ANALYSIS OF MOBILE PAYMENT TECHNOLOGIES' ADOPTION USING INTERPRETIVE STRUCTURAL MODELING: SOLIPAY CASE

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ABSTRACT

ANALYSIS OF MOBILE PAYMENT TECHNOLOGIES' ADOPTION
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INTERPRETIVE STRUCTURAL MODELING:
SOLIPAY CASE

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In today's fast-paced world, smartphones have become an indispensable part of modern life. They have also revolutionized the way payments are made. Carrying multiple physical cards or assets can be cumbersome for modern individuals. Traditional payment methods have limited capabilities, leading to the emergence of new options tailored for the dynamic society of today. Mobile payment systems are pioneers in fulfilling the modern requirements of instant flexibility, security, validity, and availability. In recent years, they have gained significant traction as a preferred payment method. This study aims to reveal the impact mechanisms on technology acceptance for mobile payment systems in Türkiye with a case study. More than 50 factors negatively affecting the adoption of MPS were reviewed through the existing literature. They were evaluated with the two rounds of Delphi method for prioritization. 21 of the barriers were selected. Output of the Delphi study was used as input for Interpretive Structural Modelling with seven experts from the field. Age and technological infrastructure emerged as the most impacting barriers for the adoption of mobile payment systems. Relations among the selected barriers were also clarified with this study.

Keywords: Mobile Payment Systems, Technology Acceptance, Interpretive Structural Modelling, Technology Adoption

ÖZ

MOBİL ÖDEME TEKNOLOJİLERİNİN BENİMSENMESİNİN
YORUMLAMALI YAPISAL MODELLEME
KULLANILARAK ANALİZİ:
SOLIPAY VAKASI

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Günümüzün hızlı dünyasında akıllı telefonlar modern yaşamın vazgeçilmez bir parçası haline gelmiştir. Ödemelerin yapılma biçimlerinde de devrim yarattılar. Birden fazla fiziksel kart veya varlık taşımak modern bireyler için hantal ve zor hale gelmiştir. Geleneksel ödeme yöntemlerinin yetenekleri sınırlıdır ve bu durum günümüzün dinamik toplumuna özel yeni seçeneklerin ortaya çıkmasına neden olmaktadır. Mobil ödeme sistemleri esneklik, güvenlik, geçerlilik ve kullanılabilirlik gibi modern gereksinimleri karşılamada öncüdür. Son yıllarda tercih edilen bir ödeme yöntemi olarak önemli bir seviyede ilgi görmektedirler. Bu çalışma, Türkiye'de mobil ödeme sistemlerinin teknoloji kabulü üzerindeki etki mekanizmalarını bir örnek olay çalışmasıyla ortaya çıkarmayı amaçlamaktadır. Mobil ödeme sistemlerinin benimsenmesini olumsuz yönde etkileyen 50'den fazla faktör mevcut literatür aracılığıyla incelenmiştir. Bu faktörler iki turlu Delphi yöntemiyle değerlendirilerek önceliklendirilmişlerdir. Çalışmanın sonunda 21 tanesi seçilmiştir. Delphi çalışmasının çıktısı, alanından yedi uzmanın katılımıyla Yorumlayıcı Yapısal Modelleme için girdi olarak kullanılmıştır. Çalışmanın sonucunda yaş ve teknolojik altyapı, mobil ödeme sistemlerinin benimsenmesinin önündeki en etkili engeller olarak ortaya çıkmıştır. Bu çalışma ile seçilen engeller arasındaki ilişkiler de açıklığa kavuşturulmuştur.

Anahtar Sözcükler: Mobil Ödeme Sistemleri, Teknoloji Benimsenmesi, Yorumlamalı Yapısal Modelleme, Teknoloji Adaptasyonu

DEDICATION

To My Family and Friends….

ACKNOWLEDGMENTS

To begin, I would like to express my sincere gratitude to my esteemed supervisor. Professor Doctor Sevgi Özkan Yıldırım provided me with a wealth of knowledge, insights, and motivation. Her constructive feedback, insightful suggestions, and unwavering encouragement during challenging moments were invaluable and pivotal in refining my ideas and successful completion of my thesis.

I am eternally grateful for the opportunity to have had her as my supervisor and mentor. As I embark on the next chapter of my academic journey, I am filled with gratitude for the privilege of working under the supervision of Professor Doctor Sevgi Özkan Yıldırım.

I am profoundly grateful for the support and encouragement of my friends. They have been there for me through thick and thin, offering a listening ear and valuable experiences. I am truly happy to have such supportive friends in my life.

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LIST OF ABBREVIATIONS

ISM	Interpretive Structural Modelling
TISM	Total Interpretive Structural Modelling
Digraph	Directed Graph
Solipay	Soliclub Mobile Application Payment Module
TAM	Technology Acceptance Model
UTAUT	Unified Theory of Acceptance And Use of Technology
SSIM	Self-Structural Interaction Matrix
NFC	Near Field Communication
MP	Mobile Payment
MPS	Mobile Payment Systems
PoS	Point of Sale
NFC	Near Field Communication
QR	Quick Response
METU	Middle East Technical University
M-Payment	Mobile Payment
BTK	Information Technologies Institution of Türkiye
M2M	Machine to Machine
MSME	Micro Small Medium Enterprises
SMS	Short Message Service
Solipay	Soliclub Mobile Application Produced by UTARIT Company
UTARIT	A Technology Company Specialized in Smartcard Systems
MTS	Magnetic Secure Transmission
B2C	Business to Customer
C2C	Customer to Customer
P2P	Peer to Peer
DCB	Direct Carrier Billing
MENA	Middle East and North Africa
CIS	The Commonwealth of Independent States

CHAPTER 1

1. INTRODUCTION

1.1. Background and Overview

Technology plays a pivotal role in the modern era, permeating various aspects of modern daily life. The rapid advancements in both communication and information technologies have significantly altered the human experience in recent decades. Mobile phones have revolutionized communication, transforming it in ways unimaginable just two decades ago. Information technology has also undergone tremendous change, with the advent of highly accessible personal computers.

These two major technological breakthroughs converged rapidly within a relatively short time frame, culminating in the creation of smartphones. Smartphones combine the power of information and communication technologies into a single, relatively small device, making them affordable for a large segment of society. Their rapid evolution has seen them infiltrate and transform nearly every aspect of modern daily life. As ubiquitous mobile devices, smartphones have brought countless opportunities through their continuous evolution up to day as inseparable companions of modern individuals.

Smartphones allow not only to communicate easily anywhere and anytime but also provide access to a vast amount of information through mobile services and the internet. More than just communication tools, mobile phones now have multimedia capabilities such as cameras and high-resolution displays, enabling us to enjoy music, record conversations, manage our schedules, and more. Essentially, modern mobile phones have combined the functionality of desktop computers and home entertainment systems into a portable format, allowing us to use them in diverse ways and creating a new way of life. (Falke et al., 2007)

Payment needs in daily life are just another field of modern life to be heavily invaded by smartphones as a paradigm called Mobile Payment Systems (MPS). This paradigm uses almost all of the available technologies existing on a smartphone such as QR codes, NFC, Bluetooth, SMS or even any application installed on smartphones. MPS's growth aligns with the ongoing hardware and software advancements of mobile devices. Even wearable devices such as smart wristbands or watches have become new tools of MPS in recent years. MPS has been defined many times by many researchers and stayed as a hot topic over the years with incoming technological innovations. These academic definitions and development of the MPS concept in academics will be given in the next chapter which is dedicated to the literature.

However, it can be basically said that within the realm of payment systems, MPS with the power of all available options has risen to prominence, eclipsing numerous alternative options that have existed for varying durations. For example, cash has been a staple for millennia, while credit cards have been around for decades.

The use of mobile payment systems seems to gain widespread acceptance worldwide in parallel with the rapidly increasing penetration rates of smartphones. Figure 1, given below shows the global smartphone penetration rates and forecasts for 2030.

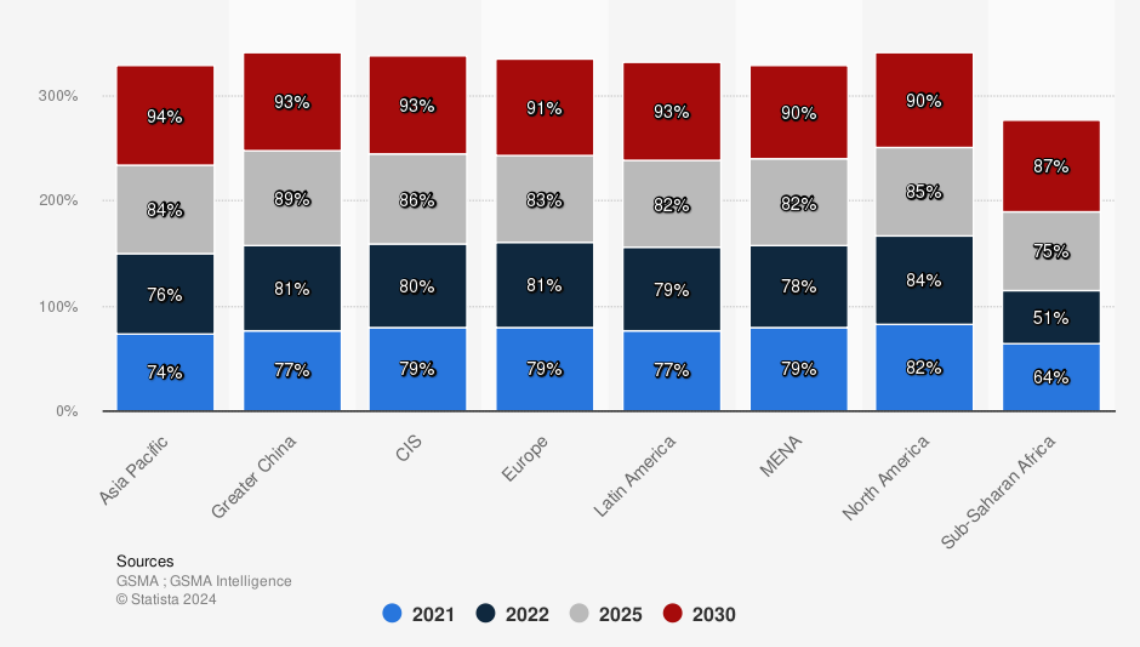

Figure 1: Global Smartphone Penetration Rate with Projections, (GSMA, 2023)

In a similar manner it can be observed from the Figure 2 that MPS market size is also showing significant increases in parallel with smartphone penetration rate. However, it is also clear that there exist significant differences between regions of the world. Far East & China region heavily using MPS even though the region has similar smartphone penetration rates with rest of the world population.

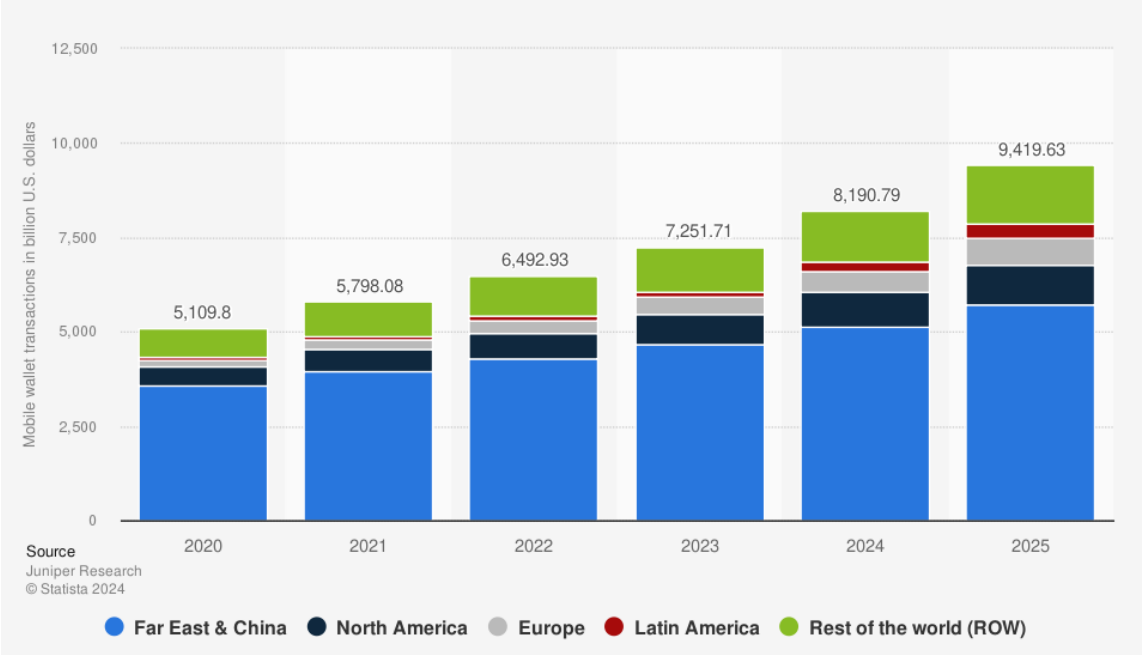

Figure 2: Mobile Payment Market Size, (Juniper Research, 2021)

This chapter will give brief information about MPS and its basics in a fundamental level. The chapter will continue with answers to questions about the relevance, motivation, research aims of the thesis study.

1.2. A Brief History of Payment

It is asserted that the Lydians were the originators of the concept of money. However, it is evident that the idea is crucial for the formation of civilization, allowing for the organized exchange of goods and services. It is believed that the concept originated with the advent of the earliest human populations. Historical and archaeological records demonstrate that, as civilizations developed, a variety of different mediums were utilized as forms of currency.

The earliest employed method, often referred to as the barter system, remains an elemental form of currency. It enables the exchange of commodities and services between individuals. Notwithstanding, it is encumbered with inherent limitations, including restricted adaptability in options and potential discrepancies in quantities.

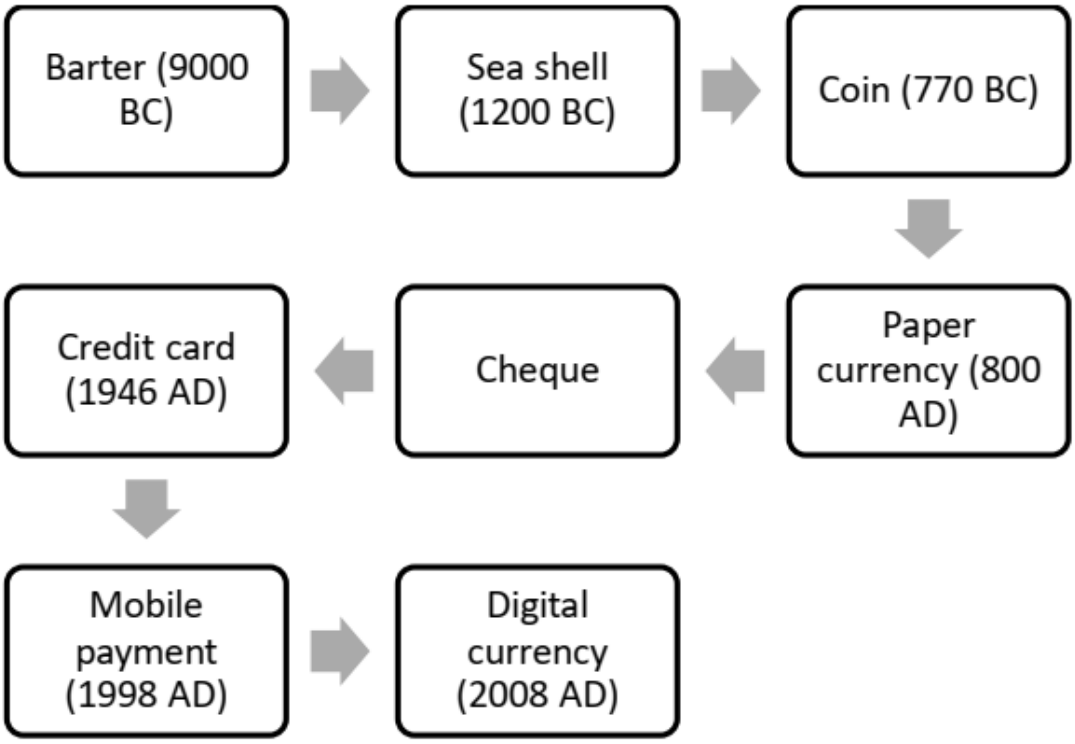

Figure 3: History of Payment, (Luna, 2017)

Therefore, people looked for better solutions based on existing resources and capabilities which resulted in examples of sea shells, stones, crops or fruits. It worked for a while on a local scale and solved some of the problems related to barter.

Nonetheless, the need for standardization and advancement in metalworking around 700s BC paved the way for the creation of metal coins crafted from precious metals such as silver or gold. It was not a perfect solution, but it was good enough for the time.

Invention of paper around 700 AD, followed by realization of its advantages such as its lightweight, high capacity to carry information or ease of production led the way for paper money around 800 AD. It changed the whole paradigm irreversibly. It is still heavily in use around the world, even though it has a decreasing rate of use.

Emergence of banks created another paper based option called cheque which was a great revolution at the time and solved some of the problems about the paper money. However, it brought its own set of problems as known.

Credit cards were another revolutionary trend created by the banking system in the U.S.A around the 1940s which is also called plastic money. The revolution in the monetary system, characterized by the absence of physical currency, drastically altered individuals' spending patterns.

Then, the first example of a mobile payment system seen around the late 1990s by Coca Cola Company. It allowed people to buy drinks from vending machines using SMS from any mobile phone. Following years brought many options with the upcoming technologies such as Bluetooth, QR or NFC.

Up to the point, there was still physical currency but mostly kept in banks and people were using credit cards or mobile devices for payment. Actually, no one sees the actual physical money most of the time.

However, another revolution called "Digital Currency" such as Bitcoin came to existence around the late 2000s and started to challenge the concept of physical currency and became accepted as real money recently. There is no physical asset in this type of money.

The rapid advancements in technology, particularly in fields like artificial intelligence (AI), have made it increasingly challenging to predict the future of payment methods.

1.3. Motivation and Relevance

First of all, MPS is increasingly becoming more common for daily life in Türkiye. It is not surprising anymore to encounter people making transactions over their phones instead of credit cards or cash at markets, restaurants or even taxis. Researchers are also aware of the situation and a quick preliminary examination of literature showed an abundance of research papers about MPS. Some papers also have bold claims about MPS. For example, the utilization of mobile payment has been formally acknowledged as a fundamental factor in driving the socioeconomic progression of a nation. (Asamoah et al., 2020) Notwithstanding the advantages presented by MPS, there are prevailing challenges associated with its diffusion and adoption among countries such as smartphone penetration rate differences among the regions of the world, income levels or poverty in other words, unbanked population rates and macroeconomic stability. (Asongu & Asongu, 2018) Smartphone penetration rate differences among the regions of the world also were shown at the Figure 1 given in the previous section. So, the importance of MPS for a country is one of the basic pillars for the motivation of this thesis study. Studying the reasons for such differences among countries seems meaningful especially when there is not much study for Türkiye.

Türkiye is given as a "upper-middle income" country by the World Bank which is also shown at Figure 4.

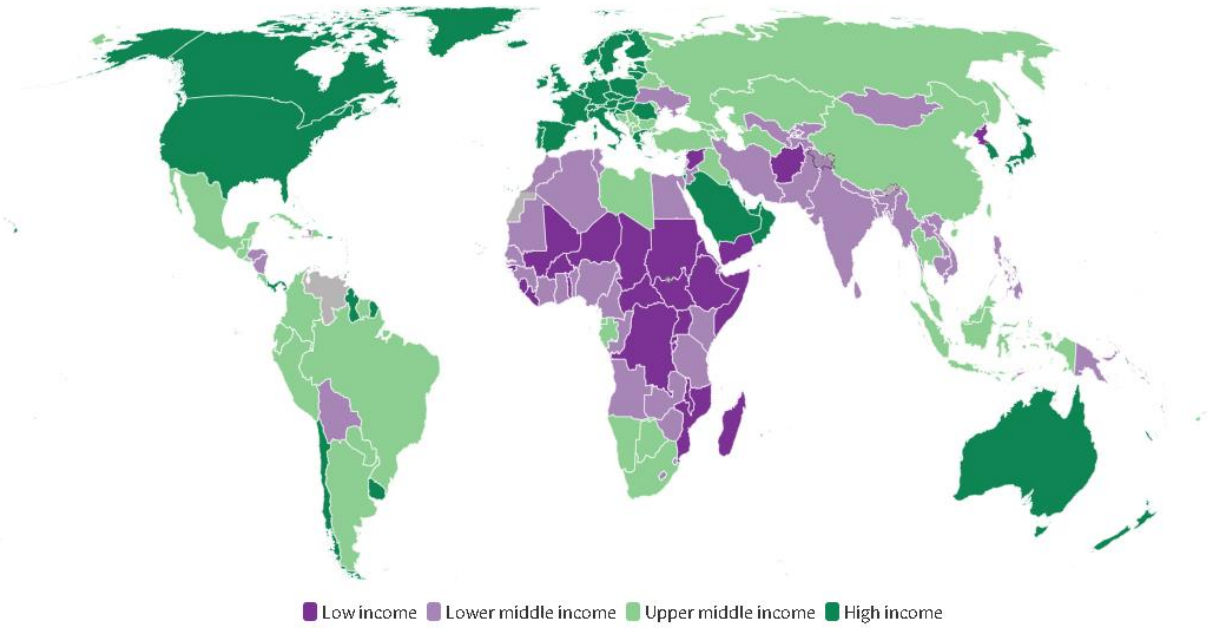

Figure 4: The World by Income and Region, (WDI, 2022)

And according to a highly cited systematic review paper examining 310 papers about MPS spanning the last 20 years, almost half of the papers are about countries defined as “high income” by the World Bank and just %16 percent are about “upper-middle income” ones. It is also given that number of articles almost tripled in last three years as it can be seen from the Figure 5 given below. (C. K. Behera & Kumra, 2023)It is worth to note that Türkiye shares this “upper-middle income” level with a significant amount of the World Population such as Latin American Countries, Russia and China and most of the far east countries. Hence, it is a clear sign that the percent of studies in Türkiye about MPS is not enough. Such an implication is decisive for this thesis study.

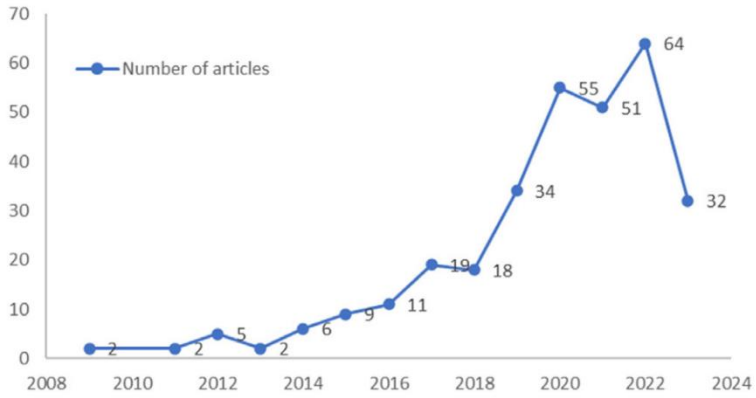

Figure 5: Number of Articles on MPS, (C. K. Behera & Kumra, 2023)

Türkiye is a country characterized by a youthful population with more than 85 million citizens. There are around 83 million active mobile subscribers as of 2023 Q3 as reported by BTK. It is stated that penetration rate is 114,8% calculated by BTK by excluding M2M subscribers and also removing part of the population aged 0-9 children. (BTK, 2023) Detailed information about penetration rates and number of mobile subscribers are shown in detail given Figure 6 below. High population rate with young demographics which many countries around the globe don't possess makes Türkiye an important case to study for MPS.

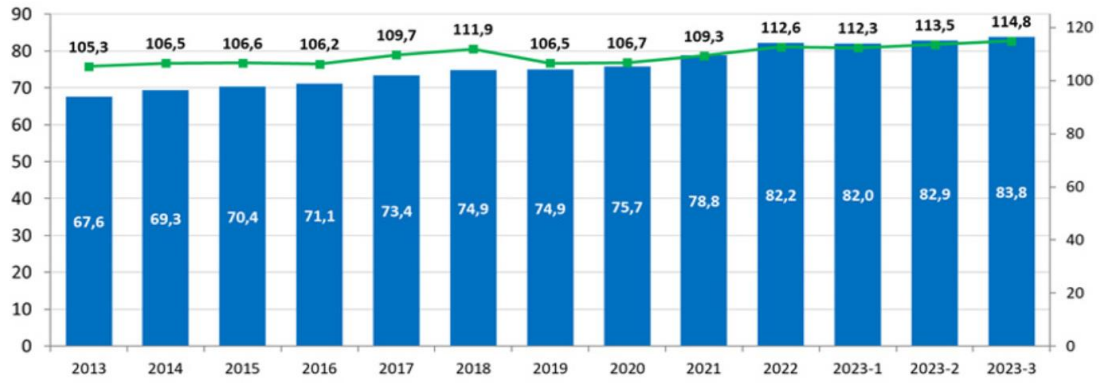

Figure 6: Number of Mobile Subscribers in Türkiye, (BTK, 2023)

Finally, Dahlberg et al., 2015 notes that despite the vital role that tourism, EduTech, and MSME industries play in economic growth, research on the influence of MPS in these sectors is limited. Industry-specific knowledge can improve the applicability and effectiveness of research findings on MPS implementation in these sectors. Targeted strategies and interventions can be developed to facilitate the successful adoption and utilization of MPS, ultimately contributing to the sustainable growth and competitiveness of these industries. Therefore, the motivation behind the selection of the Solipay MPS solution which is applied at 15 universities around the country can be understood clearly.

1.4. Scope

This thesis study mainly focuses on bringing out and clearly understanding relations between barriers which hinder mobile payment systems' adoption among the population. It can be claimed that universities can be seen as pioneers in technology production and use among the population of a country which is an essential factor contributing to the selection of universities as subjects of analysis in this research.

Türkiye has more than 200 universities with varying sizes, reputation and history. Among all, Middle East Technical University (METU) which is one of the leading universities of Türkiye in terms of population size, history, reputation and quality of academic studies, is chosen for the case analysis study.

There are a number of reasons for the selection. First of all, METU uses MPS technologies heavily on campus for a number of services such as campus cafeteria and sports facilities. Solipay(*Solipay-SoliClub | Mobile Payment System*, 2024), which is provided by a company which is named as UTARIT Information Technologies, is the main MPS solution application for METU. Solipay is also used by 15 universities around the country according to the official web page at the time. Solipay has many features and use case scenarios which can be customized for each universities' needs. Such a widespread application and big population implies better generalizability of the results obtained from the study.

Even though main features of Solipay application persists in general, this study mainly focuses on Solipay application's use case scenario and features for METU campus which may or may not be valid for other universities. QR code is the main type of MPS technology used by Solipay application for METU campus with a variety of options to add credit including cash kiosk points, credit cards and BKM Express which is a well-known digital wallet in Turkey that allows its users to link their credit and debit cards to their virtual wallet.

Interpretive Structural Modelling (ISM) is mainly used for this case analysis study with its known limitations.

1.5. Research Questions

The objective of this thesis study is to undertake an in-depth analysis of mobile payment technologies, with a particular emphasis on their utilization by users within a confined geographical area, such as a university campus. The study aims to identify and investigate any potential barriers that may hinder the successful adoption of these technologies. By employing the interpretive structural modeling (ISM) methodology, the interrelationships and dependencies among these barriers will be systematically examined. The findings of the study will contribute to the body of knowledge on mobile payment technologies and provide valuable insights for developers seeking to enhance their usability and adoption.

Interpretive structural modeling (ISM) is selected for the case analysis due to the intricate nature of the problem defined, involving multiple dimensions and stakeholders. End-users, developers, regulators, and service providers are among the parties involved in the issue. Technology, culture, costs, security, privacy and many other dimensions or factors make the issue highly complex. ISM provides a valuable means to explore the relationships among all these parties, factors and dimensions with establishing a more comprehensive definition of the problem.

The primary research questions that will be investigated in this thesis are as follows:

1. What are the primary impediments to the acceptance of mobile payment systems among university populations in Turkey?

2. What are the primary relationships among obstacles encountered in the adoption of MPS within the context of university populations of Türkiye?

3. What are the potential solutions or recommendations that can be formally put forward to alleviate the impact of barriers in the adoption of MPS for service providers?

As discussed earlier, the scarcity of research studies on this critically significant and intricately nuanced issue is evident when comparing our country to other developed nations. Therefore, the main contribution of this thesis study will be to enrich the literature of MPS adoption studies within the context of Türkiye and propose possible solutions or at least help to show directions on the road to solution.

1.6. Summary

This chapter presents a concise overview of MPS basics and its evolution, followed by the explanation of research motivation, scope and research problem definition.

The subsequent chapter will comprehensively present the current body of literature on MPS, encompassing its various types, historical evolution, enabling technologies, infrastructural requirements, ecosystem dynamics, and the existing barriers that have been identified in the research literature regarding its adoption. The chapter will also discuss the theoretical underpinnings that have been employed in the study of MPS.

The research methodology and techniques including the ISM with the steps for data collection, will be presented in the following chapter.

Chapter 4 presents a thorough description of the implementation of the ISM technique as well as the outcomes of the analytical activities at each step of ISM Implementation.

In conclusion, Chapter 5 seeks to analyze and synthesize the findings to address the research inquiries posed by the thesis study. Additionally, Chapter 5 presents insights gained from the research and proposes directions for future work.

CHAPTER 2

2. LITERATURE REVIEW

2.1. MPS Definitions

Mobile Payment has been evolving through the last few decades. Consequently, its definition has also undergone evolution. Early researchers, appearing in literature around the 2000s, defined it as simple as any type of payment made via a mobile handset. (Krueger, 2001) Then, broader definitions seem to appear with inclusion of participants and security concepts. Mobile payment, referred to as a modern or traditional form of secure monetary transaction, is conducted through mobile network systems, facilitating peer-to-peer or business-to-peer transfers. (Van Der Heijden, 2002)

In their work, Karnouskos and Fokus (2004) have proposed mobile payment as an exceptional solution not solely restricted to e-payments, but also with the potential to enhance e-commerce and m-commerce. Their definition of m-payment encompasses any payment process initiated, activated, or approved using a mobile device. Hence, the definition was expanded to include the process of mobile payment. Then, Turowski & Pousttchi (2004) contributed to the previous definition by adding the "authorization" and "realization" aspects of the payment.

In 2005, Dewan and Chen defined mobile payments as the process of using mobile devices like wireless handsets, personal digital assistants (PDAs), radio frequency (RF) devices, and NFC-based devices to make payments. So, a more detailed definition of what may refer to a mobile handset was.

According to Mallat, (2007), mobile payments can be utilized for a range of peer-to-business transactions, including ticketing, utility bill payments (phone and others), digital services payments (games, subscriptions, ringtones, etc.), and payments at point-of-sale (PoS) and vending machines, among other potential points. Hence, focus of definition was shifted to the receiver party of the mobile payment with including various services and also payment accepting device types.

In 2006, Ondrus and Pigneur defined mobile payment as a wireless transaction between two parties using any mobile device. They emphasized that the mobile device's physical appearance can vary, but it should have the capability to securely process the payment. Dahlberg et al. (2007) and Ghezzi et al. (2010) also stated that other types of communication technologies, such as Bluetooth, RFID, or NFC, can be employed to make payments for bills, services, and goods.

Another broader definition of MPSs, as given by Au & Kauffman, (2008) involved using a mobile device to start, authorize, and finalize financial transactions in exchange for goods and services.

Diniz et al. (2011) briefly defined mobile payment as a digital payment method conducted through portable handheld devices, with or without the involvement of telecommunication networks and not necessarily the participation of financial institutions and banks.

In their definition of mobile payment transactions, De Bel and Gâza, (2011) included the concepts of initiation and confirmation but omitted authorization.

Liébana Cabanillas (2012) concisely defined MPS in a manner that highlights the integral components of this form of business activity as the use of an electronic device connected to a mobile network, facilitating the successful completion of an economic transaction.

As outlined by Arvidsson (2014), MPS enable point-of-sale payments at both online and offline stores, offering users the convenience of making payments anytime, anywhere using their smartphones by employing encryption and authentication measures for enhanced overall security of the payment process.

In their 2015 study, Dahlberg et al. elaborated on the definition of mobile payment. They described it as a type of virtual payment facilitated by a mobile device, where money is transferred remotely or in close proximity from the payer to the receiver. This transfer can occur directly or through an intermediary, and it can be made in exchange for a service, a product, or as a money transfer.

As a recent definition stated by Luna (2017), MPS is a financial process, either personal or business-related, where electronic mobile communication devices are utilized to commence, authorize, and execute financial transactions.

It can be said that the definition of MPS is in a constant evolution process because of disruptive and rapid technological advancements in the last few decades. In addition to technological advancements, recently emerging business paradigms are challenging the established definitions and necessitating their revision inevitably.

2.2. Types of MPS

Classification of MPS depends on many parameters such as amount of payment, charging method, validation of tokens used, business model or location. In this section, we present some basic and self-explanatory forms of MPS classifications as reference information that may be helpful to note. Firstly, Micro, Mini and Macro mobile payments are types of MPS based on the range of values charged on payment. Next, Post-paid and Pre-Paid mobile payments are types of MPS based on the charging method of credit. Another type of classification, Online and Offline mobile payments are types of MPS based on validation methods tokens exchanged. In continuation, Business models form a type of

classification for MPS such as Consumer to Consumer (C2C or P2P), Consumer to Business (C2B), Consumer to Machine (such as vending machines) or Consumer to Online (Shin, 2009).

Finally, the main concern of this study is MPS categorization based on location such as remote and proximity mobile payments as given at Figure 7. Keyword of contactless is also used as a synonym for proximity payments. Therefore, these types will be given in detail in related sections. However, it is worth noting that any type of MPS technology may belong to a number of classifications or categories of classifications at once.

Types of MPS based on location are mostly self-explanatory and the most common type of categorization. However, it is useful to explain the primary difference in terms of technology. Remote Mobile Payment (RMP) utilizes less advanced technologies like cellular networks (or WiFi), and the payer and payee are often separated in time and space. RMP, exemplified by the SMS payment method, was the earliest mobile payment solution developed to facilitate online purchases and mobile phone bill payments (Kim et al., 2010; Slade et al., 2015). But, CMPs/PMPs (Contactless Mobile Payment, Proximity Mobile Payment) employ more advanced technology, such as near-field communication (NFC), to facilitate cashless transactions. This is achieved by presenting the smart device equipped with the payment platform at the POS terminal, eliminating the need for physical contact between the consumer's payment device and the retailer's equipment (Lacmanoviü et al., 2010).

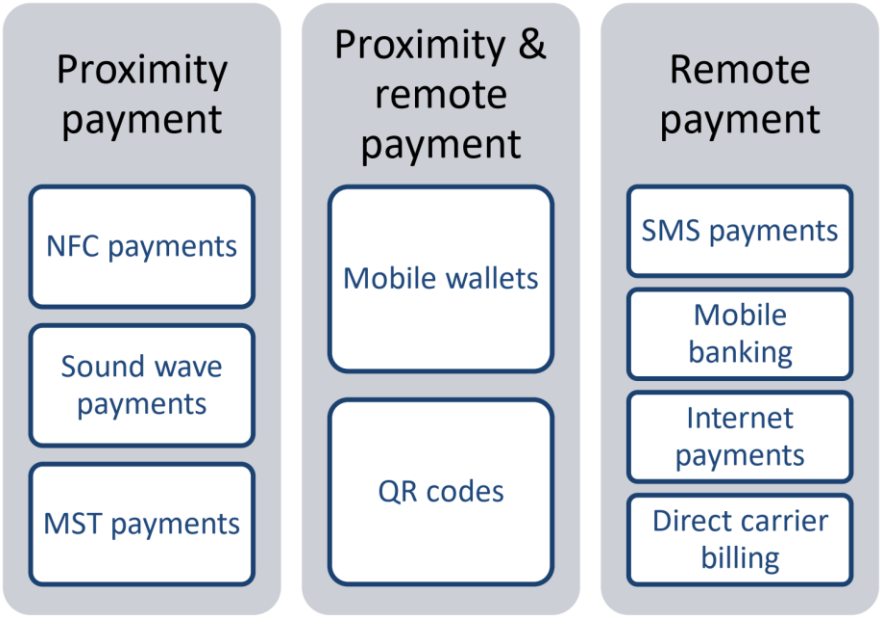

Figure 7: Types of Mobile Payment Systems (MobileTransaction, 2018)

2.2.1. Proximity/Contacless Mobile Payments

Proximity payments are specifically designed for close-range transactions between payers and payees. They eliminate the need for physical contact, making them ideal for various everyday scenarios such as shops or public transport. For example, in shops, customers can simply tap their payment-enabled device on a point of sale equipment to complete their purchase quickly and securely. This not only reduces queues but also enhances both convenience and hygiene. Public transportation systems have also embraced proximity payments to streamline the process of fare collection which eliminates physical tickets. Proximity payments have become increasingly popular due to their numerous advantages such as speed, convenience, and security. Additionally, they promote a cashless society, reducing the reliance on physical cash and fostering a more efficient and sustainable payment ecosystem. With the relentless progress of technology, proximity payments are poised to become increasingly ubiquitous in the years to come. Major technologies used for this type of payment will be given in subsections.

2.2.1.1. NFC

Close-range wireless technology called **Near Field Communication (NFC)** enables data exchange between various devices. This technology facilitates a wide range of applications, one of which is payment processing (Luna, 2017).

According to de Kerviler et al. (2016), smartphones or any other devices equipped with radio frequency identification (RFID) technology can be used to facilitate payments through Near Field Communication (NFC) due to their ability to emit low-energy sensing signals.

With the increasing popularity of smartphones and their diverse applications, NFC has gained substantial traction. Unlike SMS payment systems, NFC payments are conducted in person at a store or a compatible terminal by simply bringing a mobile device near the terminal. This technology has garnered significant attention due to its user-friendly approach to data exchange, which involves merely bringing devices close together. Furthermore, NFC's applications are limitless and can be integrated into various features (Luna, 2017).

NFC technology, as described by Grassie (2007), has several advantages:

- **Scope and Availability**: NFC can be implemented in all existing mobile terminals with a dedicated chip, enabling a wide range of new services for users and the device itself.

- **Wide Range of Applications**: NFC technology can be used for various purposes, including bill payments, car payments, and leisure activities.

- **Ease of Use**: NFC requires minimal effort, as the parties involved only need to be within a specific proximity.

- **Security**: NFC payments are secure as they require the user to manually activate or approach the receiver for payment, ensuring proactive user behavior.

- **Added Value Services**: NFC can be used on devices with contactless features as a platform for cash withdrawals, payments, and transport payments worldwide.

- **Economic Attractiveness**: NFC is based on open standards, eliminating the need for licensing fees, making it economically attractive for users and developers.

Apple Pay and Samsung Pay are prime examples of NFC mobile payment technologies, enabling the efficient and contactless exchange of funds.

2.2.1.2. MTS

Magnetic secure transmission (MST) technology establishes a link between a user's mobile device and the payment terminal using "magnetic" signals. This process imitates the magnetic connection created when swiping conventional credit cards. MST technology's main advantage is its compatibility with most NFC-ready terminals or even just terminals with a magnetic stripe reader. MST-enabled devices, in fact, work with most card readers that don't need cards to be inserted into the terminal. Users can initiate a connection by simply holding their phone near where a card would be swiped. Utilizing MST technology eliminates the need for frequent upgrades for merchants, while customers benefit from increased accessibility of this payment solution at various locations. Samsung obtained the technology from LoopPay in 2015. Note 5 and the Galaxy S6 series, as well as all subsequent models of phone and Gear and Galaxy fitness watches, have shipped with Samsung's MST technology. (samsung.com, 2017) However, this is a proprietary technology offered by Samsung Pay. LG also has had a similar proprietary technology called Wireless Magnetic Communication (WMC). (lg.com,2017) But, it is already discontinued.

2.2.1.3. Sound Wawe Payment

Sound Based Payment technology enables contactless payments using sound waves, transcending platform limitations. Its versatility extends to various devices like smartphones, mobile phones, card swipe machines, and point-of-sale devices, offering a seamless payment experience.

Sound Based Payment technology facilitates offline, contactless payments in proximity by utilizing encrypted sound waves. It employs a unique Software Development Kit (SDK) capable of encoding data into audible signals. Transmitted wirelessly, these sounds leverage existing payment infrastructure for seamless transactions. (*Sound Wave Payment | Ambimat Electronics*, 2024)

Sound-based payment technology allows seamless integration with current hardware, enabling offline transactions even in extreme conditions, with an assurance of accessibility, cost-effectiveness, convenience, security, and speed.

The technology may be helpful in countries with low smartphone penetration rates. However, it is still an emerging technology.

2.2.2. Remote Mobile Payments

Remote Mobile Payment (RMP) relies on technologies such as cellular networks or WiFi, differentiating it from more recent solutions. In RMP, the payer and payee are frequently separated in both time and space. Exemplified by the SMS payment method, RMP emerged as the pioneering mobile payment solution, enabling the ease of online purchases and payments of phone bills (Kim et al., 2010; Slade et al., 2015).

2.2.2.1. SMS Based Payment

As stated by Valcourt et al. (2005), mobile payment via SMS necessitates a communication protocol that facilitates the exchange of short text messages between two mobile devices.

In certain African nations, SMS mobile payment has gained prominence. These nations often have sizable unbanked populations, where cash is both frequently used but dangerous to use, and where smartphone ownership and internet availability are limited (Lowry, 2016).

Concerns have emerged surrounding consumer protection in SMS payments billed directly to mobile phone invoices which include third-party charges appearing on phone bills (Luna, 2017). Consequently, its popularity has waned.

2.2.2.1. Direct Carrier Billing

In this payment system, mobile network operators are utilized to facilitate payments rather than banks. The process involves entering a phone number, and upon successful authentication, the payment occurs either through the deduction of funds from a prepaid account or the addition of the charge to a postpaid bill. Consequently, the consumer settles the bill with the telecommunications company (Carr, 2007).

The payment process of DCB is integrated seamlessly into apps or websites. It is mostly used for digital subscriptions, in-app purchases, streaming services, and larger digital content purchases.

Main advantages are seamless user experience, higher transaction limits than SMS option, no banking requirement. Carrier fees and complexity of setup for merchants are main disadvantages of DCB

2.2.2.1. Internet Payments

This type of payment is conducted through mobile browsers like Chrome. When a person enters card details and clicks on specific links, the money is transferred to the intended recipient. It is simple as the name implies.

2.2.2.2. Mobile Banking

This type of payment requires a mobile app. The app is developed by banks and requires consumers to install it on their smartphones. The app can be used once the app verifies that the SIM card in the phone matches the phone number linked to the account. After this, the smartphone can be used to access the account, check account balances, view transaction history, transfer funds, and generate statements (Shankar & Kumari, 2016).

Such apps basically allow bank account owners to make payments directly from their bank account using smartphone or tablet through the bank's mobile app. This includes sending money to friends, paying bills, or making purchases online and in-store.

Almost all major banks offer mobile banking apps with payment functionality mainly because of its advantages for the bank such as lower number of employees and offices. It is also creating advantages for customers such as ease of use, security, time savings and 7/24 availability of banking services. However, it requires logging in the banking app each time which decreases the quality of user experience for daily activities.

2.2.3. Proximity & Remote Mobile Payments

These types of mobile payments can be conducted with both close proximity and remote access. Hence, it can be claimed that these are hybrid types. Mobile wallets and QR Codes are major branches of this type of MPS.

2.2.3.1. Mobile Wallets

Mobile wallets mean virtual wallets which are secure digital platforms, usually accessible through mobile applications, that facilitate payment processes. They operate by using a complex system to protect user data. Consumers add funds to their virtual wallets by providing their bank or card credentials. The mobile device then acts as a secure transmitter of payment information, allowing users to make payments in close proximity or through online platforms (Abadzhmarinova, 2014).

Mobile wallets come with numerous advantages: they reduce cash handling concerns, minimize fraud, expedite payments, and save effort and time (Shaw, 2014).

Typically, these are applications or platforms that securely store users' payment information, such as credit/debit card details, bank account information, and even cryptocurrencies. Examples include Apple Pay, Google Pay, Samsung Pay, and PayPal.

BKM Express mobile wallet system exists in Türkiye as a well-known country local example, which allows users to merge multiple bank accounts into a single mobile application. This system combines various banking features and seamlessly routes funds into a unified interface.

2.2.3.2. QR Code Payments

QR is an acronym for quick response. Apart from the previously mentioned forms of contactless communication, QR codes are another form of such communication. Denso Wave invented QR codes in the year 2000. A QR code is a two-dimensional bar code that can be printed or displayed on a screen and scanned by a special reader to provide more information than traditional bar codes. QR codes can be used to store a variety of information, including web addresses, basic texts, and numeric information such as phone numbers and coordinates (Fonseca et al., 2012).

In the realm of mobile payments, QR codes, a type of two-dimensional barcode, have emerged as an innovative technology (Gao et al., 2009; Gao & Küpper, 2006).Certain specialized applications enable users to instantly transfer money to payees by simply pointing their mobile camera at the recipient's digital payment code. This functionality eliminates the need for manual entry, making it convenient and expeditious, even when done remotely.

The scientific literature contains numerous studies exploring the implementation and diverse applications of QR codes. These applications range from mobile ticketing for passengers (Cheng & Huang, 2013) to mobile learning initiatives (Hsin-Chih Lai et al., 2013).

QR codes allow users to conveniently make purchases using their mobile phones, revolutionizing the traditional payment methods. Becoming fast, contactless, ubiquitous, convenient, cost effective for both merchants and users make it ideal for mobile payments. However, it is also susceptible to phishing attacks in rare cases. Users should be careful for the source of QR codes. Developers and merchants also should be careful for encryption of data given at QR codes. For example, some apps generate unique data for each transaction to enhance security.

Some of the well-known global examples which heavily use QR Code Payments are PayPal, Venmo, Alipay and WeChat Pay. There are numerous local and global banking or merchant-specific apps using QR Code Payments such as İşCep, MaximumMobil and Utarit Solipay (*Solipay-SoliClub | Mobile Payment System*, 2024) which is also analyzed for the case study in this thesis.

2.3. MPS Architecture

To provide a clearer understanding of the MPS concept, this section briefly describes the fundamental architecture of MPS, as depicted in Figure 8. Key parties and concepts involved in the system are;

- **Customer:** The individual with the mobile device which mobile payment app installed.
- **Merchant:** The store accepting the mobile payment with a compatible device.
- **Payment Gateway/Processor:** Handles secure communication and facilitates the transaction. (Usually embedded in merchant's terminal device)
- **Acquiring and Issuing Banks:** The merchant's and the customer's banks.
- **Card Payment Networks:** (e.g., Visa, MasterCard) Route the transaction to the appropriate bank.
- **PAN:** The primary account number of the customer (sensitive card data).
- **Token:** Randomized stand-ins for sensitive payment card data.
- **Token Service Provider:** Firms managing the token lifecycle with tokenization, storing, transferring and de-tokenization.

Key steps of a mobile payment which shown at the Figure 8 are;

1. **Tokenization:** Before the transaction, the customer's sensitive card data is replaced with a unique token (a secure digital stand-in) within their mobile app.
2. **Tap to Pay:** Customer taps the device on the NFC or such compatible technology enabled payment terminal. QR code scanning is also valid.
3. **Data Transmission:** The mobile app transmits the payment token, merchant ID, and transaction details securely to the payment terminal.
4. **Payment Gateway:** The terminal forwards information to the payment gateway which is usually embedded in the terminal device.
5. **Authorization Request:** The payment gateway communicates with the card network over the acquirer's bank which routes the request to the customer's issuing bank.

6. **Verification and Approval:** The issuing bank verifies the customer's account, token validity, and available funds over token service provider. If everything checks out, it approves the transaction.

7. **Confirmation:** Approval is sent back through the card network, payment gateway, and terminal.

8. **Funds Transfer:** The issuing bank releases funds to the merchant's acquiring bank.

9. **Settlement:** The acquiring bank deposits funds into the merchant's account (usually after deducting fees)

10. **Notifications:** Customer and merchant receive payment confirmations

The exact flow of the process can vary slightly depending on the specific payment provider and the type of mobile payment being used. Nevertheless, the entire process is completed in seconds, providing a seamless user experience.

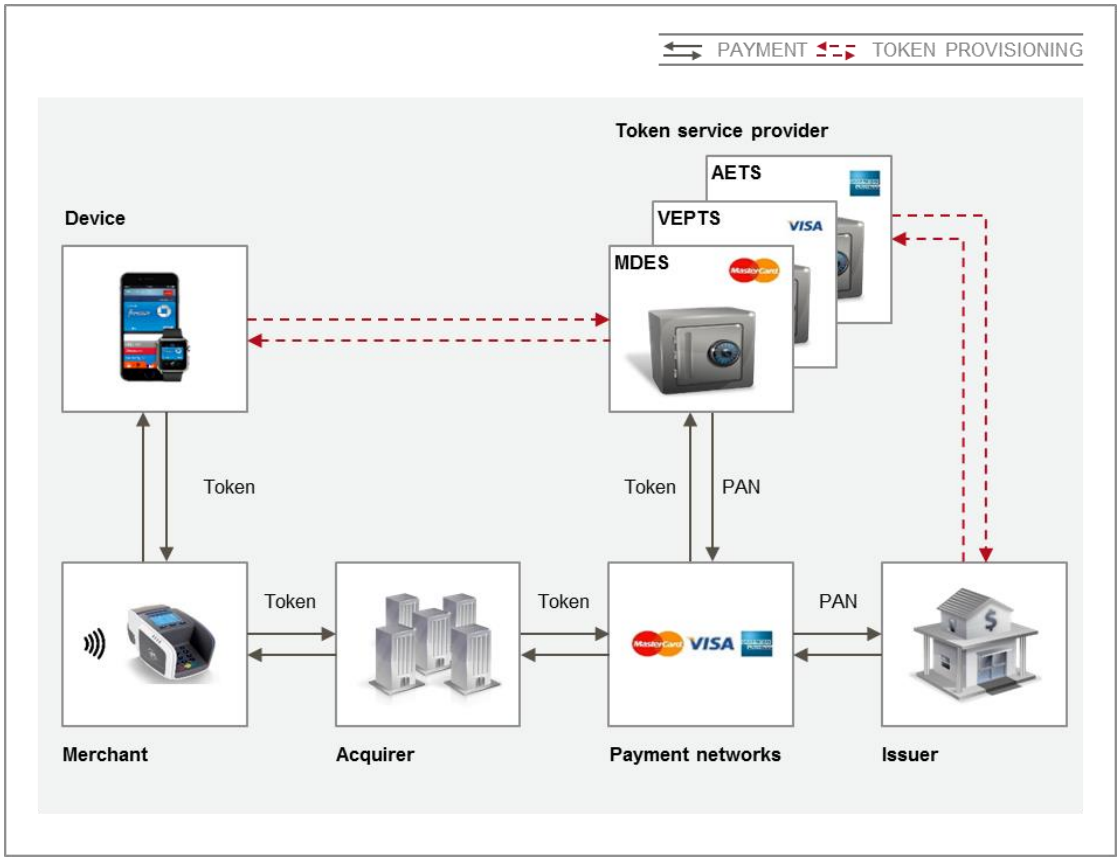

Figure 8: Mobile Payment Systems Architecture, (Meyer, 2016)

2.4. MPS Habitat Players

The MPS habitat typically encompasses the stakeholders or members depicted in Figure 10 and which is also given below, accompanied by comprehensive explanations.

However, it is worth noting that MPS is a rapidly evolving area which means its habitat with all of the players are also evolving. During this rapid evolution, some of the players may go extinct and new ones may emerge with new technologies, threads or regulations. In some cases, roles explained below may also overlap in the same entity. Moreover, the exact players and their impacts or functions can vary based on the country or region.

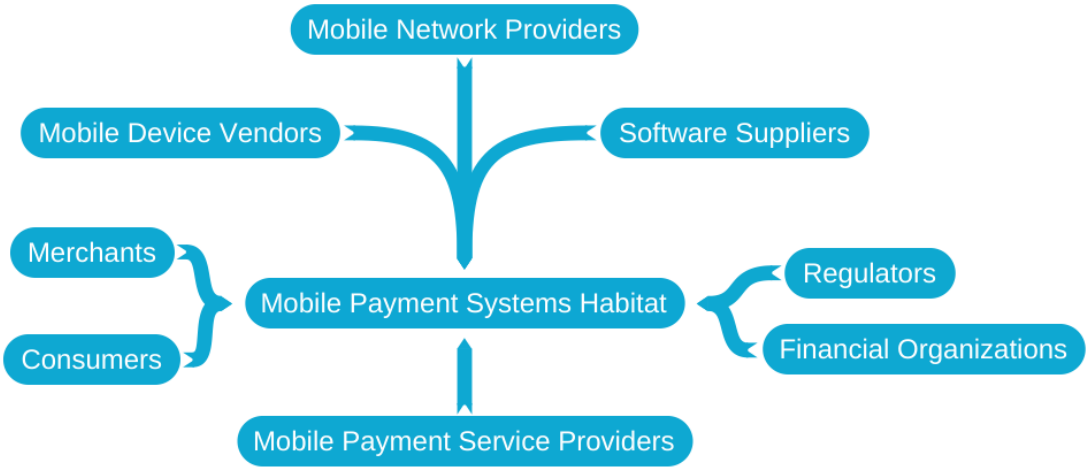

Figure 9: MPS Habitat Players

- **Consumer:** In mobile payments, the consumer is the individual who initiates, activates, and confirms the payment using a mobile device. As the payer, the consumer is the party responsible for making the payment. (S. Karnouskos and Fokus, 2004)

- **Merchant:** They are represented with the physical stores or web portals where goods and services can be purchased using mobile payments. They are known as the payees and accept the payments from customers. (S. Karnouskos and Fokus, 2004)

- **Financial Organizations:** Issuing and acquiring banks, payment processors (PayPal, Stripe etc.) and payment networks (Visa, MasterCard etc.) form this category and handle monetary issues during the whole payment process.

- **Mobile Payment Service Providers:** In the realm of NFC applications, developers create wallet applications or user interfaces that can be downloaded from app stores. (Penttilä et al., 2016) These developers can come from various

related fields or be third-party entities. The primary responsibility of these application providers is to securely store virtual money and only execute transfers after proper authentication is provided.

- **Mobile Network Providers:** Telecom companies providing critical infrastructure for MPS. They may play a direct role in some mobile payment systems (carrier billing, NFC-SIM based solutions)

- **Mobile Device Vendors:** The primary responsibility of device manufacturers is to continuously upgrade technology by enhancing the capabilities of devices to execute mobile payment services effectively. (S. Karnouskos and Fokus, 2004) These devices should serve as reliable intermediaries between banks and mobile network operators (MNOs), ensuring secure and convenient transactions. (Dennehy & Sammon, 2015) Manufacturers must prioritize providing safe and dependable devices at reasonable prices, upholding customer trust and satisfaction.

- **Software Suppliers:** Developers create software that adheres to standards, making it suitable for users and available in the market. (S. Karnouskos and Fokus, 2004) Additionally, this software includes servers and their maintenance staff, which are essential for managing such vast amounts of data.

- **Regulators:** Governmental agencies and central banks setting regulations and standards for the payments industry.

2.5. Significance And Impact of MPS

2.5.1. Convenience and Accessibility

Mobile payment systems offer unparalleled convenience by allowing users to make transactions anytime and anywhere, reducing the need for physical wallets or cash. (Cruz et al., 2010)

2.5.2. Enhanced Security Measures

Many mobile payment systems integrate advanced security features like biometric authentication (fingerprint, facial recognition), tokenization, and encryption, making transactions more secure than traditional methods.

2.5.3. Financial Inclusion

MPS have the potential to bring financial services to underserved populations, enabling them to participate in the formal financial system, fostering economic growth and stability especially in developing countries. (GSMA, 2018)

2.5.4. Business Advantages

Mobile payment systems have transformed business models, enabling small businesses and entrepreneurs to accept payments easily, leading to increased sales and improved customer experiences. Mobile payments also offer cost-effective solutions, faster transactions and customer retention.

2.5.5. Technological Advancements

With ongoing technological innovations, mobile payment systems continue to evolve, incorporating new features like wearables, IoT (Internet of Things) integration, and blockchain-based transactions for further convenience and security.

With the increasing dependence on smartphones and digital devices, mobile payment systems align with evolving consumer behaviors, preferences, and the shift towards a cashless society. The widespread adoption of mobile payment systems has not only transformed consumer payment habits but has also influenced financial institutions, businesses, and economies, shaping the future of digital transactions and financial services.

Mobile payment systems' significance in modern economies lies not only in their transactional capabilities but also in their potential to reshape financial landscapes and foster inclusive growth across various sectors.

2.6. Theories used in MPS Acceptance Research

A review of acceptance research in the context of MPS during thesis study uncovered a diverse landscape of theoretical frameworks utilized to depict the complex interplay of factors impacting acceptance of MPS and relations among them. These frameworks provide invaluable insights into the complex dynamics at play in MPS acceptance, shedding light on the multifaceted nature of the phenomenon.

Moreover, a majority of scholars seem to have opted to utilize a combination of multiple theories in addressing the complex and multidimensional nature of the problem.

Comprehending these theoretical frameworks is essential for researchers and practitioners aiming to understand and enhance MPS acceptance. By integrating insights from diverse frameworks, a holistic understanding of the factors influencing MPS acceptance can be achieved. Therefore, brief explanations and main points of the most commonly used ones of these theoretical frameworks will be mentioned at this section.

2.6.1. TAM

The Technology Acceptance Model (TAM), formulated by Davis in 1989, expands the structure of the Theory of Reasoned Action (TRA). It posits that an individual's acceptance

of a technology is determined by their intention to use it voluntarily. This intention is shaped by the person's attitude toward using the technology. Attitudes, in turn, are influenced by two primary beliefs: perceived usefulness (PU) and perceived ease of use(PEU). TAM has gained widespread recognition and validation across various domains. Its well-established theoretical foundation and empirical support make it a valuable tool for researchers. TAM is often used in isolation or in combination with other relevant theories in management information systems (MIS) research. TAM is used for research on MPS adoption. (Shaw, 2014) Mobile wallet adoption is also another field for the use of TAM. (N. Singh & Sinha, 2020)

2.6.2. UTAUT

The Unified Theory of Acceptance and Use of Technology (UTAUT) is an extension of the Technology Acceptance Model (TAM). It was developed by Venkatesh et al. (2003) to forecast users' intentions to adopt or use new technologies. The key constructs of UTAUT are performance expectations, effort expectancy, social influence, and facilitating conditions.

Research on UTAUT in the context of MPS involves analyzing stakeholders' behavior before, during, and after adoption. Despite the UTAUT theory's inconsistent results in elucidating post-adoption behavior (Y. Kim & Crowston, 2011), some research has employed it to explicate such behavior. For instance, (N. Singh et al., 2020) integrated the UTAUT theory with the ECM model to unravel continuance usage behavior of MPS. Explanation of MPS adoption is tried to be made with combination of UTAUT and TAM. (Thakur & Srivastava, 2014) Another similar study also followed the same combination to get better results with the combination of UTATUT and TAM. (Chawla & Joshi, 2019)

2.6.3. Diffusion of Innovations DOI

Rogers', (1995) Diffusion of Innovations Theory (DOI) postulates that the qualities of an innovation, rather than individual views, determine the adoption of new technologies. The elements of Rogers' innovation diffusion theory include relative advantage, complexity, compatibility, trialability, and observability. The theory's emphasis on adoption, consideration of social influence, attention to contextual factors, and broad applicability make it a valuable tool for understanding the adoption and diffusion of mobile payment systems (MPS).

Shaw et al. (2022) conducted a multinational study on m-wallet adoption. In their research model, they modified the Diffusion of Innovation (DOI) theory by considering compatible advantage as a combination of compatibility and relative advantage, while eliminating complexity. Another study tried to explain intentions to use with DOI.(Kaur, Dhir, Bodhi, et al., 2020)

2.6.4. Innovation Resistance Theory IRT

The Innovation Resistance Theory (IRT), proposed by Ram & Sheth in 1989, offers a theoretical framework to categorize factors that affect customers' resistance to new products or services. These factors are grouped into functional and psychological barriers and include usage, risk, value, tradition, and image.

To understand the low acceptance rates of MPS, researchers have used IRT to explore the variables that prevent the acceptance and use of mobile payment technologies. IRT mainly emphasizes the pre-adoption phase, overlooking the resistance that can arise during or after the adoption process. IRT is used in a study to understand MPS resistance. (Leong et al., 2020) Another study also used IRT to explain levels of resistance for MPS. (Talwar et al., 2021)

2.6.5. Push-Pull Mooring PPM

Originating from migration theory introduced by Ravenstein in 1885, the PPM framework analyzes users' switching intentions from multiple angles. Push factors, representing negative aspects, motivate individuals to leave their current location. On the other hand, pull factors, which are positive aspects, attract individuals to a new location, as explained by Bansal et al., (2005). Mooring factors, encompassing personal, social, and cultural variables, serve to moderate switching intentions. The PPM theory recognizes the significant impact of mooring factors, such as habit and inertia, in shaping users' continued usage behavior. This long-term perspective is especially pertinent in mobile payment research, where retaining users and promoting sustained usage are crucial for the success of mobile payment services.

In their study, Loh et al. (2022) employed the fundamental principles of the PPM in conjunction with the status quo bias theory to investigate the factors influencing consumers' switching intention from cash to mobile payment. Another study combined PPM and TAM with addition of UTAUT to explain adoption of MPS in stores. (Handarkho & Harjoseputro, 2020)

2.7. Factors Influencing Acceptance of MPS

Since the early 2000s, numerous studies have been conducted to investigate the factors that influence the adoption of MPS. A number of theories and their combinations were employed for different scenarios of MPS usage adoption, as mentioned in the preceding sections.

As a result of the high number of studies over the last two decades, researchers have identified almost a hundred factors that influence the adoption of various MPS technologies in different usage scenarios. These factors have been categorized, named,

and theorized in many ways. It was unsurprising to observe that some factors claimed have very similar definitions with different and interesting names.

In their studies, researchers also appeared to utilize different groupings or classifications for these combinations of factors. The categorization of factors can vary depending on the perspective of the researcher and the specific use case scenario, as a single factor may belong to multiple categories.

Creating a graphic representation is an effective method for gaining a visual understanding of multiple factors simultaneously in a structured and conceptual manner. Figure 10 is prepared for this purpose. However, it is important to acknowledge that the categorization utilized in Figure 10 is primarily intended to organize a substantial number of factors based on fundamental similarities. This approach aims to enhance readability and facilitate comprehension. As it is mentioned before, many factors may belong to more than one category and categories are also subjective based on researchers' aims and research contexts.

Figure 10: Literature-Derived Factors Influencing Mobile Payment System Adoption

In conjunction with Figure 10, which presents a concise summary of factors influencing MPS adoption, Table 1 provides citations for the related factors. There are 93 factors given at Table 1 for this literature review. Almost all of the factors have self-explanatory names. Hence, definitions for each item were not provided to keep such a long table shorter.

The most prevalent group of variables from literature search is demographics which include age, gender and income. In a study conducted by Ali et al. (2011) in Malaysia, the influence of demographic variables on the adoption of mobile banking was examined. Their findings indicated that demographic factors have a more significant impact on adoption compared to other factors. However, due to the conflicting nature of demographic research findings, making definitive claims can be challenging.

Privacy, trust and security related factors are also common for the adoption of MPS in addition to perceived usefulness and perceived ease of use. Social factors are another important group of common factors such as social norms, social influence, traditional barriers etc. There are also quite interesting factors studied in the literature such as playfulness or stickiness to cash.

There are too many similar factors in the literature with slightly different or really creative renaming. It is observed that researchers tried to explain the adoption of MPS with a combination of fundamental factors with addition of scenario, technology or culture specific factors. These factors given at Table 1 were reviewed through the thesis study. And 40 of 93 factors were used for the thesis study after an initial expert review followed by Delphi Method. Definitions for the selected factors are also given in related sections.

Table 1: Factors Influencing Acceptance of MPS

#	**Factors**	**References**
1	Adoption readiness	Chakraborty et al., 2022; Liu & Dewitte, 2021; Liu et al., 2021; Nguyen et al., 2021; Su et al., 2018; Thakur & Srivastava, 2014
2	Age	Boden et al., 2020; Chakraborty et al., 2022; Handarkho & Harjoseputro, 2020; Kumar et al., 2019; Slade et al., 2015; Zhou, 2013; Kabata, 2015; Ali et al., 2011
3	Attitude	Chakraborty et al., 2022; Liu and Dewitte, 2021; Liu et al., 2021; Nguyen et al., 2021; Su et al., 2018; Ramos-de-Luna et al., 2016; Schierz et al., 2010; Phonthanukitithaworn et al., 2015; Aydin & Burnaz, 2016
4	Behavioral beliefs	Yang et al., 2012; Keramati et al., 2012
5	Compatibility	Keramati et al., 2012; Aloysius et al., 2016; Al-Qudah et al., 2022; Al-Sharafi et al., 2022; Chawla & Joshi, 2019; Handarkho and Harjoseputro, 2019; Mallat, 2007; Phonthanukitithaworn et al., 2015; Aydin & Burnaz, 2016b; Mu et al., 2017
6	Complexity	Al-Qudah et al., 2022; de Kerviler et al., 2016; Loh et al., 2022; Mallat, 2007; Kaur et al., 2020; Singh et al., 2020; Verkijika & Neneh, 2021
7	Consumer engagement	Singh et al., 2020; Sun et al., 2020
8	Consumer trust	Chakraborty et al., 2022; Liu and Dewitte, 2021; Liu et al., 2021; Nguyen et al., 2021; Su et al., 2018
9	Convenience	Keramati et al., 2012; Aloysius et al., 2016; Al-Qudah et al., 2022; Al-Sharafi et al., 2022; Chawla and Joshi, 2019; Handarkho and Harjoseputro, 2019; Mallat, 2007
10	Costs	Al-Qudah et al., 2022; de Kerviler et al., 2016; Loh et al., 2022; Mallat, 2007; Keramati et al., 2012; Li et al., 2014; Lesa & Tembo, 2016

Table 1 cont.

11	Credibility	Y. Kim et al., 2016; Zhu et al., 2017
12	Customer involvement	Boden et al., 2020; Chakraborty et al., 2022; Handarkho and Harjoseputro, 2019; Kumar et al., 2019; Slade et al., 2015
13	Customer satisfaction	Singh et al., 2020; Sun et al., 2020
14	Deal promotion	Aloysius et al., 2016; Al-Qudah et al., 2022; Al-Sharafi et al., 2022; Chawla and Joshi, 2019; Handarkho and Harjoseputro, 2019; Mallat, 2007
15	Distribution network	Uwamariya & Loebbecke, 2020; Koomson et al., 2021
16	Ease of use	Kaur et al., 2020; Singh et al., 2020; Verkijika & Neneh, 2021; Aydin & Burnaz, 2016
17	Effort Expectancy	Oliveira et al., 2016
18	Enjoyment	Koenig-Lewis et al., 2015; Aloysius et al., 2016; Al-Qudah et al., 2022; Al-Sharafi et al., 2022; Chawla and Joshi, 2019; Handarkho and Harjoseputro, 2019; Mallat, 2007; Kaur et al., 2020; Singh et al., 2020; Verkijika & Neneh, 2021
19	Experience value / Functional Value	Singh et al., 2020; Sun et al., 2020
20	Facilitating conditions	Aloysius et al., 2016; Al-Qudah et al., 2022; Al-Sharafi et al., 2022; Chawla and Joshi, 2019; Handarkho and Harjoseputro, 2019; Mallat, 2007; Oliveira et al., 2016
21	Gender	Hamza & Shah, 2014; Boden et al., 2020; Chakraborty et al., 2022; Handarkho and Harjoseputro, 2019; Kumar et al., 2019; Slade et al., 2015; Zhou, 2013; Kabata, 2015
22	Hedonic motivation	Okello Candiya Bongomin et al., 2021; Koomson et al., 2021; Oliveira et al., 2016

Table 1 cont.

23	Image	Jaradat & Al-Mashaqba, 2014; Jaradat & Faqih, 2014
24	Income	Boden et al., 2020; Chakraborty et al., 2022; Handarkho and Harjoseputro, 2019; Kumar et al., 2019; Slade et al., 2015
25	Individual mobility	Ramos-de-Luna et al., 2016; Schierz et al., 2010; Y. Kim et al., 2016
26	Initial trust	Chakraborty et al., 2022; Liu and Dewitte, 2021; Liu et al., 2021; Nguyen et al., 2021; Su et al., 2018
27	Innovativeness	Boden et al., 2020; Chakraborty et al., 2022; Handarkho and Harjoseputro, 2019; Kumar et al., 2019; Slade et al., 2015; Aloysius et al., 2016; Al-Qudah et al., 2022; Al-Sharafi et al., 2022; Chawla and Joshi, 2019; Mallat, 2007; Oliveira et al., 2016
28	Interpersonal susceptibility	Peng et al., 2012
29	Lack of availability	Pinchot et al., 2016
30	Lack of awareness	Pinchot et al., 2016
31	Lifestyle	Aloysius et al., 2016; Al-Qudah et al., 2022; Al-Sharafi et al., 2022; Chawla and Joshi, 2019; Handarkho and Harjoseputro, 2019; Mallat, 2007
32	Low satisfaction	Kaur, Dhir, Singh, et al., 2020; Semerikova, 2020; Sharma et al., 2018
33	Mobile money adoption	Uwamariya & Loebbecke, 2020, 2020; Koomson et al., 2021
34	Number of merchants	Li et al., 2014

Table 1 cont.

35	Operation scenario / Use context	Li et al., 2014
36	Output quality	Jaradat & Al-Mashaqba, 2014; Jaradat & Faqih, 2014
37	Pain of payment	Chakraborty et al., 2022; Liu and Dewitte, 2021; Liu et al., 2021; Nguyen et al., 2021; Su et al., 2018
38	Payment adoption	Boden et al., 2020; Chakraborty et al., 2022; Handarkho and Harjoseputro, 2019; Kumar et al., 2019; Slade et al., 2015
39	Payment convenience	Chakraborty et al., 2022; Liu and Dewitte, 2021; Liu et al., 2021; Nguyen et al., 2021; Su et al., 2018
40	Perceived behavioral control	Lee et al., 2019; Liébana-Cabanillas et al., 2019; Mombeuil & Uhde, 2021; Pal et al., 2021; Talwar et al., 2020; Singh et al., 2020; Sun et al., 2020; Nguyen et al., 2016
41	Perceived benefits	Kaur et al., 2020; Singh et al., 2020; Verkijika & Neneh, 2021
42	Perceived compatibility	Hamza & Shah, 2014; Ramos-de-Luna et al., 2016; Schierz et al., 2010; Peng et al., 2012
43	Perceived cost	Anthony & Mutalemwa, 2014; Phonthanukitithaworn et al., 2015; Islam, 2016
44	Perceived ease of use	Jaradat & Al-Mashaqba, 2014; Hamza & Shah, 2014; Aloysius et al., 2016; Al-Qudah et al., 2022; Al-Sharafi et al., 2022; Chawla and Joshi, 2019; Handarkho and Harjoseputro, 2019; Mallat, 2007; Keramati et al., 2012; Koenig-Lewis et al., 2015; Schierz et al., 2010; Peng et al., 2012; Kabata, 2015; Wang & Idertsog, 2015; Y. Kim et al., 2016; Islam, 2016; Nguyen et al., 2016
45	Perceived enjoyment	Kabata, 2015; Nguyen et al., 2016

Table 1 cont.

46	Perceived expressiveness	Anthony and Mutalemwa, 2014
47	Perceived mobility	Anthony and Mutalemwa, 2014
48	Perceived privacy	Lee et al., 2019; Liébana-Cabanillas et al., 2019; Mombeuil and Uhde, 2021; Pal et al., 2021; Talwar et al., 2020
49	Perceived risk	Liébana-Cabanillas et al., 2019; Thakur and Srivastava, 2014; Koenig-Lewis et al., 2015; Shah et al., 2014; Islam, 2016
50	Perceived satisfaction	Kaur et al., 2020; Singh et al., 2020; Verkijika & Neneh, 2021
51	Perceived security	Al-Qudah et al., 2022; de Kerviler et al., 2016; Loh et al., 2022; Mallat, 2007; Ramos-de-Luna et al., 2016; Oliveira et al., 2016; Shah et al., 2014; Goeke & Pousttchi, 2010; Schierz et al., 2010; Peng et al., 2012; Kabata, 2015; Aydin & Burnaz, 2016; Pinchot et al., 2016
52	Perceived severity	Uwamariya & Loebbecke, 2020, 2020; Koomson et al., 2021
53	Perceived support from provider	Anthony and Mutalemwa, 2014
54	Perceived trust	Anthony and Mutalemwa, 2014; Phonthanukitithaworn et al., 2015; Nguyen et al., 2016
55	Perceived usefulness	Jaradat & Faqih, 2014; Jaradat & Al-Mashaqba, 2014; Hamza & Shah, 2014; Aloysius et al., 2016; Al-Qudah et al., 2022; Al-Sharafi et al., 2022; Chawla and Joshi, 2019; Handarkho and Harjoseputro, 2019; Mallat, 2007; Lee et al., 2019; Liébana-Cabanillas et al., 2019; Mombeuil and Uhde, 2021; Pal et al., 2021; Talwar et al., 2020; Uwamariya & Loebbecke, 2020, 2020; Koomson et al., 2021; Keramati et al., 2012; Koenig-Lewis et al., 2015; Schierz et al., 2010; Peng et al., 2012; Kabata, 2015; Aydin & Burnaz, 2016; Y. Kim et al., 2016; Nguyen et al., 2016

Table 1 cont.

56	Perception of external control	Jaradat & Al-Mashaqba, 2014;
57	Performance expectancy	Tossy, 2014; Oliveira et al., 2016
58	Personal innovativeness	Ramos-de-Luna et al., 2016; Aydin & Burnaz, 2016; Oliveira et al., 2016
59	Personal traits	Yang et al., 2012
60	Playfulness	Jaradat & Al-Mashaqba, 2014;
61	Price value	Oliveira et al., 2016
62	Privacy	Shah et al., 2014
63	Privacy concern	Chakraborty et al., 2022; Liu and Dewitte, 2021; Liu et al., 2021; Nguyen et al., 2021; Su et al., 2018; Y. Kim et al., 2016
64	Privacy risk	Kaur, Dhir, Singh, et al., 2020; Semerikova, 2020; Sharma et al., 2018; Al-Qudah et al., 2022; de Kerviler et al., 2016; Loh et al., 2022; Mallat, 2007; Liébana-Cabanillas et al., 2019
65	Product involvement	Boden et al., 2020; Chakraborty et al., 2022; Handarkho and Harjoseputro, 2019; Kumar et al., 2019; Slade et al., 2015
66	Provider reputation	Gong et al., 2020
67	Relative advantage	Behera et al., 2023; Kaur et al., 2020; Singh et al., 2020; Verkijika & Neneh, 2021
68	Relative convenience	Lee et al., 2019; Liébana-Cabanillas et al., 2019; Mombeuil and Uhde, 2021; Pal et al., 2021; Talwar et al., 2020
69	Reliability	Kaur et al., 2020; Singh et al., 2020; Verkijika & Neneh, 2021
70	Rewards	Aydin & Burnaz, 2016

Table 1 cont.

71	Risk barrier	Kaur, Dhir, Singh, et al., 2020; Semerikova, 2020; Sharma et al., 2018
72	Satisfaction	Lee et al., 2019; Liébana-Cabanillas et al., 2019; Mombeuil and Uhde, 2021; Pal et al., 2021; Talwar et al., 2020; Kaur et al., 2020; Singh et al., 2020; Verkijika & Neneh, 2021; Singh et al., 2020; Sun et al., 2020; Zhou, 2013
73	Security	Aloysius et al., 2016; Al-Qudah et al., 2022; Al-Sharafi et al., 2022; Chawla and Joshi, 2019; Handarkho and Harjoseputro, 2019; Mallat, 2007; Wang & Idertsog, 2015
74	Security risk	Kaur, Dhir, Singh, et al., 2020; Semerikova, 2020; Sharma et al., 2018
75	Self-compassion	C. K. Behera & Kumra, 2023
76	Self-efficacy	Jaradat & Al-Mashaqba, 2014; Lee et al., 2019; Liébana-Cabanillas et al., 2019; Mombeuil and Uhde, 2021; Pal et al., 2021; Talwar et al., 2020; Uwamariya & Loebbecke, 2020, 2020; Koomson et al., 2021; Y. Kim et al., 2016
77	Smartphone addiction	Boden et al., 2020; Chakraborty et al., 2022; Handarkho and Harjoseputro, 2019; Kumar et al., 2019; Slade et al., 2015
78	Social influence	Yang et al., 2012; Tossy et al., 2014; Rana et al., 2022; Aloysius et al., 2016; Al-Qudah et al., 2022; Al-Sharafi et al., 2022; Chawla and Joshi, 2019; Handarkho and Harjoseputro, 2019; Mallat, 2007; Gong et al., 2020; Lu et al., 2017; Koenig-Lewis et al., 2015; Oliveira et al., 2016; Kabata, 2015; Aydin & Burnaz, 2016; Y. Kim et al., 2016; Mu et al., 2017
79	Social norms	Hamza & Shah, 2014; Lesa & Tembo, 2016
80	Stickiness to cash	Boden et al., 2020; Chakraborty et al., 2022; Handarkho and Harjoseputro, 2019; Kumar et al., 2019; Slade et al., 2015
81	Stress to use	Gong et al., 2020; Lu et al., 2017

Table 1 cont.

82	Subjective beliefs	Phonthanukitithaworn et al., 2015
83	Subjective normalization	Li et al., 2014
84	Subjective norms	Jaradat & Al-Mashaqba, 2014; Jaradat & Faqih, 2014; Ramos-de-Luna et al., 2016; Schierz et al., 2010; Phonthanukitithaworn et al., 2015; Islam, 2016; Nguyen et al., 2016
85	Sunk costs	Kaur, Dhir, Singh, et al., 2020; Semerikova, 2020; Sharma et al., 2018
86	Switching cost	Kaur, Dhir, Singh, et al., 2020; Semerikova, 2020; Sharma et al., 2018
87	Tradition barrier	Kaur, Dhir, Singh, et al., 2020; Semerikova, 2020; Sharma et al., 2018
88	Traditional payment habit	Kaur, Dhir, Singh, et al., 2020; Semerikova, 2020; Sharma et al., 2018; Keramati et al., 2012
89	Trust	Tossy et al., 2014; Keramati et al., 2012; Aloysius et al., 2016; Al-Qudah et al., 2022; Al-Sharafi et al., 2022; Chawla and Joshi, 2019; Handarkho and Harjoseputro, 2019; Mallat, 2007; Lee et al., 2019; Liébana-Cabanillas et al., 2019; Mombeuil and Uhde, 2021; Pal et al., 2021; Talwar et al., 2020; Uwamariya & Loebbecke, 2020, 2020; Koomson et al., 2021; Mu et al., 2017; Zhu et al., 2017
90	Trust in provider	Li et al., 2014
91	Uncertainty avoidance	Gong et al., 2020; Lu et al., 2017
92	Usage barrier	Kaur, Dhir, Singh, et al., 2020; Semerikova, 2020; Sharma et al., 2018
93	Value barrier	Kaur, Dhir, Singh, et al., 2020; Semerikova, 2020; Sharma et al., 2018

2.8. Summary

This chapter has extensively reviewed various existing studies on MPS, tracing the evolution of these studies alongside the development of MPS technologies. Throughout the chapter, numerous definitions and available MPS technologies have been examined. Additionally, the main components of MPS architecture and players of MPS habitat have been defined. Significance and impact of MPS technologies given in a summarized way. Frequently employed theories used for MPS adoption also have been revised. Factors extracted from the literature, which are used to explain MPS adoption, have been concisely presented for utilization in subsequent chapters. Finally, an attempt has been made to summarize existing research studies in the context of Türkiye.

CHAPTER 3

3. METHODOLOGY

3.1. Introduction

This chapter presents an exploration of the research methodology utilized in this thesis study. The primary objective of the thesis research is to analyze the correlations between barriers to the adoption of mobile payment systems within the context of the Solipay (*Solipay-SoliClub | Mobile Payment System*, 2024) application within the METU campus environment. A quantitative experimental research approach was employed for the study. A comprehensive depiction of the research process followed during the investigation is presented in a flowchart on the subsequent page, at Figure 11.

The initial stage of the research process involves defining the problem and formulating research questions. Then, the literature review began by examining mobile payment systems (MPS) acceptance in general. Existing acceptance theories and previous studies were reviewed. Hindrance factors impacting MPS adoption were extracted from the literature. The literature review chapter presents these factors along with existing acceptance theories.

For the purpose of choosing the most applicable barrier factors from the literature findings, the Delphi approach, which is a well-structured, cyclical process, will be employed. This method is designed to collect expert perspectives and knowledge on intricate topics. The Delphi approach, which will be discussed in a related section along with the reasons for its selection, aligns well with this thesis study. After two rounds of surveys with Information Technologies professionals from various branches and levels of expertise, the number of barriers was reduced to 21 items.

Following the selection of the most related 21 barriers for the case study, the Interpretive Structural Modeling(ISM) technique was employed to depict the complex interrelationships among the variables. This technique will be further explored in subsequent sections. It is primarily employed to make complex situations more manageable by simplifying and modeling the connections between different components of the system under investigation. Hence, it is aimed to model the complex relationships between the barriers in the adoption of Mobile Payment technologies in the context of Solipay Case Analysis. This method utilizes expert assessments in consecutive rounds to identify and examine complex relations among barriers. It employs a structured matrix table along with systematic analysis to facilitate the process effectively. The final outcome of the ISM is a simplified framework that visualizes the relationships among barriers. The framework incorporates various parameters like criticality level and impact direction. This

framework will be employed in subsequent chapters to analyze the relationships with relevant stakeholders of the case study.

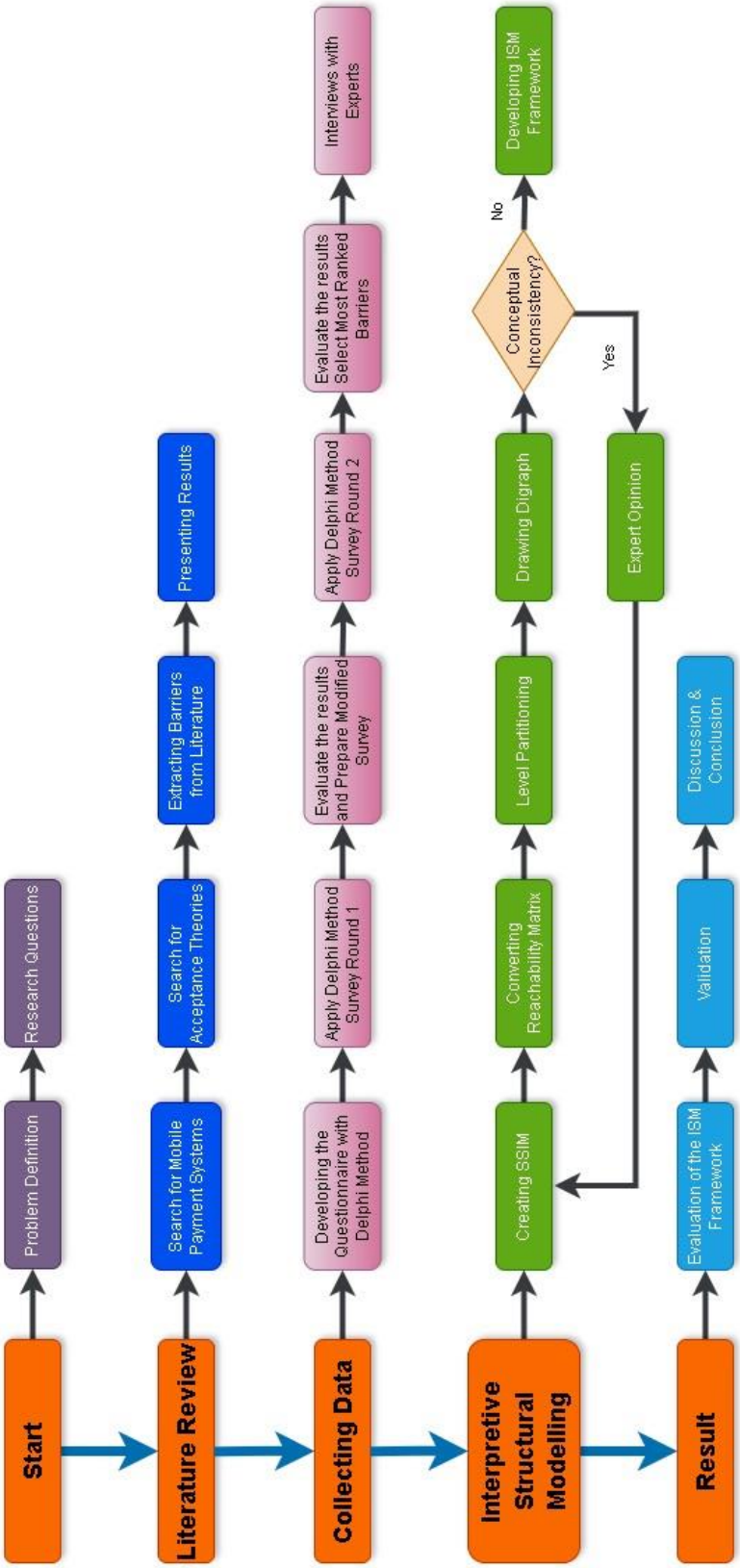

Figure 11: Flowchart of Research Process

3.2. Data Collection

The data collection phase comprises two primary stages, each involving specific sub steps. In the first stage, two rounds of questionnaires are administered to identify the most suitable barriers for the case study, as described in the Delphi Method section. The subsequent stage, which utilizes the ISM method, consists of ISM Expert Reviews to gather data from experts about the interrelations among the barriers. The subsequent titles will examine each step providing a thorough explanation of it.

3.2.1. Delphi Method

The Delphi method is a systematic, iterative process that aims to gather expert opinions and insights on complex topics when information is limited or incomplete. It involves multiple rounds of questionnaires with controlled feedback, allowing experts to refine their assessments in light of the group's responses. The key features include anonymity, which reduces social pressure and group influence, and the goal of achieving consensus or identifying areas of disagreement. (Skulmoski et al., 2007)

As per the definition, one of the primary applications of the Delphi Method is to prioritize issues by assessing the relative significance of various factors or issues. It is well-suited for determining the appropriate choice of barriers for this thesis study.

Main steps of the Delphi Method include;

- Problem Formulation
- Expert Panel Selection
- Questionnaire Development (Round 1)
- Data Analysis
- Feedback and Subsequent Rounds
- Final Analysis and Consensus

In this study, the problem formulation step has been already completed, which is deciding related barriers impacting adoption of MPS for the case analysis.

The next critical step for the Delphi Method is expert panel selection. To ensure the quality of the study, qualified information technologies personnel from the METU campus will be selected for the expert panel.

Questionnaire development for the first iteration is the next step for the Delphi Method.

The questionnaire given at Appendix A is prepared for the first round. It is created with the METU Computer Center online survey tool. It starts questioning demographics such as age and gender with professional work experience years and frequency of Solipay Application usage with preferences. The latter section of the survey entails evaluating 40 elements derived from the literature using the Likert scale. Essentially, this scale assigns numerical values ranging from 1 to 5 to each element. The last section of the questionnaire asks participants to rank the importance of these 40 factors.

Upon the conclusion of the first round, the results were evaluated. Subsequently, a second questionnaire was crafted for the next round with the addition of average values from the first round. Most voted first five rankings from the first round for each item were also given for the second round's ranking part. The second questionnaire is omitted from the appendix as it is largely identical to the first one, with the only exception being the inclusion of reference values.

During the second round, participants assess their scores and rankings in relation to the average points or rankings from the first round. This helps them reevaluate their own assessments based on the collective performance from the initial round.

Following the conclusion of the second round, the outcomes were assessed and contrasted with those from the first round. Based on scoring, ranking values, and expert opinions, 21 of the most highly rated factors were shortlisted for the study's subsequent phase. This marked the completion of the Delphi technique's use. The associated graphs and tables relating to the findings of each round will be presented in the related figures and appendix part. Since the 40 item and their scorings will occupy too much space, scoring and ranking results of the questionnaires are given at the related appendix pages.

Based on the findings, it can be inferred that the scores remained relatively stable after the second round of the questionnaire, indicating no significant changes. However, the ranking portion of the questionnaire yielded inconsistent results across rounds. It is important to acknowledge that sorting 40 items presents a considerable challenge for participants. Therefore, the focus was placed on the scoring component of the questionnaire results. Details for each item can be reviewed from the related appendix page.

3.2.2. *Participants Profile*

The questionnaire is prepared with METU Online Survey Tool and distributed to information technology personnel of METU who know English. Since the education language of METU is English, there are many personnel who are fluent in English. Majority of the related personnel are also graduates of METU from various departments. Software developers, system administrators, network administrators, smartcard application support personnel, information technology support personnel and administrative personnel are among the participants of the questionnaire. Web link of the online questionnaire is shared with the related personnel. The questionnaire is filled anonymously by the personnel because of privacy concerns.

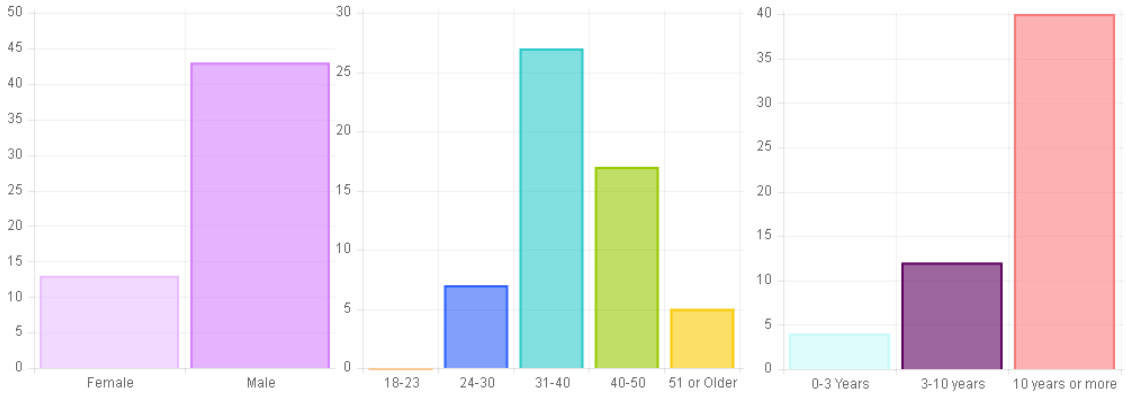

Figure 12: Gender, Age and Work Experience of Questionnaire Participants

The METU online survey tool revealed that 70 participants accessed the questionnaire, but only 48 of them fully completed it. During the second round, there was a slight decrease in participation, with 44 individuals partially participating and 58 individuals participating in total. As it can be seen from the infographic, most of the participants have an experience of 10 years or more. Male participants were in the majority because of the mostly male stereotype of information technology workers. And the majority of the participants were 30 to 50 years old.

3.2.3. *Expert Reviews*

In this thesis study, Interpretive Structural Modelling (ISM) was the primary method employed. It required evaluating the relationships among the factors by a group of experts from related fields. These experts were interviewed as part of the expert review process of ISM to define four types of ISM relationships (V, A, X, O) among the selected 21 factors on a 21x21 matrix. The detailed information about the related ISM process for this matrix and its evaluation will be given in the related sections. Experts' insights and additional comments were also noted during sessions for better evaluations. The filled matrix charts for each expert will be provided in the related appendix pages for reference. These matrices are the main source of data for the ISM process.

3.2.4. Expert Profile

There were seven experts in total for this thesis study. Detailed information about the experts is shown at the table below. The majority of these experts, five in total, were selected from the Information Technologies Department of the Middle East Technical University (METU). These five individuals are primarily responsible for the smooth operation of the Solipay app on the METU campus, including solution support, background systems and software. They have extensive experience in the payment systems of the METU campus.

Table 2: Expert Profiles

	Work Experience	Company /Institution	Department/Title
Expert 1	26 Years	METU Computer Center	Smartcard Applications Department, Manager
Expert 2	12 Years	METU Computer Center	Smartcard Applications Department, Software Developer
Expert 3	10 Years	METU Computer Center	Smartcard Applications Department, Software Developer
Expert 4	3 Years	METU Computer Center	Smartcard Applications Department, Solutions Expert
Expert 5	3 Years	METU Computer Center	Smartcard Applications Department, Solutions Expert
Expert 6	15 Years	METU Cafeteria	Field Technical Solutions Expert
Expert 7	14 Years	UTARIT	Solipay Technical Solutions Expert

One expert was selected from the company which is the developer of the Soliclub/Solipay application, namely UTARIT. The expert is mainly dealing with technical solutions in the field for hardware and software issues of both end users and merchant side. Participation of such a qualified and experienced field expert from the developer side provides valuable insights.

The final expert was selected from the METU Cafeteria technical personnel to provide insights from the merchant's perspective. The selected expert is responsible for the smooth payment process of people using Solipay. He guides and redirects the users encountering

software or hardware related problems to the related parties such as METU Computer Center or UTARIT.

3.2.5. Interpretive Structural Modeling

Interpretive Structural Modeling (ISM) is the main method of research for the thesis study. ISM is a technique for developing graphical representations of complex systems. It integrates group judgements and provides a systematic method for developing structural models for complex problems. It is useful to evaluate technology assessment due to the increasingly complex issues at the interface of technology and society. ISM is a methodology used in the field of management and systems engineering to analyze and understand complex relationships among various elements within a system. It helps in developing a structural model that illustrates the hierarchical relationships among different components or variables in a complex system. It can be used to understand and resolve complex interdependencies. (Watson, 1978)

Figure 13 has been prepared to provide an overview of the fundamental flowchart of the ISM process, facilitating a more lucid comprehension of the entire procedure. More detailed information about major steps will be provided in the following sections for a more comprehensive understanding of the ISM method.

Advantages and justifications for using ISM in this thesis study will also be discussed under the relevant sections of this chapter. Additionally, the initial iteration of the ISM application, based on the data collected, will be presented in this chapter. The results obtained from the first iteration will establish a preliminary understanding of the problem. Review of the first iteration will be also useful to understand how the ISM process is applied on the given data. Subsequent iterations of the ISM application will be addressed and discussed in the next chapter, with the aim of optimizing and clarifying the final ISM framework for the research problem.

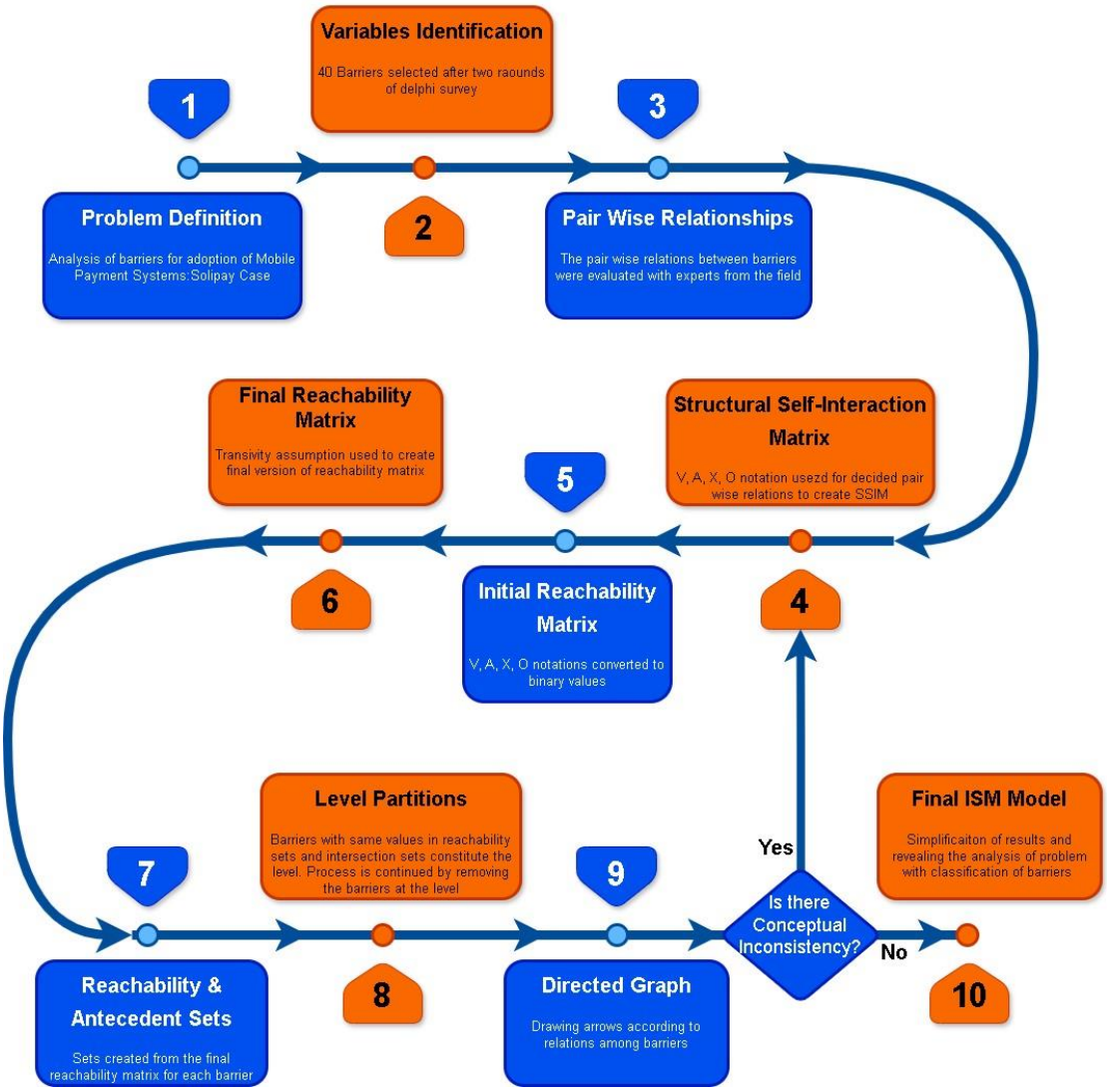

Figure 13: ISM Flowchart

3.2.6. ISM Key Steps

Key steps involved in ISM are;

1. Identifying Elements

   The first step involves identifying and defining the elements or variables that constitute the system under study. These elements can be concepts, factors, or components that influence or are influenced by other elements within the system. A company which wants to analyze factors influencing its decision-making process for launching a new product might be a good example to use ISM. The elements to consider might include market demand, technological feasibility, resources, competition, and regulatory compliance.

2. Pairwise Comparisons

   Second step includes experts or stakeholders whom are asked to compare elements in pairs to determine the relative influence or impact of one element over another.

3. Building a Reachability Matrix

   This step involves creating a matrix where each element is compared to every other element in the system. Based on the pairwise comparisons, a reachability matrix is constructed. This matrix helps identify the relationships among the elements and indicates the direction of influence between them.

4. Developing the ISM Diagram

   Using the reachability matrix, an ISM diagram or a digraph is constructed. This diagram represents the hierarchical structure of the elements, showcasing the relationships and dependencies among them. Elements with higher influence are placed at the top, while those with lesser influence are placed at the bottom.

5. Formulating Levels and Clusters

   The ISM diagram is analyzed to identify different levels or clusters of elements based on their interrelationships. This helps in understanding the hierarchical structure and grouping of elements within the system.

6. Interpreting and Validating the Model

   The model is interpreted to gain insights into the relationships and dependencies among the elements. Experts or stakeholders interpret the model to understand how different elements interact. They validate the model's accuracy based on their domain knowledge and experiences in the industry.

However, there are also limitations and challenges associated with ISM, such as the inflexibility of the process, time-consuming nature, and difficulties in incorporating minority views. The skill of the facilitators was also found to influence the success of an ISM session. (Watson, 1978)

According to Watson (1978), the major issues of the era increasingly seem to occur at the interface between technology and society, cutting across the boundaries of multiple systems. These complex issues heavily toll traditional reductionist models and paradigms, indicating the need for tools to structure complexity in technology assessment.

3.2.7. Advantages of ISM

- Understanding complex relationships: ISM excels at untangling the intricate web of factors influencing mobile payment adoption. It helps you go beyond a simple list of factors and explore how these factors interact, influence, or depend on each other.

- Identifying critical drivers: By analyzing the relationships, ISM can reveal the key drivers that have a significant influence on mobile payment adoption. This can help you prioritize your research focus and identify areas where interventions might be most effective in promoting broader adoption.

- Structured approach: ISM provides a systematic and step-by-step process for analyzing qualitative data from expert opinions and user insights. This ensures a rigorous and transparent methodology for your research.

- Visual representation: ISM generates a clear and concise digraph (directed acyclic graph) that visually depicts the relationships between factors. This makes it easier to communicate complex findings to a broader audience, including academics and policymakers.

3.2.8. Reasons of Using ISM

- The research focuses on the interplay between various factors affecting mobile payment adoption.

- Identifying critical factors driving adoption and prioritizing of factors with exposing relations among them for further investigation are major objectives of this research study.

- Revealing complex relationships among factors is one of the major advantages of using ISM.

- ISM also promises structured and strong visual representation of these relationships.

- Solipay is used at the campus and all major stakeholders such as operators, developers, providers and users of Solipay are available for such an analysis.

These are major reasons why ISM technique is selected for this thesis study.

3.3. Application of ISM Steps

3.3.1. Identifying Elements

The selection of 21 barriers for analysis using the ISM method was completed in the previous section through the application of the Delphi method. These 21 barriers will be inputs of the ISM.

3.3.2. Pairwise Comparisons and SSIM

The second step involves consulting experts or stakeholders who are tasked with comparing elements in pairs. This exercise aims to assess the relative influence or impact of one element over another, thereby establishing a hierarchy of elements based on their significance.

To investigate the relationships between 21 factors, a 21x21 matrix, which named as Structural Self-Interaction Matrix is formed on the computer. Figure 14 shows the formed matrix with related values. The main goal is to compare each cell in the matrix based on rules of ISM which is given below.

For each cell;

- Put **A**, means the column influences the row

- Put **V**, means the row influences the column

- Put **O**, means no relation between

- Put **X**, means interactive relations

This step is repeated for each of the experts. It takes a long time for a 21x21 matrix. It takes even longer time to reach a consensus for such big tables. Nevertheless, final SSIM decided with the experts for the process is given at Figure 14. SSIM matrix for each expert is also given at the related appendix pages. Since, these tables occupy too much space, they were placed at the appendix pages instead of this section. Main reason is to keep the reader focused on main issues instead of figures.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Age		V	V	V	V	V	V	O	V	V	V	V	O	V	V	O	V	O	V	O	O
Behavioral Beliefs			X	X	V	X	X	O	X	X	V	V	X	X	V	X	X	A	X	V	V
Compatibility				X	X	V	A	A	A	X	X	X	X	V	X	A	X	A	O	A	X
Complexity					V	V	V	V	V	V	V	V	V	V	V	V	X	A	V	V	A
Effort Expectancy						V	O	O	A	A	O	O	A	A	O	A	A	A	X	O	V
Functional Value							O	A	A	A	A	A	O	X	V	A	A	A	O	A	X
Information Privacy Concern								O	A	X	X	X	O	O	O	O	A	A	V	A	V
Lack of Availability									O	V	V	O	O	V	V	X	O	A	V	V	X
Lack of Awareness										V	V	V	V	V	V	O	X	A	V	V	X
Low Satisfaction											V	V	X	A	A	A	X	A	V	X	X
Perceived Risk												X	A	V	V	A	A	A	V	X	X
Perceived Security													A	A	O	A	A	A	V	X	X
Perceived Support From MPS Provider														V	O	O	V	O	O	V	V
Perceived Usefulness															X	A	A	A	O	A	V
Performance Expectancy																A	A	A	V	A	A
Reliability																	V	A	V	V	V
Self Efficacy																		A	V	V	V
Technological Infrastructure																			V	V	V
Traditional Payment Habit																				O	A
Trust in Provider																					X
Use Context																					

Figure 14: SSIM for 21 Factors

3.3.3. Building a Reachability Matrix

In this phase, a matrix is generated that compares each individual element with every other component in the system. This process of pairwise comparisons results in the formation of a reachability matrix. This matrix serves as a valuable tool for understanding the relationships among the elements, specifically highlighting the direction of influence between them.

V in the SSIM matrix, point (i, j) takes the value 1, while point (j, i) takes the value 0.

A in the SSIM matrix, point (i, j) takes the value 0, while point (j, i) takes the value 1.

X in the SSIM matrix, both cells take the value 1.

O in the SSIM matrix, both cells take the value 0.

Next, transitivity checks must be initiated. Essentially, this signifies that if factor x impacts y and factor y influences factor z, then factor x also exerts an impact on factor z.

As time goes by, a final version of the Reachability Matrix is generated after conducting the required checks and performing the necessary calculations.

Making all these calculations for a 21x21 matrix manually is undoubtedly a substantial task for any individual. To facilitate this process, automation tools are available to perform the calculations and checks based on the provided inputs. These tools were also utilized in this thesis study. Figures 15 and 16 illustrate the Reachability and Final Reachability Matrices, respectively.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Driving Power
Age	1	1	1	1	1	1	1	0	1	1	1	1	0	1	1	0	1	0	1	0	0	15
Behavioral Beliefs	0	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	0	1	1	1	18
Compatibility	0	1	1	1	1	1	0	0	0	1	1	1	1	1	1	0	1	0	0	0	1	13
Complexity	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	18
Effort Expectancy	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	5
Functional Value	0	1	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	5
Information Privacy Concern	0	1	1	0	0	0	1	0	0	1	1	1	0	0	0	0	0	0	1	0	1	8
Lack of Availability	0	0	1	0	0	1	0	1	0	1	1	0	0	1	1	1	0	0	1	1	1	11
Lack of Awareness	0	1	1	0	1	1	1	0	1	1	1	1	1	1	1	0	1	0	1	1	1	16
Low Satisfaction	0	1	1	0	1	1	1	0	0	1	1	1	1	0	0	0	1	0	1	1	1	13
Perceived Risk	0	0	1	0	0	1	1	0	0	0	1	1	0	1	1	0	0	0	1	1	1	10
Perceived Security	0	0	1	0	0	1	1	0	0	0	1	1	0	0	0	0	0	0	1	1	1	8
Perceived Support From MPS Provider	0	1	1	0	1	0	0	0	0	1	1	1	1	1	0	0	1	0	0	1	1	11
Perceived Usefulness	0	1	0	0	1	1	0	0	0	1	0	1	0	1	1	0	0	0	0	0	1	8
Performance Expectancy	0	0	1	0	0	0	0	0	0	1	0	0	0	1	1	0	0	0	1	0	0	5
Reliability	0	1	1	0	1	1	0	1	0	1	1	1	0	1	1	1	1	0	1	1	1	15
Self Efficacy	0	1	1	1	1	1	1	0	1	1	1	1	0	1	1	0	1	0	1	1	1	16
Technological Infrastructure	0	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	19
Traditional Payment Habit	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3
Trust in Provider	0	0	1	0	0	1	1	0	0	1	1	1	0	1	1	0	0	0	0	1	1	10
Use Context	0	0	1	1	0	1	0	1	1	1	1	1	0	0	1	0	0	0	1	1	1	12
Dependence Power	1	14	18	7	13	17	11	5	7	16	16	16	6	15	15	5	10	1	16	13	17	

Figure 15: Initial Reachability Matrix

Figure 15 shows how the Structural Self-Interaction Matrix prepared at the previous step and shown at Figure 14 is converted to the Initial Reachability Matrix with the application of rules mentioned above. After application of the binary conversion rules, SSIM is converted to the Initial Reachability Matrix as shown in the figure 15.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	Driving Power
Age	1	1	1	1	1	1	1	1*	1	1	1	1	1*	1	1	1*	1	0	1	1*	1*	20
Behavioral Beliefs	0	1	1	1	1	1	1	1*	1	1	1	1	1	1	1	1	1	0	1	1	1	19
Compatibility	0	1	1	1	1	1	1*	1*	1*	1	1	1	1	1	1	1*	1	0	1*	1*	1	19
Complexity	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1*	19
Effort Expectancy	0	1*	1	1*	1	1	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	0	1	1*	1	19
Functional Value	0	1	1*	1*	1*	1	1*	1*	1*	1*	1*	1*	1*	1	1	1*	1*	0	1*	1*	1	19
Information Privacy Concern	0	1	1	1*	1*	1*	1	1*	1*	1	1	1	1*	1*	1*	1*	1*	0	1	1*	1	19
Lack of Availability	0	1*	1	1*	1*	1	1*	1	1*	1	1	1*	1*	1	1	1	1*	0	1	1	1	19
Lack of Awareness	0	1	1	1*	1	1	1	1*	1	1	1	1	1	1	1	1*	1	0	1	1	1	19
Low Satisfaction	0	1	1	1*	1	1	1	1*	1*	1	1	1	1	1*	1*	1*	1	0	1	1	1	19
Perceived Risk	0	1*	1	1*	1*	1	1	1*	1*	1*	1	1	1*	1	1	1*	1*	0	1	1	1	19
Perceived Security	0	1*	1	1*	1*	1	1	1*	1*	1*	1	1	1*	1*	1*	1*	1*	0	1	1	1	19
Perceived Support From MPS Provider	0	1	1	1*	1	1*	1*	1*	1*	1	1	1	1	1	1*	1*	1	0	1*	1	1	19
Perceived Usefulness	0	1	1*	1*	1	1	1*	1*	1*	1	1*	1	1*	1	1	1*	1*	0	1*	1*	1	19
Performance Expectancy	0	1*	1	1*	1*	1*	1*	1*	1*	1	1*	1*	1*	1	1	1*	1*	0	1	1*	1*	19
Reliability	0	1	1	1*	1	1	1*	1	1*	1	1	1	1*	1	1	1	1	0	1	1	1	19
Self Efficacy	0	1	1	1	1	1	1	1*	1	1	1	1	1*	1	1	1*	1	0	1	1	1	19
Technological Infrastructure	0	1	1	1	1	1	1	1	1	1	1	1	1*	1	1	1	1	1	1	1	1	20
Traditional Payment Habit	0	1	1*	1*	1	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	1*	0	1	1*	1*	19
Trust in Provider	0	1*	1	1*	1*	1	1	1*	1*	1	1	1	1*	1	1	1*	1*	0	1*	1	1	19
Use Context	0	1*	1	1	1*	1	1*	1	1	1	1	1	1*	1*	1	1*	1*	0	1	1	1	19
Dependence Power	1	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	21	1	21	21	21	

Figure 16: Final Reachability Matrix

However, binary conversion is not enough to have the final version of the Reachability Matrix. Next step is applying transitivity checks as mentioned at the beginning of the section. To sum up again, this entails that if factor x has an effect on factor y and factor y has an influence on factor z, then factor x also indirectly has an impact on factor z. After the related checks, value of the cell is updated and an asterisk sign is placed to mark the change. Figure 16 shows the Final Reachability Matrix for the 21 factors.

3.3.1. Level Partitioning

The Final Reachability Matrix figure shows that each row and column ends with a total point. These points are designated as "Driving Power" and "Dependency".

Singh et al. (2007) developed a method for determining the driving power and dependency of barriers. The driving power of a barrier is the number of other barriers that it affects, while the dependency of a barrier indicates the extent to which it is affected by other barriers. To calculate the driving power, the binary values of each barrier in a row are summed. To calculate the dependency, the binary column values of each barrier are summed.

These values are subsequently utilized in the creation of levels and categorization of barriers. This section is focused on level partitioning which is done according to the iterative steps defined below.

Determining Reachability, Antecedent, and Intersection Sets:

- Calculate the final reachability matrix.
- For each barrier, identify the reachability set (barriers that can be reached, including the barrier itself) and the antecedent set (barriers that affect it, including the barrier itself).
- Determine the intersection set, which consists of barriers that are present in both the reachability set and the antecedent set.

Segregating Barriers into ISM Layers:

- Separate barriers based on their values in the reachability set and intersection set.
- Identify the highest-level barriers in each ISM layer, characterized by having the same values in both sets.
- Create the first table by grouping these top-level barriers.

Iterative Process for Subsequent Layers:

- Remove the first-level barriers from the table.
- Repeat the process of identifying reachability, antecedent, and intersection sets for the remaining barriers.
- Continue creating subsequent ISM layers until all barriers are assigned to their respective layers.

Elements(Mi)	Reachability Set R(Mi)	Antecedent Set A(Ni)	Intersection Set R(Mi)∩A(Ni)	Level
1	1,	1,	1,	2
2	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21,	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21,	1
3	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21,	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21,	1
4	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21,	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21,	1
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15	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21,	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21,	1
16	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21,	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21,	1
17	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21,	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21,	1
18	18,	18,	18,	2
19	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21,	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21,	1
20	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21,	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21,	1
21	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21,	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21,	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 19, 20, 21,	1

Figure 17: Level Partitioning Iteration Sample

As previously stated, this process can generate a significant workload, especially when such numerous factors require analysis. With an increase in the number of iterations, the number of tables also multiplied substantially. Six iterations and six tables are used for this calculation by the online ISM calculation tool mentioned. However, it has no significant benefit to place all of these six big tables here. This is just the first iteration of ISM application and next iterations will also produce such high numbers of tables for major steps. Hence, only the outcome of a single iteration for level partitioning process is displayed in the Figure 17 as an example.

3.3.2. MICMAC Analysis

MICMAC Analysis divides the factors into 4 different categories: Drivers, Linkage, Autonomous, and Dependent. This classification aids in analyzing the dependency and driving power characteristics of barriers. In this analysis, the barriers are plotted on a coordinate plane based on their driving power and dependency information.

- **Autonomous:** These factors have low driving power (little influence on others) and low dependence power (not heavily influenced by others). They may be considered independent and potentially less crucial for immediate focus.

- **Dependent:** These factors have low driving power but high dependence power (heavily influenced by others). They might be vulnerable to changes in other factors and warrant attention.

- **Driver:** These factors have high driving power (significantly influence others) but low dependence power (not heavily influenced by others). They are key drivers of the system and deserve focus for promoting desired outcomes.

- **Key:** These factors have high driving power and high dependence power (both influencing and influenced by others). They are critical elements in the system and require careful consideration for intervention strategies.

MICMAC analysis for this project can be seen at Figure 18. It basically shows that factors 1 and 18 seem as driver variables with very high driving power values and very little dependence power values. These are “Age” and “Technological Infrastructure” factors and placed at quadrant IV. It also means these factors are very important and requires significant focus.

All of the remaining factors seem to consolidate at the same point on the graph and third quadrant which named as key variables. These factors have high driving and high dependence power values.

Such consolidations are not expected for this stage. However, this is the first iteration of the ISM and the process is continued for better understanding and clarification of the results.

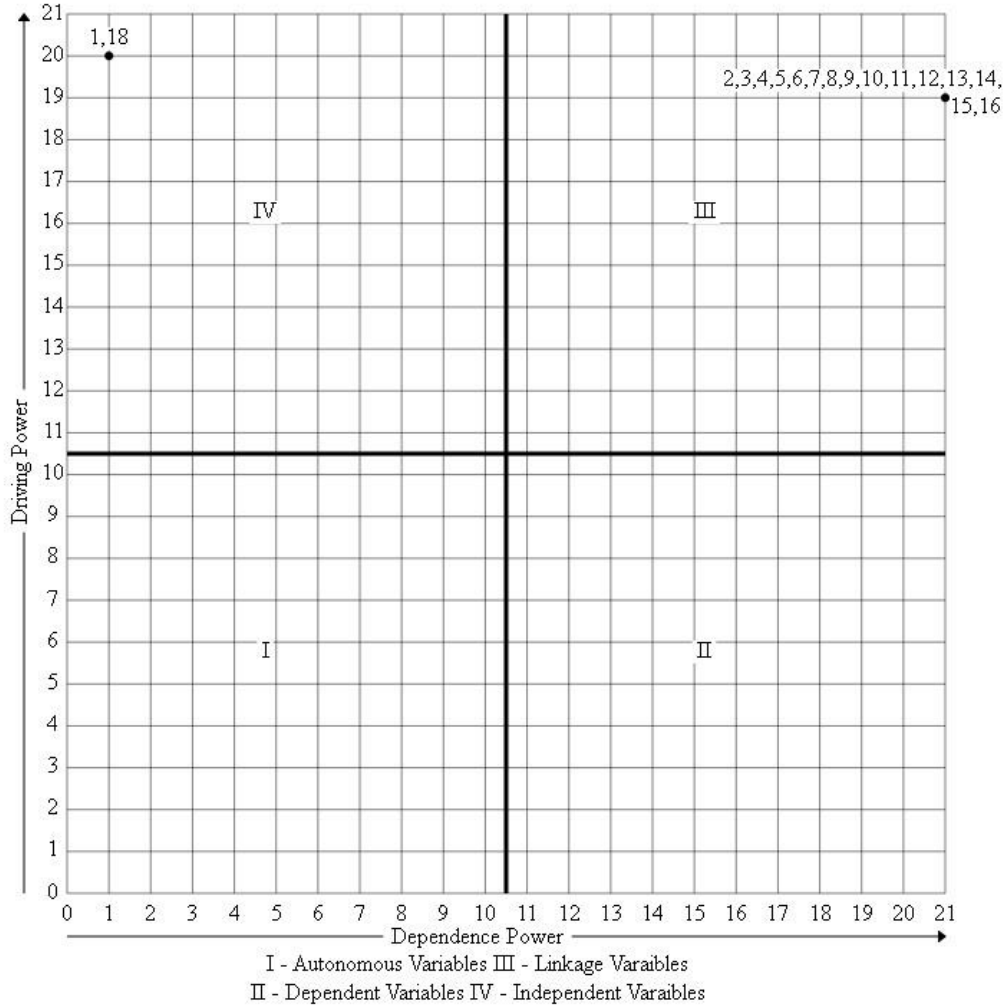

Figure 18: MICMAC Analysis

3.3.3. Creating Digraph

The digraph is essential to visualize ISM analysis results and make inferences. The digraph for ISM can be drawn based on the following rules:

- Represent the elements as nodes, using shapes such as boxes or circles.
- Draw directional arrows to depict the influence relationships identified in the matrix.
- The direction of the arrow follows the influence, with the arrow pointing from the influencing element to the influenced element.
- Different colors or line styles can be employed to emphasize distinct categories of factors based on MICMAC analysis.

Due to the considerable number of relations involved, creating a digraph for this project may present a challenge. To simplify the process and enhance efficiency, the use of software tools is highly recommended. As such, the SmartISM (Ahmad & Qahmash, 2021) online software is utilized to generate such a digraph. It is shown at Figure 19. It can be seen from the graph that there are two main factors affecting all others. There are also just two levels for the factors. It is noted that the results seem unusual at this initial iteration. However, the process is continued for the completion of the first iteration. Reviewing a full scale ISM application is also another reason to continue the process instead of interrupting and revising the process.

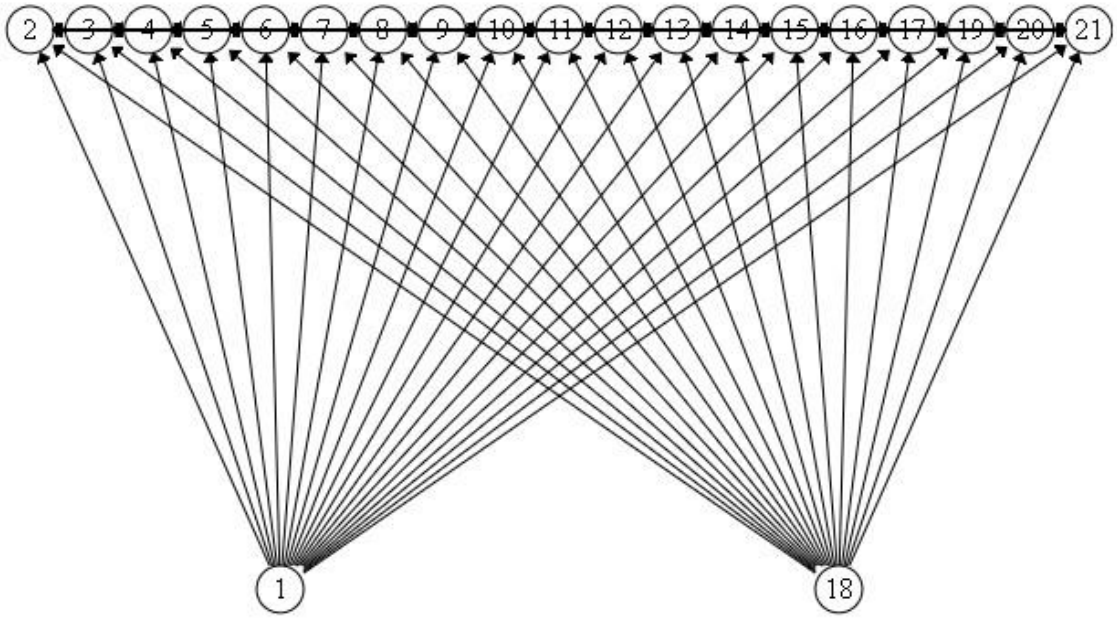

Figure 19: Digraph

3.3.4. Creating ISM Final Model

In this stage, the graph is visually simplified and organized, with barrier ID numbers replaced by real item names. This makes the graph easier to understand and interpret. Final version of the ISM Framework is shown at Figure 20. It shows that Age and Technological Infrastructure are two main barriers affecting all others at the same level. There are two levels of factors. Second level also has horizontal and interactive impacts between the all factors along the level. As noted before, results of the initial iteration of the ISM seem weird and obviously needs to be reviewed. However, all of the steps are processed to clarify the situation and get an overview of a sample ISM process.

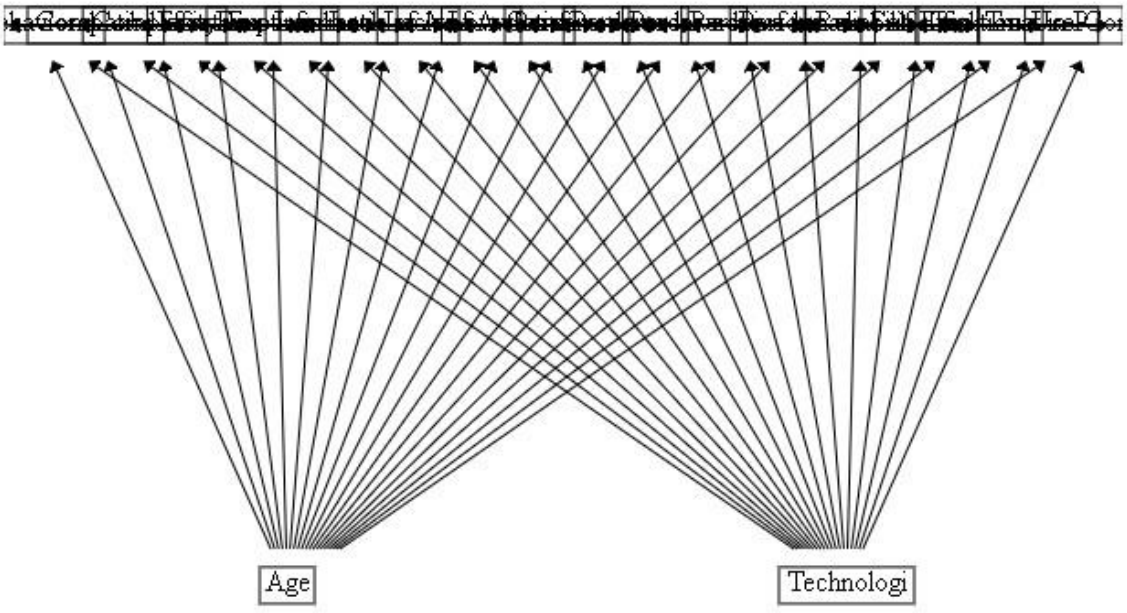

Figure 20: Final Model

3.3.5. Interpeting the Final Model

As it can be seen clearly that there are just two levels for the existing final model. Age and Technological Infrastructure are root factors impacting all others. And all remaining factors are also interrelated between them. It is obvious that the results do not seem logical and there might be something wrong.

However, whether the digraph may reflect the truth, it's important to acknowledge that subject matter experts are still in the early stages of understanding the ISM method, and there may be more to explore. Additionally, the ISM method also emphasizes the importance of revision and iteration. It is already shown at the ISM Flowchart given at Figure 13 with the question of “Is there any conceptual inconsistency?”

So, the ISM flowchart is followed and SSIM stage is revisited. To allow for several iterations, decisions were reevaluated and revised. The SmartISM (Ahmad & Qahmash, 2021) online tool is invaluable for carrying out these iterations efficiently. This chapter just revealed the initial iteration of the ISM process and the further iterations will be addressed and discussed at the next chapter.

The next chapter will provide **the results of the iterations and the finalized model.**

3.4. Summary

In this chapter, the research methodology and research design employed to attain the desired outcomes are outlined. The rationales behind the selection of factors, data collection techniques, and research methods are presented in detail.

More importantly, the first iteration of the ISM technique application is explained in detail in this chapter. Hence, it is aimed to give a better understanding for the application of the method itself. However, initial results of the ISM application gave hints for the requirement of more iterations to get clearer and more optimized results. The subsequent iterations with the discussions and the final version of the ISM framework will be presented in the next chapter.

CHAPTER 4

4. RESULTS AND DISCUSSION

4.1. Introduction

The objective of this chapter is to provide explanations and discussions of the various iterations and optimizations made through the ISM method employed in the thesis study. The previous chapter primarily focused on introducing the functions and applications of the ISM method through a single, streamlined iteration. However, preliminary results indicated that the ISM method demands significantly more attention and effort than initially anticipated. Consequently, the further and final iterations of the ISM process will be addressed in this chapter.

Rather than presenting only the final results, which may create the illusion that ISM is straightforward and processes run smoothly, I believe that it is more valuable to share experiences from the entire process. This approach provides a more realistic understanding of the challenges and complexities encountered during implementation.

The chapter will conclude by presenting the opinions of professionals and interested parties on the final ISM Framework.

4.2. Possible Problems

Following the initial surprise caused by the unconventional result of the prototype ISM model, it was time to engage in a thorough analysis of the underlying issues.

During the two-round Delphi process, barriers with the highest average points were selected. However, some barriers are particularly challenging to convey in everyday Turkish, making them highly confusing. Both experts and survey participants reported difficulties with such issues through the process. Relying solely on scores without considering the items' clarity may pose a problem. Therefore, underestimating the language barrier could lead to incorrect conclusions.

Initially, ranking these 40 barriers was viewed as a supplemental approach to corroborate the questionnaire design, in addition to scoring. Nevertheless, this choice impacted the results negatively. Participants frequently expressed concerns that the sorting of 40 items is too confusing. The inconsistency of findings during and between rounds further suggests difficulties with the ranking component of the questionnaire. The potential harm it could cause may outweigh any potential benefits.

The selection of barriers in the ISM process may be influenced by questionnaire and language-related issues. A total of 21 barriers were identified for consideration. The pairwise comparison, a fundamental and critical step in the process, posed challenges for both me, as the moderator, and the experts involved. Completing this step, which includes creating the structural self-interaction matrix (SSIM), required careful attention and effort. It was a highly demanding endeavor, requiring significant time and effort from all participants. Potentially, the tiring nature of the interviews may have diminished result quality which is directly related with the model accuracy. The model is subjective and dependent on the expert's quality and level of attentiveness.

The challenge of becoming a novice for ISM was shared by all participants. It appeared that the challenge was addressed in subsequent sessions.

4.3. Possible Solutions

As an initial step, the ISM matrixes and processes were simplified by gradually reducing the number of items from 21 to 15 in a few iterations. This reduction in complexity was achieved by carefully revising the existing items, particularly focusing on those that were often perceived with similar meanings and received similar scores. Deleting the existing row and related column from the matrix was an easy and safe step.

The simplification of the matrices and minimizing the items for revision yielded positive outcomes. The SmartISM (Ahmad & Qahmash, 2021) tool played a crucial role in elucidating the relationships and meanings, thanks to its impressive specifications. The tool efficiently and promptly computes all potential outcomes, facilitating seamless exploration and understanding of the complex data.

Given the limited resources available and the need for immediate data collection, the approach taken was the most practical and efficient solution feasible under the circumstances.

4.4. Further Iterations of ISM Process

4.4.1. Revision 1

Great complexity caused by the high number of items was dealt with at the first revision. Most of the experts have complained through the initial iteration of ISM that some of the barriers were very similar and confusing to discriminate between. Similar complaints were also noted during the Delphi study among the participants. Low satisfaction, functional value, perceived risk, compatibility and perceived support from mobile payment services providers were the five barriers removed from the ISM process. Subsequent to a rapid evaluation to mitigate the number of barriers, 16 barriers remained available for utilization. Thus, a simpler form of the ISM process emerged.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Age		V	V	V	V	O	V	V	V	V	O	V	O	V	O	O
Behavioral Beliefs			X	V	X	O	X	V	X	V	X	X	A	X	V	V
Complexity				V	V	V	V	V	V	V	V	X	A	V	V	A
Effort Expectancy					O	O	A	O	A	O	A	A	A	X	O	V
Information Privacy Concern						O	A	X	O	O	O	A	A	V	A	V
Lack of Availability							O	O	V	V	X	O	A	V	V	X
Lack of Awareness								V	V	V	O	X	A	V	V	X
Perceived Security									A	O	A	A	A	V	X	X
Perceived Usefulness										X	A	A	A	O	A	V
Performance Expectancy											A	A	A	V	A	A
Reliability												V	A	V	V	V
Self Efficacy													A	V	V	V
Technological Infrastructure														V	V	V
Traditional Payment Habit															O	A
Trust in Provider																X
Use Context																

Figure 21: Revision 1 SSIM

Figure 21 shows the simpler form of the SSIM matrix after the deletion of five factors. Values of the SSIM were not changed at this stage because the main concern of this revision was to clarify the situation with reducing the complexity resulted in a simplified matrix.

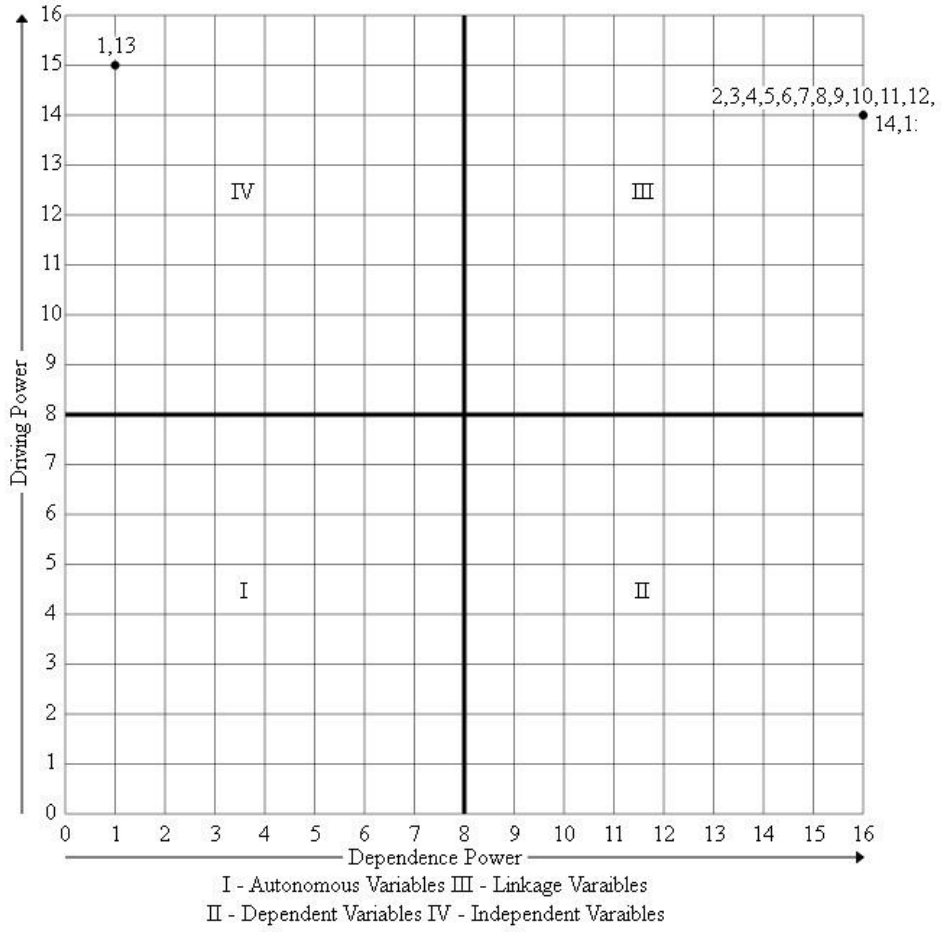

Figure 22: Revision 1 MICMAC Analysis

As the next step, the SmartISM (Ahmad & Qahmash, 2021) tool is employed once more to observe and assess any changes that have occurred. Updated SSIM shown at Figure 21 was used as input to the SmartISM tool. As previously stated, the ISM process creates enormous amounts of tables and calculations. Since these are automated and don't have a meaningful contribution to understand the issue, just important ones are given here. Figure 22 shows the MICMAC analysis results of the updated 16 factors table.

It can be seen that there is no meaningful change for MICMAC analysis when compared with the initial iteration of the ISM process. Same factors were placed in the same quadrants and with almost exact same values. However, it is wiser to check the digraph or

final model produced for this iteration to make the final comments for this revision. Next figure shows the automatically produced final ISM model.

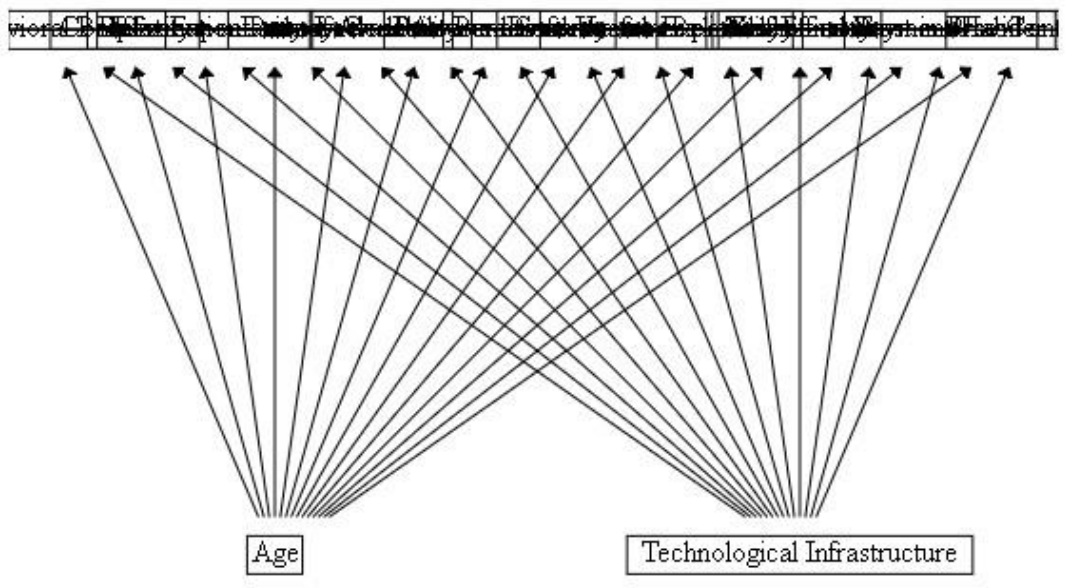

Figure 23: Revision 1 Final ISM Framework

Figure 23 shows the final ISM framework for this revision with 16 barriers. It is very similar with the initial one, but it is way simpler. As it can be observed from the figures, although there was not a substantial difference among SSIM, MICMAC Analysis, and the final model, it was substantially simpler and easier for everyone to revise the remaining pairwise comparisons on the SSIM. Main contrition of this revision is simplification of the problem. Discussion and update of the decisions made for pairwise comparisons were handled at the next iteration.

4.4.2. Revision 2

The second revision focused on reviewing the pairwise comparisons in a concise table, leading to more logical and well-supported decisions. 21x21 table was obviously challenging and consuming for the experts to evaluate. Updated 16x16 table means significant decrements in the required effort to evaluate the factors' relations.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Age		V	V	V	V	O	V	V	O	O	O	V	O	V	O	O
Behavioral Beliefs			O	V	V	O	O	V	V	V	A	X	O	A	V	V
Complexity				V	V	V	V	V	V	V	V	X	A	V	O	O
Effort Expectancy					O	O	A	O	A	O	O	A	A	V	O	O
Information Privacy Concern						O	O	X	O	O	O	O	O	V	A	O
Lack of Availability							O	O	V	V	X	O	A	V	O	V
Lack of Awareness								V	V	V	O	A	O	V	O	O
Perceived Security									O	O	A	A	A	V	X	V
Perceived Usefulness										V	A	A	O	O	A	V
Performance Expectancy											A	O	A	O	O	V
Reliability												O	A	O	V	V
Self Efficacy													O	V	O	O
Technological Infrastructure														V	V	V
Traditional Payment Habit															O	O
Trust in Provider																V
Use Context																

Figure 24: Revision 2 SSIM

Figure 24 shows the updated and revised form of the SSIM matrix after the discussion of the relations for the remaining 16 factors. Values of the SSIM were updated at this stage. Then, the updated SSIM table was used to recalculate remaining processes of the ISM with the SmartISM tool.

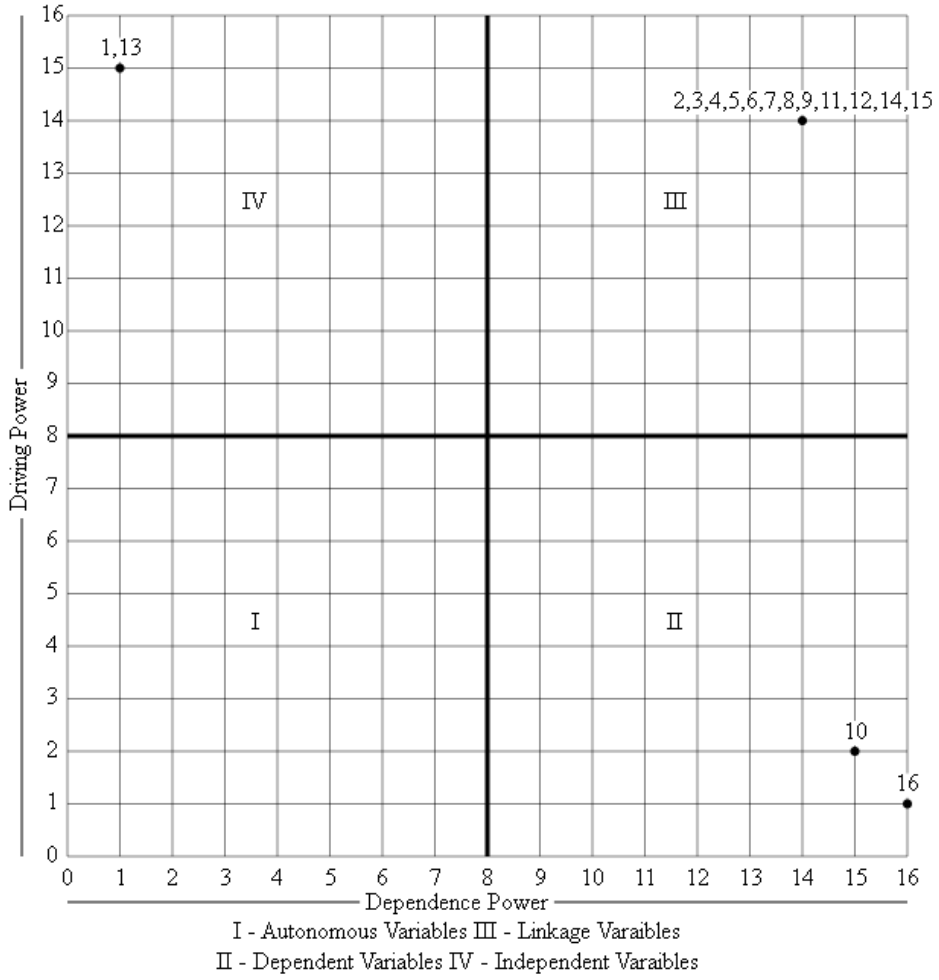

Figure 25: Revision 2 MICMAC Analysis

As mentioned earlier, the ISM process generates a large number of tables and calculations. Since these are automated and do not significantly contribute to understanding the issue, only the important ones are presented here. Figure 25 displays the MICMAC analysis results for the updated table comprising 16 factors.

It can be inferred from the MICMAC analysis that values of the factors changed and also quadrants of some factors dramatically changed. Factors numbered with 10 (Performance Expectancy) and 16 (Use Context) were moved to dependent variables quadrant. MICMAC analysis gives the initial ideas about the situation. However, digraph or final framework are much more beneficial to understand the relations. Next figure shows the automatically produced final framework model by the SmartISM tool.

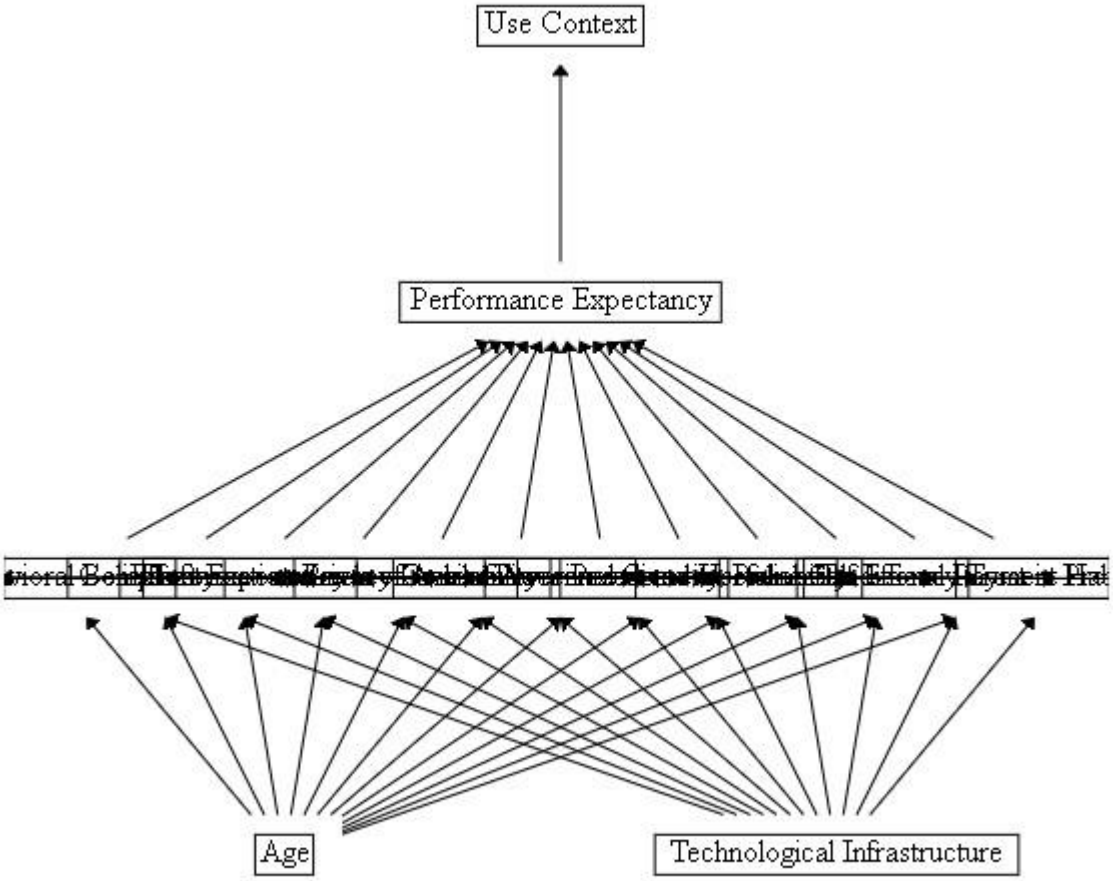

Figure 26 Revision 2 Final ISM Framework

As shown in Figure 26, there are 4 levels for the final ISM framework instead of 2 levels when compared with the previous iteration. Relations among the factors are also different. While the new version showed significant improvements over its predecessor, issues persisted as evident from the MICMAC analysis. A notable observation was that most factors converged at a single point. It was not a welcomed or satisfying result. Consequently, it was decided that a further iteration was necessary.

4.4.3. Final Revision

During the final iteration, one of the barriers was also found confusing for both experts and users. Effort Expectancy and Performance Expectancy factors were frequently argued and confused. Therefore, the Performance Expectancy factor was removed, reducing the total number of barriers from 16 to 15.

Afterward, pairwise comparisons, which were color-coded to indicate suspicious observations in previous iterations, were reviewed again based on the experts' evaluations. It was more simple for this time because of the mostly stabilized ideas for the most of the factors and relations among them. Experts were more adapted to the process and the factors have become well known and understood by the participants.

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Age		V	V	V	V	O	V	V	O	O	V	O	V	O	O
Behavioral Beliefs			O	V	V	O	O	V	V	A	X	O	V	V	V
Complexity				V	O	O	O	V	V	V	X	A	V	O	O
Effort Expectancy					O	O	A	O	O	O	A	A	V	O	O
Information Privacy Concern						O	O	X	O	O	O	O	V	A	O
Lack of Availability							O	O	V	X	O	A	V	O	V
Lack of Awareness								V	V	O	A	O	V	O	O
Perceived Security									O	A	A	A	V	X	V
Perceived Usefulness										A	A	O	O	A	V
Reliability											O	A	O	V	V
Self Efficacy												O	V	O	O
Technological Infrastructure													V	V	V
Traditional Payment Habit														O	O
Trust in Provider															V
Use Context															

Figure 27: Final Revision SSIM

Final decisions were fixed on the SSIM table shown at Figure 27. It was again used as an input for the SmartISM tool. As mentioned before, the tool produced huge amounts of tables and graphs. The significant ones among them are presented in the following figures. To ensure clarity, detailed and lengthy calculations of the ISM process are not included in this part of the thesis study.

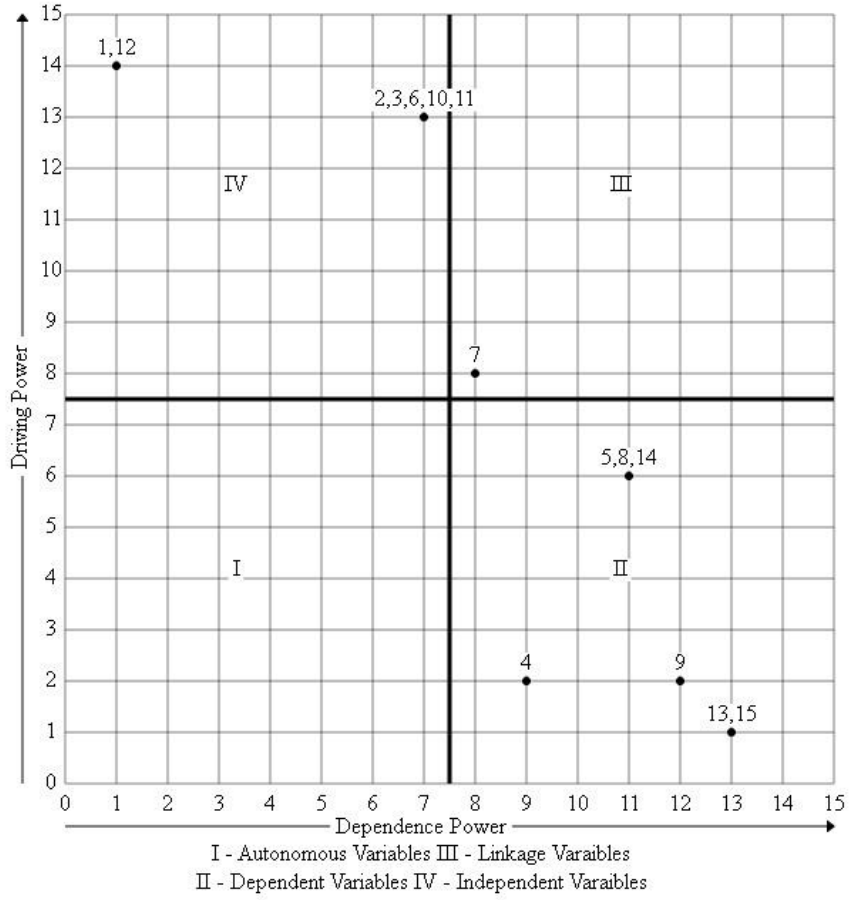

Figure 28: Final Revision MICMAC Analysis

Figure 28 shows the MICMAC analysis results for the updated table comprising 15 factors and also the final revision. It can be seen that five of the factors moved to the quadrant IV which means Independent Variables. However, they are still away from the existing two factors in this quadrant from the previous iterations. It means that there will be different levels for these factors which will be seen in the following digraph in a clearer manner. It is also clear that many variables moved from quadrant III to II which are Linkage Variables and Dependent Variables quadrants. It is a much more balanced distribution for the related factors. Digraph and final ISM framework will make the results clearer.

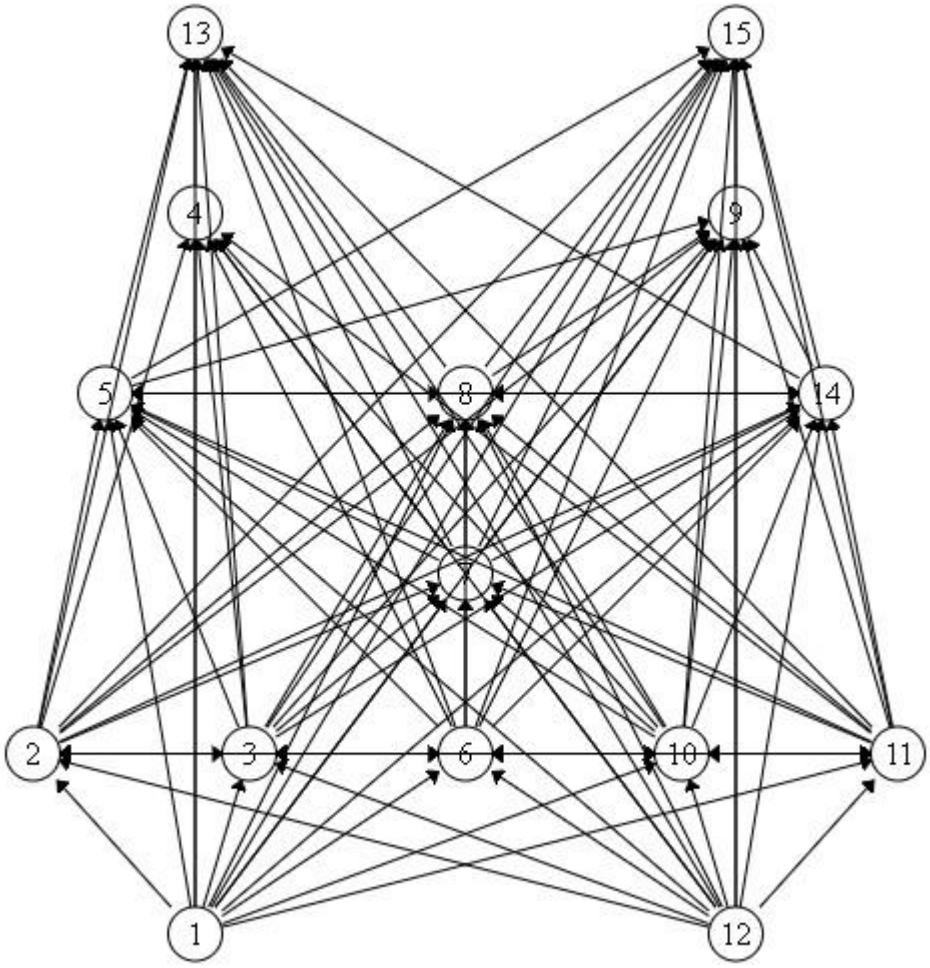

Figure 29: Final Revision Digraph

Figure 29 shows the digraph automatically produced by the SmartISM tool for the results of the analysis. All of the existing relations among the factors are automatically drawn and levels of the factors shown. It can be seen that there are 5 levels of factors and complex relations among the factors exist. Final framework will give a better result.

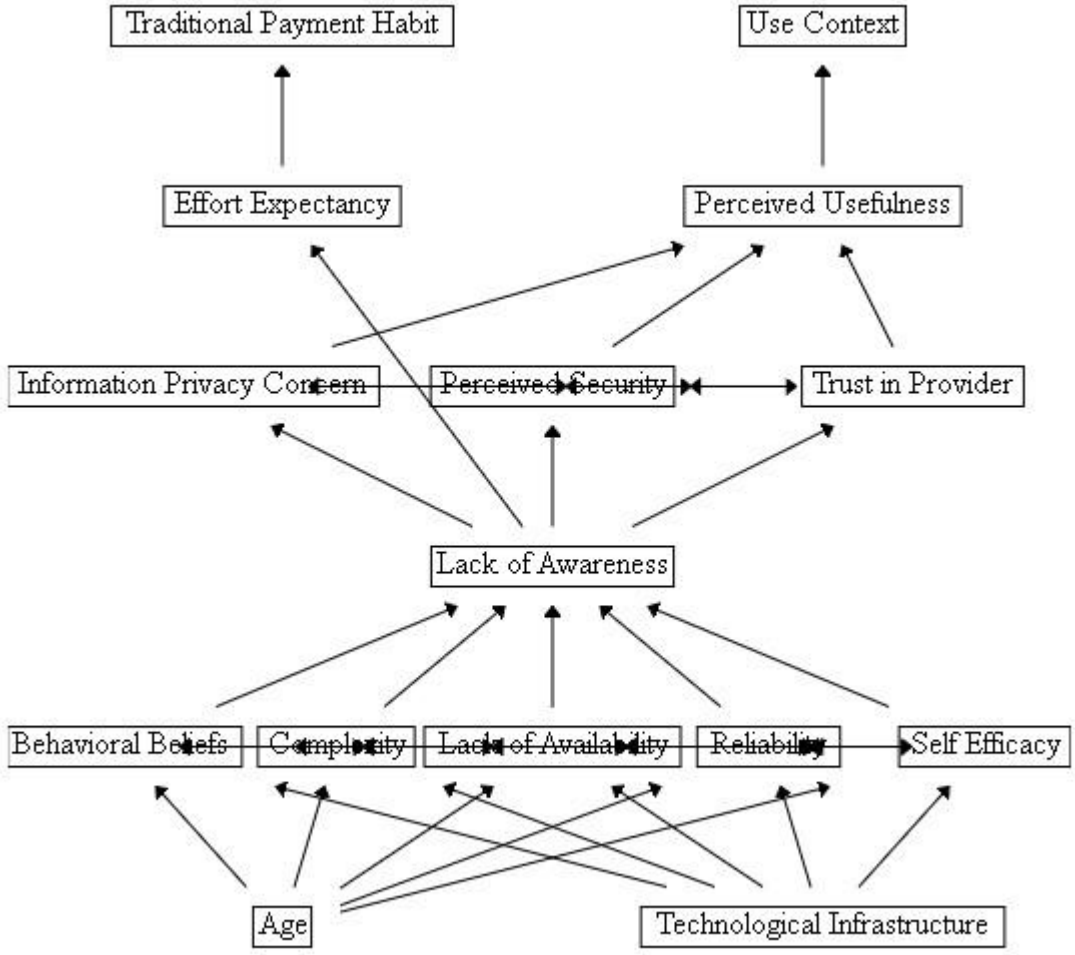

Figure 30: Final Revision ISM Framework

Figure 30 shows the final ISM framework generated by the SmartISM tool for the final results. Factor numbers are replaced with factor names and duplicate relations are simplified for a better representation of the final model. 5 levels of barriers and relations among the barriers are now displayed in a clear view on the model and also satisfy the participants of the ISM process.

The final revision exhibited notable improvements when compared with the initial and previous iterations, also eliciting positive reactions from experts for its enhanced quality and clarity.

4.5. Reviews From Stakeholders

The SmartISM tool is an important facilitator to use at ISM iterations. However, it does not generate professional visuals. It is a minimalist software providing the bare minimums to make the work done. Therefore, the final revision of the ISM framework shown at the Figure 30 is needed to be recreated in a graphical design software. It is visually represented in a graphics program to enhance its aesthetics and readability. This visualization shown at Figure 31, also facilitates sharing the model with stakeholders because of better readability and user friendliness.

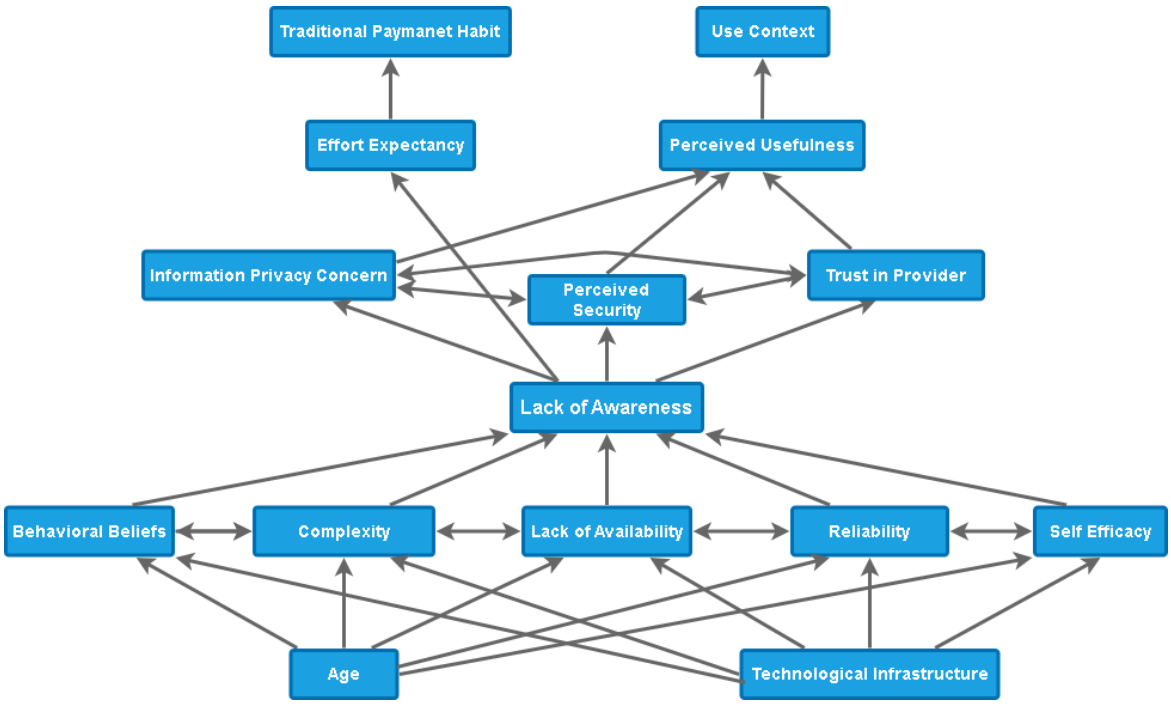

Figure 31: Final ISM Framework

In the final revision, the outcomes were shared with stakeholders and experts. Almost all of them agreed with the results, including the most of the experts. However, one expert made a minor objection. Given the subjective nature of the method and its reliance on individual perspectives, the issue was discussed but ultimately not used to alter the final model because there is not a consensus or majority among the experts. Implications of the final ISM framework will be discussed at the next chapter under the Conclusion section.

CHAPTER 5

5. CONCLUSION

The integration of mobile payment systems into modern life have become increasingly prevalent in recent years. This research intends to investigate the widespread use of mobile payment systems in Turkey and explore the impact mechanisms influencing their acceptance. The case study focuses on "Solipay," a mobile payment system utilized in a leading university in Turkey.(*Solipay-SoliClub | Mobile Payment System*, 2024) Through the application of Interpretive Structural Modelling, the study aims to provide insights that can facilitate predictions for the broader society and contribute to the understanding of mobile payment system acceptance.

The purpose of this study is to conduct a comprehensive analysis of mobile payment technologies, with a particular emphasis on their utilization by users within a geographically constrained environment, such as a university campus. The primary aim is to identify and investigate potential obstacles that may impede the successful adoption of these technologies.

Within the context of this thesis, three fundamental research inquiries were explored:

- What are the primary factors that hinder the acceptance of Mobile Payment Systems (MPS) among university campus populations in Turkey?
- Within the context of university campus populations in Turkey, what are the key relationships among the obstacles encountered in the adoption of MPS?
- To lessen the negative effects of barriers on service providers adopting MPS, what practical solutions or suggestions could be formally proposed?

Our country lags behind other developed nations in the number of studies examining this critical and complex issue. Hence, the primary contribution of this thesis study is to expand the body of knowledge on MPS adoption studies within the Turkish context. It aims to provide potential solutions or at least guide the path toward solutions.

The research findings identify commonly used factors in the literature for the field, evaluate their validity in the context of Turkey, and explore the relationships among them.

The research uses the interpretive structural modeling (ISM) methodology to systematically assess the relationships and dependencies between the identified barriers. In a complex situation entailing numerous dimensions and stakeholders, Interpretive Structural Modeling (ISM) is an apt choice for a case analysis. Various parties, including

end-users, developers, regulators, and service providers, are involved in this issue. Technology, culture, costs, security, privacy, and other factors contribute to its complexity. ISM enables a thorough examination of the interrelationships among these parties, factors, and dimensions, leading to a more extensive understanding of the problem.

From the final ISM diagram, it is evident that age and technological infrastructure pose significant barriers that impact all other factors. This aligns with Turkey's status as a developing country, rather than a developed one. This implies that even on university campuses in our country, there is an inadequacy of technological infrastructure for the widespread use of MPS. The lack of availability and awareness, as significant factors, suggest that this idea has far-reaching effects.

The adoption of mobile payment systems is heavily influenced by the quality and availability of hardware and software, as well as people's access to these technological infrastructures. However, our research indicates that addressing this issue on a national scale or campus scale is challenging because of the amount of resources required.

Age appears to be a crucial factor closely linked to acceptance problem. Historically, the gap in technological infrastructure between our country and developed nations was even more pronounced. Consequently, older individuals had even less exposure to these technologies in previous decades. This could explain why age significantly impacts all other factors. In contrast, younger generations have more exposure to technological infrastructure due to globalization and recent advancements in information and communication technologies.

The second level of the ISM framework consists of behavioral beliefs, complexity, availability, reliability, and self-efficacy. These factors are interconnected and influence each other. Stakeholders and experts agree that these are critical factors closely related to the upper and lower levels.

Lack of awareness stands out as a core factor at the third level and interacts with other factors in the upper and lower layers. It is discussed among experts and stakeholders that this significantly critical factor holds potential solutions. In the context of METU Campus, educational initiatives can improve the acceptance of mobile payment systems for all age groups. These initiatives include:

- Offering workshops and seminars to educate students, faculty, and staff about the benefits and security of mobile payments
- Providing incentives such as discounts and promotions to encourage the use of mobile payments
- Working with local businesses to ensure that mobile payments are widely accepted on campus

“Lack of awareness” as a core factor directly affects the upper levels, potentially alleviating the effects of all these barriers on acceptance.

The fourth level of the framework consists primarily of security-related factors such as "Information Privacy Concern," "Perceived Security," and "Trust in Provider." These factors are interconnected and closely associated with the lack of awareness factor. All parties involved acknowledge this situation. Solutions proposed for addressing the lack of awareness factor are also applicable to these three factors.

At the fifth level, it is particularly the "Perceived Usefulness" factor that significantly affects the "Use Context." Furthermore, enhancements made at lower levels can also address issues associated with "Personal Usefulness."

In order to validate the accuracy and credibility of our research findings, the final ISM Framework was presented to the group of stakeholders, subject-matter experts, and the technical expert from UTARIT for Solipay. This comprehensive framework encompasses a systematic approach to mobile payment systems development. Upon thoroughly reviewing the ISM Framework, the stakeholders, subject-matter experts, and the Solipay side agreed that it serves as a valuable tool for guiding future mobile payment system developments. They welcomed the ISM Framework as a practical guide and acknowledged the framework's ability to address potential challenges in a proactive manner.

Overall, the positive feedback received from stakeholders, subject-matter experts, and the Solipay developers reinforced our confidence in the ISM Framework's ability to drive innovation and contribute to the advancement of mobile payment systems technologies.

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APPENDICES

APPENDIX A

QUESTIONNAIRE ITERATION 1

A SURVEY OF THE ADOPTION OF MOBILE PAYMENT TECHNOLOGIES ON THE METU CAMPUS:

SOLICLUB/SOLIPAY MOBILE PAYMENT SYSTEM CASE STUDY

ITERATION 1

This questionnaire aims to gather data for a thesis research project in Information Systems titled "ANALYSIS OF MOBILE PAYMENT TECHNOLOGIES' ADOPTION USING INTERPRETIVE STRUCTURAL MODELING: SOLIPAY CASE."

- Participation in the survey is entirely optional and based on one's own volition.
- There are no time constraints for completion.
- The privacy of the participants is assured, as their personal information will not be utilized in any capacity.
- During the survey, if any situation arises that makes you feel uncomfortable, you are free to leave at your convenience.
- If you agree to participate in the research, you are expected to score 40 factors that are thought to have an impact during the adaptation of mobile payment systems as obtained as a result of literature research, and then rank them from the most influencing to the least influencing.
- Participating in the research requires you to evaluate 40 factors identified through literature research as potentially influential during the adaptation of mobile payment systems. Final section is sorting of the same factors. Please rank these factors in order of influence, from most to least.
- The task is anticipated to require roughly 20-30 minutes of your time.

- For inquiries or expressions of opinion regarding the research, please contact the researcher at ozk****@metu.edu.tr.

We deeply appreciate your participation in the survey by contributing your valuable insights.

With my full understanding and consent, I voluntarily agree to participate in this study after reading the information provided above.

Yes / No

PART 1: Information about participants

Gender: Male / Female

Age: 18-23 / 24-30 / 31-40 / 40-50 / 51 or Older

On average, how many times per month do you use Soliclub/Solipay App at the campus?

1-3 / 4-10 / 11-20 / 21-50 / More than 50

What is the duration of your professional work experience?

0-3 / 3-10 / 10 years or More

Which methods do you prefer to make payments in the campus facilities such as cafeteria or sports center?

- Using Physical Kiosk Devices for cash loading to METU Smartcard
- Using Online Virtual POS for loading credit onto the METU Smartcard using Internet access
- İşCep Mobile QR
- SoliClub/SoliPay Mobile QR

Within the aforementioned options, would you favor a single methodology or a combination of methodologies for payment?

- Just one of them
- More than one
- All of them

PART 2: Assessment of barriers using the Likert Scale

Literature research yielded 40 potential barriers for adoption of mobile payment systems. Detailed explanations of these barriers are provided in the following part.
In assessing the SOLICLUB Application for the METU Campus's adaptation of mobile payment systems, you should use a scoring system. Assign a score of **5** for the barrier you believe to be **"too effective"** and a score of **1** for the barrier you perceive to be "too **little effective**."

Here are the corresponding points:

5: Too effective
4: It has effect
3: Partially effective
2: Less effective
1: No effect

B1	**Age**	impact of a person's age on using mobile payment system	**1 - 2 - 3 - 4 - 5**
B2	**Behavioral Beliefs**	a person's underlying convictions about the likely outcomes and consequences of using mobile payments	**1 - 2 - 3 - 4 - 5**
B3	**Compatibility**	how well a user believes mobile payments align with existing technology, lifestyle, past experiences, values and needs	**1 - 2 - 3 - 4 - 5**
B4	**Complexity**	perceived level of complexity of using a mobile payment system	**1 - 2 - 3 - 4 - 5**
B5	**Concern**	any type of concern when using a mobile payment system	**1 - 2 - 3 - 4 - 5**
B6	**Costs to Use**	cost of using mobile payment systems	**1 - 2 - 3 - 4 - 5**
B7	**Credibility**	service provider's reputation, trustworthiness and expertise	**1 - 2 - 3 - 4 - 5**
B8	**Effort Expectancy**	expected amount of effort for the usage of a mobile payment system	**1 - 2 - 3 - 4 - 5**
B9	**Gender**	impact of a person's gender on using mobile payment system	**1 - 2 - 3 - 4 - 5**
B10	**Information Privacy Concern**	a user's fear and anxiety about the collection, use, and potential misuse of their personal and financial data by mobile payment providers	**1 - 2 - 3 - 4 - 5**

B11	**Lack of Availability**	limitations on where and how the technology can be used	**1 - 2 - 3 - 4 - 5**
B12	**Lack of Awareness**	lack of awareness about the technology or limited and inaccurate information regarding the technology	**1 - 2 - 3 - 4 - 5**
B13	**Low Satisfaction**	having a negative experience or developing an overall unfavorable opinion about a mobile payment system	**1 - 2 - 3 - 4 - 5**
B14	**Operational Scenario**	specific types of purchases, transactions, and situations where the technology can be used	**1 - 2 - 3 - 4 - 5**
B15	**Pain of Payment**	negative feelings associated with spending money which affects how people perceive different payment methods	**1 - 2 - 3 - 4 - 5**
B16	**Perceived Ease of Use**	a user's perception of how easy it will be to learn, understand, and interact with a mobile payment system	**1 - 2 - 3 - 4 - 5**
B17	**Perceived Risk**	a user's assessment of the potential negative consequences they might face when using mobile payments	**1 - 2 - 3 - 4 - 5**
B18	**Perceived Security**	a user's subjective beliefs and feelings about how safe their money and data are when using these systems which goes beyond the actual security measures in place	**1 - 2 - 3 - 4 - 5**
B19	**Perceived Severity**	individual's assessment of the seriousness or magnitude of the potential risks associated with using mobile payments.	**1 - 2 - 3 - 4 - 5**
B20	**Perceived Support From Mobile Payment Services Provider**	a user's belief that the company behind the mobile payment system will provide reliable assistance and offer solutions	**1 - 2 - 3 - 4 - 5**
B21	**Perceived Usefulness**	a user's perception of how much using the technology will improve their life, enhance their payment experience, and provide tangible benefits	**1 - 2 - 3 - 4 - 5**
B22	**Performance Expectancy**	degree to which an individual believes that using a particular technology will enhance their performance and help them achieve their desired goals	**1 - 2 - 3 - 4 - 5**
B23	**Personal Traits**	an individual's unique characteristics, dispositions, and tendencies that play a role in	**1 - 2 - 3 - 4 - 5**

		how likely they are to adopt mobile payment systems	
B24	**Price Value / Functional Value**	consumer's cognitive trade-off between the perceived benefits of the technologies and the monetary cost of using them.	**1 - 2 - 3 - 4 - 5**
B25	**Reliability**	service reliability of mobile payment systems	**1 - 2 - 3 - 4 - 5**
B26	**Security**	includes several distinct but interrelated aspects such as fraud prevention, protection from hacking, strong encryption etc.	**1 - 2 - 3 - 4 - 5**
B27	**Self-Compassion**	characteristics such as anxiety, efficacy, fatigue, wait-and-see tendencies and the excessive choice of technology effect	**1 - 2 - 3 - 4 - 5**
B28	**Self-Efficacy**	individual's confidence in their ability to learn, set up, and successfully use a mobile payment system.	**1 - 2 - 3 - 4 - 5**
B29	**Service Provider Related Factors**	a broader concept including all available aspects which may be related with service provider including security, reliability, stability, support, trust etc.	**1 - 2 - 3 - 4 - 5**
B30	**Social Influence**	opinions, behaviors, and experiences of others within a person's social circle have on their own attitudes and actions	**1 - 2 - 3 - 4 - 5**
B31	**Social Values**	guiding principles or beliefs people within a society hold about what is desirable, important, and ethical	**1 - 2 - 3 - 4 - 5**
B32	**Stickiness to Cash**	continued preference for and reliance on physical currency, even when convenient alternatives are available	**1 - 2 - 3 - 4 - 5**
B33	**Stress to Use**	the mental strain, frustration, or anxiety that a user may experience while interacting with the technology	**1 - 2 - 3 - 4 - 5**
B34	**Subjective Norms**	perceived social pressure an individual feel to either use or not use mobile payments.	**1 - 2 - 3 - 4 - 5**
B35	**Sunk Costs / Switching Costs**	time, money, or effort someone has already put into something which create a sense of investment and tendency to continue with a behavior or endeavor	**1 - 2 - 3 - 4 - 5**
B36	**Technological Infrastructure**	factors including integration, device compatibility, networking, connectivity, underlying hardware and software infrastructures	**1 - 2 - 3 - 4 - 5**

B37	**Traditional Payment Habit**	deeply ingrained routines and preferences including cards, cash or other alternatives people pay for goods and services	**1 - 2 - 3 - 4 - 5**
B38	**Trust in Provider**	includes several factors such as ethical practices, privacy protection, reliability, security and reputation	**1 - 2 - 3 - 4 - 5**
B39	**Uncertainty Avoidance**	people within a society feeling uncomfortable with ambiguity, unpredictability, and unfamiliar situations	**1 - 2 - 3 - 4 - 5**
B40	**Use Context**	specific circumstances, situations, and environment in which a person might use mobile payments	**1 - 2 - 3 - 4 - 5**

PART 3: Categorization of barriers from highest efficacy to lowest efficacy
Out of the 40 barriers you just rated, please rank the ones you believe are the most effective. Place the most critical barrier in the first rank.
While sorting, you need to use drag-and-drop to move the barriers listed on the left to the panel on the right in an order from the most effective to the least effective. You can change the order at any time while listing by just dragging the related item.

#	List of Barriers	Ranking of Barriers
1	Age	
2	Behavioral Beliefs	
3	Compatibility	
4	Complexity	
5	Concern	
6	Costs to Use	
7	Credibility	
8	Effort Expectancy	
9	Gender	
10	Information Privacy Concern	
11	Lack of Availability	
12	Lack of Awareness	
13	Low Satisfaction	
14	Operational Scenario	
15	Pain of Payment	

16	Perceived Ease of Use	
17	Perceived Risk	
18	Perceived Security	
19	Perceived Severity	
20	Perceived Support From Mobile Payment Services Provider	
21	Perceived Usefulness	
22	Performance Expectancy	
23	Personal Traits	
24	Price Value / Functional Value	
25	Reliability	
26	Security	
27	Self-Compassion	
28	Self-Efficacy	
29	Service Provider Related Factors	
30	Social Influence	
31	Social Values	
32	Stickiness to Cash	
33	Stress to Use	
34	Subjective Norms	
35	Sunk Costs / Switching Costs	
36	Technological Infrastructure	
37	Traditional Payment Habit	
38	Trust in Provider	
39	Uncertainty Avoidance	
40	Use Context	

Thank you for your participation and valuable insights. We appreciate your time and effort in completing the survey.

APPENDIX B

RESULTS OF QUESTIONNAIRES

Factors with average points from first (left) and second (right) iteration are shown below. Next 5 values in each row next to the average points shows the most voted first five rankings for each item. They are used to better understand the criticality of the item.

Age	**4.08**	**39**	**1**	**4**	**5**	**16**	**3.98**	**39**	**31**	**1**	**2**	**27**
Behavioral Beliefs	**3.66**	**18**	**32**	**38**	**21**	**22**	**3.7**	**37**	**3**	**24**	**35**	**10**
Compatibility	**3.88**	**26**	**1**	**15**	**3**	**4**	**3.83**	**29**	**5**	**7**	**8**	**9**
Complexity	**4.36**	**3**	**13**	**1**	**2**	**4**	**4.53**	**1**	**4**	**9**	**12**	**20**
Concern	**3.66**	**23**	**31**	**6**	**10**	**11**	**3.62**	**10**	**11**	**13**	**31**	**32**
Costs to Use	**3.16**	**5**	**2**	**1**	**24**	**4**	**3.38**	**1**	**11**	**30**	**2**	**3**
Credibility	**4.32**	**6**	**15**	**28**	**9**	**10**	**4.23**	**14**	**7**	**3**	**4**	**12**
Effort Expectancy	**4.36**	**16**	**6**	**7**	**20**	**23**	**4.26**	**23**	**6**	**12**	**22**	**28**
Gender	**1.58**	**40**	**39**	**35**	**6**	**7**	**1.39**	**40**	**35**	**39**	**4**	**5**
Information Privacy Concern	**3.78**	**4**	**3**	**5**	**10**	**29**	**3.96**	**1**	**4**	**9**	**19**	**2**
Lack of Availability	**3.76**	**9**	**11**	**10**	**13**	**17**	**3.89**	**4**	**8**	**20**	**25**	**28**
Lack of Awareness	**3.68**	**15**	**30**	**3**	**12**	**17**	**3.74**	**22**	**10**	**19**	**21**	**25**
Low Satisfaction	**3.64**	**18**	**29**	**26**	**28**	**30**	**3.7**	**20**	**25**	**4**	**12**	**13**
Operational Scenario	**3.42**	**22**	**19**	**39**	**5**	**13**	**3.5**	**28**	**37**	**11**	**16**	**21**
Pain of Payment	**3**	**12**	**38**	**9**	**27**	**40**	**2.91**	**8**	**18**	**32**	**36**	**2**

Perceived Ease of Use	**4.34**	**1**	**2**	**4**	**5**	**9**	**4.37**	**1**	**18**	**2**	**14**	**3**
Perceived Risk	**3.94**	**7**	**4**	**11**	**15**	**6**	**3.87**	**6**	**8**	**4**	**12**	**15**
Perceived Security	**4.28**	**8**	**2**	**4**	**7**	**1**	**4.52**	**2**	**3**	**4**	**39**	**9**
Perceived Severity	**3.7**	**20**	**29**	**12**	**15**	**21**	**3.85**	**10**	**5**	**11**	**26**	**29**
Perceived Support From Mobile Payment Services Provider	**3.64**	**18**	**25**	**11**	**17**	**7**	**3.63**	**6**	**7**	**15**	**16**	**27**
Perceived Usefulness	**3.96**	**6**	**11**	**13**	**14**	**18**	**4.09**	**5**	**17**	**19**	**2**	**9**
Performance Expectancy	**3.68**	**20**	**8**	**12**	**16**	**24**	**3.74**	**10**	**30**	**14**	**27**	**35**
Personal Traits	**3.58**	**1**	**8**	**28**	**31**	**14**	**3.78**	**15**	**16**	**29**	**1**	**2**
Price Value / Functional Value	**3.48**	**9**	**32**	**1**	**6**	**17**	**3.48**	**37**	**14**	**18**	**27**	**3**
Reliability	**4.36**	**5**	**3**	**8**	**2**	**7**	**4.37**	**1**	**8**	**12**	**2**	**4**
Security	**4.5**	**1**	**2**	**7**	**3**	**4**	**4.61**	**1**	**7**	**2**	**4**	**3**
Self-Compassion	**3.38**	**31**	**23**	**33**	**25**	**32**	**3.46**	**24**	**31**	**33**	**35**	**15**
Self-Efficacy	**3.6**	**16**	**22**	**26**	**35**	**37**	**3.83**	**2**	**33**	**19**	**21**	**32**
Service Provider Related Factors	**3.68**	**28**	**8**	**10**	**32**	**33**	**3.8**	**25**	**26**	**5**	**6**	**16**
Social Influence	**3.24**	**37**	**30**	**39**	**40**	**36**	**3.22**	**36**	**18**	**34**	**13**	**15**
Social Values	**2.64**	**39**	**38**	**36**	**29**	**34**	**2.43**	**37**	**12**	**24**	**31**	**38**
Stickiness to Cash	**3.08**	**19**	**38**	**11**	**27**	**4**	**2.54**	**14**	**23**	**34**	**37**	**38**

Stress to Use	**2.68**	**10**	**15**	**36**	**6**	**11**	**3.17**	**10**	**16**	**20**	**27**	**7**
Subjective Norms	**3.02**	**36**	**39**	**26**	**31**	**33**	**2.72**	**30**	**32**	**37**	**33**	**34**
Sunk Costs / Switching Costs	**3.92**	**37**	**35**	**7**	**21**	**34**	**2.89**	**38**	**4**	**15**	**20**	**21**
Technological Infrastructure	**3.92**	**12**	**2**	**3**	**30**	**34**	**3.96**	**3**	**7**	**13**	**6**	**9**
Traditional Payment Habit	**3.58**	**19**	**13**	**35**	**2**	**8**	**3.46**	**15**	**22**	**23**	**1**	**2**
Trust in Provider	**3.9**	**5**	**7**	**10**	**23**	**1**	**3.93**	**7**	**5**	**8**	**3**	**6**
Uncertainty Avoidance	**3.24**	**19**	**16**	**27**	**28**	**8**	**3.48**	**27**	**28**	**40**	**10**	**12**
Use Context	**3.48**	**29**	**7**	**13**	**24**	**31**	**3.52**	**30**	**35**	**8**	**10**	**15**

APPENDIX C

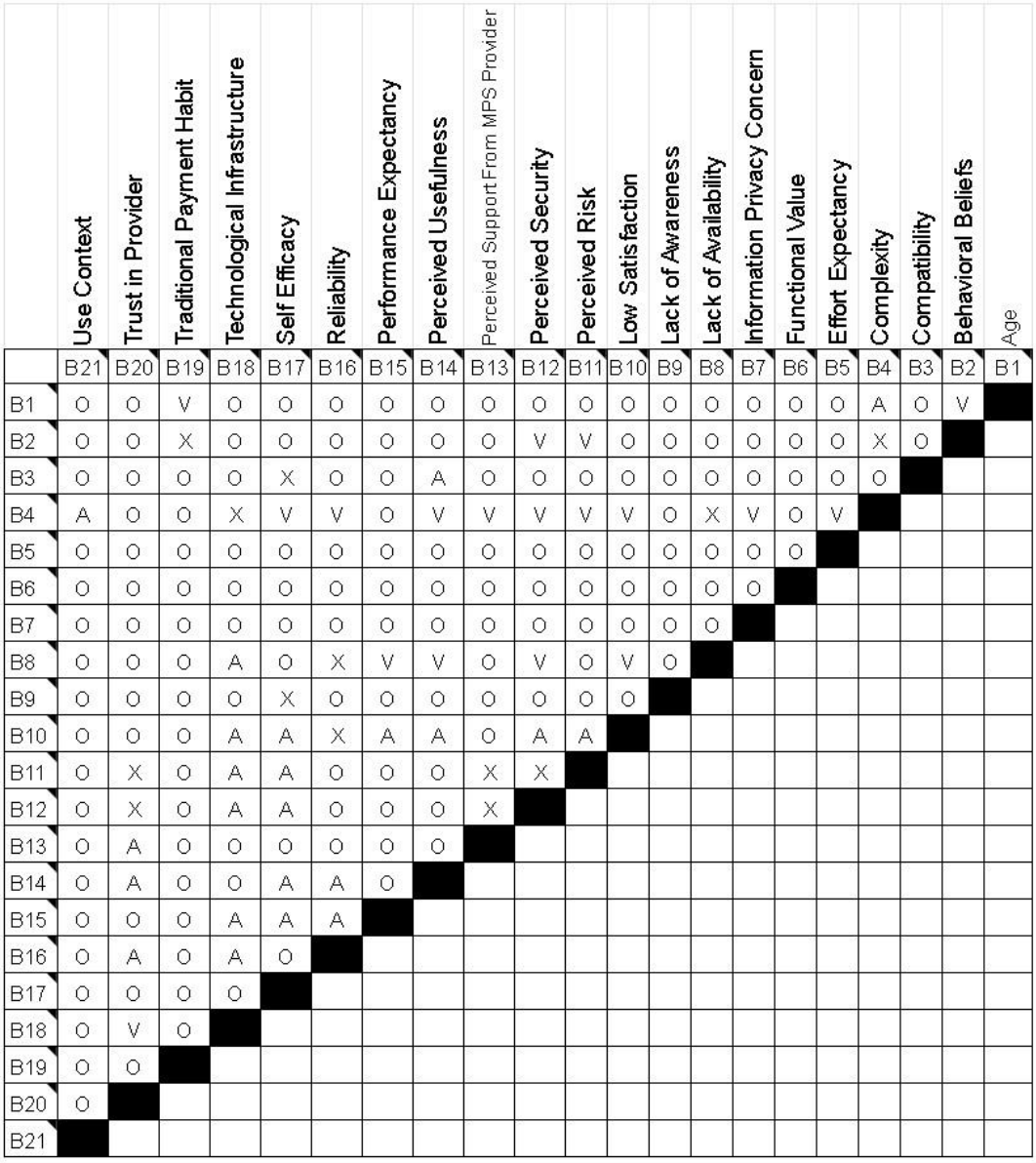
21 BARRIERS SELECTED FOR ISM

Age	impact of a person's age on using mobile payment system
Behavioral Beliefs	a person's underlying convictions about the likely outcomes and consequences of using mobile payments
Complexity	perceived level of complexity of using a mobile payment system
Information Privacy Concern	a user's fear and anxiety about the collection, use, and potential misuse of their personal and financial data by mobile payment providers
Lack of Awareness	lack of awareness about the technology or limited and inaccurate information regarding the technology
Low Satisfaction	having a negative experience or developing an overall unfavorable opinion about a mobile payment system
Functional Value	consumer's cognitive trade-off between the perceived benefits of the technologies and the monetary cost of using them.
Reliability	service reliability of mobile payment systems
Traditional Payment Habit	deeply ingrained routines and preferences including cards, cash or other alternatives people pay for goods and services
Perceived Risk	a user's assessment of the potential negative consequences they might face when using mobile payments
Perceived Security	a user's subjective beliefs and feelings about how safe their money and data are when using these systems which goes beyond the actual security measures in place
Technological Infrastructure	factors including integration, device compatibility, networking, connectivity, underlying hardware and software infrastructures
Use Context	specific circumstances, situations, and environment in which a person might use mobile payments
Lack of Availability	limitations on where and how the technology can be used
Effort Expectancy	expected amount of effort for the usage of a mobile payment system
Perceived Support From Mobile Payment Services Provider	a user's belief that the company behind the mobile payment system will provide reliable assistance and offer solutions

Perceived Usefulness	a user's perception of how much using the technology will improve their life, enhance their payment experience, and provide tangible benefits
Self-Efficacy	individual's confidence in their ability to learn, set up, and successfully use a mobile payment system.
Trust in Provider	includes several factors such as ethical practices, privacy protection, reliability, security and reputation
Performance Expectancy	degree to which an individual believes that using a particular technology will enhance their performance and help them achieve their desired goals
Compatibility	how well a user believes mobile payments align with existing technology, lifestyle, past experiences, values and needs

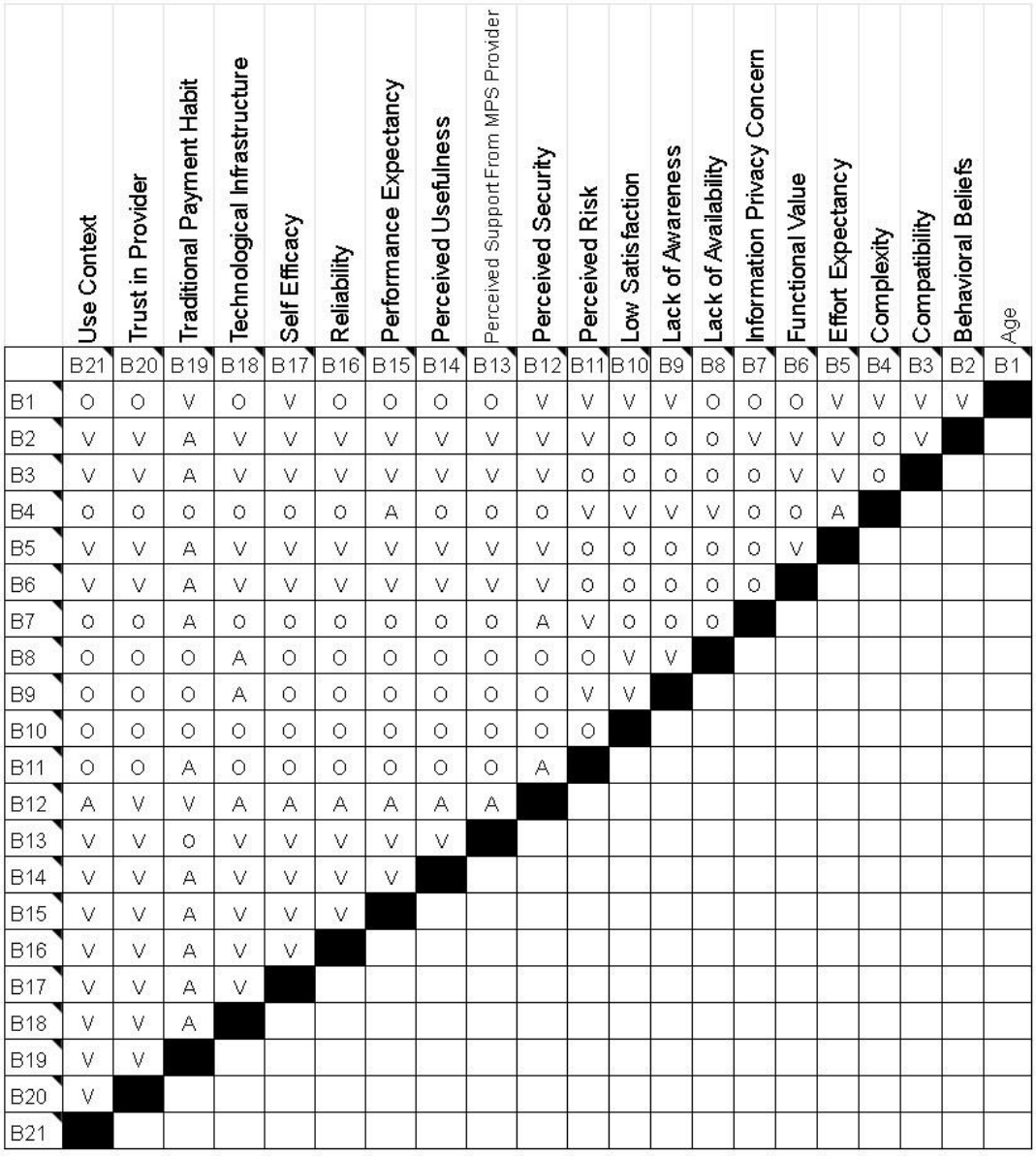
APPENDIX D

ISM EXPERT SSIM MATRICES



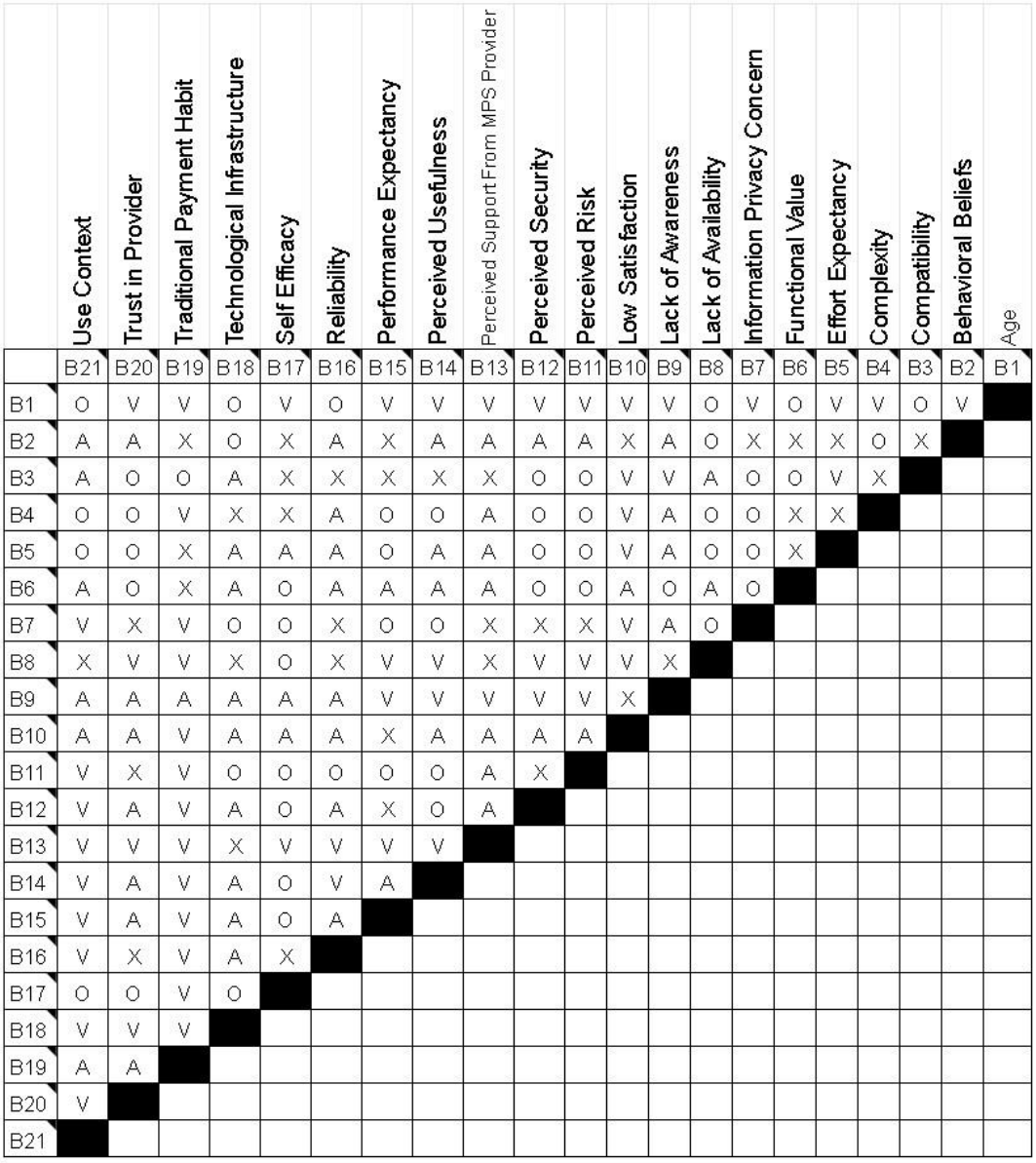
	Use Context	Trust in Provider	Traditional Payment Habit	Technological Infrastructure	Self Efficacy	Reliability	Performance Expectancy	Perceived Usefulness	Perceived Support From MPS Provider	Perceived Security	Perceived Risk	Low Satisfaction	Lack of Awareness	Lack of Availability	Information Privacy Concern	Functional Value	Effort Expectancy	Complexity	Compatibility	Behavioral Beliefs	Age
	B21	B20	B19	B18	B17	B16	B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1
B1	O	O	V	O	O	O	O	O	O	O	O	O	O	O	O	O	O	A	O	V	
B2	O	O	X	O	O	O	O	O	O	V	V	O	O	O	O	O	O	X	O		
B3	O	O	O	O	X	O	O	A	O	O	O	O	O	O	O	O	O	O			
B4	A	O	O	X	V	V	O	V	V	V	V	V	O	X	V	O	V				
B5	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O					
B6	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O						
B7	O	O	O	O	O	O	O	O	O	O	O	O	O	O							
B8	O	O	O	A	O	X	V	V	O	V	O	V	O								
B9	O	O	O	O	X	O	O	O	O	O	O	O									
B10	O	O	O	A	A	X	A	A	O	A	A										
B11	O	X	O	A	A	O	O	O	X	X											
B12	O	X	O	A	A	O	O	O	X												
B13	O	A	O	O	O	O	O	O													
B14	O	A	O	O	A	A	O														
B15	O	O	O	A	A	A															
B16	O	A	O	A	O																
B17	O	O	O	O																	
B18	O	V	O																		
B19	O	O																			
B20	O																				
B21																					

Figure 32: ISM Expert 1 SSIM



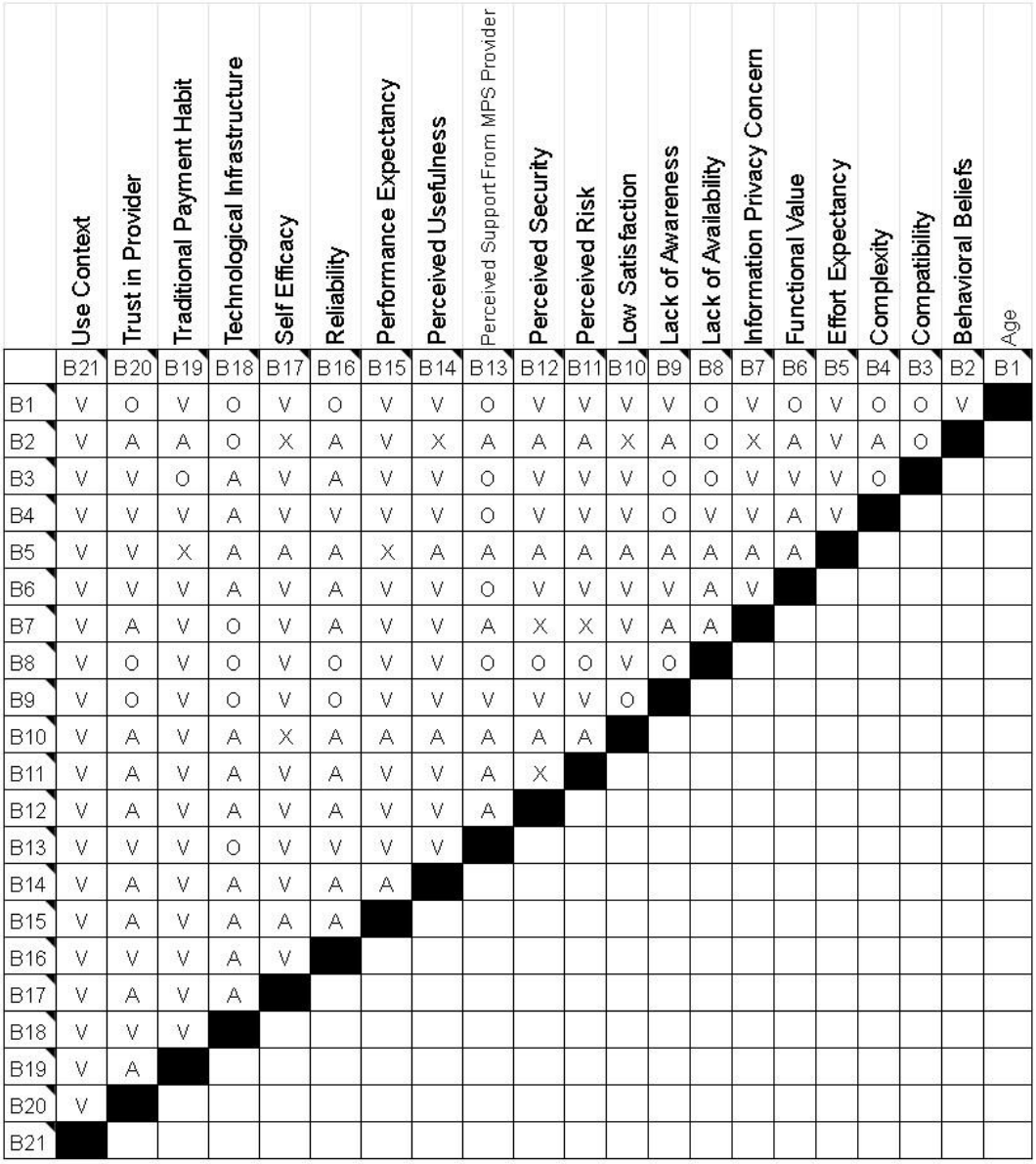
	Use Context	Trust in Provider	Traditional Payment Habit	Technological Infrastructure	Self Efficacy	Reliability	Performance Expectancy	Perceived Usefulness	Perceived Support From MPS Provider	Perceived Security	Perceived Risk	Low Satisfaction	Lack of Awareness	Lack of Availability	Information Privacy Concern	Functional Value	Effort Expectancy	Complexity	Compatibility	Behavioral Beliefs	Age
	B21	B20	B19	B18	B17	B16	B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1
B1	O	O	V	O	V	O	O	O	O	V	V	V	V	O	O	O	V	V	V	V	
B2	V	V	A	V	V	V	V	V	V	V	V	O	O	O	V	V	V	O	V		
B3	V	V	A	V	V	V	V	V	V	V	O	O	O	O	O	V	V	O			
B4	O	O	O	O	O	O	A	O	O	O	V	V	V	V	O	O	A				
B5	V	V	A	V	V	V	V	V	V	V	O	O	O	O	O	V					
B6	V	V	A	V	V	V	V	V	V	V	O	O	O	O	O						
B7	O	O	A	O	O	O	O	O	O	A	V	O	O	O							
B8	O	O	O	A	O	O	O	O	O	O	O	V	V								
B9	O	O	O	A	O	O	O	O	O	O	V	V									
B10	O	O	O	O	O	O	O	O	O	O	O										
B11	O	O	A	O	O	O	O	O	O	A											
B12	A	V	V	A	A	A	A	A	A												
B13	V	V	O	V	V	V	V	V													
B14	V	V	A	V	V	V	V														
B15	V	V	A	V	V	V															
B16	V	V	A	V	V																
B17	V	V	A	V																	
B18	V	V	A																		
B19	V	V																			
B20	V																				
B21																					

Figure 33: ISM Expert 2 SSIM



	Use Context	Trust in Provider	Traditional Payment Habit	Technological Infrastructure	Self Efficacy	Reliability	Performance Expectancy	Perceived Usefulness	Perceived Support From MPS Provider	Perceived Security	Perceived Risk	Low Satisfaction	Lack of Awareness	Lack of Availability	Information Privacy Concern	Functional Value	Effort Expectancy	Complexity	Compatibility	Behavioral Beliefs	Age
	B21	B20	B19	B18	B17	B16	B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1
B1	O	V	V	O	V	O	V	V	V	V	V	V	V	O	V	O	V	V	O	V	
B2	A	A	X	O	X	A	X	A	A	A	A	X	A	O	X	X	X	O	X		
B3	A	O	O	A	X	X	X	X	X	O	O	V	V	A	O	O	V	X			
B4	O	O	V	X	X	A	O	O	A	O	O	V	A	O	O	X	X				
B5	O	O	X	A	A	A	O	A	A	O	O	V	A	O	O	X					
B6	A	O	X	A	O	A	A	A	A	O	O	A	O	A	O						
B7	V	X	V	O	O	X	O	O	X	X	X	V	A	O							
B8	X	V	V	X	O	X	V	V	X	V	V	V	X								
B9	A	A	A	A	A	A	V	V	V	V	V	X									
B10	A	A	V	A	A	A	X	A	A	A	A										
B11	V	X	V	O	O	O	O	O	A	X											
B12	V	A	V	A	O	A	X	O	A												
B13	V	V	V	X	V	V	V	V													
B14	V	A	V	A	O	V	A														
B15	V	A	V	A	O	A															
B16	V	X	V	A	X																
B17	O	O	V	O																	
B18	V	V	V																		
B19	A	A																			
B20	V																				
B21																					

Figure 34: ISM Expert 3 SSIM



	Use Context	Trust in Provider	Traditional Payment Habit	Technological Infrastructure	Self Efficacy	Reliability	Performance Expectancy	Perceived Usefulness	Perceived Support From MPS Provider	Perceived Security	Perceived Risk	Low Satisfaction	Lack of Awareness	Lack of Availability	Information Privacy Concern	Functional Value	Effort Expectancy	Complexity	Compatibility	Behavioral Beliefs	Age
	B21	B20	B19	B18	B17	B16	B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1
B1	V	O	V	O	V	O	V	V	O	V	V	V	V	O	V	O	V	O	O	V	
B2	V	A	A	O	X	A	V	X	A	A	A	X	A	O	X	A	V	A	O		
B3	V	V	O	A	V	A	V	V	O	V	V	V	O	O	V	V	V	O			
B4	V	V	V	A	V	V	V	V	O	V	V	V	O	V	V	A	V				
B5	V	V	X	A	A	A	X	A	A	A	A	A	A	A	A	A					
B6	V	V	V	A	V	A	V	V	O	V	V	V	V	A	V						
B7	V	A	V	O	V	A	V	V	A	X	X	V	A	A							
B8	V	O	V	O	V	O	V	V	O	O	O	V	O								
B9	V	O	V	O	V	O	V	V	V	V	V	O									
B10	V	A	V	A	X	A	A	A	A	A	A										
B11	V	A	V	A	V	A	V	V	A	X											
B12	V	A	V	A	V	A	V	V	A												
B13	V	V	V	O	V	V	V	V													
B14	V	A	V	A	V	A	A														
B15	V	A	V	A	A	A															
B16	V	V	V	A	V																
B17	V	A	V	A																	
B18	V	V	V																		
B19	V	A																			
B20	V																				
B21																					

Figure 35: ISM Expert 4 SSIM

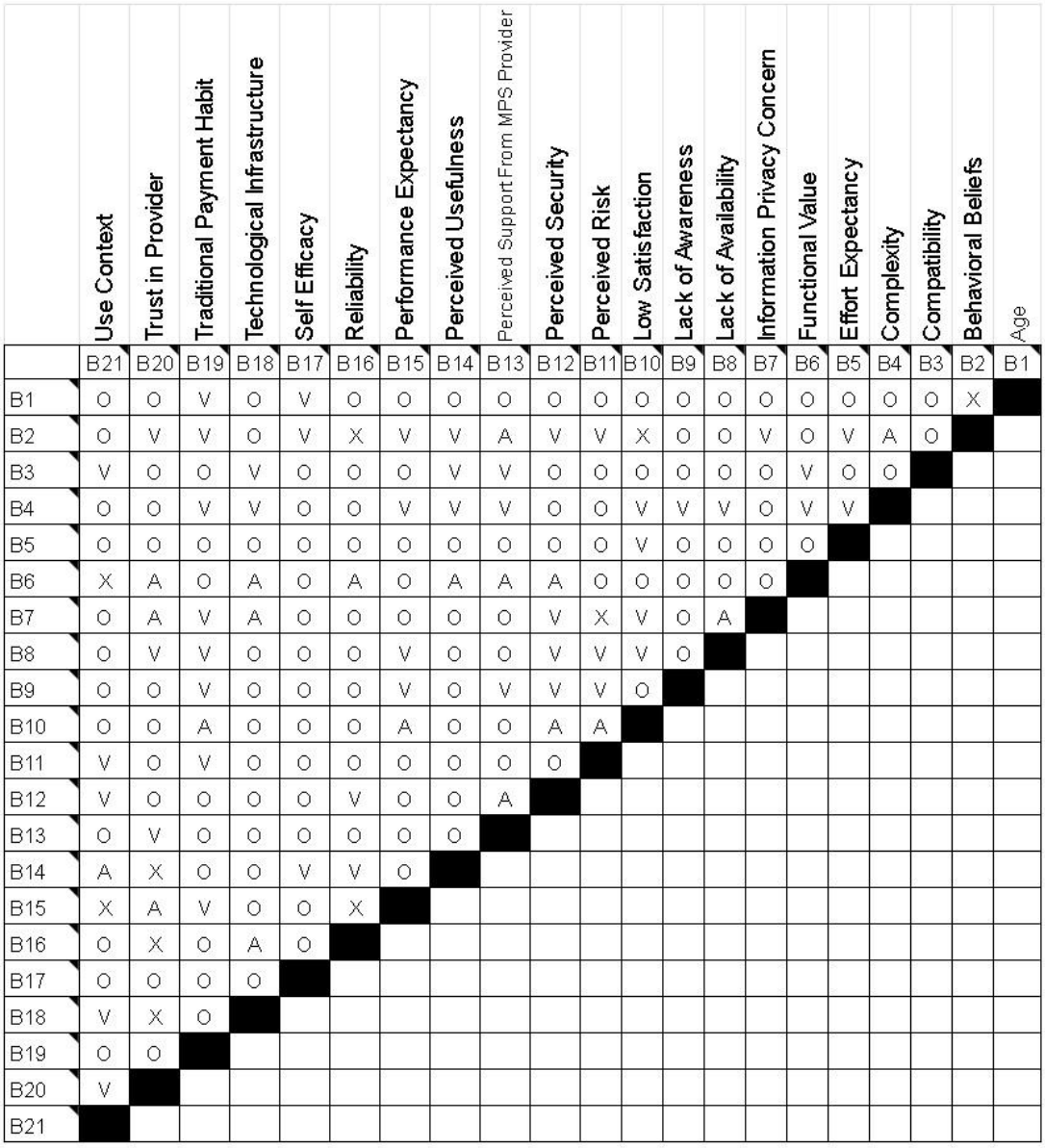
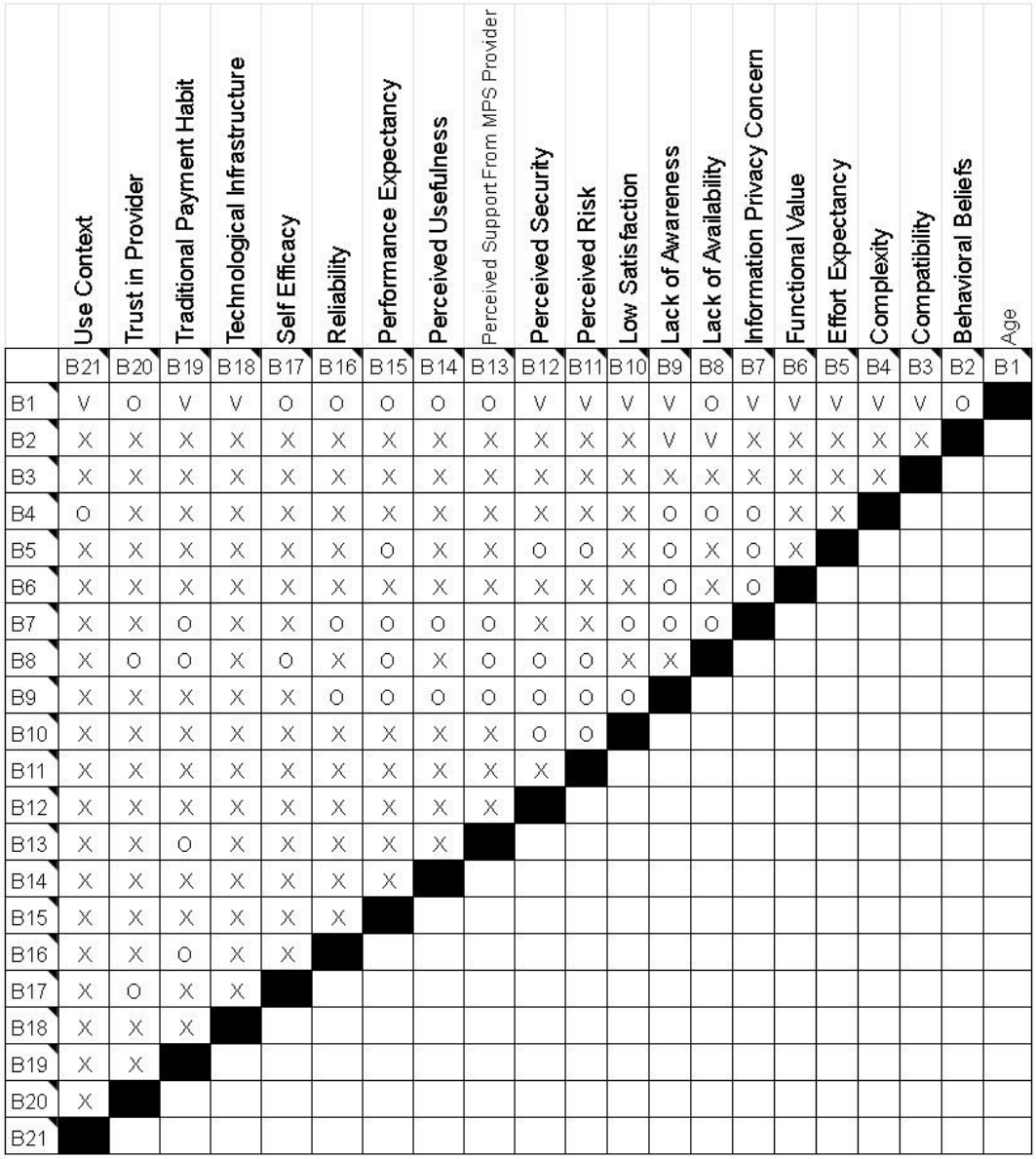
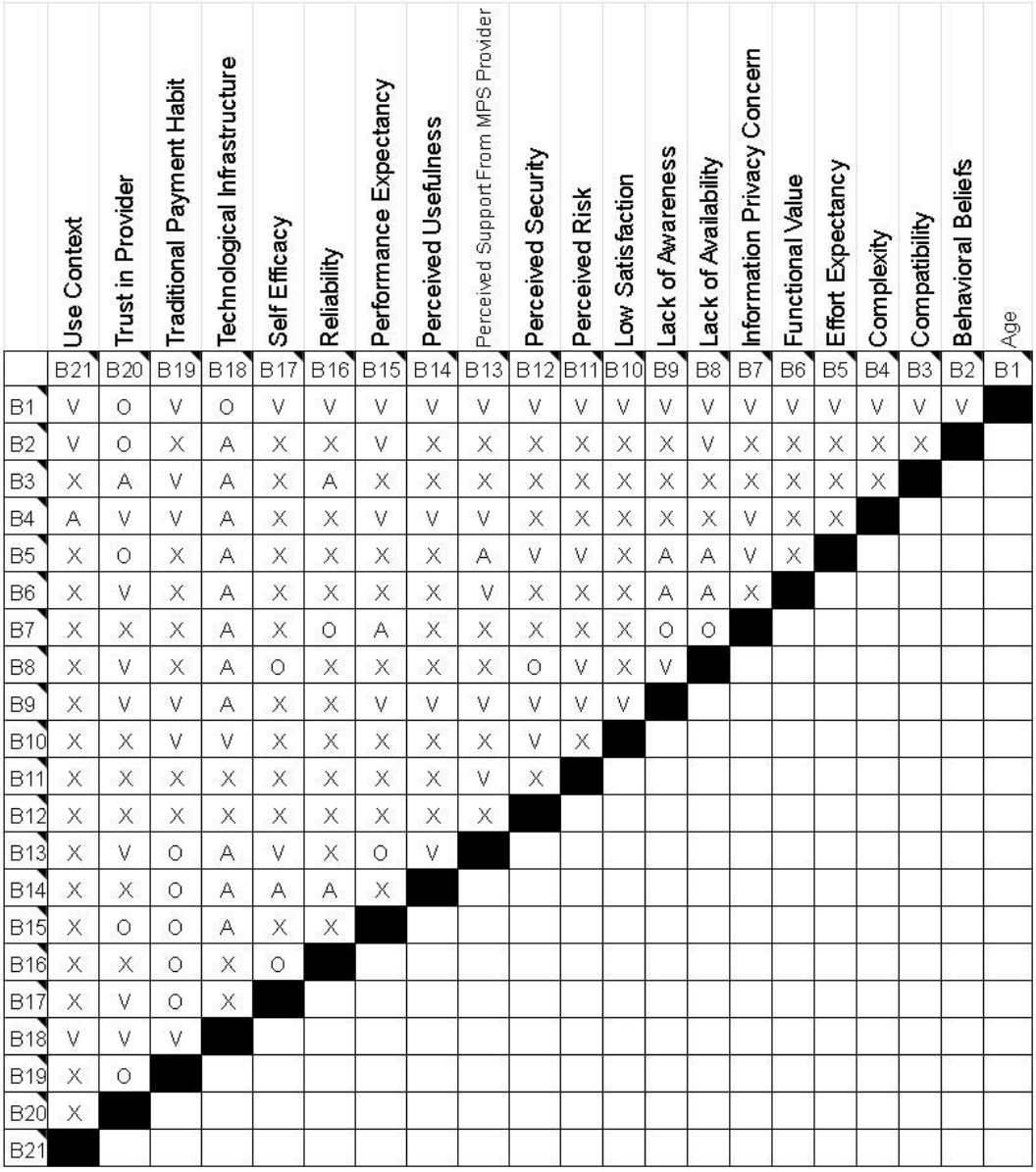


Figure 36: ISM Expert 5 SSIM



	Use Context	Trust in Provider	Traditional Payment Habit	Technological Infrastructure	Self Efficacy	Reliability	Performance Expectancy	Perceived Usefulness	Perceived Support From MPS Provider	Perceived Security	Perceived Risk	Low Satisfaction	Lack of Awareness	Lack of Availability	Information Privacy Concern	Functional Value	Effort Expectancy	Complexity	Compatibility	Behavioral Beliefs	Age
	B21	B20	B19	B18	B17	B16	B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1
B1	V	O	V	V	O	O	O	O	O	V	V	V	V	O	V	V	V	V	V	O	
B2	X	X	X	X	X	X	X	X	X	X	X	X	V	V	X	X	X	X	X		
B3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
B4	O	X	X	X	X	X	X	X	X	X	X	X	O	O	O	X	X				
B5	X	X	X	X	X	X	O	X	X	O	O	X	O	X	O	X					
B6	X	X	X	X	X	X	X	X	X	X	X	X	O	X	O						
B7	X	X	O	X	X	O	O	O	O	X	X	O	O	O							
B8	X	O	O	X	O	X	O	X	O	O	O	X	X								
B9	X	X	X	X	X	O	O	O	O	O	O	O									
B10	X	X	X	X	X	X	X	X	X	O	O										
B11	X	X	X	X	X	X	X	X	X	X											
B12	X	X	X	X	X	X	X	X	X												
B13	X	X	O	X	X	X	X	X													
B14	X	X	X	X	X	X	X														
B15	X	X	X	X	X	X															
B16	X	X	O	X	X																
B17	X	O	X	X																	
B18	X	X	X																		
B19	X	X																			
B20	X																				
B21																					

Figure 37: ISM Expert 6 SSIM



	Use Context	Trust in Provider	Traditional Payment Habit	Technological Infrastructure	Self Efficacy	Reliability	Performance Expectancy	Perceived Usefulness	Perceived Support From MPS Provider	Perceived Security	Perceived Risk	Low Satisfaction	Lack of Awareness	Lack of Availability	Information Privacy Concern	Functional Value	Effort Expectancy	Complexity	Compatibility	Behavioral Beliefs	Age
	B21	B20	B19	B18	B17	B16	B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1
B1	V	O	V	O	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	V	
B2	V	O	X	A	X	X	V	X	X	X	X	X	X	V	X	X	X	X	X		
B3	X	A	V	A	X	A	X	X	X	X	X	X	X	X	X	X	X	X			
B4	A	V	V	A	X	X	V	V	V	X	X	X	X	X	V	X	X				
B5	X	O	X	A	X	X	X	X	A	V	V	X	A	A	V	X					
B6	X	V	X	A	X	X	X	X	V	X	X	X	A	A	X						
B7	X	X	X	A	X	O	A	X	X	X	X	X	O	O							
B8	X	V	X	A	O	X	X	X	X	O	V	X	V								
B9	X	V	V	A	X	X	V	V	V	V	V	V									
B10	X	X	V	V	X	X	X	X	X	V	X										
B11	X	X	X	X	X	X	X	X	V	X											
B12	X	X	X	X	X	X	X	X	X												
B13	X	V	O	A	V	X	O	V													
B14	X	X	O	A	A	A	X														
B15	X	O	O	A	X	X															
B16	X	X	O	X	O																
B17	X	V	O	X																	
B18	V	V	V																		
B19	X	O																			
B20	X																				
B21																					

Figure 38: ISM Expert 7 SSIM