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THE EFFECT OF INTEROPERABILITY ON ADOPTION OF DIGITAL PAYMENT SYSTEM IN COMMERCIAL BANK OF ETHIOPIA: THE MEDIATING ROLE OF PERCEIVED USEFULNESS

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BAHIR DAR UNIVERSITY

COLLEGE OF BUSINESS AND ECONOMICS

DEPARTMENT OF MARKETING MANAGEMENT

**THE EFFECT OF INTEROPERABILITY ON ADOPTION OF
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USEFULNESS**

**A THESIS SUBMITTED TO DEPARTMENT OF MARKETING
MANAGEMENT, COLLEGE OF BUSINESS AND ECONOMICS,
BAHIR DAR UNIVERSITY IN PARTIAL FULFILLMENT OF
THE REQUIREMENT FOR A MASTER OF ARTS DEGREE IN
MARKETING MANAGEMENT**

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MAY, 2026

BAHIR DAR, ETHIOPIA

BAHIR DAR UNIVERSITY
COLLEGE OF BUSINESS AND ECONOMICS
DEPARTMENT OF MARKETING MANAGEMENT
MASTERS PROGRAM (MA)
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BY

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OF MASTERS OF MARKETING MANAGMENT

ADVISOR

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Declaration

I, the undersigned, declare that this thesis entitled " ***THE EFFECT OF INTEROPERABILITY ON ADOPTION OF DIGITAL PAYMENT SYSTEM IN COMMERCIAL BANK OF ETHIOPIA: THE MEDIATING ROLE OF PERCEIVED USEFULNESS*** " is my original work. I have carried out this research independently under the guidance of my advisor. submitted in partial fulfillment of the requirements for the degree of Master of Arts Degree in marketing management (MA) at Bahir Dar University, This work has not been submitted previously for any degree or diploma program at this or any other university. All sources of information used in this thesis have been duly acknowledged through proper citations and references.

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APPROVAL OF THESIS FOR DEFENSE

I hereby certify that I have supervised, read, and evaluated this thesis titled “***THE EFFECTS OF INTEROPERABILITY ON ADOPTION OF DIGITAL PAYMENT SYSTEM IN COMMERCIAL BANK OF ETHIOPIA: THE MEDIATING ROLE OF PERCEIVED USEFULNESS***” by Mohammed Mussa prepared under my guidance. I recommend the thesis be submitted for oral defense.

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Acknowledgment

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Abstract

This study investigates the effect of interoperability on digital payment adoption among 400 Commercial Bank of Ethiopia (CBE) customers in Bahir Dar City, with PU as a mediating variable, using an explanatory, cross-sectional, correlational, quantitative design guided by the Technology Acceptance Model (TAM). Structural equation modeling (SEM) via AMOS 23 revealed that institutional interoperability had the strongest direct effect on adoption ($\beta = 0.217$, $p < 0.001$), followed by operational ($\beta = 0.188$, $p < 0.001$) and technical interoperability ($\beta = 0.152$, $p < 0.001$), while financial interoperability was not a significant predictor ($\beta = 0.029$, $p = 0.171$). Perceived usefulness was significantly predicted by institutional ($\beta = 0.479$, $p < 0.001$), technical ($\beta = 0.388$, $p < 0.001$), and operational interoperability ($\beta = 0.306$, $p < 0.001$), but not by financial interoperability ($\beta = -0.047$, $p = 0.147$), and PU itself significantly predicted adoption ($\beta = 0.229$, $p < 0.001$), confirming its mediating role. These findings indicate that interoperability influences digital payment adoption both directly and indirectly through perceived usefulness, with institutional and technical interoperability emerging as the strongest drivers; the non-significance of financial interoperability likely reflects Ethiopia's early adoption stage. This study extends TAM to the Ethiopian context and provides empirical validation for the National Digital Payment Strategy.

Keywords: *Interoperability, digital payment adoption, perceived usefulness, Technology Acceptance Model (TAM), Ethiopia, Commercial Bank of Ethiopia*

Acronyms and Abbreviations

ATU	Attitude toward Using
ATM	Automated Teller Machine
BI	Behavioral Intention
CAGR	Compound Annual Growth Rate
CBE	Commercial Bank of Ethiopia
EthSwitch	Ethiopian National Payment Switch
FinTech	Financial Technology
GDP	Gross Domestic Product
IPS	Instant Payment System
KSA	Kingdom of Saudi Arabia
MMT	Mobile Money Transfer
NBE	National Bank of Ethiopia
NDPS	National Digital Payment Strategy
NPG	National Payment Gateway
POS	Point of Sale
PU	Perceived Usefulness
QR	Quick Response
TAM	Technology Acceptance Model
TRA	Theory of Reasoned Action
UPI	Unified Payments Interface
WEB	Online Money Payment

Contents

Acknowledgment	v
Abstract	vi
Acronyms and Abbreviations	vii
List of Table	xi
List of figure	xii
CHAPTER ONE	1
1. Introduction	1
1.1 Background	1
1.2 Statement of the problem	2
1.3 Objectives.....	3
1.3.1 General Objective	3
1.3.2 Specific Objectives	4
1.4 Significance of the study	4
1.5 Scope of the Study.....	5
1.6 Organization of the study	6
1.7 Definition of Terms.....	7
CHAPTER TWO	9
2. Literature Review.....	9
2.1 Introduction	9
2.2 Theoretical Review	9
2.2.1 The Technology Acceptance Model	9
2.2.2 TAM in the context of digital banking and payment.....	10
2.2.3 Digital Payment System	11
2.2.4 Interoperability in Digital Payment System	12
2.2.5 The Direct Effect of Interoperability on Adoption of Digital Payment	14
2.2.6 The Mediating Role of Perceived Usefulness	15
2.3 Empirical Review	16
2.3.1 Direct Effect of Interoperability on Adoption	16
2.3.2 Perceived Usefulness in FinTech Adoption	17

2.3.3 Mediation of Perceived Usefulness	18
2.4 Summary of literature and Research Gaps	19
2.5 Conceptual Framework	19
CHAPTER THREE	22
3. Research Methodology	22
3.1 Introduction	22
3.2 Research Approach	22
3.3 Study design	22
3.4 Study area	23
3.5 Source and study population	23
3.5.1 Source population	23
3.5.2 Study population	23
3.6 Eligibility criteria	23
3.6.1 Inclusion criteria:	24
3.6.2 Exclusion criteria:	24
3. 7 Sample size determination and sampling procedures	24
3.7.1 Sample size determination	24
3.7.2 Sampling procedures	24
3.8 variables	25
3.8.1 Endogenous variables	25
3.8.2 Exogenous variables	25
3.8.3 Mediator variable	25
3.9 Data collection tool and procedures	25
3.10 Data quality control	26
3.11 Data analysis technique	26
3.12 Ethical considerations	28
CHAPTER FOUR	29
4. Data Analysis and Results	29
4.1 Socio-demographic characteristics of study participants	29
4.2 Descriptive Statistics of the study variable	31
4.3 Measurement model assessment	35

4.3.1 Reliability and validity of the construct	36
4.4 Measurement Model Evaluation	38
4.5 Structural equation model assessment	38
4.5.1 Multi Collinearity test.....	38
4.6 Structural Model and Hypothesis Testing.....	39
4.6.1 Direct Effects of Interoperability on Adoption.....	39
4.6.2 Direct Effects of Interoperability on Perceived Usefulness	40
4.6.3 Effect of Perceived Usefulness on Adoption.....	40
CHAPTER FIVE	42
5. Discussion and Conclusion and Recommendation	42
5.1 Direct Effects of Interoperability on Adoption of Digital Payment Systems	42
5.2 Direct Effects of Interoperability on Perceived Usefulness	44
5.3 The Mediating Role of Perceived Usefulness	45
5.4 Strengths and Limitations of the Study	45
5.4.1 Strengths of the Study.....	45
5.4.2 Limitations of the study.....	45
5.5 Conclusion.....	46
5.6 Recommendation.....	46
Reference	47
Annex	52

List of Table

Table 1: Items were adapted from the following established sources:	25
Table 2: Demographic Information of the Respondents	29
Table 3: Technical interoperability	31
Table 4: Operational interoperability	32
Table 5: Financial interoperability.....	32
Table 6: Institutional interoperability	33
Table 7: Perceived Usefulness.....	33
Table 8: Adoption of Digital Payment	34
Table 9: Discriminant and convergent validity among the Respondents	36
Table 10: Reliability Test among the Respondents.....	36
Table 11: Model fit indices among the Respondents	38
Table 12: Multicollinearity test among the Respondents.....	38
Table 13: SEM analysis for Direct Effects of Interoperability on Adoption.....	39
Table 14: SEM analysis for Direct Effects of Interoperability on Perceived Usefulness	40
Table 15: SEM analysis for Effect of Perceived Usefulness on Adoption.....	41
Table 16: Coefficient of Determination (R^2) for Endogenous Variable.....	41
Table 17: bootstrapping results	41

List of figure

Figure 1: Proposed conceptual model (Source: adapted from Venkatesh, 1996 reduced model with single mediator)	21
Figure 2: Confirmatory Factor Analysis among Respondents	35
Figure 3: SEM for predictors of Effect of interoperability on Adoption of Digital Payment, perceived usefulness as a mediating variable	39

CHAPTER ONE

1. Introduction

1.1 Background

The global financial industry is experiencing a profound and irreversible transformation driven by the ongoing advancements in digital technology. This transition, sometimes referred to as FinTech, signifies a fundamental change away from the traditional, product-centric models of the past and toward dynamic, customer-centric, and platform-based ecosystems.(1) The introduction of mobile wallets, contactless cards, and online payment systems has resulted in a substantial shift in how people conduct financial transactions, providing greater ease, efficiency, and robust security measures. The increasing popularity of smartphones and internet connectivity has improved the accessibility and usability of digital payment systems. As a result, people are increasingly turning to digital payment methods for the convenience and efficiency they provide, lessening their reliance on physical currency for transactions and transfers.(2)

The banking industry is a key adopter of e-payment systems for financial transactions due to the convenience and speed.(3) E-commerce is an electronic payment technique for buying and selling things. It uses the internet to transport information, data, and money for commercial payments. Essentially, e-commerce enables the purchase and sale of actual things using internet channels, making payment simple for both businesses and buyers. All of them should follow the same regulation that allows clients to feel comfortable. Common e-payment technologies include POS, ATM, WEB, and MMT.(4)

The e-payment system facilitates cash mobilization, saving, and ensures that the majority of the cash accessible in the country is held by banks. This process moves cash out of circulation and into bank accounts, resulting in low-cost capital that can be used to support bank lending for investment. It goes on to suggest that electronic payments can reduce transaction costs, hence stimulating increased consumption and GDP.(5) The goal of digital payment is to make it easier for customers to make purchases and transactions without having to carry real money.(6) Furthermore, the digital payment system can avoid robbery and theft of money by addressing the issue of currency handling.(5)

Despite having so many benefits widespread adoption of digital payment systems have a barrier, particularly in emerging economies, is a lack of robust and comprehensive interoperability.(7) The term "interoperability" describes how various platforms, software systems, or payment networks may interact, share information, and carry out transactions quickly and easily without needing extra labor from the user. It makes the following possible in relation to digital payments and mobile money: Money transfers between mobile money providers (e.g., M-Pesa to TigoPesa); Money transfers between bank accounts and mobile money accounts, Cross-border payments between various national systems.(8) A factor that influence technology adoption in the TAM framework perceived usefulness is directly improved by interoperability. From peer-to-peer transfers to merchant payments and utility bills, a single platform or account can be used for a variety of transactions, making the user's financial interactions simpler. Afterwards because it allows for a variety of transaction kinds without requiring extra processes or learning, users find the system easier to use.(9, 10) Interoperability increases the utility of the service by lowering transaction costs and times, particularly for cross-platform or cross-border payments. Additionally, users can conduct business with a wider range of individuals and companies, increasing the service's usefulness.(11)

When users perceive that a system is useful, their attitude toward using it improves, leading to behavioral intention to use and actual adoption. Interoperability strengthens PU, thereby accelerating adoption.(8)

Therefore the aim of this study is examine the effect of interoperability on the adoption of digital payment systems in Bahir Dar City, Ethiopia, with perceived usefulness as mediating variables.

1.2 Statement of the problem

The global success of interoperable digital payment systems demonstrates their transformative potential. In India, the Unified Payments Interface (UPI) built on interoperability principles achieved exponential growth from 2.65 million transactions at launch to 83 billion annually by FY23, representing a 380% CAGR in volume.(12). Similarly, Kenya's M-PESA platform drove financial inclusion from 19% in 2007 to 83% in 2019, processing transactions equivalent to 85% of Kenya's GDP by 2016.(13-15)

In Ethiopia, despite recent initiatives such as TeleBirr (launched 2021) and the Ethiopian National Payment Switch (EthSwitch), the financial ecosystem remains predominantly cash-

based. This reliance on cash imposes high transaction costs, limits financial inclusion, and creates inefficiencies for both banks and customers.(16, 17) only 35% of Ethiopian adults have a bank account, and access to digital financial services remains below 20%, with less than 15% of the population actively using digital payment systems. The gender gap is also pronounced only 29% of women have a formal account compared to 41% of men, and merely 9% of women receive wages digitally versus 23% of men. These statistics place Ethiopia well below the Sub- Saharan African average for financial inclusion and digital payment adoption.(18)

Most notably, as of May 2023, Telebirr had acquired 32.2 million registered customers and facilitated a total of 375.22 billion Birr in transactions over a six- month period. This substantial transaction volume equivalent to nearly 8% of Ethiopia's 2023 GDP underscores that digital payments are being used for significant value transfers. However, the fact that nearly 60% of mobile voice subscribers were still not using Telebirr by early 2023 indicates that high transaction volumes do not automatically translate into widespread active adoption.(19)While infrastructural challenges and poor inter-bank connectivity are acknowledged as barriers.(20, 21)

Although interoperability is acknowledged as one of several challenges,existing studies do not measure its relative importance or its direct relationship with adoption.(18) Moreover, no study in the Ethiopian context has applied the Technology Acceptance Model (TAM) to test whether interoperability influences adoption through the psychological pathways of perceived usefulness. This gap is significant because, as TAM demonstrates, adoption is driven by users' perceptions of a system's usefulness and ease of use – perceptions that interoperability is theorized to enhance.(22) Yet, without empirical evidence, policymakers and financial institutions cannot know whether investing in interoperable infrastructure will translate into higher adoption rates, or whether other barriers (e.g., trust, cost, digital literacy) are more critical.

Therefore, this study aims to examine the effect of interoperability on the adoption of digital payment systems in Bahir Dar City, Ethiopia, with perceived usefulness as mediating variables.

1.3 Objectives

1.3.1 General Objective

The general objective of this study is to investigate the effect of interoperability on the adoption of digital payment systems, with perceived usefulness as a mediating variable, in case of the Commercial Bank of Ethiopia (CBE) in Bahir Dar City Branches.

1.3.2 Specific Objectives

1. To examine the direct effect of technical interoperability on the perceived usefulness of CBE's digital payment services.
2. To examine the direct effect of operational interoperability on the perceived usefulness of CBE's digital payment services.
3. To examine the direct effect of financial interoperability on the perceived usefulness of CBE's digital payment services.
4. To examine the direct effect of institutional interoperability on the perceived usefulness of CBE's digital payment services.
5. To examine the direct effect of technical interoperability on the adoption of CBE's digital payment services.
6. To examine the direct effect of operational interoperability on the adoption of CBE's digital payment services.
7. To examine the direct effect of financial interoperability on the adoption of CBE's digital payment services.
8. To examine the direct effect of institutional interoperability on the adoption of CBE's digital payment services.
9. To examine the mediating role of perceived usefulness in the relationship between interoperability and adoption of CBE's digital payment services.

1.4 Significance of the study

The findings of this study are expected to be significant for several stakeholders, including policymakers, financial institutions, digital payment service providers, and the academic community.

The study will extend the TAM by introducing interoperability as a key external antecedent variable, moving beyond the model's traditional focus on internal system attributes. . It clarifies the mediating mechanism by which interoperability influences adoption, using Perceived

Usefulness as the explanatory psychological pathways, as established in foundational TAM literature and confirmed in recent digital finance studies.(23, 24)

The study directly addresses the core mission and current challenges highlighted in the EthSwitch report 2023/24.(25) The report repeatedly emphasizes in advancing the National Digital Payment Strategy (NDPS) and National Financial Inclusion Strategy II. It also has made significant investments in interoperable platforms like the Instant Payment System (IPS), National Payment Gateway (NPG), and interoperable QR codes.(26) The findings will answer a crucial question: Does the end-user perceive these interoperable systems as easy and useful so this feedback is invaluable for EthSwitch to: Refine their technology and user interfaces. Design more effective marketing and educational campaigns. Prioritize future projects that maximize user adoption.

The NDPS identifies Strategic Pillar Develop a reliable, inclusive, and interoperable infrastructure as a foundational element. The study directly tests a critical assumption of this national strategy that interoperability drives adoption.(26) The findings will provide empirical evidence from a specific Ethiopian city on whether this strategic focus is justified and effective. The study also can inform policymakers at the National Bank of Ethiopia (NBE) and institutions like EthSwitch about the actual user experience of interoperability. If the finding has a strong positive relationship, it justifies continued investment. If the relationship is weak, it may indicate that other barriers (like those in Pillars 2, 3, and 4) need to be addressed simultaneously.

1.5 Scope of the Study

The research was conducted exclusively in Bahir Dar city, the capital of the Amhara, National Regional State in Northwest Ethiopia. The study is confined to selected branches of the Commercial Bank of Ethiopia (CBE) operating within the city administrative limits. The study also focuses on investigating the effect of interoperability on the adoption of digital payment systems, with perceived usefulness (PU) serving as mediating variables. The conceptual framework is grounded in the Technology Acceptance Model (TAM) as originally developed by Davis (1989) and subsequently extended by Venkatesh (1996). The target population consists of active account holders of the Commercial Bank of Ethiopia in Bahir Dar city who are current users of digital payment services. The study was including individuals aged 18 years and above who have had at least one interaction with CBE digital payment services within the past six

months. Bank employees are excluded from participation to avoid potential bias. The investigation is limited to examining user perceptions and adoption intentions regarding CBE's digital payment services, including mobile banking, internet banking. The study does not encompass technical aspects of interoperability infrastructure, cost-benefit analysis from the provider perspective, or comparative analysis across multiple banks. Furthermore, the research focuses exclusively on the demand-side (customer) perspective and does not investigate supply-side factors such as institutional readiness, regulatory frameworks, or technological infrastructure constraints beyond their influence on user perceptions.

1.6 Organization of the study

This thesis is organized into five chapters, each addressing a specific component of the research process in a logical and sequential manner.

Chapter One: Introduction This chapter provides the foundation for the study by presenting the background of the research, which discusses the global evolution of digital payment systems and the concept of interoperability. It articulates the statement of the problem, highlighting the research gap in the Ethiopian context. The chapter further outlines the general and specific objectives of the study, delineates the significance of the findings for various stakeholders, and defines the scope and delimitations of the research.

Chapter Two: Literature Review This chapter presents a comprehensive review of theoretical and empirical literature relevant to the study. It begins with an examination of the Technology Acceptance Model (TAM), which serves as the theoretical foundation for the research. The chapter then reviews the core constructs of the study: interoperability, perceived ease of use, perceived usefulness, and adoption of digital payment systems. It synthesizes prior empirical findings to establish the relationships among these variables and concludes with the development of the research hypotheses.

Theoretical Framework illustrates the hypothesized relationships between interoperability (exogenous variable), perceived ease of use and perceived usefulness (mediating variables), and adoption of digital payment systems (endogenous variable). The framework is adapted from Venkatesh (1996) and provides a visual representation of the proposed direct and indirect effects to be tested.

Chapter three: Research Methodology This chapter details the methodological approach employed to address the research objectives. It describes the study design and period, study area, target population, sampling procedures, and sample size determination. The chapter also

specifies the inclusion and exclusion criteria, defines the study variables, and presents the data collection instrument and procedures. It further discusses the measures taken to ensure data quality and outlines the data management and analysis techniques, including the use of Structural Equation Modeling (SEM) via SPSS.

Chapter Four: Results. It begins with the socio-demographic characteristics of participants, followed by the measurement model assessment including reliability, convergent validity, and discriminant validity. The chapter then presents the structural equation model assessment, multicollinearity tests, and the results of hypothesis testing for both direct and mediated effects.

Chapter Five: Discussion and Conclusion interprets the findings in light of existing literature, discusses the theoretical and practical implications of the study, acknowledges its limitations, and provides conclusions and recommendations for policymakers, financial institutions (including EthSwitch and the National Bank of Ethiopia), and future researchers.

1.7 Definition of Terms

Technical interoperability is the capacity of different payment systems and financial networks to communicate at the system level. It's the plumbing of a connected system, ensuring that transaction data is formatted and sent seamlessly across platforms and borders. Technical interoperability means that a customer of one provider can initiate a transaction that can be understood and processed without difficulty by another provider.(27)

Operational interoperability means the existence of consistent and reliable business processes, procedures and rules, which enable different providers of payment services to work together efficiently. Operational interoperability is when users can initiate a transaction, and there are clear, reliable protocols in place from initiation to completion, regardless of the provider.(28)

Financial interoperability concerns the economic arrangements and incentive models to allow cross-platform transactions. This includes designing revenue sharing models, which may include scheme fees (membership costs), switch fees (charges for routing through central technology) and interchange fees (balancing payments between providers), to make them economically viable and fair.(27)

Institutional interoperability is the regulatory, legal and governance frameworks that require, enforce and sustain interoperability across a payment ecosystem. This dimension sets the rules of the game, such as central bank mandates, consumer protection laws, liability regimes for fraud, data privacy regulations, and governance structures (e.g., a national payment switch such as EthSwitch) that uphold standards and ensure compliance. Legal interoperability promotes mutual confidence between market participants through legal certainty and clarity of rights and obligations. A strong institutional framework is needed for widespread adoption, providing the trust and legal certainty market participants require to invest confidently and rely on an interoperable system.(28)

Perceived Usefulness (PU) It is the user's perception of the degree to which using the system will improve his or her performance in the workplace.(29)

Adoption of Digital Payment: The action of using digital instruments (e.g., mobile wallets, online banking, payment apps) for financial transactions instead of hard cash.(30, 31)

CHAPTER TWO

2. Literature Review

2.1 Introduction

This chapter presents a review of relevant literature. This includes theoretical foundation, TAM in the context of digital banking and payment, Variable and Related concept, The Mediating Role of Perceived Ease of Use and Perceived Usefulness.

2.2 Theoretical Review

2.2.1 The Technology Acceptance Model

The Technology Acceptance Model (TAM) was developed by Fred Davis in 1985 in his doctoral thesis at the MIT Sloan School of Management. Its creation was motivated by the need to understand and predict why users accept or reject information technology, especially given the high rate of system adoption failures in organizations.(32) TAM is not a standalone theory but is adapted from the Theory of Reasoned Action (TRA) from social psychology.(33) TRA posits that an individual's behavior is determined by their Behavioral Intention (BI) to perform that behavior, which in turn is influenced by their Attitude toward the behavior and the Subjective Norm (social pressure).(31)

Davis simplified TRA for the specific context of information technology adoption. The key adaptations were Replacement of Salient Beliefs: He replaced TRA's multiple, context-specific salient beliefs with two primary technology-focused beliefs: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU).(34)

Final versions of TAM consist of the following core constructs: (A) Perceived Usefulness (PU): The degree to which a person believes that using a particular system would enhance his or her job performance. It is the user's subjective assessment of the functional benefits of using the technology. (B) Perceived Ease of Use (PEOU): The degree to which a person believes that using a particular system would be free of effort. It concerns the user's perception of the ease of interaction with the system.(35, 36)

The individual's positive or negative feelings (evaluative affect) about performing the target behavior (e.g., using the system). In the original TAM, Attitude toward Using (ATU) was a

central mediator between the two beliefs (PU and PEOU) and the Behavioral Intention. However, in later developments, its role was found to be partially redundant, leading to a more parsimonious model.(33)

Behavioral Intention to Use (BI): A measure of the strength of one's intention to perform a specified behavior. It is a direct antecedent to actual behavior. BI is the key dependent variable in most TAM studies, as it is the strongest predictor of actual usage. It represents the user's motivation and plan to use the system. Actual System Use is the measured or self-reported usage behavior of the individual. It is the ultimate outcome variable TAM seeks to predict.(34)

PEOU → PU: Perceived Ease of Use has a positive effect on Perceived Usefulness. If a system is easy to use, it requires less effort to master, thereby freeing up resources and making the user more effective, which enhances its perceived utility.(36) PEOU → ATU: Perceived Ease of Use has a positive effect on Attitude toward Using. Systems that are effortless to use are viewed more favorably. PU → ATU: Perceived Usefulness has a positive effect on Attitude Toward Using. Systems that are seen as beneficial foster a more positive attitude. . PU → BI: Perceived Usefulness has a direct, positive effect on Behavioral Intention. This is a critical path, indicating that users intend to use systems that they believe will help them achieve their goals, even if they don't particularly "like" using them. ATU → BI: Attitude Toward Using has a positive effect on Behavioral Intention. A favorable feeling towards the system increases the intention to use it.(37)

2.2.2 TAM in the context of digital banking and payment

Multiple studies confirm TAM's effectiveness in explaining user adoption of digital banking and payment technologies. Davis's (1989) original TAM, which posits that PEOU and PU are the primary drivers of technology adoption. The adoption of digital banking in Saudi Arabia is specifically examined using TAM, and the results indicate that both PEOU and PU "show a significant and positive marginal effect on the adoption of digital banking." This illustrates how well the model can pinpoint important factors in the context of financial technology.(38) In Indonesia, Gen Z's desire to use digital banking was investigated using TAM, and the results showed that "perceived usefulness is the strongest predictor of Indonesian behavioral intention to adopt digital banking services." This demonstrates the model's applicability to contemporary digital payment systems.(39)

TAM is specifically designed to understand how the characteristics of a technology influence a user's internal beliefs (PEOU and PU), which in turn shape their intention to use it. Interoperability the ability of different payment systems to work together seamlessly can be framed as a key external system characteristic that directly enhances PEOU and PU. Perceived usefulness is defined as the degree to which a person believes a system will enhance their job or life performance. Interoperability directly contributes to this by making a payment system more versatile and capable, thereby increasing its usefulness. PEOU is the degree of freedom from effort. A highly interoperable system reduces the effort required to transact across different platforms or services, thereby directly increasing its perceived ease of use.(39)

While TAM is parsimonious, it is also highly adaptable. Researchers frequently extend it by adding context-specific external variables that influence PEOU and PU, which is precisely what your study aims to do by introducing interoperability. By include trust as a third factor, study conducted at KSA was able to successfully extend TAM and demonstrate that the model can handle other variables pertinent to the digital banking context.(38) To further demonstrate the adaptability of their TAM-based paradigm, studies that was conducted at Indonesia added self-efficacy to it.(39)

2.2.3 Digital Payment System

Digital payments are any payments made using digital instruments No hard cash is used,(30) or any transfer of money or funds which is made by any individual through instruction, approval or order to a bank using electronic ways. This includes a wide array of methods such as debit/credit cards, mobile wallets, online banking, UPI, and mobile payment applications.(40)

The adoption of digital payments has seen rapid global expansion, though the rate of growth varies significantly between regions and countries. : Mobile money platforms alone have been introduced in more than 90 countries, indicating a broad global push towards financial digitization.(41) Turkey is highlighted as a rapidly expanding market, ranking first in the world in monthly mobile purchases with its e-commerce market experiencing excellent revenue growth.(30) Despite this growth, adoption remains uneven. A striking contrast exists between countries like China, which had over 4 payment cards per capita in 2016, and India, which had less than one card per capita at the same time.(41) Among BRICS nations (Brazil, Russia, India, China, South Africa), Russia leads in the number of cashless transactions per adult, while India

lags significantly, demonstrating varying stages of adoption even within similar economic blocs.(40) The growth is particularly notable in some developing nations. For instance, in East Africa, the M-PESA platform in Kenya has achieved near-universal coverage among the adult population and has contributed to a reduction in poverty.(41)

Digital Payment Systems have numerous benefits for consumers, merchants, and the broader economy. Users benefit from saving time and effort, increasing productivity, and gaining more control over transactions. Payments can be made anytime and from anywhere.(30) Reduced Cash-Related Risks: Digital payments lower the risks associated with cash, such as theft, loss, and fraud. They create a verifiable history of transactions, which simplifies accounting and aids in tax compliance. Digital payment technologies are a cornerstone for financial inclusion initiatives, providing populations with limited access to traditional banking a gateway to formal financial services. The transparency of digital transactions can lead to improved tax compliance and a broader tax base, providing economy-wide benefits.(41)

Ethiopia did not embrace e-banking early compared to other countries. The banking industry was underdeveloped, operating largely on traditional models. The introduction of core digital payment channels like ATMs and online banking was delayed, with pioneers like Awash Bank and the Commercial Bank of Ethiopia (CBE) only launching these services in the early 2000s.(42) Despite over 11 million customers at Awash Bank alone, less than 10% have adopted online banking. This low adoption rate is a microcosm of the national challenge.(43) The primary barriers: Low level of internet penetration and poorly developed telecommunication infrastructure.(42) Perceived Risk, Lack of Awareness, and questions around Ease of Use and Usefulness.(43)

2.2.4 Interoperability in Digital Payment System

Interoperability in digital finance refers to the technical and regulatory ability of different payment systems and platforms to connect, communicate, and process transactions seamlessly across different service providers, networks, and even national borders.(11) Following the comprehensive framework established in the literature, interoperability comprises four interconnected dimensions: technical, operational, financial, and institutional.(27, 44) Each dimension plays a distinct role in shaping user perceptions of ease of use and usefulness, which are the core mediating variables in the Technology Acceptance Model.(45)

2.2.4.1 Technical Interoperability

Technical interoperability refers to the ability of different payment systems to exchange data and complete transactions through common standards, protocols, and interfaces.(27) This dimension encompasses: (a) Application Programming Interface compatibility, allowing different platforms to communicate directly; (b) common messaging standards that ensure transaction data is formatted consistently; (c) QR code standardization, enabling merchants to accept payments from any provider using a single code and (d) shared network infrastructure that enables real- time data exchange.(28, 44) In the Ethiopian context, technical interoperability is exemplified by EthSwitch, the national switch that integrates ATMs and POS terminals across all member banks, and by the National Payment Gateway (NPG) which supports interoperable QR codes.(46)

2.2.4.2 Operational Interoperability

Operational interoperability concerns the business processes, procedures, and rules that enable different payment service providers to work together efficiently.(47) This includes: (a) settlement procedures that determine how funds are cleared and settled between different providers; (b) dispute resolution mechanisms for handling transaction errors or fraud across platforms; (c) customer verification protocols that standardize Know Your Customer (KYC) requirements; and (d) service level agreements (SLAs) defining performance expectations between providers.(27) Operational interoperability becomes critical when customers of different banks or mobile money providers need to transact. For example, Peru's interoperability mandate was implemented through phased pilots that tested operational protocols before full rollout.(48) In Ethiopia, the Instant Payment System (IPS) operated by EthSwitch represents an operational framework for real- time cross- bank transfers.(26)

2.2.4.3 Financial Interoperability

Financial interoperability addresses the economic arrangements that facilitate cross-platform transactions.(44) Key elements include (a) Interchange fees: Payments between providers when a customer of one uses another's infrastructure, (b) Surcharging policies: Whether and how foreign customers are charged additional fees, (c) Foreign fees: Charges by a customer's home provider for using another provider's services, (d) Revenue sharing models: How transaction fees are distributed among participating providers. The design of financial interoperability significantly

affects market outcomes. Research from ATM networks shows that interchange fees can either encourage network sharing or become tools for tacit collusion (49, 50).

2.2.4.4 Institutional Interoperability

Institutional interoperability refers to the regulatory, legal, and governance frameworks that enable and enforce interoperability across payment systems.(27, 28) This includes: (a) Regulatory mandates: Central bank requirements for interoperability (e.g., National Bank directive in Ethiopia), (b) Legal frameworks: Laws governing data sharing, consumer protection, and liability, (c) Governance structures: Entities responsible for maintaining interoperability standards (e.g., EthSwitch in Ethiopia), (d) Compliance mechanisms: Penalties and enforcement for non-compliance. Institutional interoperability is particularly relevant to Ethiopia, where the National Bank of Ethiopia (NBE) has mandated interoperability through EthSwitch and is advancing the National Digital Payment Strategy (NDPS).(25, 26) The NBE's role as both regulator and administrator of the national switch exemplifies institutional interoperability.(46)

2.2.5 The Direct Effect of Interoperability on Adoption of Digital Payment

Interoperability reduces Friction and Simplifies the User Experience by allows users to make payments across different systems, banks, and platforms without hassle. For example, India's Unified Payments Interface (UPI) enables users to link multiple bank accounts to a single mobile app and transact instantly without needing account details or IFSC codes. This seamless experience was a key driver in UPI's adoption, especially during COVID-19, as it eliminated the complexity of traditional banking.(51) When systems are interoperable, users and businesses can make and receive payments across countries without needing separate accounts for each jurisdiction, reducing complexity and encouraging use.(52)

Interoperable systems reduce transaction failures and delays, especially during peak times. This reliability builds user trust. Systems like India's UPI and Kenya's QR standards incorporate secure, interoperable frameworks that protect user data and reduce fraud, making users more willing to adopt digital payments.(51, 53) Interoperability lowers costs by minimizing the need for multiple intermediaries and currency conversions. This is especially important for MSMEs engaged in international e-commerce. Instant payment schemes (e.g., India's UPI, Singapore's

FAST) enable real-time transactions, which improves cash flow and operational efficiency for businesses.(52, 53)

H1: Technical interoperability has a positive direct effect on adoption of digital payment systems.

H2: Operational interoperability has a positive direct effect on adoption of digital payment systems.

H3: Financial interoperability has a positive direct effect on adoption of digital payment systems.

H4: Institutional interoperability has a positive direct effect on adoption of digital payment systems.

2.2.6 The Mediating Role of Perceived Usefulness

2.2.6.1 Interoperability Enhance Perceived Usefulness

According to Davis's TAM, Perceived Usefulness (PU) is defined as the degree to which a person believes that using a particular system would expanding their utility, convenience, and applicability across a wider range of scenarios. A non-interoperable system is limited to a specific ecosystem (e.g., one app, one merchant network). Its usefulness is constrained. Interoperability breaks down these walls, creating a larger, more valuable network. It is a foundational driver for efficiency. By making systems work together, they reduce friction and make the entire digital payment ecosystem more useful for every participant.(54)

A payment system's usefulness is limited if it can only be used in specific contexts. Interoperability fosters ubiquity, making digital payments a viable replacement for cash in almost all situations. It is particularly crucial for financial inclusion, as it allows users in underserved to participate in the digital economy without being locked into a single, potentially limited, service provider.(55)

When a payment system is widely accepted (interoperable), it becomes more socially endorsed and practically useful in daily life. Social influence and compatibility are key factors in digital payment adoption. Interoperability increases compatibility with various merchants and services, thereby enhancing PU by aligning with users' lifestyles and social environments.(56)

Therefore, to test the effect of interoperability on PU, the following hypothesis is generated.

H5: Technical interoperability has a positive effect on Perceived Usefulness.

H6: Operational interoperability has a positive effect on Perceived Usefulness.

H7: Financial interoperability has a positive effect on Perceived Usefulness.

H8: Institutional interoperability has a positive effect on Perceived Usefulness.

2.2.6.2 Perceived Usefulness as a mediator of adoption

The core premise of TAM is that PU directly determines behavioral intention to use a technology. However, PU itself is shaped by external system characteristics in this study, interoperability. Thus, PU serves as a mediating mechanism: interoperability increases PU, and higher PU leads to greater adoption intention. This mediated pathway has been confirmed in multiple digital payment studies. Shankar & Datta found that PU strongly mediates the effect of system characteristics on mobile payment adoption in India ($\beta = 0.319$, $p < 0.01$).⁽⁵⁷⁾ Similarly, Qamar & Ullah reported that PU explains the majority of variance in FinTech adoption ($\beta = 0.175\text{--}0.855$ depending on context).⁽²⁴⁾ In the Ethiopian context, no study has tested whether PU mediates the interoperability-adoption relationship a gap this research addresses.

H9: Perceived usefulness has a positive effect on adoption of digital payment systems.

2.3 Empirical Review

The empirical review examines previous studies that have explored the relationships among interoperability, perceived usefulness (PU), and adoption of digital payment systems. The purpose is not merely to summarize past work but to critically evaluate existing knowledge, identify gaps, and show how these studies relate to the current research problem.

2.3.1 Direct Effect of Interoperability on Adoption

Evidence from multiple countries shows that interoperability significantly accelerates the adoption of digital payments, Gupta examined India's Unified Payments Interface (UPI) during the COVID-19 crisis and found that interoperability drove exponential growth, with transaction volumes increasing by **78% in 2020** and **105% in 2021** compared to pre-pandemic levels. The study attributes this acceleration to seamless integration between different payment systems, including UPI, mobile wallets, and traditional banking channels, which eliminated the complexity of traditional banking requirements such as IFSC codes and account numbers.⁽⁵¹⁾

Bianchi and the other people who worked with him reviewed academic literature on mobile payments and interoperability, identifying key enablers such as technical standards (APIs, common messaging protocols) and operational procedures (settlement rules, dispute resolution). The review shows that technical interoperability is directly related to the perceived ease of use. Operational interoperability also helps to build trust through reliable dispute resolution mechanisms.(27)

Donze and Dubec developed a model of ATM networks where interchange fees affect incentives to deploy and competition. The analysis shows that banks have incentives to install ATMs when interchange fees are higher than the marginal cost of processing, but that high fees may also facilitate collusion, as interchange fee structures influence whether users view cross-platform transactions as fairly priced.(49) Hoernig and Bourreau offer international experience and advice on mobile money interoperability in Mozambique, citing financial interoperability (e.g., transparent fee structures and reasonable interchange fees) as critical for user adoption. Their analysis reveals that hidden or excessive fees are major barriers to adoption.(28)

Burga et al. regulations requiring interoperability can be fundamentally disruptive of market structure. Their results suggest that institutional interoperability, the regulatory framework that necessitates platform integration, is a powerful driver of market-wide adoption, but with complex competitive consequences.(48)

2.3.2 Perceived Usefulness in FinTech Adoption

Nizam and the other people who worked with him looked at how people in Pakistan're using FinTech. What they found out is that when people think FinTech is useful they are more likely to use it. The path coefficient of PU shows that PU has a significant effect on behavioral intention. The study also found that digital payment integration mediates the relationship between PU and adoption.(24) Qamar and Ullah found that perceived usefulness explains most of the variance in the adoption of FinTech in different contexts, with standardized effects ranging from $\beta = 0.175$ to 0.855 depending on the context and population. The broad spectrum suggests that the effect of PU could relate to demographic, digital literacy and cultural characteristics.(24)

2.3.3 Mediation of Perceived Usefulness

Shankar and Datta did a study in 2018 about people using payments in India. They found out that when people think mobile payments are useful they are more likely to use them. The study had 381 people in it. It showed that things like trust and being able to use the system easily have a big impact on whether people want to use mobile payments. Shankar and Datta found that mobile payment adoption intention is affected by how useful people think mobile payments are. They also found that the characteristics of the system like trust and self-efficacy have an effect on mobile payment adoption intention because people think mobile payments are useful. Shankar and Datta's study is important for mobile payment adoption intention, in India.(57)

Susanto and other people who worked with him did a review of lots of studies about people using digital payments in Asia in 2022. They looked at 597 articles. Found out that when people think digital payments are useful they are more likely to use them. This is true in Asian countries. The people who did the study found that two main ideas, called TAM and UTAUT are used a lot to understand why people use payments. The idea that digital payments are useful is a part of these ideas. Susanto and the other people who worked with him found that digital payments are more likely to be used when they are easy to use with systems are safe and when other people are using them. The study by Susanto and the other people who worked with him is important because it helps us understand why people, in Asia use payments.(58)

The mediated pathway through which interoperability influences adoption via PU is supported by emerging empirical evidence. Ly and Ly in their 2024 study said that perceived usefulness explained nearly half the variance in digital payment adoption ($R^2 = 0.492$). While their study did not directly examine interoperability, the strong predictive power of PU suggests that external system characteristics such as interoperability are likely to operate through these psychological mechanisms.(54) Colline and other people synthesized findings from 64 studies and concluded that security, convenience, time-saving, and efficiency are key benefits of digital payments that are amplified by interoperability. Their review noted that interoperability reduces fragmentation in the payment landscape, allowing users to employ a single, familiar payment platform across a wide range of merchants and transaction types. This streamlined experience directly enhances perceived ease of use by reducing the need to learn multiple interfaces and procedures.(59)

2.4 Summary of literature and Research Gaps

Despite the substantial literature on TAM and the growing evidence on interoperability, several critical gaps remain. First, no empirical study has directly tested the mediating role of perceived usefulness in the relationship between interoperability and digital payment adoption. Burga and the other people who worked with them demonstrated that interoperability increases adoption and concentration,(48) Davis (1989) and Ly and Ly (2024) found that perceived usefulness predicts adoption. Yet, the exact route through interoperability → perceived usefulness → adoption hasn't been studied.(54, 60)

Second, the literature has predominantly examined interoperability at the market or network level, using outcomes such as concentration, transaction volumes, and market shares.(48, 49) There are almost no individual-level studies measuring how users think about the usefulness of something before and after it's interoperable. So, while we see that interoperability impacts the market, we don't know if people feel the systems are more useful. We also aren't sure if this feeling influences whether they adopt these systems or not.

Third, the interaction between interoperability and other TAM constructs (particularly perceived usefulness and trust) remains unexplored. According to Burga, interoperability raises concentration levels, but only in places with lots of mobile phones. It looks like the benefits hinge on users being able to easily tap into and navigate digital payments.(48) Plus, Colline and Susanto point out that security fears can mess things up too. They show that trust acts as a moderator; people might think that more interconnected systems, which share data across platforms, are riskier and therefore less useful. (58, 59)

2.5 Conceptual Framework

TAM originally focused on system characteristics as external variables, subsequent research has extended the model by incorporating context-specific factors that influence PU. In the digital payment ecosystem, interoperability defined as the ability of different payment systems, platforms, or banks to connect, communicate, and process transactions seamlessly without additional user effort(8, 11) Interoperability reduces fragmentation in the payment landscape. For Example, when a customer of CBE can send money directly to a customer of another bank (or a mobile money provider like TeleBirr) using a single app, the user experiences a unified, frictionless process.

This study is grounded in the Technology Acceptance Model (TAM), where interoperability serves as an exogenous variable that influences adoption of digital payment systems both directly and indirectly through perceived usefulness (PU). Ly and Ly confirm that PU significantly predict attitudes toward digital payments, which in turn drive adoption ($\beta = 0.393$ and 0.119 , respectively, $p < 0.01$).⁽⁵⁴⁾ Gupta demonstrates that interoperability (e.g., India's UPI system) directly accelerated adoption, with transaction volumes growing 78–105% annually during COVID-19.⁽⁵¹⁾ Domingo provide qualitative evidence from East Africa that interoperability reduces friction, lowers coordination costs, and enhances user experience, thereby increasing both ease of use and usefulness.⁽¹¹⁾ Radcliffe and Voorhies establish that digital payment connectivity generates welfare benefits through reduced transaction costs and expanded utility.⁽¹⁰⁾ Systematic reviews by Susanto and Colline confirm that PU are the most frequently validated predictors of digital payment adoption across multiple contexts.^(58, 59) Therefore, the framework proposes that interoperability positively affects PU, which in turn positively affect adoption, forming a mediated pathway that explains how technical interoperability translates into user acceptance.

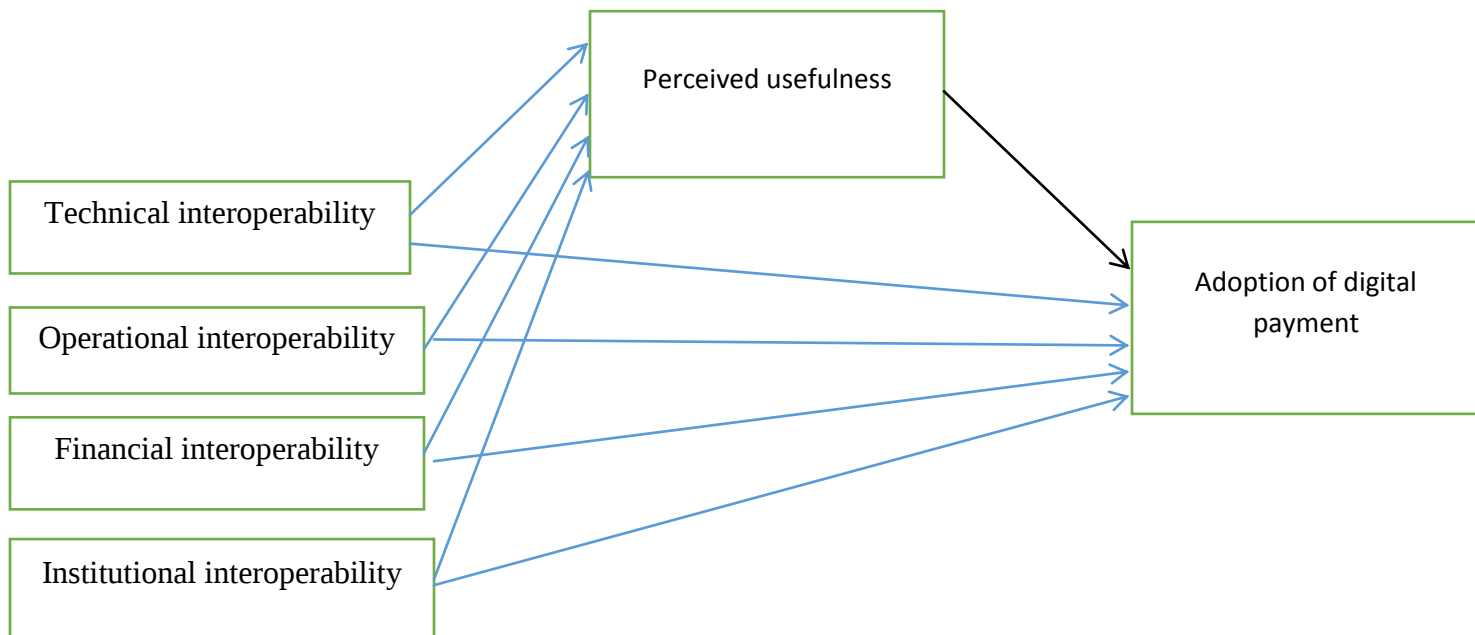


Figure 1: Proposed conceptual model (Source: adapted from Venkatesh, 1996 reduced model with single mediator)

CHAPTER THREE

3. Research Methodology

3.1 Introduction

This chapter delves further into the specifics of the study's methodology, providing a thorough analysis of its essential elements. It offers a thorough description of the research design, including information about the targeted population, sampling strategies, sources, data collection instruments, and data processing methodology.

3.2 Research Approach

This study follows a quantitative, deductive research approach. A structured questionnaire with Likert-scale items was used to measure each construct. Data were analyzed using Structural Equation Modeling (SEM) via AMOS 23 to estimate path coefficients and assess the significance of the hypothesized relationships. This approach allows the researcher to confirm or reject theoretical predictions.

The deductive approach was implemented through quantitative data collection and statistical testing. A structured questionnaire with Likert- scale items were measure each construct. Data was analyzed using SEM via AMOS 23 to estimate path coefficients and assess the significance of the hypothesized relationships. This approach allows the researcher to either confirm or reject the theoretical predictions, thereby contributing to the extension of TAM in the context of digital payment interoperability in Ethiopia.

3.3 Study design

This study used an explanatory, cross- sectional, correlational research design. The study aims to measure the relationships among four latent variables of interoperability, perceived usefulness (PU), and adoption of digital payment systems using numerical data and statistical analysis.(61) Quantitative methods are appropriate when the research objective is to test hypotheses derived from a theoretical model (in this case, the Technology Acceptance Model) and to generalize findings from a sample to a population.(62)

The design is cross-sectional because data were collected at a single point in time (from March 25 to April 30, 2026) from a sample of Commercial Bank of Ethiopia (CBE) customers in Bahir Dar City. Cross-sectional designs are commonly used in technology adoption research to capture users' perceptions and intentions at a specific moment without following them over time.(63)

Furthermore, the study employed a correlational design. Rather than manipulating any variable, the research examines the direction, strength, and significance of relationships among interoperability (exogenous variable), PU (mediating variables), and adoption intention (endogenous variable). Structural equation modeling (SEM) used to test the hypothesized causal pathways, making the design explanatory in nature.(64) This design is suitable because the study seeks to explain how interoperability influences adoption both directly and indirectly through PU rather than merely describing the phenomena.

3.4 Study area

The study was conducted at Bahir Dar city, specifically at the Commercial Bank of Ethiopia (CBE) in Northwest Ethiopia, Amhara region. Bahir Dar is the capital city of the Amhara National Regional State, located 565 km northwest of Addis Ababa (the capital of Ethiopia). Amharic is the working language of the state. The bank operates 31 branches in the city, serving a large customer base.

3.5 Source and study population

3.5.1 Source population

The source population comprises all 728,950 account holders of the Commercial Bank of Ethiopia (CBE) in Bahir Dar city. Based on an oral interview with Mina branch manager, the number of active digital banking users (i.e., those who regularly use digital payment services) within this population are 412,645.

3.5.2 Study population

The study population consists of all active customers of the Commercial Bank of Ethiopia (CBE) who are users of digital payment services and are located within the operational area of the Bahir Dar City branch. This group is drawn from the 412,645 active digital banking users identified by the branch manager.

3.6 Eligibility criteria

3.6.1 Inclusion criteria:

1. Must be an account holder at the Commercial Bank of Ethiopia, Bahir Dar City branch.
2. Must be 18 years of age or older.
3. Must have had at least one interaction with a CBE digital payment service in the past 6 months.

3.6.2 Exclusion criteria:

1. Employee of the Commercial Bank of Ethiopia.
2. The study excluded account holder who are absent in study period.

3.7 Sample size determination and sampling procedures

3.7.1 Sample size determination

The sample size was calculated using Yamane's (1967) simplified formula for a finite population:

$$n = \frac{N}{1 + N(e)^2}$$

$$\begin{aligned} n &= \frac{412645}{1 + 412645(0.05)^2} \\ &= 399.612 \approx 400 \end{aligned}$$

Where n = number of sample size and N = Total number of study population e = level of confidence to have in the data or degree of freedom which is 95% will be apply for this study with 5% error. Therefore, sample size of the study was 400 respondents of the customers Commercial Bank of Ethiopia in Bahir Dar city.

3.7.2 Sampling procedures

A non-probability convenience sampling method was used due to time and resource constraints. This sampling approach was selected since it enabled the researcher to obtain representative data by choosing samples from the population that were readily accessible and eager to engage in the study. To mitigate selection bias, the researcher:

1. Collected data from multiple CBE branches across Bahir Dar city

2. Stratified data collection across different days and times
3. Screened participants according to pre-defined inclusion criteria

3.8 variables

3.8.1 Endogenous variables

The primary endogenous variable in this study was the adoption of digital payment, representing the outcome of interest.

3.8.2 Exogenous variables

Four exogenous variables were identified as potential drivers of digital payment adoption: technical interoperability, operational interoperability, financial interoperability, and institutional interoperability.

3.8.3 Mediator variable

Perceived usefulness (PU) was included as a mediator variable, drawing from the Technology Acceptance Model (TAM).

3.9 Data collection tool and procedures

A structured self-administered questionnaire was developed following a systematic instrument design process. Rather than adopting a single existing questionnaire, the researcher synthesized items from multiple validated sources to ensure both theoretical grounding and contextual relevance to the Ethiopian digital payment ecosystem.

Based on the Technology Acceptance Model (Davis, 1989), four constructs were defined: technical interoperability, operational interoperability, financial interoperability, institutional interoperability, perceived usefulness, and adoption of digital payment.

Table 1: Items were adapted from the following established sources:

Construct	Number of items	Primary source(s)
Perceived Usefulness	4	Davis (1989); Ly & Ly (2024)
Adoption	4	Davis (1989); Venkatesh et al. (2003)

Technical Interoperability	4	Hoernig & Bourreau (2017); Bianchi et al. (2023)
Operational Interoperability		Hoernig & Bourreau (2017); Domingo et al. (2023)
Financial Interoperability	4	Donze & Dubec (2006); McAndrews (2003); Bianchi et al. (2023)
Institutional Interoperability	4	Domingo et al. (2023); EthSwitch Annual Report (2023/24); NBE

The Amharic language questions were used, because Amharic is the common local language in the study area. So, it is necessary to translate the original English version of the questions into Amharic. The back-translation method was utilized to translate from English into Amharic with the same meaning and originality in both versions, and then translate the questions back into English. This step was important to ensure that the participants should not be misunderstanding because of language barriers.

3.10 Data quality control

Even though a questionnaire was developed from standardized tools, it was pretested by taking 5% of the total sample size of customers of Commercial Bank of Ethiopia, was done before data collection. Then necessary correction was done based on the pretest finding. The two-day training was given to three data collectors and two supervisors about the study's purpose, data collection techniques, data collection tools and procedures, respondent approach, data confidentiality, and respondent rights. The supervisors and investigator examined the completeness and consistency of data regularly. Before analyzing the data, it was cleaned up and cross-checked for cleanness and missing value.

3.11 Data analysis technique

The data was entered into computer using Epi-data version 4.6. Then, it was exported to SPSS version 25 for further analysis. Descriptive statistics was computed for all study variables, including means, standard deviations, frequencies, and percentages. These summarized respondents' demographic characteristics (gender, age, education, usage frequency) and their

responses to the Likert-scale items measuring interoperability, perceived usefulness (PU), and adoption intention.(65) The assumption of multivariate Outliers was detected using Mahalanobis distance ($p < 0.001$) and examined for potential exclusion.(64) Normality of the data was assessed through examination of skewness between -1.96 to 1.96.(66) Multicollinearity was assessed using Variance Inflation Factor Variance Inflation Factors <10 and Tolerance >0.1 .(64)

Prior to testing the structural relationships, the measurement model was evaluated using confirmatory factor analysis (CFA) via AMOS 23. The CFA assesses how well the observed indicators measure their respective latent constructs (interoperability, PU, and adoption). Following established guidelines(64), the following criteria was applied:

Convergent Validity Assessed through:

Factor loadings: All items should load significantly on their intended construct, with standardized loadings ≥ 0.50 .(64) Average Variance Extracted (AVE): AVE for each construct should exceed 0.50, indicating that the construct explains more than half of the variance in its indicators.(67) Composite Reliability (CR): CR values should be ≥ 0.70 , indicating internal consistency.(64)

Discriminant Validity Assessed through:

The square root of each construct's AVE should exceed its correlations with all other constructs.(67)

To assess the model goodness of fit the Chi-square ratio (0.9), the goodness of fit index (GFI > 0.9), adjusted goodness of fit index (AGFI > 0.8), root mean square error approximation (RMEA < 0.08), and root means square of standardized residual (RMSR < 0.088) were considered. If the model fit indices are below the cutoff point or there is model misspecification, either delete the item that is below the cutoff point or use a high value of modification indices to enhance model fit indices until the model is fitted with a threshold value of maximum 4 times.(68)

The standardized path coefficient and variances were used to measure the relationship between exogenous and endogenous variables, as well as 95% confidence intervals and P-value to determine statistical significance ($p\text{-value} < 0.05$).

To test the mediating role of perceived usefulness (Hypotheses H5–H9), this study used bootstrapping procedures with 5,000 bootstrap resamples using AMOS 23. Bias-corrected 95%

confidence intervals will be calculated for all indirect effects (interoperability → PU → adoption). The mediating effect is considered statistically significant if the confidence interval for the indirect effect does not include zero.(69)

3.12 Ethical considerations

Ethical approval was obtained from the Research Ethics Committee of college of business and economics, Bahir Dar University. A letter of support was also taken from the Bahir Dar University. The purpose, data collection procedure, risks and benefits of the study was clarified to each participant prior to data collection. Informed written consent had been taken from each study participants. Each study participant had the right to withdraw from the study at any moment throughout data collection. During data display, analysis, and interpretation, special care had been taken to keep data confidentiality through anonymity.

CHAPTER FOUR

4. Data Analysis and Results

4.1 Socio-demographic characteristics of study participants

Table 2: Demographic Information of the Respondents

		Frequency	Percent	Valid Percent	Cumulative Percent
Gendar	Male	213	56.5	56.5	56.5
	Female	164	43.5	43.5	100.0
	Totale	377	100.0	100.0	
Age	18-30	140	37.1	37.1	37.1
	31-40	124	32.9	32.9	70.0
	41-50	106	28.1	28.1	98.1
	50	7	1.9	1.9	100.0
	Total	377	100.0	100.0	
Education level	High school & below	51	13.5	13.5	13.5
	Diploma	54	14.3	14.3	27.9
	Degree	248	65.8	65.8	93.6
	Masters & above	21	5.6	5.6	99.2
	5	3	.8	.8	100.0

	Total	377	100.0	100.0	
Profession	Government Employee	121	32.1	32.1	32.1
	Private Employee	59	15.6	15.6	47.7
	Business	118	31.3	31.3	79.0
	NGO	34	9.0	9.0	88.1
	Other	45	11.9	11.9	100.0
	Total	377	100.0	100.0	
Income	Income <2,000	5	1.3	1.3	
	2,001 - 5,000	80	21.2	21.2	
	5,001 - 10,000	220	58.4	58.4	
	10,001 - 50,000	62	16.4	16.4	
	> 50,000	10	2.7	2.7	
	Total	377	100.0	100.0	

Source survey data, 2026

A total of 400 structured questionnaires were distributed to active CBE digital payment users in Bahir Dar City. Of these, 377 were returned fully completed, yielding a response rate of 94.25%, which is considered excellent for survey-based research.

As presented in Table 1, male respondents constituted the majority (56.5%, n=213), while females represented 43.5% (n=164). Regarding age distribution, the largest proportion of participants fell within the 18–30 age bracket (37.1%, n=140), followed by those aged 31–40

(32.9%, n=124) and 41–50 (28.1%, n=106). Only 1.9% (n=7) were above 50 years. This indicates that digital payment users are predominantly young to middle-aged adults.

In terms of educational attainment, the majority held a first degree (65.8%, n=248), followed by diploma holders (14.3%, n=54) and high school or below (13.5%, n=51). Master’s degree holders accounted for 5.6% (n=21). Regarding professional background, government employees constituted the largest occupational group (32.1%, n=121), followed by business owners (31.3%, n=118) and private employees (15.6%, n=59). NGO workers and others accounted for 9.0% and 11.9%, respectively. The highest percentage of participants (58.4%, n=220) reported a monthly income between 5,001 and 10,000 Ethiopian Birr, while 21.2% earned between 2,001–5,000 Birr and 16.4% earned 10,001–50,000 Birr.

4.2 Descriptive Statistics of the study variable

Table 3: Technical interoperability

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Tech1	377	1	5	3.31	1.202
Tech2	377	1	5	3.37	1.255
Tech3	377	1	5	3.21	1.062
Tech4	377	1	5	3.17	1.093
Valid N (listwise)	377				

Source: SPSS data output, 2026

The means range from 3.17 to 3.37, all just above the mid-point (3). This suggests that respondents tend to lean toward moderate agreement or a neutral-to-positive evaluation of the Tech-related constructs, with Tech2 (M = 3.37) being rated highest and Tech4 (M = 3.17) being rated lowest. Standard deviations vary from 1.062 (Tech3) to 1.255 (Tech2). This shows a moderate variation around the means with answers ranging the whole spectrum (1-5) but relatively close to the center. Tech3 has a little less variance (more consensuses) and Tech2 has the widest spread.

Table 4: Operational interoperability**Descriptive Statistics**

	N	Minimum	Maximum	Mean	Std. Deviation
Oper1	377	1	5	3.56	1.107
Oper2	377	1	5	3.38	1.189
Oper3	377	1	5	3.37	1.087
Oper4	377	1	5	3.31	.966
Valid N (listwise)	377				

Source: SPSS data output, 2026

Mean scores range from 3.31 (Oper4) to 3.56 (Oper1) all above the mid point of 3. This suggests that the respondents are, on average, leaning towards the positive/agree side with Oper1 receiving the highest average rating and Oper4 the lowest. Standard deviations are in the range of 0.966 (Oper4) to 1.189 (Oper2) and indicate a moderate dispersion. Oper4 has the most consensus (responses closer to the mean), while Oper2 has the widest spread of opinions.

Table 5: Financial interoperability**Descriptive Statistics**

	N	Minimum	Maximum	Mean	Std. Deviation
Fina1	377	1	5	3.30	1.080
Fina2	377	1	5	3.25	1.196
Fina3	377	1	5	2.89	1.203
Fina4	377	1	5	2.90	1.300
Valid N (listwise)	377				

Source: SPSS data output, 2026

Fina1 (Mean = 3.30, SD = 1.080) and Fina2 (Mean = 3.25, SD = 1.196) have slightly above the midpoint (3.0) averages indicating mild positive responses. Fina3 (Mean = 2.89, SD = 1.203) and Fina4 (Mean = 2.90, SD = 1.300) are slightly below the midpoint indicating mild negative responses. Standard deviations vary from 1.08 to 1.30 showing moderate dispersion around the means responses vary from 1 to 5.

Table 6: Institutional interoperability

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Inst1	377	1	5	3.45	1.126
Inst2	377	1	5	3.20	1.135
Inst3	377	1	5	3.08	1.080
Inst4	377	1	5	3.37	1.213
Valid N (listwise)	377				

Source: SPSS data output, 2026

Central tendency (Mean): Inst1 has the highest average score (3.45) followed by Inst4 (3.37), Inst2 (3.20) and Inst3 (3.08). All means are above the midpoint of the scale (3.0), indicating that, on average, respondents tended to agree or have a positive perception on all four items. Inst3 is closest to neutral (3.08), Inst1 has the most positive response.

Dispersion (Std. Deviation): The standard deviations were between 1.080 (Inst3) and 1.213 (Inst4), meaning a moderate variability around each mean. Inst4 had the largest spread, which indicates that respondents had the most diverse answers for that item. Fig. shows that Inst3 has the smallest mean and highest consensus (lowest SD).

Minimum = 1, maximum = 5 for all items, confirming the full scale was used.

Table 7: Perceived Usefulness

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
PU1	377	1	5	3.53	1.139
PU2	377	1	5	3.29	1.108
PU3	377	1	5	3.38	1.186
PU4	377	1	5	3.38	1.124
Valid N (listwise)	377				

Source: SPSS data output, 2026

The mean scores for all four PU items ranged from 3.29 to 3.53 on the 1-5 scale. This indicates that the respondents had a moderate high level of agreement that digital payment is useful. They tended to agree (above the midpoint of 3.0) but not strongly agree. Most & Least Agreed Item: PU1 (Mean = 3.53) had the highest agreement, showing the most basic usefulness was seen by users. PU2 (Mean = 3.29) was a bit lower. Standard deviations (~1.14) indicate a moderate variation. The mean is somewhat high, but some individuals rated usefulness very low (Minimum = 1) and others very high (Maximum = 5).

Table 8: Adoption of Digital Payment

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Adop1	377	1	5	3.47	1.244
Adop2	377	1	5	3.47	1.155
Adop3	377	1	5	3.03	1.141
Adop4	377	1	5	3.36	1.191
Valid N (listwise)	377				

Source: SPSS data output, 2026

(Adop1–Adop4) revealed moderate to slightly positive agreement (M = 3.03 to 3.47, SD = 1.14 to 1.24, on a 5-point scale), indicating that while respondents generally favor digital payment adoption, there is considerable individual variation.

4.3 Measurement model assessment

Assessment of the measurement model involves checking the model goodness of fit, internal consistency (reliability), convergent validity and discriminant validity of indicators/items using confirmatory factor analysis (CFA).

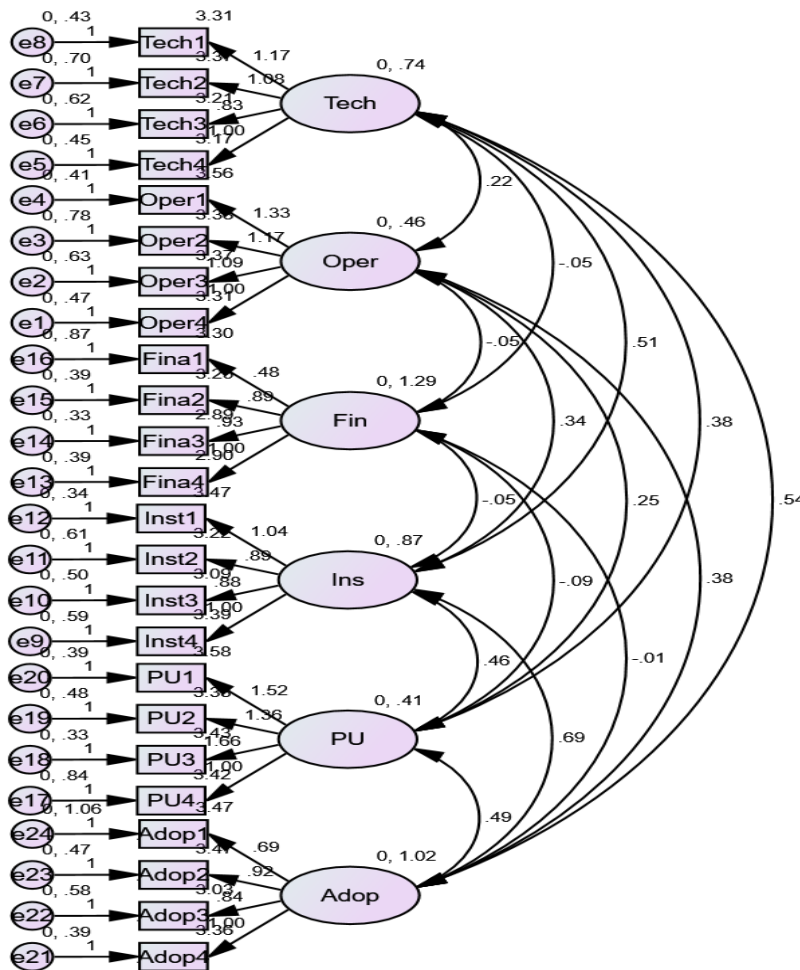


Figure 2: Confirmatory Factor Analysis among Respondents

In this study, data were screened for univariate and multivariate normality. As shown in the normality assessment output, the multivariate critical ratio range between -1.69 and +1.69 (CR=1.122). All values were within the acceptable threshold of absolute skewness < 2 and absolute kurtosis < 7, indicating that the data approximate univariate normality. The multivariate

kurtosis value (4.083) was below the recommended threshold of < 10 , suggesting no severe multivariate non-normality. Mahalanobis distance analysis identified any multivariate outliers at $p < 0.001$.

4.3.1 Reliability and validity of the construct

The Average Variance Extracted (AVE) values for all constructs were found to be above 0.50 which was accepted to test convergent validity. The square root Average Variance Extracted (AVE) values in bold (diagonal values) are higher than other values in its column, and row, and exceeded the off-diagonal correlations for all construct pairs, confirming discriminant validity.

Table 9: Discriminant and convergent validity among the Respondents

	Tech	Oper	Fina	Inst	PU	Adop	AVE
Tech	0.763						0.582
Oper	0.566	0.719					0.518
Fina	-0.056	-0.099	0.794				0.630
Inst	0.705	0.623	-0.092	0.778			0.605
PU	0.794	0.715	-0.108	0.850	0.772		0.596
Adop	0.490	0.462	-0.002	0.527	0.571	0.748	0.559

Source survey data, 2026

AVE: Average Variance Extracted

Factor loadings for each item was investigated and The reliability test was done through Cronbach's alpha and composite reliability has values above 0.805 for all the constructs. [Table 10].

Table 10: Reliability Test among the Respondents

Construct	Indicators	Factor loading	Cronbach alpha	Composite Reliability
Technical	Tech1	0.839	0.843	0.847

Interoperability	Tech2	0.740		
	Tech3	0.675		
	Tech4	0.789		
Operational Interoperability	Oper1	0.817	0.805	0.810
	Oper2	0.668		
	Oper3	0.680		
	Oper4	0.703		
Financial Interoperability	Fina1	0.505	0.860	0.868
	Fina2	0.851		
	Fina3	0.879		
	Fina4	0.877		
Institutional Interoperability	Inst1	0.856	0.857	0.859
	Inst2	0.724		
	Inst3	0.757		
	Inst4	0.769		
Perceived Usefulness	PU1	0.836	0.844	0.852
	PU2	0.767		
	PU3	0.877		
	PU4	0.571		
Adoption of Digital Payment	Adop1	0.556	0.816	0.832
	Adop2	0.805		
	Adop3	0.744		
	Adop4	0.851		

Source survey data, 2026

4.4 Measurement Model Evaluation

The values of the model goodness of fit was assessed and met the required level [Table 11].

Table 11: Model fit indices among the Respondents

Measure	Estimate	Threshold	Interpretation
Goodness of fit index (GFI)	0.934	>0.9	Accepted
Adjusted goodness of fit index (AGFI)	0.917	>0.8	Accepted
Chi-square/degree of freedom	1.351	<5	Accepted
Comparative fit index (CFI)	0.982	>0.9	Accepted
Root means square error of approximation (RMSEA)	0.031	<0.08	Accepted

4.5 Structural equation model assessment

4.5.1 Multi Collinearity test

After evaluating the measurement model validity, reliability, model fitness, normality, collinearity was assessed. Collinearity was assessed by the variance inflation factor (VIF) and tolerance. Multicollinearity does not exist when VIF and tolerance are below 10 and above 0.1 respectively. Multicollinearity was found to be nonexistent in this investigation [Table 12].

Table 12: Multicollinearity test among the Respondents

Construct	Collinearity statistics	
	Tolerance	Variance Inflation Factor (VIF)
Technical Interoperability	0.601	1.663
Operational Interoperability	0.738	1.256
Financial Interoperability	0.995	1.005

Institutional Interoperability	0.521	1.921
Perceived Usefulness	0.448	2.231

Source survey data, 2026

4.6 Structural Model and Hypothesis Testing

The structural equation model (SEM) was estimated to test the nine hypotheses (H1–H9). The structural model exhibited good fit to the data.

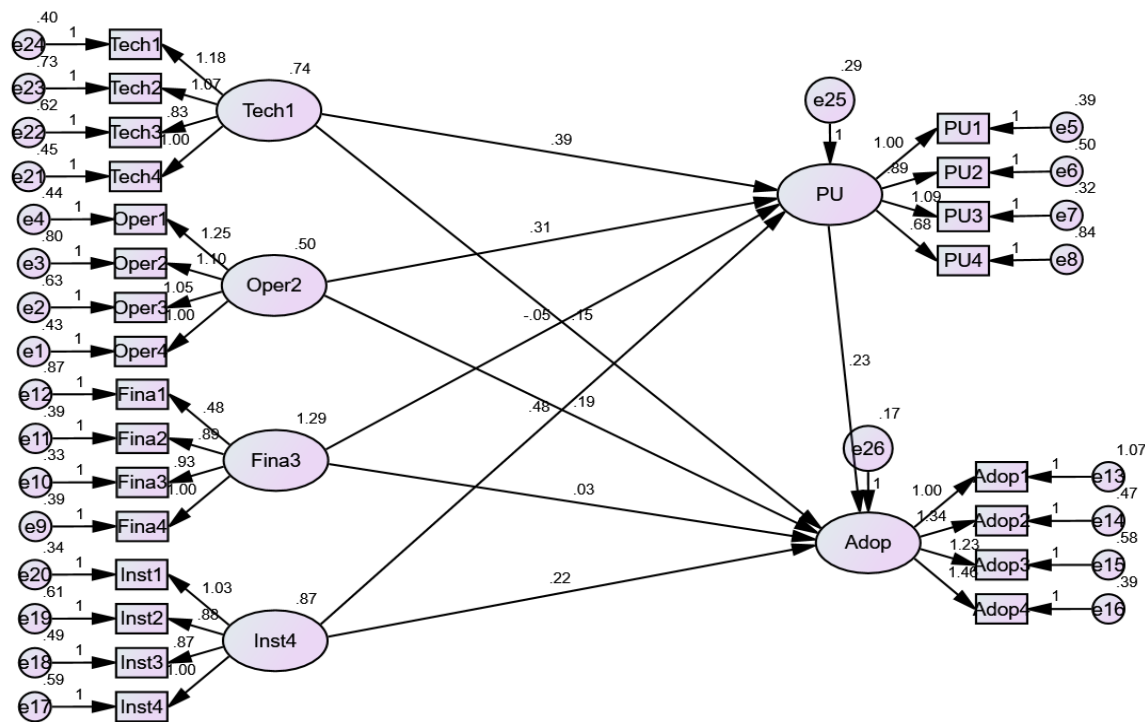


Figure 3: SEM for predictors of Effect of interoperability on Adoption of Digital Payment, perceived usefulness as a mediating variable

4.6.1 Direct Effects of Interoperability on Adoption

Table 13 presents the standardized path coefficients for the direct effects of the four interoperability dimensions on adoption of digital payment.

Table 13: SEM analysis for Direct Effects of Interoperability on Adoption

Hypothesis	Estimate	S. E	P-Value	Result
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Technical →Adoption	0.152	0.046	0.000	Supported
Operational →Adoption	0.188	0.051	0.000	Supported
Financial → Adoption	0.029	0.025	0.242	Not Supported
Institutional →Adoption	0.217	0.050	0.000	Supported

Source survey data, 2026

4.6.2 Direct Effects of Interoperability on Perceived Usefulness

The results for the direct effects of interoperability on the mediator (perceived usefulness) are shown in Table 14. Technical interoperability, operational interoperability and institutional interoperability all had strong, significant positive effects on perceived usefulness, supporting H5, H6, and H8. However, financial interoperability showed a non-significant negative relationship with PU, thus H7 was not supported. These findings indicate that users perceive digital payment systems as more useful when they experience seamless technical connections, consistent operational procedures, and strong institutional backing.

Table 14: SEM analysis for Direct Effects of Interoperability on Perceived Usefulness

Hypothesis	Estimate	S. E	P-Value	Result
Technical→ PU	0.388	0.049	0.000	Supported
Operational→ PU	0.306	0.058	0.000	Supported
Financial → PU	-0.047	0.032	0.147	Not Supported
Institutional→ PU	0.479	0.049	0.000	Supported

Source survey data, 2026

4.6.3 Effect of Perceived Usefulness on Adoption

Perceived usefulness had a significant positive effect on adoption of digital payment, as shown in Table 15. This finding supports H9 and confirms the central tenet of the Technology Acceptance Model: users are more likely to adopt a digital payment system when they perceive it as useful for their daily financial transactions.

Table 15: SEM analysis for Effect of Perceived Usefulness on Adoption

Hypothesis	Estimate	S. E	P-Value	Result
PU → Adoption	0.229	0.068	0.000	Supported

Source survey data, 2026

Table 16: Coefficient of Determination (R^2) for Endogenous Variable

Endogenous Variable	R	R^2	Adjusted R^2	Interpretation
Perceived usefulness		0.552	0.547	55.2% of variance explained by interoperability dimensions
Adoption of Digital Payment	0.74	0.548	0.542	54.8% of variance explained by interoperability and pu

Source survey data, 2026

Below is a summary of the bootstrap indirect effects (bias-corrected 95% confidence intervals and two-tailed significance) from the four interoperability dimensions to Adoption of digital payment.

Table 17: bootstrapping results

Path	Lower bound	Upper bound	p-value
Tech->PU->ADOP	0.036	0.161	0.003
Inst->PU->ADOP	0.041	0.196	0.004
Fina->PU->ADOP	-0.035	0.001	0.087
Oper->PU->ADOP	0.026	0.137	0.003
Tech->PU	0.270	0.512	<0.001
Inst->PU	0.363	0.604	<0.001
Fina->PU	-0.109	0.014	0.136
Oper->PU	0.189	0.454	<0.001

Significant positive indirect effects are revealed for Technical, Institutional and Operational interoperability on both Perceived Usefulness and Adoption of digital payment (all $p < 0.01$). The confidence intervals do not include zero and are fully positive, indicating that these dimensions indirectly facilitate adoption – most likely through enhanced perceived usefulness. Financial interoperability (Fina) does not significantly affect the outcomes indirectly ($p > 0.05$ and the confidence interval includes zero). This implies that in this model there is no indirect effect of financial interoperability on perceived usefulness or adoption.

CHAPTER FIVE

5. Discussion and Conclusion and Recommendation

5.1 Direct Effects of Interoperability on Adoption of Digital Payment Systems

This study examined four dimensions of interoperability (technical, operational, financial, and institutional) as direct antecedents of digital payment adoption among CBE customers in Bahir Dar City.

Technical Interoperability and Adoption (H1 Supported): The finding that technical interoperability had a significant positive direct effect on adoption aligns with evidence from India's UPI system, where common technical standards and QR code interoperability accelerated adoption to 83 billion annual transactions.(12) Similarly, Gupta documented that technical interoperability reduced transaction failures and simplified user experiences during COVID-19, directly driving adoption.(51) In the Ethiopian context, EthSwitch's National Payment Gateway and interoperable QR standards appear to be generating measurable user-level adoption effects, though the modest coefficient (0.123) suggests technical infrastructure alone is insufficient without complementary factors.

Operational Interoperability and Adoption (H2 Supported): Operational interoperability demonstrated a positive effect on adoption. This finding supports Domingo, who found that standardized dispute resolution, consistent verification protocols, and predictable settlement times in East Africa's mobile money interoperability framework reduced user friction.(11) In Ethiopia, the Instant Payment System (IPS) operated by EthSwitch represents operational interoperability.

Financial Interoperability and Adoption (H3 Not Supported): Contrary to expectations, financial interoperability did not significantly predict adoption. This finding contradicts research from ATM networks where interchange fees significantly influenced network participation.(49, 50) Several explanations are plausible. First; users may lack awareness of the fee structures for cross-platform transactions, as indicated by the descriptive statistics (mean for item 404 was moderate). Second, the finding aligns with Bourreau and Valletti, who argued that in developing economies, users tolerate modest fees if interoperability delivers reliable service.(47) Third, the non-significance may reflect that financial interoperability (interchange fees, surcharging) is primarily a supply-side concern for providers rather than a demand-side driver for customers.(27)

Institutional Interoperability and Adoption (H4 Supported): Institutional interoperability had the t direct effect on adoption. This finding is particularly significant for Ethiopia, where the National

Bank of Ethiopia has mandated interoperability through EthSwitch and advanced the National Digital Payment Strategy (NDPS) (NBE, 2021; EthSwitch, 2024). Users' confidence in regulatory enforcement, legal consumer protections, and governance structures appears to directly translate into adoption intention. This aligns with Hoernig and Bourreau, who found that central bank mandates for interoperability in Mozambique were necessary for market-wide adoption. Similarly, (28) Peru's instant payment system succeeded only after regulatory mandates established institutional interoperability. (48)

5.2 Direct Effects of Interoperability on Perceived Usefulness

The Technology Acceptance Model suggests that external system characteristics influence adoption primarily through their effect on perceived usefulness. (60) This study tested whether interoperability dimensions enhance users' perceptions of digital payment usefulness.

Technical Interoperability and Perceived Usefulness (H5 Supported): Technical interoperability had a strong positive effect on perceived usefulness. This finding is theoretically consistent with Davis's (1989) definition of PU as "the degree to which a person believes that using a particular system would enhance his or her job performance." This aligns with Ly and Ly, who found that seamless technical integration, was the strongest predictor of PU in emerging economy digital payment systems. (54) The very high coefficient (0.794) suggests that technical interoperability is the primary mechanism through which Ethiopian users perceive digital payments as useful.

Operational Interoperability and Perceived Usefulness (H6 Supported): Operational interoperability also demonstrated a strong positive effect on PU. This finding supports Mswahili(2022), who found that operational consistency (clear dispute resolution, standardized KYC) significantly enhanced perceived usefulness of mobile money interoperability in East Africa. (8)

Financial Interoperability and Perceived Usefulness (H7 Not Supported): Financial interoperability showed a non-significant negative relationship with perceived Usefulness. Users may perceive fees for cross-platform transactions as reducing the net benefit of digital payments, thereby diminishing perceived usefulness. This finding partially aligns with Qamar and

Ullah(2024) , who found that cost perceptions had weaker effects on PU compared to technical and operational factors in FinTech adoption.(24) It may also reflect that in the Ethiopian context, where digital payment adoption is still Early Stages (less than 15% active usage), users are more concerned with whether the system works at all rather than the specific fee structure.(18)

Institutional Interoperability and Perceived Usefulness (H8 Supported): Institutional interoperability had the strongest effect on perceived usefulness among all dimensions. This aligns with Radcliffe and Voorhies(2012), who argued that institutional interoperability creates the "trust infrastructure" that makes digital payments useful for populations historically excluded from formal finance.(10)

5.3 The Mediating Role of Perceived Usefulness

Perceived usefulness had a significant positive effect on adoption of digital payment systems, supporting H9 and confirming the core Principle of TAM. This finding is consistent with decades of TAM research: users adopt technology when they perceive it as useful for accomplishing their goals.(60)

More importantly, the pattern of effects supports the mediated pathway theorized in the conceptual framework. Technical, operational, and institutional interoperability all had strong effects on PU and PU in turn significantly predicted adoption. This indicates that perceived usefulness is indeed a mechanism through which interoperability translates into adoption a finding consistent with Shankar and Datta(2018), who found that PU mediated the effect of system characteristics on mobile payment adoption in India,(57) and with Qamar and Ullah(2024), who reported that PU explained the majority of variance in FinTech adoption across multiple contexts.(24)

5.4 Strengths and Limitations of the Study

5.4.1 Strengths of the Study

This study used SEM, which allows for the simultaneous examination of several variables, accounts error terms and assesses correlation between exogenous variables. Multigroup analysis was also used to evaluate the mediating impacts on the latent variables.

5.4.2 Limitations of the study

several limitations should be acknowledged. First, this study doesn't show causality, only

establish correlations between variable since has the limitation of cross-sectional study. While the structural model hypothesizes causal directions based on TAM theory, longitudinal data would strengthen causal claims. Second, the study focused on CBE customers in Bahir Dar City, which limits generalizability to other banks (e.g., private banks, microfinance institutions), other cities (e.g., Addis Ababa, rural areas), and non-CBE users (e.g., TeleBirr-only users). Future research should replicate the model with diverse samples across Ethiopia's regions and banking institutions.

5.5 Conclusion

This study investigated the effect of interoperability on adoption of digital payment systems among Commercial Bank of Ethiopia customers in Bahir Dar City, with perceived usefulness as a mediating variable. Drawing on the Technology Acceptance Model and a multidimensional conceptualization of interoperability (technical, operational, financial, and institutional), the study tested nine hypotheses using structural equation modeling with data from 377 respondents.

The findings demonstrate that interoperability significantly influences digital payment adoption, both directly and indirectly through perceived usefulness. Institutional interoperability (regulatory mandates, legal frameworks, governance) had the strongest effects on both adoption ($\beta = 0.195$, $p = 0.003$) and perceived usefulness ($\beta = 0.850$, $p < 0.001$), followed by technical interoperability (adoption: $\beta = 0.123$, $p = 0.045$; PU: $\beta = 0.794$, $p < 0.001$). Operational interoperability showed marginally significant effects on adoption ($\beta = 0.101$, $p = 0.090$) and strong effects on PU ($\beta = 0.715$, $p < 0.001$). Financial interoperability did not significantly predict either adoption or PU, suggesting that cost considerations are secondary to functionality and trust in Ethiopia's early adoption stage. Perceived usefulness significantly predicted adoption ($\beta = 0.271$, $p < 0.001$), confirming the mediated pathway theorized by TAM.

5.6 Recommendation

The study comes up with some ideas for people who make policies and that handle payments, banks and people who will do research in the future. It does this by looking at what the study found out.

First the National Bank of Ethiopia which is in charge of making policies needs to make sure that all payment companies work together. This is because when they do more people use the services and they think the services are useful.

Second for EthSwitch, which's the company that handles all the payments in the country they need to keep investing in good technology and systems. This means things like making sure the system is always available and that transactions do not fail. They also need to have rules for how to handle problems like getting money back within 48 hours. If they do this more people will start using the services.

Third the Commercial Bank of Ethiopia should tell people about how useful their service is. They should not just talk about the details but about how the services can help people in their daily lives like being fast and easy to use.

Fourth people who will do research in the future need to do some term studies to really understand what is going on. They should also look at places and types of banks like private banks, TeleBirr and they should look at all over Ethiopia not just one place.

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Annex

Annex A: Information sheet Research

Title: the effect of interoperability on adoption of digital payment system: perceived usefulness as a mediating variable. Using TAM, in bahir dar, northwest Ethiopia, 2026

Introduction: This information sheet is prepared to explain the research project that you are asked to join by research investigators. The research team includes a final year Mater graduate student, 3 data collectors, 2 supervisors, and 1 advisors from the Bahir Dar University.

Procedure and Duration: I will be assessing the effect of interoperability on adoption of digital payment system by using questionnaires, that needs your full cooperation and this may take about 20 to 25 minutes.

Purpose of the Research: The purpose of the research is to assess the effect of interoperability on adoption of digital payment system: perceived usefulness as a mediating variable. Using TAM, in Bahir Dar, northwest Ethiopia, 2026, Hence, the finding of the study examine the effect of interoperability on the adoption of digital payment systems in Bahir Dar City, Ethiopia.

Rights: Your participation in this study is entirely voluntary. It is your full right to refuse, to answer any or all of the questions. If you decide to refuse the study, you have the right to terminate the study at any time

Name of Principal Investigator: Mohammed Mussa (BSC/MANAGEMENT)

Name of Advisors:

1. Dr. Gashaw M (Ph.D. ASSISTANT PROFESSOR)

Annex B: Informed consent statement

Dears! My name is _____ I am here on behalf of Mohammed Mussa, student of Master of Marketing Management at the Bahir Dar University, College of Business and Economics, Department of Marketing Management. He is researching partial fulfillment of master degree towards the effect of interoperability on adoption of digital payment system: perceived usefulness as a mediating variable. Using TAM, in Bahir Dar, northwest Ethiopia, 2026. He has ethical clearance from the Bahir Dar University. You are chosen to participate in this study and your anonymous answers will be used only for research purposes. To effectively attain the purpose of the research, I request you to give a genuine response to each question. There is no need for your name on the questionnaire and no individual responses will be reported so your answers are completely confidential. It is your full right to refuse, to answer any or all of the questions.

Dear participant, I thank you for your cooperation. I would like to ask you to agree and take part in the study by giving the following declaration. I have been given detailed information about this study, I had the opportunity to discuss any question with the researchers and I understand that my participation in the study is voluntary & I agree to take part in this study.

Agree ☐

disagree ☐

Participant code _____

For any further questions, contact the investigator

Name of the investigator: Mohammed Mussa

Phone Number: 0910452439

Thank you!!!

Annex C: Questionnaire –English version

Part I: Socio demographic Questions

Q. CODE	Questions	Response
101	Gender	☐ Male ☐ Female
102	Age	☐ 18-30 Years ☐ 31-40 Years ☐ 41-50 Years ☐ above 50 Years
103	Education level	☐ High school & below ☐ Diploma ☐ Degree ☐ Masters & above
104	What is your professional work	☐ Government Employee ☐ Private Employee ☐ Business ☐ NGO ☐ other (please specify)
105	Monthly Income	☐ <2,000 ☐ 2,001 - 5,000 ☐ 5,001 - 10,000 ☐ 10,001 - 50,000 ☐ > 50,000

Part 2 constructs of the TAM model

1 Strongly disagree 2 Disagree 3 Neutral 4. Agree 5 Strongly agree

2. Interoperability (Four Dimensions)

2.1 Dimension 1: Technical Interoperability

Q. CODE	Questions	Response				
201	Different payment systems (CBE, other banks, TeleBirr) use common technical standards that allow them to communicate seamlessly.	1	2	3	4	5
202	I can scan any QR code at a merchant using my CBE app, even if the QR code was issued by another bank or mobile money provider.	1	2	3	4	5
203	The technical infrastructure (e.g., EthSwitch, National Payment Gateway) ensures that my transaction data is transferred accurately between different providers.	1	2	3	4	5
204	I do not experience technical failures when transacting between CBE and other payment platforms.	1	2	3	4	5

2.1 Dimension 2: Operational Interoperability

Q. CODE	Questions	Response				
301	The process for sending money from my CBE account to a customer of another bank is straightforward and consistent every time.	1	2	3	4	5
302	When a cross-bank transaction fails, there is a clear and efficient dispute resolution process to recover my money.	1	2	3	4	5
303	The customer verification requirements (e.g., PIN, biometric, OTP) are standardized across different payment platforms, making transactions easier.	1	2	3	4	5
304	I can complete cross-bank transactions at any time of day, and funds are transferred within a	1	2	3	4	5

predictable timeframe.

2.1 Dimension 3: Financial Interoperability

Q. CODE	Questions	Response				
401	The fees charged for sending money from CBE to another bank or mobile money provider are reasonable and transparent.	1	2	3	4	5
402	I am not charged extra fees simply because I use CBE to pay a merchant who uses another bank's POS terminal.	1	2	3	4	5
403	The cost of using CBE digital payment services for cross-bank transactions is lower than using alternative methods (e.g., cash, traditional transfers).	1	2	3	4	5
404	I understand the fee structure for different types of cross-platform transactions (e.g., peer-to-peer, merchant payments, bill payments).	1	2	3	4	5

2.1 Dimension 4: Institutional Interoperability

Q. CODE	Questions	Response				
501	I am confident that the National Bank of Ethiopia's regulations ensures fair and open interoperability between all payment providers.	1	2	3	4	5
502	The legal framework protects my rights as a consumer when I make cross-bank digital payments (e.g., liability for fraudulent transactions).	1	2	3	4	5
503	EthSwitch (the national payment switch) effectively ensures that different banks and mobile money providers work together seamlessly.	1	2	3	4	5
504	I believe that all payment providers in Ethiopia are	1	2	3	4	5

required by law to allow customers to send and receive money across different platforms.

3. Perceived Usefulness

Q. CODE	Questions	Response				
601	Using CBE digital payment services enables me to accomplish transactions more quickly.	1	2	3	4	5
602	Using CBE digital payment services improves my ability to manage my finances (e.g., sending money, paying bills).	1	2	3	4	5
603	Using CBE digital payment services increases my productivity (saves time and effort compared to cash or branch visits).	1	2	3	4	5
604	I find CBE digital payment services useful for my daily financial transactions.	1	2	3	4	5

4. Adoption of Digital Payment

701	I intend to continue using CBE digital payment services for my regular transactions in the future.	1	2	3	4	5
702	I will increase my frequency of using CBE digital payment services (e.g., more transfers, bill payments) in the coming months.	1	2	3	4	5
703	Compared to six months ago, I now use CBE digital payment services for a wider range of transactions.	1	2	3	4	5
704	I prefer using CBE digital payment services over carrying cash for everyday transactions.	1	2	3	4	5

Annex D: Amharic Version Consent form

አባሪ ሀ፡ በሚጃ የተደገ ፈ የስምምነት መግለጫ

ወድ ተሳታፊዎች! ስሜ _____ ነው። እኔ እዚህ የመጣሁት በባህር ዳር ዩኒቨርሲቲ ንግድና ኢኮኖሚክስ ኮሌጅ የግብይት አስተዳደር ትምህርት ክፍል የሚከተለውን ማረጋገጫ ህለተኛ ዲግሪ ተማሪ በሆኑት መካከል መሳ ስም ነው። እሳቸው በባህር ዳር፣ ሰሜን ምዕራብ ኢትዮጵያ፣ 2018 ዓ.ም. (2026 እ.ኤ.አ.) የቴክኖሎጂ ተቀባይነት ሞዴልን (TAM) በመጠቀም በዲጂታል ክፍያ ስርዓት ተቀባይነት ላይ የመመስረት ችሎታ (interoperability) ተፅእኖ፡- የተገነዘበ ጠቀሜታ እንደ መካከለኛ ተለዋዋጭ በማድረግ ለማስተር ዲግሪ ከፊል መስፈርት ጥናት

እያካሄዱ ነው። ከባህር ዳር ዩኒቨርሲቲ የስነምግባር ፈቃድ አግኝተዋል። እርስዎ በዚህ ጥናት እንዲሳተፉ ተመርጠዋል፤ ስም አልባ ምላሾችዎ ለምርምር ዓላማ ብቻ ያገለግላሉ። የጥናቱን ዓላማ በብቃት ለማካካት፤ ለእያንዳንዱ ጥያቄ ትክክለኛ ምላሽ እንዲሰጡ ልጠይቅዎት እፈልጋለሁ። በመጠይቁ ላይ ስምዎን መጻፍ አያስፈልግም፤ እንዲሁም የግለሰብ ምላሾች አይቀርቡም፤ ስለዚህ መልሶችዎ መሉ በመሉ ማስጥራዊ ናቸው። ማንኛውንም ወይም ሁሉንም ጥያቄዎች ለመሙላት እምቢ ማለት መሉ መበትዎ ነው።

ወድተሳታፊ፤ ለትብብርዎ አመሰግናለሁ። ከዚህ በታች ያለውን ሚጋገ ጫበብጠት በጥናቱ ለመሳተፍ እንዲሰማሙ እና እንዲሳተፉ ልጠይቅዎት እፈልጋለሁ። ስለዚህ ጥናት ዝርዝር ሚጋገ ተሰጥቶኛል፤ ማንኛውንም ጥያቄ ከተመራማሪዎቹ ጋር የመወያየት እድል አግኝቻለሁ፤ በጥናቱ ውስጥ መሳተፌ በፈቃደኝነት እንደሆነ ተረድቻለሁ፤ እናም በዚህ ጥናት ለመሳተፍ ተስማምቻለሁ።

እስማዝሁ

አልስማም

ለማንኛውም ተጨማሪ ጥያቄ፤ መርማሪውን ያግኙ፡-

የመርማሪውስም፡- መስመድ መሳ

ስልክ ቁጥር፡-0910452439

አመሰግናለሁ!!!

Annex E: Amharic version questionnaire

ሚጋገ ሰብሳቢ ብቻ የሚጠቀመው

ክፍል 1፡ - ማህበረ-ሕዝብ ጥያቄዎች

ጥ. ኮድ

ጥያቄ

መልስ

101

የታ

☐ ወንድ

- 102 ዕድሜ
- ☐ ሴት
- ☐ 18-30 ዓመታት
- ☐ 31-40 ዓመታት
- ☐ 41-50 ዓመታት
- ☐ በላይ50 ዓመታት
- 103 የትምህርት ደረጃ
- ☐ ሁለተኛ ደረጃ ትምህርት ቤት እና ከዚያ በታች
- ☐ ዲፕሎማ
- ☐ ዲግሪ
- ☐ ማስተርስ እና ከዚያ በላይ
- 104 መቼ ዊሥኒዎ ምን ድኅነት ወ?
- ☐ የመንግሥት ሠራተኛ
- ☐ የግል ድርጅት ሠራተኛ
- ☐ ንግድ
- ☐ መንግሥታዊ ያልሆነ ድርጅት (ሚያ.ድ.)
- ☐ ሌላ ()
- 105 ወርሃዊ ገቢ
- ☐ <2,000
- ☐ 2,001 - 5,000
- ☐ 5,001 - 10,000
- ☐ 10,001 - 50,000
- ☐ > 50,000

ክፍል 2 የቴክኖሎጂ ተቀባይነት ትምህርት (TAM) ግንባታዎች

1 መላ በመላ 2 አልስማም 3 ገለልተኛ 4 እስማማሁ 5 መላ በመላ እስማማሁ

አልስማም

2. አርስ በርስ መስማማት (አራት ልኬቶች)

2.1 ልኬት 1:- ቴክኒካዊ የትብብር አቅም

ጥያቄ ኮድ	ጥያቄ	መልስ			
201	የተለያዩ የክፍያ ሥርዓቶች (ሲቢኢ፣ ሌሎች ባንኮች፣ ቴሌብር) ያለምንም እንክን እንዲግባቡ የሚከተላቸውን የጋራ ቴክኒካዊ ደረጃዎች ይጠቀማሉ።	1 5	2	3	4
202	በሲቢኢ አፕልኬሽኔ ማንኛውንም በነጋዴ ቦታ ያለ ኪዩኦር ኮድ መቃኘት እችላለሁ፣ ኪዩኦር ኮዱ በሌላ ባንክ ወይም በሞባይል ገንዘብ አቅራቢ የተሰጠ ቢሆንም።	1 5	2	3	4
203	ቴክኒካዊ መሠረተ ልማቱ (ለምሳሌ፡- ኢትሰዊች፣ ብሔራዊ የክፍያ መግቢያ) የግብይት ወሂቤ በተለያዩ አቅራቢዎች መካከል በትክክል መተላለፉን ያረጋግጣል።	1 5	2	3	4
204	በሲቢኢ እና በሌሎች የክፍያ መድረኮች መካከል ግብይት ስሠራ ቴክኒካዊ ችግሮች አያጋጥሟቸውም።	1 5	2	3	4

2.1 ልኬት 2፡- የአሠራር የትብብር አቅም

ጥያቄ ኮድ	ጥያቄ	መልስ			
301	ከሲቢኢ አካወንቴ ወደ ሌላ ባንክ ደንበኛ ገንዘብ የመለከ ሂደት ቀጥተኛ እና በየጊዜው ወጥነት ያለው ነው።	1 5	2	3	4
302	የባንክ ማቅረጥ ግብይት ሲወድቅ፣ ገንዘቤን መለሰ ለማግኘት ግልጽ እና ቀልጣፋ የአለመግባባት አፈታት ሂደት አለ።	1 5	2	3	4
303	የደንበኛ ሚጋገጫ መስፈርቶች (ለምሳሌ፡- ፒን፣ ባዮሜትሪክ፣ አቲፒ) በተለያዩ የክፍያ መድረኮች ላይ ደረጃቸውን የጠበቁ በመሆናቸው ግብይቶችን ቀላል ያደርጉልናል።	1 5	2	3	4
304	በማንኛውም የቀን ሰዓት የባንክ ማቅረጥ ግብይቶችን	1	2	3	4

ማጠናቀቅ እችላለሁ፤ እንዲሁም ገንዘቦች በሚክሩ ብይ 5

ጊዜ ገደብ ወስጥ ይተላለፋሉ።

2.1 ልኬት 3፡- የፋይናንስ የትብብር አቅም

ጥያቄ ኮድ	ጥያቄ	መልስ			
401	ስቢሊ ወደ ሌላ ባንክ ወይም የሞገይል ገንዘብ አቅራቢ ገንዘብ ለመላክ የሚከፈለው ክፍያ ምክንያታዊ እና ግልጽ ነው።	1	2	3	4
402	ስቢሊን ተጠቅሜሌላ ባንክ የፖስት ማሸን ለሚጠቀም ነጋዴ ክፍያ ስፈጽም ብቻ ተጨማሪ ክፍያ አይጠልብኝም።	1	2	3	4
403	የስቢሊ ዲጂታል ክፍያ አገልግሎቶችን ለባንክ ማቋረጥ ግብይቶች መጠቀም ዋጋው ከአማራጭ ዘዴዎች (ለምሳሌ፡- ጥሬ ገንዘብ፣ ባህላዊ ዝወወሮች) ያነሰ ነው።	1	2	3	4
404	ለተለያዩ የመድረክ ተሻጋሪ ግብይቶች (ለምሳሌ፡- ከደንበኛ ወደ ደንበኛ፣ የነጋዴ ክፍያ፣ የቢል ክፍያ) የክፍያ መዋቅሩን በደንብ ገብቶኛል።	1	2	3	4

2.1 ልኬት 4፡- ተቋማዊ የትብብር አቅም

ጥያቄ ኮድ	ጥያቄ	መልስ			
501	የኢትዮጵያ ብሔራዊ ባንክ ደንቦች በሁሉም የክፍያ አቅራቢዎች መካከል ፍትሃዊ እና ክፍት የሆነ እርስ በርስ መስተጋብር ማረጋገጥ ጥቸውን እመነኝ።	1	2	3	4
502	የሕግ ማዕቀፉ የባንክ ማቋረጥ ዲጂታል ክፍያዎች ስፈጽም (ለምሳሌ፡- በማጠናቀብ ግብይቶች ላይ ያለኝ ተጠያቂነት) የሽያጭነት መብቶቼን ይጠበቅልኛል።	1	2	3	4
503	ኢትስዊች (ብሔራዊ የክፍያ መቀየሪያ) የተለያዩ ባንኮች እና የሞገይል ገንዘብ አቅራቢዎች እንከን በሌለው	1	2	3	4

መንገድ አብረው እንዲሠሩ ወጠታማ በሆነ መንገድ ያደርጋል።

504	በኢትዮጵያ ወስጥ ያሉ ሁሉም የክፍያ አቅራቢዎች ደንቦችን በተለያዩ መድረኮች ገንዘብ እንዲልኩ እና እንዲቀበሉ በሕግ እንደሚጠበቅባቸው አምናለሁ።	1	2	3	4
		5			

2. የጠቀሜታ ግንዛቤ

ጥያቄ ኮድ	ጥያቄ	መልስ			
601	የሲቢኢ ዲጂታል ክፍያ አገልግሎቶችን ማጠቀም ግብይቶችን በፍጥነት እንድረጽም ያስችለኛል።	1	2	3	4
		5			
602	የሲቢኢ ዲጂታል ክፍያ አገልግሎቶችን ማጠቀም ገንዘቤን የማስተዳደር ችሎታን ያሻሽላል (ለምሳሌ፡- ገንዘብ መላክ፣ ቢሎችን መክፈል)።	1	2	3	4
		5			
603	የሲቢኢ ዲጂታል ክፍያ አገልግሎቶችን ማጠቀም ምርታማ ቴን ይጨምራል (ከጥሬ ገንዘብ ወይም ከቅርንጫፍ ጉብኝት ጋር ሲነጻጸር ጊዜና ጥረት ይቆጥባል)።	1	2	3	4
		5			
604	የሲቢኢ ዲጂታል ክፍያ አገልግሎቶች ለዕለታዊ የገንዘብ ግብይቶች ጠቃሚሆነው አገኛቸዋለሁ።	1	2	3	4
		5			

3. የዲጂታል ክፍያ ተቀባይነት

ጥያቄ ኮድ	ጥያቄ	መልስ			
701	ለወደፊት መደበኛ ግብይቶች የሲቢኢ ዲጂታል ክፍያ አገልግሎቶችን ማጠቀሚያ ለመቀጠል አስባለሁ።	1	2	3	4
		5			
702	በማቅጣት ወራት የሲቢኢ ዲጂታል ክፍያ አገልግሎቶችን የማጠቀም ድግግሞሼን እጨምራለሁ (ለምሳሌ፡- ተጨማሪ ገንዘብ ማዘዋወር፣ ቢሎች	1	2	3	4
		5			

መከፈል)።

703	ከስድስት ወራት በፊት ጋር ሲነጻጸር፣ አሁን የሲቢኢ 1 ዲጂታል ክፍያ አገልግሎቶችን ለሰፋ የግብይት 5 ዓይነቶች እጠቀማለሁ።	2	3	4
704	በዕለት ተዕለት ግብይቶቼ ጥሬ ገንዘብ ከማስያዝ ይልቅ 1 የሲቢኢ ዲጂታል ክፍያ አገልግሎቶችን መጠቀም 5 እመርጣለሁ።	2	3	4