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## **Dissertations in Forestry and Natural Sciences**

**WILLIAM CLIFFORD GOMERA**

# **The use of mobile technology to enhance the interaction between microfinance institutions and micro businesses in the Tanzanian context**



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William Clifford Gomera

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## **Abstract**

Micro businesses (MBs) are operations run by their owners in various fields of activity, and are located in areas with high footfall, such as bus stands, markets, and around road junctions. The owners of MBs are characterised by low levels of education, a lack of finance, full-time business activities, and a lack of collateral for loans. However, the first two of these are the most pressing challenges, and require the attention of microfinance institutions (MFIs) to provide microfinance services, including training, which is an important service. This can help in capacity building for MBs, and allows MFIs to reduce loan defaults, thus strengthening the interaction.

Although training can enhance the business performance of MBs in Tanzania, it may lack continuity due to the geographical distances and times involved. There is also limited research to explain how training can be delivered effectively and efficiently without affecting the working schedules of MBs. Against this background, this study focuses on the development of a pilot prototype for a mobile training application that can contextualise MBs needs in terms of addressing the relevant geographical and time constraints.

This project employs a design science research (DSR) approach, reinforced by design thinking, frugal innovation, and usability evaluations, to design and develop a pilot prototype of a *micro business-microfinance (MBMF) mobile training application*. To accomplish this, several studies are conducted that correspond to the various activities of the DSR framework: problem explication, definition of requirements, design and development, demonstration, and evaluation. A qualitative study was conducted at the problem explication to explore the nature of the interaction between MFIs and MBs, and to identify the services offered in this interaction, the challenges encountered during the interaction and the proposed solution to the practical problem. Quantitative and qualitative studies were conducted at the definition of requirements to describe the general requirements for mobile microcredit services and specific requirements for the provision of mobile training to MBs. In addition, the functional and non-functional requirements of the potential end users were identified.

The qualitative study carried out at the design and development focused on interpreting the defined requirements to create a workable pilot prototype of an MBMF mobile training application. The study also implemented the developed prototype to determine its feasibility in terms of training. At the evaluation, we established the perceptions of potential users of the features and utility of the pilot prototype.

This study contributes to existing research by using design thinking, frugal innovation, and usability evaluation to reinforce the stages of the DSR framework to produce a 'good enough' solution to a practical challenge. Furthermore, this work sets out design principles for mobile training in the context of MFIs and MBs in Tanzania.

***Universal Decimal Classification:*** 004.382.745, 334.722.1, 658.114.1

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koulutus; käyttäjäkeskeinen suunnittelu; käytettävyys; innovaatiot;  
prototyypit; Tansania



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Joensuu, December 18, 2020

William Clifford Gomera

# List of abbreviations

CBE	College of Business Education
DSR	Design science research
FGD	Focus group discussion
ICT	Information and communication technology
ICT4D	Information and communication technology for development
MBMF	Micro business-microfinance
MB	Micro business
MFI	Microfinance institutions
MCP	Microcredit programme
MSMEs	Micro, small and medium enterprises
M4D	Mobile phone for development
PI – PV	Research papers one to five
RoSCA	Rotating savings and credit association
SACCOs	Savings and credit co-operative societies
SMEs	Small and medium enterprises
SMS	Short message services
SSA	Sub-Saharan Africa
TCRA	Tanzania Communication Regulatory Authority
UEF	University of Eastern Finland
USSD	Unstructured supplementary service data





# List of original publications

This dissertation is based on data presented in the following articles, which are referred to throughout the dissertation by the Roman numerals I–V.

- I Gomera, W. C., & Apiola, M. (2015). Improving MFI-MB interaction with technology: An explorative study in Dar es Salaam, Tanzania. In 2015 IEEE AFRICON 2015 (pp. 1–8). IEEE.
- II Gomera, W. C., Suhonen, J., & Oreku, G. (2020). Enabling factors and user requirements for microcredit services through mobile devices - Dar es Salaam Tanzania context. *African Journal of Information Systems*, 12(1), Article 1. Retrieved January 07, 2020 from <https://digitalcommons.kennesaw.edu/ajis/vol12/iss1/1>.
- III Gomera, W.C., & Oreku, G. (2016). Mobile technology in training micro businesses: Users' requirements and architectural design. *International Journal of ICT Research in Africa and the Middle East (IJICTRAME)*, 5(2), 14–24.
- IV Gomera, W. C., Oreku, G., Apiola, M., & Suhonen, J. (2017). Mobile training in micro business: Design science research for frugal innovation. In 2017 IEEE AFRICON, 2017 (pp. 480–485). IEEE.
- V Gomera, W. C., Suhonen, J., Tukiainen, M., Oreku, G. S., Tedre, M., & Oyelere, S. S. (2020). Usability evaluation of frugal innovation: A case of mobile training for micro business in Tanzania. *African Journal of Science, Technology, Innovation and Development*, 1-14. DOI: 10.1080/20421338.2020.1772951 .



# Author's contribution

The publications included in this dissertation are original articles on deriving the designing principles through design and development of a pilot prototype in Tanzanian MBs and MFIs context. The author was the main contributor to all the papers denoted as PI, PII, PIII, PIV and PV are detailed below.

- I) Research paper one (**PI**): I am the main author of the article which focused on explore the interaction between MFIs and MBs. The author drafted the research setting, conducted the interviews, analysed the data and developed the draft of the research paper. Co-author was involved in reviewing the study plan and editing, discussion and the final version of the paper.
- II) Research paper two (**PII**): I am the main author of the article which focus on identifying general user requirement and enabling factors for applying mobile technology to microcredit services. The author designed the research plan, including developing a questionnaire, participated in the data collection. Also, the author performed data cleaning, data entry, data analysis and drafted the first round of research findings thereafter involved co – authors in the discussion of the findings, check of the paper quality and editing.
- III) Research paper three (**PIII**): I am the main author of the article focused on the user requirement and architectural design of the mobile training for Tanzanian MBs. The author designed the research setting, organised the user requirement workshops, collected data from the participants and wrote the draft of the paper. Co- author involved on language editing, discussion and formulation of the class diagram/ blue print of mobile training application for MBs.
- IV) Research paper four (**PIV**): I am the main author of the article which focused on design and develop the pilot prototype of mobile training

application. The author organised workshops for development of pilot prototype of MBMF mobile training application, by forming a team of researchers, research participants (MFIs officer and MB owners) and software engineer. Co-authors were greatly involved in paper setting, editing and discussion.

- V) Research paper five (**PV**): I am main author of the article which focus on the usability evaluation of the pilot prototype of mobile training application. The author prepared an evaluation plan, conducted workshop through focus group discussion (FGD), developed questionnaire for data collection, performed data analysis and research report writing. Other authors greatly involved in setting the paper flow, discussion and editing the paper.

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# 1 Introduction

This chapter presents background information on the current study, which involves the development of mobile technology to enhance the interaction between microfinance institutions and micro businesses in the Tanzanian context. The chapter presents the background and motivation for the research, the research objectives and questions, a description of the research process, the main results and contributions of the individual papers, and the structure of the dissertation.

## 1.1 Background and motivation for the research

A *micro business* (MB) is an informal business operation in which all activities are carried out by the owner. In Tanzania, MBs form a substantial part of the economic system, and are widespread in every sector, including food processing, clothes, electronics, agricultural products, manufacturing, and academia. The owners of MBs are characterised by a low level of education, the use of survival strategies, a lack of financial capital, a lack of substantial assets for collateral, and full-time occupation with business activities (Nyankomo, 2014; Kipesha, 2012). To mitigate the challenges facing MBs, *microfinance institutions* (MFIs) provide microfinance services including microloans, training and microsavings services to MBs in order to improve their performance (Ang, 1991). In addition, MFIs facilitate the provision of loans to MBs based on a relationship lending model, in the form of *microcredit programmes* (MCPs).

The relationship lending model includes microfinance services, soft information sharing, and rules and regulations that are primarily established by governments. The concepts of relationship lending have been responsible for pioneering microfinance services such as loans, savings, training, business consultancy and loan monitoring procedures (Alex, 2014; Berger, Klapper, & Udell, 2001; Blavy, Basu, & Yülek, 2004; Boermansa & Willebrand, 2012; Comeig, Fenandez-Bilanco, & Ramirez,

2015; Haider et al., 2017; Makorere, 2014). Microfinance services offered through relationship lending focus on long bonds and the collection of soft information; these are important, as they can act as a substitute for collateral (Drucker & Puri, 2008; Elsas, 2005; Yunus, 2011; De la Torre, Peria, & Schmukler, 2008; Berger, Klapper, & Udell, 2001; Uchida, Udell, & Yamori, 2012; Kira & He, 2012).

In this study, the term *interaction* is used to refer to the contact between an individual MFI and an MB. An interaction involves the ties created by MFIs as part of the provision of microcredit services, which can help customers to gain a competitive edge. In short, an interaction focuses on the structure of the MFI in terms of offering MCPs and the ties that a particular institution has with customers (Sani et al., 2018; Nyankomo, 2014; Berger, Klapper, & Udell, 2001).

Of the services offered via these interactions between MFIs and MBs, training and microloans are considered the most important. Training has been shown to make up a large part of the agenda of MFIs, as it is a means of building capacity (Haider et al, 2017; Hameed et al., 2017; Karlan & Valdivia, 2011; Mashenene & Rumanyika, 2014). Berge et al. (2012) argue that business skills and business finance have equal significance to MBs. Kessy and Temu (2010) point out that in order to reduce loan defaults, training programmes for loan recipients should be effectively conducted and monitored.

The most common way of conducting training is via in-person meetings between loan officers and MB owners. Training sessions are held in the offices of the MFI, or sometimes in facilities close to the workplace of the MB. When training is conducted on the premises of the MFIs, the trainees (MBs) need to leave their business, and are sometimes required to travel long distances to attend training sessions; however, when training is conducted near the workplaces of MBs, loan officers have to travel to these areas. In all cases, the owners of MBs must close their businesses or leave their business operations to someone else in order to attend training sessions (Kjetil & Bertil, 2010; Berge et al., 2012).

Commonly used training practices also face many challenges. These include a lack of continuity, a lack of time to attend training on the part

of MB owners, inappropriate means of delivering training materials, and high costs for the preparation of hard copies. Other challenges include inappropriate training environments, especially when the training must be done close to the MB's workplace, and the need for physical proximity between the trainer and the trainee (Berge et al., 2012; Kjetil & Bertil, 2010; Gherhes et al., 2016; Valerio, Parton, & Robb, 2014). These challenges have an adverse effect on the quality of training offered by MFIs, resulting in a lack of training continuity and high training costs.

The most common solutions that have been proposed to the aforementioned challenges are as follows. Firstly, there is a need for all MFIs to offer unique training materials. Secondly, there is a need for the trainer to outsource training programmes from academic institutions specialising in business education. There is also a need for a specific training schedule, for example over a period of one month or short lectures over more than a year (Berge et al., 2012; Isaga, 2015; Kjetil & Bertil, 2010; Valerio, Parton, & Robb, 2014; Mckenzie & Woodruff, 2012). However, all of these proposed solutions are costly, time-consuming, and ineffective (Valerio, Parton, & Robb, 2014; Mckenzie & Woodruff, 2012).

The opportunities emerging from digital technology have given rise to the idea of finding solutions to these training challenges in the form of mobile technology. The digital technology revolution has brought many changes to financial services in Tanzania and in many other developing countries. Financial inclusion, for example, has enabled low-income earners to gain access to payments, money withdrawals, credit and savings, without the need for personal contact with service providers. Digital technology has increased the usage of mobile phones for different activities in African countries (Singh & Padhi, 2015; Oladejo & Adereti, 2010; Diniz et al., 2008; Riggins & Weber, 2016; Daowd, 2016), and the widespread availability of mobile technologies has brought new opportunities to practitioners in terms of their daily activities (Mahfuz, Khanam, & Hu, 2016; Tchouassi, 2012; Azom & Muying, 2010; Daowd, 2016; Kevin, Benard, & Ronald, 2013). In addition, digital technology has allowed researchers and academics to find practical solutions related to mobile phone (Ajmeru et al., 2013; Paruthi, Frias-Martinez, & Frias-Martinez, 2016; Rouse & Verhoef, 2016).

## 1.2 Research objectives and questions

The aim of this dissertation is to suggest guiding principles for the design and development of mobile applications in the context of Tanzanian MFIs and MBs. The establishment of these design and development principles is based on activities and approaches connected with the development of a pilot prototype of a *micro business-microfinance (MBMF)* mobile training application. The study addresses five main research questions, as follows:

**Research question 1:** *What is the nature of the interaction between MBs and MFIs?*

The nature of the interaction between MFIs and MBs is important in this study, as it allows us to connect the practical aspects in relation to the intended end users with the theoretical aspects of small business financing. The establishment of the interaction between MFIs and MBs forms the basis for identifying the quality of services offered in the interaction, the importance of each service, practical challenges and the related information required to accomplish the service. Also, the nature of this interaction helps us to determine the characteristics of potential users prior to the identification of a potential solution that is suitable for both parties in the interaction.

**Research question 2:** *What are the key features of a technological innovation that would enhance the interaction between MFIs and MBs?*

The identification of key features is important, as it forms the basis for finding an appropriate technological solution to address the practical challenges of training. The answer to this question can be used to establish user requirements, which must be incorporated into a technological solution to enhance the interaction between MFIs and MBs.

**Research question 3:** *How does the pilot prototype mobile training application support the interaction between MFIs and MBs?*

This question focuses on determining the extent to which the pilot prototype of the MBMF mobile training application can enhance the

interaction between MFIs and MBs. Here, we justify the role of the pilot prototype of MBMF mobile training application in improving the interaction between MFIs and MBs through assessing the extent it support the training activity.

This draws on the principle of system development, which requires finding a reasonably successful solution in terms of fulfilling the user requirements and determining its suitability to support the interaction between MFIs and MBs.

**Research question 4:** *What can be learned from the design of a mobile training application to support the interaction between MFIs and MBs?*

This question aims to identify the lessons learnt in the design and development process within a sparse resources settings. The success of any system is measured in terms of achieving its purpose. The answer to this question therefore enabled the researcher to define new practical and theoretical information related to the reinforcement of the *design science research (DSR)* framework with design thinking, frugal innovation, and usability evaluation. In addition, the developed pilot prototype MBMF mobile training application was to demonstrate the enhancement of the interaction between MFIs and MBs through mobile technology by sharing training materials with MBs.

**Research question 5:** *What kind of guiding principles can be drawn up for stakeholders in the context of Tanzanian MFIs in regard to mobile training applications?*

The development and implementation of the principles of mobile technological applications is a vital issue for stakeholders. Since the development and implementation of mobile training applications for MBs can be challenging for MFIs, MBs, researchers, policy makers and software engineers, the answer to this question can be used to develop explorative principles for this process. This study therefore provides MFIs, MBs, researchers, policy makers and software engineers in the Tanzanian context with guiding principles to support the development and implementation of mobile training applications.

### **1.3 Description of the research process**

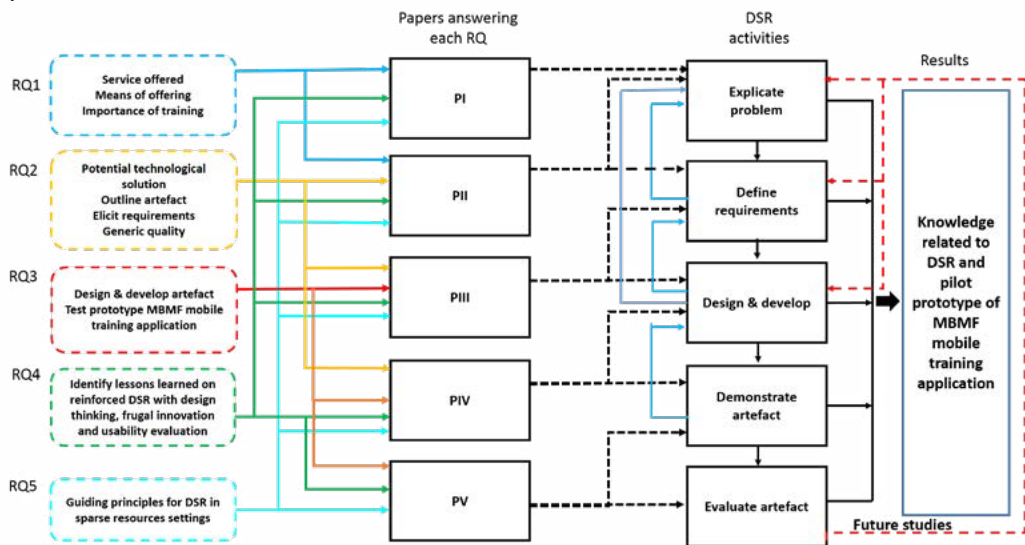
In order to address the research questions, the DSR framework was used as the primary research approach for proposing the design principles, and for the design and development of a pilot prototype of an MBMF mobile training application. The usage of DSR approach is because of its stage-by-stage aspect of design and developing an artifact and its focus on contribution to research and the practical world (Johannesson & Perjons, 2014; Hevner et al., 2004). This project followed the five activities in the DSR framework: explication of the problem, definition of requirements, design and development of the solution, demonstration of the solution and evaluation of the artifact (Johannesson & Perjons, 2014). In each of these activities, the connections between the overall development process, the existing scientific knowledge, and the practical aspects of MFIs and MBs were taken into account.

The research followed both the DRS framework proposed by Johannesson and Perjons (2014) and a three cycle view of DSR proposed by Hevner (2007). The process was iterative and incremental, in order to permit progression from one activity to another while continuously aiming to obtain a deep understanding of the problem, redefine the requirements and improve the designed artifact, as shown in Figure 1 below. The iterative aspect enabled the outcome of each preceding activity to be assessed and improved while continuing with the next activity of the DSR framework. This project involved one complete cycle of the DSR process, with two outcomes: (i) a set of proposed design principles, and (ii) a pilot prototype for an MBMF mobile training application. The evaluation activity led to suggestions for a second cycle that would use the results of this dissertation as a basis for future studies, and which would focus on upgrading the existing artifact (design and development), redefining the needs of practitioners (redefinition of user requirements) or conducting different projects in sparse resource settings (a new explicated problem).

In addition to using the DRS framework of Johannesson and Perjons (2014) and a three cycle view of DSR of Hevner (2007), the research process in this work was complemented with design thinking (Brown & Wyatt,



2010), frugal innovation (Agarwal & Brem, 2012) and usability evaluation (Baguma et al., 2013). Design thinking was found to be an appropriate approach for identifying digital technology opportunities for the interaction between MFIs and MBs and transformation of the microfinance industry at large (Fehér & Varga, 2017). Frugal innovation was used to address the challenges that affect societies with scarce resources via the formation of a small team; this provided an effective and affordable solution to meet users' needs (Agarwal & Brem, 2012). The nature, characteristics and economic level of MBs and MFIs make them suitable for frugal innovation approaches. Figure 1 illustrates the research process, and shows the connections between the articles on which the dissertation is based (PI to PV) and the activities used in the DSR framework to address the research questions.



**Figure 1.** General research process

## **1.4 Role and contribution of the articles forming the dissertation**

The dissertation is based on five research articles, which have been published in peer-reviewed journals and conference proceedings.

**PI** focused on exploring the nature, challenges and services offered in the interaction between MFIs and MBs in Dar Es Salaam, Tanzania. The results indicated that loan defaults, low levels of skill, misuse of borrowed funds, and weak loan monitoring are the main challenges encountered in the interaction between MFIs and MBs. It was also revealed that microloans, microsavings and training are the main services offered via loan officers. It was suggested that technological innovation was needed in the areas of education, market networks and information sharing in order to strength this interaction.

**PII** described the nature of the interaction, the root causes of the training challenges and the factors enabling the use of mobile technology by MBs and MFIs in Dar Es Salaam, Tanzania. It was established that the interaction between MFIs and MBs was based on relationship lending and agency theory. The findings of this research confirmed that training is as important service as microloans. Furthermore, the study confirmed that the continuity of training was limited by geographical distance, time constraints and the low levels of education among owners of MBs. Mobile technology was shown to be a potential solution to the challenges identified in the paper.

**PIII** focused on defining user requirements for a mobile training application for Tanzanian MBs. The study identified the characteristics and working environment of MBs in order to identify a solution that addressed the practical challenges of training. An architectural design and a data flow diagram for the application were also developed.

**PIV** concentrated on the design, development and demonstration of a pilot prototype of the mobile application, and presented a preliminary evaluation of the pilot prototype from the perspective of an MFI. The study established that by using frugal innovation, a good enough and affordable solution could be developed for resource-constrained societies. The

outcome of this study was a demonstration of a pilot prototype for the MBMF mobile training application.

**PV** focused on the evaluation of the design process and the development of a pilot prototype. The study proposed that the stage-by-stage and rigorous research process of DSR could be enforced by design thinking, frugal innovation, and usability evaluation to produce an effective solution for a resource-constrained society.

The overall contribution shows that despite meagre resources, researchers can effectively apply human-centric, environmental, systematic and rigorous design to provide easy-to-use, good enough technological solutions for resource-constrained societies. Table 1 summarises the results and contribution of each paper.

**Table 1.** Results and contributions of each paper and corresponding DSR stages

Article	Method used in article	DSR activities	Results	Contributions
PI	Qualitative study • Interview and focus group	Problem explication	Microcredit services include micro-loans, micro-savings, and training	Confirms the strong relationship between formal and informal practitioners
			Challenges are loan defaults, lack of skills and geographical distance	Suggests the use of mobile technology to address micro-credit challenges
PII	Quantitative study • Questionnaire	Problem explication	Confirms that training is as important as the provision of micro-loans	Positions the interaction between MFIs and MBs in terms of relationship lending and agency theory  Describes the reinforcement DSR with design thinking

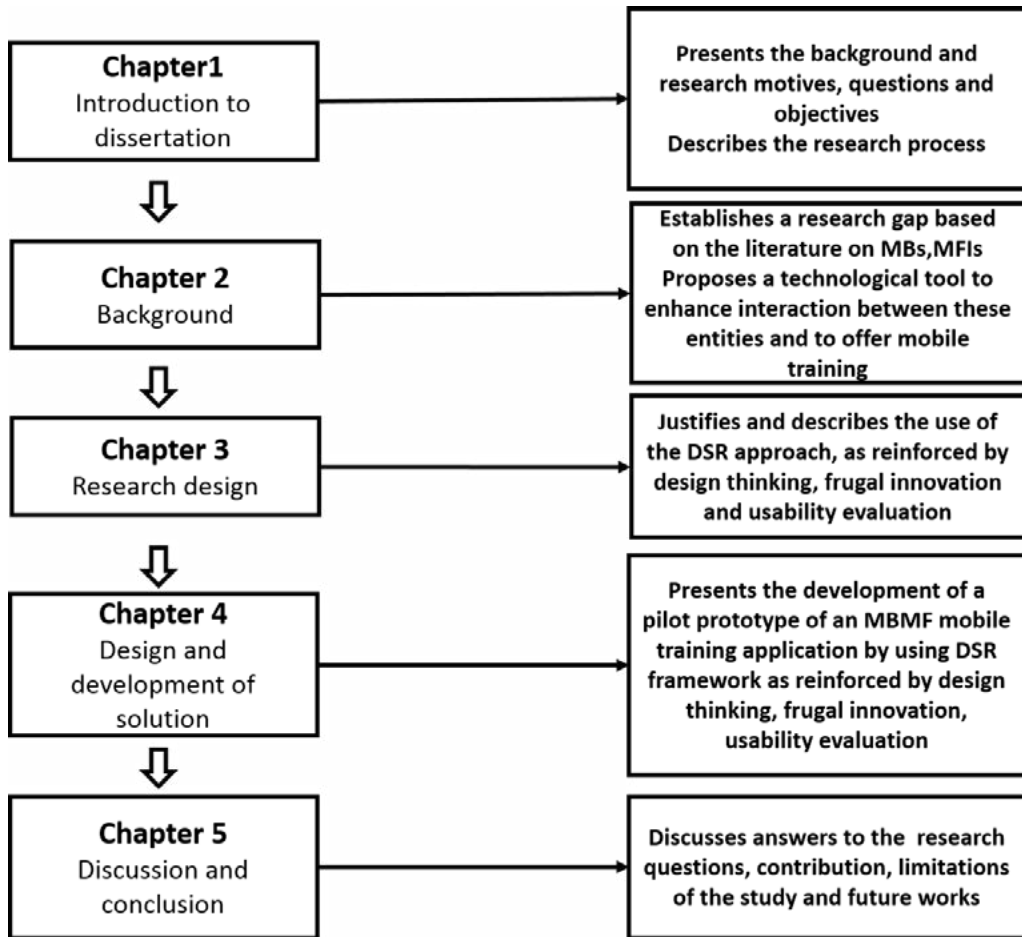
Article	Method used in article	DSR activities	Results	Contributions
		Definition of user requirements	Root causes of training challenges are geographical distance, time constraints, and low levels of education of owners of MBs	Identifies environmental concerns during the design process  Proposes the use of mobile devices as a potential solution to training challenges
PIII	Qualitative study • Observation, interview and focus group	Definition of user requirements	Describes the characteristics, nature, and working environments of MBs	Confirms the use of design thinking to complement the DSR framework, and initiates the design and development stage of the pilot prototype
		Design and development	Defines requirements for mobile training  Presents a data flow diagram and architecture for design	
PIV	Qualitative study • Focus group and brainstorming group	Design and development	Presents a pilot prototype for a MBMF training application	Describes the use of frugal innovation to complement the DSR framework, and suggests technological solutions to challenges affecting Tanzanian MBs  Proposes design principles for low-resource settings  Confirms the suitability of using a small, multidisciplinary team
		Demonstration	Demonstrates the prototype	

Article	Method used in article	DSR activities	Results	Contributions
PV	Mixed method study • Questionnaire and focus group	Evaluation	Evaluates the pilot prototype of the MBMF training application Evaluates the design process	Describes the use of frugal innovation in producing an artefact to enhance mobile training for MBs Describes the use of usability evaluation to complement the DSR framework

Overall, the contributions of these research papers (PI to PV) can be divided into two types: (i) knowledge-based contributions to the academic and research literature in terms of finance, technology and research methods; and (ii) practical approaches to tackling the geographical and time constraints related to the interaction between MFIs and MBs, via a mobile training application.

## 1.5 Dissertation structure

This dissertation is organised based on the activities of the DSR process, as follows. First, an overview of the theoretical background is presented in Chapter 2, and the research design is explained in Chapter 3. The design and development of the pilot prototype for mobile training for MBs are described in Chapter 4. Finally, a discussion and conclusions are presented in Chapter 5. Figure 2 illustrates in detail the structure of the dissertation and the issues covered in each chapter.



**Figure 2.** Structure of the dissertation

## 2 Background

This chapter reviews the literature on MB practices, and discusses the relationship between MFIs and MBs. It covers the challenges related to the interaction between MFIs and MBs, and reviews existing forms of digital technology for the provision of MFI services.

### 2.1 Micro business practices

The existence of heterogeneous definitions of MBs in different regions of the world (Raley & Moxey, 2000; Gregori, Cardinali, & Palanga, 2014) implies a need for each individual country to have its own definition, since based on the indicators set by World Bank, no single definition is applicable to all MBs worldwide. For example, if the World Bank's definition was used in Tanzania, almost all businesses would fall under the category of *micro, small, and medium enterprises* (MSMEs) (Nyankomo, 2014).

The term micro business mostly defined based on the number of people employed i.e. as business employing less than ten people (Greenbank, 2000) sometimes defined based on the amount of capital invested (Nyankomo, 2014). Some literature define MBs based on nature as owner managed business, team managed business, family business. Ethic business, hi-tech business or business with differing legal status (Devins et al., 2005).

According to Tanzania's SME policy of 2003, MBs are defined as organisations "engaging up to 4 people, in most cases family members or employing capital amounting up to Tanzania Shillings (TZS) 5 million." In practice, however, most MBs have been identified as independently owned firms employing only an owner/manager (URT, 2003). MBs are therefore a form of small capital, and are owner/manager businesses operating mainly to sustain a family (Gherhes et al., 2016; Greenbank, 2001; Hamisi, 2011).

This dissertation adopted the definition given by URT, (2003), because it focus the same context as the current study and includes aspects like

number of people employed, capital invested and nature of business. The majority of MBs in Tanzania are labour-intensive and relatively easy to start, and are widely distributed across the country, including both rural and urban areas (Nyankomo, 2014). MBs operate mainly in areas with high footfall, such as at bus stops and in marketplaces. This type of business falls under the informal sector, which is characterised by practitioners who are not registered and who do not keep records of their operations for public use (Mramba et al., 2014)

Tanzanian MBs play a major role in alleviating poverty, reducing income inequality, and contributing to economic development by increasing GDP and generating sources of employment. MBs are estimated to form 98% of the 3.1 million MSMEs in Tanzania (Kibona, 2018), contributing about one third (27% to 33%) of the country's GDP (Tanzania, 2017), and employing about 20%–33% of the country's labour force. About 5.2 million people are estimated to be employed in MSMEs in various sectors such as trade, accommodation, food, agriculture, and manufacturing (Nyankomo, 2014).

MBs have been shown to constitute the dominant form of informal business in almost all countries worldwide (Diao, Kweka, & McMillan, 2018; Kibona, 2018). In Tanzania, the informal property ownership estimated to be 89% and 98% of business are informal, of which, 60% are MBs (Lotto, 2014). The informal sector accounts for about 94% of the current rates of productivity growth and new employment (Diao, Kweka, & McMillan, 2018). Moreover, informal operations provide about 71% of household income (Tanzania, 2017), contribute over 45% of GDP, and create over 33% of the current employment (Lotto, 2014).

In this context, MBs can be seen to play an important role in terms of employment and economic growth (Gregori, Cardinali, & Palanga, 2014; Mramba et al., 2014). However, there are also clear constraints on the expansion of MBs, since only 20% of MBs attain sustainable growth, while the remaining 80% remain stagnant or fail (Hamisi, 2011). This indicates a need to find a means of improving their performance and hence increasing their contribution to economic development.



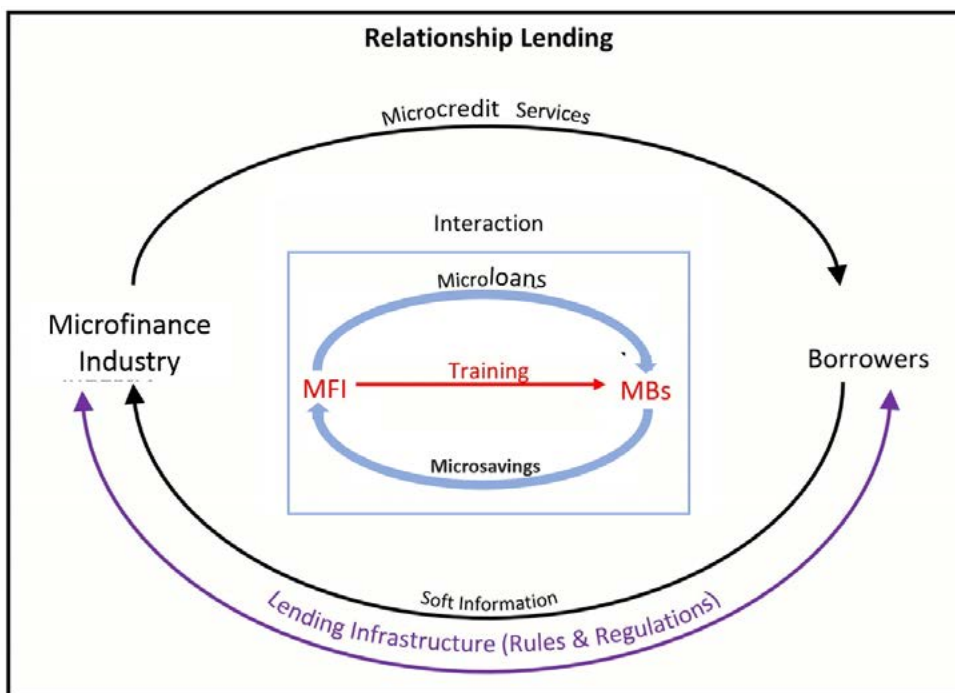
## **2.2 Relationship between microfinance institutions and micro businesses**

MFIs have gained popularity through offering MCPs (Hermes & Lensink, 2007; Mahmud, 2003), which are designed to enhance the sustainability of MBs in financial (through microloans and microsavings) and technical (through training) terms. The most important services offered in MCPs are microloans, microsavings, insurance, training, and business networking (Ang, 1991; Berger, Klapper, & Udell, 2001). The argument for applying relationship lending is that although various lending techniques such as asset-based lending and financial information credit scoring seem to be feasible, an absence of soft information on customers tends to limit the trustworthiness of the interaction between the participants (Boermansa & Willebrand, 2012). Depending on the characteristics of borrowers and the lending environment, MCPs seem to be the most effective techniques for resource-constrained societies.

In Tanzania, this sector encompasses different forms of MFIs such as non-government organisations (NGOs), non-banking financial institutions (NBFIs), microfinance companies, savings and credit co-operative societies (SACCOs), and rotating savings and credit associations (RoSCA) (MF Transparency, 2011). These institutions arose from financial sector reforms that led to the liberalisation of the financial sector and the establishment of private MFIs to support low-income earners. The introduction of MFIs as part of the National Microfinance Policy of 2001 has therefore been one of the key measures for alleviating poverty (Fox, 2016; URT, 2003; United Republic of Tanzania, 2014). This policy has enabled MBs to receive microcredit through services such as MFIs, since these reach many people and have been more effective in this regard than more well-established financial institutions (Mori & Olomi, 2012).

Relationship lending practice is a substitute for collateral by offering multiple services to customers (De la Torre, Peria, & Schmukler, 2008) through microfinance services. Among other things, these microfinance services can assist in capacity building for customers and can simplify the collection of soft information, which in turn strengthens the relationship

(Blavy, Basu, & Yülek, 2004). In this case, relationship lending forms a practical basis for a more focused interaction between MFIs and MBs. MFIs can offer many services as part of this interaction, including training. This service has been proven to help in strengthening the interaction between MFIs and MBs (Alex, 2014; Berger, Klapper, & Udell, 2001; Blavy, Basu, & Yülek, 2004; Boermansa & Willebrand, 2012; Comeig, Fenandez-Bilanco, & Remirez, 2015; Haider, at al., 2017; Makorere, 2014). This study therefore focuses on the provision of training services via this interaction, as shown in Figure 3.



**Figure 3.** Provision of training services to MBs via relationship lending

### 2.3 Challenges related to the interaction between microfinance institutions and micro businesses

The interaction between MFIs and MBs faces many challenges, including information asymmetry, time constraints on MBs, the high operating costs and low outreach capabilities of MFIs, poor loan monitoring, geographical

distance, and agency costs (Bwana & Mwakujonga, 2013; Mori & Olomi, 2012; Nyankomo, 2014; United Republic of Tanzania, 2014; Wanambisi & Bwisa, 2013; Svoboda, 2016).

These challenges result in loan defaults and weak lending relationships. For example, the geographical distances between MFIs and MBs create a need for intermediaries (loan officers), which affects loan-monitoring processes and leads to inaccuracies in the information received from customers and local authorities (Presbitero & Robellotti, 2014; Makunyi & Rotic, 2017; Boermansa & Willebrand, 2012). In addition, the use of loan officers as intermediaries between MFIs and MBs cause the agency problems. An agency relationship is one in which one or more persons (the principal(s)) engage another person (the agent) to perform work on their behalf. This reveals the impact of loan officers on the interaction between MFIs and MBs, (Comeig, Fenandez-Bilanco, & Ramirez, 2015; MF Transparency, 2011).

The challenges identified above require the attention of practitioners and researchers in terms of finding a means (*how*) of tackling them. Earlier researchers have clearly demonstrated the need to enhance the interaction and information flow between MFIs and customers via digital technology (Diniz et al., 2008; Hajji et al., 2016). Our study therefore focuses on how technology can best be used to address the challenges related to geographical distance, reduce the responsibility and power of intermediaries, and alleviate time constraints.

## **2.4 Digital technology solutions for microfinance institution services**

Digital technology involves the application of computers, the Internet, digital communication, and other ubiquitous information and communication devices such as cell phones, PDAs, and iPods (Kauffman & Riggins, 2012; Gabor & Brooks, 2017). It includes the design of appropriate software to enable the speed, security, and efficiency of operations and services to be improved. For several years, the financial industry has been steadily

adopting digital technology (Fitzgerald et al., 2014; Lei, 2009; Sajić, Bundalo, & Bundalo, 2019; Kauffman & Riggins, 2012; Gabor & Brooks, 2017).

Digital technology has been used as a driver for the provision of mature and efficient services, and has facilitated outreach by MFIs to their customers via the provision of information and online services, and the promotion of business associations and networks (Diniz et al., 2008; Jawadi, Jawadi, & Ziane, 2010; Kauffmann, 2005; Sajić et al., 2017; Sajić, Bundalo, & Bundalo, 2019). Digital technology can offer affordable solutions to many of the challenges associated with outreach by MFIs. It can enable MFIs to reach remote rural clients in an effective, low-cost way by saving costs as arising from transactions, transport, time, and high levels of human resources (Augburg, Schmid, & Krishnaswainy, 2011; Comeig, Fenandez-Bilanco, & Ramirez, 2015; Sajić, Bundalo, & Bundalo, 2019; Bada, 2012). In addition, digital technology innovations, such as personal computers connected to the Internet and smart mobile devices, have been adopted by MFIs to perform different activities. Digital technology has therefore been shown to be a powerful tool for reducing operating costs and allowing financial institutions to expand into rural and low-income areas (Augburg, Schmid, & Krishnaswainy, 2011; Weber, Kulkarni, & Riggins, 2012; Gabor & Brooks, 2017). Likewise, information technology, mobile devices, and digital technology can encourage customers to use the services offered by these institutions (Mahfuz, Khanam, & Hu, 2016; Jawadi, Jawadi, & Ziane, 2010).

Digital technology has played an intermediary role between MFIs and their customers, and has changed the landscape of relationship lending and MFI-MB interaction in particular. Mobile technology has been especially noted as being useful in terms of offering mobile microcredit services and practical solutions to the challenges encountered in the interaction between MFIs and customers. The use of smart mobile devices with appropriate applications has speeded up and facilitated a multitude of microcredit services from MFIs. Examples of the use of mobile technology services by MFIs include microloans, social microlending, mobile money transfers, mobile banking and e-learning services (Singh & Padhi, 2015; Riggins & Weber, 2016). These services provide evidence of the wide usage of mobile technology in MFI services, and are described in the following section.

### **2.4.1 Microloans using smart lending devices**

A prototype application named PhotoLoan is among the solutions that have been designed, developed and implemented for loan activities. PhotoLoan was developed and implemented on the Android platform, and has a customised Web version that operates on all platforms (Sajić, Bundalo, & Bundalo, 2019; Daowd, 2016; Abswaidi, 2016). The primary purpose of the PhotoLoan application is to enable the fast-forwarding of client service requests for financial services using smart mobile devices. In addition, borrower can also send brief description of additional information and attach the picture (photograph, image) of goods such as television sets, washing machines, furniture, cars, apartments, and other items to justify the purpose for which the client needs a loan. Using the PhotoLoan mobile application, the user is able to send a request for a loan, to review exchange rates, and to find basic information about all appropriate banking branches, banking agencies and ATMs, shops/stores, and tourist organisations (Daowd, 2016; Ashta & Assadi, 2009).

### **2.4.2 Social microlending**

Social microlending was invented for organisations, and operates in the form of a peer-to-peer (P2P) scheme that allows for a direct connection between lenders and borrowers. The P2P approach represents a significant change to the market structure (Poushter, 2016; Riggins & Weber, 2016), as it enables connections between numerous worldwide lenders and entrepreneurs in developed and developing countries. P2P microcredit practices include Kiva, MicroPlace and Virgin Money (Flannery, 2009; Harvey, 2016; Mwela, 2014).

Kiva, is one of the worlds large online peer-to-peer social lending platform operates via website. In kiva, borrowers post loans through field partners like; microfinance institutions, social businesses, schools, and other non-profit organizations then, individual lenders from across the globe browse and provide funds (Mendelson Shen, 2019).

Once an application is accepted, the funds are transferred to the MFI, which in turn loans the funds to borrowers (Mendelson Shen, 2019; Paruthi, Frias-Martinez, & Frias-Martinez, 2016; Ghosh & Vachery, 2016).

MicroPlace is primarily a marketplace for microfinance securities, and not only requests funding for loans, but also targets specific MFIs rather than the ultimate entrepreneur. An intermediary distributes funds to individual borrowers, whereas a lender chooses the recipient of the funds and routes the money via the intermediary. When repayments are received from the client, the institutional investors receive their principal (plus interest) and can then pay back their own investors (Riggins & Weber, 2016). Virgin Money is a real P2P funding scheme in which the borrower and the lender know each other before making a transaction, although unfortunately there are no Web 2.0 tools on its website to encourage direct contact and build trust between peers (Poushter, 2016).

### **2.4.3 Mobile money transfers**

A mobile money transfer is another type of technology service that is used by MFIs. In Tanzania, there are currently numerous mobile money service providers, such as *M-pesa (Vodacom)*, *Tigopesa (Tigo)*, *Airtel Money (Airtel)*, *T-Pesa (TTCL)*, *Z-Money (Zantel)* and *HaloPesa (Hallotell)* (Ajmeru, Pandit, Borgaonkar, & Sriganesh, 2013; Masamila, et al. 2010). MFIs use mobile money transfers to disburse loan funds to borrowers and to accept loan payments from borrowers. This technology enables MFIs to lend to individuals that are geographically too far away to interact with efficiently. It also saves borrowers the cost of travelling to MFI offices to make transactions or to check loan balances (Donner and Tellez, 2008; Masamila, et al. 2010; Harry, Sewchurran, Brown, 2014). Since MFIs do not provide mobile services or lease phone traffic on cell towers, they rely on mobile service providers to fill this gap. Most mobile service providers already have capabilities for the transfer of funds, meaning that the additional cost of coordination with MFIs is minimal. Mobile service providers fulfil two intermediary roles: (i) they provide liquidity and immediacy to borrowers and MFIs, by allowing transactions to occur immediately and without lags; and (ii) they monitor loan payments by providing a transaction history to some MFIs, which are automatically linked to a database. The effective systematic applicability of mobile phone technology can enable the

accounts of MBs be debited or credited by amounts equivalent to the cash deposited or withdrawn.

#### **2.4.4 Mobile banking**

Mobile banking is another digital financial service used by MFIs to enhance microcredit services. A typical mobile banking transaction consists of a transfer of electronic data, which communicates a loan or savings transfer, a deposit, or a repayment from either the MFI or the client (Harry, Sewchurran, Brown, 2014; Gabor & Brooks, 2017; Sajić, Bundalo, & Bundalo, 2019). The whole process resembles a 'relay race', in which commands are communicated by various players to reach the end goal of the settlement of funds. The introduction of mobile banking has transformed individual and group collection methods. There are many services and devices associated with mobile banking that have been adopted by MFIs (Sajić, Bundalo, & Bundalo, 2019; Sajić et al., 2017; Gabor & Brooks, 2017).

Automated teller machines (ATMs) or point-of-sale (POS) devices can be used to conduct many banking transactions that would otherwise require attention from staff. They can furnish account information, accept deposits, draw down on pre-approved loans, and transfer funds. Interactive voice response (IVR) technology and Internet banking can enable transactions such as mobile banking, checks on account balances, information about products, and finding the location of the nearest branch and its office hours on the Internet. In addition, the growing number of digital-based financial services can enhance microcredit activities such as processing loan applications using a pre-set credit scoring model, reviewing a client's historical data, and monitoring loan performance by reviewing a list of borrowers and their loan repayment statuses. This technology can help MFIs to analyse clients' behaviour history in order to make more reliable loan application decisions, devise more effective collection strategies, target marketing efforts more accurately, and increase client retention (Gabor & Brooks, 2017).

Smart cards are used for financial services such as managing savings accounts, disbursing loans, or making transfers. A smart card is different

from the other methods described here in that it operates using chips, which are relatively expensive but can be used to store information offline. Cards can be used in conjunction with ATMs or POS terminals (Rouse & Verhoef, 2016; Riggins & Weber, 2016). Since this technology facilitates electronic transactions, it has been shown to lessen the operational cost from the institution's perspective and to facilitate outreach from the MFIs to their customers (Tchouassi, 2012; Singh & Padhi, 2015; Rouse & Verhoef, 2016; Jawadi, Jawadi, & Ziane, 2010).

#### **2.4.5 E-learning for microfinance**

Another technological system adopted by MFIs involves e-learning solutions for microfinance. This digital technology has been applied by MFIs to train their staff. PlaNet Finance and *e-change LCC* are two examples of training systems used by MFIs to train their staff. CDs, video clips and audio are used to deliver online learning materials to loan officers and other staff. MFIs can benefit from increasing the performance and efficiency of loan officers, as this leads to successful and sustainable microfinance operations, and can reduce the cost of training participants such as travel and accommodation expenses for traditional classroom training (Admiraal & Lockhorst, 2009; Batalla-Busquets & Martínez-Argüelles, 2014).

E-change LCC piloted distance learning technologies to improve the performance of MFIs loan officers with a programme called "Harnessing the Power of Technology to Improve Staff Training." Their approach to training staff using distance learning encouraged self-initiated learning by microfinance and microenterprise organisations, and allowed for human interaction, real-life experimentation, critical thinking and reflection via a computer terminal, a phone, or a television. E-change LCC also tested the extent to which distance-learning technologies are able to improve access to learning opportunities and the performance of middle and junior staff in MFIs (Batalla-Busquets & Martínez-Argüelles, 2014).

PlaNet University is an online training platform that offers a free training system, with a curriculum in microfinance. Training materials are available in both French and English, and the training catalogue is made



up of standard content that has been adapted to a diverse and open audience. The training programs offered on this platform were designed in collaboration with consultants and microfinance practitioners (Karlan & Valdivia, 2011; Birdthistle, 2006; Bielli & Klobas, 2003).

PlaNet provides two types of training: self-paced and tutored. In the former, the learner follows the modules in an autonomous way based on his or her availability. For a self-paced approach to work well, the training contents must be of a very good quality, very clear and engaging, elaborative information, simple concepts, and procedures.

In the second approach, a relationship is built between participants, and the training content is shared between the tutor and learners using e-mail or chat tools. The trainees are MFI staff from Africa, Asia, and Latin America (Batalla-Busquets & Martínez-Argüelles, 2014; Karlan & Valdivia, 2011). It has, however, been noted that significant amounts of time, resources, and staff are required to build, operate and maintain learning management systems.

## **2.5 Micro business training practices**

### **2.5.1 Importance of training in the interaction between MFIs and MBs**

Training of the owners of MBs is important in terms of their interactions with MFIs, due to the role it plays in supporting other microcredit services (Hussin, Ismail & Alias 2015; Asah, Fatoki & Rungani 2015). The training service provides skills on, loan servicing, savings disciplines, finance, management and marketing, hence, result into improved microcredit services such as microloans, microsavings and insurance (Marivate 2014). The importance of this training and the constraints affecting personal involvement in and attitudes towards training justifies the decision made in this study to focus on this aspect.

The logic behind training is that it is positively linked to intangible outcomes such as knowledge and skill development (Marivate 2014; Aladejebi 2018; Baah-Mintah, Owusu-Adjei & Koomson 2018). The ability

of a firm to stay competitive is directly related to its ability to make effective decisions on operations. Training enhances the decision-making process for both MBs and MFIs. The training process can be seen in terms of capacity building for MBs and can be used by MFIs as a mechanism for collecting soft information for loan appraisals, thereby creating an opportunity to strengthen the interaction by enhancing proper decision making and gathering relevant information.

In addition, Hussin, Ismail and Alias (2015), and Baah-Mintah, Owusu-Adjei and Koomson (2018) have found that entrepreneurial skills can make positive contributions towards the performance and growth of a business. Training equips MBs with business management, financial and marketing skills, which lead to greater business success. These skills can improve the performance of MB owners, since most have minimal education, are illiterate, have poor financial knowledge, lack entrepreneurial skills, and have poor time management and marketing skills.

Training can also help to ensure that loans to MBs are managed in a responsible manner, resulting in more accurate loan servicing and hence in a stronger relationship between the lender and borrower. A study by Aladejebi (2018) indicated that there is a significant positive relationship between training and timely loan repayment. It is therefore valuable to focus on how MBs can be given access to training and can incorporate these skills into their business management.

Both of the factors mentioned above strengthen the interaction between MFIs and MBs, and they give rise to the motivation for this study. The decision to focus on improving the training process was based on the following factors.

Despite the importance of training in the context of the interaction between Tanzanian MFIs and MBs, solutions that address the constraints affecting the training of MBs have not been given a great deal of attention (Adeyeye & Oni 2017). Constraints such as the working environment of MBs, unexpected customer interruptions, time constraints and geographical distance require careful study (Henrekson 2014; Bagheri 2017). These constraints also force MB owners into a dilemma: if cannot be addressed may limit their businesses to grow.

Of the numerous microcredit services offered via this interaction, training involves the exchange of the most information, and hence requires a sophisticated means of information sharing (Bagheri 2017). There are limited numbers of studies of technology-based solutions that can tackle the challenges affecting training, compared to other microcredit services (Henrekson 2014; Bagheri 2017). This gives rise to a need to find a sophisticated technological method to facilitate the sharing of information and training materials.

The existing barriers to effective training mean that this study needs to tackle issues such as lack of time, lack of an appropriate training environment, low investment in finding technological solutions for training, and the use of technology for the provision of skills development and training for small businesses. In view of the aforementioned factors, it is clear that it is important to find a technological tool to support work-based training practices.

### **2.5.2 Nature and type of micro business training**

Birdthistle (2006) found that MB owners prefer an informal training strategy, which can provide skills, development and business experience to MBs to enhance their business activities. Through training, MB owners may expand their core competencies and improve their ability to assimilate and utilise new information. Rather than using established training methods or procedures, owners prefer an approach that can be conceptualised as experiential (Ekanem & Smallbone, 2007). This approach is generally referred to as informal learning, implicit learning, incidental learning, work-based learning, or learning 'on the job'. The need for informal training as a feature of learning by MB owners is influenced by the owners' attitudes towards training, the culture in which the MB is operating, the structure and working environment of operation.

Attitudes towards learning and training are closely related to the expectations of entrepreneurs regarding their business (Allan & Lawless, 2005; Greenbank, 2000), whereby training output is expected to have an immediate impact on solving business challenges, thus leading to growth. MB owners tend to believe that the only way of learning how

to run a business is by doing, and many who start along this route are highly competent in a certain field but suddenly need to develop a whole new range of competencies (Walker & Brown, 2004). Informal training forms part of the process of managing the business and dealing with challenges and problems that arise from the very nature of the work and the environment in which it takes place. Informal training is also reactive, rather than proactive. MB owners are much less likely to value formal training, as they rely on previous work and life experience, although many need specific operational business skills to develop greater competencies (Walker, Webster, & Turner, 2005; Adams, Silva, & Setareh, 2013).

The preservation and development of competencies are therefore critical issues for MBs. The current economic environment is characterised by global competition, rapid technological developments, short product life cycles, and consumers that are relatively demanding. In this competitive and complex environment, human capital is increasingly recognised as a key engine for economic growth (European Commission, 2003b). MB owners are obliged to acquire new knowledge and to learn new methods, since without adequate skills, the ability of MBs to remain competitive and grow may be negatively affected.

A shortage of skills is one of the main problems facing MBs, and if this challenge is not properly addressed, it will impose long-term constraints on the growth of this kind of business. In view of this, many MFIs are attempting to increase the human capital of MBs in order to improve the livelihoods of their clients. MFIs rely on the training of MBs to address the problem of loan defaults (Anane, Cobbinah, & Manu, 2013), and hence to strengthen the lending relationship (Akpan & Nneji, 2015). Training services are also considered to be a means of the capacity building to MB owners (Aragón-Sánchez, Barba-Aragón, & Sanz-Valle., 2003). Haider et al., (2017) recommended that microfinance and other financial institutions should provide effective training to SMEs, including MBs. Also, Greenbank (2001) found a significant association between microfinance training, loans, and the performance of MBs.

The training offered by MFIs to MBs focuses on financial management, record keeping, entrepreneurial and marketing skills (Kessy & Temu,

2010; Adams, Silva, & Setareh, 2013; Berge et al., 2012; Isaga, 2015). Financial management skills can help MB owners with financial discipline, and the focus is on equipping MBs with the ability to manage funds, separate business and personal assets, and understand the importance of loans. Financial discipline can also help MBs to manage their credit and make timely payments on loans (Anane, Cobbinah, & Manu, 2013). Entrepreneurial skills training aims to encourage entrepreneurial traits and ambitions, while record keeping training aims to equip MB owners with proper record keeping for their business. Marketing skills training can equip trainees with customer care and after-sales service skills. Training that is associated with advisory and consultancy services has contributed to the performance of MBs by improving sales revenue and increasing financial discipline (Kessy & Temu, 2010).

### **2.5.3 Digital and mobile training for micro businesses**

In some cases, video and radio components have been used to deliver lessons, although these sessions have been provided during MFI meetings or at specific times in the case of radio sessions, and hence have not been able to overcome time and geographical constraints (Chong, Karlan, & Valdivia 2010). The use of mobile training, e-learning, and Internet-based training have been proposed to address these constraints (Batalla-Busquets & Martínez-Argüelles 2014).

Unlike chalk-and-blackboard lessons, mobile training and e-learning can involve any form of electronic technology that supports the learning process (Admiraal & Lockhorst, 2009). There are several types of digital technology that MBs can use to receive training from different stakeholders (Fillis & Wagner, 2005). Over time, MB owners have started to grasp the use of new and innovative technological tools that focus on effective internal and external communication.

Mobile training can be understood in a variety of ways, depending on the element on which the researcher focuses (Admiraal & Lockhorst, 2009). Mobile training has been defined to include different aspects like; the role of education (Laouris & Eteokleous, 2005), the mobile devices support training service (Traxler 2007), ubiquitous communications and intelligent

user interfaces (Sharma & Kitchens, 2004). Moreover, Nyiri, (2002) defined the mobile training in general perspective as a learning arises in person-to-person mobile communication.

Moreover, according to Traxler (2005), mobile training is carried out through mobile devices, and can be used to deliver learning to trainees that are on the move. In this study, we adopt the definition of Traxler (2005), who described mobile training as “Any sort of training that happens when the trainee is not at a fixed, predetermined location, and/or learning that happens when the trainee takes advantage of the training opportunities offered by mobile technologies”. The researcher used this definition because; it support the revolutionary concepts of mobile devices that best serve users’ values and promote mobile phone as a great opportunity to redefine training paradigms of everywhere-anytime. Moreover, this is a relatively wide definition that focuses on both the technological component, time and the mobility or geographical aspect.

Batalla-Busquets and Martínez-Argüelles (2014) identified the following variables as affecting mobile training within organisations: the intensive use of digital technology, the capability to innovate with such technologies and a high level of adaptability in the working environment. We therefore considered both the working environment and the characteristics of the end users during the design and development process. This opens up opportunities for an ‘anytime, anywhere’ training model in which the trainer finds an appropriate situation, environment, and time for training. The materials can be taken to a workplace or even used at home if this is an appropriate learning environment.

Gabor and Brooks (2017) recommended that when determining the types of device for use in developing mobile training activities, mobile and smart devices should be considered. In addition to being a new technology, mobile training involves a new methodology that affects several aspects, including the design of new didactic resources, which need to be adjusted to the terminals used and the mobility of the student. This requires a full range of multimedia components, such as interactive material, links to other sites and resources, downloadable streaming videos, and communication systems such as help lines, e-mail, chat rooms, and video

conferencing. The materials are therefore hosted on a network, and can be accessed from the student's device.

Mobile training provides many opportunities for small organisations such as MBs. It can also be a more effective form of learning, as it has the potential to offer training that is tailored to the trainee's existing knowledge, skills, needs, and preferred training style. The characteristics of mobile training practices, such as the flexibility of the training process, can contribute significantly to overcoming time and space barriers and allowing a trainee to learn anytime, anywhere. This technology can facilitate informal training by eliminating the need for a meeting space, reducing costs due to the elimination of travel expenses, and providing timely access to information, greater flexibility in the workplace, and greater flexibility in terms of addressing the learners' needs. For MBs, mobile training seems to support both immediate problem-solving at work and collaboration with other colleagues (Allan & Lawless, 2005). Mobile training provides broad access to information and a new, flexible and ubiquitous training environment.

However, according to Admiraal and Lockhorst (2009), one major potential drawback of the use of mobile training for MBs is the technological infrastructure needed. Mobile training initiatives require considerable investment in both information technology and staff. In addition to technological issues, there are other potential drawbacks of using e-learning: Batalla-Busquets and Martínez-Argüelles (2014) found that it was difficult to keep the participation in online learning environments at a reasonable level, due to continuous pressures of work and competing priorities. This finding suggests the importance of paying more attention to informal learning processes that involve the problems that really matter in organisations. Owners of MBs learn when they feel they need to (also known as just-in-time learning). In summary, the required technology infrastructure and the attitudes of owner-managers towards the use of technology, learning, and training seem to be important potential drawbacks in mobile training initiatives for MBs.


## **2.6 Summary of literature and research gap**

This study acknowledges prior research works that have explored, identified, designed, and evaluated digital technology solutions for enhancing the relationship between MFIs and MBs. The contributions of these studies have mainly been related to the nature of relationship lending, the microcredit services offered as part of this relationship, the challenges facing the relationship and ways of strengthening it. A wide body of literature has focused on the use of mobile and digital technology to support outreach by MFIs to MBs (see Table 2). These studies have clearly shown that MFIs are capable of adopting new technological opportunities to meet their core objective of alleviating poverty.

Most studies of the training of MSMEs focus on the type of training offered, the entity providing the training, and its importance. However, the picture is far less clear when it comes to the availability, development and adoption of mobile and digital technology to facilitate the training process offered by MFIs to MBs. To the knowledge of the author, this is because there is a limited range of published research that has focused on the mobile training strategies adopted by MFIs to enhance the human capital of MBs. This study is therefore dedicated to the design and development of a pilot prototype of a mobile training application for MBs.



**Table 2.** Identification of a research gap in the literature

Services offered by MFIs Mobile and digital tools adopted by MFIs	Loan applications	Loan decisions	Loan repayments	Savings	Loan monitoring	Training of MFIs staff	Training of MB owners	
Microloans using smart devices (Singh & Padhi, 2015; Riggins & Weber, 2016)								
Social microlending (Ashta & Assadi, 2009; Flannery, 2009; Augburg, Schmid & Krishnaswainy, 2011)								
Mobile money transfers (Petersen & Rajan, 2002; Chale & Mbamba, 2014)								
Mobile banking (Donner & Tellez, 2008; Diniz, Pozzebon, Jayo & Araujo, 2008; Feher & Varga, 2017)								
Mobile training (Batalla-Busquets & Martinez-Arguelles, 2014; Traxier, 2005)								
Gap in the existing literature								Limited research in the existing literature



### **3 Research design**

This chapter discusses DSR and its supplementation with design thinking, frugal innovation and usability evaluation, in terms of the design and development of a pilot prototype MBMF mobile training application. The chapter also describes the research methods used and the connections between the theoretical background, the research design, and the specific methods used at each stage of the project.

#### **3.1 Design science research framework reinforced by design thinking, frugal innovation and usability evaluation**

The primary research approach used in this dissertation is DSR, which focuses on both the design knowledge created during the research process and the design and development of solutions for practical problems emerging from real-life settings and situations (Hevner & Chatterjee, 2004). The term 'practical problem' refers to a situation that hinders practitioners in their daily activities or the difference between the current state of affairs and a preferred state. A research process is sometimes needed to identify a practical problem, while in other cases, it is an obvious issue raised by people in a real working environment (Venable, 2006).

The training service offered to MBs involves two different classes of actors, MFIs and MBs, which operate in different environments and have different characteristics. A detailed analysis and the development of a solution to these practical challenges therefore need a rigorous research approach, and DSR is used to guide the process from the initial to the final stage.

This study is among the few projects within the innovation ecosystem of Tanzania that has applied the DSR framework. Most higher education institutions focus on qualitative and quantitative research, and DSR is not yet widely taught. However, some projects in the country were identified

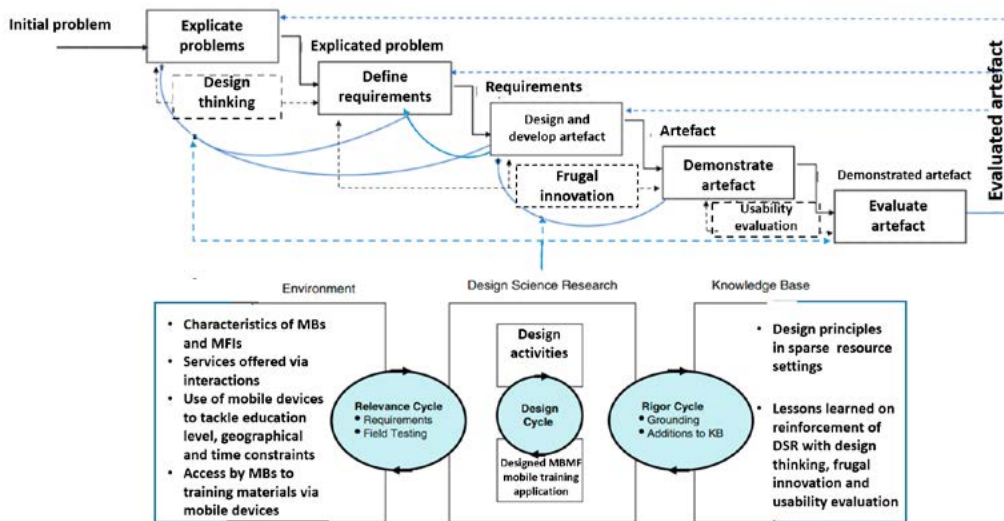
as having used the DSR framework to solve practical problems, including the development of a mobile application for small scale farmers (Misaki, Apiola, & Gaiani, 2019), bookkeeping for informal workers (Mramba, Tullilahti, & Apiola, 2016), and the design and development of a mobile application for female entrepreneurs (Kapinga, Suero, & Mbise, 2019). Others include mobile training for Tanzanian higher learning institutions (Mwandosya & Montero, 2019), mobile technology for market searches by street traders (Rumanyika et al., 2019) and the use of mobile phones for the monitoring of loans to MBs (Gomera & Oreku, 2018).

This study applied the DSR framework proposed by Johannesson and Perjons, (2014), in conjunction with the cycles of DSR proposed by Hevner et al. (2004). The decision to use both approaches was made for five main reasons: (i) it emphasises on the contribution of the interaction between theory, practice and research; (ii) it allows for the application of other methods to reinforce the primary approach; (iii) it provides clear strategies for application and a means of measuring the output of each activity; (iv) it is highly connected to the activities of the project; and (v) DSR can help to ensure that the design tasks faced by practitioners are addressed, the real problems are properly conceptualised and represented, appropriate techniques for the solution are constructed, and solutions are implemented and evaluated using appropriate methods (Baskerville, et al., 2018; March & Smith, 1995).

The use of research cycles ensures that the knowledge contribution is realised for each activity in the DSR research project. Figure 4 illustrates the connections between the research cycles proposed by Hevner et al. (2004) and the activities of the DSR framework put forward by Johannesson & Perjons (2014). The use of a combination of DSR cycles (Hevner et al., 2004) and the DSR framework (Johannesson & Perjons, 2014) in this dissertation resulted in an iterative research process that gives a deep understanding of the initial problem while proceeding with other design activities of the project.

Rather than use the more elaborate four-cycle DSR model suggested by Drechsler and Hevner (2016), this study emphasises the application of the three research cycles proposed by Hevner et al. (2004): the relevance

cycle, the rigor cycle, and the design cycle. The decision to focus on a three-cycle model was based on several reasons: (i) the three-cycle model can support the DSR in an iterative process through the interconnected design, relevance, and rigor cycles, with a focus on the knowledge contributions, which is the primary objective of this study; (ii) the three-cycle model corresponds to a single complete cycle of the DSR framework, which is the process applied in this study; and (iii) the model supports the evaluation of an artifact's instant impact in a real-world context (Bider, Perjons & Johannesson, 2020), which corresponds to the last activity performed in our project. In contrast, the emphasis of the change and impact (CI) cycle of the four-cycle model is on the extent to which the designed artefact can feasibly address the practical problem in a wider context, including the long-term effects, long-term changes and the dynamic environment (Drechsler & Hevner, 2016). The CI cycle has not been applied in this work, as its scope extends beyond the timeline of a single complete DSR cycle (Johannesson & Perjons, 2014). However, we recommend applying the CI cycle in a second DSR cycle based on the evaluated artifact (Drechsler & Hevner, 2016) that will result in redefined requirements, changes to the explication of the problem or the identification of a completely new problem to be addressed (Bider, Perjons & Johannesson, 2020).



**Figure 4.** Modified research design, adapted from (Johannesson & Perjons, 2014) and (Hevner et al., 2004)

As shown in Figure 4 above, the relevance cycle bridges the contextual environment of the research project and the design science activities. The rigor cycle connects the design science activities with the knowledge base of scientific theory, experience, and expertise that informs the research project. The central design cycle iterates between the core activities of building and evaluating the design artifacts and the processes of the research (Hevner et al., 2004). The activities identified in the DSR framework contribute to the practical solution, and each activity in the framework leads to a specific output that makes a viable contribution in practical and research terms. There are five activities: explication of the problem, definition of requirements, design and development, demonstration, and evaluation. The selection and application of Johannesson and Perjons's (2014) DSR framework was based on its effectiveness, its explanatory detail, and the stage-by-stage process of developing a practical solution.

Each activity in the DSR cycle is described in detail below.

### **3.1.1 Explication of the problem**

The first activity in DSR involves explicating the problem. The goal of this activity is to precisely formulate the initial problem, justify its importance, and investigate its underlying causes (Johannesson & Perjons, 2014; Lacerda, Antunes & Dresch 2015). The process of problem explication should follow the guidelines proposed by Johannesson and Perjons (2014), as follows:

- Position the problem so as to clarify the practical area in which the problem appears;
- Formulate the problem precisely, in an understandable manner;
- Justify the problem by explaining why and to whom the problem is important;
- Ensure that the problem is of general interest by focusing on a general scenario rather than simply local practice;
- Ensure that the problem is solvable by defining, analysing and focus to deliverance of training materials to MBs.
- Specify the sources of the problem; and
- Describe how the problem has been explicated.

### **3.1.2 Define requirements**

The second activity, according to Johannesson and Perjons (2014), is to identify and outline a solution to address the explicated problem and to elicit the requirements for the artifact. The requirements are the properties of the artifact that are desired by stakeholders, and are used in the design and development of the artifact (Oyelere et al., 2018; Lacerda, Antunes & Dresch 2015). A requirement for an artifact may be functional, structural, or environmental, or may involve the effects of using the artifact. Functional requirements refer to the practical problem to be addressed and the needs and wants specified by stakeholders for the specific situation at hand (Alwazae, Perjons & Johannesson 2015), while structural requirements refer to the structure and environmental situation that will favour the usage of a proposed solution (Johannesson & Perjons, 2014). Johannesson and Perjons (2014) proposed two sub-activities: outlining the artifact, and eliciting requirements. Defining the requirements involves choosing the

type of artifact that will be designed to solve the problem. In this activity, the specifications and constraints of the problem are reinterpreted to create an idea and outline of the solution, and to explain the proposed solution in conceptual terms (Brown & Wyatt, 2010; Razzouk & Shute, 2012).

### **3.1.3 Design and development of a solution**

The third activity in the DSR framework involves the design and development of a solution that fulfils the requirements identified in the previous activity. This includes designing the functionality and structure of the solution. This state aims to fulfil the user requirements and solve the practical challenges that have been identified (Sarmiento, Villarouco & Gomes 2018; Costa, Soares & de Sousa 2016). The activity therefore ends with the creation of a solution that addresses the explicated problem and fulfils the defined requirements. In addition, this activity focuses on coming up with prescriptive research knowledge about the design decisions taken and the reasons behind (Miller & Salkind 2002).

For this activity, Johannesson and Perjons (2014) (pg. 125) proposed guidelines that can be followed during building and developing the solution. These guidelines involve:

- Clearly describing both the functionality and the structure of each component of the solution;
- Describing the purpose of each component and explaining it in relation to the requirements to be addressed;
- Describing the solution and its components for use in solving the problem;
- Clarifying how the solution differs from others in terms of both functionality and structure;
- Describing the procedure used to develop an artefact in this activity.

Johannesson and Perjons (2014) propose four sub-activities for the design stage: imagining and brainstorming, assessment and selection, sketching and building, and justification and reflection. In the imagining and brainstorming activity, new ideas are generated or existing ones are elaborated, which are later used to inform the design of the artifact. At this



stage, the project team generates numerous ideas that could be used as solutions to the identified practical problem, based on the root causes of the problem and the characteristics of potential users. In the assessment and selection sub-activity, the ideas generated in the previous activity are assessed to allow designers to select one or more of them as the basis for further design. In this sub-activity, the best idea is selected from those generated in the previous sub-activity, based on criteria identified by the project team. In the third sub-activity, sketching and building, the solution is actually constructed, thus translating the requirements and the idea into a functional artifact. In the final sub-activity, justification and reflection, the arguments and design decisions are justified and reviewed.

### **3.1.4 Demonstration of the solution**

The fourth activity verifies the feasibility of the solution by demonstrating its use in an example case. This primarily involves descriptive knowledge that explains the operation of the solution in a particular situation. This activity demonstrates that the solution can solve the problem (or some aspects of it) in the illustrative case, and can be considered a weak form of evaluation, since if the solution can address the problem in one situation, then it may also be suitable for other situations. The input is the solution created in the previous activity, and the output is a demonstrated solution (Livari 2015; Peffers, et al. 2008).

Johannesson and Perjons (2014) identify two sub-activities: choosing or designing a case, and applying the solution to the chosen case. The case may be a fictitious one developed by the researchers who designed the solution, a well-documented case from the literature, a real-life case, or a combination of these. The second sub-activity involves applying the solution to the chosen case, which includes documenting the outcome.

### **3.1.5 Evaluation of the solution**

In the fifth activity, the solution is evaluated, thus determining the extent to which the solution can solve the explicated problem and conform to the users' requirements (Shrestha, Cater-Steel & Toleman, 2014). Johannesson and Perjons (2014) identify six purposes of the evaluation activity in DSR:

utility (the main purpose of the solution), substantiation of the design theory, comparison with other solutions or design theories, the qualities of the solution, side effects and why the solution does or does not work.

The evaluation activity includes ex-ante and ex-post evaluation, and naturalistic or artificial evaluation. An ex-ante evaluation implies that the solution is evaluated without being fully developed or used; this typically focuses on the design and development process of a product (Prat, Comyn-Wattiau, & Akoka 2014; Venable, Pries-Heje, & Baskerville 2016). Ex-post evaluation focuses on the usability of the solution (Pries-Heje, Baskerville, & Venable 2008; Venable, Pries-Heje, & Baskerville 2012). Usability measures the user's perceptions towards the artificial and anticipated use of the application (International Standardisation Organisation [ISO] 9241-210 2010). The aspects that are evaluated, such as attractiveness, perspicuity, and user enthusiasm towards the prototype. Attractiveness refers to the user's overall impressions of the product or subjective perceptions of its visual design (Chau 1996), while perceived perspicuity refers to beliefs about how easy it is to interact with the product (Bargas-Avila & Hornbæk 2011; Schrepp, Hinderks, and Thomaschewski 2017). Enthusiasm refers to the user's excitement and attitudes toward the product (Turner et al. 2010).

### **3.1.6 Design thinking, frugal innovation and usability evaluation**

As the primary research approach, DSR also allows other research approaches to be applied, and in this research, three other research approaches were applied in conjunction with DSR. The main reasons for reinforcing the DSR were that (i) the diverse activities undertaken at the design and development stage required the use of different approaches, and (ii) the particular characteristics of end users made this suitable. End user of the potential solution consisted of MFIs and MBs with deferent characteristics i.e. formal operations for MFIs and informal operations for MBs. Therefore, the supplemented approaches were appropriate for generalising of the research problem and narrowing to the manageable status. In this study, we therefore applied a combination of design thinking, frugal innovation, and usability evaluation in addition to DSR.

*Design thinking* is an approach that involves finding appropriate solutions to complex problems by focusing on human needs (Dijksterhuis & Silvius, 2017). It is based on the three concepts of inspiration, ideation and implementation. The stages of this methodology include (i) understanding the problem to be solved (empathy); (ii) defining the core problems that have been identified; (iii) generating ideas (ideation); (iv) producing a number of inexpensive versions of the product or specific features (prototype); and (v) rigorously testing the complete product (Brown & Wyatt, 2010; Owen, 2006). These stages to some extent correspond to DSR activities, although DSR is a guided, stage-by-stage framework. Design thinking is characterised by a focus on solving non-structured problems, applying a customer-centric approach, and emphasising customer value creation and experience. In addition, design thinking enhances creativity by bringing together various practitioners, users, designers, developers, and researchers (Brown & Wyatt, 2010; Meinel, Lindberg, & Wagner, 2010; Owen, 2006). In regard to the application of design thinking, Harvey (2016) and Meinel, Lindberg, and Wagner (2010) showed that since the behaviour of the end users is always changing, it is not sufficient simply to offer new digital services, or just to copy existing services. They recommended that digital services should be easy to use, comfortable and natural, and should meet the needs of the targeted end user. Researchers, practitioners and digital innovators should therefore not merely digitalise or automate existing processes, but instead should adequately understand the challenges faced by the customer; hence, a human-centric approach has a vital role in ensuring the utility and usability of the end product.

The concept of frugal innovation takes into account the challenges that are faced by societies with scarce resources by carrying out certain activities to provide effective and affordable solutions to meet the needs of MBs. Frugal innovation is a response to limitations on resources, whether financial, material, or institutional, and uses a range of methods to turn these constraints into opportunities (Agarwal & Brem, 2012). This approach can be used to respond to constraints due to sparse resources without compromising the quality of the solution (Knorringer et al., 2016; Tran & Ravaud, 2016). The idea of using limited technical,

financial and time resources calls for the approach that affords a more prominent role to local producers and consumers (Radjou & Prabhu, 2014; Govindarajan & Ramamurti, 2011; Tiwari & Herstatt, 2012). This is made possible by involving multidisciplinary team collaborate without highlighting the conflicts of interest. Frugal innovation motivates people to work proficiently with what they have, using affordable and effective tools, processes, and techniques to come up with viable solutions (Brem et al., 2014).

*Usability evaluation* focuses on a user-centric experience of the working environment in terms of both the product and the design process. Various aspects of usability need to be considered, such as the design features, perceived usefulness and ease of use, and the attitudes of prospective end users (Kjeldskov & Stage, 2004; Schrepp, Hinderks, & Thomaschewski, 2017). Usability can be applied to measure the degree to which users perceive the system's features and the degree to which they believe the designed solution will solve the identified challenge. It also measures the amount of effort involved in using the system and the degree to which respondents are interested in using it or intend to use it in the future (Baguma, et al., 2013; Brown, Venkatesh, & Goyal, 2011; Schrepp, Hinderks, & Thomaschewski, 2017; Yogasara et al., 2011; Chau, 1996; Davis & Viswanath, 2004).

The choice to use design thinking, frugal innovation and usability evaluation to reinforce the DSR framework was made based on different reasons for each of the three approaches, and these are summarised in Table 3.

**Table 3.** Reasons for using design thinking, frugal innovation and usability evaluation to reinforce the DSR framework

<b>Approach</b>	<b>Reason</b>
Design thinking	Human-centric and environmental focus
	Can avoid the vague problem explicated Can avoid the design of a solution that is too narrow (Brown & Wyatt, 2010; Dolak, Uebernickel, & Brenner, 2013)
	Allows the 'big picture' of the problem to be borne in mind while focusing on its specifics
	Allows for the development of interpersonal skills, communication across disciplines, and working in teams (Razzouk & Shute, 2012).
Frugal innovation	Can produce an original and good-enough solution using limited resources
	Can produce a solution that has the minimum features necessary to function
	Emphasis on developing more with fewer resources (Knorrin-ga et al., 2016; Tran & Ravaud, 2016)
	Can be applied in a well-organised small team of researchers, technicians and practitioners (Zeschky, Winterhaltere, & Gassmann, 2014; Agarwal & Brem, 2012)
Usability Evaluation	The solution can be tested as a pilot prototype
	The pilot prototype can be assessed by focusing on user requirements
	The users' perception of the prototype can be measured (Davis, 1993)
	Is connected to design thinking and frugal innovation, especially in terms of human experience, working environment and design processes (Davis & Viswanath, 2004).

### **3.2 Research design of the study**

#### **3.2.1 Research methods**

This dissertation is based around five published articles, PI to PV. These studies were carried out because for each activity in the DSR process, a unique approach is required to realise a particular outcome. The DSR framework allows for the use of different research method/s (Bryman, 2012) in each activity to accomplish the design and development process. As the entire research process was iterative and incremental, the usage of

each strategy was in line with the continuous redefinition of the project's goals.

The qualitative study reported in PI focused on exploring the interaction between MFIs and MBs, the services offered, the challenges therein, and the possibility of improving this interaction through technology. The paper focused on the 'problem explication' activity in the DSR, which provided insight into the practical problem of the interaction between MFIs and MBs. The exploratory approach used in PI involved the collection of qualitative data through interviews and semantic analysis (Bryman, 2012). The research was conducted in Dar Es Salaam with 16 MFIs officers and 20 MBs, and all participants were purposively selected based on their willingness to participate in the study and the identification of MBs who had received loans from MFIs. The study contributed to the establishing the basis of the project by explicating the problem.

The quantitative study reported in PII focused on the general challenges, the nature of the interaction, the services offered in the interaction between MFIs and MBs, and the factors enabling the use of mobile technology solutions. The paper generalised the 'problem explication' activity by involving a large number of respondents. There was also a focus on the 'defining user requirements' activity, in which general user requirements were established for mobile microcredit services and the importance of training in the interaction between MFIs and MBs was examined. The data collection tool was a questionnaire containing items based on the Likert scale, with answers ranging from 1: strongly disagree to 5: strongly agree, and other closed questions (Creswell, 2014). The collected data were then analysed using simple descriptive statistics. The participants in the study were purposively selected from MFIs and MBs in Dar Es Salaam city: the MBs selected were those with loans from MFIs who were willing to participate in the study, while the MFIs were identified through the MBs. A total of 91 MB owners and 22 MFI officers participated in the study.

The qualitative study reported in PIII focused on the 'defining user requirements' and 'design and development' activities of DSR. The paper established the qualities of the proposed solution based on the

characteristics of the MBs, the root causes of the problem, the participant's interests and opinions and the initial design for the proposed mobile training application. This study was based on empirical data that were collected from a task analysis, semi-structured interviews, focus group discussions (FGDs), and observations. The collected data were analysed using content analysis (Bryman, 2012). The project team was composed of the researcher, 12 MFIs, 20 MBs, and one IT expert. The main contribution of this study was the elicitation of requirements and the construction of a data flow diagram and the architectural design of the solution. The results of the study contributed to answering research questions two, three, four and five.

The constructive study reported in PIV focused on the design, development and demonstration of the pilot prototype of the MBMF mobile training application, and described the decision to develop a practical solution to the training challenges using sparse resources (Zeschky, Winterhaltere, & Gassmann, 2014; Agarwal & Brem, 2012). It was accomplished through a participatory approach involving the researchers, a software engineer and the practitioners (MFIs and MBs). Participatory approach is an important in maintaining a small project team comprising people with different technical capacities, levels of practical experience and research capabilities. The research strategies and methods used were therefore based around how a small team could be organised and obtain the required output in a setting with sparse resources. In this study, FGDs, brainstorming groups, and prototyping methods were used to collect data. All the participants of the project team (in this case, the researcher, one software engineer, 20 MFI officers, and 30 MB owners) were involved in making design decisions, assigning the work to team members, and agreeing on the next task to be accomplished. The selection of participants based on willingness to participate in the project. At the demonstration stage, a participatory design meeting was conducted in which the agenda was to reach a common understanding of the services offered by the pilot prototype of the MBMF mobile training application. The demonstration session combined instructions of how to use the videos, audio, and slides to accomplish training. The main contribution of PIV was to develop and

demonstrate a pilot prototype of the MBMF mobile training application, and the results contributed to addressing research questions two, three, four, and five.

The mixed-method study reported in PV involved the evaluation of the pilot prototype; more precisely, it was conducted to assess whether the prototype mobile training application met the identified user requirements and to verify the appropriateness of the design process. The qualities identified at the 'definition of requirements' stage were compared to the actual features of the pilot prototype. The study involved 53 owners of MBs who were located in Dar Es Salaam city and who had received microcredit services from MFIs. The sampling was purposive, based on MBs who owned smart phones and who were willing to participate in the study. Data collection methods included a questionnaire and an FGD (Creswell, 2014). The data collection tools (a questionnaire and an FGD) attached in Appendix 1. The questionnaire contained items on a Likert scale (1: strongly agree, 2: agree, 3: neutral, 4: disagree, and 5: strongly disagree). The FGDs were used to obtain rich, qualitative information and insightful feedback that the questionnaire could not capture. Moreover, the focus groups provided a forum for discussing the defined requirements of the MBMF mobile training application and the participants' feelings about the application (Kontio & Bragge, 2004; Tremblay, Hevner, & Berndt, 2010). Descriptive statistics (for the questionnaire), and content analysis (for the FGD) were used to generate the results of the study from the collected data. In addition to evaluating the pilot prototype of the MBMF mobile training application, the study contributed to answering research questions three, four and five.

Within each design approach applied in conjunction with the DSR framework, there were different activities that were related to the method used in each individual study. The activities performed in each study consisted of identifying participants, selecting data collection methods and determining data analysis methods. Table 4 summarises the research papers, the research questions answered by each paper, the DSR activities undertaken, the research methods, participants, and the period of the study.



**Table 4.** Activities and data collection methods in each research paper

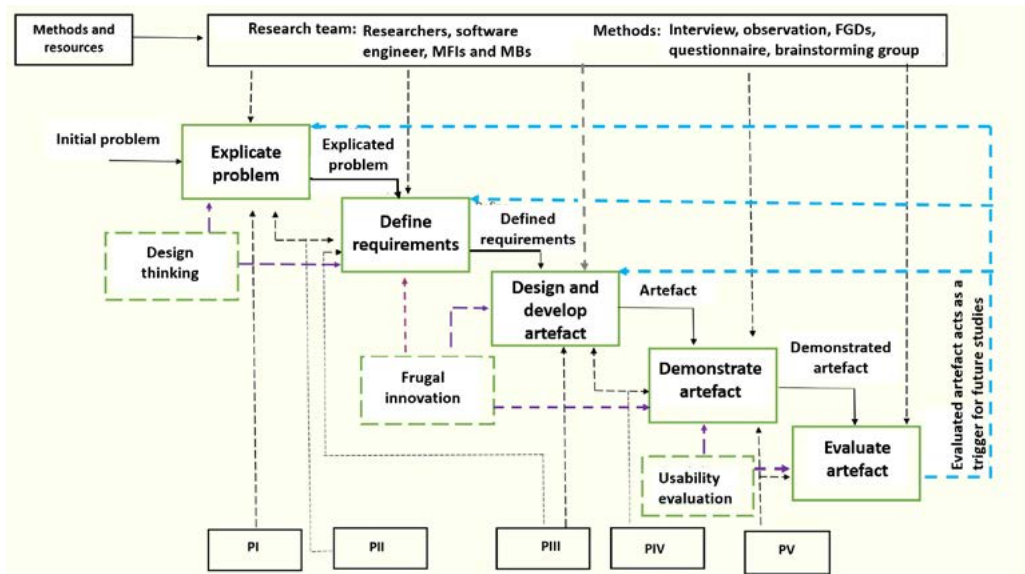
<b>Paper</b>	<b>RQs</b>	<b>DSR activities</b>	<b>Methods of data collection and analysis</b>	<b>Participants</b>	<b>Period of study</b>
PI	RQ1 RQ4 RQ5	Problem explication	Qualitative: • Interview • Content analysis	16 MFI officers 20 MBs	September 2014 to March 2015
PII	RQ1 RQ2 RQ4 RQ5	Problem explication Definition of requirements	Quantitative: • Questionnaire • Descriptive analysis	22 MFI officers 91 MBs	September 2015 to July 2016
PIII	RQ2 RQ3 RQ4 RQ5	User requirements Design and development	Qualitative: • Participatory • Interview • Observation • Semantic analysis	1 IT expert 12 MFI officers 20 MBs	January to July 2016
PIV	RQ2 RQ3 RQ4 RQ5	Design and development Demonstration Evaluation	Qualitative: • Prototyping • Focus group, • Participatory • Content analysis	1 IT expert 20 MFI officers 30 MBs	September 2016 to March 2017
PV	RQ3 RQ4 RQ5	Evaluation	Mixed research • Questionnaire • Focus group • Content analysis • Descriptive analysis	53 MBs	September 2018 to March 2019

### **3.2.2 Contributions of design thinking, frugal innovation and usability evaluation to the design process**

Design thinking was applied at the 'problem explication' and 'definition of user requirements'; frugal innovation was applied at the 'design and development' and 'demonstration', and usability evaluation was partially applied at the 'demonstration' and 'evaluation'. Figure 5 shows the connections between the activities of the DSR framework, the design thinking, frugal innovation and usability evaluation approaches, and the papers underpinning this dissertation.

The inclusion of these additional approaches in the activities of the DSR framework unified the practitioners, researcher, and software engineer in solving practical challenges of a complex nature with limited resources. This unified research design gave rise to the methodological contributions of this study in terms of the inclusion of appropriate research strategies to solve a practical problem. The use of design thinking, frugal innovation and usability evaluation enriched the design process in several respects, as follows:

- A theoretical foundation was contributed at the problem explication;
- A wider perspective on the analysis of problem explication was facilitated by expanding alternatives through creation whereas, narrowing the problem and specifying the user requirements performed through selection;
- The research design was enhanced by focusing on both a solution to the practical challenge and the design constraints imposed by the sparse resources setting;
- The design process was complemented by a user-centric perspective and an emphasis on user-centred design.



**Figure 5.** Incorporation of design thinking, frugal innovation and usability evaluation into the DSR framework

### 3.3 Research ethics

Every research process should comply with ethical guidelines in order to ensure the integrity and quality of the study, and at the same time should make a positive contribution in environmental and societal terms. The importance of ethical practice in the field of information technology must be upheld in both a technical and moral sense in terms of designs or implementation processes. The project team should ensure that the proposed solution is optimally efficient, not harmful, and beneficial not only in the short run but also in the long term (Dearden & Kleine 2018). Moreover, the researcher must ensure that participants are well informed of the purpose, methods and intended possible uses of the research outcomes to justify the research project (Cotton, 2014; Hirschheim & Klein, 1994; Luppicini, 2008). Among other research ethics, this study adhered to those set out in (National Advisory Board on Research Ethics, 2009), (Nieminen, 2010) and (Dearden & Kleine 2018) for humanities, social

and behavioural sciences. These ethical standards cover aspects such as respecting the autonomy of research subjects, doing no harm, abiding by confidentiality and data protection rules, acting with fairness and without discrimination towards all project participants, and avoiding working in isolation (National Advisory Board on Research Ethics, 2009; Nieminen, 2010; Dearden & Kleine 2018).

Ethics formed a vital component of all the studies making up this dissertation and the activities involved in designing and developing a pilot prototype of an MBMF mobile training application. The ethical aspects considered in this study included: (i) promising the participants that their personal information would not be disclosed; (ii) ensuring that the research process and the proposed outcome would not be harmful to the environment or to human beings; (iii) ensuring that the information obtained during data collection was highly controlled, as it involved data on personal businesses and financial institutions for which confidentiality was the highest priority (the data were destroyed after completion of the study); (iv) clarification of the objectives and benefits of the study to all participants before the actual study began; in other words, the researcher undertook not to take advantage of the research information given by participants; (v) encouraging willing participation during data collection and the development of the project; (vi) ensuring compliance by the researcher with the law governing research practice, by providing each MFI with an introduction letter that explained the purpose of the study and its social impact; (vii) analysing data and materials anonymously, and storing information and pictures in a form that ensured that the participant's identity would not be disclosed; (viii) obtain permission to conduct research in the MFIs; and (ix) ensuring that the researcher observed the regulations on intellectual property and rights. Table 5 summarises the ethical factors considered in each of the activities in this study.

**Table 5.** Ethical issues and action taken in each study

<b>Issue</b>	<b>Action</b>
Permission for data collection from MFIs	The researcher obtained data collection permission from MFIs through consent letter as shown in Appendix 2
Agreement on the model used for data collection	The researcher respected the participants' request not to use a tape recorder, due to business confidentiality considerations
Accurate and open reporting of research findings	The project findings were reported in reputable journals and the design pilot prototype was shared with the MFIs for future usage
Confidentiality	The identities of the respondents were hidden. Pictures of the participants in the study were blurred, although those of the research assistants were not
Benefits of the study	It was clarified that no direct benefits would accrue to participants rather than finding a solution to a practical challenge
Acting with fairness and without discrimination	The selection of respondents based on participants' willingness to participate in a project team
Intellectual property and individual rights	The project team was empowered to make decisions concerning the mobile training model
	Trust for participatory design with selected participants
	The prototype was made available via MFIs websites
Willingness of participants	A consent letter was attached to the questionnaire given to participants as sample shown in Appendix 1
	Participants were free to withdraw from the study
	Participants were not forced to talk during focus group discussions
Anonymous analysis	Information, material and pictures supplied by participants concealed were anonymised to conceal their identities
Data management	Data were used only for academic and research purposes
Confidentiality	Data were analysed anonymously
Avoidance of harm	The study were morally and environmental friendly



## **4 Development process of the pilot prototype**

Owners of MBs in many developing countries, and in Tanzania in particular, own mobile devices but are limited in terms of their use, due to the absence of specific mobile applications for their daily activities. This motivated the development of a pilot prototype of the MBMF mobile training application. This chapter presents the results of developing the pilot prototype with respect to each activity in the DSR framework, complemented by design thinking, frugal innovation, and usability evaluation.

### **4.1 Problem explication**

The first activity undertaken as part of this research work was to explicate the problem. In this activity, we identified the problem and positioned it in terms of the real, practical interaction between MFIs and MBs. The findings of the 'problem explication' activity were based on the guiding principles proposed by Johannesson and Perjons, (2014). The problem was explicated based on the lending relationship between MFIs and MBs, and precisely positioned the need for mobile training and the solution in an environment constrained by geographical distance, education level, and time limitations.

Based on the guiding principles, the findings of both the qualitative study in PI and the quantitative study in PII were connected to the explicated problem. Table 6 summarises the guiding principles used for problem explication and their respective sub-activities.

**Table 6.** Guidelines for problem explication and their respective sub-activities

<b>Guidelines for problem explication (Johannesson &amp; Perjons, 2014)</b>	<b>Sub-activity</b>
Show the practical problem to address	Identify the challenges that affect the interaction between MFIs and MBs
Formulate the problem in a precise, concise, and easy-to-understand way	Establish that geographical and time constraints constitute a practical problem affecting the training service
Justify the importance of the problem	Show that the training service is important in strengthening the interaction between MFIs and MBs
Define the problem in a way that makes it small enough to be solved	Establish that mobile training can enhance training
Ensure that the problem is of general interest rather than local practice	Confirm that the project tackles the root causes of time constraints and geographical distance that affect MSMEs in most developing countries

#### **4.1.1 Interaction between MFIs and MBs**

In order to position the practical problem and the potential solution to the interaction between MFIs and MBs, it was necessary to establish the general interaction practices between MFIs and MBs, which was achieved via studies conducted in Dar Es Salaam, Tanzania. The qualitative study in PI and the quantitative study in PII established the services, nature, working environment, challenges, and potential solutions to the problem of the interaction between MFIs and MBs. The findings in relation to each aspect are described below, and are summarised in Table 8 at the end of this sub-section.

The study in PI explored the services offered, and identified a range of services including microloans, microsavings and training, business consultancy, microinsurance and business networking. However, we found that microloans and microsavings were given priority by MFIs. In the same study (PI), microloans were unanimously reported as being the most important service and generating the most revenue. The work in PI and PII also confirmed that training was offered to MBs before and after loan disbursement.



PII established that the interaction between MFIs and MBs was equivalent to relationship lending, and was used as a substitute for collateral and a mechanism for the collection of soft information. PI and PII also confirmed that the interaction between MFIs and MBs was accomplished through loan officers, who acted as intermediaries. Loan officers performed various different roles such as marketing, training, signing loan agreements and loan monitoring.

In PI and PII, we confirmed that most MBs operate in noisy environments such as markets, bus stands, around road junctions, and other places with high footfall. Some of these areas contain permanent but simple buildings that do not support the use of computers. MFIs officers were found to work in well-structured offices with ICT facilities, except for loan officers, who worked in well-established office premises and carried out fieldwork in the vicinity of MBs.

Both PI and PII examined the challenges facing the interaction between MFIs and MBs. In PI, we established that loan defaults pose the main challenge, since these represent 20% of the loans disbursed via this interaction. Furthermore, PI identified that owners of MBs were characterised by weak business skills and strategies, poor business performance, fraud and misuse of borrowed funds, poor loan monitoring; the large geographical distances between MFIs and MBs were also significant challenges encountered in this interaction.

In PII, we identified other challenges such as bribery, incorrect information, a lack of availability of both MFI officers and MB owners at convenient times, poor customer care, late responses, time constraints, and short intervals for loan repayments. Descriptive statistics on these challenges are presented in Table 7, which summarises the results gathered from respondents who were asked the question: *“What are the challenges affecting the provision of microcredit services by MFIs to MBs?”*

**Table 7.** Quantitative findings on challenges affecting microcredit services (N = 113)

Challenges affecting microcredit services	Response (%)	
	Yes	No
Bribery	90.1	9.9
Incorrect information	87.9	12.1
Time constraints	90.1	9.9
Poor customer care	87.9	12.1
Late responses	83.3	16.7
High interest	83	17
Late loan disbursements	84.6	15.4
Short loan repayments	79	21

In PI, we identified that there was a need for improving loan appraisal mechanisms, especially in relation to fraudulent loan applicants. In addition, effective training on various aspects relating to business was identified as a potential remedy for loan defaults. Moreover, PI and PII revealed that both MFI officers and MBs proposed the use of mobile technology as a potential solution to most of the challenges facing this interaction. The identified areas in which mobile technology could be used included educational solutions for improved training services, loan processing and monitoring, customer and client profiling and fraud identification, and marketing and business networking. PII confirmed that the proposed usage of mobile technology would be able to address the geographical and time constraints involved. In addition, it appeared that mobile technology could be a good substitute for transport, and hence reduce costs, that at the end might lower the interest. Furthermore, PII revealed that most owners of MBs possess mobile phones, which offered an opportunity for innovative activities relating to mobile microcredit services to be introduced into this interaction.

**Table 8.** Services, nature, challenges, and potential solutions identified in PI and PII

<b>Aspect of interaction</b>	<b>Identified issues</b>	<b>Papers</b>
Services offered via interaction	Microloans are important for revenue generation	PI
	Microsavings services are currently offered	
	Insurance, business information and networking are currently not given attention	
	Pre- and post-loan training is offered to MBs	PI & PII
Nature of interaction	Loan officers are intermediaries	PI & PII
	Soft information is collected and used for loan appraisal	PII
	Relationship lending is used as a substitute for collateral	
	Specific information is needed for each microcredit service	
Working environment	MBs operate in high footfall areas such as markets, bus stands and market places	PI & PII
	MFIs operate in well-structured premises	
	MFIs loan officers travel around (field work) for marketing and loan monitoring purposes	
Challenges of interaction	Loan defaults	PI
	Weak business skills and strategies	
	Fraud and misuse of borrowed funds	
	Fraudulent loan applicants	
	Poor loan monitoring	PI & PII
	Poor information flow	
	Geographical distance between MFIs and MBs	
	Time constraints on owners of MBs	
	Low level of education of MBs	
	Bribery, poor customer care, high interest rates, late loan disbursements and short periods for loan repayment	
Potential solutions	Improvements in the loan appraisal process	PI
	Improvements in the training service	PI & PII
	Use of mobile technology for microcredit services	
	Take advantage of the ownership of mobile phone by MBs as an opportunity for mobile technology innovation	PII

#### **4.1.2 Training practice and its importance in the interaction between MFIs and MBs**

Through the qualitative study in PI and the quantitative study in PII, we confirmed that the training offered to MBs was closely linked to loan provision. In PI, we showed that training provision was conducted in two main sessions: before a loan was issued (pre-loan), and after the loan was disbursed (post-loan). Pre-loan training was a condition of the loan, meaning that before an applicant is approved for a loan, he/she must attend training offered by the MFI. PI revealed that the typical duration of pre-loan training was a minimum of two full business days, while post-loan training was offered to MBs on a random schedule. The findings of PI were that pre-loan training attracted many trainees, while post-loan training attracted fewer.

From both PI and PII, we found that the training facilitators were loan officers. These studies revealed that the loan officers were responsible for preparing the training materials, the training venue, registering the trainees, setting up training timetables, designing the model for training and giving presentations during the training sessions. Loan officers were required to ensure that MBs were well equipped with all the skills needed for effective business operation.

The results of PI and PII clearly showed that the model used for training involved in-person delivery from the trainers (loan officers) to the trainees (MBs). For the training to take place, the loan officer and the MB owners needed to meet in a particular time at a specific place, meaning that the MB owners were required to take time off work to attend.

Additionally, PI revealed that the training venue was either the offices of the MFI or a location near the business premises of the MBs, whichever was suitable for all parties in the training programme. However, most MFIs decided to arrange training near the MBs business premises, because owners were unwilling to leave their businesses in order to attend training in a place far from their working environment.

In the qualitative study in PI, we established that both MFIs and MBs considered training to be as important as microloans. The findings regarding the importance of training are presented in Table 9 as it shows

the participants responses to the questionnaire of a five-point Likert scale (1: strongly disagree to 5: strongly agree). The higher the mean score, the more strongly the respondents agreed with the statement. The comparison of mean values across the Likert scale in Table 9 show that respondents have attitude of agreement on the statements given concerning importance of training on business performance. The low standard deviation of the scores indicates that there were no large variations in the respondents' opinions on the given statements.

**Table 9.** Quantitative description of the responses of MBs on the importance of training in business performance (N = 113)

<b>Statement on the importance of training</b>	<b>Mean</b>	<b>Mode</b>	<b>Standard deviation</b>
A lack of financial skills affect my ability to pay loans	3.58	4	0.38
Improved business skills would have a positive effect on the performance of my business	3.97	5	0.43
Business training would be useless to my daily business undertakings	1.23	2	0.29

The importance of training in the interaction between MBs and MFIs depends on the roles played by training in the relationship. The studies in PI and PII illuminated the part played by training, as briefly explained below.

First, PI and PII revealed that training was used as a mechanism of capacity building for MBs, and was intended to equip MBs with different skills such as financial management, entrepreneurial, customer care, and record keeping skills, to mention only a few. In PII, training in business skills and strategies was often considered as a potential way of strengthening the interaction between MFIs and MBs. In addition, the separation of business and personal resources was considered an important skill for business personnel. The training also aimed to equip MBs with proficiency in time management and profit determination. The training programme conducted with this aim of capacity building was mostly referred to as "erevuka kibiashara", which in Kiswahili means "to be informed in business".

Secondly, training was believed to act as a means of determining the trustworthiness of customers applying for loans. One task of the loan arrangers conducting the training sessions was to observe the behaviours of the attendees in order to classify them as trustworthy or untrustworthy. Training was provided as a precondition for loan approval.

Thirdly, we confirmed that training was used as an orientation mechanism for the loan payment schedule to be followed by MBs. Loan disbursement officers used pre-loan training sessions to give information to MBs on how to make payments on time. This helped them to introduce several issues of interest, including the impacts of late payment. The training on credit management (“mjasiriamali na mikopo” in Kiswahili) was primarily aimed at preventing loan default. This was achieved by offering training on systematic planning for money usage, and especially on using the money for business activities rather than for personal purposes. The training also explained the importance of adhering to due dates, and the impacts of loan defaults for both MFIs and MBs. Another important function of the training sessions from the standpoint of the MFIs was to determine the trustworthiness of the clients.

The training sessions also constituted a mechanism for collecting soft information from MBs, and created close contact between MFIs and MBs that helped loan officers to find out detailed information about their customers.

Based on the above explained roles played by training, we established the importance of effective training. From the results of PI and PII, we concluded that training has a positive impact on the business performance of MBs, loan repayments to MFIs, the collection of soft information, and the loan appraisal process. The close relationship between training and the aforementioned aspects justifies the finding that an effective training programme has a significant impact on strengthening the interaction between MFIs and MBs. Table 10 summarises the findings in relation to training practices and their importance in the interaction between MFIS and MBs.

**Table 10.** Training practices and their importance to the interaction between MFIs and MBs

<b>Category</b>	<b>Specific findings</b>
Training practices	MFIs offer pre-loan and post-loan training
	Loan officers organise training
	Training is performed in person between trainer and trainee
	Training is offered at a specific premises
Importance/usefulness of training	Training is aimed at capacity building for MBs
	Training is used for loan appraisal purposes
	Training is oriented to the loan repayment schedule
	Training is used for the collection of soft information

**4.1.3 Challenges and potential solutions for training services**

From the results of PI and PII, we confirmed that the training service offered to MBs lacks continuity, and established that the root causes for lack of this continuity include the geographical distance between MFIs and MBs, time constraints, and low levels of education among MBs. The distance between MFIs and MBs also imposes travelling costs and requires significant travel times for either the MB owners or the MFI officers.

Time constraints affect the training timetable, as it becomes difficult to set a fixed time for training. From the quantitative findings of PII shown in Table 11, we find that these time constraints can affect performance, loan servicing and the training service itself. The low standard deviation indicates that there was no large variance in the responses. As before, the higher the mean score, the more strongly the respondents agreed with the statement, which was presented using a questionnaire based on a five-point Likert scale (1: strongly disagree to 5: strongly agree). The comparison of mean values across the Likert scale in Table 11 show that respondents have attitude of agreement on the statements given concerning their time for training.

**Table 11.** Quantitative findings on the effect of time constraint to training (N = 113)

<b>Statement on the effect of time constraints</b>	<b>Mean</b>	<b>Mode</b>	<b>Standard deviation</b>
Time constraints affected the contact between MB and MFIs	3.54	5	0.51
Time constraints hindered MBs from participating regularly in the training offered by MFIs	3.63	4	0.42
MFI officers agreed that customers had no time for training	4.27	4	0.39

From the results of PI, we found that most MBs work for more than nine hours a day, and six or seven days a week. This work schedule does not give them sufficient time to attend the training organised by loan officers.

The results of PI and PII also show that the low levels of education of MB owners affect continuity, since most owners are not motivated to attend training, and especially formal training. Moreover, most MB owners do not follow up by attending post-loan training, as it is not mandatory; owners claim that it is more important to manage their small businesses than to attend training.

Since most of the owners reported that training was highly important in terms of business and loan management, PI and PII identified a potential solution to these challenges. It was found that the primary consideration for MBs would be a technological solution that addresses distance and time constraints.

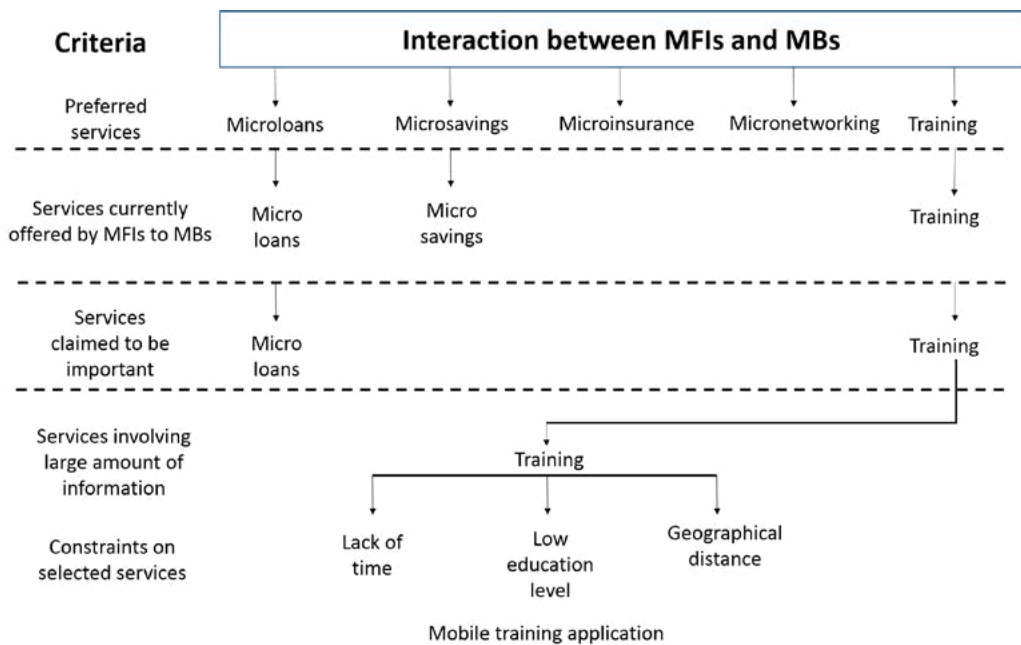
Based on the work in these two papers, we confirmed that mobile training/education might have the potential to change this situation. The results of PI clearly show that educational technology applications can help in offering a number of training programmes in areas of business such as marketing, bookkeeping, customer relations, management, and appropriate ways of dealing with credit. PI and PII revealed that one important application of such a technological solution would be to provide tools to address the constraints on both MBs and MFIs. From the results of PI, we confirmed that various modes of delivering learning materials could be developed, and that various types of technology that can operate



as standalone solutions, such as massive open online courses (MOOCs), should be considered and researched.

The results of PI and PII show that mobile phones are mostly used by MB owners for money transfers, phone calls, short messages, and social media communication such as Facebook, Instagram and WhatsApp. This means there is the opportunity to use mobile devices in the training of MB owners. PII also examined the factors enabling the use of mobile devices in training. The findings of this study, which was conducted in 2017, indicated that a majority (85.7%) of MB owners had smart phones or related devices, while only 14.3% owned a non-smart phone. A considerable increase in the ownership of smart devices was seen, rising from 60% in 2015 to 85.7% in 2017.

The work in PII indicated that most MB owners were willing to receive services from MFIs via mobile devices. The services that participants were highly interested in receiving in this way included training, loan balance information, loan processing, mobile money, marketing, business networking, and business information. However, as shown in Figure 6, the present work focused on the delivery of training services.



**Figure 6.** Potential solution to the challenges involved in training

To arrive at the problem definition, we confirmed that the current in-person training model could be replaced and enhanced by mobile technology. We supported the problem explication activity by focusing on addressing the geographical and time constraints that affect training through the use of mobile technology to deliver training materials to MBs. Due to the low educational levels of MB owners, any attempt at enhancing training through mobile devices should consider the type of language and features that can motivate trainees.

## 4.2 Definition of requirements

Immediately after identifying the practical problem that was affecting the training of MBs, the second activity in our project was to define the requirements. In this activity, we transformed the explicated problem into a set of requirements and qualities for a mobile training application. Based on the results of the quantitative study in PII and the qualitative study in PIII, we established the qualities and requirements to be used by the

project team during the design and development of training materials. At this stage, the participants (MFIs and MBs) formed part of the project team.

Both functional and non-functional requirements were considered. Functional requirements refer to the functions of the solution that depend on the problem to be addressed, and the needs and wants of the stakeholders (Johannesson & Perjons, 2014). Based on the results of PI and PII, we established that the solution to the current problem with the training of MBs would be the use of a mobile application. The aim of this solution was to enable MFIs to deliver training materials to MBs anytime, anywhere, and hence to tackle the geographical and time constraints on the training process.

Non-functional requirements involve the qualities and the environment of a solution, and the effects of its use. This type of requirement pertains to the model of a solution (Johannesson & Perjons, 2014). In PII and PIII, we established that one of the required qualities would be that the solution had a simple interface in terms of the layout of the menu, in order to enhance the delivery of training materials to MBs. When establishing this quality, we took into consideration the educational level of the MB owners.

The environmental requirements are typically more generic (Johannesson & Perjons, 2014). From the results of PII and PIII, we determined that the solution could be used on different mobile devices and different platforms to adopt different working environments. We established that using mobile devices to enhance training could simplify the process and motivate MB owners to use mobile devices; this might also contribute to an increase in their motivation to undertake training, as most of them keep these devices at hand throughout the day.

Based on the results of PII, we established the information required for mobile microcredit services, as summarised in Table 12. In addition, we confirmed that the consideration of shared information is important for a technological solution to improve the microcredit service.

**Table 12.** Information shared in relation to microcredit services

<b>Microcredit service</b>	<b>Related information</b>
Loans	Size of loan applied for and size of loan disbursed; amount of interest; collateral; size of business; loan repayment due dates; loan balance
Savings	Amount in customer's savings account; records of account transactions
Training	Delivery of training materials
Insurance	Amount of loan insured
Business network	Market; suppliers; price of services or products

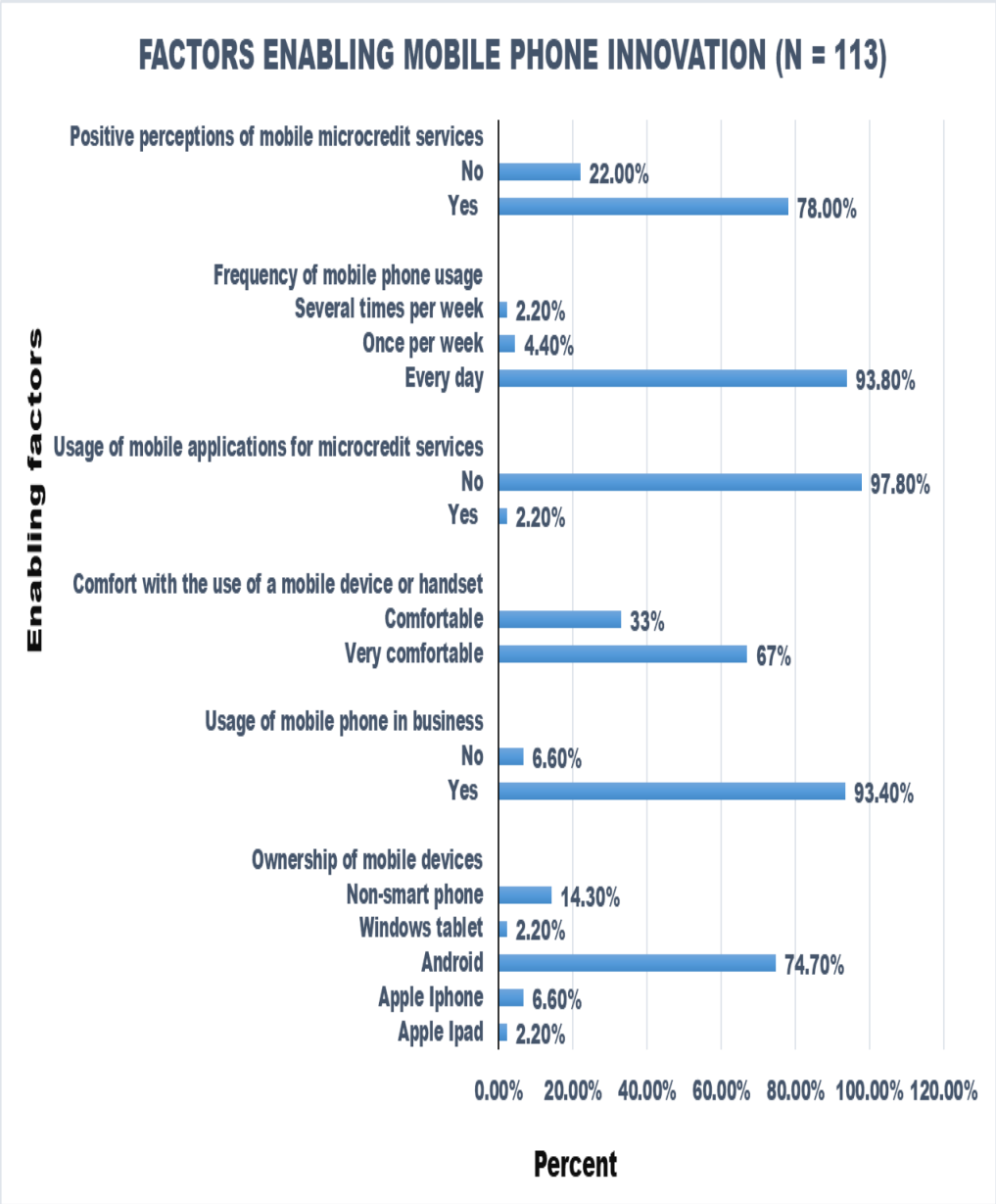
#### **4.2.1 Mobile training solution for microcredit services**

The 'definition of requirements' involved outlining the solution to the root causes, eliciting the requirements for the outlined solution and identifying the qualities of the potential solution. This phase contained several sub-activities, as proposed by Johannesson and Perjons (2014).

##### **Outline solution: Mobile application for training MBs**

In this sub-activity, we outlined the solution in terms of tackling the challenges of training. In PII and PIII, we identified a mobile application as an appropriate tool for addressing the time and geographical constraints on training, based on the factors that we had confirmed as enabling mobile technology, and the ability of the mobile application to offer training anywhere, any time.

Using the results of the quantitative study in PII, we identified the factors that support the use of a mobile application in the training of MBs, including the possession of smart phones by the owners of MBs, their high usage of mobile phones for business purposes, the high general frequency of mobile phone usage and the positive attitudes towards mobile phones among MB owners. However, we identified that there was a low frequency of application for microcredit services. Quantitative information on these enabling factors is presented in Figure 7.



**Figure 7.** Factors enabling the use of a mobile technology solution

From the results of PII and PIII, we established that the use of mobile devices can enhance training anytime, anywhere, meaning that this was an appropriate way to address time and geographical constraints.

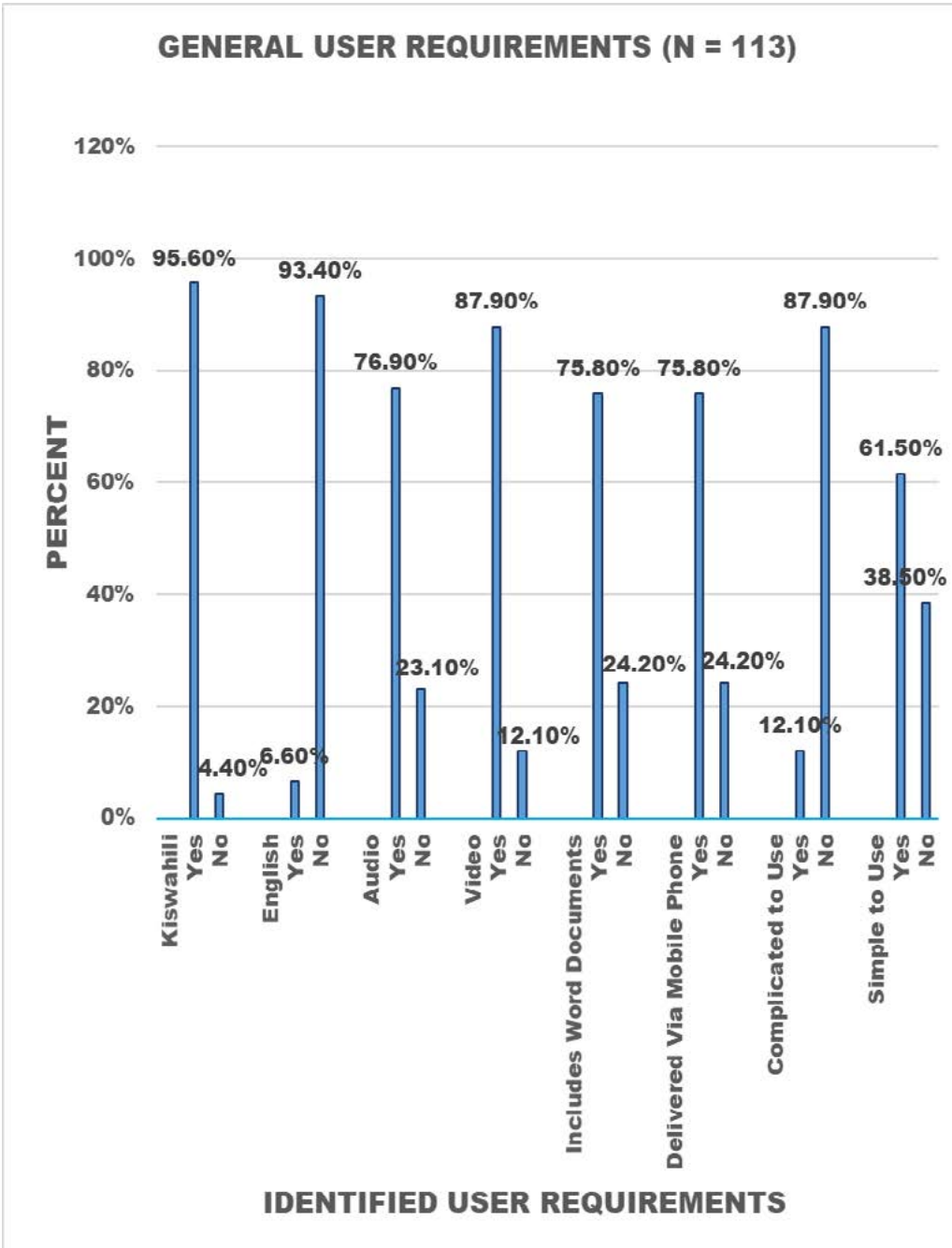
The ability to deliver training anywhere eliminates the need for MB owners to be at specific places for training, and means that training is

determined by the nature and environment of the business. With a mobile device, a trainee can access training materials at home, or while using public or private transport. In addition, PII and PIII revealed that the usage of mobile devices addresses the need for travelling and thus eliminates travelling time and expenses.

The delivery of training at anytime allows the scope for MB owners to schedule training times as they deem appropriate. In PIII, we noted that due to the specific working environment of MBs, there is no single time that is appropriate for training, and that an appropriate training period depends on the kind of business and business location. We also found that some environments allowed for training during working hours, while others did not. Due to the nature of these businesses, some have extremely busy schedules that make it impossible to undertake training during working hours.

### **Eliciting requirements for the delivery of mobile training to MBs**

The second sub-activity involved eliciting the requirements for the outlined solution. These requirements focused on the features of mobile training that can address the practical challenges. Based on the results of PII and PIII, we established that the application should be embedded in a mobile phone, should use the Kiswahili language in interfaces and interactions, should be simple to use and should allow for information sharing via different forms of multimedia, such as video, audio, and text documents. Figure 8 summarises the preferred requirements of the mobile application, as identified in PII.



**Figure 8.** Identified user requirements

The aim of eliciting requirements from PII and PIII was to ensure that these requirements addressed the root causes of the problem. Table 13 summarises these root causes and how they correspond to each of the elicited requirements.

**Table 13.** Root cause addressed by each elicited requirement

<b>Root cause</b>	<b>Elicited requirement</b>
Time constraints on owners of MBs	Usage of mobile devices for training anytime
	Provision of offline training
Geographical distance between MFIs and MBs	Use of mobile devices for training anywhere
	Use of different multimedia to fit different training environments
Low educational level of owners of MBs	Development of a simple-to-use application
	Provision of an interface in the Kiswahili language for a better understanding

#### **4.2.2 Generic qualities of the proposed mobile training application**

This section describes the generic qualities that characterise the set of requirements proposed by participants. These qualities are relevant and useful when defining requirements, as they the results to the features of the proposed mobile training. In addition to the two sub-activities described above (outlining the solution and eliciting requirements), we established a set of generic qualities based on the ‘5Es’ framework proposed by Johannesson and Perjons (2014), which helps in drawing up a short list of high-level qualities for a solution. The ‘5Es’ of the framework are efficacy, efficiency, effectiveness, elegance, and ethicality.

These generic qualities form the basis for the ‘definition of requirements’ activity of a DSR project. We extracted the following five high-level qualities from the replies given by respondents in the studies conducted in PII and PIII.

- Efficacy—Participants identified that the proposed mobile training application should help them receive training materials without the need for in-person sessions with trainers. The primary outcome desired by both MFIs and MBs for the proposed solution was to



enhance the delivery of training materials to owners of MBs within their working environment.

- Efficiency—Participants wanted a simple, understandable application, and Kiswahili was therefore proposed as the only language used in the application interface. The training materials should also be simple and understandable.
- Effectiveness—The desired effect of the proposed mobile training application to MBs is to eliminate the constraints on time and geographical distance that affect training sessions. Since owners of MBs are not willing to leave their businesses to attend training, the proposed artefact should aim to offer training within a work place or in any other place, without disturbing their business activities.
- Elegance— An attractive mobile application was shown to be able to motivate owners of MBs to view the training materials. The flow of materials in any form of multimedia should take into consideration the aspects of attractiveness and the different training environments used.
- Ethicality—We found that owners of MFIs needed a closed application in order to share information with their customers or prospective customers.

The defined requirements and the associated features of the proposed pilot prototype were used as input for the 'design and development' activity. The 'definition of requirements' activity was accomplished based on the guidelines proposed by Johannesson and Perjons (2014), which helped the project team to formulate the relationship between the requirements, anticipated functions, and generic qualities of the proposed mobile training application, as listed in Table 14.

**Table 14.** Guidelines used to define requirements

<b>Guidelines for defining requirements</b>	<b>Defined user requirements</b>	<b>Anticipated function of mobile application</b>	<b>Generic quality from 5Es framework</b>
Specify solution	Mobile training application	Training anytime, anywhere	Efficacy
Formulate specific requirements	Different kind of Multimedia	Training in different environments	Effectiveness
	Use of the Kiswahili language	Motivation of MB owners with low levels of education	Efficiency
	Lightweight files	Facilitation of offline training	Elegance
Justify Requirements	Simple design	Simplicity of use to ensure effective training	Efficient, effective application
Establish feasibility of solution	Effective delivery of training material	Strengthening of the interaction between MFIs and MBs	Application of ethical procedures for MFIs and MBs

### **4.3 Design and development of the pilot prototype**

The third activity involved the design and development of a pilot prototype of the mobile training application, based on the requirements, features, and qualities established in the ‘definition of requirements’ activity. This was accomplished by the project team based on the results of two qualitative studies, PIII and PIV. The functionality and structure of the application was designed at this activity. The primary results from this activity were: (i) an original research contribution in terms of the application of design thinking and frugal innovation in combination with DSR; and (ii) the development of a pilot prototype for a mobile training application that addressed the challenges identified in the ‘problem explication’ activity. Also, the decision on the design and development of the pilot prototype of mobile training application was based on the input outlined in the proposed solution and the set of requirements established in the previous activity.

In the design and development activity, we followed the four sub-activities proposed by Johannesson and Perjons (2014): 'imagine and brainstorm'; 'assess and select', 'sketch and build' and 'justify and reflect'. Despite the chronological listing of these stages, we carried out these sub-activities in a parallel, iterative manner.

#### **4.3.1 Imagine and brainstorm**

In this sub-activity, the project team brainstormed ideas for delivering training materials to MBs to address the current geographical and time constraints. This brainstorming session was reported and analysed in PIII, and involved representatives of MBs and MFIs (participants and practitioners), a software engineer (technical personnel), and researchers (including the moderator of the session). As part of this activity, the team connected the information gathered in the problem explication and requirement definition activities. In PIII, we briefly discussed the practical problem to be addressed by the potential solution and the requirements identified by the end users. A brief discussion was carried out before the 'imagine and brainstorm' session, in which we generated ideas that could enhance the delivery of training materials to MBs.

The 'imagine and brainstorm' sessions were undertaken in the studies reported in PIII and PIV by creating discussion groups. These groups contained a mixture of MFI officers and MB owners, and aimed to generate ideas that would be suitable for the nature of the interaction and their working environment. The ideas identified from these sessions included: (i) a completely new application, with its own platform; (ii) a new application that could use an existing platform to support the operations of the application; and (iii) the delivery of training materials via existing social media such as WhatsApp or Facebook. The emphasis of the last idea was on the creation of groups on social media such as WhatsApp and posting training materials to the group. After reviewing the ideas generated in this sub-activity, the session was closed, and the 'assess and select' stage was begun.

### **4.3.2 Assess and select**

In PIV, we assessed the ideas generated in the brainstorming sessions and selected certain ones. Each idea was considered independently, in order to justify its applicability in terms of addressing the explicated problem and meeting the defined requirements, as the basis for development of the artefact. The criteria applied in this selection process were (i) ability to address the geographical and time constraints; (ii) human-centricity; (iii) frugality; and (iv) originality.

The constructive study reported in PIV shows that after discussion, it was decided that the use of WhatsApp, Facebook groups, or any other social media for training would not be viable. The argument underpinning this decision was that existing social media could not be fully controlled by a particular MFI. In addition, social media such as WhatsApp and Facebook were found not to facilitate direct contact between MFIs and MBs, and were not tailor-made for the interaction, which was one of the preliminary requirements of potential end users.

The second idea was to develop a complete application with its own platform. In PIV, we drew up guidelines for the project with the aim of keeping it as simple as possible, and to avoid duplicating the design of present infrastructure. Also, the guidelines that took into consideration the aspects of originality, simplicity and the development of a good enough application. This idea for the design of the new application was found to duplicate the design of present infrastructure, and the project team therefore opted to drop it.

The third idea was to use existing platforms to deliver training materials to MBs. An application would be designed that addressed the practical problem, met the defined user requirements and fit with the concept of frugality. This would be an independent application that could be downloaded to a smartphone and used to deliver materials via existing platforms. After the detailed discussion reported in PIV, the idea of using existing platforms such as YouTube, the Internet Archive ([www.archive.org](http://www.archive.org)) and Google Drive was found to be viable.

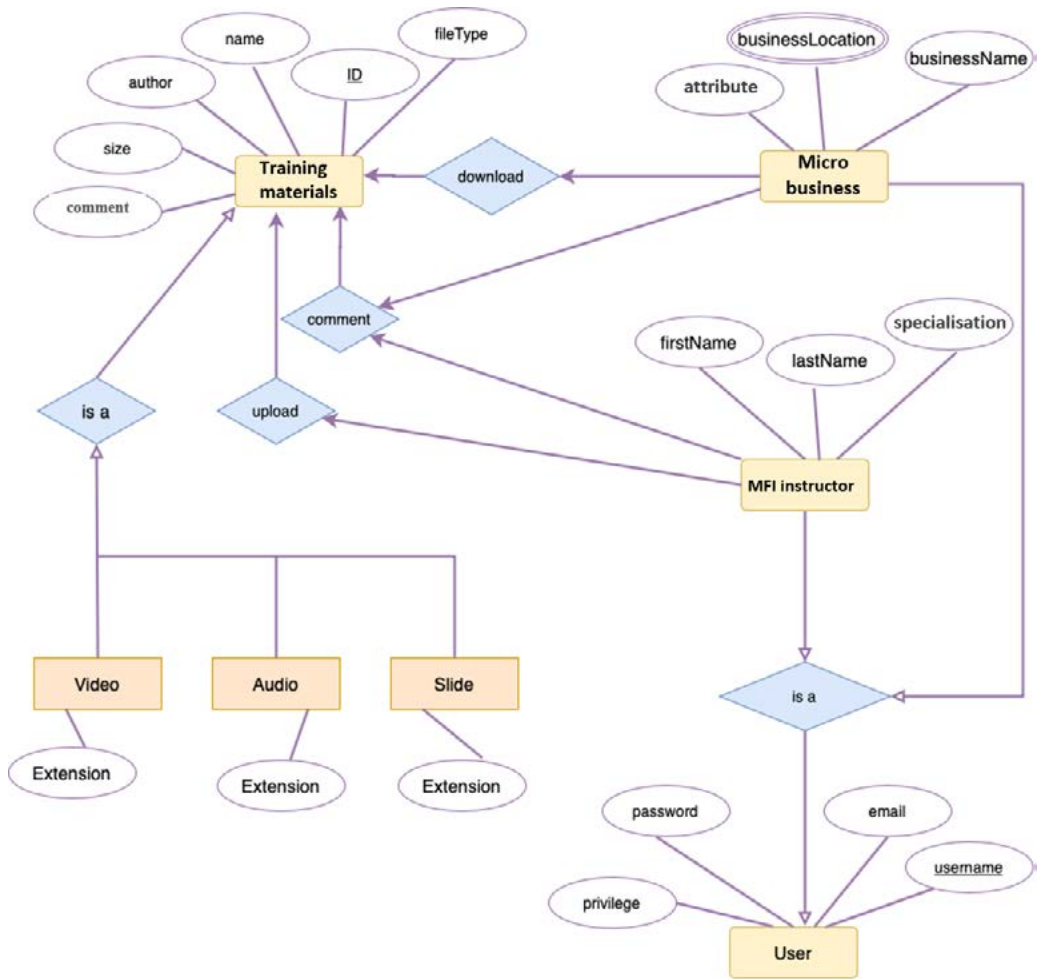
The outcome of the 'assess and select' activity was that the application would use YouTube for the delivery of videos, Archive.org for audio, and

Google Drive for slides. In the study reported in PIV, we finally decided that the application would be completely new, and would be developed specifically for MFIs and MBs, but would use the existing platforms mentioned above. The selected idea was supported by the concepts of design thinking and frugal innovation, which were the main approaches applied at this stage of DSR. The idea was also found to be appropriate in terms of tackling the root causes of the problem, i.e. the geographical and time constraints on MBs, as identified at the problem explication stage.

### **4.3.3 Sketch and build**

In this sub-activity, we constructed a pilot prototype for the mobile training application. In the study reported in PII, an entity relation diagram of the system and a class data diagram/ blueprint were sketched to illustrate the relationship between MFIs and MBs and the flow of materials in the application.

The entity relation diagram of the system in Figure 9 below represents the flow of training materials and the relationships between participants in the training activity, and shows that the training materials originate with MFIs, are prepared and uploaded by an MF instructor and are received by MBs. This diagram was considered to be an appropriate depiction of the interrelationships of the mobile training system.



**Figure 9.** Entity relation diagram for the proposed system

We then started to build a pilot prototype of the mobile training application, based on the ideas selected in the previous sub-activity ('assess and select') by identifying the components required for operation of the system to ensure the proper flow of information within the application. The sketches of the mobile training application represented in Figure 4.4 shows the functions of the application and the interface between the application and the user.

## Description of components

Using the information found from the participants in PIII, we determined the required components of the proposed pilot prototype. As part of this sub-activity, we elaborated the designed components and their interactions in the delivery of mobile training.

In the study in PIII, the project team established the five main types of operational component that would be needed for the application to meet user requirements: (i) an input/source component; (ii) a processing component; (iii) an output/sink component; (iv) a data storage component; and (v) a data flow component. These are expected to operate as shown in Table 15. The design of these components was based on a task analysis and the relationships between the different activities that take place in current training practices.

**Table 15.** Five components in class diagram of mobile training application

<b>Component</b>	<b>Function</b>
Input/source component	MFI's create and upload training materials in the form of video, audio or documents, and MB owners post comments
Processing component	The system converts the input information to a transferable format
Output/sink component	Training materials are viewed by end users after processing, and comments are viewed by MFIs
Storage component	Data or/and information are stored in a database for processing, use or updating

In relation to the operational components summarised in Table 15, the project team created interaction (sequence) diagrams for MFI users (Figure 10 below) and owners of MBs (Figure 11 below).

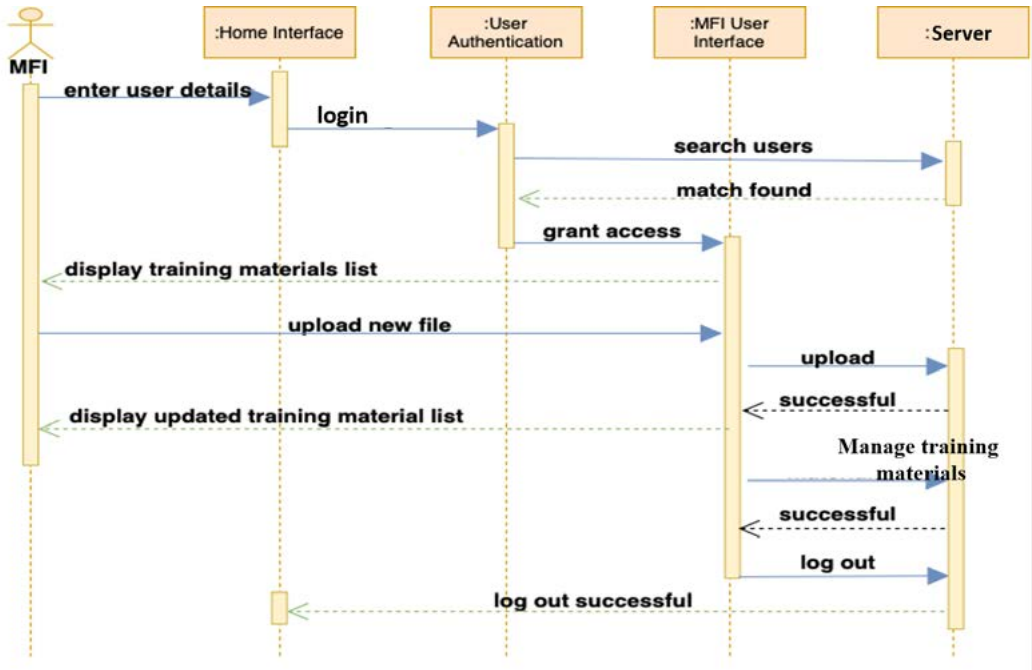


Figure 10. Interaction diagram for MFI users

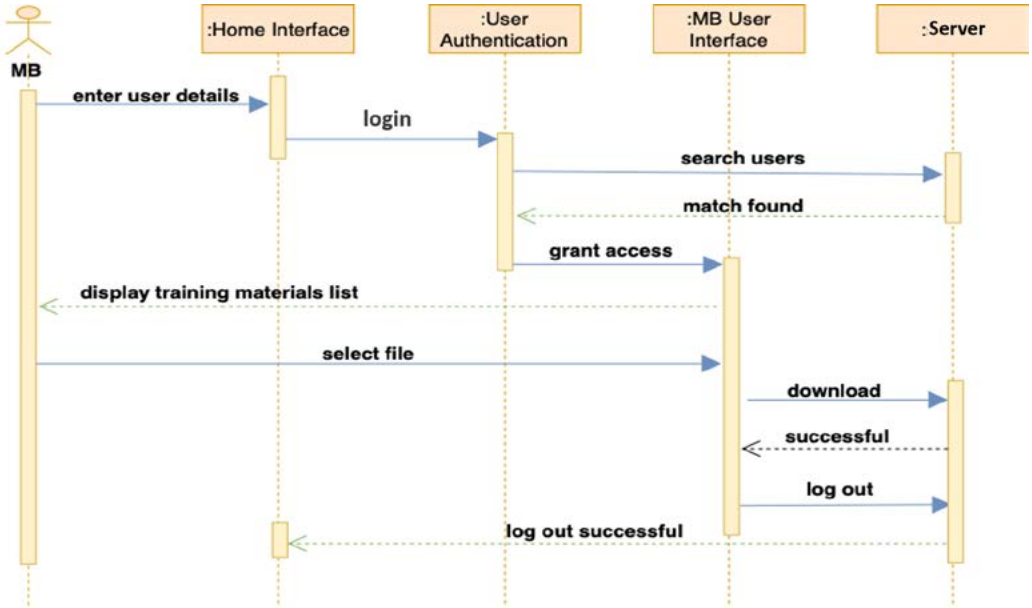
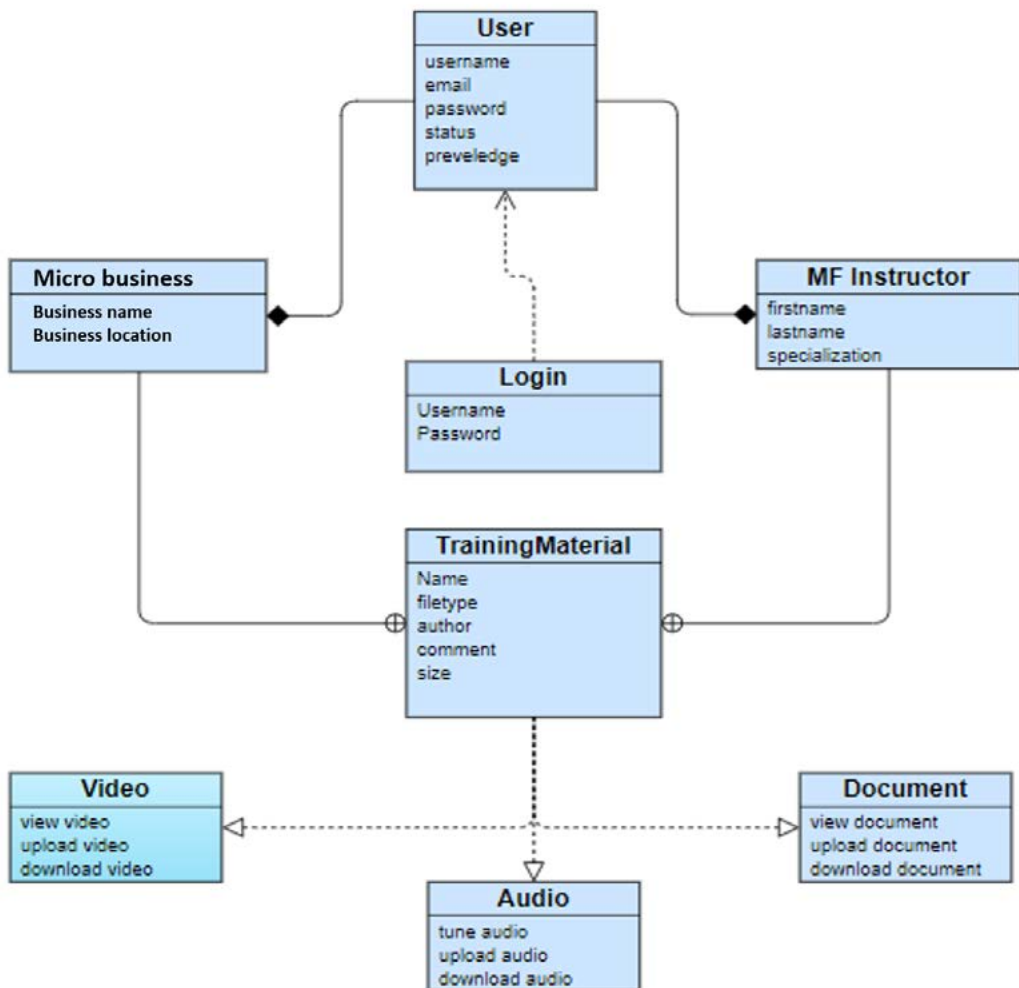


Figure 11. Interaction diagram for MB users





**Figure 12.** Class diagram

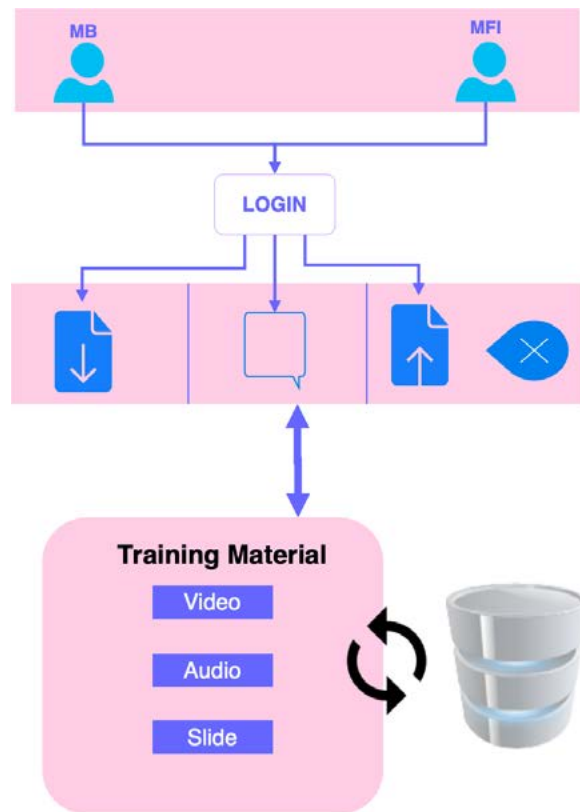
The class diagram in Figure 12 shows that the training departments of MFIs are responsible for developing training materials. The process of developing training materials involves creating content that fits the context of the working environments of MBs. When training materials have been developed, the department manages the system by controlling the access process, and converting the material to transferable formats to suit the business environments and devices of MB owners. The system will also maintain a database to allow MB owners and MFI staff to access materials for training. The database would be stored in the information management system of the MFI, in order to monitor and control the sharing of training

materials with specific people. Moreover, the class diagram shows that the system can assist in the flow of training materials from the MFI input point through processing, storage and sending to MBs as the output point. This is a closed system in which each MFI needs to download the application to share training materials with its customers.

### **Architectural design**

In the qualitative study reported in PIII, we developed an architectural design that provided an overview of both the core functions and the overall structure of a mobile training application for MBs. We also aimed to establish the extent to which this application could take into account the level of education, the nature of the working environment and the characteristics of MBs. Figure 13 shows the system of interaction between MBs and MFIs throughout the training service, as determined in the architectural design in PIII.

As part of this sub-activity, we established the flow of the training service, the components involved in training, and the kind of multimedia that would be appropriate for the application. The architectural design was supported by the class diagram in Figure 12 The architectural design guided the software developer in creating the pilot prototype.



**Figure 13.** Architecture of the mobile training application

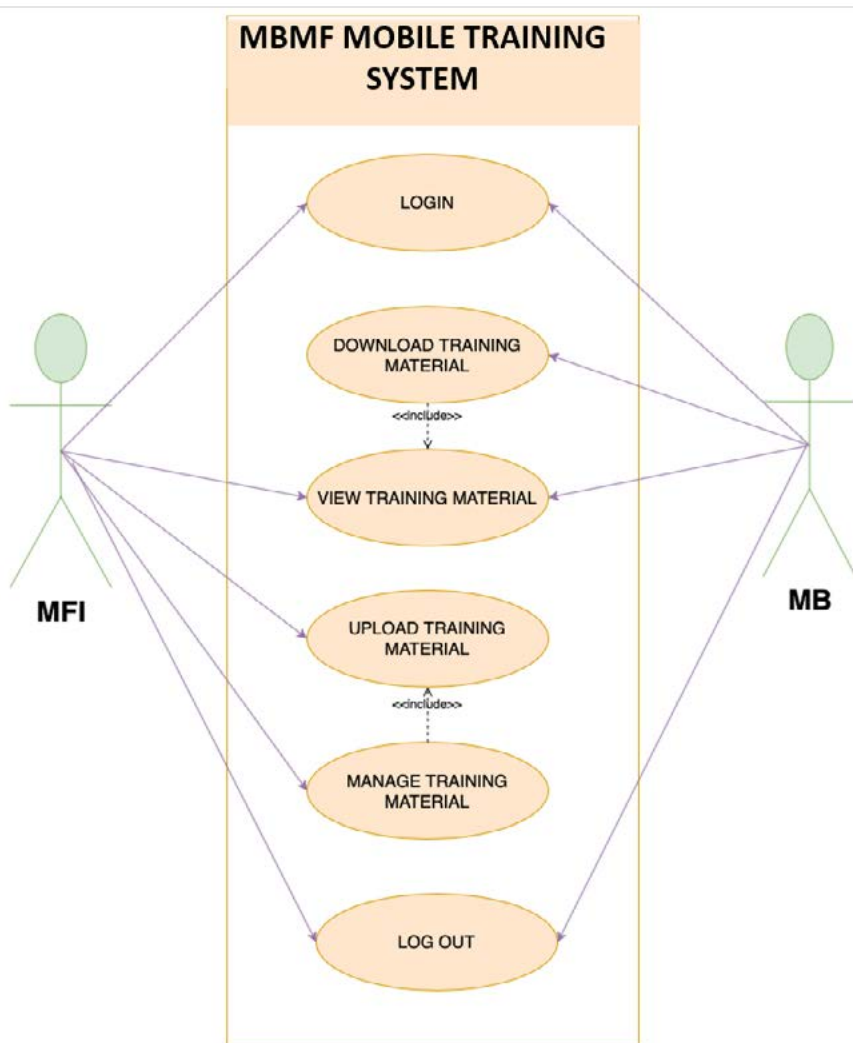
The architectural design indicates that the training process starts with the MFIs uploading the training materials, which are then received by the MBs. Each party first needs to log into the application, and the MB owners also need to download the application to their mobile devices. At each step, there is an option that can help user to select from the available options (for example, the selection of the topic or multimedia format), and all of these options are presented via the application interface.

To accompany the blueprint sketching process in PIII, we established the steps that should be followed by MB owners when using the mobile training application. These steps include:

- Load the mobile training application
- Register as either MB or MFI (this is an option for users based on registration)
- Login or register (for new users)

- Select a service (the service offered in this design is training)
- Select a topic
- Select a multimedia format (i.e. video, audio, image or notes)
- Download materials (for MBs) or upload materials (for MFIs)

The steps involved in using the mobile training application are clearly depicted in the use case diagram in Figure 14 below, which shows the available procedures for both MFI officers and MB owners.



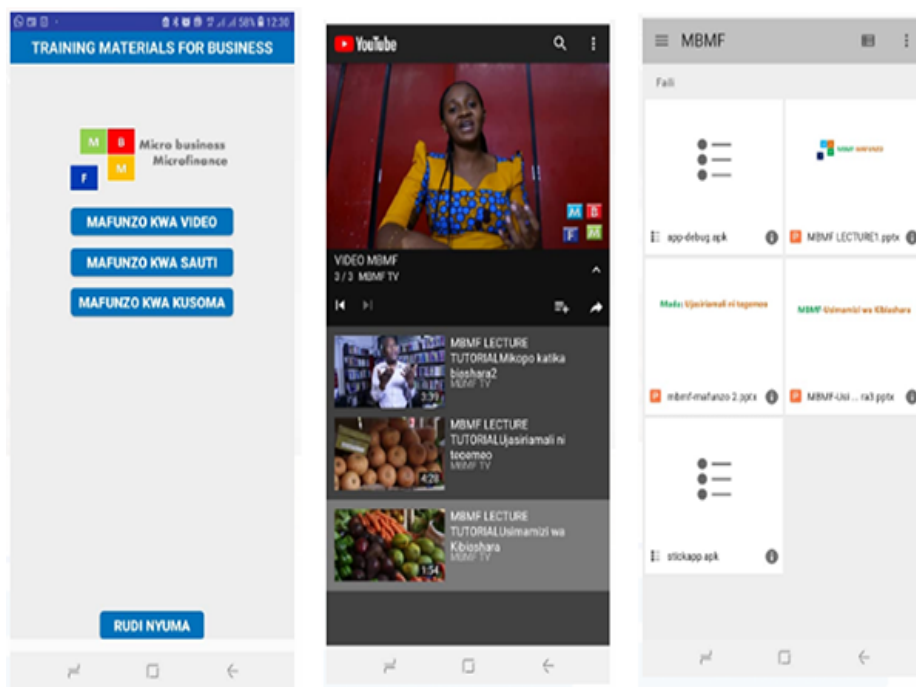
**Figure 14.** Use case diagram for the proposed MBMF mobile training system

## **Construction of a working pilot prototype**

In the constructive study reported in PIV, we established that the pilot prototype would include functions such as the main menu and the video, audio and slide delivery components. The project team, which included researchers, a software engineer, and the practitioners (MBs and MFIs), decided that the system would be developed as an Android application using *Android Studio*. In line with the concept of frugal innovation described in PIV, programming was kept to a bare minimum. The main menu of the pilot prototype also allows for other microcredit services to be included if desired by users.

The development activity that formed the focus of PIV resulted in a pilot prototype for an MBMF mobile training application, with the following specific results: (i) the delivery of training materials using YouTube as the video platform, Archive.org for audio, and Google Drive for slides; (ii) three video lectures, which were prepared as a demonstration activity; and (iii) instructions on how to prepare and upload materials to the system.

The application menu included three buttons for each service (i.e. video, audio and slides). Figure 15 shows several screen shots from the main menu, and the topics covered in different multimedia formats, such as videos and slide presentations. The left-hand image shows a screenshot of the main training menu with four sub-menus in Kiswahili: *MAFUNZO KWA VIDEO* for video training; *MAFUNZO KWA SAUTI* for audio training; *MAFUNZO KWA KUSOMA* for slides; and *RUDI NYUMA* to allow the user to return to the previous screen. The central screen shot shows an example of video training, and the right-hand screen shows training slides.



**Figure 15.** Screenshot of the main menu, and examples of video and slide-based training

During the design and development activity, several video lectures were prepared as examples of training materials. These videos were filmed at the College of Business Education (CBE), and consisted of short lectures given by lecturers at CBE and other experts in the area of business and finance.

The outputs of this stage were:

- A prototype of the application, using YouTube as the video platform, Archive.org for audio, and Google Drive for slides;
- Three example video lectures for the testing phase.

To allow for discussion and commentary, it was decided that the YouTube comment section would be used.

### **Justify and reflect**

In the development of the pilot prototype, a number of decisions were reached, and in PIV, we highlighted several different factors that led the

developing team to make these decisions. Table 16 lists each decision made, the justification (reason) for this decision, and the quality/feature of the application that reflects this decision.

**Table 16.** Decisions reflecting the qualities of a pilot prototype of MBMF mobile training application

<b>Decision</b>	<b>Reason</b>	<b>Resulting feature of application</b>
Development of a pilot prototype for the MBMF training application	To provide scope for MFIs to customise the application for MBs	Pilot prototype of an MBMF mobile training application
	To propose guidelines for preparing tailor-made applications	
	To allow for other developing countries to find the best way of training entities with the same characteristics as MBs	
Use of existing platforms and services	To avoid unnecessary duplication of infrastructure	Pilot prototype that is available with three different types of platform
	To maintain originality and tailor-made for a 'good enough' product	
Development of a simple application	MBs need a simple, attractive application and motivation to use it	User-friendly application
	MBs have low levels of education, and therefore need short training periods	Simple navigation system for the application
	Most end users are not competent in English	Interface designed in Kiswahili
	Most potential end users are not competent in technology	Use of small size files for content
Provision of the application via mobile devices	MBs work throughout the day	Application can be saved in the mobile device, and training materials are available in mobile devices at any time
	MBs work in varying environments	
	Geographical and time constraints on training need to be addressed	
Usage of video, audio and slides for training	MBs work in different environments that are not suitable for only one type of multimedia	Prototype offers training materials in the form of video, audio, images, and short text documents
	MBs are interested in different forms of multimedia	
Consideration of general requirements for all microcredit services	The interaction between MFIs and MBs involves other microcredit services	In addition to training, the prototype offers scope for other services such as loan monitoring

#### 4.4 Demonstration of the pilot prototype

The fourth activity in the DSR process was to demonstrate the developed pilot prototype. In the qualitative study in PIV, we established procedures for using the application and confirming whether it performed the intended training service. Demonstration of the application involved describing the steps that needed to be followed to download the application to a smartphone and the procedures for using it, whereas demonstration of the service involving establishing the feasibility of the application in terms of performing the intended activities and tackling the geographical and time constraints on MB owners.

The demonstration activity consisted of participatory meetings that were organised into two sessions. The first involved the researcher, assistant researchers (for presentation and data collection), a software engineer, and MB owners, as shown in Figure 16, while the second involved the researcher, the assistant researchers, a software engineer, and MFI officers, as shown in Figure 17. Both meetings were conducted at the premises of an MFI. The figures have been deliberately blurred to protect the identities of the participants.



**Figure 16.** Pictures of the first demonstration session with MB owners





**Figure 17.** Pictures of the second demonstration session with MFI officers

Internet-connected smart phones were used to demonstrate the pilot prototype application. During the demonstration, the researcher introduced the application to the participants, who were MB owners or MFI officers who owned smart phones. The researcher, the assistant researchers and the software engineer acted as the facilitators of the demonstration session.

#### **4.4.1 Usage of the demonstrated pilot prototype**

During the demonstration, the development team explained the steps required to download the application to a smart phone, and the basic usage of the application, and instructed the participants on the preparation and uploading of training materials in the form of video, audio and documents. In PIV, we establish these steps as follows:

- Load the pilot prototype application
- Enter as an MB owner or MFI officer (is the option for users basing on registration)
- Log in or register (for new users)
- Select a service (training is the only service in the prototype application)
- Under the training service, select a topic
- Download materials (for MBs) or upload materials (for MFIs)

#### **4.4.2 Demonstration of the service offered by the pilot prototype**

In paper IV, we demonstrated that MB owners could actually receive the training service via the downloaded application. We demonstrated the use of training materials in all three proposed forms of multimedia, in order to show that the application could allow MB owners to select the appropriate multimedia for their working environment. The selection of a particular form of multimedia for training is made by clicking the appropriate button.

The training materials used in the demonstration included lectures entitled *Umuhimu wa mikopo katika biashara* (informal translation: “The importance of loans in business”), *Ujasiriamali ni tegemeo* (“Entrepreneurship is a life saver”) and *Usimamizi wa biashara* (“Business management”). Each lecture was available as a video, audio, and slides. In PIV, we confirmed that the developed prototype could provide the intended service.

As part of the demonstration, we provided instructions to MFIs on the preparation and uploading of training materials in all formats. At the end of the session, MFIs were given the opportunity to practice the process of uploading training materials to the application, before an evaluation of the prototype was carried out.

#### **4.5 Evaluation of the pilot prototype**

The fifth activity in the development of our pilot prototype training application was an evaluation. In the mixed-method study in PV, we sought answers to the evaluation question proposed by Johannesson and Perjons (2014) for a DSR project, which was “How well does the artifact solve the explicated problem, fulfil the defined requirements, and contribute to the knowledge world?”

The pilot prototype was therefore presented to the participants and used in a natural working environment. The research team observed the process of evaluation to see how the process took place, how the prototype was perceived, and whether the challenges to training identified in earlier stages were addressed by the application. In PV, we determined

the users' perceptions on usability, the extent to which the training challenges were addressed, and recommendations for improving the pilot prototype. These aspects are discussed in detail in the sub-sections below, and at the end of the section, Table 4.13 summarises the findings of PV.

#### 4.5.1 Usability of the pilot prototype

In PV, we considered the usability aspects of the prototype, i.e. the attractiveness, perspicuity, and user enthusiasm towards the pilot prototype. Quantitative data were collected from the responses to a questionnaire based on the Likert scale (1: strongly agree, 2: agree, 3: neutral, 4: disagree, 5: strongly disagree). The lower the mean score, the more strongly the participant agreed with the given statement. Descriptive statistics on attractiveness, perspicuity, and user enthusiasm are listed in Table 17. The comparison of all mean values across all statements of the Likert scale show that respondents had positive attitudes toward attractiveness, perspicuity, and user enthusiasm.

**Table 17.** Respondents' perception of the usability aspects of the pilot prototype MBMF mobile training application (N = 53).

Usability aspect	Evaluated item	Mean	Standard deviation
Attractiveness	I felt proud to use the application	1.19	.39
	The application had a nice appearance and operated well	1.32	.51
	I liked the way the training took place	1.28	.46
	The interaction was friendly	2.13	1.08
	I enjoyed the multimedia design	1.32	.47
Perspicuity	The interactions looked good	1.25	.43
	Navigation was easy	2.17	1.09
	The artefact was easy to use	1.36	.56
	The language was clear	1.23	.42
User enthusiasm	I felt proud to see a specific application for MBs	1.28	.46
	I felt excited about the application	1.38	.49
	I found the application to be interesting	1.23	.47
	I found the application to be motivating	1.30	.50

## **Attractiveness**

The findings of PV showed that the pilot prototype was perceived to be attractive and was seen positively by most of the users. It was also strongly agreed that the prototype was attractive in terms of its operation. The attractiveness of the application was measured based on several different aspects such as enjoyment, interaction with the application, interface, relevance of the service offered and appearance.

We found that the end users were satisfied with the way in which the training was delivered, and most of them enjoyed the choice of different multimedia in the prototype. MB owners reported that they were entertained by the use of different forms of multimedia in the application, and considered that this provided options for which format to use at a convenient time and in a suitable environment. The most highly enjoyed multimedia was the video training, which was offered via the YouTube platform.

We found that the pilot prototype was considered to provide a service that was relevant to the end users' activities, and that matched the gaps in the skills of MB owners. However, the solution was proposed to embed photos that show the working environments, products and services offered by MBs. The embedding of these photos in the application would call sense of tailor-made solution to MBs.

The participants moderately agreed that the interactions with the prototype were user-friendly. However, the mixed-method study reported in PV, revealed that simplicity in the interaction can be increased for friendliness and enjoyable interface.

## **Perspiciuity**

In PV, we found that the participants strongly agreed with the decision to use the Kiswahili language. The language was found to be clear by all the participants, and low standard deviations were seen for this item in the responses. The participants commented that the prototype was easy to use and understandable, since it used the local language at all stages of the training.

We found that most participants strongly agreed that the navigation of the pilot prototype was effective and easy to use. However, the mixed-method study in PV revealed that the current navigation can be shortened for users to access the training. It was therefore suggested that it would be useful for the navigation to be easily accessible to illiterate people by including an audio explanation when the application was launched.

The clarity of the interface was positively commented on by participants, although they recommended the inclusion of more local examples and more detailed explanations of the contents. In addition, the participants noted the long lag between launching the application and being able to use it. This slowness negatively affected their first impressions of the application, and it was felt that this would demotivate potential users. They therefore advised that the navigation should be improved to give a positive first impression.

### **User enthusiasm**

From the study in PV, we found that the participants felt proud of using the pilot prototype, which was tailor-made to fit their needs and characteristics. The participants liked the pilot prototype as it fitted with their needs for training and the characteristics of most MBs, and allowed for training in different situations. They also reported that they were excited by the prototype, interested in using it, and motivated to use it.

The findings of PV confirmed that the perceptions of the prototype's features and operations matched the previously identified user requirements for the mobile training application. The participants were excited to find the user requirements they had previously identified incorporated into the pilot prototype.

The independent training process provided by the application motivated the participants, and it was found to fit into their working environment, thus motivating most of the MBs who participated in the evaluation process. The participants indicated that they were eager to see their loan officers training them via this application. Lastly, the participants reported that they were excited to see a specific technological solution

to the practical challenges of time limitations, geographical distance and education level.

#### **4.5.2 Extent to which the pilot prototype addresses the challenges and strengthens the interaction**

The mixed-method study reported in PV also focused on assessing the extent to which the pilot prototype addressed the root causes of the problems encountered in training (low education levels, time constraints, and geographical distance) and enhanced the interaction between MFIs and MBs.

In this study, we confirmed that the prototype addressed the issue of time constraints, as it allowed both the trainer and the trainee to use it at their convenience. The pilot prototype was designed to use mobile devices to deliver training materials and to support training without an in-person meeting; hence, the problem of setting a specific time for a meeting between the trainee and the trainer has been addressed. The participants' feedback on their experience of the proposed training solution was positive; the prototype application was found to provide flexibility for both the trainer and the training timetable. The participants commented that the pilot prototype allowed MB owners to find a convenient time for training, as the training materials could be found on the mobile devices any time. This gives MBs the opportunity to manage their business full time while receiving continuous training at suitable times.

The geographical distance between the trainer and the trainee was one of the challenges identified as affecting training, and we therefore needed to evaluate the extent to which the mobile application could address these challenges. Through the evaluation of the pilot prototype in PV, we confirmed that the delivery of training materials to the trainees' was possible without an in-person meeting between MFIs and MBs. Since every trainee was able to watch, read, or listen to the training materials on their mobile devices, there was no need to meet at a given place to receive training from the loan officer. Since the pilot prototype was found to eliminate the problem of distance, the issue of travelling expenses was also addressed.

A low level of education was also identified as one of the challenges facing training continuity, and this problem was also shown to be addressed by the pilot prototype through the use of the Kiswahili language and the provision of short, precise training sessions. In PV, we confirmed that the originality of the prototype and its tailor-made nature increased the motivation of MB owners to receive training. The study confirmed that the pilot prototype considered the level of education of owners, particularly when selecting the language and the multimedia formats used.

#### **4.5.3 Suggestions for improvement**

Although the user requirements matched the features of the pilot prototype, many avenues for improvement were identified by the participants for incorporation in the final version of the MBMF mobile training application. In the study reported in PV, we found that many aspects needed to be addressed in future to improve the quality of the current pilot prototype.

In PV, we confirmed that potential users would like the actual application to include the possibility of receiving instant feedback on shared materials. The aspiration was to create a platform for instant online meetings with trainers. The respondents suggested the option of the trainer leaving materials/comments for reference in case trainees are offline during training. In addition, the findings showed that symbols and figures were important in terms of expressing items and concepts. Another important recommendation for improvement was to extend the use of Kiswahili to the navigation process, since this was found to include some English expressions. The participants recommended that the application should use Kiswahili for both training materials and the navigation process.

Both MFIs and MBs commented that certain pages, videos, audio files and lecture notes were long and boring. The participants recommended that a more concise presentation of materials, such as smaller files with less content, would be ideal, since some trainees would be listening to, reading or watching the training materials while doing other activities, and long training sessions might make them lose concentration on the subject matter.

We also found that MFIs found it difficult to prepare video materials. Only one video-based learning session was successfully developed by MFIs, and this was achieved with the help of an external video production expert. The MFI officers commented that the process of video production could be outsourced, or a technical specialist should be employed to develop training materials.

Participants proposed that all aspects of the navigation and material layout should be presented in Kiswahili. During the evaluation, we found that some items within the application (the navigation button, YouTube comments and the headings of some commands) were still in English. Since the application was mainly written in Kiswahili, it was suggested that all its features should be written in a single language.

Finally, MB owners were very concerned with internet costs, and asked that video files could be downloadable for future use. Another proposed option was that training materials could be accessed via a Bluetooth interface, meaning that videos could be downloaded free of charge at the MFI premises during visits by MB owners. It was also pointed out that training would be delivered on small mobile screens, and that the power consumption and low battery life of smartphones, especially of particular models, should be considered.

**Table 18.** Summary of evaluation

<b>Focus of evaluation</b>	<b>Aspect evaluated</b>	<b>Specific findings confirmed in pilot prototype</b>
Usability	Attractiveness	The application's, interface and service found enjoyable to users
		Participants were satisfied with the different multimedia used
		Participants were entertained by the multimedia formats
		The application provided a relevant service to fit the skills gap of MBs
		Participants moderately agreed that the application was user-friendly
	Perspicuity	Participants were happy with the use of Kiswahili



Focus of evaluation	Aspect evaluated	Specific findings confirmed in pilot prototype
		<p>Participants commented that the application was clear</p> <p>Participants commented that the application was easy to use and understandable</p> <p>The navigation was confirmed to be moderately good and easy to use</p> <p>The clarity of the interface was positively commented on</p>
Addressing the challenges and strengthening the interaction	Challenges addressed by prototype	<p>The application addressed the time constraints through training any time</p> <p>The application tackled the issue of geographical distance through training anywhere</p> <p>The original, tailor-made prototype addressed the challenge of low educational levels</p>
	Aspect strengthened	<p>The interaction was strengthened through effective training</p> <p>The interaction was strengthened through smooth information flow</p> <p>The interaction was strengthened through closer and more active communication</p>
Possibilities for improvement	Comments on the appearance of the artefact	<p>Participants suggested considering active chatting if someone is online</p> <p>Participants suggested including symbols and figures</p> <p>Participants suggested that Kiswahili should be used throughout the navigation process</p>
	Usage	<p>There is a need for brief and precise training materials</p> <p>Video production requires a specialist for quality materials</p> <p>Local storage is needed for offline training</p>



## 5 Discussion and conclusion

This chapter interprets and discusses the results based on data collected during the development of the pilot prototype of the MBMF mobile training application, and relates these results to the research questions. In addition, this chapter examines the applicability of the results, the research contributions of this work, the limitations of the study and suggestions for further work.

### 5.1 Interpretation of the results

This section discusses the main results and the answers to the research questions, with the aim of contributing to existing knowledge. Relevant knowledge includes descriptions of the form and functions of the artefact (the MBMF mobile training application), the field in which the artifact operates (financing and MB), and the design principles and impact (artifact and research impact) of the project. The knowledge contribution of a design project is important because a full and well-organised framework or design approach can develop or be modified over time through multiple processes of trial and error (Baskerville, et al., 2018; Walsham, 2012). Therefore, the interpretation of results have discussed by answering the research questions and summarised information presented in Table 20 at the end of this sub-section.

RQ 1: What is the nature of the interaction between MBs and MFIs?

The answer to this question corresponds to the 'problem explication' activity of this project. In PI and PII, we established the nature of the interaction between MFIs and MBs, the information shared and the services offered in this interaction, and the challenges faced.

With regard to interaction, we confirmed that the interaction between MFIs and MBs was based on a lending relationship, as postulated by

Uchida et al. (2012). Relationship lending is considered a very important aspect of the services offered by MFIs, as it has been identified as helping in the collection of soft information from MBs. The collection of soft information is vital, since owners of MBs can neither produce financial information nor provide collateral, as most are low-income earners (see Blavy, Basu, & Yülek, 2004; Comeig, Fenandez-Bilanco, & Ramirez, 2015; De la Torre, Peria, & Schmukler, 2008). This information is also useful in the loan appraisal and monitoring process. The types of information collected include the place of residence, the type and location of the business and other pieces of information from the local authority.

The findings revealed that the services offered via the interaction between MFIs and MBs included microloans, microsavings, training, marketing, business networking, and business information, although the last three of these are not given priority. Of the services offered, training was reported as being most important by all parties in the interaction. Training is very important, as it equips MBs with the financial and business skills that can help to reduce loan defaults. In addition, training enhances the closeness between MFIs and MB owners, facilitating the loan monitoring process. Our findings confirmed those of Kessy and Temu (2010), who recommend an emphasis on the training of MBs to create positive impacts on business performance and loan servicing.

The results of PI and PII showed that all of the services offered by MFIs and the information sharing with MBs were conducted through loan officers. The findings confirmed that agents (loan officers) are necessary due to the nature of the interaction between MFIs and MBs. This means that the parties to the interaction (MFIs and MBs) depend heavily on the work of loan officers, who play the roles of custodian of soft information, marketing officer, trainer, contract negotiator, and loan collector. This reliance on the work of loan officers (i) leads to an agency problem, as the goal of the principal (MFI) may contradict the goal of the agency (loan officer); and (ii) may pose an increased risk to the institution, as previously identified by scholars such as Comeig, Fenandez-Bilanco, and Ramirez (2015) and Makunyi and Rotic (2017).

The challenges facing the interaction between MFIs and MBs were shown to be associated with both agency and non-agency problems; both types of problem affect the quality of the information and the services offered via the lending relationship. Using data analysis, we showed that agency challenges arise from the use of loan officers, including bribes during loan disbursement, incorrect information given to MBs, poor customer care, and late responses to customers' enquiries (Ang, 1991; Berger et al., 2001). Non-agency challenges include a low number of loan officers compared to the number of customers served, the large geographical distance between the locations of MBs and the offices of MFIs, time constraints on MB owners, and low levels of education. All of these factors were found to affect the interaction; as previously identified by Alex (2014), these challenges have a considerable impact on the interaction between MFIs and MBs.

Several other challenges were identified in terms of the interaction and communication between MFIs and MBs. These included incorrect information provided by MFIs, unavailability of loan officers at the desired time, poor customer care, and late responses to customers' enquiries. Others included late loan disbursements and short lending periods. The study confirmed that some of the identified challenges are not the agency problem, and that solutions aiming to address the interaction, communication and relationship challenges should focus on issues other than merely the agency problem. We confirmed that the suggested technological solution would enhance the interaction between MFIs and MBs.

RQ2: What are the key features of a technological innovation that would enhance the interaction between MFIs and MBs?

This question corresponds to the 'definition of user requirements' activity within the DSR framework. The answer focused on factors that enable the usage of mobile devices among MBs, user requirements for mobile training, and the justification for focusing on the training service to improve the interaction between MFIs and MBs.

In PII, we confirmed that a mobile technology solution could enhance the interaction between MFIs and MBs. This claim was grounded in the factors that were identified as supporting the usage of mobile devices in microcredit services. These included: (i) the daily usage of a mobile phone by both MB owners and MFI officers; (ii) the use of mobile phones for business and official purposes by both parties; (iii) the positive perception of the use of mobile microcredit services and the reported comfort of MB owners in using mobile phones; (iv) the ownership of smart mobile devices by owners of MBs; and (v) the absence of a tailor-made application for MB activities. We found that the current usage of mobile phones by MBs was typically limited to phone calls, text messages, money transfers, personal alarms, Internet searches, calculations, and social media communication.

The findings of this study concurred with those of Bagheri (2017), Bada, (2012), Hellstrom, (2010) and Henrekson (2014), who revealed that there is no tailor-made mobile phone application for the interaction, communication, and relationship with MFIs. There is therefore real potential for the development of a mobile application for this particular purpose, as suggested by ICT-enabled outreach theory (Diniz et al., 2008; Mahfuz et al., 2016). In addition, we found that although the current use of mobile devices is mainly limited to calls and normal text messages (Mramba et al., 2014; Kapinga, Monterp, and Mbise, 2017), the delivery of mobile microcredit services among MBs would be possible if there was a well-designed solution that took into account the level of education of MB owners, and their working environments and activities.

In PII, we identified the general features of a solution that could help in offering microcredit services and the specific features of a mobile training solution. In terms of the requirements for a technological tool, the findings of PII and PIII provided evidence that an effective solution would strengthen the relationship between MFIs and MBs. It was found that mobile technology solutions could support the interaction, communication and relationship between MFIs and MBs. The general features could also allow for the scalability of microcredit services embedded in a single application. We therefore established that mobile technology solutions could potentially support MB activities. In addition, this technology should

enhance the communication platform, reduce the power of loan officers, set a standardised period of time for responding to customers' queries, and reduce incidences of bribery and unnecessary personal contact between loan officers and MBs.

Furthermore, the studies reported in PII and PIII revealed that the training service can play an important role in strengthening the interaction between MFIs and MBs. These findings supported those of Marivate (2014), Aladejebi (2018) and Baah-Mintah, Owusu-Adjei & Koomson (2018), who highlighted the importance of training in fostering the business and financial performance of the MBs. However, due to factors such as the large amounts of information shared as part of the training process, the challenges affecting training, and the working environments of MBs, which do not support in-person training, the decision was made to focus on mobile training.

The findings of PII and PIII indicated that participants would prefer a mobile training application with certain user requirements, including the use of Kiswahili, multimedia options, simplicity of use and delivery via mobile phone.

The use of the Kiswahili language was the main requirement, as most MB owners have a low level of education and are Swahili speakers. The provision of multimedia options such as audio, videos and slides was proposed to facilitate the delivery of training to MB owners in different environments. A simple mobile training application was recommended as a match for the level of education of MB owners, and the development of a mobile application was undertaken with the aim of delivering training anytime, anywhere. The findings of this study were in line with the user requirements identified by other scholars (e.g. Kapinga, Montero, & Mbise, 2017; Mramba, Apiola, Kolog, & Sutinen, 2016), who focused on providing mobile solutions for the activities of other types of informal practitioners.

The decision to focus on the issue of training to improve the interaction between MFIs and MBs was due its importance to all parties. From the findings of PI, we established that training is considered an equally important service as microloans by MFIs and MBs. In PII, we showed that training has a positive impact on loan repayments, as it can equip

MB owners with financial skills and improve business performance; participants strongly disagreed with the statement that the training service was useless. The importance of training to owners of Tanzanian MBs has been highlighted by other authors such as Adams, Silva, and Setareh (2013), Greenbank (2000), and Kessy and Temu (2010).

As a capacity building mechanism, training was shown to improve the competitive operation and performance of MBs, resulting in strengthening of the interaction with MFIs. In addition, training was found to be a method of gauging the trustworthiness and behaviour of MBs, and to help MFI officers to eliminate untrustworthy MBs during loan appraisal, thus reducing defaults. Moreover, effective training may result in active loan monitoring, further strengthening the interaction. Lastly, the interaction between MFIs and MBs is based on soft information, and effective training was found to assist in the collection of such information. Based on these aspects, the decision was made to focus on the design of the training application in order to strengthen the interaction between MFIs and MBs.

As there is a clear need for a mature lending relationship, the identified user requirements for mobile training application were shown to favour the interaction between MFIs and MBs. Hence, at this stage, it was recommended that care should be taken to ensure that the suggested technological solution was well designed in order to fulfil the user requirements of the potential end users and ensure the effective delivery of training materials.

RQ 3: How does the pilot prototype mobile training application support the interaction between MFIs and MBs?

The pilot prototype of our MBMF mobile training application forms the core of this project, as the aim was to invent a tool to enhance mobile training and support the interaction between MFIs and MBs. The pilot prototype was the focal point, while the various activities of design and development led to its realisation. The evaluation of the pilot prototype confirmed that it addressed the identified challenges and contained features that correspond to the user requirements identified earlier. The



artifact was evaluated to demonstrate that it led to enhancement of the mobile training service to MBs. Moreover, the prototype was shown to have the potential to strengthen the interaction between MFIs and MBs from a relationship lending perspective.

With regard to the way in which the pilot prototype can support the interaction between MFIs and MBs, this section discusses (i) the importance of training in this interaction; and (ii) the potential of the prototype in terms of enhancing the delivery of training to MBs. Hence, the results confirm the importance of the pilot prototype in the interaction between MFIs and MBs.

This study confirmed that participants considered training to be important in terms of capacity building and the loan monitoring process. An effective training process could therefore strengthen the relationship between MFIs and MBs. The results supported earlier findings that both MBs and MFIs consider training to be very important (Kessy and Temu, 2010).

The study also directly addressed the factors hindering the delivery of training services by MFIs, and indirectly focused on strengthening the interaction between MFIs and MBs. Our mobile technological solution, which was introduced as a platform for the delivery of training materials to MBs, aimed to improve the quality of training and interaction in general. As shown in PIII, the application addressed the root causes of the problem related to time constraints, geographical distance, and low educational level of MBs. The output of PIV was the pilot prototype of our mobile training application.

From the findings of the demonstration stage in PIV, we established that the prototype would help to support the interaction between MFIs and MBs by delivering training material to MBs anytime, anywhere. In addition, the output of this study paved the way of developing the actual mobile application for training and other mobile microcredit services. We have therefore confirmed the importance of using mobile technology in training MBs. Based on these findings and confirmation from other scholars (e.g. Kessy and Temu, 2010; Birdthistle, 2006; Berge, Kjetil, Kartika, & Bertil, 2012; Kjetil & Bertil, 2010) who have identified the importance of training

in strengthening the relationship between MFIs and MBs, we established that a technological solution that can support the efficient and effective provision of training to MBs will eventually strengthen this interaction.

In the usability evaluation of the pilot prototype, we explored the impact of the pilot prototype on the interaction between MFIs and MBs. The DSR impact delineated by Agarwal and Lucas (2005), as a bottom line of the information technology research. These include: (i) dramatically alters cost structures; (ii) provides new levels of customer service; (iii) compels the development of organisational strategies in response to changes in technology; and (iv) creates new, innovative forms of business that generate positive economic activity and enrich people's lives.

The scope of DSR impacts therefore, likely to address the goal of the research and the problem being addressed. The design process adopted in our study and pilot prototype MBMF mobile training application confirmed here to reflect some of these impacts. Based on our evaluation of the prototype, we identified the following aspects:

- Cost reductions can be made due to the elimination of time and geographical distance constraints
- The MB-MFI interaction can be strengthened by improving the quality of customer service
- The frugal design provides opportunities for MFIs to easily respond to changes in technology and the associated opportunities for interaction
- The application provides the scope for innovative forms of microcredit service provision which can generate positive economic activity
- The application has the potential to improve the lives of informal practitioners (MBs) by making their daily operations more effective.

RQ 4: What can be learned from the design of a mobile training application to support the interaction between MFIs and MBs?

As it is becoming increasingly important to measure the impact of research in academia, it is recommended the DSR project to report both artifact and theoretical lesson to the research and practical world (Baskerville et

al., 2018; Hevner et al., 2004). The answer to RQ 4 therefore involves the practical and theoretical lessons obtained during the design of the pilot prototype of the MBMF mobile training application. These lessons are the results of reinforcing the DSR framework with design thinking, frugal innovation, and usability evaluation.

The study revealed the importance of focusing on human and environmental factor during the design of the mobile training solution, and especially for low-income earners. This human and environmental focus emphasised by the usage of design thinking, as postulated by Owen (2006). Since it is important to design solutions for societies with unique working environments and activities, a consideration of the characteristics and nature of the end users, including their working environments, is very important. As confirmed in PV, the use of design thinking in this project enabled a deeper analysis of the constraint on MBs in terms of educational level, time and geographical constraints.

Moreover, the application of design thinking in this project helped in generalising the problem to capture the wider aspect of the practical world, before narrowing it down to a solvable status (Brown & Wyatt, 2010; Meinel, Lindberg, & Wagner, 2010). In the evaluation activity, we confirmed that the project managed to solve the specific problem of providing a training service to MBs while at the same time looking at its general impact in terms of strengthening the interaction between MFIs and MBs. The lessons learnt from this study therefore include the generalisation of the issue, before narrowing it to a solvable problem, and the human-centric and environmental design.

Another lesson was the use of a small team of researchers, practitioners, and technologists in a sparse resources setting to develop a good enough technological solution to tackle a practical problem. The experience from the project propose that the sparse resources setting research and rigor approach as per Hevner et al. (2004), results to a solution that can tackle practical challenges of low income earners. Rigor is needed to ensure that the design follows the prescribed theoretical process, while frugality focuses on the use of available resources.

Through the design and development of the application prototype, we established that the aspect of frugality could be used to formulate a project team of people who differed in terms of education level, research capabilities, area of expertise, and experience. The project team consisted of one undergraduate computer engineering student from Dar Es Salaam Institute of Technology (DIT), one junior researcher who was a lecturer at CBE, Tanzania, and a PhD student at the University of Eastern Finland's (UEF) School of Computing. Other team members were 20 MFI officers, who were experts in financial and loan monitoring issues, and 30 MB owners, who were informants and participants in participatory studies. The entire team was closely supervised by three senior researchers from Tanzania and Finland.

The findings presented in PIV and PV indicated that the pilot prototype had the minimum number of features necessary to function without reducing the quality of the system. We established that the mobile solution would use existing infrastructure for its operation. Based on our findings, we decided that the pilot prototype of the mobile training application would use YouTube as the video platform, Archive.org for audio, and Google Drive for slides. This supported the idea that frugal innovation projects have to continuously consider the simplicity of the solution in resource-constrained societies.

Another lesson learned from PV was that usability evaluation is appropriate for assessing the pilot prototype of technological solution and can provide feedback for earlier identified user requirements. The reinforcement of usability evaluation in DSR framework is because the project had to come up with theoretical contribution before the application is fully utilised in the entire public. The application of usability evaluation within DSR determined the perception of users towards the evaluated pilot prototype. The usability evaluation is appropriate also for early stage analysis of potential product (Kontio & Bragge, 2004; Tremblay, Hevner, & Berndt, 2010).

We also learnt that participatory design helps to provide feedback from the potential end users. The studies in PIII, PIV and PV involved potential users of the pilot prototype in the research team. The participatory design

and creation as recommended by Cotton (2014), Goodyear-Smith, Jackson, and Greenhalgh (2015) and Neuhofer (2016), was adhered in this project. Participants gave feedback on the functions and features of the pilot prototype in relation to the user requirements identified previously. For example, during the development of the pilot prototype, the discussion made by the project team. After discussion with the whole team, it was decided that certain tasks such as the architectural design, the dataflow diagram in PIII, and the studio work for the development of our application in PIV would be done by researchers and engineers.

In summary, we have established that (i) a human- and environment-centric approach; (ii) a small and participatory project team; and (iii) the usability evaluation of the pilot prototype are important for projects with sparse resources settings. Although the application is at the prototype stage, the results show that design thinking, frugal innovation and usability evaluation have huge potential in terms of strengthening DSR, if implemented effectively. It was therefore confirmed that the design and development can involve multiple design approaches, as summarised in Table 19.

**Table 19.** Lesson on reinforced DSR project with design thinking, frugal innovation and usability evaluation

General lesson	Aspects contributing to specific lesson	Specific lesson
Reinforcement of DSR with design thinking, frugal innovation and usability evaluation	Design thinking	A human- and environment-centric was used The explicated problem can be expanded to generalise the knowledge and narrowed to give a solvable problem
	Frugal innovation	A small, consistent, multidisciplinary team was formed, and existing infrastructure was used in a sparse design process
	Usability evaluation	The user perceptions and participatory approach can provide feedback to earlier defined requirements, and estimate the utility and usability of the product

RQ 5: What kind of guiding principles can be drawn up for stakeholders in the context of Tanzanian MFI in regard to mobile training applications?

A set of design principles is an acceptable DSR contribution in the form of prescriptive knowledge that offers theory-based experience of DSR in a scientific discipline. These principles capture knowledge about the design of specific solutions (e.g. our pilot prototype of an MBMF mobile training application) and its design process (Haj-Bolouri, 2019; Yang, & Yuan, 2012). The answer to RQ 5 focuses on the principles derives from the design process and the methods used in designing the pilot prototype of pilot prototype of MBMF mobile training application.

The response to RQ5 therefore centres on drawing up a set of guiding principles for the development of a mobile phone application and its incorporation into the interaction between MFIs and MBs, specifically for the provision of training services. These principles are proposed based on a process that included is this project. The process applied in this project include DSR (Johannesson and Perjons 2014; Hevner, 2007; Venable, 2006), design thinking (Brown & Wyatt, 2010; Dijksterhuis & Silviu, 2017; frugal innovation (Agarwal & Brem, 2012; Zeschky, Winterhaltere, & Gassmann, 2014), and usability evaluation (Baguma et al., 2013; Yogasara et al., 2011; Schrepp, Hinderks, & Thomaschewski, 2017).

Although a theoretical contribution cannot often be fully obtained from a single project, something new should emerge from this rigorous research process (Baskerville, et al., 2018). This justifies the use of the research cycle of Hevner et al. (2004) in conjunction with the activities of the DSR framework (Johannesson and Perjons 2014) as a knowledge contribution at each stage of the design process (see Figure 3.1 in Chapter 3).

The use of DSR should result in a set of principles and approaches that can be used in other projects with the same characteristics, in different social settings. In the present work, we formulated principles that apply to the development of mobile microcredit services in the interaction of MFIs and MBs. Seven principles were identified as being important in the design of a mobile application for MFIs and MBs, as follows.

## Principle 1: Appreciation of the contribution of each member of the project

Regardless of their level of understanding, resources and characteristics, the researcher identified the contribution of each team member in terms of accomplishing the project. The contribution of each member of the project team was achieved during the innovation contextualisation. Despite the small size of the team, there were permanent members that are experienced and non-experienced researchers, software engineers working together with practitioners such as MFIs and MB owners. A small and permanent team has revealed the main pillars of successful design and development of the pilot prototype of MBMF mobile training application. Based on this study, the researcher proposes that trust and participatory project teamwork involving senior researchers, junior researchers, experts, and practitioners could be applied in other innovative and technological projects. However, disadvantages such as misunderstandings should not be ignored in the design process when participants have multidisciplinary backgrounds.

## Principle 2: Apply a tailor-made solution to solve a practical problem

In PV, we established the principle of using technology that was tailor-made for specific users to solve practical challenges. The reasons for this were (i) to ensure that the project team focused on the characteristics of end users; and (ii) to solve a specific practical challenge. Two different classes of users were involved, i.e. MFIs and MBs., The design principles for our mobile training application for MBs therefore needed to be guided by a detailed analysis of the end user characteristics. Basing on the established practical challenges and characteristics of MBs, the pilot prototype of MBMF mobile training application was designed as the tailor-made solution . MFIs and MBs were therefore the specific, targeted primary users of the application. The principle of using a tailor-made solution was important in developing an effective, simple, and easy to use application.

### Principle 3: Acting informal to transform informal practitioners to formal

Since the most of MBs are informal, this dissertation has come up with principles of transforming the informal practitioners to formal. The principle of transforming informal practitioners to formal emphasises strengthening the activities of informal practitioner in order to make them formal. Our focus on the characteristics of potential end users meant that the development of our pilot prototype was driven by attractiveness, enthusiasm, and perspicuity to ensure that informal practitioners were equipped with the necessary skills. Consequently, the training application designed target at strengthening the interaction between MFIs and MBs that may transform the practises of MBs. Our guidelines therefore propose that researchers, practitioners, and experts should work on transform the practices of informal workers to formal level.

### Principle 4: Relationship between formal and informal institutions

This principle relates to the fact that the nature of the interaction between MFIs (formal) and MBs (informal) was based on a long-term relationship between the two parties. This resulted in the use of a relationship lending model which took into consideration the services offered, the means of service provision and the challenges involved. An analysis of the relationship between MFIs and MBs supported the design and development of a solution that was suitable for this interaction, enhanced the services within the interaction, and addressed the challenges associated with this interaction. For instance, MFIs may decide to include other services that can strengthen this interaction; for example, mobile services such as record keeping (Gomera et al., 2019), marketing information (Kapinga, Montero, & Mbise, 2019), bookkeeping (Mramba, Tulilahti, & Apiola, 2016), and loan monitoring services (Gomera & Oreku, 2018) could be considered. In addition, MFIs can reach MBs at any time over long geographical distances, and can support their business undertakings via reductions in loan defaults, simplification of soft



information collection and improvements to the operational performance of MBs.

#### Principle 5: Designing should consider environmental aspect

The working environment in which the solution will operate is the main determinant of its performance. In order to create a solution with a better environmental fit (Walsham, 2012), a DSR process should aim at assuming the environmental friendly product. The principle of considering the environmental aspect in design helps to create a quality solution with a high level of utility. Hence, in view of the working environments of MBs, the focus was on the use of mobile devices and various types of multimedia and training channels. In PII and PIII, the project team decided to design a solution that would support training at MBs' working environment. The training materials that contain short context and delivered through various multimedia confirmed to support MBs at their working environment.

We therefore propose that it is important to conduct a survey to assess the working environment of the end users in order to select the most suitable device, type of training materials, and channel for training. Since, the environment should make mobile training easy, friendly, attractive, and motivate to learners, then environmental centric is considered as an important aspect of the DSR process.

#### Principle 6: Consideration of technological solution for challenges affect informal practitioners

The technological solution was developed in line with the practical environment, challenges, and activities of MFIs and MBs. In DSR, a technological artifact can be categorised as a construct, model, method, or instantiation (March & Smith, 1995). In this dissertation, constructs define and communicate practical problems and solutions, whereas models translate constructs into real-world technological design for informal practitioners. In addition, the methods elaborate the feasibility to justify that the designed artifact is working for its intended purpose.

In this project, the proposed technology was an application that enhanced the sharing of training materials with trainees. At the demonstration and evaluation activities, the project team focused on assessing the ability of the artifact to work in the real world, its effects and the extent users perceive the product. The demonstration and evaluation of the pilot prototype confirmed the extent the design idea enhance the interaction between MFIS and MBs. From this standpoint, people who have access to this technology can be assumed to be better off, with improved productivity.

To implement the proposed technological solution, MFIs need to invest in technical equipment in order to develop training material and upload it for MBs to view. Some basic computing skills are therefore required of MFI officers wanting to use this mobile training application. MFIs also need to take the time to demonstrate how MBs can effectively use this application to view the training materials and any other services that can be embedded in the application. The MBMF training application involves technological platforms such as the Android operating system, YouTube, Archive.org and Google Drive.

#### Principle 7: Consistency of the team throughout the project

The project involved a consistent small project team throughout the stages of the DSR framework. The involvement of the team is required not only in the initial activities but throughout the entire design process, including the evaluation stage. The team comprised one computer engineering undergraduate student from Dar Es Salaam Institute of Technology (DIT), a junior researcher from CBE, Tanzania, a PhD student from the University of Eastern Finland, two MFI officers and their loan officers, and three senior researchers from Tanzania and Finland. The use of a consistent team creates opportunities for quick response on demand of potential end-users and connected flow of idea, events, arguments, and activities. This also helps to reduce the time and funds required for the recruitment of new participants in the study. However when applying permanent research team, care should be taken to minimise the disadvantages of using the

same respondents in each research activity. To achieve this, we recruited new participants for the quantitative studies in PII and PIV, in order to determine whether the same idea could be achieved by using a larger sample size.

These principles are considered as the experience achieved during the project of using mobile technology to enhance the interaction between MFIs and MBs based on the DSR framework. This study provides a fresh perspective on the delivery of mobile training to MBs in the context of MFIs and MBs in Tanzania. Since the world is dynamic, with different cultures, working environments and characteristics of end users, these principles are also dynamic and context-dependent, and can be improved further by practitioners, engineers, and researchers. We therefore suggest that further work is required to develop a comprehensive framework for the development of mobile applications for the provision of mobile microcredit services to MFIs and MBs.

**Table 20.** The position of the DSR project in terms of the practical and research worlds

<b>Design science research objective (Johannesson and Perjons, 2014)</b>	<b>Result of the project</b>	<b>Assessed impact</b>
Technology and science evolutions	The application of DSR cycles to the connection between mobile technology and the practical interaction between MFIs and MBs	The use of a design cycle enhanced the connection between business practices of MBs and MFIs with the theories underlying the relationship lending and allowed for the development of mobile technology to pave the way for the delivery of mobile training to Tanzanian MBs
Design artefacts	The development and evaluation of a pilot prototype of a mobile training application	The prototype was demonstrated to facilitate the delivery of mobile training to MBs anytime, anywhere, and to strengthen the interaction between MFIs and MBs

<b>Design science research objective (Johannesson and Perjons, 2014)</b>	<b>Result of the project</b>	<b>Assessed impact</b>
	The reinforcement of the DSR framework and proposal of guiding principles for design	The concepts of design thinking, frugal innovation and usability evaluation were used in an interchanging and complementary way within the DSR framework
Design theory	A set of design principles	The design principles developed in this study covered the technological, economical and human resources aspects of the problem, thus contributing to existing knowledge of the design process
DSR process	A DSR design process reinforced with design thinking, frugal innovation and usability evaluation	A design lesson was derived from the application of three different design approaches (design thinking, frugal innovation and usability evaluation) for future projects that involve potential users with different characteristics and economic levels
DSR impact	An assessment of the impact of the project	<p>The impact of the artifact was assessed based on the anticipated benefits, such as tackling the distance and time constraints on training, cost reductions and an improved training service</p> <p>The impact of the research was assessed based on the proposed guiding principles to improve future design processes</p>

## **5.2 Research outcomes and applicability of the results**

A DSR project must be correctly positioned in the science-technology dualism of interactive cycles (Baskerville et al., 2018). Within the application domain, researchers must reference and apply the appropriate knowledge bases of scientific (descriptive) and technical (prescriptive). Contributions to both science (theories) and technology (artifacts) are encouraged by different disciplines (Baskerville et al., 2018). The contribution of DSR consists of the results in terms of the developed artefacts and design

theory, which can influence both practice and research. In general, both design artifacts and design theories have potential practical and research impacts (Baskerville et al., 2018; Walsham, 2012).

As part of this project, five studies were conducted involving the application of DSR, reinforced by design thinking, frugal innovation and usability evaluation. Accordingly, the outcomes of the study provided a scientific contribution and solution to the practical challenge through the use of a small, well-organised team of researchers, technical personnel, and practitioners in an environment with sparse resources. The guiding principles and the pilot prototype of the MBMF mobile training application formed the scientific contribution of the design process in this environment, and the practical implications involved the interaction between formal and informal institutions.

This study paves the way for a project team to be easily set up and a DSR project implemented in an environment with sparse resources. It was found that empowerment and trust in a participatory design involving researchers, consultants, and MFI and MB staff members were important aspects. Although this project is still at the prototype stage, the results show that frugal innovation is possible, and has huge potential for the near future if implemented effectively.

Using the data analysis presented here, many successful technology initiatives may emerge at a grassroots level. Informal technology hubs led by self-educated technology enthusiasts are a new component of the innovation ecosystem of developing countries. In our project, technologists and researchers formed a project-based team including illiterate workers, and successfully co-created a life-improving technological solution using limited resources. Grassroots-level innovation activities, such as frugal innovation with inter-skilled teams, have huge potential for the future, and offer lessons that deserve to be grasped by first-world researchers and developers.

The results confirmed that a combination of suitable research approaches could generate the solution to the problem at hand. This combination of research approaches was chosen based on the nature of the activity, the characteristics of the potential users, and their economic

level. The use of DSR, which was reinforced by design thinking, frugal innovation and usability evaluation, resulted in the creation of a pilot prototype for an MBMF mobile training application.

The development of this pilot prototype of MBMF demonstrates the practical implications of bringing together formal institutions (MFIs) and informal practitioners (MBs) to find a practical solution. The practical implications of the findings of the study are potentially valuable for policy makers, researchers, governments and private institutions.

Through frugal innovation study in PIV and usability evaluation in PV, researcher conducted demonstration sessions to equip potential users with usage support to the software ecosystem (YouTube, Google Drive and archive.org) including the mobile training application. The demonstration sessions were important as MBs have low education level that require special considerations when designing ICT solution to tackle challenges affect their activities. Therefore the findings confirmed that the ICT solution that suit working environment, simple to use and consider education level should be the focus aspects for designing team during finding solution to challenges setback MBs' activities.

The findings can open up new avenues for improving the skills of informal practitioners, enhancing education strategies for the workplace, and improving the interaction between informal practitioners and formal institutions. The study can also provide input to government institutions regarding the involvement of informal practitioners in policies such as those relating to tax, trade, innovation etc. This is due to its focus on skill development, research methods, technology and the activities of informal practitioners.

More specifically, in the area of financing for MBs, the project has shown the existence of a practical connection between relationship lending theory and agency theory on the one hand and the daily microcredit activities of MFIs and MBs on the other. This can be useful to governments, business personnel and the MFI industry in general, in terms of reaching grassroots practitioners in different sectors using existing theories.

In addition, the findings relating to the undertakings of MBs are particularly important to local authorities, owners of business premises

and other stakeholders with an interest in formalising the activities of MBs, since they offer the possibility of understanding the characteristics of MBs, their business environments, and appropriate ways of meeting with owners during working hours. The findings also highlight the perceptions of the MBs of ways of improving their performance through informal training.

Furthermore, the findings confirmed that technology can be used to address the challenges involved in the interaction between MFIs and MBs. This indicates that there are new possibilities for designing and engineering applications that can help MBs automate their performance in different respects.

This dissertation has opened new avenues for research, design and development, and interaction opportunities between formal institutions and MBs. The results suggests that a second DSR process cycle might lead to adjusted user requirements, an altered artifact or a new problem explication activity (Dreschsler and Hevner, 2016; Bider, Perjons and Johannesson 2020). An important direction for future research, design and development would be to find appropriate ways of using digital technology to connect MB operations with government policies and the activities of formal private institutions. The justification for future studies of this interaction is supported by the fact that MBs have been included in different policies such as tax, finance and education (Harry, Sewchurran, Brown, 2014; Dube and Casale 2019; Elly 2017; Haji 2017; Ebifuro, Mienye & Odubo 2016; Gabor & Brooks 2017); therefore,, the study has paved the way on the use of mobile technology for the interaction between formal institutions and MB owners in order to implement these policies (Obeng & Blundel 2015; Isaga, Masurel & Van Montfor 2015).

Government institutions such as revenue authorities, trade bodies, financial and education agencies can use experience provided in this study to design and develop mobile applications for MBs, for example for registration, tax administration, training, funding and other activities related to business formalisation. Future studies may investigate the importance of MBs in the economy, challenges affecting MBs and

opportunities for using digital technology to formalise the activities of these informal practitioners (Bagheri 2017; Henrekson 2014).

### **5.3 Impacts of applying the DSR approach**

The application of the DSR approach in this study had impacts on the validity and liability of the project and also caused certain difficulties to be experienced by the researcher, and these aspects are discussed in this section. The qualities associated with DSR helped in meeting the validity and reliability criteria proposed in various studies (e.g. Bashir, Afzal, & Azeem, 2008; Creswell & Miller, 2000; Cronholm & Göbel, 2016; Noble & Smith, 2015). The use of DSR allowed the researcher to employ several strategies to ensure the validity and reliability of the project, as listed below.

- Long-term field work with participants allowed the interim data analysis and corroboration of matching the findings with the actual practices
- The use of various other research methods to support DSR allowed for triangulation between data collection and analysis
- The emphasis of the DSR on precise problem explication and definition of requirements resulted in the extraction of low-inference descriptors from a detailed description of people and situations
- The use of photographs and the existence of the solution developed in the project improved the quality of the data collected for this study
- The presence of an active project team allowed for participant assessment of the researcher's work, in which participants reviewed the researcher's findings and the actions taken at each stage.

Apart from contributions obtained from the validity and reliability applied in this project, the researcher encountered certain challenges that were associated with the application of DSR throughout the entire period of the study. The problems posed by DSR and the measures taken by the researcher to overcome them are listed below.



- The study revealed that DSR narrows the gap between practitioners and the research world through participants being transparent to researchers, as observed by Smith (2015). However, the transparency resulted to participants feared losing control of their business secrets. The researcher found that most of the MFIs were reluctant to be involved in the study, for fear that confidential financial information would be revealed. MFI officers considered their information “too confidential” to be published, and were unwilling to share all of this information. The researcher therefore had to rely on long-term relationships to create the trust necessary for participants to be comfortable sharing information.
- The DSR approach is time consuming for the project to be completed. Despite of full-time commitment that could establish a solution to the challenges facing the interaction between MFIs and MBs, the project ended up at the level of a pilot prototype of the MBMF mobile training application. Therefore, the researcher created a scalability option that could allow other mobile microcredit services to be embedded in the actual application (Gomera & Oreku, 2018). In addition, evaluation of the pilot prototype was carried out in terms of the anticipated usability of the application as perceived by the potential end users.
- In DSR, a large amount of the respondents’ time is required for participatory design (Cronholm and Göbel, 2016). The study identified the relevant challenges and opted to apply frugal innovation via the use of a small innovation team for the design and development of the solution.

We therefore call for further studies of frameworks or methods of strengthening DSR, especially in resource-constrained environments. A framework that can mitigate time constraints, scarcity of resources, and the amounts of data required for the project may assist researchers (especially in developing countries such as Tanzania) to apply the DSR approach more often, and to generate numerous solutions to different practical problems.

## **5.4 Limitations of the study and suggestions for future work**

This study describes the theoretical contributions of a study based on a reinforced DSR framework in resource-limited environments. The design process was described in terms of the development of a pilot prototype for MBMF mobile training in the Tanzanian context. The study accomplished several tasks: assessing the interaction between MFIs and MBs, identifying the services offered in MCPs, establishing factors enabling the mobile microcredit services to MBs, defining user requirements and designing a pilot prototype for the mobile training application. However, the study is subject to a number of limitations, which can be used as the basis for future studies, and these are discussed below.

The findings of the study cannot be generalised to all types of customers receiving microcredit services from MFIs. MFIs provide microcredit services to various clients including employees, SMEs and street traders. These customers may have very different characteristics, creating lending relationships with different natures. Hence, before generalising these findings, a study should be conducted to explore the nature of these relationships, preferred services and ways of working.

Another limitation of this study is that it was conducted over a single complete DSR cycle, and the results of its evaluation were not used to improve the application. The artifact developed was inadequate to use the designed prototype in a practical environment without improvements. The study ended by evaluating the pilot prototype of the application, recommending ideas for improvement, and suggesting that future research could be undertaken to transform the current pilot prototype into an actual working application. It would be appropriate for a second round of this DSR project to be carried out, triggered by the current artifact (Bider, Perjons and Johannesson 2020).

The study also focused on a three-cycle view of the DSR (Hevner et al., (2004) rather than a four-cycle view (Dreschsler & Hevner, 2016). Using the three-cycle DSR model, we evaluated the artifact's immediate impact without considering the wider contexts of societal transformation or

the emergent changes. The last (CI) cycle of the four-cycle view of DSR presented by Dreschsler & Hevner (2016) may be valuable in this regard, since this approach can capture the dynamic nature of information system artifact design for volatile environments and emphasises the long-term impact of the evaluated artifact (Dreschsler and Hevner, 2016; Bider, Perjons and Johannesson 2020). Furthermore, as an iterative and progressive approach, DSR requires that the outcomes of the study are evaluated over the long term and that the dynamic impacts on a changing environment are considered and improved (Dreschsler and Hevner, 2016). We therefore call for future DSR studies of this topic that consider the second-order impacts of the design artifacts on the wider organisational and societal contexts. As shown in Figure 3.2, this would involve reiterating the cycle, including explicating the problem again, redefining the user requirements, and redesigning and redeveloping the application, with the current study serving as a trigger for a new or improved artefact.

Another limitation of this study is that its theoretical contribution (i.e. the proposed guiding principles) is based on a single case; this is not always ideal, since researchers and participants differ greatly in terms of their approaches and responses. Since technology is not static, we suggest that further studies should be carried out with different designs that incorporate new technologies, more stakeholders, and different areas of business. A focus on digital technologies, and specifically mobile technologies, is recommended due to their benefits to low-income earners and groups that are less advantaged in other ways, and also due to its easy to use, wide penetration, affordability, and connectivity. More research in this area may increase the usage of mobile phones, which will eventually transform economic growth, social interaction, and knowledge sharing in developing countries such as Tanzania. The development of mobile applications for MBs can be researched from several different perspectives, such as the awareness of MB owners of mobile phone functions and new apps, effective ways of using mobile phones to improve social commitment, and the use of mobile phones to enhance formal contributions to economic development.

This project should be evaluated against the fact that the current innovation ecosystem in Tanzania, as for other developing countries, is not yet fully accustomed to DSR approaches; higher education institutions focus mainly on qualitative and quantitative research, and DSR is not yet widely taught. We therefore propose the wider expansion of DSR to the Tanzanian context. These projects may be initiated by universities, companies, technology hubs, or self-educated technologists to provide many opportunities for future technology development. Many of the opportunities do not necessarily require programming skills, and strong impacts can be achieved by using existing tools and software packages. In the future, projects such as this may be expanded to mobile MOOC platforms, allowing large numbers of informal workers to receive education that is contextualised for their needs.

We call for numerous future studies to identify the barriers that restrict the wider expansion of innovation projects in the various sectors that involve both informal practitioners and resource-constrained societies. This would help in developing ways of overcoming these barriers, and would lead to a strong positive impact on economic and human development. The impacts of different software solutions also need to be carefully studied in formal research setups. A plan for future studies and the aspects these should consider is given in Table 21. These studies arise from our evaluation of the pilot prototype of the MBMF mobile training application.

**Table 21.** Proposed plan for future studies

S/N	Second DSR cycle	Aspects to consider
1	Accommodate the recommendations arising from the demonstration and evaluation of the MBMF prototype	Application of the CI cycle of DSR to ensure that the mobile training application for MBs considers the complex changes in the community, technology and working environment
2	Redefine the user requirements	Scalability of the current mobile training application in terms of providing other microcredit services (microloans and microsavings), and the changes in and complex nature of the interaction, environment and technology
3	Re-explicate the problem in the context of a mobile form of interaction between formal institutions and MBs	Potential use of a mobile form of interaction between MBs and financial bodies, government departments, tax administration and other entities involved in transforming MBs into formal operations
4	Use a reinforced DSR approach in a limited-resource context with informal practitioners	Appropriate use of a reinforced DSR approach in the context of digital technology, informal practitioners and environments with sparse resources
5	Deploy DSR within the technological ecosystems of developing countries	Deployment of DSR by academic institutions, companies, technology hubs, and self-educated technologists to improve the technological ecosystem of developing countries



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# Appendix 1

## Tools for data collection

### A. QUESTIONNAIRE

Dear respondent,

This questionnaire is aimed at collecting data for the purpose of accomplishing a study titled **“Usability evaluation of frugal innovation: A case of mobile training for micro businesses in Tanzania”**. We request your responses by filling this questionnaire. We guarantee that the responses collected during this study will be treated with due confidentiality, and will be used purely for academic purposes and not otherwise. By answering and return this questionnaire as researchers request you are providing the permission for scientific research and scientific report on said study.

Regards

William Clifford Gomera - Researcher

### QUESTIONNAIRE

The practical testing of a prototype of mobile training application is now complete. We ask you to reflect your feelings and carefully respond to the following statements. Please TICK [√] on the appropriate box to show your feeling. (NOTE 1 tick for each question/statement.

How do you feel with the mobile training application to MBs	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
<b>Attractive Aspect</b>					
1. I felt proud to use the application	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. The application had a nice appearance and operated well	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I liked the way training took place	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

4.	The interaction was friendly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5.	I enjoying watching video, reading document and listening the training in this application	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Perspiciuity Aspect</b>						
1.	The interaction looked good	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.	The navigation of an application is easy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.	An application seems easy use	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.	Language used in this application is clear	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Stimulation Aspect</b>						
1.	I feel proud having an application specific for my activities	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2.	During opening an application I felt excited	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3.	The application is interesting by viewing relevant training material at local language	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4.	An application seems to motivate frequently opening and viewing training materials	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## B. GUIDE OF THE FOCUS GROUP DISCUSSION (FGD)

I want to thank you for taking the time to meet with me today. My name is William Clifford Gomera and I would like to introduce a mobile training application that can be used to training you (MBs) at any time anywhere.

The discussion should take a maximum of 2 hours. All responses will be kept confidential. This means that your responses/ argument and comments will only be shared with research team members and we will ensure that any information we include in our report does not identify you as the respondent. Remember, you don't have to talk about anything you don't want to and you may decide to remain silent if you feel like not want to talk. You are allowed to ask any question concerning the application to group member.

<b>Focus group Question</b>
1. Do the current training practise give you chance to receive training materials anywhere anytime?
2. Can you identify the challenges you are facing on the current training practises
3. What enjoyment do you get from the current training practises?
4. Does interface of an application looks attractive?
5. How did you feel when viewed training materials through an application downloaded in you mobile device?
6. What comments can you provide on the interaction with mobile training application
7. What comment can you provide on the clarity and understandability of an application?
8. What complication have you observed from the tested application
9. Do you feel proud to own this application in your mobile phone? Does it motivate you to use it often? Is it excited?
10. Would you be interested on the actual mobile training application?
11. How the application could be improved basing on features and activities?



# Appendix 2

## Sample of letter from MFIs offered an opportunity to conduct research



Millenium MicroFin (T) Limited (MML)  
Tunaboresha Maisha

Green Acres House, Victoria area, Bagamoyo Road.

P.o.Box 65544, Dar es salaam, Tanzania,

Telephone: +255 713842876/ +255 22760636.

Email: [info@microfin.co.tz](mailto:info@microfin.co.tz); Website: [www.microfin.co.tz](http://www.microfin.co.tz);

23<sup>rd</sup> January, 2015

Mr. William Clifford Gomera,  
PhD Candidate,  
University of Eastern Finland (UEF),  
P. O. Box 1968,  
Dar es Salaam,  
Tanzania.

Dear William C. Gomera,

**Re: An opportunity to conduct your research at MML.**

We are delighted to inform you that after received your request for an opportunity to conduct a research for the award of PhD, the Management has accepted to start your study as per your plans. You have been granted permission to collect data and conduct your research in collaboration with MML's staff and customers (MBs) for the research titled: *"the use of mobile technology to enhance the interaction between microfinance institutions and micro businesses in the Tanzanian context."*

We hope that the data you will collect from our institution will only be for the purpose of study as it was intended. Moreover, any information provided will be treated as confidential and be used specifically for the subject mentioned above.

We ask you to adhere to research ethics and guidance concerning confidentiality of information from research participants.

Thus, we wish you all the best during the data collection assignment and the remaining lap of your professional qualification journey.

Sincerely,

On behalf of MML,

  
Managing Director





## Paper II

Gomera, W. C., Suhonen, J., & Oreku, G. (2020). Enabling factors and user requirements for microcredit services through mobile devices - Dar es Salaam Tanzania context. *African Journal of Information Systems*, 12(1), Article 1. Retrieved January 07, 2020 from <https://digitalcommons.kennesaw.edu/ajis/vol12/iss1/1>.



1-1-2020

## Enabling Factors and User Requirements for Microcredit Services through Mobile Devices - Dar es Salaam Tanzania Context.

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# Enabling Factors and User Requirements for Microcredit Services through Mobile Devices - Dar es Salaam Tanzania Context.

Research Paper

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## ABSTRACT

Microfinance institutions (MFIs) play a considerable role in providing capital to micro businesses (MBs) through microcredit services. However, the interplay between MFIs and MB owners has been hindered by several factors, such as challenges with information sharing. The current study aims at identifying the specific challenges of microcredit services in Dar es Salaam, Tanzania, and also at determining the enabling factors, preferred features, and general requirements for a mobile technology solution to support the interplay between MFIs and MBs. The participants in the study were 91 MB owners and 22 MFI officers, and the data for the study were collected via a questionnaire. The study confirmed that the interaction, communication, and relationship between MB owners and MFIs is affected by various challenges. It was confirmed that digital technology can be used to address the identified challenges, and that a tailor-made mobile technology solution would be appropriate for supporting the interaction, communication, and relationship between MFIs and MBs.

## Keywords

Microcredit services, information flow, mobile devices, mobile technology, micro business, micro finance institutions.

## INTRODUCTION

*Micro businesses* (MBs) play an important role in the economy of many countries, especially in Africa, Asia, and South America. They provide employment to people with a low level of education and a small household income (Kibassa, 2012; Rathore and Ilavarasan, 2014). However, most of the MBs have challenges in financing their operations and hence depend on capital from *microfinance institutions* (MFIs) through microcredit services. As a result, MFIs were established to satisfy the needs of low-income earners (Bada, 2012; Diniz, Pozzebon, Jayo, and Araujo, 2008; Ifelunini, and Wosowei, 2012; Okibo and Makanga, 2014; Svoboda, 2016). The most important activities of MFIs are pre- and post-loan training and the monitoring of clients as well as loan appraisals, which require clear and smooth information sharing and interaction between MFIs and their clients (Frank, Mbabazize, and Shukla, 2015; Uchida, Udell, and Yamori, 2012). Consequently, MFIs help MBs via microloans (Abedi, Mirdamadi, Hosseini, and Saleh, 2011; Gomera and Apiola, 2015), and offer training, business consultancy, and loan monitoring (Ajmera, Pandit, Borgaonkar, and Madhvanath, 2013; Gomera and Apiola, 2015; Ifelunini and Wosowei, 2012).

In Tanzania, the introduction of MFIs as part of the National Microfinance Policy in 2001 has been one of the key measures intended to alleviate poverty (Fox, 2016; United Republic of Tanzania [URT], 2003, 2014). Specifically, the policy has enabled low-income earners to receive microcredit services. The number of MFIs in Tanzania has grown from 655 MFIs in 2002 to 1,899 MFIs in 2005 (MFtransparency, 2011; Mori and Olomi, 2012). By 2013, the number had increased to over 6,000 MFIs (URT, 2014), with accumulated loans advanced for about 778.4 billion Tanzanian shillings (Kitala and Kayunze, 2014). Although the microfinance sector in Tanzania has gained importance, the outreach to the poorest households, such as MB owners, is still relatively minor (Marwa, 2014). To enhance the MFIs outreach to customers, the research world and practitioners found it necessary to focus their attention on various possible solutions to this challenge.

One of the solutions suggested and implemented by earlier researches is the usage of digital technology to support and enhance MFI services (Augburg, Schmidt, and Krishnaswainy, 2011; Bada, 2012; Ghosh and Vachery, 2016; Mbogo, 2010; Paruthi, Frias-Martinez, and Frias-Martinez, 2016; Sathe and Desai, 2006; Weber, Kulkarni, and Riggins, 2012). However, most of the existing solutions are not designed specifically to address the interaction, and information sharing challenges between MFIs and MB owners (Ajmera et al., 2013; Bada, 2012; Boekhoudt and Stappen, 2004; Rathore and Ilavarasan, 2014). Given the rapid adoption of mobile phones in developing countries, in particular Tanzania, MB owners are able to use mobile technologies to access MFI services (Ajmera et al., 2013; Addae-Korankye, 2014). Earlier studies envisaged that the use of mobile technology would be potentially applicable for minimizing costs and improving productivity, as most MB owners do not necessarily use other digital technologies, such as desktop computers and laptops (Okibo and Makanga, 2014; Paruthi et al., 2016; Rathore and Ilavarasan, 2014; Uchida et al., 2012).

As a result of the significant innovations that have taken hold in the business environment resulting from the adoption of mobile technologies, the rules of doing business have significantly shifted. Consequently, there is a clear need to design and implement mobile technology solutions to support

interaction and information sharing between MFIs and MBs. It is against this background that our research sought to answer the following specific research questions:

RQ1: What are the key services offered by MFIs to MBs in Dar es Salaam, Tanzania?

RQ2: What are the challenges related to the interaction, communication, and relationship between MFIs and MBs?

RQ3: What are the enabling factors, preferred features, and general requirements for a mobile technology solution to support the interaction, communication, and relationship between MFIs and MBs?

## **BACKGROUND AND THEORETICAL FRAMEWORK**

### **Micro Business and the Role of Microfinance Institutions in the Tanzanian Context**

The existing heterogeneity of definitions of micro business globally necessitates country-specific definitions tailored to local environments. For example, by using the World Bank definition in Tanzania, almost all enterprises fall under the category *micro, small, and medium enterprises* (MSMEs) (Marwa, 2014). Accordingly, the government of Tanzania uses the number of employees and/or total number of assets as parameters in its nomenclature of MSMEs. Most MSMEs are grouped as economic activities in manufacturing, services, commerce, and mining. The classification defines MBs as a type of MSMEs: engaging up to 4 people, in most cases family members or employing capital amounting up to Tanzania Shillings 5 million (URT, 2002). The majority of MBs in Tanzania are labor-intensive, relatively easy to start, and widely distributed across the country, including both rural and urban areas (Marwa, 2014). MBs operate mainly in areas with a high footfall, such as bus stops and market places, and they have permanent business premises and a larger amount of capital than street traders (Mramba, Sutinen, Haule, and Msami, 2014). MBs play a significant role in job creation, income generation, poverty alleviation, and income inequality reduction.

MFIs in Tanzania are the result of a financial sector reform which led to the liberalization of the financial sector and the establishment of private MFIs to support the low-income earners. MFIs provide microcredit services specifically to the disadvantaged members of society and MSMEs, even more so than the well-established financial institutions (Mori and Olomi, 2012). However, MFIs have not been able to reach the majority of low-income Tanzanians. Moreover, most MFI customers cannot produce financial statements for loan appraisals, have low education, and live in geographically dispersed areas (Addae-Korankye, 2014; Bwana and Mwakujonga, 2013). According to Mori and Olomi (2002) and Bwana and Mwakujonga (2013), MFIs have performed poorly due to high operating costs, low revenue generation ability, and small outreach to low-income earners.

### **Nature of the Interaction between Microfinance Institutions and Micro Businesses**

The interaction between MBs and MFIs is based mostly on relationship lending, which replaces the collateral need for low-income earners to qualify for loans (Ghosh and Vachery, 2016; Uchida et al., 2012). MFIs have a large number of microloan customers, making a small individual contribution to the MFIs' financial position (Makunyi and Rotich, 2017). MB owners who receive loans from MFIs are trained on how to conduct their business and in management financial skills. Therefore, the relationship between MFIs and MBs requires a smooth information flow as well as the provision of multiple services, even in distant geographical places (Presbitero and Rabellotti, 2014).

In addition, the geographical distance between MFIs and MBs increases information asymmetries, agency problems, and operational costs, which also affect interest rates and lead to a high risk of loan default (Makunyi and Rotich, 2017; Presbitero and Rabellotti, 2014). An earlier study on MFIs identified the following challenges with the interaction between MBs and MFIs: the interaction is time consuming for MBs; the interaction can be ineffective due to absence of information flow between MFIs and MBs; and sometimes local authorities do not have accurate information on MBs (Gomera and Apiola, 2015). Furthermore, it is still a common practice for MFI loan officers to collect soft information from MBs manually, and also information sharing and communication within and outside of MFI institutions is ineffective (Bada, 2012; Tchouassi, 2012). Thus, the earlier research has clearly shown the need to enhance the interaction, communication, and relationship between MFIs and MBs (Diniz et al., 2008; Hajji, Mbarki, El Jasoul, and Jaara, 2016).

### **Digital Technology Solutions Used by MFIs**

MFIs adopt digital technology for various beneficial purposes, such as for reducing the impact of distance, time, and workload to reach low-earning clients, both rural and urban (Bada, 2012; Nyapati, 2011; Weber, Kulkarni and Riggins, 2012). Consequently, digital technology has been used to enhance the services provided by MFIs, such as KIVA, the world's first online lending platform connecting online lenders to entrepreneurs across the globe (Ghosh and Vachery, 2016; Paruthi et al., 2016; Weber et al., 2012). A widely used digital technology solution is Mifos - Microfinance Open Source software - which has been designed to help MFIs with client management, loans and savings portfolio tracking, business intelligence, and reporting (Bada, 2012). Another example of an existing digital technology solution is a risk assessment fuzzy clustering software, which was specifically developed for loan appraisals and making decisions on loan disbursement (Sathe and Desai, 2006). Finally, various digital technology solutions have been implemented to support the localization of MFI services, such as the Intensive Voice Response System and WiMax (Worldwide Interoperability for Microwave Access), a technology standard for long-range wireless networking for both mobile and fixed connections (Weber et al., 2012).

However, the use of digital technologies by MFIs is still low in Tanzania and requires improvement in the areas of facilities, stakeholders' perceptions, cost minimization, and convenience (Bada, 2012; Kevin, Benard, and Ronald, 2013; Melchioly and Sæbø, 2010; Mramba, Apiola, Kolog, and Sutinen, 2016; Mwela, 2014). The reasons for the low use of digital technology include a lack of digital skills, a need for a digital solution that supports two-way communication between MFIs and their clients, and the use of inappropriate devices (Bada, 2012; Mbogo, 2010). Moreover, most of the available digital technology solutions developed for MFIs are designed for large organizations, which makes them often unsuitable for small MFIs (Augburg et al., 2011).

### **Theoretical Framework**

The theoretical foundation of the study is based on interrelation of relationship lending theory, agency theory, and Information and Communication Technologies (ICT) enabled MFI outreach theory (Ang, 1991; Hajji et al., 2016; Jawadi, Jawadi, and Ziane, 2010; Uchida et al., 2012; Yan'an, 2013), as shown in Figure 1 below. The use of the theories is justified based on the nature of MBs (Ang, 1991; Berger, Klapper, and Udell, 2001), the nature of microcredit services offered to MBs (Gomera and Apiola, 2015), and the potentials of ICT for financial inclusion (Hellström, 2010).

The *relationship lending theory* is connected to RQ1 regarding the key services offered by MFIs to MBs. Within Dar es Salaam there are many MFIs which aim to facilitate MBs with different services targeted at capacity building and access to credit. Lenders provide these services based on soft information (Comeig, Fernández-Blanco, and Ramirez, 2015; Yan'an, 2013), since borrowers have no means of producing and presenting financial statements (Uchida et al., 2012). Moreover, the structure of MFIs in Tanzania consists of the different types of credit providers, and the competition between these institutions is very stiff (Presbitero and Rabellotti, 2014). Therefore, depending on the characteristics of the lending environment, relationship lending might be the most effective technique to MBs, especially for MFIs. Relationship lending is commonly defined as a long-term implicit contract between lenders (MFIs) and the borrower (MBs) (Ang, 1991). The theory on relationship lending suggests that it may be economically beneficial to form close relationships between the businesses and MFIs (Uchida et al., 2012). Thus, relationship lending theory is important in this study because of the characteristics of MBs and the need for collateral substitute services such as training, business consultancy, and aggressive loan monitoring. Moreover, the theory is considered relevant because it establishes how the interaction between MFIs and MBs takes place in Tanzania. Also, it provides a base for identifying the key services offered by MFIs to MBs and the information required thereon (Ang, 1991; Mahfuz, Khanam, and Hu, 2016; Uchida et al., 2012).

The *agency theory* is connected to RQ2 in regard to the challenges inherent in the interaction and sharing of information between MFIs and MBs. The geographical distance between MFIs and MBs increases information asymmetries, agency problems, and operational costs, which also affects interest rates and leads to a high risk of loan default, all of which is accommodated by the agency theory (Makunyi and Rotich, 2017; Presbitero and Rabellotti, 2014). The lending services offered by MFIs are usually done through loan officers acting as agents of MFIs, which increases costs, ethical considerations, and the risk of MFIs depending too much on loan officers (Ang, 1991). Agency theory sound appealing intuitively and relevant in the micro business situation. For example, it pertains to the effects of so-called information impactedness, such as high levels of asymmetric information in regards to market imperfection and capital structure, and how, in turn, entrepreneurs who capitalize on these market uncertainties might not want it to be disclosed because that information might be used against them (Comeig et al., 2015). Moreover, agency theory is related to the problem that occurs when cooperating parties have different goals and a division of labor (Yaron and Manos, 2010). Specifically, the agency theory focuses on the relationship in which one or more persons (the principal[s]) engage another person (the agent) to perform some work on their behalf. In this study, principles of agency theory advocate the understanding of the impact of loan officers to relationship lending (MF transparency, 2011). Moreover, the study aims to determine whether all interaction and information sharing challenges between MFIs and MBs are caused by agency (Berger et al., 2001).

The *ICT enabled MFI outreach theory* is connected to the RQ3, which aimed at identifying enabling factors, preferred features, and general requirements for a mobile technology solution to support interaction, communication, and relationship. Recently, digital technologies have emerged as a powerful tool to reduce operating costs, making it viable for financial institutions to expand into rural and low-income areas (Diniz et al., 2008; Mahfuz et al., 2016). Digital technology innovations, such as a personal computer connected to the internet, a mobile phone, an automated teller machine (ATM), or a point-of-sale (POS) device located at a retail or postal outlet may be less expensive to establish than branches located in rural areas and more convenient for MBs (Hajji et al., 2016; Jawadi et al., 2010). Unlike pure cash-based transactions, transactions using digital technology can take place with less time or with no time required from a teller. Rather than hand over cash to a teller when making a deposit or loan repayment, a customer can give cash to a store clerk, swipe a debit card through a POS card reader,



and input an identification number to authorize the transaction (Weber et al., 2012). Specifically, mobile technology can reduce the number of middlemen, as in peer-to-peer lending and KIVA, which eliminate intermediaries between MFIs and borrowers, and present a viable solution to the agency problem (Ghosh and Vachery, 2016; Paruthi et al., 2016). Hence, ICT-enabled theory is important in the study because: (1) it indicates how mobile devices can strengthen the interaction between MFIs and MBs by tackling challenges of the interaction; and (2) identifies enabling factors and user requirements that can be used potentially to design a solution to tackle the identified challenges. Figure 1 below shows the connection between the three theories and the research questions of the study.

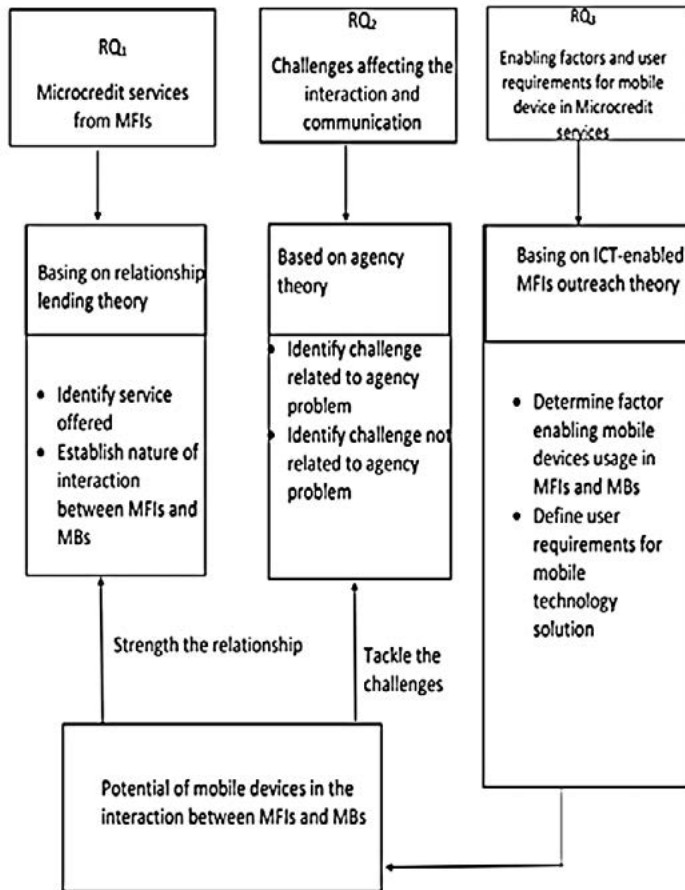


Figure 1: Theoretical Framework

## METHODOLOGY

### Research Design and Approach

The current study is part of a *design science research* (DSR) project, which aims at enhancing the interaction, communication, and relationship between MFIs and MB owners. DSR is a systematic approach toward developing a solution to practical but complex problems emerging from real-life settings (Johannesson and Perjons, 2014). The problem tackled within the DSR process can be a puzzling question or an identified need to improve the current situation for a specific groups of stakeholders. According to Hevner (2007), DSR involves different stages, providing both practical and scientific contributions. The current study was created on the basis of the DSR paradigm, which uses empirical research as a model to tackle a real-world problem (Hoadley, 2004) and hence contributes to theory building (Venable, 2006), problem explication, and requirement definition stages (Johannesson and Perjons, 2014). The empirical approach in DSR concurs with the design thinking aspects of a human-centered focus and the environment-centered concern of the targeted population (Owen, 2006).

According to Johannesson and Perjons (2014), the problem explication stage aims to identifying and defining the problem experienced by the stakeholders of a given practice, in this case, MFIs and MBs. The main aims of the problem explication stage are to explain the problem clearly, formulate the practical problem in a precise manner, and explore the significance of solving the problem (Johannesson and Perjons, 2014). The aim of the requirement definition stage is to concretize the requirements for the possible solution and also to outline the potential solutions. Various research methods can be used, both in the problem explication and requirement definition stages (Hevner 2007; Johannesson and Perjons, 2014). In this research, an empirical approach was used to both further explicate the interaction and information sharing challenges among MBs and MFIs, as well as to identify concrete user requirements and expectations for a mobile technology solution addressing the identified challenges.

### Data Collection Tool

The current study applied a descriptive research design (Creswell, 2014; Knupfer and McLellan, 2001) with the aim of: (1) understanding the existing services offered by MFIs; (2) identifying the challenges related to the interaction, communication, and relationship between MFIs and MB owners; and (3) mapping out potential enabling factors, preferred features, and general requirements for a mobile technology solution to support the interaction, communication, and relationship between MFIs and MB owners. A questionnaire was thought to be an appropriate data collection method based on the number of participants (Randolph, 2008). The questionnaire in the study included self-explanatory, yes/no, and Likert-scale questions (Creswell, 2014). The questionnaire (see Appendix 1) used in the study was developed based on the theoretical framework and literature review as shown in Figure 2. The questionnaire was pilot tested with five respondents before the final questionnaire was given to the participants.

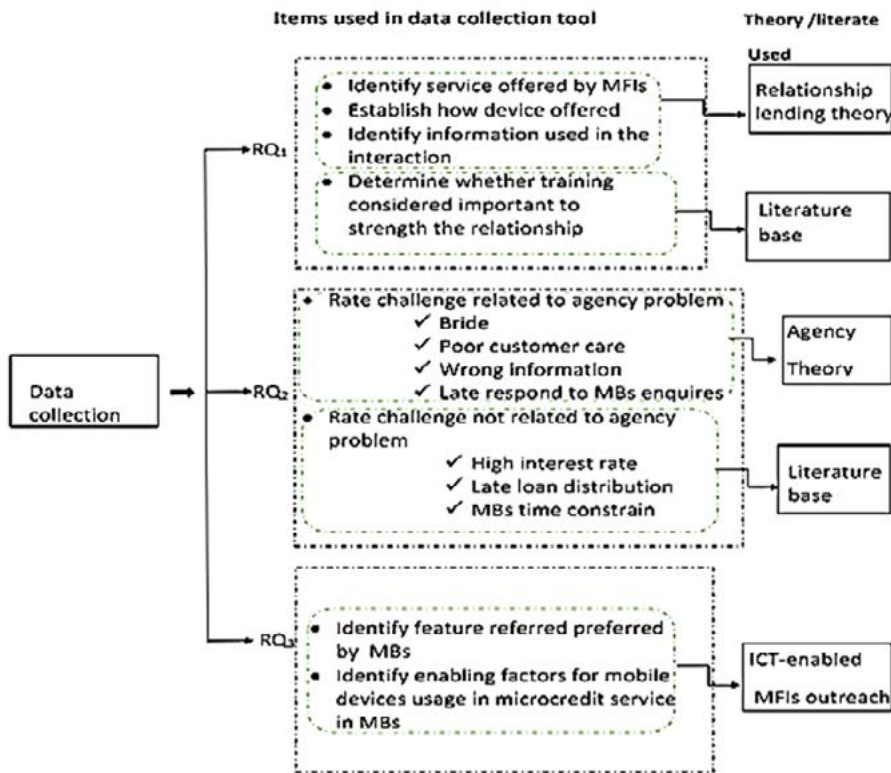


Figure 2: Data Collection Tool in Relation to the Theoretical Framework and Literature

### Research Participants and Sampling Strategy

The primary participants of the study were 120 MB owners in Dar es Salaam City. We purposefully chose MB owners based on: (1) the sector operations of MBs; and (2) the participation of MBs in microcredit services. Altogether, 91 MB owners filled out and returned the questionnaire. The participants were not paid in this particular study; however, a thorough explanation was delivered to clarify the long-term importance and benefit of the study in regard to their practical business environment. Table 1 shows the distribution of the participants according to the gender and education level of the MB owners.

		Education				Total
		Primary	Secondary	Higher education	No formal education	
Gender	Female	29	1	1	11	42
	Male	23	20	4	2	49
Total		52	21	5	13	91

**Table 1. Gender and Education of Participants**

The secondary participants in the study were MFI officers. To find suitable MFI officers for the study, we asked the MB owners participating in the study to identify MFI officers involved in microcredit services. We were able to find 28 potential MFI officers, of whom 22 agreed to participate in the study by filling in and returning the questionnaire. Therefore, altogether, 113 MB owners and MFI officers in Dar es Salaam City from various business sectors participated to the study. When considering the aims of the study, the sample size was satisfactory (Denscombe, 2010).

### Data Collection and Analysis Procedures

The data collection from the MB owners was conducted by six undergraduate students from Dar es Salaam Institute of Technology (DIT). The six students were allocated to all five municipalities of Dar es Salaam City, and they began the data collection after taking part in a three-day training session. The students were suitable candidates for data collection because they were also participating in a project aimed at developing mobile application solutions to facilitate the relationship between MFIs and MBs. The data collection from the MFIs was conducted by the first author via direct communication with MFI officers after receiving their contact details from the MB owners. The data collected from the closed questions were analyzed using descriptive statistics (Bryman, 2012). The data from the open-ended questions were analyzed qualitatively by grouping and coding to identify relevant themes emanating from the responses.

### Ethical Considerations

The MB owners and MFI officers participating in the study were each given a consent letter. The consent letter was attached to the questionnaire, and respondents were advised that by filling out and returning the questionnaires, they were simultaneously giving their consent for their answers to be analyzed and eventually published. The identities of the respondents have been hidden. Moreover, the information given by the MFI officers and MB owners was used only for the purpose of this single study. Finally, the data collected for the study will be destroyed after the first author has completed his doctoral studies. There were no direct benefits for the participants, but the study contributes to finding new solutions to the identified problems and challenges related to the interaction, communication, and relationship between MFIs and MB owners.

## FINDINGS

### The Key Services Provided by Microfinance Institutions

According to the MB owners, the main MFI services used by them are microloans (98.1%) and micro savings services (78%), followed by training related to microloans and savings. Other less frequently used services by the MB owners include business information, consultations, and networking for marketing. The MB owners considered the training service offered by MFIs to be important, since their low level of business and financial skills had a considerable effect on the MB owners' ability to repay loans (mean 3.58, mode 4). In addition, the MB owners strongly agreed that improvement in business skills would have a positive effect on their business performance (mean 3.97, mode 5). Finally, the MB owners disagreed with the notion that business training would be useless for them.

We found that a clear majority (95%) of the MB owners receive services from MFIs through loan officers who play the role of agents. However, the MB owners were not satisfied with the services offered by MFIs (mean 1.8, mode 1) whereas the MFI loan officers themselves had a very positive opinion of their own services. Also, the MFI loan officers stated that they communicate effectively (mean 4.45, mode 5) with MB owners. Table 2 summarizes the services and respective information offered by MFIs to MBs.

Service	Information concerning
Loans	Amount of loan applied for and loan disbursed; Amount of interest; Collateral; Business size; Loan repayment due dates
Savings	Amount in customer's savings account; Records of account transaction
Training	Importance of loan; Differences between business resources and personal resources; How to calculate interest and amount payable; Entrepreneurship issues; Business management issues
Insurance	Amount of loan insured
Business Network	Market; Suppliers; Price of the different services or products in the market

**Table 2: Services and Information Shared Between MFIs and MBs**

### Challenges Related to the Interaction, Communication, and Relationship between MBs and MFIs

The data collected revealed that there is an information flow problem which reduces satisfaction among the MB owners. Specifically, the MB owners felt that MFIs do not provide relevant information on time (mean 2.35, mode 1). Moreover, the MB owners indicated that there are problems in their communication with MFIs (mean 2.71, mode 1). Almost 50% of the MB owners indicated that they only met the MFI officers once during loan repayment, while less than 25% of the MB owners had more frequent contact with the MFI officers.

One clear factor hindering the interaction between MFIs and MBs was time constraints. The MB owners were not pleased with having to spend time receiving services from loan officers instead of concentrating on their business (mean 2.21, mode 1) and thought that time was the biggest constraint with regard to meeting loan officers (mean 3.54, mode 5). Also, the MB owners agreed that time constraints prevented them from participating regularly in the training offered by MFIs (mean 3.63, mode 4). The time constraint problem was confirmed by the MFI officers, who indicated that most of their customers did not have time for training (mean 4.27, mode 4). Finally, an analysis of the time spent by the MB owners on their businesses showed that a clear majority of the MB owners were working

nine or more hours each day up to six or even seven days a week. This suggests that they had no time for anything apart from concentrating on their businesses.

In addition, the MB owners pointed out various other challenges related to the microcredit services offered by MFIs, as listed in Table 3. The most problematic challenges the MB owners encountered regarding MFIs include bribery, receiving wrong information, poor customer care, and late response times. Other challenges that are not related specifically to the agency problem are high interest rates, late loan disbursements, and short loan repayment periods.

	Bribery (%)	Wrong information (%)	Unavailability at the right time (%)	Poor customer care (%)	Late response (%)	High interest (%)	Late loan disbursement (%)	Short loan repayment (%)
<b>Yes</b>	90.1	87.9	90.1	87.9	83.3	83	82.4	79
<b>No</b>	9.9	11.0	9.9	12.1	16.7	17	15.4	21

**Table 3: Challenges Faced by MBs with MFIs**

According to the MFI officers, the low education level among MB owners, poor record keeping, informal business operations, the lack of business skills, and the geographical distance between MFIs and MBs were also noted as challenges in providing services to MBs. Moreover, a lack of reliable information, poor facilities, and time issues were considered to be challenges as well.

**Enabling Factors, Preferred Features, and User Requirements for a Mobile Technology Solution**

*Enabling Factors*

As shown in Figure 2, Android was used by 74.7% of the MB owners, Apple iPhone by 6.6%, Apple iPad by 2.2%, and a Windows Tablet by 2.2%, while 14.3% of the participants did not own a smart phone. Most of the MB owners (93.4%) used mobile phones every day, and similarly, 93.4% of the participants used mobile phones for business activities. The mobile phones were mainly used for making phone calls; sending text messages; money transfers; personal alarm; Internet searches; a calculator; and social media communication, such as via Facebook, Instagram, or WhatsApp. The MB owners also indicated that they were interested in using a mobile phone for the following MFI services: training, loan balance information, loan processing, mobile money, marketing, business networking, and business information. However, only 3.3% of the respondents had a tailor-made mobile phone application designed specifically for business purposes. While the majority of the MB owners were satisfied with their mobile devices, most of them also mentioned that they encountered challenges in using mobile devices, mainly related to the high cost of an Internet connection and network problems.

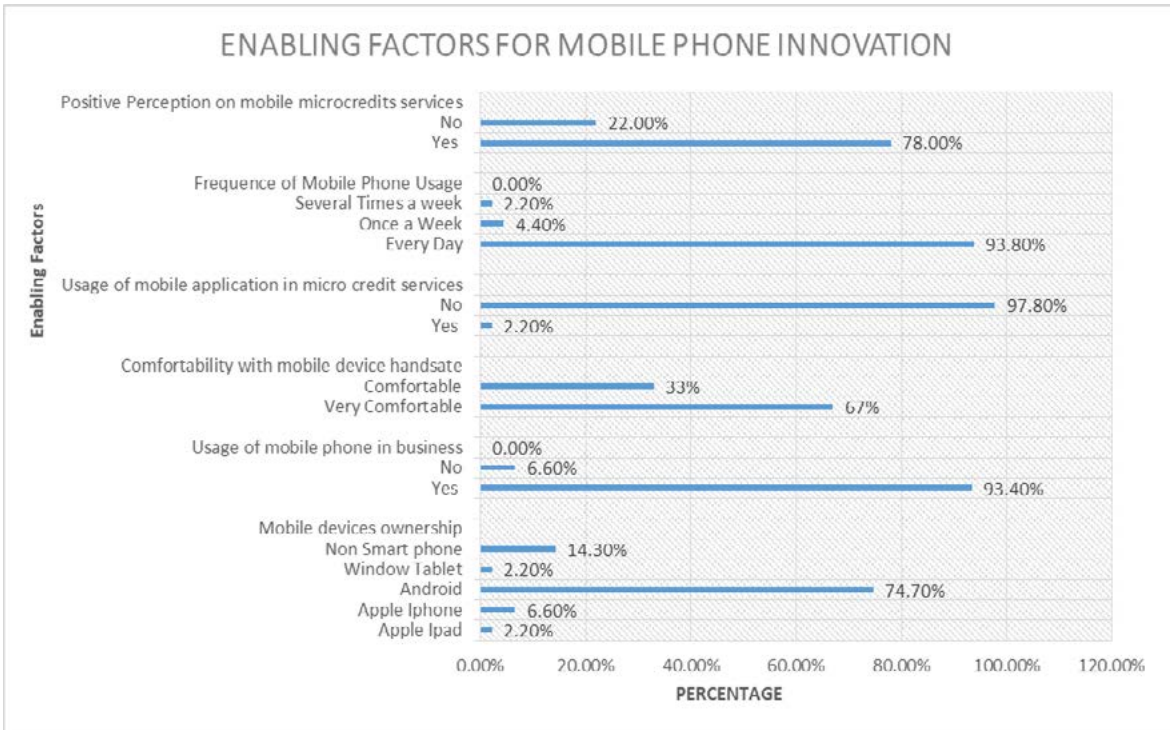


Figure 3: Enabling Factors for a Mobile Technology Solution

*Preferred Features for a Digital Technology Solution*

The MFI officers were asked to suggest a mobile technology solution to the challenges related to microcredit services. According to the MFI officers, the most preferred way to use mobile technology was to facilitate training, which will simplify the process of delivering training materials to MBs and eliminating the challenges of space and time constraints from MBs. Also, the mobile technology that can support transportation was mentioned as one of the preferences of MFIs to reduce costs which lead to high interest. Moreover, reference was made to the record keeping technology preferred by MFIs in order to assist in provision of accurate information for loan appraisal and other decisions.

*User Requirements*

The MB owners identified mobile phones as the preferred way to receive MFI services. Additionally, one of the most important requirements for supporting the interaction between MFIs and MBs was that the solution should be in the Kiswahili language. The MB owners preferred a mobile technology solution that is simple to use and has information readily available from various media, such as video, audio, and physical documents. Figure 4 summarizes the findings regarding the general user requirements.

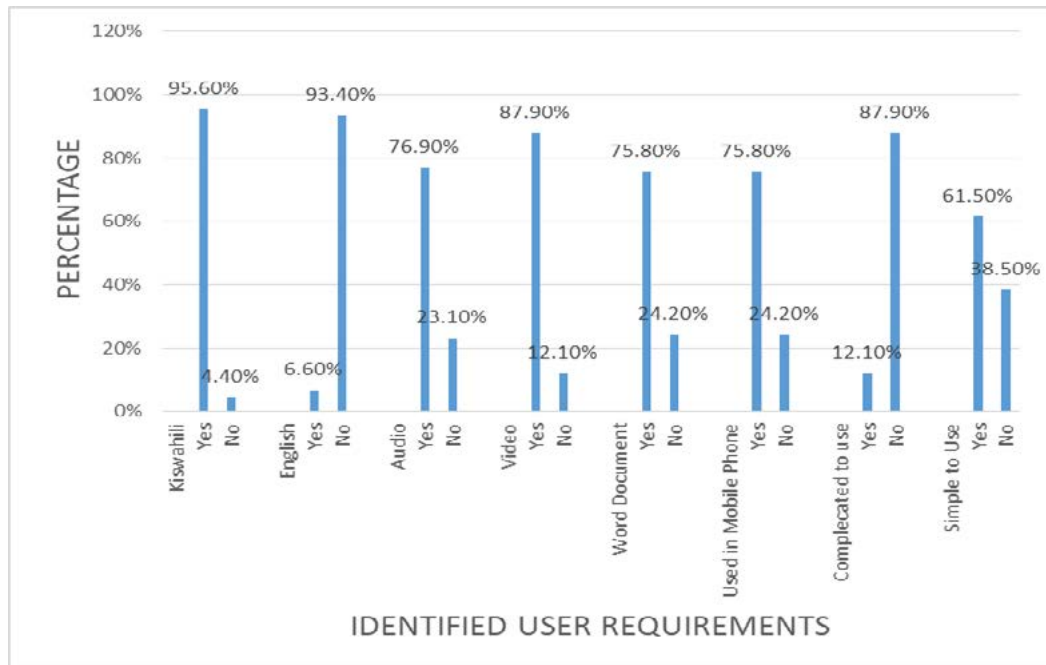


Figure 4: General user requirements

**DISCUSSION AND CONCLUSION**

From our findings, interaction and relationship between MFIs and MBs can be looked at from three fronts: the service offered, challenges thereon, and enabling factors through using mobile technologies to strengthen the interaction; ultimately, this has led to the emanation of three theories which validate the concerns raised by the research questions.

**The Key Microcredit Services Offered by MFIs to MBs (RQ1)**

The study confirmed that the main services offered by MFIs to MB owners are microloans and micro savings services. The study also revealed that MFIs do not offer other services that might be relevant to MB owners, such as business information, business networking, and marketing. Based on the literature, we also were able to identify that the MB owners receive services from MFIs through loan officers who play role of agents. The loan officers facilitate the provision of services offered by MFIs to MBs. With regard to a training service offered before and after loan disbursement, the study confirmed earlier findings that both MBs and MFIs considered training to be very important (Kessy and Temu, 2010). MFIs used training as a tool to understand customers, for loan monitoring, and to help build MBs’ capacity. The study also consolidated the earlier findings that distance and time affected the training process because it requires trainers and trainees to be located in the same place (Gomera and Apiola, 2015).

Our findings confirm that interactions based on relationship lending theory are enhanced by the use of mobile technology, as shown in Figure 5. Our study confirmed that most of the MBs consider training to



be very important, therefore, effective training process through technology can strength the relationship between MFIs and MBs. Also, we were able to confirm that's all services offered in the interaction between MFIs and MBs are offered through loan officers. This calls attention to the practices of loan officers on the interaction between MFIs and MBs.

We found that the services offered by MFIs to MB owners are accompanied by a large amount of information sharing between MFIs and MBs, which indicates the need for a solution that can reduce operating costs (Comeig et al., 2015). Moreover, the study confirmed that the microcredit services offered by MFIs were based on soft information from MB owners (Uchida et al., 2012). Thus, our study provided further evidence that the quality of soft information should be improved to improve the relationship between MFIs and MBs.

### **Challenges Related to the Interaction, Communication, and Relationship between MFIs and MBs (RQ2)**

The data analysis revealed that the main challenges related to the interaction, communication, and relationship between MFIs and MB owners were that loan officers take bribes during loan disbursement; there is a small number of loan officers compared to the number of customers being served; the geographical distance between MBs' business areas and MFIs' offices; wrong information given to MBs; and time constraints on regular meetings with loan officers. A previous study by Addae-Korankye (2014) identified that these kinds of challenges have a considerable impact on the interaction between MFIs and MBs.

The finding also confirmed that the problem of agents (loan officers) exists because of the nature of interaction between MFIs and MBs. As a result, loan officers cause some challenges that mostly affect the quality of information and services offered in relationship lending, such as bribery, poor customer care, inaccurate information, and late responses to customers' enquiries (Ang, 1991; Berger et al., 2001). Hence, the factors emanating from research findings regarding different requirements for mobile technology solutions to support the interaction, communication and relationship between MFIs and MBs have been considered. As a support variable, we will use the concept "active enabler," as identified in Figure 5.

The study also found several other issues affecting the interaction and communication between MFIs and MBs. These was wrong information provided by MFIs, an unavailability of loan officers at the desired time, poor customer care, late responses to customers' enquiries, and late loan disbursements as well as the geographical distance between MFIs and MBs. The study confirmed that some of the identified challenges are beyond the agency problem. Therefore, solutions that aim at addressing interaction, communication, and relationship challenges should also focus on issues other than merely the agency problem.

### **Preferred Features, Enabling Factors, and General Requirements for a Mobile Technology Solution (RQ3)**

According to the MFIs, the following mobile technology solutions would potentially support their work with MB owners: (1) communication platform; (2) technology that removes the challenges of geographical distance between the two parties; and (3) technology that will assist in training and record keeping. Other suggestions included setting a standardized time to respond to customers' queries and a reduction in the need for in-person contact between customers and loan officers. These measures would help loan officers to manage a large number of customers, reduce incidences of bribery since

unnecessary in-person contact between loan officers and MB owners would be reduced, and provide safer means to communicate with their customers.

The study also consolidated the findings of an earlier study done by Gomera and Apiola (2015) regarding the enabling factors for a mobile technology solution as follows: (1) the daily usage of a mobile phone by both MBs and MFI officers; and (2) the use of mobile phones for business and official purposes by both parties. The current usage of mobile phones by the MB owners was limited to phone calls, text messages, money transfers, personal alarm, Internet searches, a calculator, and social media communication. This finding concurred with the study by Mramba, Tulilahti, and Apiola (2016), which concluded that mobile phones are not fully utilized by informal business workers. However, we were encouraged to find that the users of mobile phones seemed to be comfortable in using their mobile devices.

Since most of the MB owners do not use a tailor-made mobile phone application for their interaction, communication, and relationship with MFIs, there is real potential for developing a mobile application for this particular purpose (Bada, 2012; Hellström, 2010), as suggested by ICT-enabled outreach theory (Diniz et al., 2008; Mahfuz et al., 2016). Our study found that while the current use of mobile devices is limited mainly to calls and normal text messages (Mramba et al., 2014; Kapinga, Montero, and Mbise, 2017), there is a positive perception toward the use of mobile devices among the MB owners if the solution is well designed based on the level of the MB owners' understanding.

Finally, we identified the following general user requirements for a mobile technology solution: it uses the Kiswahili language, has multiple media options, and is simple to use. Also, the solution should be affordable for both MFIs and MBs. The findings of the study are in line with the preliminary user requirements identified by Gomera and Oreku (2016) whose study focused on providing mobile training for MBs. As there is a clear need for a mature lending relationship, a simple and sophisticated mobile technological tool at the comprehension level of MBs is required. However, as suggested by Gomera and Apiola (2015), care should be taken to ensure that the suggested technological solution is well designed and with consideration of design thinking aspects (Owen, 2006), which will help to address the user requirements of potential end users. In Figure 5, we connect the findings of the study to the theoretical framework and research questions of the study, and justify our claim for the potential of mobile technology solutions to address the interaction and information sharing challenges between MBs and MFIs.

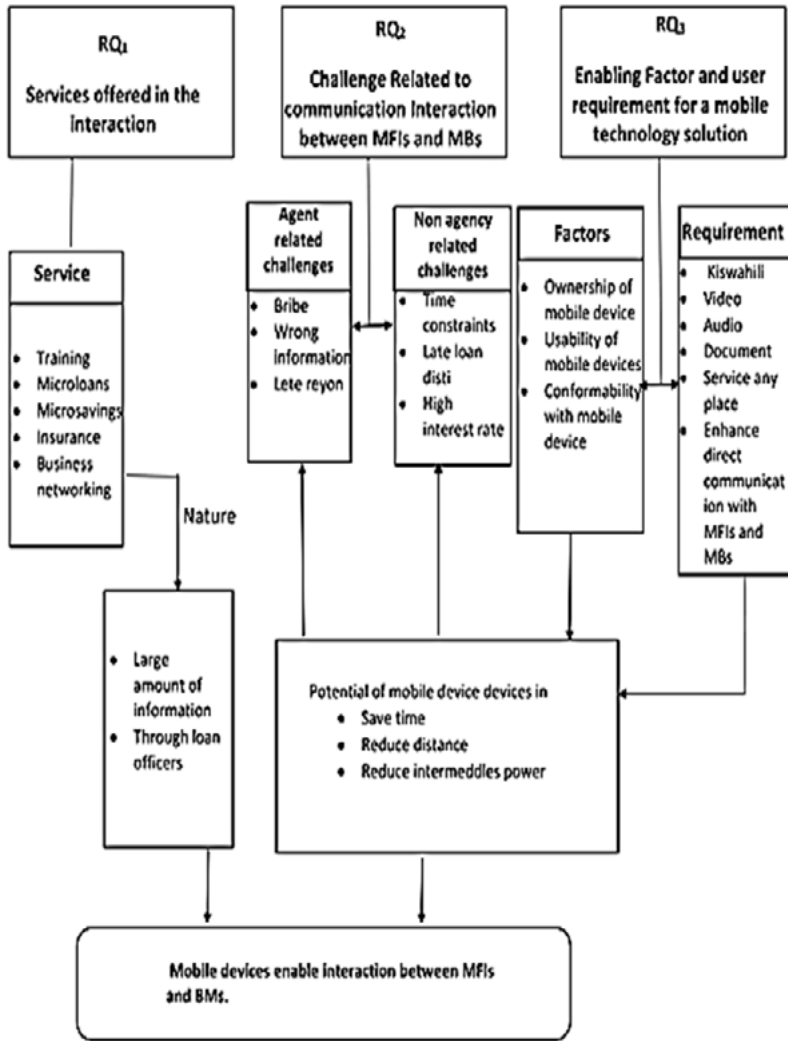


Figure 5: Mobile Devices Enabled Microcredit Services by Tackling Challenges Affecting Interaction between MFIs and MBs.

## FINAL OBSERVATIONS, LIMITATIONS OF THE STUDY, AND FUTURE WORK

Our study identified and confirmed the existence of various services and challenges related to the interaction, communication, and relationship between MFIs and MBs in the context of Dar es Salaam, Tanzania. For example, the lending relationship is a very important aspect in the services offered to MBs by MFIs (Uchida et al., 2012). Also, we were able to show the potential of applying mobile technologies (affordable devices for MBs) in tackling identified challenges and strengthening the relationship between MFIs and MBs. We posit that through a tailor-made mobile technology solution, MFIs can improve their microcredit services offered to MBs by, for example, enhancing the lending relationship by means of a smooth information flow. Our findings are practical and in keeping with Tanzanian environmental laws and regulations on information security (URT, 2015). Security issues are crucial in a context in which financial inclusion involves the sharing of financial information (Nyamtiga, Sam, and Laizer, 2013; Oreku, Mtenzi and Ali, 2013).

The sample size of 91 MBs and 22 MFI officers meant that the study was limited in its diversification, which means the study was concentrated in only one area - Dar es Salaam, Tanzania. However, given the homogenous nature of the relationship between MFIs and MBs in different Dar es Salaam contexts, caution in regard to certain aspects should be taken in generalizing the study's findings. It is the role of researchers in the areas of finance and ICT for development to conduct additional studies related to how simple and sophisticated digital technologies, especially mobile applications, can be designed to meet the needs and requirements of MB owners.

The next step in the DSR process is to identify the detailed requirements and to design and develop mobile technology solutions in order to tackle the identified challenges as well as to demonstrate and evaluate the implemented solutions in close collaboration with MFIs and MBs. This study suggests that future development work should focus on the areas of training, loan monitoring, business networking, business information, record keeping and loan status. This will lead to improved performance on the part of both MB owners and MFIs, hence strengthening the relationship between them. Since the findings targeted a group consisting of low-income earners, a frugal application design of application is particularly envisaged as appropriate for further research.

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**APPENDIX 1 – DATA COLLECTION INSTRUMENTS IN THE STUDY**

**Likert Scale Questions**

We ask you to reflect your feelings and carefully answer following questions. Please TICK [√] on the appropriate box to show your feeling. (NOTE 1 tick for each question/statement.

How do you feel with the mobile training application to MBs	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
<b>Current situation on interaction</b>					
1. The MFIs effectively provide me with relevant information	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Leaders/ managers provide me with service I need	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. I am comfortable with time I spend on receiving services	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. There is effective communication between ma and the institution	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Time is the constrain factor for me to have a regular meeting with MFI management/ leaders	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Perceived challenges of Interactions</b>					
1. Lack of business knowledge reduces my performance on loan repayment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2. Lack of on time loan status affect loan repayment	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Time is a constraint in receiving regular business training	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. MFIs do not provide business skills and loan management skills before and after loan	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Technological and Training Aspect</b>					
1. Business skills help proper business undertakings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



2. Training does not add value to me so no need of wasting my time	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3. Often I use my mobile phone for business undertakings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4. Mobile phone can be used to improve business performance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5. Mobile services will improve information sharing with MFIs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
6. Proper use of mobile phone will enhance services from MFIs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
7. I wish to use mobile application for information sharing between MFIs and MBs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. Having a specific application for our activities will reduce time constraints challenging	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**Self-Explanatory Questions**

1. Sex and Education level please cycle an appropriate

SEX	Education Level
1. Female	1. Primary education
2. Male	2. Secondary
	3. Higher Education
	4. None

2. Mention kind of mobile device you own -----

3. Understanding the existing services offered by MFIs.

A: List down the current services offered by MFIs to MBs

B: In each service identified in 1.A above identify a relevant information shared between MFIs and MBs.

C: Does communication done through loan officers YES  NO

4. Identifying challenges facing the current relationship and interaction between MFIs and MB

5. Finding out how MBs are using mobile phones.

A: Do you use mobile device for business purposes YES  NO

B: Do you any mobile application to share information with MFI? YES  NO

C: Tick current business usage of your mobile phone

5. Making calls to customers	<input type="checkbox"/>
6. Mobile money usage	<input type="checkbox"/>
7. Social networks	<input type="checkbox"/>

8. Searching business information	
9. Send normal messages to customers and suppliers	
10. Market searching	
11. Calculator	
12. Online training	
13. Calendar	
14. Note keeping	

6. Mapping out potential design ideas and general requirements for mobile technology solutions to support relationship and interaction between MBs and MFIs

A: Would you like the idea of using mobile device for information sharing between MFIs and MBs?  
 YES  NO

B: List down Preferred features, and requirements for mobile technology.

# **WILLIAM CLIFFORD GOMERA**

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The benefits of training to micro businesses and ubiquitous use of mobile devices that provide an avenue of microcredit services anywhere, anytime form a background of this dissertation. Therefore, through design science research that supplemented design thinking, frugal innovation, and usability evaluation; this study resulted in a pilot prototype of mobile training application to micro businesses and proposed design principles that potentially useful to efforts towards poverty alleviation.



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