# Factors Affecting Slow Adoption of NFC-enabled Payment Services: Sri Lankan Consumers' and Service Providers' Perspective

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Sri Lanka

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# DECLARATION

I declare that this is my own work and this thesis does not incorporate without acknowledgement any material previously submitted for a Degree or Diploma in any other University or institute of higher learning and to the best of my knowledge and belief it does not contain any material previously published or written by another person except where the acknowledgement is made in the text.

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(Signature of the candidate)

The above candidate has carried out research for the master's thesis under my supervision.

…….. ……...

Dr. H.M.N. Dilum Bandara Date

# ABSTRACT

Near Field Communication (NFC) enabled contactless payments were introduced to Sri Lanka in 2013. However, its adoption and usage remain low in Sri Lanka. This study examines the factors affecting the slow adoption of NFC-enabled payment solutions from both the consumers' and service providers' perspective. We adopted an interview-based qualitative methodology to explore service providers' perspective. Several factors from these findings and a literature survey were then used to derive a survey to explore the adoption factors from the consumers' perspective. Based on the literature survey findings and the Technology Acceptance Model (TAM) the research framework was designed to understand consumer adoption. The research framework consisted of nine independent factors and two mediating factors. A survey was distributed among the consumers to find the consumers' adoption factors towards the NFC-enabled payments. Structured Equation Modelling was used to analyze the collected survey data. The research findings demonstrate that only the perceived ease of use has a positive impact on the adoption of NFC-enabled payments. Compatibility, awareness, and the intention to use have a direct impact on the perceived ease of use; hence, have an indirect positive impact on the adoption of NFC-enabled payments in Sri Lanka. Technical issues such as limited battery power of Point of Sales (POS) devices, uncertainty around consumer transaction security, associated initial and recurrent costs, and inadequate government regulation were identified as factors affecting the slow adoption of NFC-enabled payments from the service providers' perspective. The findings of this research could be helpful for mobile commerce in general to increase the adoption of NFC-enabled payment services in Sri Lanka, and specifically to the service providers and merchants while implementing new NFC-enabled payment applications.

Keywords: Consumer adoption, Near Field Communication (NFC), NFC-enabled payments, Technology Acceptance Model

# DEDICATION

To

**My Parents**

Two strong souls who guide me and support me to achieve my life goals

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# LIST OF ABBREVIATIONS

| | |
|---|---|
| ADOP | Adoption |
| COM | Compatibility |
| COS | Cost |
| ITU | Intention to use |
| NFC | Near Field Communication |
| NPK | NFC payment knowledge |
| PEU | Perceived Ease of use |
| PI | Personal Innovation |
| POS | Point of Sale |
| PR | Perceived Risk |
| PU | Perceived Usefulness |
| RE | Reachability |
| SIM | Subscriber Identity Module |
| SN | Social Norms |
| TAM | Technology Acceptance Model |

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# 1. INTRODUCTION

## 1.1 Background

Near Field Communication (NFC) is a type of Radio Frequency Identification (RFID) technology which emerged in the early 1980s (Trivedi, 2015). Charles Walton invented RFID technology in 1983 (Trivedi, 2015). Among the different applications of NFC technology, NFC-enabled transaction services opened the door to contactless payments.

NFC can be considered as one of the most convenient payment sources as the NFC technology is integrated into mobile phones and wearable devices, enabling potentially widespread use of contactless payments. Based on the report by Grand View Research (2016), it is predicted that the value of NFC-enabled transactions would reach USD 47.43 billion by the year 2024.

NFC-enabled card-based and sticker-based payments are currently available in Sri Lanka. Once a transaction is performed through an NFC-enabled device, real-time updating takes place on the device itself, enabling customers to keep track of their updated balance. While the balance on the merchant's end may or may not update in real-time, the technology still provides other benefits such as improved, efficient, and productive customer service due to the quickness associated with the NFC technology primarily due to its contactless nature.

The usage of smartphones is on the rise. The NFC technology is used in mobile phones to enhance the consumer experience in daily micro-payments such as transport tickets, ordering coffee, and vending machines. In addition to the smartphone-based NFC-enabled technology, there are other devices which have the embedded NFC-enabled payment technology such as NFC-enabled cards and stickers.

This study pays more in-depth attention towards factors affecting the adoption of NFC-enabled payment services from the perspective of consumers in Sri Lanka while paying less attention to the same from the perspective of service providers in Sri Lanka.

## 1.2 Motivation

According to the statistics of Blue Bite's report (2019), NFC-enabled activations increased by 22% during the time from 2018-2019. Also, NFC interactions increased by 27% during the same period. Furthermore, Blue Bite report estimated that there would be 1.6 billion NFC-enabled devices by 2024. Despite the various advantages of NFC-enabled payment services, it is still not very popular nor widespread within the country. Sri Lanka has not yet embraced NFC-enabled mobile payment technology, and only the NFC-enabled sticker-based and card-based payments are currently available. According to the Sri Lankan Insight blog of Paranavithana and Herath (2020), NFC-enabled payment growth is slower in Sri Lanka, and consumers are slower in adopting to the technology when compared with the situation in other countries. Also, few service providers in Sri Lanka has provided NFC-enabled payment applications to the market.

Several studies have been conducted in different countries to find the factors affecting consumers and service providers for the adoption of NFC-enabled payment services. For example, according to Li, Liu, and Heikkilä (2014), compatibility, perceived ease of use, and knowledge about mobile payments are the main factors affecting the consumers' adoption of NFC-enabled payment methods. Jenkins and Ophoff (2016) identified that perceived value to be the main adoption factor in South Africa. Customer shopping experience and the fragmented market are the two adoption factors affecting the merchants (Hayashi & Bradford, 2014). Pal, Vanijja, and Papasratorn (2015) recommended that promoters should properly advertise the advantages of NFC-enabled payment methods to increase consumer adoption. Also, financial institutes and banking institutes can run promotional campaigns to expand their consumer base. Luna et al. (2017) recommended focusing on consumers who are likely to test new technologies to promote NFC-enabled payments.

NFC-enabled payment methods usage is still not popular, and its adoption is still slow in Sri Lanka. Several related works such as Pal, Vanijja, and Papasratorn (2015), Luna et al. (2017), Jenkins and Ophoff (2016) and Li and Liu and Heikkila (2014) discuss NFC-enabled payments. However, such literature focused only on consumers'

adoption factors and did not cover the service providers' perspective. However, these findings cannot be generalized to Sri Lanka, due to the differences in factors such as technology, banking and payment methods, telecommunication industry, and the maturity of the economy. While there is literature on NFC-enabled payments in Sri Lanka, the most related is the analysis of mobile money transactions by Castri (2013). However, it does not cover NFC-enabled payments. Hence, it is imperative to analyze the factors that have an impact on the adoption of NFC-enabled payments from both the consumers' and service providers' perspective.

### 1.3 Problem Statement

According to Paranavithana and Herath (2020), NFC-enabled payment growth is slower in Sri Lanka and consumers are slower in adopting to the technology when compared with the situation in other countries. Also, few service providers in Sri Lanka has provided NC-enabled payment applications to the market. Sri Lanka is still heavily depending upon using the cash payments and the related work from other countries cannot be applied directly due to the differences in technology, economy, banking, telecommunication industry, and payment methods. The main intention of this research is to find the factors determining the consumers' and service providers' slow adoption of NFC-enabled payment services in Sri Lanka. Therefore, it is imperative to address the following research problem:

*What are the consumer and service provider related factors affecting the slow adoption of NFC-enabled payment services in Sri Lanka?*

### 1.4 Research Objectives

The above research problem is to be addressed by achieving the following objectives:

- To identify the factors that affect the adoption of NFC-based payments using literature.

- To understand the factors that affect the slow adoption of NFC-based payment services in Sri Lanka from the perspectives of both the consumers and service providers.
- To analyze the collected research data via survey and interviews.
- To identify suggestions to increase the adoption of NFC-based payments.

### 1.5 Research Significance

Findings of this study could be beneficial to the mobile commerce industry, as it focuses on finding factors affecting the NFC-based payment adoption from both the service providers' and consumers' perspective. Also, service providers would be able to get a proper understanding of the adoption factors of consumers to promote their services within the country. Hence, it will be an advantage for the service providers too. This would be helpful to increase the adoption rate of NFC-enabled payments in the country.

### 1.6 Outline

The rest of the thesis is organized as follows; Chapter 2 outlines the literature reviews with regards to the adoption factors of consumers and service providers towards the NFC-enabled payment methods. Chapter 3 presents the research methodology using the conceptual diagram, data collecting methods, and the developed hypothesis. Data analysis is presented in Chapter 4. Chapter 5 discusses the research findings, recommendations, research limitations, and future work.

# 2. LITERATURE REVIEW

This chapter presents the literature surveys with regards to the NFC technology, NFC-enabled payment technology, and the consumers' and service providers' adoption factors towards the NFC-enabled payments. Section 2.1 and 2.2 explain the NFC-enabled mobile and other payments, respectively. Section 2.3 describes frameworks about technology adoption. NFC-enabled adoption factors from the service providers' perspective are presented in Section 2.4. Section 2.5 provides the details related to merchants' adoption factors, while Section 2.6 identifies the consumers' adoption factors. A chapter summary is presented in Section 2.7.

## 2.1 NFC-enabled mobile payments

NFC is a short-distance wireless technology that supports a secure connection between NFC compatible electronic devices (Rahul et al., 2015). NFC technology is a result of Radio Frequency Identification (RFID) technology that supports two NFC-enabled electronic devices within fewer than four centimeters (Rahul et al., 2015). NFC-enabled methods are categorized into three main operating modes (Senthuraman et al., 2015), namely:

- Reader/writer mode – NFC-enabled devices can either read or write data. This mode helps to read data from a tag embedded in a poster and useful in interactive advertisements. For example, location-based services and smart posters.
- Peer-to-peer mode – Data is shared between two NFC-enabled devices. This mode can also be used to share Bluetooth or Wi-Fi link set up information. For instance, data exchange and money transfer.
- Card Emulation mode – NFC-enabled devices can communicate with external devices, like contactless smart cards. This allows contactless payments and enables cashless payments when purchasing tickets, instead of traditional ticket purchases. In addition to this, loyalty cards and identity cards can be taken as examples for card emulation mode.

NFC-enabled mobile payments are an outgrowth of mobile commerce (m-commerce). Such payments are conducted through NFC-enabled mobile device; hence, they are also referred to as "contactless mobile payments" (Smart Card Alliance, 2011). Consumers need to have an NFC technology embedded smartphone and need to have NFC-enabled payment applications in their phones to initiate an NFC-enabled transaction. There are different NFC-enabled payment applications available in different countries, and there should be a payment account with a responsible financial institute. NFC-enabled smartphones can communicate with NFC-enabled Point of Sale (POS) readers to make transactions. Consumers have to only hold or tap the smartphone near the POS reader, and the transaction will happen through radio frequency technology. The payment process and the settlement process are like the traditional credit/debit card payment process.

*Mobile commerce* is defined as a new wave of technology-driven concept which is supported by mobile devices that offer Internet "in your pocket" to conduct banking, booking, shopping, and buying tickets (Barnes, 2002). Different services can be provided using mobile commerce. For example, people can get news updates via their mobile phones. Mobile shopping, mobile banking, mobile ticketing, playing online games, watching TV, and mobile Enterprise Resource Planning (m-ERP) can be highlighted as primary services provided through mobile commerce. Users can pay for these goods and services using mobile money.

*Mobile money* is a result of m-commerce which can be defined as electronic money where customers can use to do their transactions online via their mobile phones. According to the GSMA (2015) report, there are around 411 million mobile money accounts already in use across the world.

### 2.2 NFC-enabled payments

According to the reports of Capgemini and BNP Paribas (2016), globally non-cash transactions grew up to 8.9% and stated that non-cash transactions of developing countries grew by 2.0%. There are nearly 130 million Dollars contactless transactions happened with almost 3 million contactless terminals found in all around Europe

(Smart Payment Association, 2016). According to the statistics of the Smart Payment Association (2016), the two leaders in Europe, who embraced the contactless payment firstly are Poland and Spain. In Canada, there are around 75% of contactless payments enabled POS at all major retailers. Not only that but also, based on the figures of the Smart Payment Association (2016), 66% of consumers in Australia say that the most preferred payment way is "contactless payment". Even though the mobile penetration is high in the US, based on the statistics, in-store mobile-related transactions are only 16% during the time between December 2013 and February 2014 (Bricker & Zia, 2013). Still, contactless payment support terminals are only 30% in the United States (US) (Bricker & Zia, 2013). Most of the major retail stores in the US, such as Macy's, Walgreens, and GAP have embraced the NFC-enabled transactions (Bricker & Zia, 2013). Apple Pay and Google wallets are the two giant companies that provide mobile-based NFC payments in the US (Bricker & Zia, 2013).

Bank of Ghana (BoG) wants to make a "cash-lite" society. 40.8 million mobile transactions happened in 2013, and nearly 266 million in 2015 (KPMG Report, 2015). Based on the KPMG Report (2015), it indicated that most of the mobile operators target the unbanked countries. According to the studies of Nidugondi (2017), NFC technology in Africa has beaten the other types of mobile-based payment technologies such as Bluetooth and QR codes.

NFC based mobile payments are used in public transits in Australia, South Korea, Japan, Hong Kong, and Singapore. Also, most of the younger people in these countries use NFC mobile payments to buy videos, ringing tones, and mobile games (Asia Focus, November 2013). NFC-enabled Subscriber Identity Module (SIM) card services were introduced in Germany and Poland around 2011, while this was introduced to countries such as the Netherlands, Czechia, and United States during 2012 (Clarke, 2011). According to the statistics of Payments Bulletin Report (2017) by the Central Bank of Sri Lanka, within the first quarter of 2017, only 0.5% of mobile transactions happened, when purchasing products over the counter from mobile-based e-money transactions.

Sri Lanka embraced the new growth of NFC technology in 2012 (Daily Finance Times, 27 August 2012). Currently, Sri Lankan merchants have introduced NFC-enabled card

and sticker-based payments. NFC-enabled touch card has the embedded NFC technology, where users can touch to an NFC-enabled POS terminal to make the payment. NFC stickers are introduced as an alternative fit for NFC-enabled devices and cards. These stickers can be stuck on any device and smaller in size. Typically people stick these NFC stickers on wallets or cell phones. Al-Ofeishatand Al-Rababah (2012) mentioned that the production cost is high for NFC stickers than NFC-enabled contactless cards, even though its initial startup cost is low.

The very first NFC-enabled contactless fuel card was introduced in the year 2012 by Dialog Axiata PLC in partnership with LAUGFS Petroleum Limited (Daily Finance Times, 27 August 2012). This was the very first implementation of NFC-enabled smart card in Sri Lanka, which aimed to provide quality service for corporate customers. This concept gives many advantages for organizations that provide fuel allowance for their employees. Now it is easy for organizations to put a pre-set limit on employees' fuel allowance. Before this, the process was done manually through paper bills, and it was a hassle to monitor these transactions. With this new concept, organizations can monitor all the transactions online with information such as the time, date, and location of each transaction. Corporate fuel card employees do not have to wait a long time for paper bills, as they only have to touch the fuel card. These users will receive a quick SMS notification, once they touch the card to make the payments. Because of the fuel card, secure and fast transactions can be made, and it helps to increase the efficiency of work at petrol sheds as free from paper-based receipts (Daily Finance Times, 27 August 2012). Dialog has extended this NFC corporate fuel card service at 100 petrol stations in Sri Lanka (The Sunday Times, 08 December 2013).

Dialog introduced the first NFC-enabled travel card in Sri Lanka in June 2013 (DigiT, 17 Feb 2014). Commuters can top up NFC-enabled travel card at any of the registered merchants' places across the country. Once the commuters top up their travel cards, they can use this card to pay buses. Currently, bus routes 138, 177, and 122 in Colombo are made available with this facility (DigiT, 17 Feb 2014). Users can tap the travel card to the NFC-enabled POS equipment carried by the bus conductors. NFC-enabled travel pass is also a solution to the complaints of commuters not receiving balance cash from bus conductors, and also these conductors cannot cheat on the collected money

as the money directly goes to the bus owner's account (DigiT, 17 Feb 2014). In addition to the NFC-enabled travel card, Dialog introduced NFC-enabled smart sticker as an alternative option for buying a card (Daily Finance Times, 24 September 2013). This NFC-enabled sticker can be pasted on wallets, phones, or even on a key tag while travelling by bus. NFC-enabled stickers also act like NFC-enabled cards and give the same benefits to the users, except commuters do not have to carry a card.

Table 2.1: NFC-enabled applications available in Sri Lanka.

| Service provider | Application |
|---|---|
| Dialog | • Dialog initiated Sri Lanka's very first NFC-enabled smart card and sticker which can be used to pay for buses. |
| Mobitel | • Mobitel has introduced NFC-enabled fuel card where people can pay for fuel stations.<br>• Mobitel has introduced NFC-enabled "One card" for students and parents which act as a student tracker, as well as students can pay their school fees and tuition fee. |
| HNB | • HNB introduced an NFC-enabled multi-function visa card that operates both as a visa ATM/debit card and e-bus ticketing facility. |
| Commercial Bank of Ceylon and Dialog | • Commercial Bank has introduced NFC-enabled visa and Master card, where users can pay to NFC-enabled POS machines at Dialog outlets in Sri Lanka. Customers do not have to give their Visa or Master card to staff as customers can initiate a transaction on their own by tapping the card. |

## 2.3 Framework towards technology adoption

Davis, Bagozzi, and Warshaw (1989) introduced the Technology Acceptance Model (TAM), in order to explain the behavior of users' acceptance of the technology. TAM model predicts the factors why a certain system will not be acceptable to users and this model explains the reasons for the unacceptance as well as the actions which need to be taken to increase the acceptance of the system. Perceived usefulness and perceived ease of use (Davis, Bagozzi, & Warshaw, 1989) are the two main variables, which explains the computer acceptance behaviors. Perceived ease of use is the level to which a person thinks that using and handling a particular computer system could be easy to use with minimum effort. Perceived usefulness is defined as the level to which a person thinks that using a specific system would increase job performance (Davis, Bagozzi, & Warshaw, 1989).

TAM model has been used in the industry of information systems, which helps to understand the adoption of different technologies. Most researches used TAM as the basic model and extended this model by adding new factors. The author in this research argues that this model has only focused on two factors and ignores the concepts of gender, experience, and age.

Venkatesh et al. (2003) introduced another framework, which is called the Unified Theory of Acceptance and Use of Technology (UATUT). This model was formulated based on different eight models, which explains on user acceptance of the technology. UATUT model explains four determinants and moderators of user acceptance of new technology. The direct four determinates are named as performance expectancy, effort expectancy, social influence, and facilitating conditions. Four moderators were also identified; these are named as gender and age, experience, and Voluntariness of Use were included. Venkatesh, Thong, and Xu (2012) extended the UATUT model by adding another new determinate to understand user acceptance of computer technology. These added determinants are hedonic motivation, price, and habit, which influence the user acceptance of new technology.

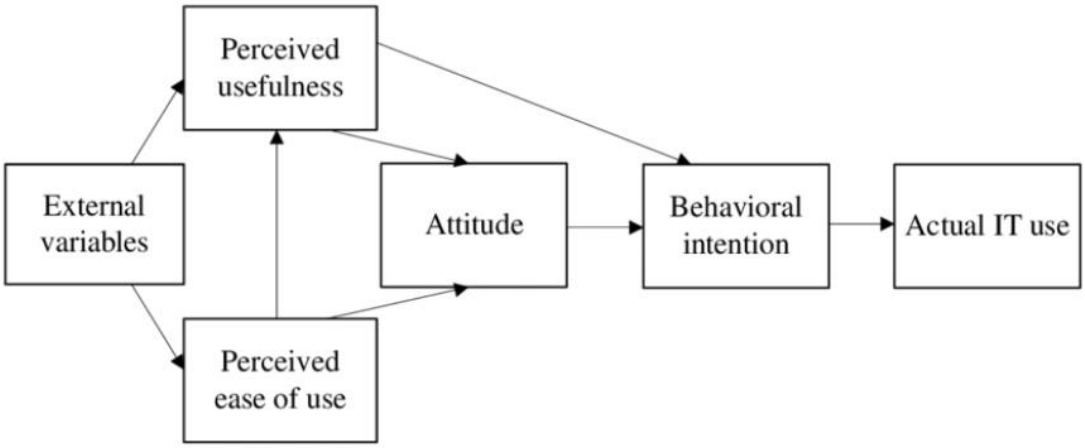


Figure 2.1: Technology Acceptance (TAM) model (Davis, 1989).

### 2.4 Service Providers' adoption factors towards NFC payments

Several service providers offer NFC-enabled payments in Sri Lanka. Telecommunication companies and some of the Sri Lankan banks have NFC-enabled

payment options. This study only focuses on two telecommunication service providers in the country, namely Dialog Axiata PLC and Mobitel (Pvt.) Ltd. Some of the important service providers' adoption factors towards NFC-enabled payment services are cost, government regulations, infrastructure, and security. Next, we briefly discuss each of these factors:

*Cost*

The cost has a definite impact on the adoption of any technology in developing countries, and also companies in developing countries would not be able to initiate a full-scale technology adoption if the cost involved with the new technology is high (Agreraha et al., 2015). According to the studies of Sharma and Citurs (2005), technology implementation is unfavourable when the cost involved in the technology is high.

*Government Regulations*

Every country has a set of regulations which governs the payment methods. Following are some of the Regulation Acts in Sri Lanka with regards to the mobile payments. Payment and Settlement Systems Act, No 28 of 2005, contains regulations on the payments for the stored value cards in Sri Lanka. Another related act is the Act No. 1 of 2013 – Payment Cards and Mobile Payment Systems Regulations. As per the regulation, service providers are not able to provide an NFC-enabled card with an Rs.10,000 maximum top-up for a normal account holder (Dialog ezcash, 2019).

*Infrastructure*

There are no NFC card terminals for contactless payments in Sweden, and this has been the reason for no adoption of contactless payments in the country (Corp & Mattson, 2010). According to their studies, they have explained that non-availability of infrastructure platform leads to the non-adoption of contactless payments in Sweden. Further, they emphasized that there is a slow process of hardware infrastructure development. It is therefore essential that NFC becomes a standard component in all new mobile phones. Studies of The Hong Kong Bank Associations (2016) suggested that NFC payment service providers in Hong Kong must consider

using the existing infrastructure to minimize cost and to encourage mass NFC acceptance.

*Security*

Security is one of the primary areas of concern for NFC payments. Customers are still reluctant to use NFC-enabled payments because of the security concerns of the technology (Al-Amri et al., 2016). Hence, service providers should consider the human and security of the NFC payment methods to maximize the adoption rate. According to the studies of Liebenau and Calderwood (2011), service providers have taken privacy as a major concern when implementing mobile internet in Japan.

## 2.5 Merchants' adoption factors towards NFC payments

Hayashi and Bradford, (2014) identified NFC payments as one of the growing mobile payments in the world and explained on five main key attributes of mobile payments on the merchants' perspective. These five attributes are shopping experience of the customer, cost, customer data control, security, and fragmented market. In addition to this, Bussler (2016) mentioned hardware cost, cost of training, security, and lack of understanding about the added value on NFC payments are some of the challenges faced by merchants when it comes to NFC payments. Next, we discuss the identified merchants' adoption factors towards the NFC-enabled payments such as the shopping experience of the customer, cost, security, fragmented market, and customer data control.

*Shopping experience of customers*

According to a survey done by Hayashi and Bradford, (2014), most of the merchants accepted that mobile payments enhance the customer shopping experience, while some of the merchants think that mobile payments confuse the customer and it is a complex process. There are several ways of enhancing customers' shopping experience when using NFC payments. Mobile payments help customers to shop more conveniently as it reduces time waiting at POSs, and customers will receive relevant advertisements and promotional messages to their mobile phones (Hayashi & Bradford, 2014).

Research by Hayashi and Bradford, (2014) focused mainly on retail shops and on mobile commerce while little attention was given on NFC payments.

*Cost*

One of the significant concerns of merchants is the initial cost which they have to invest in NFC payment infrastructure. NFC-enabled Point of sales (POS) terminals (hardware) cost a considerable amount of dollars (Bussler, 2016). The investment for NFC payment devices and operational cost are considerably higher than other mobile payment processes (Hayashi and Bradford, 2014). Merchants require relevant software to integrate with other systems. In addition to that, merchants have to invest in training the staff on NFC payments as it is a new payment technology. Based on the studies of Hayashi and Bradford, (2014), the main difficulty of NFC based payment adoption is the considerably high amount of investment cost to both merchants and consumers than other technologies. However, Hayashi and Bradford, 2014 emphasized that mobile payments lead to a reduction in the overall merchants' operating cost such as waiting time of customers and as a result, the labor cost. Further Hayashi and Bradford (2014) emphasized the highest priority of merchants which belong to narrow profit margin retail categories is the cost, while the cost is a lower priority among department stores which belong to wide profit margin category.

*Security*

According to Hayashi and Bradford (2014), merchants have to consider security in two aspects such as security on the payment process as well as security on customer data. 75% of the interviewed merchants raised the concern on security (Hayashi & Bradford, 2014). To protect NFC payment transactions, NFC transactions has tokenization at the point of initiating the NFC transaction (Bussler, 2016). However, it is typical that merchants pay much attention to the security of "contactless" side of NFC payments (Bussler, 2016). Proper standards should be implemented on the security of consumer data, and consumer privacy and this will lead to an increase in the adoption of mobile payments (Hayashi & Bradford, 2014).

*Fragmented Market*

There are different technologies available in the market today. According to Hayashi and Bradford (2014) studies, they emphasized that these different technologies (fragmentation) make it difficult for merchants and customer mobile payment adoption. In addition to this, they have mentioned that NFC-based payments might be acceptable for public transportation. Market fragmentation would be to set up standards for ownership of consumer data, consumer privacy and security on mobile-based payments (Hayashi & Bradford, 2014).

*Lack of understanding of the added values on NFC payments*

The excitement of NFC based payment should come from retailers themselves to penetrate this concept among consumers, and this could be achieved by educating the benefits which can be achieved by using NFC based payments (Bussler, 2016). Merchants will embrace the concept of NFC based payments if they know the added values of using NFC technology in business. Loyalty programs can be integrated with NFC payments, which allow merchants to build their brand names. From these integrated loyalty programs, retailers can send promotions and coupons, and customers can track their points at any time. Walgreens supermarket has embedded its loyalty program via NFC technology (Davenport, 22 August 2016).

*Customer Data control*

Mobile payments allow merchants to collect information on consumers' buying behavior and payment behavior. Also, when the customer signs up for mobile payments and loyalty programs, the customer has to provide their personal information such as name, address, mobile number and e-mail address to merchants. Merchants have a concern on how these data would be used by third-party mobile providers and other competitors in the market (Hayashi & Bradford, 2014). These customer data will be useful to understand the buying patterns of consumers and these data would be useful for rival companies to increase their sales. Merchants have a serious concern on the uncertainty of consumer data and the privacy of these data.

## 2.6 Consumers' adoption factors towards NFC payments

After going through different literature, following consumers' adoption factors towards the NFC-enabled payments were identified:

*Perceived Ease of Use*

Consumers are likely to adopt NFC-based payments, if it is easier to use (Li, Liu, & Heikkilä, 2014). According to Pal, Vanijja, and Papasratorn (2015), perceived ease of use is considered as a significant factor for user adoption of NFC-enabled mobile payments. They have included two user groups named as late adopters and early adopters. According to the views of early adopters, they take perceived ease of use as the strangest factor.

*Perceived usefulness*

According to the findings of Luna et al. (2017), perceived usefulness is considered as one of the determinant factors to use NFC payments in future. Perceived usefulness is referred to as one of the strongest predictors for NFC-based payment usage among consumers (Pal, Vanijja, & Papasratorn, 2015). Another important insight of their research is that the perceived usefulness is shown as the main factor for late adopters (Pal, Vanijja, & Papasratorn, 2015).

*Perceived Risk*

One of the Business dictionary (2019) defined perceived risk as a certain user's uncertainty level on the outcome of a certain purchase. Security risk and privacy risk are considered in this study under perceived risk. Security is an essential factor for NFC based mobile payments as customers have a concern on hackers, and security will be a highly important factor for new payment methods (Jenkins & Ophoff, 2016). According to Luna et al. (2017) studies, security is a significant concern for novel technologies such as NFC based payments. Consumers look at security from two angles, such as the chances to happen fraudulent transactions and the regulations and laws implemented to protect consumers when making NFC-related payments (Hayashi, 2012). Perceived risk has an influence on each stage of the customer's process of decision making (Mitchell, 1992).

*Cost*

The consumer has a concern on the cost involved for NFC based payment and equipment needed to initiate an NFC based payment (Hayashi, F, 2012). To make an NFC related payment using a mobile phone, they should have a smartphone which has NFC technology. Hence, equipment cost has a dependency on whether consumers have an NFC-enabled smartphone or not and the NFC payment fee (Hayashi, 2012). Consumers will check the overall value of using a particular system such as the total cost, benefits what could be received by using an NFC payment method (Jenkins & Ophoff, 2016).

*Personal innovativeness*

Based on the studies of Luna et al. (2017), personal innovativeness is a factor to determine the use of NFC payments. Some individuals have the intention of trying new technologies, which comes to the market. Individuals with high capabilities of innovation are likely to use and try new techniques (Pal, Vanijja, & Papasratorn, 2015).

*Compatibility*

According to the studies of Luna et al. (2017), compatibility is a vital factor for the acceptance of NFC payments by the users. They have further emphasized that the NFC payment technology should be compatible with users' lives at the stage of introduction to the market and that users recognize the compatibility factor. Compatibility is a leading feature to the acceptance of this type of new technology such as the NFC (Tornatzky and Klein, 1982). Compatibility is a determinant of intention to use NFC payments (Li, Liu, & Heikkilä, 2014).

*Reachability*

Reachability is defined as the active and continuous touch with the customers at every day (Pal, Vanijja, & Papasratorn, 2015). Customers should be given prompt service at any given time to feel that they have continuous support throughout the day. Pal, Vanijja and Papasratorn (2015) have proved that reachability has an apparent positive effect on the adoption of NFC payments. Reachability is one of the critical factors to the success of mobile payment systems (Kim, Mirusmonov, & Lee, 2010).

*NFC payment Knowledge*

Different technologies provide different services to consumers. People with background knowledge of NFC payment method are more likely to use or encouraged to experience this new payment method (Pal, Vanijja and Papasratorn, 2015). Based on the studies of Rogers (2015) knowledge about the innovation and its advantages should be obtained by the customers to agree on using the new innovation. User intention to use NFC payment systems increases when consumers have more knowledge on NFC payment method (Li, Liu, and Heikkilä, 2014). Jenkins and Ophoff (2016) explained that consumers would embrace any new technology, if they know how to use or have the skills to use any new technology. Authors further explained that if users have the proper knowledge to use NFC payments, they will adopt the NFC concept faster.

*Awareness*

As per the studies of Ramya and Mohammed-Ali (2018), awareness is needed to create a cashless society. Lack of awareness among the public leads to preventing the adoption of NFC-enabled payments (YouGov Report, 2013). According to the statistics of the YouGov Report (2014), NFC-enabled payment account ownerships in the UK raised from 16% to 25% and the awareness of the NFC payment technology increased from 55% to 70%. It indicates that awareness is considered as a significant factor in the adoption of NFC-enabled payments in the UK.

*Social Norms*

Social influence is the way how individuals change their behaviors according to the people they associate closely. Khan and Alshare (2015) explained social influence as the degree to which an individual thinks the importance of their close one's belief on a certain technology before using it. Alshare (2015) has emphasized that social influence is strong on the intention to use mobile payment devices when consumers are young. Jenkins and Ophoff (2016) stated that social studies do not support a positive relationship between social influence.

*Intention to Use*

Consumers intention to use a particular new technology plays a major role. Consumers behavior towards a technology affects the usage of that service or product. Studies of

Davis, Bagozzi, and Warshaw (1989) have stated that behavioral intention plays a vital role when it comes to actual system usage through their TAM model. Also, Venkatesh et al. (2003) explained that the behavioral intention is a major factor as the intention is stored in consumers' minds, and it always affects user behavior. Some interesting statement is that the intention is strong among young men with less exposure to new technology (Venkatesh, 2012).

Table 2.2: A summary of existing studies.

| Source | Factors considered | Research Limitation |
|---|---|---|
| Pal, Vanijja, and Papasratorn (2015) | Perceived ease of use<br>Perceived usefulness<br>Personal innovativeness<br>NFC payment knowledge<br>User mobility<br>Compatibility<br>Reachability<br>User convenience | Sample - people who use a credit or debit card. Not included actual users<br><br>Factors such as gender and financial status of a certain person have not taken into consideration. These factors also could have an impact towards using such a system |
| Luna et al. (2017) | Attitude toward the use<br>Perceived ease of use<br>Personal innovation<br>Perceived usefulness<br>Compatibility<br>Subjective norms<br>Security<br>Individual mobility | The sample was taken only from Brazil. Culture is totally different with Sri Lanka |
| Jenkinsand Ophoff (2016) | Social influence<br>Perceived ease of use<br>Perceived financial resources<br>Perceived risk<br>Perceived value | Sample-Young South African university students (ignored other age groups) |
| Li, Liu, and Heikkila, (2014) | Compatibility<br>Perceived ease of use<br>Perceived usefulness<br>Perceived risk<br>Mobile payment knowledge<br>Perceived complementarity | The proposed model was evaluated using limited no of empirical data gathered in China. |

## 2.7 Summary

Above related work provides a clear understanding on how NFC mobile payment has emerged as a result of mobile commerce, the technology about NFC mobile payment, different frameworks which explain on user acceptance towards new technology, service providers' and consumers' different factors which affecting adoption of NFC mobile payment. Many factors affecting the adoption of mobile payment in different

contexts have been identified. Most of the studies focused on the mobile payment adoption factors rather than the consumer-related adoption factors of the NFC-enabled payments. Less attention has been given to the perspective of service providers towards the adoption of the NFC technology. One could argue that to increase the use of NFC mobile payments, it is essential to examine the factors those have a definite impact on the adoption of mobile payments from both consumers' and service providers' perspective.

Table 2.3: Factors influence the choice of NFC-enabled payment methods.

| Resource | Perceived ease of use | Perceived usefulness | Perceived risk | Compatibility | Cost | Social norms | Reachability | NFC payment knowledge | Personal innovation | Intention to use |
|---|---|---|---|---|---|---|---|---|---|---|
| Davis, Bagozzi, and Warshaw (1989) | X | X | | | | | | | | X |
| Jenkins and Ophoff (2016) | | | X | | X | | | | | |
| Pal, Vanijja, andPapasratorn (2015) | X | X | | | | | X | X | X | |
| Li, Liu, and Heikkila (2014) | X | | | X | | | | X | | |
| Hayashi (2012) | | | X | | X | | | | | |
| Luna et al. (2017) | | X | | X | | | | | X | |
| Venkatesh et al. (2003) | | | | | | X | | | | X |
| Khanand Alshare (2015) | | | | | | X | | | | |
| Kim, Mirusmonov,and Lee, 2010 | | | | | | | X | | | |

# 3. METHODOLOGY

This chapter focuses on the research framework, data collection methods, target population, developed hypothesis, and the selected data collection approaches. The research methodology contains two approaches based on interviews and consumer questionnaire. Section 3.1 explains about the research methodology. The conceptual framework is presented in Section 3.2. Section 3.3 has given the identified variables of consumer adoption. Target population and data collection are addressed in Section 3.4 and 3.5, respectively. Section 3.6 focuses on the pre-survey interview design. Section 3.6 presents the questionnaire design. Research hypothesis are given Section 3.8 while Section 3.9 presents the chapter summary.

## 3.1 Research Methodology

The research methodology is illustrated in Figure 3.1. Consumer adoption factors were identified from literature such as Davis, Bagozzi, and Warshaw (1989), Jenkins and Ophoff (2016), Pal and Vanijja and Papasratorn (2015), Li, Liu and Heikkila (2014), Hayashi (2012), Luna et al. (2017), Venkatesh et al. (2003), Khan and Alshare (2015), and Kim, Mirusmonov and Lee (2010). Identified consumer adoption factors include perceived ease of use, perceived usefulness, perceived risk, compatibility, cost, social norms, reachability, NFC payment knowledge, personal innovation and intention to use (see Table 2.3). Then the set of hypotheses were built to identify the consumer adoption factors towards the NFC-enabled payments. Further, based on the literature, a set of interview questions was derived to gather information from the NFC-enabled payment service providers. While both banks and telecommunication service providers typically provide NFC-related payment services, in Sri Lanka, only the telecommunication service providers support services such as transport ticketing, fule cards, and parking. Hence, only the telecommunication service providers were considered to capture the perspective of NFC service providers. Based on the feedback from service provides and identified consumer adoption factors survey questions were derived (see Appendix A). An interview was also used to test whether the survey questionnaire meaningful and relevant answer the research question. The

questionnaire was then distributed among the consumers. Quantitative data analysis was then conducted to identify the validity of the formulated hypothesis. Finally, research findings and recommendations were derived.

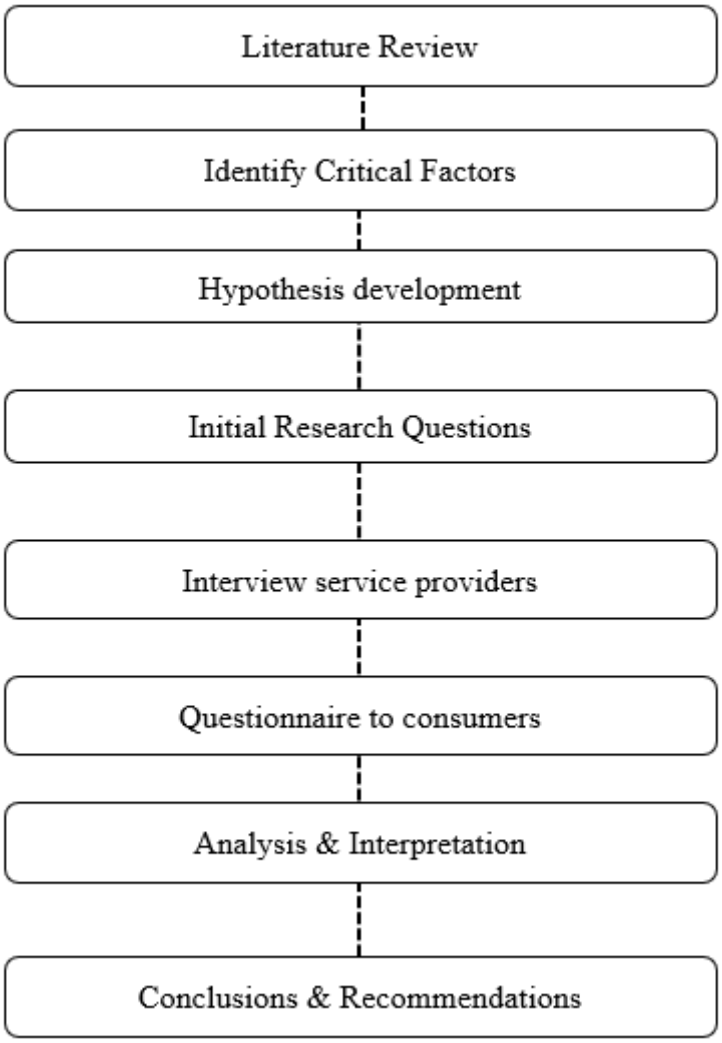


Figure 3.1: Research methodology.

### 3.2 Conceptual Framework

Different factors may influence customers and service providers adoption towards NFC-based payments in the country. In this study, we attempt to identify the adoption factors of NFC-enabled payments from the customers' perspective. The main objective of this study is to find whether the identified factors positively affect the adoption of

NFC payments in Sri Lanka. The Technology Acceptance Model (TAM) was chosen to model the conceptual framework, as it focuses on applying the implementation of different technical systems based on various situations such as culture and time. Also, TAM gives attention to users' behavioral intention towards the use of a particular system. Hence, the TAM model is used combined with other different factors which may influence the customer adoption towards NFC-enabled payments in Sri Lanka. Based on the interviews with service providers, a set of factors were identified for the service providers' adoption towards NFC payments in the country. Figure 3.2 shows the conceptual diagram consisting of independent, dependent, and mediating variables which were identified through TAM and other variables were identified after going through different literature surveys. The theoretical framework has two mediating factors and nine independent factors towards the adoption of NFC-enabled payments. Consumer adoption factors are considered as the dependent variable in this study.

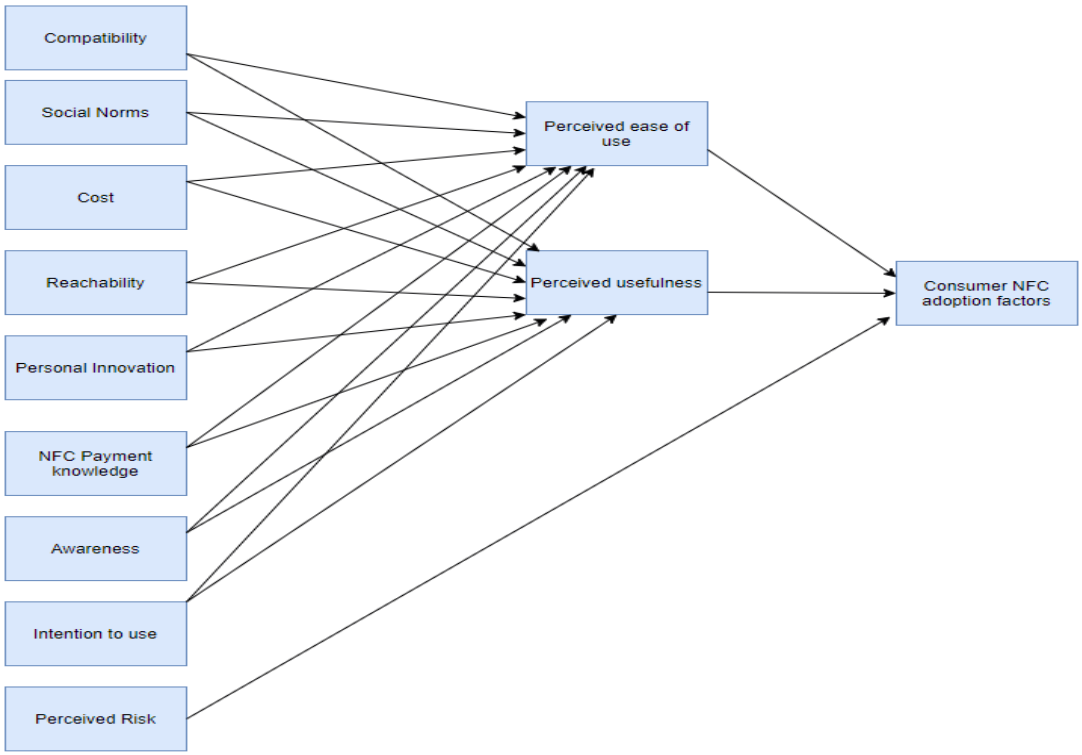


Figure 3.2: Conceptual diagram of consumer adoption factors.

### 3.3 Variables related to consumer adoption towards NFC-enabled payments

Based on the conceptual diagram in Figure 3.2 the set of dependent, independent, and mediating variables listed in Table 3.1 has been identified. These factors were identified after going through different literature surveys of the NFC-enabled payment adoption factors in different countries (see Table 2.3). Consumer adoption factors of NFC-enabled payments is the dependent variable of this study, which differs based on the mediating and independent variables. The main objective of this research is to understand whether the mediating and independent variables positively or negatively affect the adoption of NFC-enabled payments in Sri Lanka.

Table 3.1: Identified variables towards the NFC-enabled payments.

| **Dependent Variable** | **Independent Variables** | **Mediating variables** |
|---|---|---|
| Consumer adoption factors of NFC | Compatibility (COM)<br>Social Norms (SN)<br>Cost (COS)<br>Reachability (RE)<br>Personal Innovation (PI)<br>NFC payment knowledge (NPK)<br>Awareness (AW)<br>Intention to use (ITU)<br>Perceived Risk (PR) | Perceived ease of use (PEU)<br>Perceived usefulness (PU) |

### 3.4 Target Population

Two different population groups have been selected for this study to identify the adoption of NFC payments from customers' and service providers' perspective. Sri Lankan population between the age of 20-49 years was selected to identify the customers' NFC adoption factors. According to the Department of Census and Statistics of Sri Lanka, the population between the age of 20-49 years is around nine million (Department of Census and Statistics, 2018). The primary reason to deselect the other age groups is the unlikeness of purchasing an NFC-enabled payment type.

To identify the NFC payment adoption factors of service providers, two leading mobile service providers have been chosen. This study has focused only on telecommunication service providers to identify the service providers' NFC adoption factors. According to the records of the Telecommunication Regulatory Commission of Sri Lanka, there are five registered telecommunication service providers: Hutchison

Telecommunications Lanka (Pvt.) Ltd, Etisalat Lanka (Pvt.) Ltd, Dialog Axiata PLC, Mobitel (Pvt.) Ltd, and Bharti Airtel Lanka (Pvt.) Ltd. (Telecommunication Regulatory Commission of Sri Lanka, 2019). Among the five telecommunication service providers, only two have introduced NFC-enabled payments in Sri Lanka, namely Dialog Axiata PLC and Mobitel (Pvt.) Ltd. Hence, Dialog and Mobitel have been chosen to identify the service providers' NFC adoption factors in Sri Lanka.

To calculate the sample size of customers' NFC payment adoption factors, the SurveyMonkey website was used. According to the statistics, the population size of the age between 20-49 is 9,343,000 (Department of Census and Statistics, 2018). Sample size has been calculated by giving 5% as the margin error and a confidence level as 95%. Based on these provided parameters sample size is 385. The questionnaire was distributed among the age group between 20-49 years to get the responses.

Two telecommunication service providers with NFC-enabled payment services have been identified to carry out the interviews to find the service provider's perspective on NFC-enabled payments.

### 3.5 Interview Design

An interview was designed to gather data to understand the service providers NFC payment adoption factors and to understand the customers' behavior towards the NFC-enabled payments. The interview questions were created based on the factors identified from the literature survey (see Appendix B). The interview questions consist of closed and open-ended questions and Yes/No questions. Data gathered through the interviews were manually coded, as only two interviews conducted. Inductive coding approach (Thomas, 2006) was used to code the data collected through interviews. The inductive coding approach is defined as open coding where code is created based on the interview data instead of having a set of predefined codes.

### 3.6 Data Collection

The study contains both qualitative and quantitative data collection methods. Combination of both interview (qualitative data collection) and questionnaire (quantitative data collection) have been used as the data collection methods to gather data to identify NFC payment adoption factors from service providers' perspective and customers' perspective. Two interviews were conducted with different NFC service providers to understand their views. A questionnaire was distributed among the Sri Lankan population to identify customers' perspective.

Consumers were selected based on the age group and the survey was distributed among random people. To capture the service provider's perspective, only the telecommunication industry was aimed and interviewed the existing NFC-enabled payment service providers in the telecommunication industry.

### 3.7 Questionnaire Design

A questionnaire was made to gather data to identify the customers' NFC payments adoption factors. The questionnaire was designed based on the factors identified through the literature articles and the factors identified after conducting interviews with the service providers. The questionnaire contains close-ended, open-ended Likert-scale questions, and several demographic-related questions (see Appendix A). The questionnaire was sent to people in electronic format. Table 3.2 shows the survey questions related to each of the identified consumer adoption factors. Two redundant questions (Q5 i and ii) were added to check the accuracy level of the responses.

### 3.8 Hypothesis development

Following hypothesis are derived according to the proposed conceptual framework of NFC payment adoption in Sri Lanka from the consumers' perspective:

$H_A$ : Alternate Hypothesis

$H_0$ : Null Hypothesis

Table 3.2: Questionnaire mapping table.

| Adoption Factors | Related Questions in the Questionnaire |
|---|---|
| Perceived Ease of use | 5 (i, ii, iii, iv, v, vi) |
| Perceived Usefulness | 6 (ii, iii, iv, v) |
| Perceived Risk (Security, Trust and Privacy) | 7 (i, ii, iii, iv, v, vi, vii, viii, ix, x, xi) |
| Compatibility | 5(vii, viii, ix) |
| Social Norms | 8 (i, ii, iii, iv) |
| Cost | 9(i, ii, iii, iv) |
| Reachability | 5 (x, xi) |
| NFC Payment knowledge | 3, 4 |
| Personal Innovation | 1, 10 |
| Awareness | 6 (i) |
| Intention to use | 11, 6(vi) |
| Demographic questions | 14, 15, 16, 17 |

*Hypothesis 1*

$H1_A$: Perceived ease of use has a positive impact on the adoption of NFC-enabled payments

$H1_0$: Perceived ease of use has no impact on the adoption of NFC-enabled payments

*Hypothesis 2*

$H2_A$: Perceived usefulness has a positive impact on the adoption of NFC-enabled payments

$H2_0$: Perceived usefulness has no impact on the adoption of NFC-enabled payments

*Hypothesis 3*

$H3_A$: Perceived risk has a positive impact on the adoption of NFC-enabled payments

$H3_0$: Perceived risk has no impact on the adoption of NFC-enabled payments

*Hypothesis 4*

$H4_A$: Compatibility has a positive impact on perceived ease of use towards the adoption of NFC-enabled payments

$H4_0$: Compatibility has no impact on perceived ease of use towards the adoption of NFC-enabled payments

*Hypothesis 5*

$H5_A$: Social norms have a positive impact on perceived ease of use towards the adoption of NFC-enabled payments

$H5_0$: Social norms have no impact on perceived ease of use towards the adoption of NFC-enabled payments

*Hypothesis 6*

$H6_A$: Cost has a positive impact on perceived ease of use towards the adoption of NFC-enabled payments

$H6_0$: Cost has no impact on perceived ease of use towards the adoption of NFC-enabled payments

*Hypothesis 7*

$H7_A$: Reachability has a positive impact on perceived ease of use towards the adoption of NFC-enabled payments

$H7_0$: Reachability has no impact on perceived ease of use factor towards the adoption of NFC-enabled payments

*Hypothesis 8*

$H8_A$: NFC payment knowledge has a positive impact on perceived ease of use towards the adoption of NFC-enabled payments

$H8_0$: NFC payment knowledge has no impact on perceived ease of use towards the adoption of NFC-enabled payments

*Hypothesis 9*

$H9_A$: Personal innovation factor has a positive impact on perceived ease of use towards the adoption of NFC-enabled payments

$H9_0$: Personal innovation factor has no impact on perceived ease of use towards the adoption of NFC-enabled payments

*Hypothesis 10*

$H10_A$: Awareness has a positive impact on perceived ease of use towards the adoption of NFC-enabled payments

$H10_0$: Awareness has no impact on perceived ease of use towards the adoption of NFC-enabled payments

*Hypothesis 11*

$H11_A$: Intention to use has a positive impact on perceived ease of use towards the adoption of NFC-enabled payments

$H11_0$: Intention to use has no impact on perceived ease of use towards the adoption of NFC-enabled payments

*Hypothesis 12*

$H12_A$: Compatibility has a positive impact on perceived usefulness towards the adoption of NFC-enabled payments

$H12_0$: Compatibility has no impact on perceived usefulness towards the adoption of NFC-enabled payments

*Hypothesis 13*

$H13_A$: Social norms have a positive impact on perceived usefulness towards the adoption of NFC-enabled payments

$H13_0$: Social norms have no impact on perceived usefulness towards the adoption of NFC-enabled payments

*Hypothesis 14*

$H14_A$: Cost has a positive impact on perceived usefulness towards the adoption of NFC-enabled payments

$H14_0$: Cost has no impact on perceived usefulness factor towards the adoption of NFC-enabled payments

*Hypothesis 15*

$H15_A$: Reachability has a positive impact on perceived usefulness towards the adoption of NFC-enabled payments

$H15_0$: Reachability has no impact on perceived usefulness towards the adoption of NFC-enabled payments

*Hypothesis 16*

$H16_A$: NFC payment knowledge has a positive impact on perceived usefulness towards the adoption of NFC-enabled payments

$H16_0$: NFC payment knowledge has no impact on perceived usefulness towards the adoption of NFC-enabled payments

*Hypothesis 17*

$H17_A$: Personal innovation has a positive impact on perceived usefulness towards the adoption of NFC-enabled payments

$H17_0$: Personal innovation has no impact on perceived usefulness towards the adoption of NFC-enabled payments

*Hypothesis 18*

$H18_A$: Awareness has a positive impact on perceived usefulness towards the adoption of NFC-enabled payments

$H18_0$: Awareness has no impact on perceived usefulness towards the adoption of NFC-enabled payments

*Hypothesis 19*

$H19_A$: Intention to use has a positive impact on perceived usefulness towards the adoption of NFC-enabled payments

$H19_0$: Intention to use has no impact on perceived usefulness towards the adoption of NFC-enabled payments

### 3.9 Summary

Based on the literature surveys, a set of consumer adoption factors were identified. Based on those factors and using the TAM model, a conceptual framework was designed. This study has used both qualitative and quantitative data collection methods to analyze the adoption factors of consumers and service providers towards the NFC-enabled payments in Sri Lanka. Two interviews were conducted with selected two telecommunication companies to understand the service providers' adoption factors of NFC-enabled payments and to understand the customers' behaviors towards the NFC-enabled payments in Sri Lanka. Based on the results of the conducted interviews, a questionnaire was designed to be distributed among the consumers who are within the age group of 20-49 years. Data Analysis of the collected data from the survey is presented in the next chapter.

# 4. DATA ANALYSIS

Descriptive analysis was conducted to get a basic understanding of the collected data before moving to the comprehensive analysis of interview and survey data. Section 4.1 presents the data gathered from the interviews. Preparation of data is presented in Section 4.2. Section 4.3 focuses on the reliability analysis, while Section 4.4 illustrates the descriptive analysis. Section 4.5 presents the analysis of survey data using the structural equation model. Finally, Section 4.6 presents the chapter summary.

## 4.1 Data analysis of interview

Two major NFC service providers in the telecommunication sector were interviewed to understand the service providers' perspective on the adoption of NFC-enabled payments in Sri Lanka. These findings were also used to identify the types of questions to be included in the customer questionnaire.

Table 4.1 lists the profiles of the two representatives interviewed to gather the service providers' perspective. A set of interview questions given in Appendix A were given to the interviewees a day before the interview. During the interviews, information about NFC-enabled payment options currently available in Sri Lanka, strategies adopted by the providers to achieve the market potential, possible role of merchants in promoting NFC, major barriers to implement NFC-enabled payments, and feedback about increasing the adoption of NFC-based payment methods were gathered.

Table 4.1: Participant profile.

| | **Service provider 1** | **Service provider 2** |
|---|---|---|
| **Designation** | Senior Manager – IS Strategy & Customer Solutions | Manager-Enterprise Product Integration and Delivery Management-Enterprise Technology |
| **Customer base** | Island wide mobile users | Island wide mobile users |
| **Experience** | Around 19 years | Around 7 years |

Table 4.2 presents the different NFC-enabled payment services currently offered by the telecommunication service providers interviewed. As summarized in Table 4.2,

Service provider 1 offers NFC-enabled payment method such as fuel card, bus pass, and easy cash NFC-enabled payment services. In contrast, Service provider 2 provides fuel card and parking services. Based on the feedback, both service providers agreed that fuel card as the most successful services among the services they offer.

Table 4.2: NFC service types.

| | **Fuel Card** | **Travel card (Bus pass)** | **Money Transfer** | **Parking** |
|---|---|---|---|---|
| **Service provide 1** | × | × | × | |
| **Service provide 2** | × | | | × |

Table 4.3: Reasons for the success of fuel card NFC payment method.

| **Service provider** | **Service Provider 1** | **Service Provider 2** |
|---|---|---|
| **Advantages of Using NFC-Enabled Payments** | No paperwork<br>Auto-generate report<br>Fast and secured transaction<br>Tap and go mechanism<br>Single card<br>Operational efficiency<br>Cost reduction<br>SMS notification<br>Set Usage limit<br>Monitor activity | Convenience<br>Transparency<br>Management Analytics<br>Fraud reduction<br>Secured transaction |

Table 4.3 presents the reasons that led to the success of the fuel card NFC-enabled payment method. However, service provider 1 emphasized that the growth rate is low, and it is below the expected growth rate while the service provider 2 stressed that the growth rate is moderate. The factors that slow down the adoption of NFC-enabled payment services in the industry, as identified from the interview responses, are listed in Table 4.4.

Infrastructural issues were common to both service providers. Service provider 1 emphasized mainly on the government regulations and behavior of the government institutes. Further, the service provider 1 stated that not being a banking institute is also another reason that affects the growth of NFC-enabled payments.

Telecommunication industries have a different set of rules with regards to the financial transactions when compared to the banking institutes (e.g., maximum NFC-enabled transaction fee per day) and this could be one of the significant challenges for the service providers. Proper rules and regulations are not yet implemented especially for the NFC-enabled transactions. The service provider also emphasized the initial investment is needed to enable NFC-based payment methods. However, service provider 2 mainly focused on the human aspects, such as the mindset of consumers and the attitude of the merchants. Apart from that, the service provider highlighted the lack of stored-value card applications within the country.

Table 4.4: Factors slowing down the adoption of NFC-enabled payment services.

| | **Service Provider 1** | **Service Provider 2** |
|---|---|---|
| Government regulations | × | |
| Infrastructure issues | × | × |
| Behavior of the government institutes | × | |
| High initial investment | × | |
| Telecommunication company and not a bank | × | |
| Mind-set of consumers | | × |
| The attitude of the merchants (conductors) | | × |
| Lack of application for stored-value cards | | × |

According to the service providers, it is hard to see a significant market potential for NFC-enabled payment in the future because of the other competing technologies like QR codes. Moreover, the service provider further emphasized this is mainly due to the above-explained reasons presented in Table 4.4 for the slowness of the adoption towards the NFC-enabled payments. However, service provider 1 stated that there is a market potential for NFC technology, as new technologies take a considerable amount of time to adopt within countries like Sri Lanka.

*Strategies adopted by the service providers to achieve the market potential*

Service provider 1 has adopted a few strategies such as SMS campaigns, promotions, and service free for fuel cards (20% off service at service centers) to achieve a more significant market. However, service provider 2 had a different perception when it

comes to the strategies. Also, stated that NFC is a technology, and it is not a product. Hence, no strategies or promotional campaigns are organized from the service provider to promote this technology.

Table 4.5: Barriers to implementing NFC-enabled payments.

| | **User Level** | **Financial Institute Level** | **Technical Level** |
|---|---|---|---|
| **Service provider 1** | Trust<br>Security | Credit Limit | POS- power issues<br>Maintenance cost<br>Maintenance takes time |
| **Service provider 2** | Security | National level policy should be given<br>Proper regulations should be given on NFC payments | Security issues (hacking) |

Service providers were asked about the significant barriers that they encounter while implementing NFC-enabled payments under three sections, such as user level, financial institute level, and technical level barriers (see Table 4.5). According to Table 4.5 both service providers stated that consumers focus on the security aspect of the NFC-enabled payments; hence, security plays a significant barrier among users for the implementation of the NC enabled payments. When it comes to the financial institutes level barriers, service provider 2 emphasized that there should be national-level policy and regulations with regards to the NFC-enabled payments and financial institutes should join with the government and come up with a set of policies. Further, service provider 1 stated that the credit limit given in the NFC-enabled payments is considerably low and this will also have an impact on accepting this technology among the consumers. Service provider 1 stated that the POS power issues, maintenance cost, and the time taken to repair any POS terminals as technical level barriers while service provider 2 said that device hacking can be a significant technical problem.

*Bad experiences reported about NFC-enabled payments*

Service provider 1 stated that many of their consumers complained about the power issues in POS terminals, and many fuel stations do not have the POS terminals. Apart from that, a few consumers have complained about the cash limit of NFC-enabled

payments. Technical difficulties are the most frequent negative experiences reported by consumers to service provider 2.

Table 4.6: Feedback on increasing the adoption of NFC-based payment.

| **Service provider 1** | **Service provider 2** |
|---|---|
| One single card with parallel solutions | Banking license for telecommunication companies |
| Single POS for all service providers | More stored value applications |
| | Customer awareness |

Finally, service providers were asked to provide feedback to increase the adoption of NFC-enabled payment methods, as presented in Table 4.6. According to the perception of service provider 1expressed that one single card with multiple parallel solutions would help consumers, as they do not have to carry multiple cards for different services. The service provider 1 further explained that it would be much easier for merchants if they would have a single POS machine which accepts cards from all the service providers rather than having different machines for different service providers.

## 4.2 Preparation of data

The online survey was conducted between February 15, 2019 to April 14, 2019 during which 387 responses were received. First, the data cleansing process was conducted to ensure the accuracy of the collected data. Inaccurate data records had to be removed manually to ensure the accuracy level of the collected data set. Dataset was reduced to 380 after cleaning the inaccurate data records. Four records were removed due to mismatching answers given for two questions used to detect random answers, and three responses were deleted due to invalid data for some of the questions. Questions were measured using 5-points Likert scale having options from Strongly disagree, Disagree, Neither Agree nor Disagree, Agree, and Strongly agree. These responses were coded by assigning values 1, 2, 3, 4, and 5, respectively.

### 4.3 Reliability Analysis

The accuracy of the research questionnaire is assessed using Cronbach's Alpha value of the collected data. The variables of the study, which were created through the conceptual framework, were tested for Cronbach's Alpha value to ensure survey responses were reliable. Cronbach's Alpha is widely used to test the reliability of an instrument, and the rage from 0.7 to 0.95 is considered as the acceptable value of Alpha (Tavakol & Dennick, 2011). IBM SPSS Statistics 23 software was used to calculate the Cronbach's Alpha value of each question.

#### 4.3.1 Cronbach's Alpha value

The calculated Cronbach's alpha values for the mediating and independent variables are listed in Table 4.7 For the factor Awareness, only one question was asked to measure the awareness factor. Hence, no Cronbach's alpha was calculated. After considering Alpha coefficient values, it could be concluded that the data collected from the survey are reliable and consistent to analyze the data further. However, the variables such as Personal innovation and Intention to use have a considerably low Alpha coefficient value. Hence, the inter-item correlation has been calculated in the following section, which is another reliability test.

Table 4.7: Cronbach's alpha value of variables.

| Variables | Cronbach's Alpha |
|---|---|
| Perceived Ease of use (PEU) | 0.753 |
| Perceived Usefulness (PU) | 0.757 |
| Perceived Risk (PR) | 0.815 |
| Compatibility (COM) | 0.647 |
| Social Norms (SN) | 0.737 |
| Cost (COS) | 0.506 |
| Reachability (RE) | 0.751 |
| NFC payment knowledge (NPK) | 0.638 |
| Personal Innovation (PI) | 0.387 |
| Intention to use (ITU) | 0.304 |

#### 4.3.2 Inter-item Correlation

The inter-item correlation was calculated to check the reliability and consistency between different questions which were used to test the hypothesis of the study. Table 4.8 to 4.13 represent the inter-item correlation for each identified variables of the

study. According to the calculated inter-item correlation figures for the consumer adoption factors, it could be stated that the consumer adoption factors were positively correlated with the given dimensions.

Table 4.8: Inter-item correlation for perceived ease of use.

| | **Q5(i)** | **Q5(ii)** | **5(iii)** | **5(iv)** | **5(v)** | **5 (vi)** |
|---|---|---|---|---|---|---|
| I am comfortable in performing NFC-based payments 5 (i) | 1.000 | 0.585 | 0.416 | 0.530 | 0.284 | 0.208 |
| With NFC making a payment is so simple 5 (ii) | 0.585 | 1.000 | 0.615 | 0.523 | 0.158 | 0.160 |
| Easy to register for different services 5 (iii) | 0.416 | 0.615 | 1.000 | 0.521 | 0.343 | 0.263 |
| NFC payments are hassle free 5 (iv) | 0.530 | 0.523 | 0.521 | 1.000 | 0.355 | 0.363 |
| Errors or mistakes can be easily resolved 5 (v) | 0.284 | 0.158 | 0.343 | 0.355 | 1.000 | 0.216 |
| NFC payments fit well with my lifestyle 5 (vi) | 0.208 | 0.160 | 0.263 | 0.363 | 0.216 | 1.000 |

Table 4.9: Inter-item correlation for perceived usefulness.

| | **6 (ii)** | **6 (iii)** | **6 (iv)** | **6 (v)** |
|---|---|---|---|---|
| I can easily track transactions made via NFC payments 6 (ii) | 1.000 | 0.404 | 0.497 | 0.136 |
| Compared to other payment options (e.g., cash, mobile), NFC payments are hassle free 6 (iii) | 0.404 | 1.000 | 0.671 | 0.505 |
| NFC payments are faster than other payment options 6 (iv) | 0.497 | 0.671 | 1.000 | 0.454 |
| I am more likely to use a NFC-based pre-paid card, if it gives interest on my money 6 (v) | 0.136 | 0.505 | 0.454 | 1.000 |

Table 4.10: Inter-item correlation for compatibility.

| | **5 (vii)** | **5 (viii)** | **5 (ix)** |
|---|---|---|---|
| NFC payments fit well with my lifestyle | 1.000 | 0.188 | 0.421 |
| Existing payment platforms support NFC-enabled payments | 0.188 | 1.000 | 0.526 |
| NFC-enabled payments are compatible with other payment methods | 0.421 | 0.526 | 1.000 |

Table 4.11: Inter-item correlation for social norms.

| | **8 (i)** | **8 (ii)** | **8 (iii)** | **8 (iv)** |
|---|---|---|---|---|
| I see many people in social media using NFC-enabled payments | 1.000 | 0.359 | 0.350 | 0.278 |
| People around me recommend NFC payment methods | 0.359 | 1.000 | 0.513 | 0.360 |
| My employer encourages me to use NFC-enabled payments | 0.350 | 0.513 | 1.000 | 0.617 |
| Government encourages to use NFC payments | 0.278 | 0.360 | 0.617 | 1.000 |

Table 4.12: Inter-item correlation for cost.

| | **Q9(i)** | **Q9(ii)** | **Q9(iii)** | **Q9(iv)** |
|---|---|---|---|---|
| Registration fees of NFC-enabled payment methods are reasonable | 1.000 | 0.114 | 0.218 | 0.025 |
| NFC-based payment options are costly compared other mobile-based payment methods | 0.114 | 1.000 | 0.327 | 0.210 |
| My merchant charges additional fee/commission if I use NFC to pay | 0.218 | 0.327 | 1.000 | 0.303 |
| It's expensive to replace an NFC card if lost or broken | 0.025 | 0.210 | 0.303 | 1.000 |

Table 4.13: Inter-item correlation for perceived risk.

| | 7(i) | 7(ii) | 7(iii) | 7(iv) | 7(v) | 7(vi) | 7(vii) | 7(viii) | 7(ix) | 7(x) | 7(xi) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| I believe NFC-based payments are more secure | 1.000 | 0.667 | 0.131 | 0.368 | 0.479 | 0.157 | 0.107 | 0.436 | 0.556 | 0.085 | -0.014 |
| I can trust the NFC technology | 0.667 | 1.000 | 0.186 | 0.215 | 0.544 | 0.322 | 0.175 | 0.513 | 0.706 | 0.130 | -0.049 |
| I'm concerned about the privacy while performing NFC-based payments | 0.131 | 0.186 | 1.000 | 0.585 | 0.343 | 0.498 | 0.348 | 0.097 | 0.256 | 0.459 | 0.157 |
| I trust NFC payments backed by financial institutes than 3rd-party companies | 0.368 | 0.215 | 0.585 | 1.000 | 0.487 | 0.356 | 0.226 | 0.151 | 0.309 | 0.289 | 0.142 |
| I can trust my NFC service provider | 0.479 | 0.544 | 0.343 | 0.487 | 1.000 | 0.340 | 0.221 | 0.437 | 0.595 | 0.294 | 0.108 |
| I like the concept of "Never Leave My Hand " while paying | 0.157 | 0.322 | 0.498 | 0.356 | 0.340 | 1.000 | 0.476 | 0.045 | 0.302 | 0.315 | 0.381 |
| I don't have to disclose credit card or pin no | 0.107 | 0.175 | 0.348 | 0.226 | 0.221 | 0.476 | 1.000 | -0.064 | 0.158 | 0.151 | 0.094 |
| I am comfortable to give my credit card to merchant | 0.436 | 0.513 | 0.097 | 0.151 | 0.437 | 0.045 | -0.064 | 1.000 | 0.514 | 0.121 | 0.190 |
| I believe NFC payments are generally secure | 0.556 | 0.706 | 0.256 | 0.309 | 0.595 | 0.302 | 0.158 | 0.514 | 1.000 | 0.257 | 0.118 |
| I'm worried about losing my money if the card is lost | 0.085 | 0.130 | 0.459 | 0.289 | 0.294 | 0.315 | 0.151 | 0.121 | 0.257 | 1.000 | 0.373 |
| I have heard negative stories about security of NFC payments | -0.014 | -0.049 | 0.157 | 0.142 | 0.108 | 0.381 | 0.094 | 0.190 | 0.118 | 0.373 | 1.000 |

Table 4.14: Inter-item correlation for reachability.

| | Q5(x) | Q5(xi) |
|---|---|---|
| Most places I shop accept NFC-based payments | 1.000 | 0.613 |
| NFC recharge centers are easier to find | 0.613 | 1.000 |

Table 4.15: Inter-item correlation for NFC payment knowledge.

| | Q4 | Q3 |
|---|---|---|
| What type of NFC-based payment options you have used | 1.000 | 0.471 |
| What types of NFC-based payment options do have access to | 0.471 | 1.000 |

Table 4.16: Inter-item correlation for personal innovation.

| | Q1 | Q10 |
|---|---|---|
| How frequently do you perform payments via your mobile phone | 1.000 | 0.257 |
| I like to try a new product or service | 0.257 | 1.000 |

Table 4.17: Inter-item correlation for awareness.

| | 6 (i) |
|---|---|
| Many services accept NFC-based payments | 1.000 |

Table 4.18: Inter-item correlation for intention to use.

| | Q11 | Q6(vi) |
|---|---|---|
| I plan to use NFC payment methods to do transactions in the near future | 1.000 | 0.180 |
| I am more likely to use an NFC-based card if it is multi-purpose (e.g., bus tickets, parking, train, & high-way tolls) | 0.180 | 1.000 |

Based on the Cronbach's alpha values and the positive inter-items correlation between the questions, it was decided to continue the data analysis considering the data set is reliable for further analysis.

### 4.4 Descriptive Analysis

Descriptive analysis was conducted to identify the basic understanding of the collected data before moving to the comprehensive analysis. This section describes the demographic data analysis of the collected survey.

#### 4.4.1 Age

Figure 4.1 illustrates the age group distribution of the participants. Majority of the respondents belong to the age group 25-34, which is calculated as 74% in figure 4. Respondents belonging to the age group 35-49 are 20%, and the age group 20-24 years

is calculated as 6%. During the data cleansing process, participants who belong to the age group 50-64 years were removed due to the invalid data records. No participants between the age group 65 and above have contributed to the survey. Hence, those two age groups were removed. There is less contribution from the age group 20-24 years to the survey.

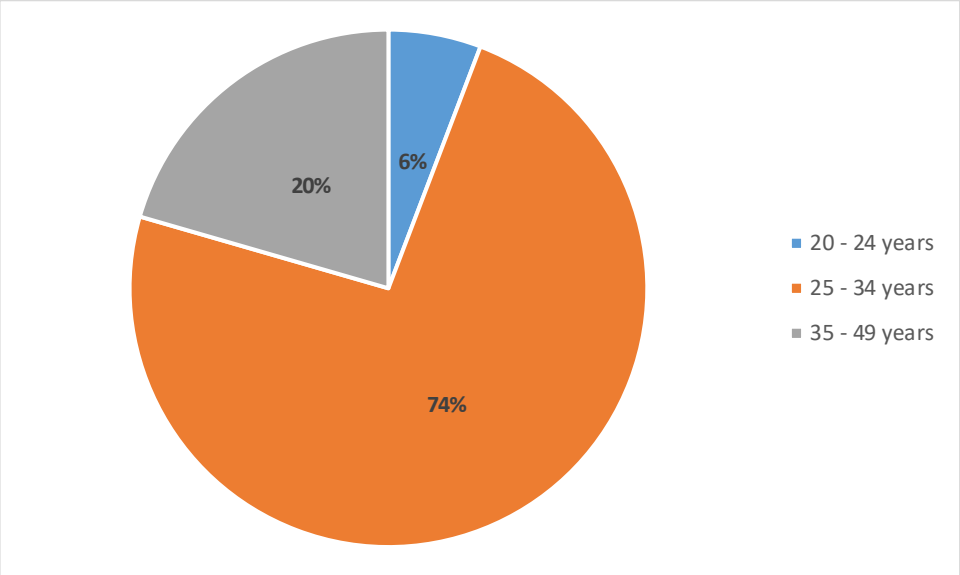


Figure 4.1: Age group of survey respondents.

### 4.4.2 Gender

Based on gender, most of them were male respondents among the total respondents who filled the survey, which is calculated as 59%. However, the female contribution is also considerably high, which is 41%.

### 4.4.3 Geographical location

According to the bar graph in Figure 4.2, majority of the respondents (318) were from Colombo. 35 respondents were from Gampaha, and 13 were from the Galle district. The geographical location could have a considerable amount of impact on the outcome of this study because of the awareness of the NFC technology within these locations. One could argue that the sample is biased towards the Western province.

### 4.4.4 Occupation

When we consider the occupation of the respondents, from Figure 4.3 we can see that most of the respondents were from the Information Technology (IT) sector. There were 23 respondents from the management sector. Respondents from Science, Finance and insurance, Health care and social assistance, Educational services, and Administrative sectors have equally contributed to this study. It could be argued that respondents who are in the IT sector are more likely to respond to surveys related to technologies.

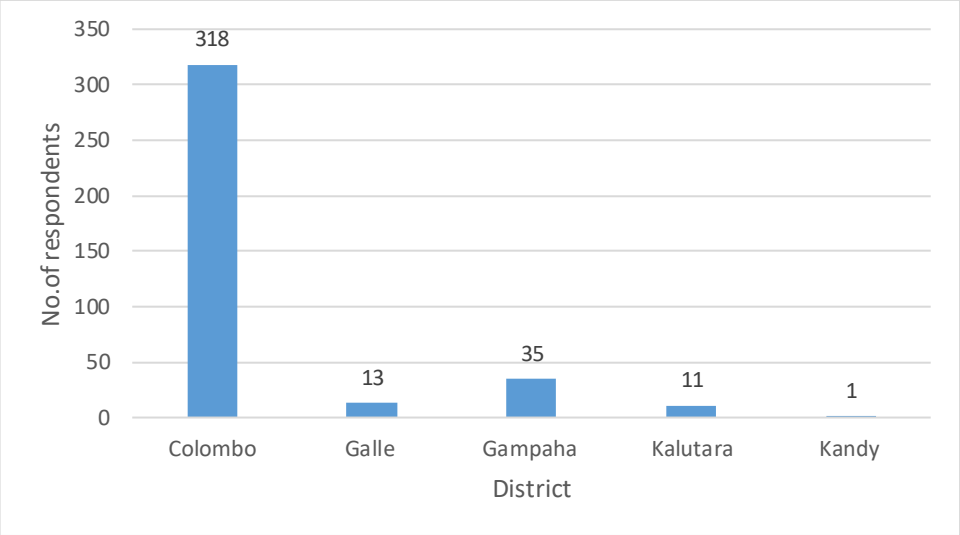


Figure 4.2: Geographical location of the respondents.

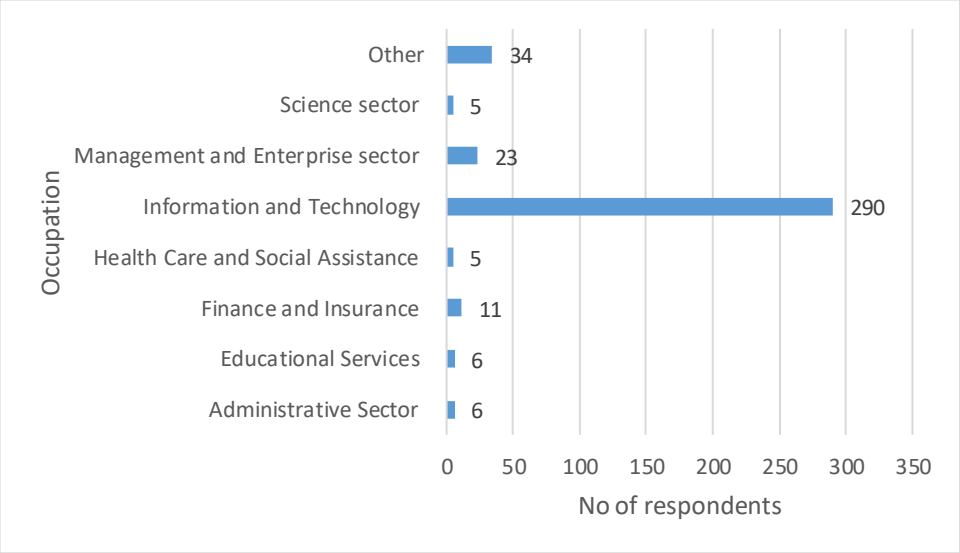


Figure 4.3: Occupation of the respondents.

### 4.4.5 Familiarity on NFC-enabled payments

From the information given in Figure 4.5 among the responses, half of the respondents are little familiar, familiar, or very familiar about the NFC-enabled payments, which is calculated altogether as 50%. This could be still seen as a low figure who knows about the NFC-enabled payments in the country. Nearly one-fourth of the respondents are neutral about the NFC-enabled payments, and 16% of them are not familiar with NFC-enabled payments. This shows that half of the respondents have at least a little idea about the NFC-enabled payments.

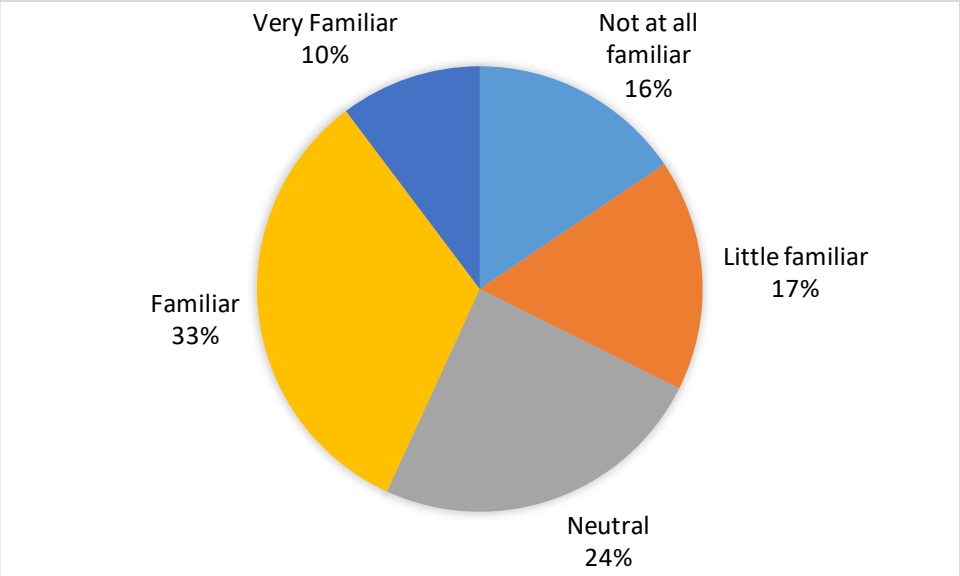


Figure 4.4: Familiarity of NFC-enabled payments.

According to Figure 4.3, most of the participants are from the IT sector. Figure 4.5 further analyses that among the IT sector respondents the familiarity about NFC-enabled payment options. It is clear from the graph only 15% respondents from IT sector do not know about the NFC-enabled payment option. Only 6% of respondents are very familiar about NFC -enabled payments, while 35% is familiar about NFC.24% of the respondents have reported that they are neutral about the NFC-enabled payment option.

### 4.4.6 Available NFC-enabled payment options

According to Figure 4.6, it is evident that the most popular type of NFC-enabled payment option of respondents has access to NFC-enabled credit and debit cards which is calculated as 178 out of 380. Apart from that, a considerable number of respondents have access to fuel cards, and both credit cards and bus passes too. The reason for having fuel card is that the private companies provide fuel allowance through NFC-enabled payment cards. Among the respondents, 89 have responded that they do not have access to any of the NFC-enabled payment options. However, the number of respondents who use bus pass and fuel cards are considered as a very-low figure among the overall responses.

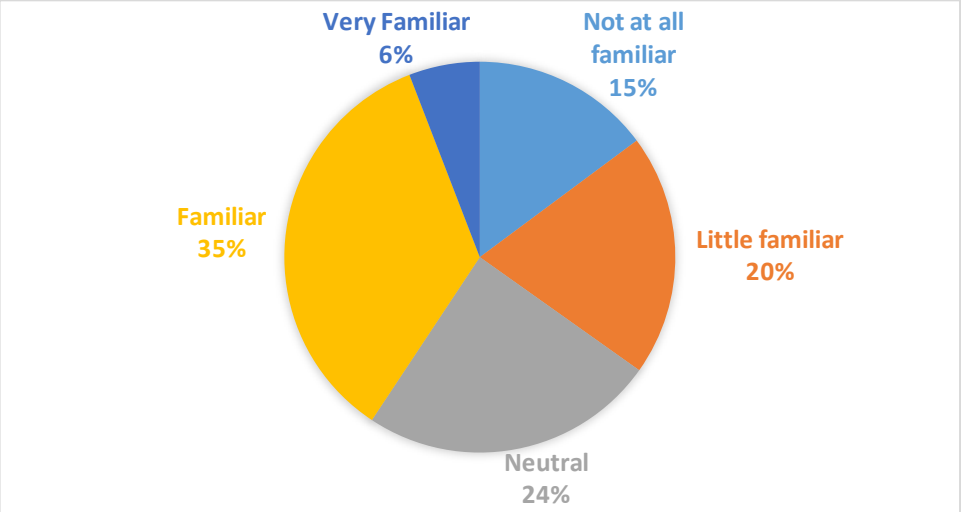


Figure 4.5: NFC-enabled payments familiarity of IT sector respondents.

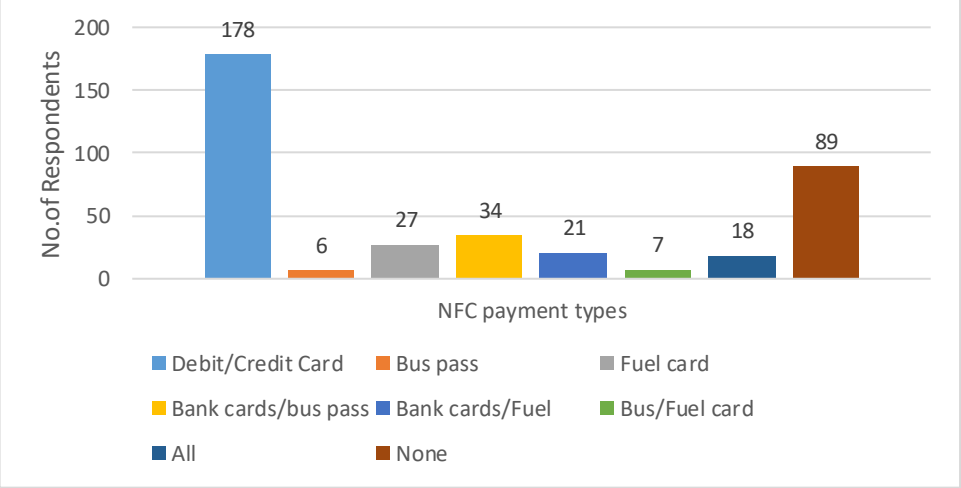


Figure 4.6: Types of NFC-enabled options having access to.

### 4.4.7 Types of NFC-enabled payments that have been used

It can be seen from Figure 4.7 that all the respondents who have access to bus cards have used NFC-enabled bus passes as is the usage calculated as 100%. Most of the respondents who have access to fuel cards also have used, which is calculated as 96.3%. It is a surprise to see that among the respondents who have access to both bus pass and fuel cards, 85.7% of them have used both the NFC-enabled payment options. It seems like they use NFC-enabled payment cards when they do not use their private vehicle. Respondents who have access to the combination of bank cards and bus pass and bank cards and fuel cards, the majority of them use both bank cards and fuel cards which is calculated as 52.4%. There is a small percentage of respondents who has used all the NFC-enabled options, which is calculated as 33.3%.

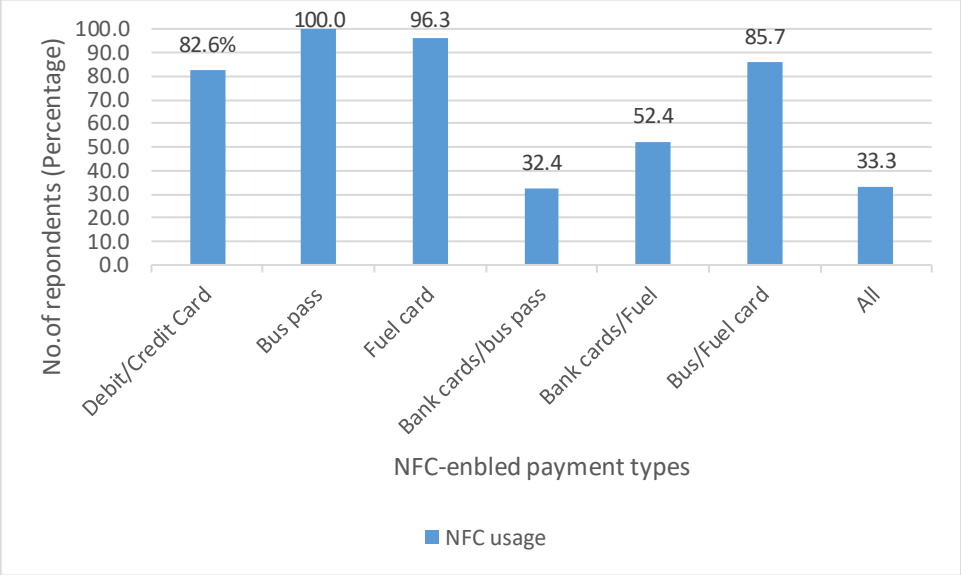


Figure 4.7: NFC-enabled payment usage.

Figure 4.8 further illustrates through a bar graph about the usage of NFC-enabled payments among the people who have access to different types of NFC-enabled payment options such as bank cards, bus pass and fuel cards. It shows from Figure 4.9 that majority of the respondents have access to bank cards, and the usage is also high. Respondents who have access to other types of NFC-enabled payments are considerably low when compared to the access and usage of NFC-enabled bank cards.

### 4.4.8 Frustrating experiences on NFC-enabled payments

Figure 4.9 illustrates that the majority has given neutral about the frustrating experiences on NFC-enabled payments. Among the respondents, ten respondents have frustrating experiences on NFC-enabled payments. Apart from them, 132 respondents have told that they do not have any frustrating experiences related to NFC-enabled payments.

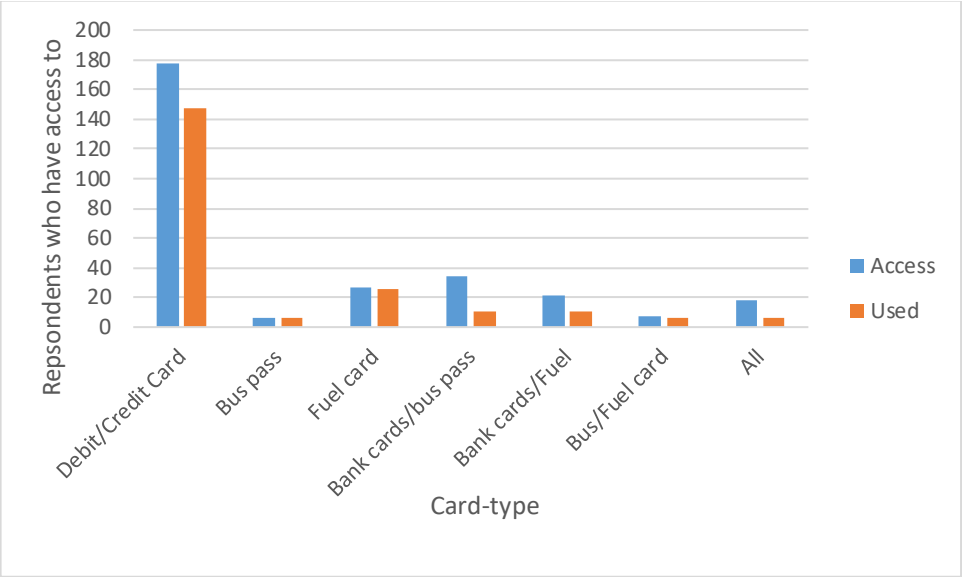


Figure 4.8: NFC-enabled payment options having access to vs usage.

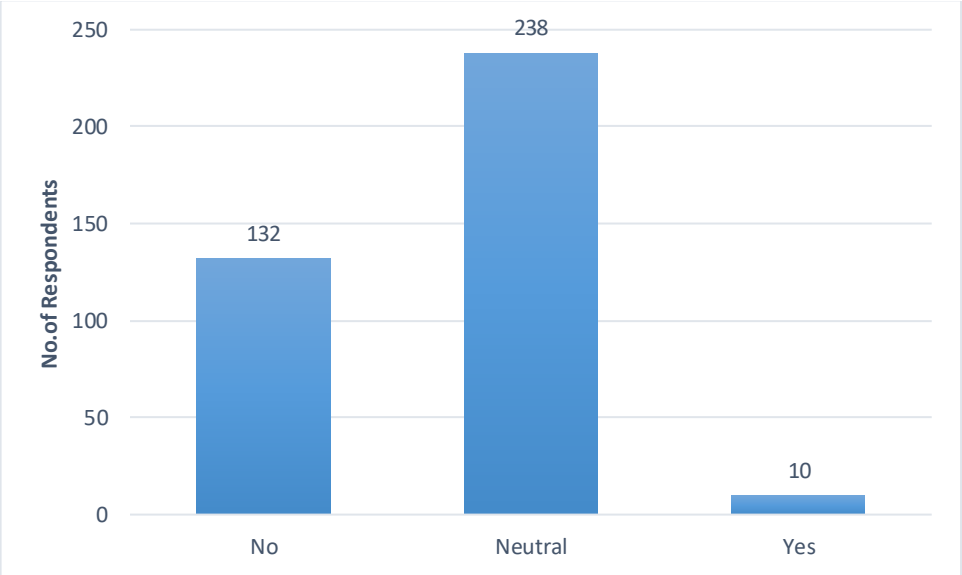


Figure 4.9: Frustrating experiences on NFC-enabled payment payments.

Based on the survey data, one respondent has reported saying the reason for the frustration is that the supermarket did not have NFC payment option. The common frustration reasons among bus pass users and the fuel card users are no POS machines, and the card did not work.

Reasons for the frustration experiences have been coded as follows:

- No POS machines
- The merchant did not know about NFC payment option
- Card did not work
- Supermarkets did not have NFC payment option

### 4.5 Data Analysis Using Structural Equation Modelling

The hypothesis of this study has been tested using the multiple regression model by calculating the path coefficient between independent and dependent variables. The *p*-value has been calculated to test the hypothesis, and it represents the probability of whether to reject the null hypothesis. The null hypothesis should be rejected when the p-value is lower and should accept the alternative hypothesis. This study contains complex dependencies among mediating variables, independent variables, and dependent variables. Hence, it was suggested to use structured Equation Modelling (SEM) approach for the data analysis of this study.

SEM model is also named as linear structural relations as the relations are developed by linear regression equations, which could also be represented through path diagrams with the use of arrows (Nachtigall et al., 2003). SEM deals with multiple linear regression equations. SEM approach contains two methods based on the covariance and variance. The covariance-based technique can be used when the sample size is large, and the data are distributed evenly. Partial Least Square (PLS) comes under the variance model. It can be best used when the sample size is small, identified relationships in the conceptual diagram are uncertain, and little available theory on the application (Kay-Wong, 2013).

After considering all the facts, SEM PLS approach has been used in this study. WarpPLS software was used to find the PLS between the identified variables. The

WarpPLS software used to test the hypothesis offers algorithms such as Warp 3 PLS regression and PLS regression. WarpPLS software uses "Warp 3" algorithm to calculate the inner model analysis while "PLS regression" has been used to calculate the outer model. The WarpPLS software provides beta values, *p* values and $R^2$ values. Beta coefficient (β) is another term used for the path coefficient in PLS of SEM model.

SEM model consists of two models, namely the inner model and outer model. The inner model can be explained as the relationship between the variables which creates the model while outer model is described as the relationship between the variables and its indicators.

Figure 4.10 represents the results diagram of the SEM analysis, which was calculated by the WarpPLS software based on the survey data. Consumer adoption factors are indicated in an oval shape. Path coefficient β and value are calculated. Multiple regression value is also calculated. As seen in Figure 4.11, the inner model represents the relationship between the adoption factor and the mediating factors (PEU → ADOP andPU → ADOP ). In contrast, the outer model represents the relationship among mediating factors and independent factors, for example, COMP → PEU.

It is essential to assess whether the collected data fits the model. Hence, it is important to calculate the model fit the values of the chosen model in the study against the collected survey data. The selected software provides mainly ten model fit, and quality indices and these indices were automatically calculated by the software. The ten foremost model fit and quality indices are; Average path coefficient (APC), Average R-squared (ARS), Average adjusted R-squared (AARS), Average block VIF (AVIF), Average full collinearity VIF (AFVIF), Tenenhaus GoF (GoF), Sympson's paradox ratio (SPR), R-squared contribution ratio (RSCR), Statistical suppression ratio (SSR) and Nonlinear bivariate causality direction ratio (NLBCDR). Moreover, it is recommended that the *p*-value for the model fit and quality indices APC, AARS, and ARS is lower than or equal to 0.05, which shows the goodness of the model fit. Table 4.19 shows the list of calculated values for the model fit and quality indices.

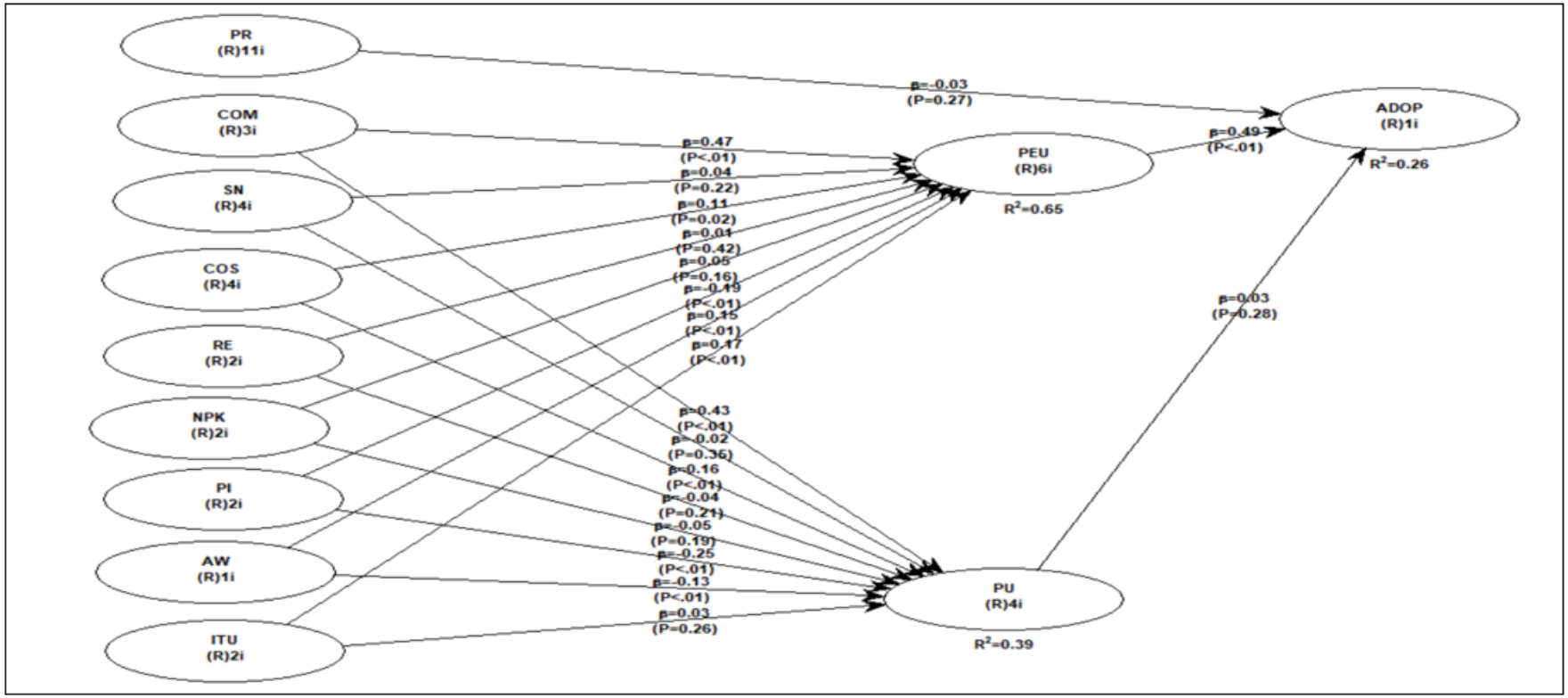


Figure 4. 10: Results of the SEM analysis.

Table 4.19: Model fit and quality indices.

| Model fit index | Accepted value | Calculated value | Result |
|---|---|---|---|
| P value of APC | Lower than or equal to 0.05 | P<0.001 | Satisfied |
| P value of APS | Lower than or equal to 0.05 | P<0.001 | Satisfied |
| P value of AARS | Lower than or equal to 0.05 | P<0.001 | Satisfied |
| AVIF | acceptable if <= 5, ideally <= 3.3 | 1.549 | Satisfied |
| AFVIF | acceptable if <= 5, ideally <= 3.3 | 2.274 | Satisfied |
| GoF | small >= 0.1<br>medium >= 0.25<br>large >= 0.36 | 0.529 | Satisfied |
| SPR | acceptable if >= 0.7, ideally = 1 | 0.789 | Satisfied |
| RSCR | acceptable if >= 0.9, ideally = 1 | 0.945 | Satisfied |
| SSR | acceptable if >= 0.7 | 1.000 | Satisfied |
| NLBCDR | acceptable if >= 0.7 | 0.921 | Satisfied |

### 4.5.1 Hypothesis testing

Table 4.20 indicates the beta value, p-value, and $R^2$ values retrieved from the WarpPLS software. Based on this analysis, the following conclusions can be derived about the hypothesis developed in Section 3.8.

*Hypothesis 1*

Based on the values received for path coefficient and *p*-value, it can be concluded that the perceived ease of use has a positive impact on the adoption of NFC-enabled payments.

*Hypothesis 2*

According to the calculated values for path coefficient and *p*-value, it can be concluded that the perceived usefulness does not have a positive impact on the adoption of NFC-enabled payments.

*Hypothesis 3*

Due to the negative value retrieved for path coefficient, it can be concluded that the perceived risk does not have a positive impact on the adoption of NFC-enabled payments.

Table 4.20: Hypothesis testing.

| **Relationship** | **Path Coefficient (β value)** | **P value** | **$R^2$ value** | **Result** |
|---|---|---|---|---|
| PEU → ADOP | 0.49 | <0.001 | 0.26 | Acceptable |
| PU → ADOP | 0.03 | 0.28 | | Not acceptable |
| PR → ADOP | -0.03 | 0.27 | | Not acceptable |
| COM → PEU | 0.47 | <0.001 | 0.65 | Acceptable |
| SN → PEU | 0.04 | 0.22 | | Not acceptable |
| COS → PEU | 0.11 | 0.02 | | Not acceptable |
| RE → PEU | 0.01 | 0.42 | | Not acceptable |
| NPK → PEU | 0.05 | 0.16 | | Not acceptable |
| PI → PEU | -0.19 | <0.001 | | Not acceptable |
| AW → PEU | 0.15 | <0.001 | | Acceptable |
| ITU → PEU | 0.17 | <0.001 | | Acceptable |
| COM → PU | 0.43 | <0.001 | 0.39 | Acceptable |
| SN → PU | -0.02 | 0.35 | | Not acceptable |
| COS → PU | 0.16 | <0.001 | | Acceptable |
| RE → PU | -0.04 | 0.21 | | Not acceptable |
| NPK → PU | -0.05 | 0.19 | | Not acceptable |
| PI → PU | -0.25 | <0.001 | | Not acceptable |
| AW → PU | -0.13 | <0.001 | | Not acceptable |
| ITU → PU | 0.03 | 0.26 | | Not acceptable |

*Hypothesis 4*

According to the calculated values for path coefficient and *p*-value, it can be concluded that the compatibility has a positive impact on perceived ease of use towards the adoption of NFC-enabled payments.

*Hypothesis 5*

Because of the values received for path coefficient and *p*-value, it is concluded that the social norms do not have a positive impact on perceived ease of use towards the adoption of NFC-enabled payments.

*Hypothesis 6*

Based on the analytics, the values calculated for path coefficient and *p*-value, it is concluded that the cost does not have a positive impact on perceived ease of use towards the adoption of NFC-enabled payments.

*Hypothesis 7*

According to the values retrieved for the path coefficient and *p*-value, it is concluded that the reachability does not have a positive impact on perceived ease of use towards the adoption of NFC-enabled payments.

*Hypothesis 8*

Based on the results calculated path coefficient and *p*-value, it can be taken as the NFC-payment does not have a positive impact on the perceived ease of use.

*Hypothesis 9*

Because of the negative value retrieved for the path coefficient, it can be concluded that personal innovation does not have a positive impact on perceived ease of use towards the adoption of NFC-enabled payments.

*Hypothesis 10*

By looking at the values received for path coefficient and *p*-value, it is stated that awareness has a positive impact on perceived ease of use towards the adoption of NFC-enabled payments.

*Hypothesis 11*

When considering the values retrieved for path coefficient and *p*-value, it can be taken as the intention to use has a positive impact on perceived ease of use.

*Hypothesis 12*

According to the calculated values for path coefficient and *p*-value, it can be concluded that the compatibility has a positive impact on perceived usefulness towards the adoption of NFC-enabled payments.

*Hypothesis 13*

Based on the values calculated for path coefficient and *p* value, it is stated that the social norms do not have a positive impact on perceived usefulness towards the adoption of NFC-enabled payments.

*Hypothesis 14*

Looking at the values retrieved for path coefficient and *p*-value, it can be concluded that the cost has a positive impact on perceived usefulness towards the adoption of NFC-enabled payments.

*Hypothesis 15*

According to the statistical values retrieved for path coefficient and p-value, it is concluded that the reachability does not have a positive impact on perceived usefulness towards the adoption of NFC-enabled payments.

*Hypothesis 16*

Based on the values received for the path coefficient and p-value, it is concluded that the NFC-enabled payment knowledge does not have a positive impact on perceived usefulness towards the adoption of NFC-enabled payments.

*Hypothesis 17*

Because of the negative value retrieved for path coefficient, it is stated that personal innovation does not have a positive impact on perceived usefulness towards the adoption of NFC-enabled payments.

*Hypothesis 18*

Due to the negative value calculated for path coefficient, it can be concluded that the awareness does not have a positive impact on perceived usefulness towards the adoption of NFC-enabled payments.

*Hypothesis 19*

According to the values calculated for path coefficient and p-value, it is stated that the intention to use does not have a positive impact on perceived usefulness towards the adoption of NFC-enabled payments.

### 4.5.2 Descriptive Analysis

At the end of the consumer questionnaire, there was an open-ended question asked from the respondents. Data were coded to extract the essential points, and these extracted data has been analyzed into a pie chart. Overall, 96 respondents had answered for the open-ended questionnaire out of the 380 participants. According to Figure 4.11, majority of the respondents are not aware of the available services within the country. It is surprising to see that only 6 respondents have a concern about the security and the privacy of this application. Respondents have also not seen any advertisements or promotional activities with regards to the NFC-enabled payment services. It is a good sign to see that 15 out of 96 respondents have an interest in using the NFC-enabled payment options in the future.

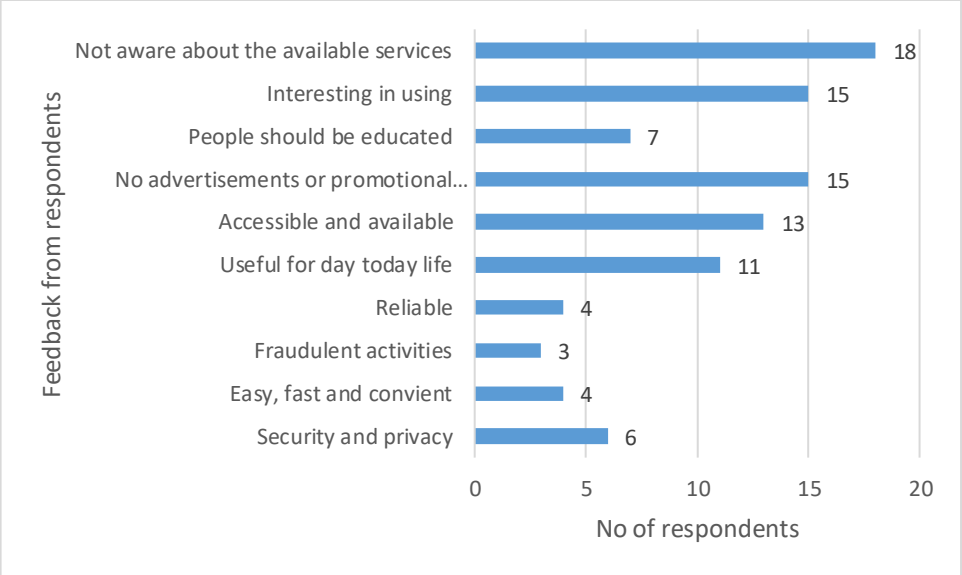


Figure 4.11: Perception of NFC-enabled payment methods.

### 4.6 Summary

This chapter focused on the detailed analysis of the gathered data through the customer survey and interviews. SEM model has been used to test the identified variables and based on the SEM results; perceived ease of use can be considered to have a positive impact on the NFC adoption. Moreover, compatibility, awareness, and intention to use have a positive effect on the perceived ease of use. Service providers' adoption factors were identified after the analysis of interview data.

# 5. CONCLUSION

This chapter focuses on the conclusions based on the results derived from the demographic and statistical analysis. Further, it examines the limitations of this study as well as future research directions. Section 5.1 presents a summary of this study based on the results derived from the data analysis. Section 5.2 presents the recommendations to improve the adoption towards NFC-enabled payment services in Sri Lanka from the consumers' and service providers' perspective. Research limitations and future research directions are presented in Section 5.3 and 5.4, respectively.

## 5.1 Summary

The main objective of this research is to find the factors affecting the slow adoption of NFC-enabled payment services from Sri Lankan consumers' and the service providers' perspective. Consumers' adoption factors were identified by engaging in a literature review. Then an interview was conducted with service providers in the telecommunication industry to examine the service providers' perspective on the slow adoption of the NFC-enabled payments. Based on the interview results, a questionnaire was developed and distributed among the consumers. Structure Equation Modeling (SEM) was used to analyze the data gathered through the questionnaire.

Among the respondents, 50% were little familiar, familiar or very familiar with the NFC-enabled payment services, which is a justifiable figure to continue this research as the majority of the population in the country still utilizes cash and/or card payments for their daily transactions. Moreover, 74% of the respondents belonged to the age group of 25-34 years. However, the data gathered in terms of geographical location and occupation was mainly from Colombo and the IT sector. It could be contended in support of the above finding that NFC-enabled payment methods are mostly available in the city of Colombo and that people who are actively engaged with the field of IT would embrace new technologies as a result of which are more interested in answering questionnaires relating to new technologies. The findings further revealed that 15% of the respondents from the IT sector did not have any idea about NFC-enabled payment

methods, while 24% were neutral about the idea of the NFC-enabled payment services. Conspicuously, even though half of the respondents have claimed that they were not familiar with the idea of NFC-enabled payment methods, only 89 out of 380 respondents have responded that they do not have access to such payment types. In view of the above, it is concluded that consumers are more familiar with the name of the service type than the name of the technology using which such service is created. For example, the term 'fuel card' as a payment method is familiar than the payment technology, which is NFC.

The identified types of NFC-enabled payments are debit/credit cards, bus passes, and fuel cards. Unfortunately, only 18 respondents have had access to all three types of NFC-enabled payment service, and only 6 have access to bus passes while 27 have had access to fuel cards. This is indicative of the slow adoption of NFC-enabled payment services in Sri Lanka. The most famous NFC-enabled payment service among the respondents is bank cards and fuel cards. All the respondents who have had access to NFC-enabled bus passes have used such passes. Among the respondents who have had bank cards, 82.6% of respondents have used, while 96.3% of users have used fuel cards. All the respondents have used the bus pass, which is a good sign.

Ten respondents have had frustrating experiences with NFC-enabled payments. The reasons for the said frustrating experiences can be noted as follows: unavailability of POS machines, the merchant did not know about NFC payment option, the card did not work, and merchants did not have NFC payment option. The respondents who have used bank cards had provided the reason for the frustration to be the supermarkets not having NFC payment option and merchant not knowing about NFC payment option, while respondents who have used bus cards and fuel cards had noted the unavailability of POS machines and card not effectively functioning to be the reasons behind frustrating experiences.

Based on the data gathered through interviews conducted to find the perspective of service providers towards NFC-enabled payment methods, the current available NFC-enabled payment methods are fuel cards, bus passes, easy cash, meal cards and parking cards. Nevertheless, according to the data gathered through the questionnaire, the popular NFC payment types are bank cards, fuel cards and bus passes. Thus, service

providers should focus on promoting and improving the remaining available NFC payment methods such as easy cash, meal cards and parking cards. Furthermore, it was the conception of service providers that the fuel card was the most successful NFC-enabled payment option up to date. According to the findings of the questionnaire, fuel card usage is higher than the bus pass usage, thereby supporting the service providers' abovementioned statement.

Data gathered through the questionnaire was statistically analyzed to test the developed hypothesis. Hypothesis were tested using the multiple regression model by calculating the path coefficient between the identified variables. Multiple regression was also calculated to determine variables' positive impact towards the NC-enabled payments.

After analyzing the data, the respondents have a main concern on using NFC-enabled payment method without putting any effort. This could be explained as the comfortableness of performing the NFC payment, how simple is to make payment using NFC payment method, the easiness of registering to different NFC-enabled payment options, whether the NFC-enabled payment are hassle-free, how can easily be resolved if there is an error or mistake in the payment and how NFC-enabled payments fit well with their lifestyles. In support of the above contention, it can be further observed that only 7% of respondents have answered the open-ended question in the questionnaire stating that NFC-enabled payments are fast, easy, and convenient. Hence, it is concluded that the perceived ease of use factor (Hypothesis 1) has a positive impact on the adoption of NFC-enabled payments. Further, Li, Liu, and Heikkilä (2014) and of Pal, Vanijja, and Papasratorn (2015) have also stated that the perceived ease of use is an essential factor for user adoption of NFC-enabled mobile payments.

Respondents do not have a concern on the perceived usefulness factor as they do not focus on the easiness of tracking NFC payments, hassle freeness compared to other payment methods, and how fast they can make the payment. Due to this perceived usefulness does not have a positive influence towards the adoption of NFC-enabled payments. However, Pal, Vanijja, and Papasratorn (2015) emphasized that perceived usefulness is a strong predictor for NFC-enabled usage among consumers.

Conspicuously, security risk and privacy risk are not significant concerns of the respondents relating to NFC-enabled payments. Accordingly, the respondents appear to be less focused on how secured the payment is, trustiness of the NFC technology, payment privacy, security concerns on the service provider and losing the NFC-enabled payment card. However, based on the data received from service providers, the main user-level concern is on security and trust with regards to NFC-enabled payment methods. Given the above, it could be contended that consumers generally do not have any concern NFC-enabled payments. Hence, the perceived risk does not have a positive impact on the adoption of NFC-enabled payments.

These findings highlight the importance of the compatibility factor, which demonstrates how NFC-enabled payment methods are compatible with the lives of consumers. The data indicated that the respondents shared concern on how NFC-enabled payments fit with their lifestyles, existing platforms support NFC-enabled payments and the compatibility of the NFC payments with other payment methods. As per the analysis, compatibility has a direct positive impact on the perceived ease of use and an indirect positive impact on the adoption of NFC-enabled payment via perceived ease of use. Therefore, compatibility has a significant positive impact on the perceived ease of use, even though it does not have any positive usefulness.

Social norms do not have a direct impact on either perceived usefulness or perceived ease of use. According to research findings, it can be concluded that the consumers are not affected by the services and technologies that are used by people or friends around them. However, studies of Khan and Alshare (2015) explain that social influence is a deciding factor with regards to the intention of the younger population to use mobile payments.

The cost factor plays a significant role as the cost has a direct impact only on perceived usefulness and not on perceived ease of use. Cost is explained in terms of the registration fee, payment fee, merchant fee and NFC card replacement cost. It could be observed that consumers have a concern about the cost of the NFC-enabled payment, and they determine the usefulness of the NFC-enabled payment option by considering the amount of cost they must bear. Furthermore, service providers have emphasized that consumers generally complain about the cash limit of current NFC-

enabled payment services. The said cash limitation is only imposed on non-bank cards. Hence, telecommunication service providers face a more significant challenge with regards to the cash limit. To mitigate this challenge, one of the service providers has introduced a financial unit, especially for the payment services. Nevertheless, the practicality of the said solution could be contested since consumers take time to be familiar with the financial units of telecommunication companies.

The survey findings do not support any contention on reachability, NFC payment knowledge and personal innovation to use NFC-enabled payment methods. These factors have a direct positive impact neither on perceived ease of use nor perceived usefulness. Hence, these factors can be safely eliminated in the adoption of NFC-enabled payment methods. However, service providers stated that consumers complain that many fuel stations do not have access to use the fuel card in the country. In support of the abovementioned contention, it could be argued that since most of the respondents are from the district of Colombo, accessibility to NFC-enabled support devices is more frequent in comparison to that of other districts.

Awareness has a considerable significant direct positive impact on the perceived ease of use. This shows that consumers should know about NFC-enabled services that are available within the country. However, in terms of the data from the open-ended question in the questionnaire that respondents were not aware of the available services within the country. Among the respondents, 19% were not aware of many NFC-enabled services available in the country, and 16% have not seen any advertisements or any promotional activities on NFC-enabled payment services. One of the service providers has conducted SMS campaigns and promotional activities, whereas the other service provider believed such promotional activities were not necessary as NFC is a technology rather than a product. However, in view of the findings from the survey, it is evident that awareness has an indirect positive impact on the adoption of NFS-enabled payments via perceived ease of use.

The impact of intention to use has a positive impact on the perceived ease of use which is indicative of the fact that consumers would plan to use NFC-enabled payment services in the future if it is convenient to use when paying for such services. 16% of the respondents have commented in the open-ended questionnaire saying that they

have an interest in using NFC-enabled payments. Hence, the intention to use has an indirect positive link to the adoption of NFC-enabled payments via perceived ease of use.

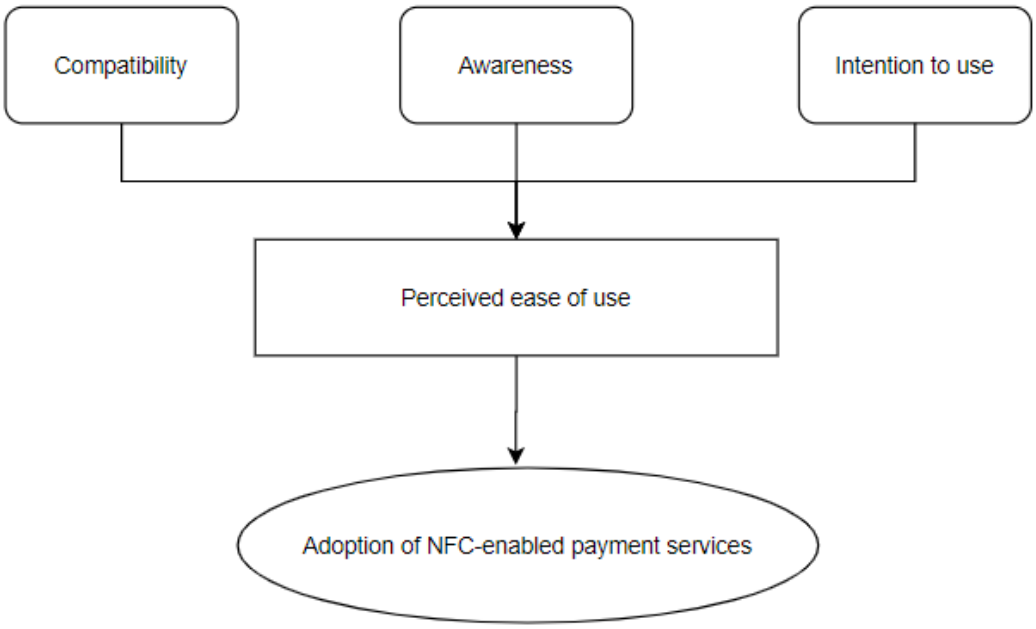


Figure 5.1: Factors affecting the consumer adoption of NFC-enabled payment.

Considering the findings of this study, it could be concluded that Sri Lanka still demonstrates a slow adoption towards the NFC-enabled payment methods and the perceived ease of use has a strong direct positive influence on the adoption of NFC-enabled payment services among the identified mediate variables. Among the identified independent variables, compatibility, awareness, and intention to use have an indirect positive impact on the adoption of NFC-enabled payment services via perceived ease of use. In summary, consumers adoption towards the NFC-enabled payment services depends upon the compatibility, awareness, and intention to use via the understanding of the ease of use of the payment method. However, perceived usefulness and perceived risk do not appear to be factors affecting the consumers' adoption of NFC-enabled payments. Alternatively, telecommunication service providers have concerns on factors such as security, not having proper government regulation, technical issues (i.e., POS power issues), and the maintenance cost.

## 5.2 Recommendations

The first NFC-enabled payment application was introduced 8-years ago in Sri Lanka and based on the results gathered through the consumer questionnaire, only 50% of the respondents were familiar about NFC- enabled payment methods. Further, only 18% of the respondents had access to bank cards, fuel cards and bus passes while none had access to parking cards or meal cards. This demonstrates that NFC-enabled payment option is still at early stages within the country. Mobile commerce industry should pay more consideration on promoting this service among the public. Promotions could be encouraged via service providers or via merchants. The findings of this study evince that awareness has a positive impact on the adoption of NFC-enabled payment services in Sri Lanka.

Table 5.1 presents the recommendations provided to increase the adoption of NFC-enabled payments in Sri Lanka. The Government can implement new rules and regulations relating to NFC-enabled payment transactions and increase its involvement with the service providers to promote this service within the country. This could be a start to promote some of the less popular NFC-enabled payment options such as fuel cards within the government sector companies. The Government can also consider providing banking license or some other sort of legal representation to service providers which would assist with the building of trust among consumers about this service.

Service providers should come up with different NFC-enabled payment application options with the help of different third-party organizations or the Government. For instance, NFC-enabled train passes, high-way bus passes and bus pass to be used in other districts apart from Colombo and Kandy. This will be helpful to make the maximum use of NFC-enabled payment methods with more benefits for consumers, service providers and other third parties.

Compatibility factor needs to be considered when introducing new NFC-enabled payment applications to the market. Based on the analyzed data, it was concluded that compatibility has a positive impact on the adoption of NFC-enabled payments. Service providers should pay attention to the availability of this service for merchants within

the country. Merchants should be educated on the advantages of having NFC-enabled payment options, and proper training should also be provided to merchants on handling this payment option.

One of the service providers opined that it would be easier for consumers if there is a single card with parallel NFC-enabled services embedded therein. Consequently, consumers do not need to carry many cards access to different services. This should be achieved with the help of service providers and with the involvement of the Government. Service providers should also consider having a single POS terminal for all NFC-enabled payments instead of having different POSs for different service providers.

Service providers should pay attention to POS terminal maintenance and resolving its technical difficulties as consumers complain about meeting with technical issues when making payments utilizing NFC-enabled payment applications. A proper communication platform should be established between the service providers and merchants so that the assistance of service providers is readily available when met with such technical issues.

Consumers' intention to use NFC-enabled payment services plays a vital role in the market. Hence, the service should be easier to use, and the benefits thereof should be clearly explained in layman's terms to consumers to make them want the service. When the service is more available within the country with multiple NFC-enabled applications, it would be easier to increase the demand for this service as a needed service in Sri Lanka.

It was clear from retrieved findings that the perceived ease of use has a direct positive impact on the adoption of NFC-enabled payment services among the consumers in Sri Lanka. Compatibility, awareness, and the intention to use factors also have a direct impact on the perceived ease of use and indirect impact on the adoption of NFC-enabled payments. Hence, service providers and merchants should mainly pay their attention towards introducing new NFC-enabled applications and promoting them to increase its adoption within the country.

Table 5.1: Summary of the suggested recommendations.

| Responsible Party | Recommendations |
|---|---|
| **Service Provider** | Promotional and advertising activities to increase awareness. |
| | Can introduce new NFC-enabled payment applications to the market |
| | single POS terminal for all NFC-enabled payment service providers |
| | single card with parallel NFC-enabled services embedded for all service providers |
| | More attention towards POS terminal maintenance |
| | |
| **Government** | The government can implement new rules and regulations relating to NFC-enabled payment transactions. |
| | The government can increase its involvement with the service providers to promote this service within the country. |
| | The Government can consider providing a banking license or some other sort of legal representation to service providers |

## 5.3 Research Limitations

Data were mainly collected from Colombo city, and only a few respondents are from out of the city Colombo. This could be identified as a limitation of this study as consumers from other rural cities could have a different perception about the adoption of NFC-enabled payment methods.

Further, it appeared that most of the respondents had access to bank cards while only a few respondents had access to other non-banking NFC-enabled payment methods such as fuel cards, and bus passes. The research could have significantly benefitted had there been more respondents who had access to other non-banking NFC-enabled payment methods in order to formulate a clear understanding on the different NFC-enabled payment options that are available in the country.

Marking another possible limitation, most respondents of the instant study were from the IT sector having an IT background. Thus, the responses could have been different had there been more respondents from outside of the IT sector and would have assisted with formulating an understanding of the perspective of the general public towards new technologies such as NFC-enabled payment options. According to the analyzed data, the fraction of male participants who contributed to the surrey is relatively high. It would have been better to collect an equal proportion of data from the female to reflect the gender distribution of the Sri Lankan population.

Due to time constraints, interviews were conducted only with telecommunication service providers. Among such telecommunication service providers, only two provide the NFC technology within the country at the time of conducting the study. The research could have benefitted more if more service providers from different areas, such as banking service providers could have been interviewed. Further, this study did not focus on the perspective of the merchants

Only limited types of NFC-enabled payment applications are available within the country consequent to which it is evident that NFC-enabled payment technology is still at an early stage in Sri Lanka. Due to the novelty of the technology, there is a lacuna of credible studies on NFC-enabled payment methods in Sri Lanka compared to the detailed studies conducted in foreign countries. Since such foreign studies are conducted utilizing the data available in those countries, the relevancy of studies is questionable as it is not directly applicable to the Sri Lankan context.

### 5.4 Future research directions

Most respondents of this survey were from the Colombo district. To overcome the issue of having most of the respondents from the district of Colombo, future researchers could conduct studies by selecting specific districts or provinces, thereby tailor-making the researches to a specific region. This could help in understanding the adoption of technology within different parts of the country.

Majority of the respondents were from the IT sector contributed to this survey. Similarly, future researchers should ensure the participation of respondents who are from a non-IT background as well to overcome the limitation that the instant study possessed of only having inputs from respondents with an IT background, in order to ensure that they take the perspective of the majority of the general public who are not familiar with new technologies into consideration as well.

This study mainly assessed the consumers' perspective on NFC-enabled payments by analyzing the adoption factors of the consumers while little focus was given to the perspective of service providers. Thus, future studies could survey by considering both banking and non-banking NFC-enabled service providers, thereby giving more focus

to service providers' perspective as well. Also, merchants' adoption factors towards NFC-enabled payments should be taken into consideration.

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## Appendix A – Interview Questions

1. Could you give me some insight about various payment services provided by your company?
2. Among those services which one seems to be more successful? And why?
3. What do you think about the growth rate of both NFC users and values of transactions since the introduction until now?
    a. If the growth rate is high, what factors seem have contributed to the rapid growth?
    b. If not, what factors seem to slow things down?
4. What do you think about the market potential for NFC-enabled payments in Sri Lanka? Do we really have a big market?
5. Could you please share some strategies adopted by your team to achieve that market potential?
6. What are the role merchants could play in promoting NFC?
7. Do you see any major barriers to implement NFC-enabled payments?
    a. Any user-level issues?
    b. Rules and regulations from the central bank?
    c. Any technical limitations in available NFC payments applications?
8. Any specific instances where either customers or merchants have had bad experiences about NFC-enabled payments?
9. Any other feedback about increasing the adoption of NFC-based payment methods to be aware of?

## Appendix B – Questionnaire

# Adoption of NFC-Enabled Payments in Sri Lanka: Customers' Perspective

This Questionnaire is designed to study about the factors affecting the adoption of NFC (Near-Field-Communication) based payments in Sri Lanka. NFC technology supports 2 devices ( e.g., touch card and POS terminal) to initiate a payment. There are different NFC payments service providers such as Dialog, Mobitel, Commercial Bank, HNB, and Seylan. NFC enabled bus passes, fuel cards, easy cash stickers, NFC enabled Debit/Credit cards are available in Sri Lanka.

The data gathered from the survey will only be used for the thesis requirement of the MBA in IT, at the University of Moratuwa, Sri Lanka. This survey is stipulated confidential and anonymous. Your responses will not be identified with you personally and all findings will appear in aggregated form.

Your participation in the research would be greatly appreciated. If you have any suggestions, would like more clarification about the questions, or how the data will be used, please feel free to contact us using the details provided below.

Thank you very much for your time and help in making this study possible.

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## Experiences Related to NFC-Based Payments

1. **1. How frequently do you perform payments via your mobile phone** * *Mark only one oval.*

   - ◯ A couple of times a week
   - ◯ A couple of times a month
   - ◯ A couple of times a year
   - ◯ Rarely
   - ◯ Never

2. **2. How familiar are you with idea of NFC-based mobile payments?** * *Mark only one oval.*

   | | 1 | 2 | 3 | 4 | 5 | |
   |---|---|---|---|---|---|---|
   | Not at all Familiar | ◯ | ◯ | ◯ | ◯ | ◯ | Very Familiar |

3. **3. What types of NFC-based payment options do have access to?** *
   For e.g., credit cards, bus pass, and fuel cards



4. **4. What type of NFC-based payment options you have used?** *

## Adoption Factors - NFC-Enabled Payments

5. **5. Are NFC-based payment options easy to use?**

***** *Mark only one oval per row.*

| | Strongly Disagree | Disagree | Neither Agree nor Disagree | Agree | Strongly Agree |
|---|---|---|---|---|---|
| I am comfortable in performing NFC-based payments. | | | | | |
| With NFC making a payment is so simple. | | | | | |
| Easy to register for different services. | | | | | |
| NFC payments are hassle free. | | | | | |
| Errors or mistakes can be easily resolved. | | | | | |
| I don't like to use so many cards to make payments. | | | | | |
| NFC payments fit well with my lifestyle | | | | | |
| Existing payment platforms support NFC-enabled payments | | | | | |
| NFC-enabled payments are compatible with other payment methods (Debit/Credit card) | | | | | |
| Most places I shop accept NFC-based payments. | | | | | |
| NFC recharge centers are easier to find. | | | | | |

6. **6. Are NFC-based payment options useful?** *Mark only one oval per row.*

| | Strongly Disagree | Disagree | Neither Agree nor Disagree | Agree | Strongly Agree |
|---|---|---|---|---|---|
| Many services accept NFC-based payments. | | | | | |
| I can easily track transactions made via NFC payments. | | | | | |
| Compared to other payment options (e.g., cash, mobile), NFC payments are hassle free. | | | | | |
| NFC payments are faster than other payment options | | | | | |
| I am more likely to use a NFC-based pre-paid card, if it gives interest on my money. | | | | | |
| I am more likely to use a NFC-based card if it is multi-purpose (e.g., bus tickets, parking, train, & high-way tolls). | | | | | |

7. **7. Do you consider NFC-enabled payment methods to be riskier than other payment methods?** *

*Mark only one oval per row.*

| | Strongly Disagree | Disgaree | Neither Agree nor Disagree | Agree | Strongly Agree |
|---|---|---|---|---|---|
| I believe NFC-based payments are more secure. | | | | | |
| I can trust the NFC technology. | | | | | |
| I'm concerned about the privacy while performing NFC-based payments. | | | | | |
| I trust NFC payments backed by financial institutes (e.g., bank) than 3rd-party companies (e.g., Dialog & Mobitel). | | | | | |
| I can trust my NFC service provider (e.g., Dialog, Mobitel, HNB, & Commercial bank) | | | | | |
| I like the concept of "Never Leave My Hand " while paying. | | | | | |
| I don't have to disclose credit card or pin no. | | | | | |
| I am comfortable to give my credit card to merchant. | | | | | |
| I believe NFC payments are generally secure. | | | | | |
| I'm worried about loosing my money if the card is lost. | | | | | |
| I have heard negative stories about security of NFC payments. | | | | | |

8. **8. I'm more likely to use NFC payments because,**

***** *Mark only one oval per row.*

| | Strongly Disagree | Disagree | Neither Agree nor Disagree | Agree | Strongly Agree |
|---|---|---|---|---|---|
| I see many people in social media using NFC enabled payments. | | | | | |
| People around me recommend NFC payment methods. | | | | | |
| My employer encourages me to use NFC enabled payments. | | | | | |
| Government encourages to use NFC payments. | | | | | |

9. **9. Are NFC-enabled payments expensive?**

***** *Mark only one oval per row.*

| | Strongly disagree | Disagree | Neither Agree nor Disagree | Agree | Strongly agree |
|---|---|---|---|---|---|
| Registration fees of NFC enabled payment methods are reasonable. | | | | | |
| NFC-based payment options are costly compared other mobile-based payment methods. | | | | | |
| My merchant charges additional fee/commission if I use NFC to pay. | | | | | |
| It's expensive to replace an NFC card if lost or broken. | | | | | |

10. **10. I like to try a new product or service,**

***** *Mark only one oval.*

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| As soon as it is available | | | | | | When I'm forced to have it (no other option) |

11. **11. I plan to use NFC payment methods to do transactions in the near future?** ***** *Mark only one oval.*

| | 1 | 2 | 3 | 4 | 5 | |
|---|---|---|---|---|---|---|
| Strongly Disagree | | | | | | Strongly Agree |

12. **12. My past experiences with NFC-based payments are frustrating.** *Mark only one oval.*

- Yes
- Neutral
- No

13. **13. If the answer is "Yes" to Q.11, please specify the reason.**

## Demographic Questions

14. **14. What is your gender?**

*Mark only one oval.*

- Female
- Male

15. **15. What is your age group?**

***** *Mark only one oval.*

- 18 - 24 years
- 25 - 34 years
- 35 - 49 years
- 50 - 64 years
- 65 and Above

16. **16. Where do you currently stay (please select the district)?** ***** *Mark only one oval.*

- Ampara
- Anuradhapura
- Badulla
- Batticaloa
- Colombo
- Galle
- Gampaha
- Hambantota
- Jaffna
- Kalutara
- Kandy
- Kilinochchi
- Kurunegala
- Mannar
- Matale
- Matara
- Monaragala
- Mullaitivu
- Nuwara Elliya
- Pollonnaruwa
- Puttalam
- Ratnapura
- Trincomalee
- Vavuniya

17. **17. What is your occupation?**

***** *Mark only one oval.*

- ◯ Administrative Sector
- ◯ Educational Services
- ◯ Finance and Insurance
- ◯ Health Care and Social Assistance
- ◯ Information and Technology
- ◯ Management and Enterprise sector
- ◯ Science sector
- ◯ Other

18. **18. What's your perception on NFC mobile payments?** *****

# Appendix C – SEM ANALYSIS

Path coefficient and P values

**Path coefficients**

| | PEU | PU | PR | COM | SN | COS | RE | NPK | PI | AW | ITU | ADOP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PEU | | | | 0.474 | 0.039 | 0.108 | 0.010 | 0.051 | -0.194 | 0.153 | 0.169 | |
| PU | | | | 0.431 | -0.019 | 0.164 | -0.042 | -0.045 | -0.253 | -0.132 | 0.034 | |
| PR | | | | | | | | | | | | |
| COM | | | | | | | | | | | | |
| SN | | | | | | | | | | | | |
| COS | | | | | | | | | | | | |
| RE | | | | | | | | | | | | |
| NPK | | | | | | | | | | | | |
| PI | | | | | | | | | | | | |
| AW | | | | | | | | | | | | |
| ITU | | | | | | | | | | | | |
| ADOP | 0.486 | 0.029 | -0.031 | | | | | | | | | |

**P values**

| | PEU | PU | PR | COM | SN | COS | RE | NPK | PI | AW | ITU | ADOP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PEU | | | | <0.001 | 0.223 | 0.017 | 0.423 | 0.161 | <0.001 | 0.001 | <0.001 | |
| PU | | | | <0.001 | 0.352 | <0.001 | 0.208 | 0.188 | <0.001 | 0.005 | 0.256 | |
| PR | | | | | | | | | | | | |
| COM | | | | | | | | | | | | |
| SN | | | | | | | | | | | | |
| COS | | | | | | | | | | | | |
| RE | | | | | | | | | | | | |
| NPK | | | | | | | | | | | | |
| PI | | | | | | | | | | | | |
| AW | | | | | | | | | | | | |
| ITU | | | | | | | | | | | | |
| ADOP | <0.001 | 0.283 | 0.271 | | | | | | | | | |

Model fit and quality indices

**Model fit and quality indices**

---

**Average path coefficient (APC)=0.151, P<0.001**
**Average R-squared (ARS)=0.431, P<0.001**
**Average adjusted R-squared (AARS)=0.422, P<0.001**
**Average block VIF (AVIF)=1.549, acceptable if <= 5, ideally <= 3.3**
**Average full collinearity VIF (AFVIF)=2.274, acceptable if <= 5, ideally <= 3.3**
**Tenenhaus GoF (GoF)=0.529, small >= 0.1, medium >= 0.25, large >= 0.36**
**Sympson's paradox ratio (SPR)=0.789, acceptable if >= 0.7, ideally = 1**
**R-squared contribution ratio (RSCR)=0.945, acceptable if >= 0.9, ideally = 1**
**Statistical suppression ratio (SSR)=1.000, acceptable if >= 0.7**
**Nonlinear bivariate causality direction ratio (NLBCDR)=0.921, acceptable if >= 0.7**

Variable coefficient

| | PEU | PU | PR | COM | SN | COS | RE | NPK | PI | AW | ITU | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R-squared | 0.650 | 0.389 | | | | | | | | | | 0 |
| Adj. R-squared | 0.642 | 0.376 | | | | | | | | | | 0 |
| Composite reliab. | 0.846 | 0.851 | 0.858 | 0.811 | 0.837 | 0.726 | 0.893 | 0.848 | 0.772 | 1.000 | 0.742 | 1 |
| Cronbach's alpha | 0.779 | 0.762 | 0.817 | 0.646 | 0.738 | 0.499 | 0.760 | 0.641 | 0.409 | 1.000 | 0.305 | 1 |
| Avg. var. extrac. | 0.488 | 0.593 | 0.369 | 0.591 | 0.564 | 0.409 | 0.806 | 0.736 | 0.628 | 1.000 | 0.590 | 1 |
| Full collin. VIF | 4.174 | 3.527 | 3.049 | 2.716 | 1.607 | 1.523 | 2.028 | 1.209 | 1.930 | 2.099 | 1.885 | 1 |
| Q-squared | 0.651 | 0.545 | | | | | | | | | | 0 |
| Min | -3.250 | -2.969 | -2.776 | -2.438 | -1.705 | -2.786 | -1.559 | -1.178 | -1.802 | -1.206 | -2.963 | - |
| Max | 2.128 | 1.890 | 2.429 | 2.248 | 1.966 | 2.106 | 2.807 | 1.473 | 2.157 | 1.869 | 1.531 | 1 |
| Median | -0.046 | 0.188 | 0.050 | 0.129 | 0.127 | 0.285 | 0.131 | 0.079 | -0.044 | 0.332 | 0.255 | - |
| Mode | 0.163 | 0.529 | -0.839 | -0.282 | 0.589 | 0.285 | 0.624 | -1.178 | -1.216 | -1.206 | 0.866 | 0 |
| Skewness | -0.814 | -0.770 | -0.669 | -0.530 | -0.170 | -0.815 | 0.162 | 0.254 | 0.177 | 0.001 | -0.874 | - |
| Exc. kurtosis | 2.044 | 0.922 | 1.158 | 0.198 | -1.006 | 0.965 | -0.536 | -1.305 | -0.601 | -1.329 | 0.500 | - |
| Unimodal-RS | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No | Yes | No | Yes | Y |
| Unimodal-KMV | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Y |
| Normal-JB | No | No | No | No | No | No | No | No | No | No | No | N |
| Normal-RJB | No | No | No | No | No | No | No | No | Yes | No | No | N |
| Histogram | View | View | View | View | View | View | View | View | View | View | View | V |

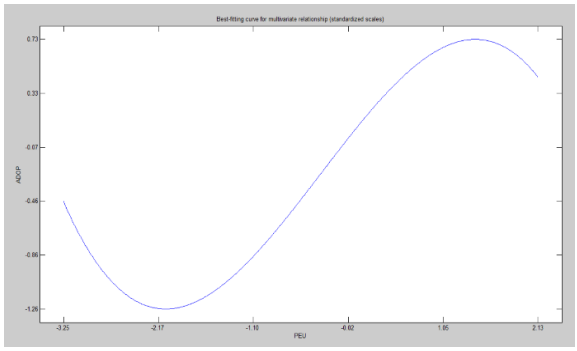
*Notes: Unimodal-RS = Rohatgi-Székely test of unimodality; Unimodal-KMV = Klaassen-Mokveld-van Es test of unimodality; Normal-JB = Jarque–Bera test of normality; Normal-RJB = robust Jarque–Bera test of normality; click on "View" cell to see corresponding histogram.*

Causality assessment coefficients: R-squared contribution

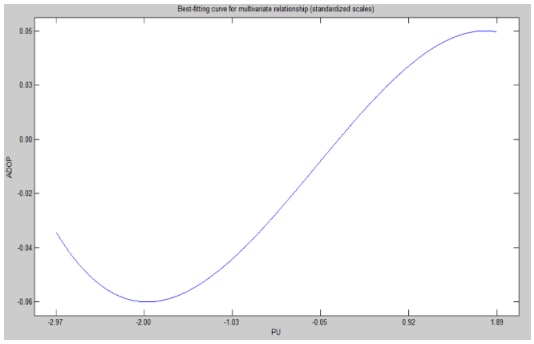
| | PEU | PU | PR | COM | SN | COS | RE | NPK | PI | AW | ITU | ADOP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PEU | | | | 0.339 | 0.012 | 0.048 | 0.004 | 0.007 | 0.076 | 0.071 | 0.093 | |
| PU | | | | 0.267 | -0.004 | 0.069 | -0.014 | 0.005 | 0.107 | -0.054 | 0.014 | |
| PR | | | | | | | | | | | | |
| COM | | | | | | | | | | | | |
| SN | | | | | | | | | | | | |
| COS | | | | | | | | | | | | |
| RE | | | | | | | | | | | | |
| NPK | | | | | | | | | | | | |
| PI | | | | | | | | | | | | |
| AW | | | | | | | | | | | | |
| ITU | | | | | | | | | | | | |
| ADOP | 0.253 | 0.011 | -0.008 | | | | | | | | | |

*Notes: R-squared contributions of predictor lat. vars.; columns = predictor lat. vars.; rows = criteria lat. vars.; negative sign = reduction in R-squared.*

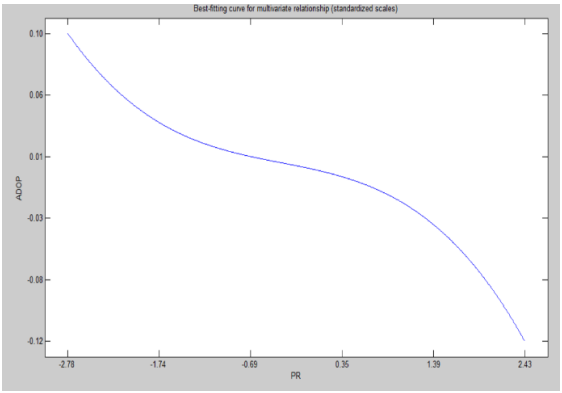
Linear and non-linear relationship among variables



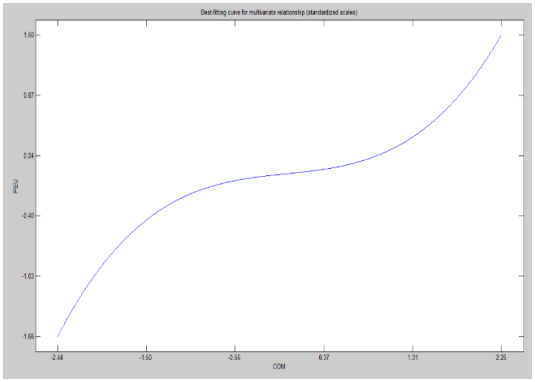

Perceived ease of use on NFC adoption



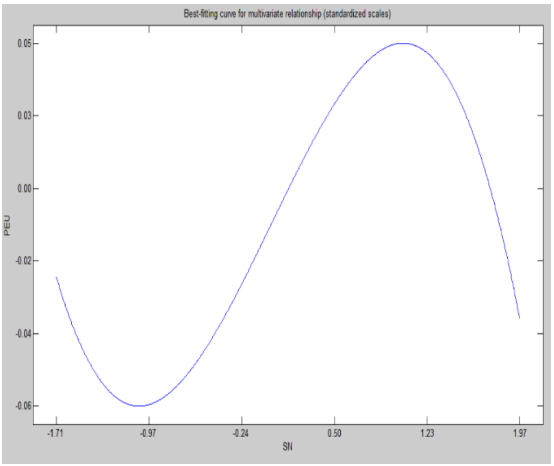

Perceived usefulness on NFC adoption



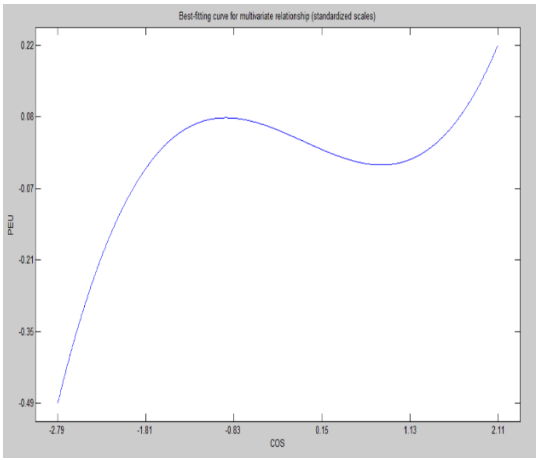

Perceived risk on NFC adoption



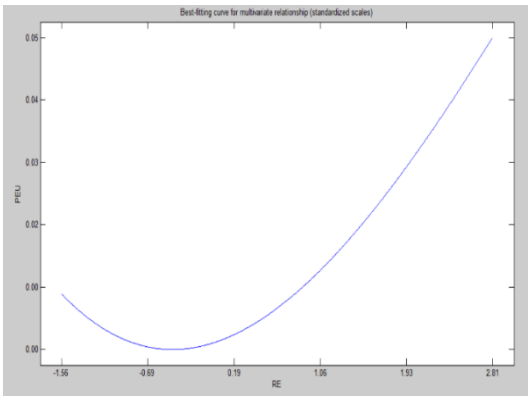

Compatibility on perceived ease of use



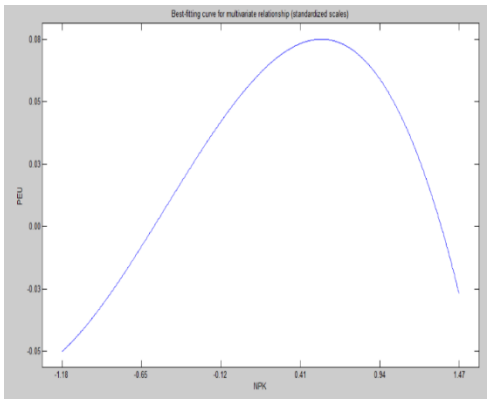

Social norm on perceived ease of use



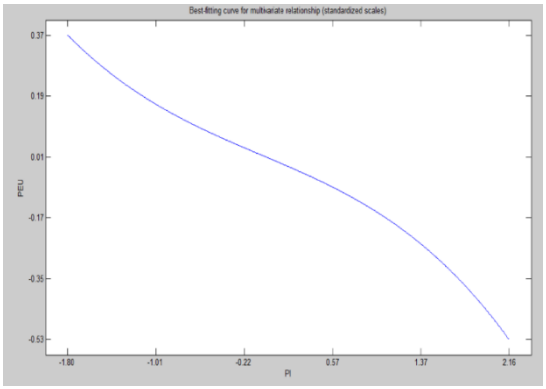

Cost on perceived ease of use



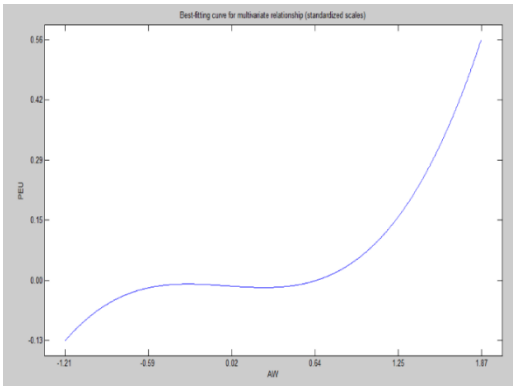

Reachability on perceived ease of use



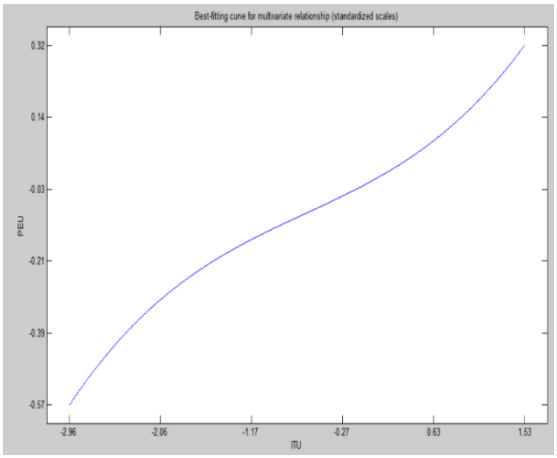

NFC payment knowledge on perceived ease use



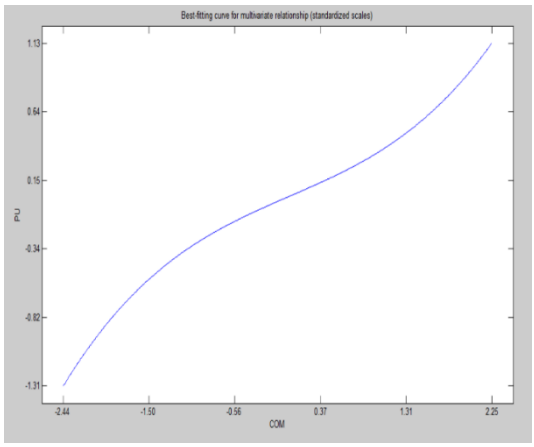

Personal innovation on perceived ease of use



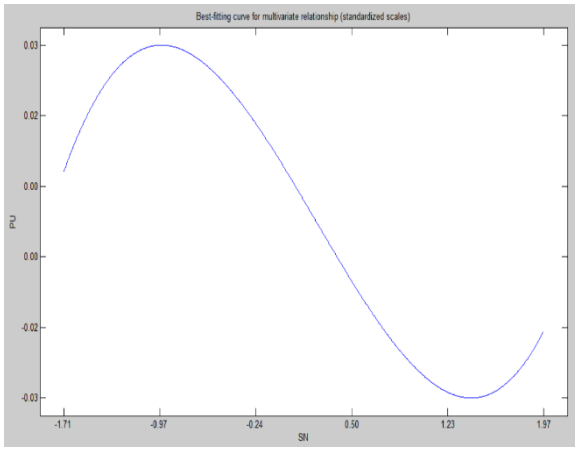

Awareness on perceived ease of use



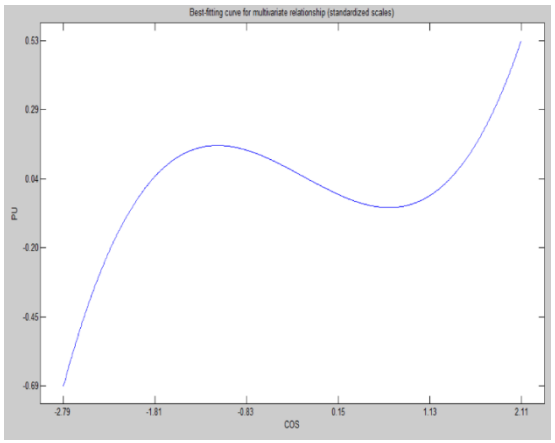

Intention to use on perceived ease of use



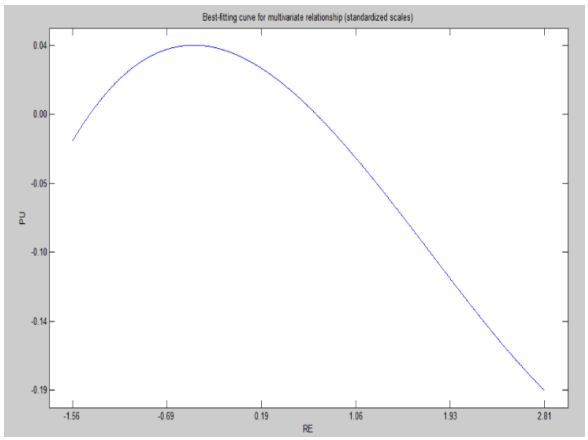

Compatibility on perceived usefulness



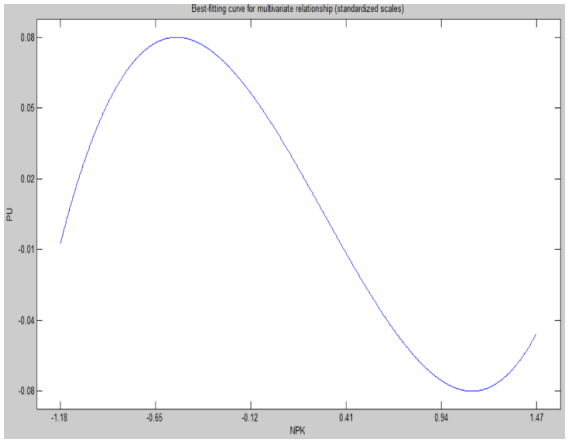

Social norm on perceived usefulness



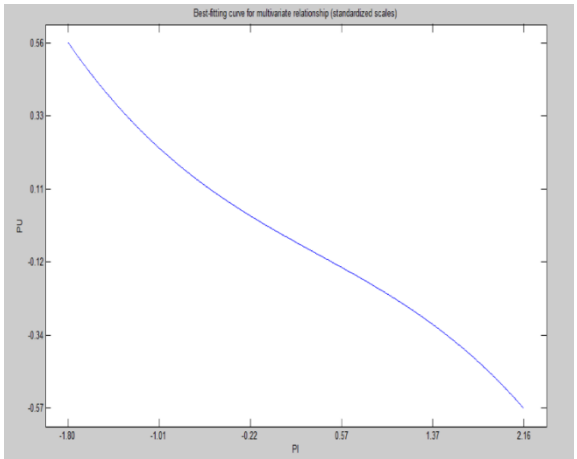

Cost on perceived usefulness



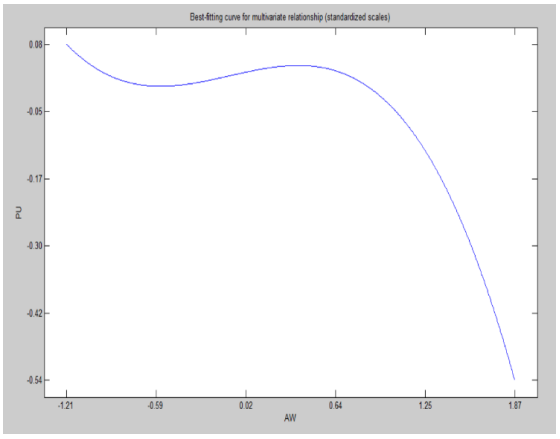

Reachability on perceived usefulness



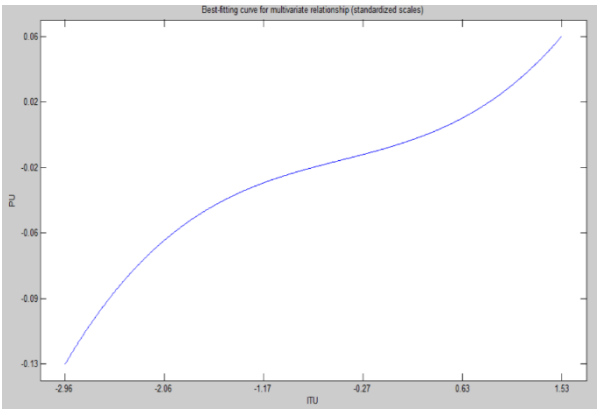

NFC payment knowledge perceived usefulness




Personal innovation on perceived usefulness




Awareness on perceived usefulness




Intention to use on perceived usefulness