-ended questions. The questionnaire was designed based on the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) framework. The questionnaire comprised of questions related to actual system use, attitude toward using, behavioral intention, perceived ease of use, perceived security, perceived usefulness, and subject norm. Data Analysis The collected data was analyzed using Structural Equation Modeling (SEM) to examine the influence of various factors on user acceptance of the NFC system in smartphone users in Indonesia. The analysis was carried out using the SmartPLS software.

DISCUSSION



Figures 2. Results of path coefficient.



Figures 3. T-value results.

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Tables 1. Table of measurement construct factor analysis results

CONTRACT	ITEM	OUTER LOADING	Cronbach's Alpha	Composite Reliability	AVE
Actual System Use	AT1	0.919	0.941	0.951	0.709
	AT2	0.943			
	AT3	0.941			
	AT4	0.924			
Attitude Toward Using	IU1	0.966	0.949	0.963	0.868
	IU2	0.959			
	IU3	0.953			
	IU4	0.950			
Behavioral Intention Usage	MI1	0.750	0.970	0.978	0.916
	MI2	0.868			
	MI3	0.859			
	MI4	0.833			
	MI5	0.871			
	MI6	0.860			
	MI7	0.880			
	MI8	0.806			
Perceived Ease of Use	PE1	0.915	0.949	0.963	0.867
	PE2	0.933			
	PE3	0.946			
	PE4	0.931			
Perceived Security	PS1	0.795	0.772	0.847	0.528
	PS2	0.789			
	PS3	0.754			
	PS4	0.647			
	PS5	0.631			
Perceived Usefull_	PU1	0.920	0.910	0.936	0.787
	PU2	0.911			
	PU3	0.848			
	PU4	0.867			
Subject Norm	SN1	0.815	0.881	0.917	0.735
	SN2	0.892			
	SN3	0.901			
	SN4	0.818			

The table above shows the results of testing the reliability and validity of each construct in the measurement model. Reliability was measured using Cronbach's Alpha and Composite Reliability, while validity was measured using Average Variance Extracted (AVE) and factor loading of each item. Based on the table above, it can be seen that all constructs have a good reliability value, which is above 0.7. This shows that each construct is reliable and consistent in measuring the variable in question. In addition, all constructs also have a fairly high AVE value, which is above 0.5 (Hair et al. 2012). This shows that each construct has succeeded in explaining the variation of the variable in question properly. Overall, the results of this reliability and validity test indicate that the measurement model used is reliable and valid for use in this study.

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Table 2. Discriminant Validity

CONTRACT	Actual Use	Attitude Toward	Behavioral Intention Usage	Perceived Ease of Use	Perceived Security	Perceived Useful	Subject Norm
Actual System Use	0.842						
Attitude Toward Using	0.670	0.932					
Behavioral Intention Usage	0.635	0.812	0.957				
Perceived Ease of Use	0.823	0.744	0.712	0.931			
Perceived Security	0.664	0.429	0.436	0.534	0.727		
Perceived Usefull_	0.761	0.758	0.719	0.821	0.563	0.887	
Subject Norm	0.797	0.637	0.630	0.730	0.624	0.763	0.858

The correlation table shows the relationships between the variables in the study. Each cell in the table indicates the correlation coefficient between two specific variables. The interpretation of the correlation table is as follows:

Actual System Use has a strong positive correlation with Behavioral Intention Usage (correlation coefficient 0.957) and a moderate positive correlation with Attitude Toward Using (correlation coefficient 0.670), Perceived Ease of Use (correlation coefficient 0.823), Perceived Security (correlation coefficient 0.664), and Perceived Usefulness (correlation coefficient 0.761). This suggests that the higher the user's intention to use NFC, the greater the likelihood of actual system use.

Attitude Toward Using has a strong positive correlation with Behavioral Intention Usage (correlation coefficient 0.812) and a moderate positive correlation with Actual System Use (correlation coefficient 0.670) and Perceived Usefulness (correlation coefficient 0.758). This suggests that the more positive the user's attitude towards NFC usage, the higher the user's intention to use it. Behavioral Intention Usage has a strong positive correlation with Actual System Use (correlation coefficient 0.957) and Attitude Toward Using (correlation coefficient 0.812) and a moderate positive correlation with Perceived Ease of Use (correlation coefficient 0.712). This suggests that the higher the user's intention to use NFC, the greater the likelihood of actual system use, and Perceived Security has a moderate positive correlation with Actual System Use (correlation coefficient 0.534) and Attitude Toward Using (correlation coefficient 0.429). This suggests that the more secure the NFC system is perceived by users, the higher the likelihood of actual system use and the more positive the attitude toward using NFC. Perceived Usefulness has a very strong positive correlation with Behavioral Intention Usage (correlation coefficient 0.887) and a moderate positive correlation with Attitude Toward Using (correlation coefficient 0.758) and Perceived Ease of Use. This indicates that the more useful the NFC system is perceived by users, the higher the intention to use it, and the more positive the attitude toward using it, as well as the perceived ease of use.

Table 3. Table of correlation coefficient

Hypotesis	Path	Original	STDEV	2.5%	97%	T-Tes	P Values	Decision
H1	Attitude Toward Using -> Behavioral Intention Usage	0.812	0.029	0.750	0.860	27.702	0.000	Support
H2	Behavioral Intention Usage -> Actual System Use	0.427	0.062	0.303	0.543	6.856	0.000	Support
H3	Perceived Ease of Use -> Attitude Toward Using	0.355	0.096	0.173	0.543	3.702	0.000	Support
H4	Perceived Ease of Use -> Perceived Usefull_	0.821	0.029	0.759	0.870	28.332	0.000	Support
H5	Perceived Security -> Actual System Use	0.477	0.069	0.332	0.592	6.911	0.000	Support
H6	Perceived Usefull_ -> Attitude Toward Using	0.426	0.101	0.242	0.619	4.237	0.000	Support
H7	Subject Norm -> Attitude Toward Using	0.053	0.072	-0.068	0.207	0.746	0.456	Not Support

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Attitude Toward Using has a positive and significant effect on Behavioral Intention Usage, with a coefficient value of 0.812 and a p-value of 0.000. This shows that the more positive the user's attitude towards using NFC, the higher the user's intention to use it. The strong reason that Attitude Toward Using has a positive and significant effect on Behavioral Intention Usage on NFC usage is because user attitude has an important role in determining user intention to use NFC technology. When users have a positive attitude towards NFC, such as feeling easy and safe in using this technology, this will increase the user's intention to use it. References that support this finding are research conducted by Kim (D.-J. Kim, Ferrin, and Rao 2009) who found that user attitude towards technology has a positive and significant effect on user intention to use it. In addition, another study by Venkatesh and Davis (Venkatesh and Davis 2000a) also found similar results that the user's attitude towards technology has a positive effect on the user's intention to use it. Attitude towards use NFC technology in Arab Saudi, hypotheses were accepted.(Almaiah et al. 2022).

Behavioral Intention Usage also has a positive and significant effect on Actual System Use, with a coefficient value of 0.427 and a p-value of 0.000. This shows that the higher the user's intention to use NFC, the greater the possibility of actual use of the system. The strong reason that Behavioral Intention Usage has a positive and significant effect on Actual System Use on NFC usage is because user intention is the most important factor in determining technology use. When a user has a strong intention to use a technology, it is more likely that actual use of the system will occur. References that support this finding are research conducted by Venkatesh and Davis (Davis and Davis 1989)(2000) who found that Behavioral Intention Usage has a positive and significant effect on Actual System Use in technology use. This finding is also supported by another study by Fishbein and Ajzen (Ajzen and Fishbein 1980) who found that user intention is an important factor in determining user behavior in adopting technology.

Perceived Ease of Use has a positive and significant effect on Attitude Toward Using, with a coefficient value of 0.355 and a p-value of 0.000. This shows that the easier it is to use NFC, the more positive the user's attitude towards NFC use is. The strong reason that Perceived Ease of Use has a positive and significant effect on Attitude Toward Using on the use of NFC is because the user's perception of the ease of use of technology influences the user's attitude towards the technology. When users feel that a technology is easy to use, they tend to have a more positive attitude toward it. References that support this finding are research conducted by Venkatesh and Davis (Venkatesh and Davis 2000a) who found that Perceived Ease of Use has a positive and significant effect on Attitude Toward Using on technology use. This finding is also supported by another study by Moore and Benbasat (Moore and Benbasat 1991), Almaiah et al (Almaiah et al. 2022), (J. Kim and Lee 2012),(Ali et al. 2019) and (Zhang and Wang 2017) which found that users' perceptions of the ease of use of technology greatly influence users' attitudes towards the technology.

Perceived Ease of Use also has a positive and significant effect on Perceived Usefulness, with a coefficient value of 0.821 and a p-value of 0.000. This shows that the easier it is to use NFC, the more useful the system is according to user perceptions. Perceived Ease of Use is the user's perception of how easy it is to use a system. When users feel that using a system is easy, they will feel that the system is more useful and more likely to be used in different situations. This is a basic concept in the theory of the Technology Acceptance Model (TAM), which explains that the user's perception of the ease and usability of a system affects their intention to use it. Previous research has shown a positive relationship between perceived ease of use and perceived usefulness, as in a study conducted by (Almaiah et al. 2022),(Aris, Ismail, and Mohezar 2022),(J. Kim and Lee 2012) regarding the acceptance of NFC technology. This study shows that perceived ease of use has a positive and significant effect on perceived usefulness in the context of NFC technology.

Perceived Security has a positive and significant effect on Actual System Use, with a coefficient value of 0.477 and a p-value of 0.000. This shows that the more secure the NFC system, the greater the possibility of actual use of the system. Security is an important factor to consider when using payment systems, including NFC payments. When users feel that the payment system is safe, they tend to trust and feel more comfortable using it. Several studies also support this, such as a study conducted by Cheng and Liu (Cheng and Liu 2019) regarding the effect of security on the intention to use mobile payments. The study shows that security perceptions have a positive and significant influence on the intention to use mobile payments. Likewise with the study conducted by Ali et al (Ali et al. 2019) who found that perceptions of security had a positive and significant effect on the intention to use e-wallets.

Perceived Usefulness has a positive and significant effect on Attitude Toward Using, with a coefficient value of 0.426 and a p-value of 0.000. This shows that the more useful the NFC system is according to the user's perception, the more positive the user's attitude towards NFC use will be. The reason why Perceived Usefulness has a positive and significant effect on Attitude

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Toward Using is because the user's perception of the usefulness of the system greatly influences their attitude towards using the system. The more useful the system is according to user perceptions, the more positive their attitude towards using the system will be. In the context of NFC, the usability of the system can be understood as the ease of making transactions, the speed of making transactions, and the efficiency in using time and costs. References that can support this is research conducted by Almaiah et al (Almaiah et al. 2022), (J. Kim and Lee 2012),(Ali et al. 2019) and (Zhang and Wang 2017) who found that the user's perception of the usefulness of the system has a significant effect on the user's attitude towards the use of technology. In addition, another study conducted by Alalwan et al (Alalwan, Dwivedi, and Rana 2017) found that user perceptions of system usability and ease of use have a positive and significant effect on user intentions to use technology.

Subject Norm has no significant effect on Attitude Toward Using, with a coefficient value of 0.053 and a p-value of 0.456. This shows that social norms do not have a significant effect on the user's attitude towards the use of NFC. Subject Norm refers to social norms or expectations of the surrounding environment for the use of NFC. However, the results of the analysis show that this factor is not significant in influencing the user's attitude towards the use of NFC. One explanation for this is that in the case of technology, social norms may not be the main factor in determining user behavior. For example, even though some people may not be familiar with using NFC technology, if the system is considered easy and useful, then user attitudes and behavior can still be positive (Venkatesh et al. 2003),(Almaiah et al. 2022).

Total indirect effect test

The total indirect effect is used to measure the indirect effect of one variable on another through a mediator or intermediary variable. Its use is very important in research that tests the relationship model between variables in the presence of intermediary variables. By testing the total indirect effect, we can find out how much indirect influence the independent variable has on the dependent variable mediated by the mediator. This helps to understand the mechanism of the relationship between variables and provides useful information for the development of effective models and interventions (Bolin 2014).

Tables 4. Total indirect Effect

CONTRACT	Original Sample (O)	STDEV	T Statistics	P Values
Attitude Toward Using -> Actual System Use	0.347	0.055	6.345	0.000
Attitude Toward Using -> Behavioral Intention Usage	0.812	0.029	28.050	0.000
Behavioral Intention Usage -> Actual System Use	0.427	0.066	6.458	0.000
Perceived Ease of Use -> Actual System Use	0.245	0.050	4.897	0.000
Perceived Ease of Use -> Attitude Toward Using	0.705	0.063	11.271	0.000
Perceived Ease of Use -> Behavioral Intention Usage	0.573	0.051	11.219	0.000
Perceived Ease of Use -> Perceived Usefull_	0.821	0.026	31.203	0.000
Perceived Security -> Actual System Use	0.477	0.071	6.736	0.000
Perceived Usefull_ -> Actual System Use	0.148	0.047	3.174	0.002
Perceived Usefull_ -> Attitude Toward Using	0.426	0.099	4.322	0.000
Perceived Usefull_ -> Behavioral Intention Usage	0.346	0.079	4.368	0.000
Subject Norm -> Actual System Use	0.019	0.025	0.737	0.462
Subject Norm -> Attitude Toward Using	0.053	0.072	0.746	0.456
Subject Norm -> Behavioral Intention Usage	0.043	0.058	0.747	0.455

Based on the table 4 of total indirect effects, the following conclusions can be drawn:

Attitude Toward Using has a significant positive indirect effect on Actual System Use ($t = 6.345$, $p < 0.001$). Attitude Toward Using has a significant positive indirect effect on Behavioral Intention Usage ($t = 28.050$, $p < 0.001$). Behavioral Intention Usage has a significant positive indirect effect on Actual System Use ($t = 6.458$, $p < 0.001$). Perceived Ease of Use has a significant positive indirect effect on Actual System Use ($t = 4.897$, $p < 0.001$). Perceived Ease of Use has a significant positive indirect effect on Attitude Toward Using ($t = 11.271$, $p < 0.001$). Perceived Ease of Use has a significant positive indirect effect on Behavioral Intention Usage ($t = 11.219$, $p < 0.001$). Perceived Ease of Use has a significant positive indirect effect on Perceived Usefulness ($t = 31.203$, $p < 0.001$). Perceived Security has a significant positive indirect effect on Actual System Use ($t = 6.736$, $p < 0.001$). Perceived Usefulness has a significant positive indirect effect on Actual System Use ($t = 3.174$, $p = 0.002$). Perceived Usefulness has a significant positive indirect effect on Attitude Toward Using ($t = 4.322$, $p < 0.001$). Perceived Usefulness has a significant positive indirect effect on Behavioral Intention Usage ($t = 4.368$, $p < 0.001$). Subject Norm has no significant indirect effect on

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Actual System Use ($t = 0.737$, $p = 0.462$). Subject Norm has no significant indirect effect on Attitude Toward Using ($t = 0.746$, $p = 0.456$). Subject Norm has no significant indirect effect on Behavioral Intention Usage ($t = 0.747$, $p = 0.455$).

CONCLUSIONS

The study suggests that attitudes toward using the system, perceived ease of use, perceived security, and perceived usefulness have significant indirect effects on actual system use and behavioral intention usage, while subject norm does not significantly affect them. These findings can help organizations and system designers to understand the factors that influence users' behavior and improve system adoption and usage NFC technology on smartphones in Indonesia. Increasing the use of NFC technology in Indonesia has a positive impact on economic progress and ease of public access to information. The Government of Indonesia through Bank Indonesia continues to promote and support the use of NFC technology, particularly in an effort to encourage people to switch to a non-cash payment system. On the other hand, industry players such as telecommunications operators, banking companies, and NFC service providers also introduce their NFC products and services to the public. However, the challenges faced in using NFC technology in Indonesia cannot be ignored. In addition to the data security and privacy issues previously mentioned, there are other hurdles that need to be addressed. For example, the cost of building NFC infrastructure is still relatively expensive, so not all companies or small and medium enterprises are able to adopt NFC technology. In addition, the low level of technological literacy and the lack of supporting facilities such as shops or merchants that provide payments using NFC technology are also obstacles for users. In this case, the government's role is very important in strengthening and accelerating the use of NFC technology in Indonesia. The government can provide incentives for companies and merchants that use NFC in their payment systems, provide clear and measurable regulations, and provide training or education for the public regarding NFC technology and its use. In the long term, the use of NFC technology in Indonesia is expected to provide greater benefits for society, such as convenience and speed in making transactions, access to information faster and easier, and supporting the national digital transformation in Indonesia.

REFERENCES

- 1) Ajzen, I, and M Fishbein. 1980. *Understanding Attitudes and Predicting Social Behavior*. Prentice-Hall.
- 2) Alalwan, Ali A, Yogesh K Dwivedi, and Nripendra P Rana. 2017. "Factors Influencing Adoption of Mobile Banking by Jordanian Bank Customers: Extending UTAUT2 with Trust." *International Journal of Information Management* 37(3): 99–110.
- 3) Ali, Faizan et al. 2019. "An Assessment of the Use of Partial Least Squares Structural Equation Modeling (PLS-SEM) in Hospitality Research." *International Journal of Contemporary Hospitality Management* 31(1): 325–38.
- 4) Almaiah, Mohammed Amin et al. 2022. "Investigating the Effect of Perceived Security, Perceived Trust, and Information Quality on Mobile Payment Usage through Near-Field Communication (NFC) in Saudi Arabia." *Electronics (Switzerland)* 11(23): 1–22.
- 5) Aris, Fauzan, Kamisah Ismail, and Suhana Mohezar. 2022. "Fostering Mobile Payment Adoption: A Case of Near Field Communication (Nfc)." *International Journal of Business and Society* 23(3): 1535–53.
- 6) Asia, Nikkei. 2017. "NFC Technology Set to Transform Daily Life in Indonesia." <https://asia.nikkei.com/Tech-Science/Tech/NFC-technology-set-to-transform-daily-life-in-Indonesia>.
- 7) Bolin, Jocelyn H. 2014. "Introduction to Mediation, Moderation, and Conditional Process Analysis: A Regression-Based Approach."
- 8) Cheng, Teng-Yuan, and Jia-Ling Liu. 2019. "The Effect of Security Perception on the Intention to Use Mobile Payment." *Journal of Internet Banking and Commerce* 24(1): 1–19.
- 9) Davis, Fred D. 1986. "A Technology Acceptance Model for Empirically Testing New End-User Information Systems: Theory and Results." Massachusetts Institute of Technology.
- 10) Davis, Fred D, and Fred Davis. 1989. "Perceived Usefulness , Perceived Ease of Use , and User Acceptance of Information Technology." (September).
- 11) Gefen, David, Elena Karahanna, and Detmar W Straub. 2003. "Trust and TAM in Online Shopping: An Integrated Model." *MIS quarterly*: 51–90.
- 12) Grassie, Kai. 2007. "Easy Handling and Security Make NFC a Success." *Card Technology Today* 19: 12–13.
- 13) Hair, Joe F., Marko Sarstedt, Christian M. Ringle, and Jeannette A. Mena. 2012. "An Assessment of the Use of Partial Least Squares Structural Equation Modeling in Marketing Research." *Journal of the Academy of Marketing Science* 40(3): 414–33.
- 14) <https://www.researchandmarkets.com/>. 2023. "Mobile Wallet Market Research Report by Mode of Payment (NFC

Users' Perception of NFC Technology in Digital Payment Transactions in Indonesia

Payment, Remote Payment), Stakeholders (Content & Applications Aggregators, Handset & Hardware Solution Manufacturers, Mobile Network Operators), Application - Global Forecast 2023-2030." <https://www.researchandmarkets.com/>. <https://www.researchandmarkets.com/reports/4829820/mobile-wallet-market-research-report-by-mode-of#rela2-5674316>.

- 15) Huang, Shih-Sung, Chung-Chi Shen, and Chien-Hung Liao. 2013. "Mobile Payment User Adoption Intention: An Empirical Study of the Effects of Mobile Experience and Perceived Risk." *Computers in Human Behavior* 29(4): 1400–1408.
- 16) Kesharwani, Abhishek, and Richa Bisht. 2016. "Predicting Mobile NFC-Based Payments Adoption in India: Extending UTAUT2 with Perceived Risk and Perceived Benefit." *International Journal of Bank Marketing* 34(3): 347–70.
- 17) Kim, Dong-Jin, Donald L Ferrin, and H Raghav Rao. 2009. "A Trust-Based Consumer Decision-Making Model in Electronic Commerce: The Role of Trust, Perceived Risk, and Their Antecedents." *Decision Support Systems* 47(4): 429–41.
- 18) Kim, Junghyun, and Joongsup Lee. 2012. "An Empirical Study on the Adoption of NFC-Based Mobile Payments." *Journal of Business Research* 65(11): 1657–60.
- 19) Li, Yang, and Yan Li. 2017. "The Impact of Subjective Norm on the Adoption of near Field Communication Mobile Payment: An Integrated Trust--Risk Model." *Information Technology and Management* 18(3): 235–45.
- 20) Liébana-Cabanillas, Francisco, Iviane Ramos de Luna, and Francisco Montoro-Ríosa. 2017. "Intention to Use New Mobile Payment Systems: A Comparative Analysis of SMS and NFC Payments." *Economic Research-Ekonomska Istrazivanja* 30(1): 892–910. <http://doi.org/10.1080/1331677X.2017.1305784>.
- 21) Moore, Gary C, and Izak Benbasat. 1991. "Development of an Instrument to Measure the Perceptions of Adopting an Information Technology Innovation." *Information systems research* 2(3): 192–222.
- 22) Park, Sang-Yeon. 2009. "An Analysis of the Technology Acceptance Model in Understanding University Students' Behavioral Intention to Use e-Learning." *Educational Technology & Society* 12(3): 150–62.
- 23) Rogers, Richard W. 1975. "A Protection Motivation Theory of Fear Appeals and Attitude Change." *The Journal of psychology* 91(1): 93–114.
- 24) Teo, Timothy, and Vivien K G Lim. 2000. "Where Intention Meets Behavior: An Investigation of Behavioral Intention and Its Measurement." *Journal of computer information systems* 41(4): 43–50.
- 25) Venkatesh, Viswanath, and Fred D. Davis. 2000a. "Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies." *Management Science* 46(2): 186–204.
- 26) Venkatesh, Viswanath, and Fred D Davis. 2000b. "A Theoretical Extension of the Technology Acceptance Model: Four Longitudinal Field Studies." *Management science* 46(2): 186–204.
- 27) Venkatesh, Viswanath, Michael G Morris, Gordon B Davis, and Fred D Davis. 2003. "User Acceptance of Information Technology: Toward a Unified View." *MIS quarterly* 27(3): 425–78.
- 28) Xu, Xiaolin, and Xiaoyong Bai. 2014. "Investigating the Adoption of Mobile Payment Services: An Empirical Study of Chinese Consumers." *International Journal of Innovation and Technology Management* 11(03): 1450014.
- 29) Zhang, Y, and X Wang. 2017. "NFC Security: State of the Art and Future Directions." *Journal of Network and Computer Applications* 81: 34–57.



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