

What Drives Microfinance Institutions Adopting Technology in Indonesia? Pre-Adoption and Post Adoption Approach in Indonesia

Sondang Martha Samosir*, Rosnita Wirdiyanti, Muhammad Algifari

We study Microfinance Institutions (MFIs) behavior towards technology-based microfinance system. Using a survey of 1371 MFIs from 33 provinces in Indonesia, we employ SEM-PLS approach to estimate intention to use (pre-adoption stage) and intention to continue the use of technology adoption (post-adoption stage) to observe MFIs behavior towards technology-based microfinance system. The results show MFIs perceived benefits to adopt technology and environment context are the strongest drivers for MFIs to encourage adopting technology. Further, overall company performance and financial capability as proxy of MFIs satisfaction after adopting the technology will increase MFIs motivation to continue using technology. Overall, our findings suggest that government support in smoothing digital microfinance ecosystem development drives shifting in most transaction of microfinance to digital platform. Eventually it will lead to higher satisfaction for MFIs due to realization of perceived benefits and increases MFIs intention to continue adopting the technology.

Keywords: Microfinance, TOE, Technology Adoption, Post Adoption, Intention

*Corresponding author: *rosnita_w@ojk.go.id*

This paper is part of the 2021 research project funded by Otoritas Jasa Keuangan (OJK). The author thanks the panelists and participants at OJK Research Seminar in November 26-27th, 2021 for their valuable comment and suggestions. The findings and interpretations expressed in this paper are entirely those of the authors and do not represent the views of OJK. All remaining errors and omissions rest with the authors.

1. Introduction

Developments in information technology and digital finance are transformed finance's market structure, including the microfinance industry (Kauffman and Riggins, 2012). Disruption in financial services cause the types of Micro Finance Institutions have become increasingly diverse and may become direct competitor to traditional MFIs, such as Peer-to-Peer Lending (Wang, 2021). Peer-to-Peer lending (P2P), an online direct lending platform to individuals or businesses integrates without an official, traditional financial intermediary participating as an intermediary. With its ability to directly match borrowers and lenders by disclosing borrowers' information, P2P can effectively solve the SME's information opaqueness, reducing information and transaction cost, and improving financial efficiency (Yum et al., 2012; Liu et al., 2019; Stiglitz & Weiss, 1981).

Microfinance has been praised for reducing poverty by fostering self-employment in low-income communities by offering access to financing. Although the first well-known microfinance providers (MFP) were Grameen Bank in Bangladesh (Yunus, 1999), Indonesia is renowned for its mass-scale microfinance sectors, led by the largest microfinance provider (MFP) serves microlending, Bank Rakyat Indonesia. There are several forms of MFP in Indonesia, including commercial banks, rural banks, peer-to-peer lending, and microfinance institutions (MFIs) that are mostly micro cooperatives for rural communities with limited capital. There are over 60,000 MFIs that reaching more than 50 million people (CGAP, 2013). However, only 221 MFIs are supervised by Otoritas Jasa Keuangan (OJK/Indonesia Financial Services Authorities).

Nevertheless, the use of ICT has become primary business strategy of most financial providers (Kauffman & Riggins, 2012). Moreover, it is generally believed that mobile technology in several studies has been identified as key factors for ICT penetration especially in developing countries (Choi et al., 2006; Mushtaq & Bruneau, 2019). On the other hand, MFIs originally was rather low tech both from MFIs themselves and their customers who mostly underserved people. Disruption in financial industry and remarkable growth of P2P¹ made information and communication technology (ICT) adoption for MFIs inevitable. Furthermore, the use of ICT has further been pointed out as one of the ways MFI can attain their objectives, broaden the

¹ OJK Fintech Statistics September 2021. www.ojk.go.id: Licensed P2P has been growing from IDR3T (January 2018) to IDR14T (September 2021).

coverage of microfinance services and potential solution to MFI survivability (Diniz et al., 2008; Kauffman & Riggins, 2012).

Previous literature on technology adoption and MFIs have well been scrutinized, where many empirical studies have explored from different angles, including mobile technology adoption (Mwafise & Stapleton; 2012; Ammar & Ahmed, 2016; Dorfleitner et al., 2018); as well as website accessibility (Tadele et al., 2016). Other studies have observed the impact of MFI's technology adoption, such as MFI survivability [Kauffman & Riggins, 2012] and competition (Wang, et al. 2021) and poverty and inequality (Mushtaq & Bruneau, 2019).

To date there has been limited formal research on the determinants of ICT adoption in the microfinance industry and post-adoption experience—something that we think is important to address. Most of MFIs are micro small enterprises (MSEs) with limited capital, limited access to funding resources, and lack of capable human resources (Dorfleitner, et al.;;) to support technology adoption. Thus, this study helps government and related party to focus their effort on factors that will encourage MFIs to embrace technology adoption.

We will apply concept from Technology, Organizational, and Environment (TOE) to develop robust theoretical framework to observe technology adoption determinants. Moreover, we aim further post adoption experience to observe factors that support continuation use of technology adoption by MFIs. To do this, we first provide a literature review in Section 2 of two relevant areas of research: (1) MFIs development in Indonesia; (2) Theoretical framework development. In Section 3, we describe research methodology which is consist of the datasets used in analysis and the modeling framework. The following section presents the estimation results and analysis. The final section concludes the empirical study with implications to policymakers and MSME in Indonesia.

2. Literature Review

2.1 MFIs Definition

Indonesian Law 1/2013 on microfinance institutions (MFIs Law) define microfinance institutions as a financial institution that is especially established to provide services in business development and society empowerment by giving loans or financing for micro-scaled business of MFI members and society, providing deposit management, or giving consultancy services in business development that is conducted not merely for profit. Ledgerwood (1999) an economic

development approach intended to benefit low-income women and men by providing financial services social intermediation services such as group formation, development of self-confidence, and training in financial literacy and management capabilities among members of a group. Thus, the definition of microfinance often includes both financial purposes and social purposes. Microfinance is not simply banking; it is a development tool.

There is a different character of MFIs in Indonesia and MFIs in other countries in term of business size and capability. MFIs example in other countries such as Grameen Bank and ASA in Bangladesh, FONDEP Micro-Crédit in Marocco. Amhara Credit and Savings Institution in Ethiopia are medium or large enterprises that providing microfinance services. In contrast, MFIs in Indonesia are mostly micro and small enterprises that serving micro customers. Thus, in this study we focused on MFIs that classify as micro and small enterprises.

2.2 Overview of microfinance evolution in Indonesia

Microfinance begins in Indonesia in the late 19th century by establishing the People's Credit Bank (Bank Kredit Rakyat) and Lumbung Desa². These two institutions were formed to assist farmers, workers, and laborers to free themselves from loan sharks. In 1905, the People's Credit Bank coverage was upgraded and changed to the Village Bank, whose services were extended to cover business activities outside the agricultural sector. In 1929, the East Indies Government issued Law No. 137 of 1929 regarding the establishment of the Village Credit Board (BKD) to manage rural credit schemes in Java and Bali.

After independence, the Indonesian Government supported local governments (province) to form *Bank Pasar*³ as well as MFIs. Institutions formed from this action such as Rural Credit and Funds Institutions (LDKP) in West Java, the County Credit Board (BKK) in Central Java, Credit for Small-scale Businesses (KURK) in East Java, Lumbung Pitih Nagari (LPN)⁴ in West Sumatra and the Village Credit Institution (LPD) in Bali (Bank Indonesia, 2003). At that time these institutions known as Bank Pasar or BKK, instead of MFIs (MFIs terms was not popular those days). Government then issued Law No. 7 of 1992 regarding banking sector, which only recognize two types of banks in Indonesia: commercial banks and rural banks. Financial institutions that did

² *Lumbung Desa* was an institution in rural areas that provided loans and collected saving in the form of rice.

³ Bank Pasar is a bank specializing in small, low-interest loans to petty traders

⁴ Lumbung Pitih Nagari is an institution that provides saving and loans services within a *nagari* (an area of land belonging to a traditional community in West Sumatra).

not fulfill the requirements in the banking law has been considered as non-formal financial institutions or illegal banks. Ibrahim (2003) found 2,272 LDKP and 5,345 BKD failed to meet the requirements as rural banks.

Reflecting on MFIs long history, it is not surprisingly that many forms of MFIs founded. Most MFIs are result from government program to reduce poverty. However, those MFIs depends on government subsidy which can be different over the time. Government program overlapping, ambiguous in regulation and authority, and competitions are some factors that harm MFIs survivability.

Nowadays, Otoritas Jasa Keuangan (OJK/Indonesia Financial Services Authority) has been mandated to license, regulate, and supervise MFIs. This action is taken to centralize MFIs development in one government agency.

2.3 Technology Context

According to the TOE framework, the organizational adoption of technology could be affected by the organizational context, which defines the organizational characteristics affecting the organizational adoption of new innovative technology (Chau & Tam, 1997). This research uses four indicators that consider the organizational context: Top Management Support, Financial Resources, Markets and Products, and Business Model. Top management support plays a significant role in starting, executing, and adopting technologies, their support can be found in their sponsoring of initiatives and participating in the adoption of new technologies within the organization, in the form of resources allocation (e.g., budget, time, human resource) (Lian, J. W., Yen, D. C., and Wang, Y. T, 2014). Financial resources have been a significant factor affecting a firm's technology adoption due to the high investment requirements in hardware, software, and employee training. Lack of funding was the main constraint that MFIs face in making better use of technology in supporting the organization's operations (European Microfinance Network, 2012). For sustainability, MFPs need to have high financial coverage of the market. MFPs need to provide a range of tailored financial products/services to the market to reach the entire target customers (Kimando and Kihoro, 2012). Researchers stress the need to match the strength of the MFP with the identified market opportunities (Ngumbao, 2012). Business models have primarily been used to clarify the utilization of ICT in business or m-commerce associations (Bouwman, H., De-Vos, H., Haaker, T., 2008; Timmers, 1998); strategic matters - such as organization

performance, value creation, and competitive advantage, (Teece, 2010); and innovation and technology management (Bjorndal, 2009).

H1. Technological context has a positive effect on adopt technology-based microfinance services.

2.4 Organizational Context

According to the TOE framework, the organizational adoption of technology could be affected by the organizational context, which defines the organizational characteristics affecting the organizational adoption of new innovative technology (Chau & Tam, 1997). This research uses four indicators that consider the organizational context: Top Management Support, Financial Resources, Markets and Products, and Business Model. Top management support plays a significant role in starting, executing, and adopting technologies, their support can be found in their sponsoring of initiatives and participating in the adoption of new technologies within the organization, in the form of resources allocation (e.g., budget, time, human resource) (Lian, J. W., Yen, D. C., and Wang, Y. T, 2014). Financial resources have been a significant factor affecting a firm's technology adoption due to the high investment requirements in hardware, software, and employee training. Lack of funding was the main constraint that MFIs face in making better use of technology in supporting the organization's operations (European

Microfinance Network, 2012). For sustainability, MFPs need to have high financial coverage of the market. MFPs need to provide a range of tailored financial products/services to the market to reach the entire target customers (Kimando and Kihoro, 2012; RBZ, 2015). Researchers stress the need to match the strength of the MFP with the identified market opportunities (Ngumbao, 2012). Business models have primarily been used to clarify the utilization of ICT in business or m-commerce associations (Bouwman, H., De-Vos, H., Haaker, T., 2008; Timmers, 1998); strategic matters - such as organization performance, value creation, and competitive advantage, (Teece, 2010); and innovation and technology management (Björkdahl, 2009).

H2. Organizational context has a positive effect on adopt technology-based microfinance services.

2.5 Environmental Context

The environmental contexts are discussed from three of view: regulatory environment, pressure from stakeholders, and government support. Zhu, Kraemer (2004) defined regulatory support as "ways in which government regulation (laws) could affect innovation diffusion". The success of

digital adoption will depend upon the established legal framework for their operations. This framework is a crucial requirement in developing countries to identify legal problems and vital legislation for their specific needs. These needs can include security, privacy and data protection and authentication. Likewise, there is a requirement for a whole legal framework to be evolved that covers all issues related to ICT and m-banking applications. Regulations are required to enable the successful adoption and adaptation of financial services, encourage their use, and increase competition among providers (Claessens and Rojas-Suarez, 2016) in the core market and supporting functions.

Moreover, government support positively correlates with SaaS adoption by Indonesian firms (Mangula et al., 2014). Mwela (2014) study of ICT and microfinance reports that NGOs provide more support than the government. Furthermore, the pressure from stakeholders refers to stress from customers and pressure from partners. The more consumers demand a company to provide up-to-date products or services, the more it is willing to adopt this technology (Wu and Chang, 2003); also, the business partners who have embraced new technologies earlier can encourage their partner companies to follow them (Zhu and Kraemer 2005)

H3. Environmental context has a positive effect on adopt technology-based microfinance services.

2.6 Digital financial literacy

Digital financial literacy is explained in two points of view: digital literacy and financial literacy. Digital literacy refers to a set of basic skills in using technology. Previous research by Bruno et al. (2010) and Van Deursen and Van Dijk (2014) argue that inadequate digital skill is considered a barrier to experiencing the benefit of using information technology. Moreover, a study by Yu et al. (2017) found that low information literacy negatively leads to information communication adoption behavior.

On the other side, financial literacy is defined as the knowledge and skills to manage financial resources to make effective financial matters. Njenga and Ndlovu (2012) stated that the new mobile banking user might have low financial literacy and expose the risk of losing privacy, services, and fraud. Financial literacy is important when an individual shifts from traditional banking to mobile banking; therefore, there is a new behavior change (Cohen and Nelson, 2011). With sufficient knowledge of financial literacy, users can obtain the full benefit of using financial services and make a proper financial management decision (Huhmann and McQuitty, 2009).

H4. Digital Financial Literacy has a positive effect on adopt technology-based microfinance services.

2.7 Perceived Benefits

Relative benefits are realized when a new service offers greater value to an organization than existing ones, such as improvements in economic benefits, organization image, convenience, and satisfaction to customers (Rogers, 1995; Taylor and Todd, 1995). In Kenya, the perceived relative advantage was a significant determinant of m-banking usage (Mburu, 2015). Al-Shamaileh and Sutcliffe (2013) found that perceived relative advantages significantly impacted the adoption decision on cloud computing. Wang'oo (2013) accomplished those relative advantages were a positive factor influencing the adoption of m-banking in rural Kenya.

H5. Perceived benefits have a positive effect on adopt technology-based microfinance services.

2.8 Intention to Actual Use

Following up a previous study from Tao (2009), the study found that the determinants of intention to use significantly predict actual use behavior. Customers' intention is explained as the base for actual behavior in adopting a new system and technology (Venkatesh et al., 2003). Regarding technology adoption, empirical studies have supported the findings that behavioral intention significantly affects the actual use behavior (Lim et al., 2011; Venkatesh et al., 2012; Yun et al., 2013; Zheng et al., 2012; Baptista and Oliveira, 2015).

H6. Perceived benefits have a positive effect on adopt technology-based microfinance services.

2.9 Actual use to firm financial capability and overall performance

The empirical study by Isobe et al. (2008) explains that the company that has implemented the technology system in their operational has the advantage in adapting to environmental changes. Furthermore, the technology adoption will improve the firm productivity. Thus, the better the technology implementation, the better the firm performance (Rao et al., 2015). In addition, several researchers argue that technology adoption decreases operational costs (Saloner and Shepard, 1995; Benitez-Amado et al., 2010) and increases the firm's efficiency and effectiveness (Milne, 2006).

H7a. Actual use contributes significantly and is positively related to firm financial capability

H7b. Actual use contributes significantly and is positively related to firm overall performance

2.10 Overall firm performance to financial capability and technology continuos adoption

Firm performance can be defined as utilizing its assets to generate profit (Marimuthu et al., 2009). Harash et al. (2014) explain that small business performance involves the degree to which the owner can manage its operational purpose and goals. In addition, Garman and Forgue (2011) argue that an increase in firm capability or performance can create awareness in firm profit and how such funds have to be used and managed efficiently.

Regarding the intention to continuous adoption of digital financial technology, we use the theory by Oliver (1980) concerning the cognitive model of the antecedents and consequences of satisfaction decisions. The study reveals that the satisfaction of certain systems influences post-exposure attitude. In this case, satisfaction measured by the adaptation of pre-exposure attitude sequencely affects the intention in usage behavior. Therefore, we hypothesize that firm performance and financial capability influence the technology's continuous adoption after using digital financial technology (Obal, 2017).

H8a. Overall firm performance contributes significantly and is positively related to firm financial capability

H8b. Overall firm performance contributes significantly and is positively related to firm technology's continuous adoption

H9. Financial capability contributes significantly and is positively related to firm technology's continuous adoption

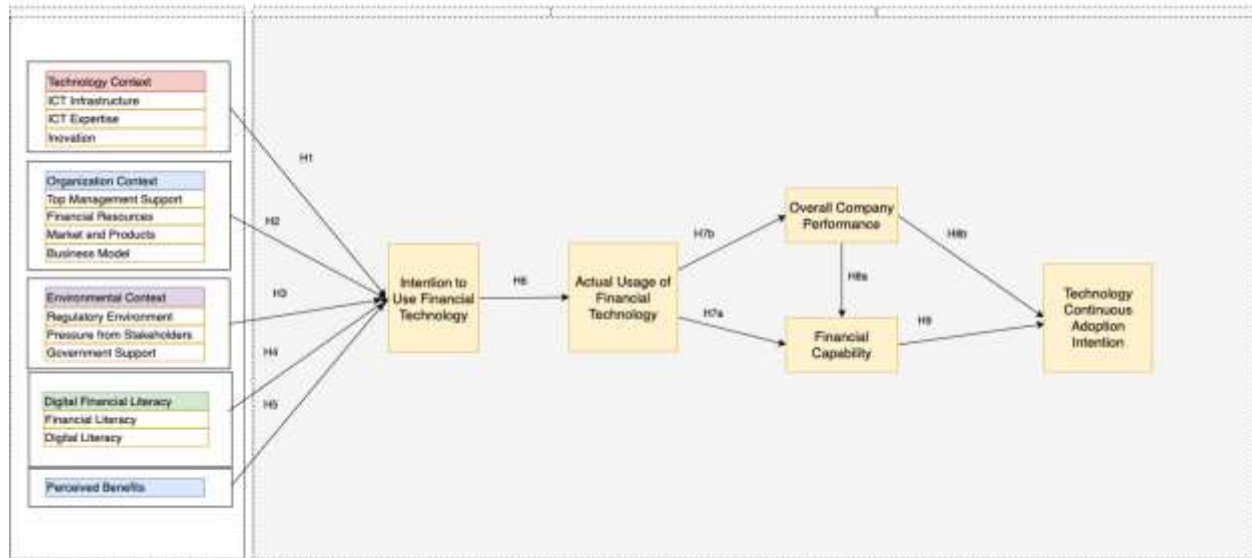


Figure 1 The proposed conceptual model

3. Methodology

The data used in this study were collected through an online survey conducted on OJK Survey platform from May to September 2021. We surveyed 1371 MFIs from 33 provinces (Aceh province excluded) in Indonesia consisted of 1247 MFIs non-supervised and 124 MFIs supervised by OJK. This survey objective is to investigate the intention to adopt digital microfinance from all respondents and observe the respondents' satisfaction of post-adoption digital microfinance.

The survey is guided by the technology-organization-environment (TOE) framework proposed by Tornatzky and Fleischer (1990) that identifies a technological innovation: technological context, organizational context, and environment context. To enrich this survey, we used extended TOE model such as perceived benefits (Gibbs and Kreamer, 2004; Huy et al., 2012), and digital financial literacy (Vissing-Jorgensen, 2003; Guiso and Jappelli, 2005). Moreover, we also followed the information systems continuance model, also known as the expectation confirmation model, proposed by Bhattacherjee (2001). Thus, we designed the questionnaire consist of five sections (TOE framework, perceived benefits, digital financial literacy) to estimate intention to use and two sections (Overall company performance and financial capability) to estimate MFIs' post-adoption satisfaction that will lead to continuous technology use. We constructed the questionnaire on a Likert scale from 1 (strongly disagree) to 6 (Strongly agree).

A pilot survey was conducted to distribute the questionnaire to 50 MFIs in Indonesia, with purpose to get feedback to improve the survey and minimize any misunderstandings and biases (Hair, Black, Babin, & Anderson, 2013). Next step, we distributed the survey to 2000 MFIs and collected 1371 completed response. Non-probability technique is used to determine the sample units for 33 provinces.

We examined the collected data using Structural Equation Modeling with Partial Least Square (SEM-PLS), which is able to process large dataset and is not required a normality of data assumption (Aguirre-Ureta and Rönkkö, 2015; Hamdollah and Baghaei, 2016). Table 1 shows descriptive statistics of data.

Table 1. Descriptive Statistics.

| Constructs | Item | Measuring items | Obs | Mean | Std. Dev |
|-----------------------------|------|---|------|------|----------|
| Technology Context (TC) | | | | | |
| ICT Infrastructure | ITI1 | MFI have sufficient IT Infrastructure to implement technology-based microfinance services | 1371 | 4.27 | 1.40 |
| | ITI2 | MFI have core system that able to support technology-based microfinance services adoption. | 1371 | 4.84 | 1.52 |
| | ITI3 | There is sufficient internet connectivity at MFIs location to support technology-based microfinance services adoption. | 1371 | 4.45 | 1.35 |
| | ITI4 | There is sufficient access to electricity at MFIs location to support technology-based microfinance services adoption. | 1371 | 4.66 | 1.27 |
| ICT Expertise | ITE1 | MFI are capable maintain technology-based microfinance services internally or with the help third party services. | 1371 | 4.02 | 1.37 |
| | ITE2 | MFI employees have sufficient have skills and competencies to operate and provide technology-based microfinance services. | 1371 | 4.09 | 1.33 |
| | ITE3 | MFI employees are experienced to provide technology-based microfinance services. | 1371 | 3.90 | 1.39 |
| Inovation | INO1 | We are capable to utilize the latest technology-based microfinance services. | 1371 | 3.43 | 1.46 |
| | INO2 | We become pioneer in adopting technology-based microfinance services for MFI industry. | 1371 | 3.28 | 1.50 |
| | INO3 | We become source of reference and source of information for our stakeholders related to technology-based microfinance services. | 1371 | 3.49 | 1.49 |
| Organizational Context (OC) | | | | | |
| Top Management Support | TOP1 | Top management/owner considers adoption technology-based microfinance services is important. | 1371 | 4.65 | 1.13 |
| | TOP2 | Top management/owner commit to allocate financial resources to adopt technology-based microfinance services. | 1371 | 4.36 | 1.20 |
| | TOP3 | Top management is committed to adopt technology-based microfinance services in our MFI. | 1371 | 4.40 | 1.18 |
| | RES1 | MFI have self-funding to adopt technology-based microfinance services. | 1371 | 3.91 | 1.41 |

| Constructs | Item | Measuring items | Obs | Mean | Std. Dev |
|-----------------------------------|-------------|---|------------|-------------|-----------------|
| Financial Resources | RES2 | MFI have access to financial support for adopting technology-based microfinance services from donors e.g., government, banks, international organization, and vendor. | 1371 | 3.83 | 1.45 |
| | RES3 | MFI have access to financial institutions such as financial and capital markets to adopt technology-based microfinance services | 1371 | 3.38 | 1.51 |
| Markets and Products | MARKETS1 | MFI are capable to identify which group of customers interest in utilizing technology-based microfinance services. | 1371 | 4.39 | 1.14 |
| | MARKETS2 | MFI aware any potential challenges to educate our customers using technology-based microfinance services. | 1371 | 4.62 | 1.05 |
| | MARKETS3 | MFI know how to educate and encourage our customers to use technology-based microfinance services. | 1371 | 4.26 | 1.18 |
| | MARKETS4 | MFI are capable to identify which products and services that can be transformed into technology-based microfinance services. | 1371 | 4.30 | 1.13 |
| | MARKETS5 | MFI aware that not all products and services fit for digitalization, so we combine traditional and digital technology into business model. | 1371 | 4.58 | 1.05 |
| Business Model | BSM1 | MFI choose technology-based microfinance services business model based on targeted customer financial needs. | 1371 | 4.31 | 1.17 |
| | BSM2 | MFI is capable to identify which technology-based microfinance services business model that suitable to their business characteristics. | 1371 | 4.16 | 1.24 |
| | BSM3 | MFI is capable to analyze advantages and disadvantages of technology-based microfinance services business models before deciding to adopt it. | 1371 | 4.02 | 1.25 |
| Environmental Context (EC) | | | | | |
| Regulatory Environment | REG1 | The existing regulations is sufficient to support technology-based microfinance services adoption. | 1371 | 4.06 | 1.26 |
| | REG2 | Technology-based microfinance services implementation will be running smoothly when the existing regulation is sufficient. | 1371 | 4.57 | 1.09 |
| | REG3 | Lack of regulatory framework in technology-based microfinance services expose risk MFIs and their customers. | 1371 | 4.57 | 1.10 |
| | STAKE1 | Most business partners (banks, lenders, vendors, suppliers, customers) use technology-based microfinance services in their activities. | 1371 | 4.57 | 1.26 |

| Constructs | Item | Measuring items | Obs | Mean | Std. Dev |
|----------------------------------|---------|--|------|------|----------|
| Pressure from Stakeholders | STAKE2 | Most business partners (banks, lenders, vendors, suppliers, customers) have recommended using technology-based microfinance services. | 1371 | 4.06 | 1.09 |
| | STAKE3 | Other MFI has adopted technology-based microfinance services thus pressuring our company to do the same. | 1371 | 4.57 | 1.10 |
| | STAKE4 | Our relationship with existing customers will be deteriorated if we do not adopt technology-based microfinance services. | 1371 | 4.57 | 1.42 |
| Government Support | STAKE5 | Our customers call us backward if we do not use technology-based microfinance services. | 1371 | 3.63 | 1.47 |
| | GOV1 | Government support is important to encourage people to use technology-based microfinance services. | 1371 | 4.74 | 1.07 |
| | GOV2 | Government commitment is needed to promote technology-based microfinance services for MFI. | 1371 | 4.83 | 0.98 |
| | GOV3 | Government programs (e.g government loan for SMEs) are required to adopt technology-based microfinance services to support technology adoption by MFI. | 1371 | 4.64 | 1.05 |
| Digital Financial Literacy (DFL) | | | | | |
| Financial literacy | LITFIN1 | MFI are actively seeking information regarding the development of financial technology, economy, national, and international finance | 1371 | 4.35 | 1.06 |
| | LITFIN2 | MFI are well informed about alternative financial sources using financial technology such as Peer to Peer (Lending/Payment), Securities Crowdfunding (SCF), Payment Gateway etc. | 1371 | 4.10 | 1.27 |
| | LITFIN3 | MFI conduct training, discussion or sharing knowledge to improve technology-based microfinance services to our employees. | 1371 | 4.05 | 1.27 |
| Digital literacy | LITDIG1 | MFI utilize basic data processing application, such as Microsoft Word, Microsoft Excel, Microsoft PowerPoint in daily operations. | 1371 | 4.77 | 1.39 |
| | LITDIG2 | MFI use online communication channels such as Whatsapp, email, instant messaging, and another Instant Messaging in daily operations. | 1371 | 4.90 | 1.28 |
| | LITDIG3 | MFI employees are capable to operate the core system. | 1371 | 3.96 | 1.62 |
| | LITDIG4 | MFIs aware that utilizing digital finance transactions might expose security risks, such as the spread of personal data (username, PIN, password) by an irresponsible party. | 1371 | 4.74 | 1.34 |
| | PRB1 | MFIs can improve competitiveness by using technology-based microfinance services. | 1371 | 4.62 | 1.09 |

| Constructs | Item | Measuring items | Obs | Mean | Std. Dev |
|-----------------------------------|-------|--|------|------|----------|
| Perceived Benefits (PB) | PRB2 | Adopting technology-based microfinance services can improve our service quality to existing customer. | 1371 | 4.56 | 1.12 |
| | PRB3 | Adopting technology-based microfinance services can improve customers satisfaction. | 1371 | 4.56 | 1.11 |
| | PRB4 | Adopting technology-based microfinance services can expand MFIs outreach to increase financial inclusion. | 1371 | 4.63 | 1.04 |
| | PRB5 | Adopting technology-based microfinance services improve operational efficiency (cost, time, process) | 1371 | 4.71 | 0.99 |
| Intention to use (IU) | INT1 | MFIs will adopt technology-based microfinance products and services in the future. | 1371 | 4.73 | 1.00 |
| | INT2 | MFIs will increase the frequency of utilizing technology-based microfinance products and services in the future. | 1371 | 4.71 | 0.99 |
| Actual use (AU) | ACT1 | How long have you been using technology-based microfinance products and services? (a) Not yet; (b) Less than 1 year; (c) 1-2 year; (d) 2-3 year; (e) 3-4 year; (f) More than 4 years | 1371 | 2.41 | 1.81 |
| | ACT2 | MFIs encourage their customers to use technology-based microfinance services when doing transaction with | 1371 | 4.30 | 1.21 |
| | ACT3 | MFIs connect digitally to sources of capital such as a bank, other MFIs, and venture capital. | 1371 | 4.29 | 1.15 |
| | ACT4 | MFIs utilize digital marketing channeling such as Fintech, E-Commerce, Facebook Ads, Google Ads, Instagram Ads, and Twitter Sponsored. | 1371 | 4.05 | 1.28 |
| Overall Company performance (OCP) | PERF1 | Time needed to process financial transactions has become shorter since technology-based microfinance services implementation. | 620 | 4.87 | 0.88 |
| | PERF2 | MFIs is capable to perform banking transactions (e.g opening accounts, checking balance, transfer, payments, account mutations) through technology-based microfinance services. | 620 | 4.65 | 1.05 |
| | PERF3 | Transaction costs have become more efficient since using digital technology-based microfinance products and services. | 620 | 4.66 | 0.97 |
| Financial capability (FC) | CAPA1 | MFI has good planning or budgeting for business continuity. | 620 | 4.82 | 0.85 |
| | CAPA2 | MFI can manage operating profit and save or reinvest a portion of operating profit. | 620 | 4.56 | 1.06 |
| | CAPA4 | MFI plan, analyze, compare, review before take investment decision to develop technology-based microfinance services. | 620 | 4.55 | 1.00 |

| Constructs | Item | Measuring items | Obs | Mean | Std. Dev |
|--|-------------|--|------------|-------------|---------------------|
| Technology Continuous Adoption Intention (TCA) | TCA1 | Considering current technology costs and benefits, MFI keeps using digital technology-based microfinance services. | 620 | 4.77 | 0.90 |
| | TCA2 | MFI will use digital technology-based microfinance services in the future. | 620 | 4.82 | 0.90 |
| | TCA3 | We actively seek any information on the development of digital technology-based microfinance service | 620 | 4.77 | 0.88 |
| | TCA4 | MFI is interested in using microfinance services based on the latest digital technology. | 620 | 4.85 | 0.89 |

Notes: All variables have a minimum value 1.00 and maximum value 6.0

4. Results

The theoretical research model of this study was analyzed using Structural Equation Modeling with Partial Least Square (SEM-PLS), which is able to process large dataset and is not required a normality of data assumption (Aguirre-Urreta and Rönkkö, 2015; Hamdollah and Baghaei, 2016). We conduct a two-step approach in analyzing the model (Anderson and Gerbing, 1988, Mehmetoglu, 2012). First, the reliability and validity of the measurement model were performed. Second, we examined the structural model and tested the hypothesis.

4.1 Measurement Model Evaluation

The measurement model allows us to examine whether the constructs are measured with satisfactory accuracy and the structural model assesses the explanatory power of the model. Composite reliability (CR), average variance extracted (AVE), item loading size significance, and discriminant validity are measurements that use the measurement model.

This study uses the factor loading, AVE, CR and Cronbach's alpha to assess convergent validity. The recommended factor loadings and AVE values to support convergent validity must be higher than 0.5 (Ryu, 2018), while the recommended CR and Cronbach's alpha values to support convergent validity are higher than 0.6 (Malholtra, 2007). Table 2 shows that the CR (> 0.70), Cronbach's Alpha ($\alpha > 0.60$), FL (> 0.50), and AVE (> 0.50) for each construct are higher than the recommended level, thus indicating that all constructs support convergent validity. Thus, we perform the Fornell–Larcker criterion, which compares the value of the square root of the AVE (along the diagonal) to the correlations of the latent variables (Hair et al. 2016; Miltgen et al. 2013). Table 3 shows the result of validity and reliability test for selected items.

Table 2. Validity and Reliability Test of Selected Items

| Constructs | Selected Items | Outer loading | Cronbach α | Composite reliability | AVE |
|-----------------------------|-----------------------|----------------------|-------------------------------------|------------------------------|------------|
| Technology context (TC) | ITI1 | 0.838 | 0.935 | 0.944 | 0.631 |
| | ITI2 | 0.818 | | | |
| | ITI3 | 0.757 | | | |
| | ITI4 | 0.728 | | | |
| | ITE1 | 0.867 | | | |
| | ITE3 | 0.879 | | | |
| | ITE4 | 0.870 | | | |
| | INO1 | 0.728 | | | |
| | INO2 | 0.703 | | | |
| | INO3 | 0.730 | | | |
| Organizational context (OC) | TOP1 | 0.776 | 0.937 | 0.845 | 0.554 |
| | TOP2 | 0.816 | | | |
| | TOP3 | 0.832 | | | |
| | RES1 | 0.606 | | | |
| | RES2 | 0.659 | | | |
| | RES3 | 0.527 | | | |
| | MARKETS1 | 0.753 | | | |
| | MARKETS2 | 0.737 | | | |
| | MARKETS3 | 0.820 | | | |
| | MARKETS4 | 0.833 | | | |
| | MARKETS5 | 0.601 | | | |
| | BSM1 | 0.815 | | | |
| | BSM2 | 0.773 | | | |
| | BSM3 | 0.790 | | | |
| Environmental context (EC) | REG2 | 0.773 | 0.862 | 0.891 | 0.510 |
| | STAKE1 | 0.683 | | | |
| | STAKE3 | 0.704 | | | |

| Constructs | Selected Items | Outer loading | Cronbach α | Composite reliability | AVE |
|--------------------------------------|---------------------------|--------------------------|---|----------------------------------|------------|
| | STAKE4 | 0.565 | | | |
| | STAKE5 | 0.592 | | | |
| | GOV1 | 0.791 | | | |
| | GOV2 | 0.799 | | | |
| | GOV3 | 0.767 | | | |
| Digital Financial Literacy (DFL) | LITFIN1 | 0.765 | | | |
| | LITFIN2 | 0.764 | 0.874 | 0.902 | 0.569 |
| | LITFIN3 | 0.785 | | | |
| | LITDIG1 | 0.795 | | | |
| | LITDIG2 | 0.767 | | | |
| | LITDIG3 | 0.723 | | | |
| | LITDIG4 | 0.674 | | | |
| Perceived Benefits (PB) | PRB1 | 0.902 | 0.946 | 0.958 | 0.822 |
| | PRB2 | 0.931 | | | |
| | PRB3 | 0.910 | | | |
| | PRB4 | 0.922 | | | |
| | PRB5 | 0.866 | | | |
| Intention to Use (IU) | INT1 | 0.966 | | | |
| | INT2 | 0.964 | 0.926 | 0.965 | 0.931 |
| Actual use (AU) | ACT2 | 0.913 | | | |
| | ACT3 | 0.904 | 0.799 | 0.873 | 0.646 |
| | ACT4 | 0.859 | | | |
| Overall company performance (OCP) | PERF1 | 0.857 | | | |
| | PERF2 | 0.832 | 0.820 | 0.893 | 0.735 |
| | PERF3 | 0.883 | | | |
| Financial capability (FC) | CAPA1 | 0.850 | | | |
| | CAPA2 | 0.865 | 0.825 | 0.896 | 0.741 |
| | CAPA3 | 0.867 | | | |

| Constructs | Selected Items | Outer loading | Cronbach α | Composite reliability | AVE |
|--|----------------|---------------|-------------------|-----------------------|-------|
| | TCA1 | 0.922 | | | |
| Technology Continuous Adoption Intention (TCA) | TCA2 | 0.910 | 0.924 | 0.946 | 0.815 |
| | TCA3 | 0.881 | | | |
| | TCA4 | 0.897 | | | |

We perform the Fornell–Larcker criterion to check discriminant validity by estimating the distinction of each construct from the others. Fornell-Larcker criterion compares the value of the square root of the AVE (along the diagonal) to the correlations of the latent variables (Hair et al. 2016; Miltgen et al. 2013). Table 4 present correlation matrix and the aquare root of AVE. we find that our constructs are different for each variable. All values on the diagonal are higher than the values below and to the left, except for EC-IU, EC-OC, EC-PB, and OC-TC. Nonetheless, with threshold 0.85 the difference is insignificant (Hamid et al. 2017).

Table 3. Correlation matrix and the square root of AVE: Fornell–Larcker criterion

| | AU | DFL | EC | FC | IU | OC | OCP | PB | TCA | TC |
|-----|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|--------------|
| AU | 0.804 | | | | | | | | | |
| DFL | 0.694 | 0.754 | | | | | | | | |
| EC | 0.674 | 0.732 | 0.714 | | | | | | | |
| FC | 0.356 | 0.435 | 0.419 | 0.861 | | | | | | |
| IU | 0.631 | 0.653 | 0.717 | 0.409 | 0.965 | | | | | |
| OC | 0.755 | 0.767 | 0.791 | 0.435 | 0.663 | 0.745 | | | | |
| OCP | 0.349 | 0.373 | 0.386 | 0.700 | 0.395 | 0.381 | 0.857 | | | |
| PB | 0.679 | 0.693 | 0.780 | 0.366 | 0.724 | 0.741 | 0.367 | 0.906 | | |
| TCA | 0.386 | 0.411 | 0.451 | 0.767 | 0.456 | 0.431 | 0.772 | 0.427 | 0.903 | |
| TC | 0.693 | 0.728 | 0.622 | 0.385 | 0.512 | 0.788 | 0.344 | 0.599 | 0.354 | 0.794 |

4.2 Structural Model and Hypothesis Testing

This study follows Hair et al. (2014) to examine the structural model (path relationship), R^2 value, t-values by employing bootstrapping procedure with 5.000 resampling, beta coefficient, the effect size (f^2), and the predictive relevance (Q^2). The path coefficients results and R^2 are shown in Table 5 and Table 6 respectively.

We examine the hypothesis using path analysis, the significant determine by t-stat ($t=1.96$). All hypotheses are significant and show positive relationships except for technological context. To

evaluate whether all dependent variables are good predictor, we observe further the change in the R^2 value to obtain the effect size (f^2) which can be seen in table 5. Usually, the specific exogenous construct of a model is omitted to evaluate the changes in R^2 . However, R^2 value will significantly change when the omitted construct has an essential impact on the endogenous construct. Cohen (1988) classify the effect size as small, medium, large with threshold 0.02, 0.15, and 0.35 respectively. From table 5, although all relationships are significant for 1% and 5%, not all of them are good predictor since the effect size are vary.

Our result shows that large effect size find in relationship between MFIs actual use and overall company performance (0.139), perceived benefit and intention to use (0.104), overall company performance and financial capability (0.676), intention to use and actual use (0.662) and overall company performance and technology continuous adoption intention (0.359). Meanwhile medium effect size is seen in relationships between environment context and intention to use (0.05), financial capability and technology continuous adoption (0.333) and intention digital financial literacy and intention to use (0.031). The rest are relationship between technological context and intention to use (0.009), organizational context and intention to use (0.008), and actual Use and financial capability (0.004) classify as small effect size and cannot be considered as good predictor.

Table 6 presents the result from blindfolding procedure to obtain the predictive relevance of the model. All dependent variables (actual use, financial capability, intention to use, firm performance, and sustainable use of financial technology) have Q^2 values more than 0, indicating that our model has good predictive relevance (Hair et al., 2014).

Table 4. The Direct Relationships of the Structural Model

| Hypothesized path | β | T-stat | p value | f^2 |
|---|-----------|--------|-----------|-------|
| H1. Technological Context \rightarrow Intention to Use | -0.096*** | 2.709 | 0.007 | 0.009 |
| H2. Organizational Context \rightarrow Intention to Use | 0.140** | 2.221 | 0.026 | 0.008 |
| H3. Environment Context \rightarrow Intention to Use | 0.273*** | 5.593 | 0.000 | 0.050 |
| H4. Digital Financial Literacy \rightarrow Intention to Use | 0.193*** | 4.813 | 0.000 | 0.031 |
| H5. Perceived Benefit \rightarrow Intention to Use | 0.349*** | 7.178 | 0.000 | 0.104 |
| H6. Intention to Use \rightarrow Actual Use | 0.631*** | 31.302 | 0.000 | 0.662 |
| H7a. Actual Use \rightarrow Financial Capability | 0.057** | 2.098 | 0.036 | 0.004 |
| H7b. Actual Use \rightarrow Overall Company Performance | 0.349*** | 16.561 | 0.000 | 0.139 |

| | | | | |
|---|----------|--------|-------|-------|
| H8a. Overall Company Performance → Financial Capability | 0.631*** | 18.961 | 0.000 | 0.676 |
| H8b. Overall Company Performance → Technology Continuous Adoption Intention | 0.461*** | 10.019 | 0.000 | 0.359 |
| H9 Financial Capability → Technology Continuous Adoption Intention | 0.445*** | 9.545 | 0.000 | 0.333 |

Table 5. R² and Q² values

| Dependent Variables | R ² | R ² Adjusted | Q ² |
|-----------------------|----------------|-------------------------|----------------|
| Actual Use | 0.398 | 0.398 | 0.255 |
| Financial Capability | 0.513 | 0.511 | 0.373 |
| Intention to Use | 0.602 | 0.600 | 0.563 |
| Performance | 0.122 | 0.121 | 0.088 |
| Technology Continuous | 0.697 | 0.697 | 0.563 |

5. Discussion

This paper research has empirically validated the proposed research model. All the construct has been tested for convergent validity and reliability. Further all hypotheses regarding the relationship between constructs are developed and tested by SEM-PLS. We found that all hypotheses are significant. Perceived benefit and environment context are the strongest determinants for MFIs intention to use, while overall company performance is the strongest determinants for technology continuous adoption intention.

5.1 Intention To Use

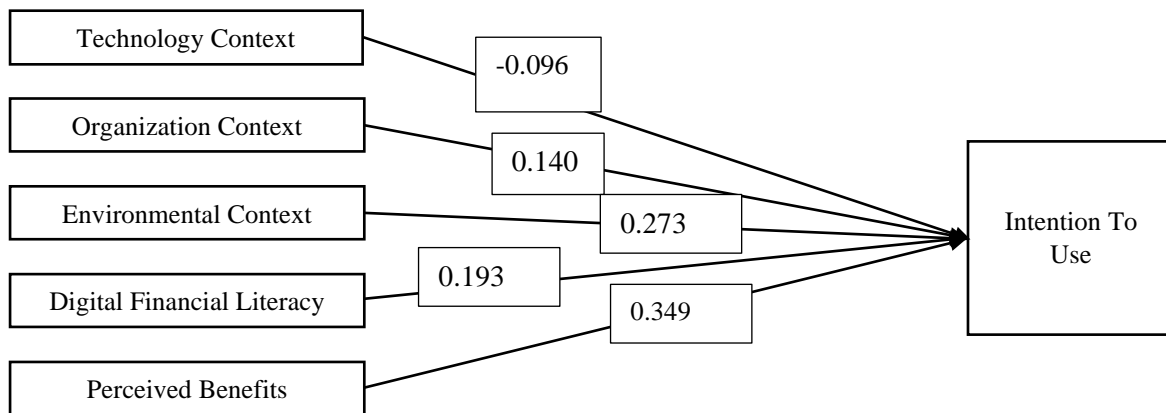


Figure 2 Intention to Use Path Analysis

From the research findings, in term of technological context, unexpectedly, the findings indicate is found to be significantly negative influence intention MFIs to adopt technology-based microfinance services. However, the technological context was small predictor ($f^2=0.007$) on the intention MFIs to adopt technology-based microfinance services. Several reasons might occur, such as lack of ICT expertise and ICT Infrastructure. This study in line with Yousif et al. (2013) concluded that MFIs often lack the skill sets or understanding needed to successfully upgrade their ICT/MIS to integrate MFS. Moreover, MFIs in developing economies, face significant challenges in processing and communicating with the traditional and manual operation methods, yet reluctant to incorporate ICT resources to improve operation efficiency (Etapé-Dubreuil, 2015). MFI owners should spend on ICT resources for their business operation (Diniz et al., 2014). Mwela (2014) found that MFIs confront many difficulties in playing out its obligation with respect of ICT use which are not sufficient facilities, bad perception of partners, low utilization of ICT in MFIs, high operation expenses to offer financial services to needy individuals and SME's.

Our H2 investigated the impact of organizational context (TC) on intention to use (IU) was supported. Organizational context in this research that consists top management support, financial resources, markets and products and business model. Our finding supported by Ammar & Ahmed (2016), revealed that top management support, organization financial resources, market and products and business model were found to have influence on m-banking implementation m-banking by microfinance providers institutions (MFPs) in Kenya. This finding also in supported with (Zhu and Kraemer, 2005; Kuan and Chau's, 2001) studies support organization financial resources as an influencing factor in the adoption of E-channels.

The H3 which is relationship between environmental context (EC) and intention to use (IU) was supported. Environmental context in this research that consists regulatory environment, pressure from stakeholders and government support. Within in the TOE framework, environmental context appears to be the strongest factor. The hypothesis findings provide evidence that the pressure from consumers, competitors, or partners, drive them to move toward digital financial technology adoption (Wu et al., 2003; Sila, 2013; Ghobakhloo, 2011; Kurnia, 2015). Additionally, subsidies or grant form government, and various choices of digital financial technology providers with ease and low-cost also encourage them to adopt. In line with the result, Chong et al. (2010) found that government support significant determinants to predict the intention to use internet

banking. Enabling Regulatory Environment factor was supported by Yousif et al. (2013), Khattab et al. (2012); Ismail and Osman (2012), Ayana (2014) and Zhu and Kraemer's (2005) studies.

The result for H4 was also supported, digital financial literacy (DFL) is found to be positive and significantly influence intention to use digital financial technology. Information literacy is an important factor in new IT adoption and increased IT usage (Yu et al., 2017), study by Wawire et al., (2017). Our finding in line with Jang et al., (2021) that assume information literacy has a direct effect on the intention to use digital technologies for learning in Korea and Finland, furthermore perceived financial literacy is considered to have direct impact on intention to use mobile financial services (Huhmann & McQuitty, 2009; Ramos, 2017).

Consistent with previous research (Iacovou et al, 1995; Looi, 2005; Kurnia, 2015) our finding on the relationship between perceived benefit (PB) and intention to use (IU) was positive and significant. Organizations are likely to perceive the benefits of digital financial technology if it is potential to improve their business process, able to manage the risks and compatible with their current business needs, process, and culture.

5.2 Actual Use

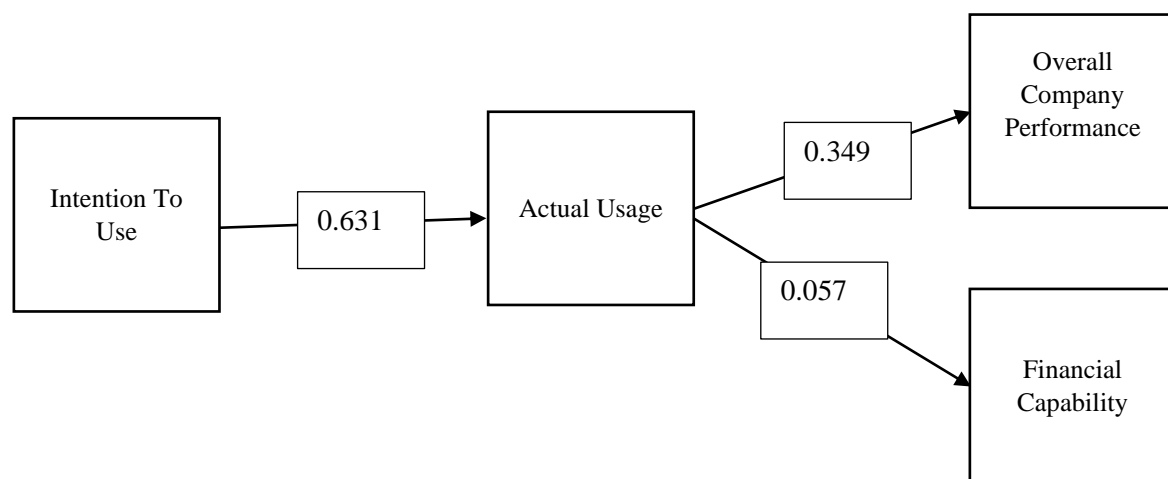


Figure 3. Actual Usage Path Analysis

Intention to use (IU) was found to be positive and significant influence the actual use (AU) of digital financial technology (H6). Adopt technology-based microfinance services adopt technology-based microfinance services The result indicates that the intention to utilize financial technology on daily operation significantly influences the actual use of digital tools in MFIs. This

is in line with innumerable studies based on TAM (Venkatesh et al. 2003). Further, our result also supports the relationship between actual use and financial capability (H7a) and actual use to overall company performance (H7b). It indicates that the frequency of usage behavior in using digital financial technology will impact the MFIs financial capability and firm performance. Consistent with Yeo & Fisher (2017), digital financial services able to increase the possibility of saving and the amount of cash saved it is convenient to use the mobile financial application. In addition, the features offered by digital financial services such as peer to peer lending can help its users in crisis times through easy access to liquidity (Johnson, 2016). Therefore, it will lead to better company performance.

5.3 Technology Continuous Adoption Intention

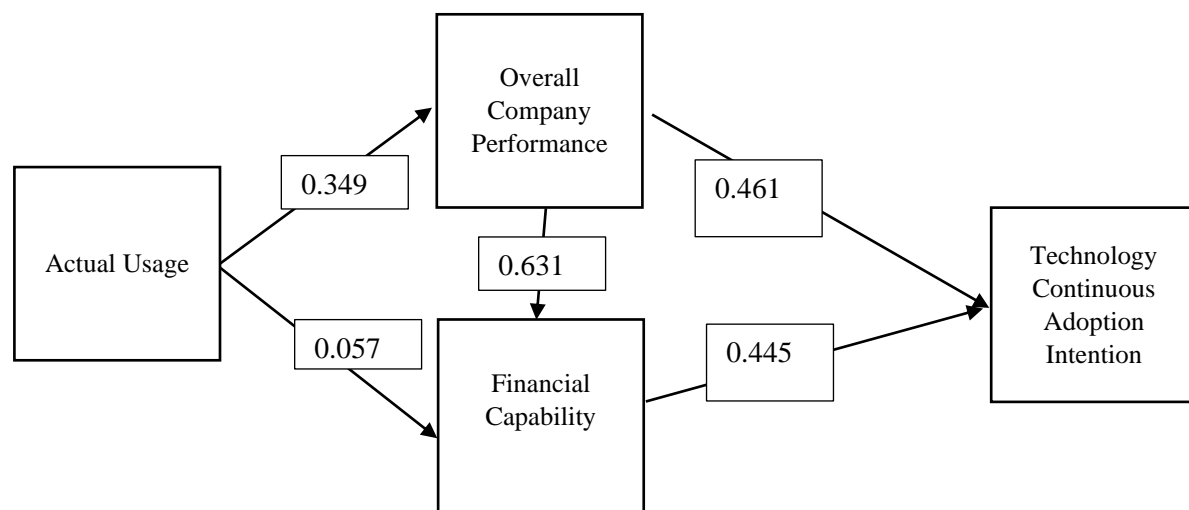


Figure 4. Technology Continuous Adoption Intention Path Analysis

From company performance context, financial capability (FC) and technology continuous adoption intention (TCA) is positively influenced by overall company performance (CP), supporting H8a and H8b. Digital financial technology may help its users to managing income, make better risk management and cope with unforeseen emergencies such as business failure, there it is believed that the usage of digital financial technology can maintain or even resulting better company performance. Then H9, which is relationship between financial capability (FC) and technology continuous adoption intention (TCA) was also supported. This finding in line with

(Bhattacharjee, 2001) that assumes satisfaction with the usage of digital financial technology is proven to be main driver of technology continuance intention to adopt, where the satisfaction can be measured by increase in financial capability.

6. Conclusion and implication

We survey 1371 MFIs to estimate empirical model by identifies determinants affecting MFIs behavior intention to adopt technology-based microfinance services. Going deeper, we examine post adoption behavior of MFI regarding the intention to continue using technology adoption. Our findings show the followings: (1) perceived benefit that represent MFIs expectation benefit from technology adoption is strongest predictor for intention to use followed by environmental context, (2) government support on environmental context are the dominant factor loadings. (3) technological context is empirically significant with negative effect to intention to use because technological readiness of MFIs relatively poor, (4) better overall firm performance and financial capability as MFIs satisfaction indicator are drivers for firm's intention to continue using digital financial technology.

As a result, it is essential for government to support the development of digital ecosystem for MFIs. Moreover, government support is also needed for technical assistance and IT Infrastructure support to encourage MFIs adopt technology-based microfinance services. Government support on digital ecosystem development will lead to shifting most transaction of microfinance in digital platform. Consequently, it will lead to higher satisfaction for MFIs (expectation benefit of MFI is realized) then eventually increase MFI intention to continue adopt the technology.

References

- Ab Hamid, M. R., Sami, W., & Sidek, M. M. (2017, September). Discriminant validity assessment: Use of Fornell & Larcker criterion versus HTMT criterion. In *Journal of Physics: Conference Series* (Vol. 890, No. 1, p. 012163). IOP Publishing.
- Al-Shamaileh, O., & Sutcliffe, A. G. (2013). Website interactivity and repeated exposure, what influences user experience?. *J. Univers. Comput. Sci.*, 19(8), 1123-1139.
- Ammar, A., & Ahmed, E. M. (2016). Factors influencing Sudanese microfinance intention to adopt mobile banking. *Cogent Business & Management*, 3(1). doi:10.1080/23311975.2016.1154257.
- Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological bulletin*, 103(3), 411.
- Ayana, G. B. (2014). Factors affecting adoption of electronic banking system in Ethiopian banking industry. *Journal of Management Information System and E-commerce*, 1
- Bank Indonesia. (2003). *Bank Perkreditan Rakyat*. Jakarta: Direktorat Pengawasan BPR Bank Indonesia, (n.d.).
- Baptista, G., & Oliveira, T. (2015). Understanding mobile banking: The unified theory of acceptance and use of technology combined with cultural moderators. *Computers in Human Behavior*, 50, 418-430.
- Benitez-Amado, J., Llorens-Montes, F. J., & Perez-Arostegui, M. N. (2010). Information technology-enabled intrapreneurship culture and firm performance. *Industrial Management & Data Systems*.
- Bhattacharjee, A. (2001). Understanding information systems continuance: An expectation-confirmation model. *MIS quarterly*, 351-370.
- Björkdahl, J. (2009). Technology cross-fertilization and the business model: The case of
- Bouwman, H., de Vos, H., & Haaker, T. (Eds.). (2008). *Mobile service innovation and business models*. Springer Science & Business Media.
- Bouwman, H., Haaker, T., & de Vos, H. (2008). Mobile applications for police officers. *BLED 2008 Proceedings*, 39.
- Bruno, F., Bruno, S., De Sensi, G., Luchi, M. L., Mancuso, S., & Muzzupappa, M. (2010). From 3D reconstruction to virtual reality: A complete methodology for digital archaeological exhibition. *Journal of Cultural Heritage*, 11(1), 42-49.
- Chau, P. Y., & Tam, K. Y. (1997). Factors affecting the adoption of open systems: an exploratory study. *MIS quarterly*, 1-24.
- Chau, P. Y., & Tam, K. Y. (1997). Factors affecting the adoption of open systems: an exploratory study. *MIS quarterly*, 1-24.
- Choi, Y., Crowgey, R.L, Price, J.M & VanPelt J.S (2006). State-of-the-art of mobile payment architecture,

- Intern. Journ. of Electr. Finance, 1, pp.94-103 Diniz, E, Pozzebon, M, Jayo, M (2008). The Role of ICT in improving Microcredit. (HEC,Montreal,Canada).
- Chong, A. Y., Ooi, K., Lin, B., & Tan, B. (2010). Online banking adoption: An empirical analysis. *International Journal of Bank Marketing*, 28, 267–287.
- Claessens, S., & Rojas-Suarez, L. (2016). Financial Regulations for Improving Financial Inclusion. Center for Global Development.
- Cohen, J. (1988). Set correlation and contingency tables. *Applied psychological measurement*, 12(4), 425-434.
- Cohen, M., & Nelson, C. (2011). Financial literacy: A step for clients towards financial inclusion. *Global Microcredit Summit*, 14-17.
- Diniz, E., Porto de Albuquerque, J., & Cernev, A. (2011). Mobile Money and Payment: a literature review based on academic and practitioner-oriented publications (2001-2011).
dissertation, University of Nairobi)
- Dorfleitner, G., Nguyen, Q. A., & Röhe, M. (2018). Microfinance institutions and the provision of mobile financial services: First empirical evidence. *Finance Research Letters*. doi: 10.1016/j.frl.2018.12.002
- Dorfleitner, G., Röhe, M., & Renier, N. (2017). The access of microfinance institutions to debt capital: An empirical investigation of microfinance investment vehicles. *The Quarterly Review of Economics and Finance*, 65, 1–15. doi:10.1016/j.qref.2016.06.005.
- Earne, J., & Sherk, J. (2013). Funding. In J. Ledgerwood, J. Earne, & C. Nelson (Eds.), *The new microfinance handbook: A financial market system perspective* (pp. 379–412). Washington, DC: The World Bank.
- Etapé-Dubreuil, G. (2015). *Management information systems for microfinance: Catalyzing social innovation for competitive advantage*. Newcastle upon Tyne, UK: Cambridge Scholars Publishing
- European Microfinance Network, (2012). *The use of technology in microfinance*.
- Garman, E. T., & Forgue, R. (2011). *Personal finance*. Cengage Learning.
- Ghobakhloo, M., Benitez-Amado, J., & Arias-Aranda, D. (2011). Reasons for information technology adoption and sophistication within manufacturing SMEs. In *POMS 22nd Annual Conference: Operations management: The enabling link*. Reno, USA, April (Vol. 29).
- Ghosh, S., & Van Tassel, E. (2011). Microfinance and competition for external funding. *Economics Letters*, 112, 168–170.
- Gibbs, J. L., & Kraemer, K. L. (2004). A cross-country investigation of the determinants of scope
- Guiso, L., & Jappelli, T. (2005). Awareness and stock market participation. *Review of Finance*, 9(4), 537–

- Hair Jr, J. F., Sarstedt, M., Hopkins, L., & Kuppelwieser, V. G. (2014). Partial least squares structural equation modeling (PLS-SEM): An emerging tool in business research. *European business review*.
- Hair, J.F., Black, W.C., Babin, B.J.& Anderson, R.E. (2010). *Multivariate data analysis*. Pearson, NJ: Pearson Education Inc
- Hair, J., Hollingsworth, C. L., Randolph, A. B., & Chong, A. Y. L. (2017). An updated and expanded assessment of PLS-SEM in information systems research. *Industrial Management & Data Systems*.
- Hamdollah, R., & Baghaei, P. (2016). Partial least squares structural equation modeling with R. In *Practical Assessment, Research and Evaluation* (Vol. 21, Issue 1). <https://doi.org/10.1108/eb-10-2013-0128>
- Harash, E., Al-Timimi, S., & Alsaadi, J. (2014). The influence of finance on performance of small and medium enterprises (SMES). *technology*, 4(3), 161-167.
- Huhmann, B. A., & McQuitty, S. (2009). A model of consumer financial numeracy. *International Journal of Bank Marketing*.
- Huy, L.V., Rowe, F., Truex, D., & Hunyh, M.Q. (2012). An empirical study of determinants of e-commerce adoption in SMEs in Vietnam an economy in transition. *Journal of Global Information Management*, 20(3), 1-35.
- Iacovou, C. L., Benbasat, I., & Dexter, A. S. (1995). Electronic data interchange and small organizations: Adoption and impact of technology. *MIS quarterly*, 465-485.
- Ibrahim, M. (2003). *Kerangka Hukum dalam Memperkuat dan Mengembangkan Lembaga Keuangan Mikro di Indonesia*. In *Kemiskinan dan Keuangan Mikro*. Jakarta: Gema PKM. 2003
- integrating ICTs in mechanical engineering products. *Research Policy*, 38(9), 1468-1477.
- Ismail, M. A., & Osman, M. A. Y. (2012). Factors influencing the adoption of e-banking in Sudan: Perceptions of retail banking clients. *Journal of Internet Banking and Commerce*, 17(3), 1–16. Retrieved from [http:// www.arraydev.com/commerce/JIBC/2012- 12/ mohamedismailv02.pdf](http://www.arraydev.com/commerce/JIBC/2012-12/mohamedismailv02.pdf)
- Isobe, T., Makino, S., & Montgomery, D. B. (2008). Technological capabilities and firm performance: The case of small manufacturing firms in Japan. *Asia Pacific Journal of Management*, 25(3), 413.
- Kauffman, R. J., & Riggins, F. J. (2012). Information and communication technology and the sustainability of microfinance. *Electronic Commerce Research and Applications*, 11(5), 450–468. doi:10.1016/j.elerap.2012.03.001.
- Khattab, I., Balola, Y., & Eldabi T. (2012, June 7–8). Factors influencing branchless banking for microfinance in Sudan: Theoretical perspectives and future directions. In *European, Mediterranean & Middle Eastern Conference on Information Systems 2012 (EMCIS2012)*. Munich.

- Kimando, L. N., Njogu, G. W. M., & Kihoro, J. M. D. (2012). Factors affecting the success of youth enterprise development funded projects in Kenya; A survey of Kigumo District Muranga County.
- Kurnia, S., Choudrie, J., Mahbubur, R. M., & Alzougool, B. (2015). E-commerce technology adoption: A Malaysian grocery SME retail sector study. *Journal of Business Research*, 68(9), 1906-1918
- Ledgerwood, J. (1999). *Sustainable banking with the poor microfinance handbook*.
Lexington Books.
- Lian, J. W., Yen, D. C., & Wang, Y. T. (2014). An exploratory study to understand the critical factors affecting the decision to adopt cloud computing in Taiwan hospital. *International Journal of Information Management*, 34(1), 28-36.
- Lian, J. W., Yen, D. C., & Wang, Y. T. (2014). An exploratory study to understand the critical factors affecting the decision to adopt cloud computing in Taiwan hospital. *International Journal of Information Management*, 34(1), 28-36.
- Looi, H. C. (2005). E-commerce adoption in Brunei Darussalam: A quantitative analysis of factors influencing its adoption. *Communications of the association for information Systems*, 15(1), 3.
- Malhotra, Naresh, 2007. *Marketing Research: an applied orientation*, pearson education, inc., fifth edition.
New Jearsey : USA
- Mangula, I. S., van de Weerd, I., & Brinkkemper, S. (2014, June). The Adoption of Software-asService: an Indonesian Case Study. In *PACIS* (p. 385).
- Marimuthu, M., Arokiasamy, L., & Ismail, M. (2009). Human capital development and its impact on firm performance: Evidence from developmental economics. *Journal of international social research*, 2(8)
- Mburu, T. G. (2015). *Adoption of mobile banking services by Nairobi county Saccos* (Doctoral
- Mehmetoglu, M. (2012). Personality effects on experiential consumption. *Personality and individual differences*, 52(1), 94-99.
- Milne, A. (2006). What is in it for us? Network effects and bank payment innovation. *Journal of Banking & Finance*, 30(6), 1613-1630.
- Miltgen, C. L., Popovič, A., & Oliveira, T. (2013). Determinants of end-user acceptance of biometrics: Integrating the “Big 3” of technology acceptance with privacy context. *Decision support systems*, 56, 103-114.
- Mushtaq, R., & Bruneau, C. (2019). Microfinance, financial inclusion and ICT: Implications for poverty and inequality. *Technology in Society*, 101154. doi:10.1016/j.techsoc.2019.101.
- Mwafise, A. M., & Stapleton, L. (2012). Determinants of User Adoption of Mobile Electronic Payment Systems for Microfinance Institutions in Developing Countries: Case Study Cameroon. *IFAC*

- Proceedings Volumes, 45(10), 38–43. doi:10.3182/20120611-3-ie-4029.00010.
- Mwela, T. R. (2014). Information And Communication Technology Usage In Development Of Microfinance Institutions Services In Peri-Urban Areas Tanzania: A Case Of Ilala Municipality In Dar-Es-Salaam City (Doctoral Dissertation, The Open University Of Tanzania)
- Ngumbao, J. K. O. (2012). Factors Influencing Youth Enrolment Levels in Public Youth Polytechnics in Mombasa County, Kenya (Doctoral dissertation, University of Nairobi, Kenya).
- Njenga, K., & Ndlovu, S. (2012). On privacy calculus and underlying consumer concerns influencing mobile banking subscriptions. In 2012 Information Security for South Africa (pp. 1-9). IEEE.
- Obal, M. (2017). What drives post-adoption usage? Investigating the negative and positive antecedents of disruptive technology continuous adoption intentions. *Industrial Marketing Management*, 63, 42-52.
- of e-commerce use: an institutional approach. *Electronic markets*, 14(2), 124-137
- Oliver, R. L. (1980). A cognitive model of the antecedents and consequences of satisfaction decisions. *Journal of marketing research*, 17(4), 460-469.
- Rao, Y., Guo, K. H., & Chen, Y. (2015). Information systems maturity, knowledge sharing, and firm performance. *International Journal of Accounting & Information Management*.
- Rogers, E. (1995). *Diffusion of Innovations*. (4th ed). New York: Free Press.
- Ryu, H. S. (2018). What makes users willing or hesitant to use Fintech?: the moderating effect of user type. *Industrial Management and Data Systems*, 118(3), 541–569. <https://doi.org/10.1108/IMDS-07-2017-0325>
- Saloner, G., & Shepard, A. (1995). Adoption of Technologies with Network Effects: An Empirical Examination of the Adoption of Automated Teller Machines. *The RAND Journal of Economics*, 26(3), 479–501. <https://doi.org/10.2307/2555999>
- Shrader, L (2013). Latest on Branchless Banking from Indonesia, CGAP. Retrieved from <https://www.cgap.org/blog/latest-branchless-banking-indonesia>.
- Sila, I. (2013). Factors affecting the adoption of B2B e-commerce technologies. *Electronic commerce research*, 13(2), 199-236.
- Stiglitz, J., & Weiss, A. (1981). Credit Rationing in Markets with Imperfect Information. *The American Economic Review*, 71(3), 393-410. Retrieved July 28, 2021, from <http://www.jstor.org/stable/1802787>.
- Tadele, H., Roberts, H., & Whiting, R. H. (2018). Microfinance institutions' website accessibility. *Pacific-Basin Finance Journal*, 50, 279–293. doi:10.1016/j.pacfin.2016.10.003.
- Tao, D. (2009). Intention to use and actual use of electronic information resources: further exploring Technology Acceptance Model (TAM). In *AMIA Annual Symposium Proceedings* (Vol. 2009, p.

- 629). American Medical Informatics Association.
- Taylor, S., & Todd, P. (1995). Decomposition and crossover effects in the theory of planned behavior: A study of consumer adoption intentions. *International journal of research in marketing*, 12(2), 137-155.
- Teece, D. J. (2010). Business models, business strategy and innovation. *Long range planning*, 43(2-3), 172-194.
- Timmers, P. (1998). Business models for electronic markets. *Electronic markets*, 8(2), 3-8.
- Tornatzky, L., & Fleischer, M. (1990). *The process of technology innovation*. Lexington, MA:
- Van Deursen, A. J., & Van Dijk, J. A. (2014). *Digital skills: Unlocking the information society*. Springer.
- Venkatesh, V., Thong, J. Y., & Xu, X. (2012). Consumer acceptance and use of information technology: extending the unified theory of acceptance and use of technology. *MIS quarterly*, 157-178.
- Vissing-Jorgensen, A. (2003). Perspectives on behavioral finance: Does "irrationality" disappear with wealth? Evidence from expectations and actions. *NBER macroeconomics annual*, 18, 139-194
- Wang, B., Yu, Y., Yang, Z., & Zhang, X. (2021). Microfinance institutions and Peer-to-Peer lending: What does microfinance competition bring? *Pacific-Basin Finance Journal*, 67, 101557. doi:10.1016/j.pacfin.2021.10155.
- Wang'oo, E. W. (2013). *The relationship between financial inclusion and economic development in Kenya* (Doctoral dissertation, University of Nairobi).
- Wu, G., & Chang, E. Y. (2003). Class-boundary alignment for imbalanced dataset learning. In *ICML 2003 workshop on learning from imbalanced data sets II*, Washington, DC (pp. 49-56).
- Yeo, J. H., & Fisher, P. J. (2017). Mobile financial technology and consumers' financial capability in the United States. *Journal of Education & Social Policy*, 7(1), 80-93.

- Yousif, F., Elizabeth, B., Jacinta, M., & Olga, M. (2013). Best practice in mobile microfinance. Grameen Foundation and Institute for Money, Technology & Financial Inclusion
- Yu, T. K., Lin, M. L., & Liao, Y. K. (2017). Understanding factors influencing information communication technology adoption behavior: The moderators of information literacy and digital skills. *Computers in Human Behavior*, 71, 196-208.
- Yum, H., Lee, B., Chae, M., 2012. From the wisdom of crowds to my own judgment in microfinance through online peer-to-peer lending platforms. *Electron. Commer. Res. Appl.* 11 (5), 469–483.
- Yun, H., C.C. Lee, B.G. Kim, and W.J. Kettinger, (2013). “What Determines Actual Use of Mobile Web Browsing Services? A Contextual Study in Korea,” *Communications of the Association for Information Systems*. Vol. 28, No. 21: 313-328, 2011.
- Zheng, X., Levine, D., Shen, J., Gogarten, S. M., Laurie, C., & Weir, B. S. (2012). A high-performance computing toolset for relatedness and principal component analysis of SNP data. *Bioinformatics*, 28(24), 3326-3328.
- Zhu, K., Kraemer, K. L., & Dedrick, J. (2004). Information technology payoff in e-business environments: An international perspective on value creation of e-business in the financial services industry. *Journal of management information systems*, 21(1), 17-54.