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Mobile Technology Use by Rural Farmers and Herders

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This is to certify that the doctoral study by

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has been found to be complete and satisfactory in all respects,
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Walden University
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Abstract

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MBA, William Woods University, 2016

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Doctoral Study Submitted in Partial Fulfillment

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Doctor of Business Administration

With specialization in Information Technology Management

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Abstract

Mobile technology business leaders from many mobile technology companies practice digital apartheid when improving rural farmers' communication and technology infrastructure in developing countries. Mobile technology business leaders who do not effectively plan mobile technology infrastructure deployment to rural farmers and herders are at a high risk of failure. Grounded in adaptive structuration theory of technology, the purpose of this qualitative multiple case study was to explore strategies mobile technology business leaders used to improve the mobile technology infrastructure for rural farmers and herders in the United Republic of Tanzania. The participants comprised three mobile technology business leaders from three different mobile technology businesses located in the United Republic of Tanzania who efficiently implemented business strategies to improve mobile technology infrastructure for rural farmers and herders of the United Republic of Tanzania. Data were collected from semistructured interviews, direct observations, and a review of company documents provided by participants. The thematic analysis process was used to analyze the data. Three themes emerged: cost of technology improvements, plans to implement infrastructure, and training and development. The key recommendations for mobile business leaders are building partnerships amongst mobile technology companies to raise capital and involve customers in their business models. The implication for positive social change includes improving access to mobile technology infrastructure to provide strategies for improving socioeconomic outcomes in and among poor rural farmers and herders' communities.

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Dedication

I dedicate this research study to my father, the late Sheikh Zuheri Bin Ali Bin Hemed Al-Buhry, who lost his battle to Leukemia, for instilling in me the drive to seek knowledge as far as possible. His constant support and sacrifices over the years have been the reason for my motivation. I will always remember his help, love, and guidance he gave me throughout life. My mother, Kijoli Zuheri bin Ali, for her support and encouragement to move across the world to seek a better education. My wife Zahra Mahmood Ali who motivated and supported me while taking on more responsibilities at family activities while I spent time working on my study. I am extremely grateful for all the love, support and understanding from our two boys Kareem and Tareq, and their understanding when I missed time and activities with them. Without forgetting my siblings Ali Zuheri, Asia Zuheri, Dr. Aisha Zuheri, and Hamza Zuheri for their generous support. I love you all, and may God continue to bless you as you pursue your passions in life.

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Section 1: Foundation of the Study

Rural farmers and herders suffer from technology bias. Although most developing countries' populations are rural farmers and herders, mobile technology business leaders have not adequately invested in the mobile technology infrastructure for rural farmers and herders as they have among urban communities. Leaders from many mobile technology companies practice digital apartheid when it comes to improving the communication and technology infrastructure of rural farmers in developing countries (Barnard-Ashton et al., 2018). The systematic exclusion of specific populations from technological advancements has inhibited farmers' and herders' progress in developing countries.

Background of the Problem

Farmers and herders from developing countries need mobile technology to improve their agricultural activities (Oppedahl, 2019). Agriculture is the backbone of most African economies; as such, most development agency leaders are concerned about herders' and farmers' access to the technology they can use to enhance agricultural productivity (Mavhunduse & Holmner, 2019). But mobile technology leaders lack strategies for improving the infrastructure to enhance farmers' and herders' use of mobile technology. Mobile technology business leaders are unsuccessfully planning and deploying robust mobile technology infrastructure to rural farmers and herders struggling to keep up with agricultural productivity. When technology infrastructure is inadequate, businesses do not have access to markets (Cunguara & Darnhofer, 2011). Rural farmers in developing countries often do not get to enjoy the benefits of their agricultural businesses because they lack adequate technology to communicate with their customers

(Muhumuza et al., 2018). Until mobile technology industry leaders invest more in rural mobile infrastructure, developing countries will continue to experience food shortages.

Problem Statement

Mobile technology company leaders struggle to deploy mobile technology infrastructures such as cellphone towers and internet hotspots to rural farmers and herders (Kabbiri et al., 2018). Fifty-seven percent of farmers and 55% of herders in the United Republic of Tanzania do not have access to mobile technology services due to the lack of adequate infrastructure for rural farmers and herders (Echanove & Steffen, 2015). The general business problem is that some mobile technology businesses do not plan mobile technology infrastructure deployments to rural farmers and herders, resulting in a loss of revenue and profits. The specific business problem is that some mobile technology business leaders lack strategies to improve mobile technology infrastructure to rural farmers and herders.

Purpose Statement

The purpose of this qualitative multiple case study was to explore strategies that mobile technology business leaders use to improve mobile technology infrastructure to rural farmers and herders. The targeted population consisted of three mobile technology business leaders from three different mobile technology organizations with successful mobile technology infrastructure strategies in the United Republic of Tanzania. The results of this study may contribute to social change by providing strategies for improving mobile telecommunications services, thus improving communications in and among poor rural farmers and herders communities.

Nature of the Study

The three research methods are qualitative, quantitative, and mixed methods (Almalki, 2016). I used a qualitative approach for this study, which provides flexibility and more powerful knowledge of the interaction between researchers and participants (Antwi & Hamza, 2015). With qualitative methods, researchers explore open-ended questions, opinions, or perceptions (Yin, 2018). Using a qualitative method enabled me to observe the responses from business leaders using open-ended questions as a method of collecting data and identify themes or patterns. In quantitative methodology, researchers test different hypotheses and theories (Saunders et al., 2015). Quantitative designs were not appropriate for this study because I did not test correlations or differences between variables. The mixed-methods approach requires both qualitative and quantitative methods to address more complex research questions (Taguchi, 2018), which made it also not appropriate for my study.

I used a qualitative multiple case study design for my research. Researchers use multiple case studies to address a situation, provide a rich context for understanding, and draw conclusions about a phenomenon (Llerena et al., 2019). A single case study design is about collecting data from a single source that may be susceptible to favoritism and not providing the extra validity that a multiple case study produces (Yin, 2018). A multiple case study was the best choice because I used three mobile technology companies in the United Republic of Tanzania to explore their strategies to improve mobile technology infrastructure to rural farmers and herders.

Other designs were considered but not chosen. Researchers use ethnography to learn about the lives, cultures, or situations of a group or community (Yang, 2017). Phenomenological research uncovers the perceptions, perspectives, understanding, and feelings of people with lived experiences of a phenomenon. Phenomenological researchers articulate and evoke dimensions of concepts and continuously reevaluate the need to theorize, categorize, and expand upon those concepts (Adams & Manen, 2017). Ethnography and phenomenology were not appropriate designs for this study because the focus was not on group cultures or the personal meanings of participants' lived experiences.

Research Question

What strategies do mobile technology business leaders use to improve the mobile technology infrastructure to rural farmers and herders?

Interview Questions

1. What strategies do you use to improve mobile technology infrastructure for rural farmers and herders?
2. How do you select areas to implement your mobile technology infrastructure strategies?
3. What steps do you take to ensure you apply correct and needed mobile technology infrastructure strategies in rural areas?
4. How do you communicate your mobile technology infrastructure implementation strategies to your intended customers?

5. What barriers or restrictions do you experience when implementing mobile technology infrastructure strategies in rural areas?
6. What additional information can you provide on strategies to improve mobile technology infrastructure in rural areas?

Conceptual Framework

I used adaptive structuration theory (AST) as the study's conceptual framework. AST is considered as one of the top three theories researchers use for group communications (Almeida, 2015). Anthony Giddens introduced AST in 1979 as the production and reproduction of social systems through members' use of rules and resources in interaction (Almeida, 2015). Another theorist known as M. Scott Poole came on later to develop the AST to align it with the technological development that many leaders were looking for to improve their productivity (Schmitz et al., 2016). Poole's focus was to improve Gidden's original definition of the theory and make AST more adaptive to different rules and resources that technology requires (Ajjan et al., 2016).

Researchers use AST to develop theoretical improvements for advancing computing infrastructure (Ajjan et al., 2016). AST presents the social structures, rules, and resources provided by technologies and institutions as the basis for human activity. AST can also be used as a tool that connects structural potentials of technology and elements of technology impacts. Scholars widely use AST to study the evolution-in-use of advanced adaptation and change at the group or organizational level (Schmitz et al., 2016).

Researchers use AST to facilitate understanding of the types of structures provided by advanced technologies and the structures that emerge in human action when people interact with these technologies (Poole & DeSanctis, 1992). Scholars who use AST incorporate technological learning changes at the micro, global, and organizational levels. I used the AST framework to study the mobile technology progress that mobile technology business leaders may apply to improve the mobile technology infrastructure for rural farmers and herders.

Operational Definitions

Mobile technology infrastructure: Mobile technology infrastructure is the telecommunication systems support vital for improving communication between users (Altamirano & van Beers, 2018).

Developing countries: Developing countries are countries with less economic and technological infrastructure compared to others (Wright, 2016).

Rural farmers and herders: Rural farmers and herders are people who earn their livelihood by growing crops and rearing livestock far from urban populations (Mwamfupe, 2015).

Assumptions, Limitations, and Delimitations

Assumptions

Assumptions are the necessary beliefs included in a doctoral study that researchers cannot verify (Walby, 2015). Assumptions may affect a study's outcome; accordingly, researchers should treat assumptions as risks. There were three assumptions in this study. The first assumption was that rural farmers and herders needed robust

mobile technology infrastructure to work on farms. The second assumption was that the participants were willing to share their information, knowledge, and experiences. The third assumption was that participants would answer all questions openly and truthfully without reservations.

Limitations

Limitations are possible obstacles that may impact a study's outcome (Levitt et al., 2017) as well as impede the discoveries of research (Marshall & Rossman, 2016). There were four limitations to this study. The first limitation was the dependence on the availability of participants and their willingness to participate in my study. The second limitation was the coordination, scheduling, and meeting time constraints from participants when collecting data. The third limitation was that participants might not have been willing to share strategic decisions for fear of disclosing information to their competitors. The fourth limitation was that participants might have struggled to remember all the details of the strategies their respective leaderships used to implement mobile technology infrastructure.

Delimitations

Delimitations are boundaries a researcher creates to maintain the scope and size of the research (Knapp, 2016). There were four delimitations in this study. The first delimitation was that three mobile technology business leaders come from three different mobile technology organizations within the United Republic of Tanzania. The second delimitation was that I only interviewed top organization leaders who are involved in improving rural mobile technology infrastructure. The third delimitation was that each

organization had an average net worth of approximately $200 million. The fourth delimitation was that each organization is a publicly listed organization with public operations data.

Significance of the Study

Contribution to Business Practice

Mobile technology business leaders can provide mobile technology infrastructure to reduce operating costs by building a direct line of communication among rural farmers and herders, their vendors, and their customers. Farmers can use mobile technology to understand how to prevent price distortion, the nominal rate of assistance, and how to add value to their products with the relative price margin (Nsabimana & Amuakwa-Mensah, 2018). Most industry leaders apply digital technologies in some way to their product manufacturing, services, provision, or business processes (Global System for Mobile Communications, 2017). Technology industry leaders may use the strategies, processes, and tools from this study to improve their strategic business approaches for providing mobile technology infrastructure for rural farmers and herders in developing countries, such as the United Republic of Tanzania, to increase business profitability.

Implications for Social Change

The strategy development of mobile technology infrastructure by mobile technology business leaders may simplify the way farmers and herders communicate with one another within and outside their communities. Rural farmers and herders can use mobile technology to learn more about their lives, their products, and the relationships they build with their customers and suppliers (Dellinger et al., 2018). Mobile technology

services are another way for rural farmers and herders to improve farming operations within their communities.

A Review of the Professional and Academic Literature

The purpose of this qualitative multiple case study was to explore the strategies mobile technology business leaders use to improve rural mobile technology infrastructure. Fifty-seven percent of farmers and 55% of herders in the United Republic of Tanzania do not have access to mobile technology services due to the lack of adequate mobile technology infrastructure for rural farmers and herders (Echanove & Steffen, 2015). Farmers and herders need to access mobile technology to improve farming.

To gain an understanding of mobile technology infrastructure to rural farmers and herders, I completed an extensive academic literature review of articles accessed from Walden University's Library, including the databases EBSCOhost, ProQuest Central, and ABI/INFORM Global, and I searched for resources using Google Scholar. Keywords searched were mobile technology infrastructure, mobile farming technology, and mobile technology leaders, AND rural mobile technology. This literature review contains 84 sources of peer-reviewed articles. Among these articles, 56 were peer-reviewed research articles published in the last five years.

Adaptive Saturation Theory (AST)

The conceptual framework for this study was Gidden's 1979 AST. Gidden's AST includes different outcomes, such as efficiency, quality, consensus, and commitment (Rains & Bonito, 2017). Gidden defined *efficiency outcome* as the driving force researchers like because they can expect to get reliable results from their research.

Researchers generally utilize AST when studying technological systems' improvements because they want to identify inconsistent findings in their studies by focusing on some of the variables that may help explain those inconsistencies (Gopal et al., 1992). Researchers find AST as a practical theory that they can adapt and use in their research processes because the user has profound domain control and accommodate a new technology (Adler et al., 2011). Efficiency is popular in the AST because researchers may refine their existing ways of doing research and get noticeable improvements in their studies (Schmitz et al., 2016).

Researchers also find AST as a useful framework due to its group structures and their influence on interaction and decision-making amongst group members (Niederman et al., 2008). AST is essential in the field of technology because stakeholders use it to examine the process by which organizations set up their rules and regulations, utilize resources, accomplish goals, and adjust or evolve to match with the industry (Niederman et al., 2008). AST is about asserting organizational structures that are formed for the technology industry researches (Niederman et al., 2008). Each organization member of the technology industry has the responsibility of improving such technology and bring it forward for other members to study, interact, and share resources (Niederman et al., 2008). AST is most associated with the relationship between researchers' inputs, such as innovations and resources, and outputs such as technology or feedback (Niederman et al., 2008).

Other than researchers, many who adopt AST use the theory for inter-professional collaboration and coordinated teamwork to achieve high-quality results to advance their

works (Barrett, 2018). AST adapters also utilize the theory to alter the technology artifact's capabilities and reinterpret workplace tasks because they become a commonplace reality in many businesses (Schmitz et al., 2016). AST emphasizes the confluence of two trends: the increasing phenomenon of user-driven adaptation and increasing technology attention (Schmitz et al., 2016). Through AST methodology, those with no special technical skills can be invited to manipulate and modify information technology (IT) capabilities such as mobile computing devices to achieve their goals (Schmitz et al., 2016). The technology that has been developed through the AST framework has allowed average users to have the power to use them are such as editable, interactive, reprogrammable, flexible, and transformable mobile devices such as cell phone, two-way radios, tablets, and computers (Schmitz et al., 2016). Thus, the traditional role for mobile device users has changed from that of a customer who waits for the final product to use to a more of an active role performing direct adaptations and giving feedback during design and implementation (DeSanctis & Poole, 1994). Mobile business leaders may rely on the AST framework to incorporate the innovation of technology and users' adaptation of such technology to improve the mobile technology infrastructure of their customers.

Additionally, AST has been useful for leaders who are not always technologically inclined. Technologically inclined leaders can benefit from AST within the organizational structures. The theory has been most effective in analyzing organizational communication and group decision-making (Barrett, 2018). AST has also been a tool to explore the structures advanced technologies have introduced into the industry and the

structures that have emerged from people interacting with such technologies (Barrett, 2018). The theory may help business leaders understand and expand the scope of their influence as group members within their organizations (Barrett, 2018), which allows technology adoption to be viewed as a dynamic process (Furumo & Melcher, 2006). The process involves a paradigm shift in technology as organizations move from legacy to digital systems (Furumo & Melcher, 2006). During this transition, many managers who are not guided by the AST framework often report disappointment in progress, generally associating problems with limitations of interactions between researchers and consumers (Furumo & Melcher, 2006).

Technology stakeholders rely on the AST to achieve their goals because they have different values, beliefs, attitudes, customs, behaviors, problem-solving approaches, and jargon that require a good quality consensus when adopting new technologies (Barrett, 2018). AST brings consensus to the technology industry because researchers rely on one another for technological advancements (DeSanctis & Poole, 1994). Improvement of mobile technology infrastructure, where most farmers and herders live, may rely on the AST framework to invent technological devices that farmers and herders may utilize for their productivity. For farmers to continue to expand and be successful, technology needs to be implemented. Though AST has considerable explanatory potential, the frequency of its use among technology researchers and its commitment to advance technology innovations have led to researchers relying on it compared to other theories available in the industry (Chin et al., 1997).

Alternative technological theories

In this section, a few alternative theories are reviewed on how they relate to technological infrastructures in rural communities. Researchers use many different theories that focus on how mobile leaders improve the infrastructure of rural farmers and herders. The altercasting theory, protection motivation theory (PMT), information infrastructure design theory (IIDT), and actor-network theory (ANT) are four alternative theories that provide alternatives for the business problem to improve mobile technology infrastructures to rural farmers and herders. These four theories all have different aspects of how best to improve mobile technology within rural communities.

Altercasting Theory

The altercasting theory is unique because the proponents of this theory believe that people can be persuaded to behave in a specific role (Pratkanis & Gliner, 2004). The theory focuses on both the social aspect and the ego of a person. Altercasting theory is a theory of persuasion that was created by sociologists Eugene Weinstein and Paul Duetschberger in 1963 (Senar, 1982). The purpose of this theory is to find the role that best fits another person and persuade them to take on that role. The theory relies on the concept of encouragement and demonstrates an identity with whom one is interacting, which is consistent with a person's own goals (Pratkanis & Gliner, 2004). Through societal, psychological, and unnoticed manipulation, an individual's likelihood of playing out a specific social role is more likely to occur (Pratkanis & Gliner, 2004). Advancement of technology infrastructure occurs when people of different talents, personalities, and technological acumen get together to promote the change. Altercasting theory is about revealing peoples' egos that may affect technology advancements.

Furthermore, altercasting can be divided into two key groups: manded and tact. Manded altercasting theory can be defined as not wanting to change behavior but openly deciding the other person's role (Pratkanis & Gliner, 2004). However, tact altercasting theory is more passive. A person does not say anything directly, but they change their behavior to suggest a role to the other person (Pratkanis & Gliner, 2004). Altercasting theory is known as a manipulative theory and focuses on how people take on different social roles and start to view themselves how other people view them. The alignment of this theory is often when a person strives to conform to the expectations of others so that they can fit in society (Senar, 1982). Altercasting theory may be dangerous if misused due to its promotion of self-interest by leaders. However, under the AST theory, leaders do not manipulate other people; instead, they encourage people's efficiency, quality, consensus, and commitment.

Protection motivation Theory

The PMT was developed by Rogers in 1975 (Brooks & Bubela, 2020). PMT focuses on how individuals protect themselves when they are around a perceived threat through the cognitive mediation process (Brooks & Bubela, 2020; Xing et al., 2019). Proponents of PMT focus on a person's emotional state and how it influences their attitude (Miraja et al., 2019). PMT advocates have also used the theory to describe human behavior in individuals, families, and the parent-child unit to show how a person may react when faced with serious decisions to make (Miraja et al., 2019). PMT emphasizes four key components that are supposed to protect a person from danger: (a) the danger is serious, (b) a person is personally defenseless to the danger, (c) the coping reaction is

efficient in averting the danger, and (d) a person who has the ability to handle the response (Miraja et al., 2019). PMT focuses more on reactions instead of how to continue advancing technologically.

Business leaders are expected to make mobile technology infrastructure improvement decisions while not being afraid of personal repercussions (Westcott et al., 2017). Having a PMT mindset, these leaders may not implement adequate measures that could help improve mobile technology. PMT is about helping individuals build and reinforce their response and self-efficiency and translate knowledge into safer behavior (Westcott et al., 2017). PMT is about explaining the cognitive mediation process of behavior change in terms of threat and coping appraisal of an induvial and their ability to protect oneself. In contrast, AST focuses on how leaders may improve the lives of people collectively.

Information Infrastructure Design Theory

The IIDT focuses on telecommunications networks, databases, and other procedures managed by different specialists (Knol & Yao-hua, 2018). The purpose of this theory is to bridge the connection between people and wireless communication systems (Knol & Yao-hua, 2018). The infrastructure within a business is important to ensure optimal business performance (Eikebrokk & Iden, 2017). People benefit from IIDT by its efforts to dramatically increase the number and heterogeneity of included components, relations, and their dynamic and unexpected interactions in IT solutions (Hanseth & Lyytinen, 2016). Technology researchers have been relying on IIDT to utilize complex IT systems as artifacts and denote them with generic labels of information infrastructures so

that people can find the use of those technologies (Hanseth & Lyytinen, 2016). From a technical viewpoint, designing a complete IT project involves discovering, implementing, integrating, controlling, and coordinating increasingly heterogeneous IT capabilities (Hanseth & Lyytinen, 2016). Having a combination of the three components allows farmers and herders the ability to expand their technological knowledge.

Furthermore, IIDT focuses on shared resources between communities and people to share resources and deliver information services (Eikebrokk & Iden, 2017). IIDT also focuses on increasing awareness of the potential improvement of the information system's stakeholders' ability to work with others with little theoretical work, which directly guides executive information systems design. (Walls et al., 1992). This theory incorporates a combination of principles to design and implement information infrastructures (Knol & Yao-hua, 2018). Though this theory bridges the connection between people and communication systems, AST is about allowing leaders to explore strategies to install effective infrastructures for rural farmers and herders (Chin et al., 1997). However, for this study, I chose AST because AST focuses on implementing mobile technology infrastructures to rural farmers and herders.

Actor network Theory

The ANT is rooted in both science and technology studies. According to Heeks and Stanforth (2015), ANT is the relationship between an underdeveloped society and technology; societies with access to technology tend to be more advanced. Because ANT proposes an alternative understanding of actors, networks, and theory, there have been critiques that it is weak in studying cultural imaginations, power relations, and scale

(Jóhannesson & Bærenholdt, 2020). For instance, technology is a great asset to developing countries to ensure economic advancement (Heeks & Stanforth, 2015). But ANT does not offer a satisfactory theory that actors can use because of its limited power to maneuver in the technology industry, caused by a lack of ability to explain the existence and working of economic markets between society and technology (Callon, 1999). ANT does not always focus on technological advancements as much as economic advancements.

In addition to these critiques of ANT, researchers tend to disagree about the ANT because it is controversial. ANT focuses on the connections between human feelings and inanimate objects (Heeks & Stanforth, 2015). These relationships constantly change as networks shift. The ANT is excellent in investigating technology infrastructures. Nothing is more intensely connected, more distant, more compulsory, and more strategically organized than a computer network; however, that is not the basic metaphor of an ANT (Latour, 1996). The ANT may lack all characteristics of a technical network; it may be local, have no required paths, or no strategically positioned nodes. Still, it can be used to align between actors and technology (Latour, 1996). Though ANT is great for technology infrastructures, it lacks the relationship between strategies and infrastructure implementation.

Summary of Framework

In summary, IT theories have been used in developing the best strategies to improve the infrastructure of rural farmers and herders. No IT theory is valid and applicable in every circumstance (Chin et al., 1997). There is no ideal IT theory;

however, the AST theory combines the understanding of advanced infrastructure and the needs of rural farmers and herders and provides strategies to leaders to fulfill those needs (Chin et al., 1997). Since AST combines the needs for rural farmers and herders and strategies for leaders, it aligns best with my study.

Technology Implementation

Mobile technology is a crucial variable in improving the technological infrastructure for rural farmers and herders. But technological advancement in a specific area requires alignment between the overall concept of the task and the input of individual characteristics, differences, and backgrounds of people tasked with accomplishing the goal (Gopal et al., 1992). Group work from mobile technology business leaders is needed to improve mobile farming technology (Gopal et al., 1992). Advancing mobile technology is a crucial step to improving technology and making it accessible to farmers and herders.

However, mobile technology can be an overwhelming concept for rural farmers and herders. Most rural farmers and herders are slow to understand and adopt new technologies on the market to improve their farming (Yigezu et al., 2018). The lack of understanding can lead to rural farmers and herders lacking strategies needed to increase production. Furthermore, this affects farmers because the low and slow adoption of improved agricultural technologies among smallholders often impedes technological development and promotion efforts to rural farmers and herders (Yigezu et al., 2018). But gaining access to technology will allow farmers and herders to improve their knowledge to advance their farming.

Infrastructure to rural farmers and herders. While technology is crucial to advancing farming, other areas also need to be improved. Technology implementation alone does not provide organizations with the answers and benefits that business leaders are looking for to resolve their problems (Turner et al., 2019). Implementing precision technology, however, can be a challenge for rural farmers and herders. Training different elements of mobile technology infrastructure for customers can be a challenge for rural farmers and herders. Aubert et al. (2012) completed a study and indicated the difficulties of modeling precision agriculture and its implementation, drawing on theories of technology acceptance and diffusion of innovations. Aubert et al. (2012) also discovered that the voluntary implementation of precision farming in sustainable farming did not show positive results in Canadian rural farmers; instead, it had a negative effect. Shrimp farmers perceive mobile phones as a tool for capacity development and extension services in shrimp farming (Anand & Kumaran, 2017). Rural farmers and herders would benefit from enhanced information access with a dedicated mobile app that shows dynamic disease diagnostics, frequently asked questions, and farm input calculation modules with the scope for two-way interaction (Anand & Kumaran, 2017). Having all the technical information in one area makes it easier for rural farmers and herders to understand.

Another area that rural farmers and herders need to analyze is soil composition. Variation is important when evaluating the performance of soil management recommendations, integrating aspects of production risk management within the formulation of recommendations, and proposing alternative approaches to implement

agronomic farming (Vanlauwe et al., 2016). The primary factor that hindered technology use and its adoption was limited access to improved technologies, such as an enhanced variety of seeds and associated packages (Vanlauwe et al., 2016). Although nearly half of the farming population on average has adopted various improved technologies, another half has not yet started benefiting from these technologies (Vanlauwe et al., 2016). Technology introduction and dissemination initiatives have primarily been campaign bases with little consideration of sustainability issues (Vanlauwe et al., 2016). Significant data processes of cloud-based and high-performance computing in farming development are essential to know where and how to adjust farming policies (Lokers et al., 2016). Suppose rural farmers and herders gain access to modern technology. In that case, they could use that technology to collect and analyze vital information for implementing different agricultural policies because of the sheer volume of data collected (Lokers et al., 2016). The benefits of the technology to enhancing farming are interminable.

Some of the areas that technology may help rural farmers improve include different farming services. Suppose rural farmers want to lead the farm landscape in the world. In that case, they need adequate access to knowledge, information, and other necessary services, including access to mobile phone technology, to improve farming (Fu & Akter, 2016). Rural farmers often used substandard farming practices due to a lack of information, knowledge, inputs, and management (Fu & Akter, 2016). Farmers transmitted information through radio, television, and satellite-based systems, but they could not voice their problems directly to experts for solutions (Fu & Akter, 2016). Rural farmers with access to mobile phones used their phones to send and receive text messages

and make calls (Fu & Akter, 2016). With the advancement of mobile phones, rural farmers need to utilize those advancements to improve their farming.

Communication systems are another way rural farmers may enhance their knowledge of farming and technology. The Digital Green in India is an innovative video communication system, a combined technology with social organizations to improve the cost-effectiveness of existing agricultural extensions (Fu & Akter, 2016). Many poor rural farmers are unaware of modern mobile technology when technological innovations came onto the market (Fu & Akter, 2016). Mobile phone technology infrastructure presented farmers with both audio and video functions that provide most of the basic needs of the poor and two-way communication between farmers and agricultural services providers (Fu & Akter, 2016). Rural farmers and herders must better understand how relevant modern IT is to their production activities and their lives (Fu & Akter, 2016). Agricultural participants need tactics to understand and follow the overall farming service deliveries used by technology leaders.

Impact on rural farmers and herders. Farmers with greater economic resources may adopt more technology and may obtain the knowledge needed to improve farming. Farmers and herders with larger farms are more willing to adopt new technologies advised by technology industry leaders, spend more time and money pursuing agricultural knowledge, and pay more attention to productive technology rather than process technology (Hu et al., 2019). According to Roberts et al. (2002), farmers who rent their cropland are less likely to adopt any advanced technology methods such as precision farming techniques, even when it has the potential to be more productive

because it costs more to invest in technology than they can afford. Precision farming techniques are methods used to focus on scarce resources, especially as it pertains to land geographical characteristics. Roberts et al. (2002) noted that investing in precision farming technology has the potential to earn the rural farmer a more significant profit through higher production, but that depends on the improvements of mobile technology infrastructure, which ultimately affects crop profitability. When looking at implementing advanced technology, farmers need to implement a cost/benefit analysis to determine if the implementation of the benefit exceeds the cost.

If the benefit exceeds the cost, then rural farmers may implement precision farming to continue expanding. Precision farming needs continued expansion, and training in the technology is paramount (Shruthi et al., 2017). The purpose of precision farming is to bring awareness to farming communities in Karnataka, India, about the technology in production and productivity of crop yields. The biggest hurdle for business leaders is the expensive equipment necessary to install technology infrastructures to perform adequate precision farming techniques in rural farmers' regions. Due to food demands and the global need to improve rural farming activities, mobile business leaders should improve their strategies with modern technology (Bilali & Allahyari, 2018). Farmers use IT to transition to agro-food sustainability by increasing resource productivity, reducing inefficiencies, decreasing management costs, and improving food chain coordination (Bilali & Allahyari, 2018). Asfaw et al. (2012) suggested that agricultural research and technological improvements are crucial to increasing agricultural productivity, reducing poverty, and meeting demands for food without

irreversible degradation of the natural resource base. Technological improvements affect more than farming.

Husbandry is an essential element in the food supply chain; therefore, it is important to improve technology infrastructures. The rural herders need to receive training about technology infrastructure and how to facilitate the process of storing milk for more extended periods before sending the milk to the markets to improve rural businesses (Bilali & Allahyari, 2018). Rural herders could use IT such as the Internet of things (IoT), BP Neural Network, and Amazon AWS to design a raw milk monitoring and warning system in the cloud to improve their milk storage capacity and increase profit (Ma et al., 2018). Modern technological advancements help lead the way for rural farmers and herders to control their farming and livestock remotely through systems like GPS locators, imaging swaths of land, and computer monitoring systems for remote control through sensors (Guo, 2019). These advancements aid in preventing human error and waste by controlling for fertilizer application, irrigation controls, medical distributions, as well as sensing for pests, weeds, and diseases (Rehman et al., 2017). Automating these functions saves rural farmers and herders time and money.

The lack of technology in farming and husbandry may create a wealth gap between rural farmers and herders, and others. Researchers studied the improvement in the quality, timeliness, and trustworthiness of the wealth gap information related to mobile technology. Wealth gap issues constitute a significant constraint for farmers and herders in less wealthy nations (Mittal et al., 2009). Striking a balance between the policies of food security and improving the income levels of rural farmers and herders to

improve productivity and profitability is the driving influence behind Mittal et al. (2009) studying mobile phone use to improve farm productivity and rural incomes. Mittal et al. (2009) were hesitant towards trying new farming strategies, even with proper access to reliable methodologies. Mittal et al. (2009) identified constraints that hold many rural farmers and herders back, such as insufficient availability of critical resources, inadequate irrigation, poor physical access, inadequate crop storage, and lack of formal credit. Improving technology may reduce the wealth gap amongst rural farmers because of the increased access to resources.

Ethiopia is one country that lacks critical resources and inadequate irrigation. Rural farmers in Ethiopia travel far from their farms to sell their products (Tadesse & Bahiigwa, 2015). Often, rural farmers do not have access to the information needed to make smart decisions about business strategies for their products (Tadesse & Bahiigwa, 2015). Rural farmers incur high market searching costs, which caused many small rural farmers to produce a limited range of goods (Tadesse & Bahiigwa, 2015). Many rural farmers and herders lack the money to invest in mobile technology infrastructures, which causes many rural farmers and herders to produce products for home consumption (Tadesse & Bahiigwa, 2015). Rural farmers and herders may not use mobile technology devices to search for information because they may not be able to access relevant information; accordingly, few rural farmers and herders use mobile technology devices for information searching (Tadesse & Bahiigwa, 2015). Rural farmers and herders use mobile technology for their basic needs because many are unaware of phone capabilities.

The United Republic of Tanzania is another country that has insufficient availability of resources. Rural farmers and herders in the United Republic of Tanzania rely on mobile phone technology to communicate amongst themselves, and others are connected to conduct their agricultural businesses (Nyamba & Mlozi, 2012). According to the Tanzania Communication Regulatory Authority (TCRA), small rural farmers and herders all across the country could benefit from vast upgrading of the information and communication technology (ICT) sector in Tanzania (Nyamba & Mlozi, 2012). Currently, asymmetry information about agriculture, rural farmers and herders limits their ability to sell their products and buy raw materials (Nyamba & Mlozi, 2012). There are minor ICT improvements in some parts of Tanzania, whereby rural farmers and herders owning mobile phones have enhanced their communication amongst themselves and other agricultural stakeholders around the country (Nyamba & Mlozi, 2012). While the improvements are minor, they affect farmers' productivity.

Application of mobile phone technology. Mobile phone technology enhances technology through several factors. Nyamba and Mlonzi (2012) identified factors influencing the use of mobile phone technology in communicating agricultural information. Nyamba and Mlozi (2012) investigated how rural farmers and herders use the technology, how technology helps farmers and herders confront business challenges, and their attitudes towards using the technology. Nyamba and Mlozi (2012) observed three objectives: the extent of mobile phone ownership, the extent of agricultural information farmers and herders sends and receive using their mobile phones, and identifying socioeconomic factors influencing mobile phone use in communications. The

three objectives affect how much knowledge and technology influence farmers and herders.

One area that is affected by the lack of education is rural farmers and herders regions in Tanzania. Farmers and herders in Tanzania, especially those in rural areas and females, are mostly uneducated and need to know how to access agricultural inputs or resources, such as technologically modern farming tools, and how to use them (Isaya et al., 2016). Tanzanian rural farmers and herders rely on radios and extension workers sent to their farms by the Ministry of Agriculture, Food Security, and Cooperatives (Isaya et al., 2016). Radio and agricultural extension workers are the primary sources of agricultural information for rural female farmers (Isaya et al., 2016). The Ministry of Agriculture, Food Security and Cooperatives should provide community radios, introductions to modern technology as the primary source of information dissemination to rural farmers and herders, and solar-powered radios free of charge subsidized cost to rural households (Isaya et al., 2016). Providing these essential tools will allow rural farmers and herders to benefit from technology.

Implementing technological infrastructures allows rural farmers and herders to improve their knowledge. Technological development could create an interplay between the evolving nature of rural lifestyles and rural enterprises (Small, 2017). Rural residents can use foresight endeavors, though fallible, as a springboard for recognizing and realizing emerging opportunities and potential mitigating threats through technology. Residents of rural farming communities must be aware of technological improvements to strategically prepare for a digital future and enhance their resilience and adaptability to

inevitable change (Small, 2017). Responsible technological development and business practices are vital for agricultural value chain participants to promote the increased trust and collaboration required to fully realize the potential benefits of digital agriculture (Small, 2017). Advancing technological infrastructure ensures continuous expansion for rural farmers and herders.

Implementing technology has caused an increase in use amongst larger farmers and herders. There has been a rapid expansion of mobile technology use among rural farmers (Duncombe, 2016). Agricultural and rural workers need efficient mobile technology services to overcome high costs and access capital, markets, and technical inputs; rural farmers and herders need mobile technology to compete successfully and contribute to productivity growth in their communities (Duncombe, 2016). Rural farmers and herders need help from adequate mobile business leaders to learn and adapt similar concepts of improving mobile technology infrastructure in the same ways as urban areas (Duncombe, 2016). Rural farmers and herders in high-potential areas need adequate mobile technology services and mobile technology infrastructure to increase production, contribute to economic growth, and reduce poverty (Duncombe, 2016). Rural farmers and herders do not have the resources to expand their technical knowledge without adequate infrastructures.

Rural farmers are a crucial part of the farming industry; therefore, it is important to provide adequate resources to improve their farming. Wyche and Steinfield (2016) studied the importance of rural farmers and herders having access to mobile technology in the rural Republic of Kenya. Wyche and Steinfield (2016) found that a rural farmer or

a herder owning a mobile device increases a chance of income growth by 70% because they will have access to more farming information outside of the community. Wyche and Steinfield (2016) emphasized the importance of mobile technology investment in rural farmers and herders like those in the Republic of Kenya because they reduce the burden of resources from their government. Rural farmers and herders with adequate knowledge of mobile technology can reduce their reliance on their local governments.

Rural farmers may benefit from technology by providing information that traders may need to make informed decisions. However, introducing mobile technology in areas may be complicated, even if researchers see more significant rewards (Gelaw et al., 2016). Rural farmers can use mobile technology to improve coffee market transactions while maintaining excellent quality. The most challenging issue threatening agriculture for rural farmers and herders in developing countries is collecting timely data on disease spread and the effectiveness of on-farm control methods Nakato et al. (2016). Mobile technology will allow farmers and herders to see how diseases are spreading in their fields.

Having access to technology that can monitor different aspects of farming may improve crop production. Many rural farmers and herders lack agricultural technology improvement initiatives such as weather forecasting, irrigation monitoring, disease diagnosis, and integrated pest management to improve their farming (Jain, Kumar, & Singla, 2015). Rural farmers and herders need technological solutions for tractability, robustness, and low-cost solutions with a tolerance of imprecision and uncertainty to their products (Jain et al., 2015). Mobile business leaders should introduce technological tools,

such as voice message delivery systems that transport voice messages between rural farmers, experts, and SMS, to simplify communication between rural farmers and herders (Jain et al., 2015). Applications of mobile farming technology infrastructure have indicated the potential to minimize the complicated manual traceability data recording process for rural farmers and herders if mobile technology business leaders invest in rural farmers and herders (Jain et al., 2015). Mobile applications can reduce the number of time farmers and herders spend manually performing the tasks.

Once mobile applications are implemented, rural farmers and herders may see a growth in the economic performance of their farms. Rural farmers and herders could increase productivity and revenue by using improved agricultural technology (Cunguara & Darnhofer, 2011). Statistical data analyzed from surveys of rural households in Mozambique show that technology has improved maize seeds, granaries, tractor mechanization, and animal traction (Cunguara & Darnhofer, 2011). Rural farmers who use mobile technology increase farming and husbandry productivity and reduce food insecurity, and, as a result, produce a marketable surplus, which results in increased household income (Cunguara & Darnhofer, 2011). Improved usage of agricultural farming and husbandry technologies leads to increased productivity in smallholder agriculture, increased household income, and reduced poverty (Cunguara & Darnhofer, 2011). Furthermore, mobile technology will increase their economy.

Communication improvements with mobile technology. Another area that can help rural farmers and herders is communication. Rural farmers and herders can harness information and communication technologies for more efficient, productive, and

profitable farming enterprises (O'Grady & O'Hare, 2017). Rural farmers' use of decision-support tools, including models of different farming activities on their own or combined with other models, is attainable and provides a radical innovation for farming management practice, especially for rural farmers and herders (O'Grady & O'Hare, 2017). Another way a rural farmer could use small farming technology is to protect the environment (O'Grady & O'Hare, 2017). Herders may use small farming technology to forecast milk production and predict feed intake and lactating dairy cows (O'Grady & O'Hare, 2017). Despite the benefits of harnessing sophisticated simulation models, small farming efficacy for everyday rural farm management is somewhat limited (O'Grady & O'Hare, 2017). Limited small farming efficacy in everyday rural farming is due to technological complexity, lack of time, and farmers' and herders' concern that they will not increase profits relative to their efforts (O'Grady & O'Hare, 2017). Technologies supporting smart farms provide rural farmers and herders with opportunities to construct and apply beneficial farm-specific models (O'Grady & O'Hare, 2017). Small farming ICT helps rural farmers and herders identify different opportunities.

Mobile technology applications may also help rural farmers and herders find the best resources. Rural farmers and herders who want to sell their products must search for the right market, the right price, the right buyer, and the correct product standards and grades (Minkoua Nzie et al., 2018). Rural farmers and herders travel frequently, and their activities require them to repeatedly load and unload their products to display to buyers and brokers (Minkoua Nzie et al., 2018). Rural farmers and herders can use ICT to help facilitate the adoption of modern agriculture advancements (Minkoua Nzie et al., 2018).

Therefore, rural farmers and herders must continue to embrace new information and technological infrastructure (Minkoua Nzie et al., 2018). However, relatively few rural farmers and herders use mobile phones for information searches due to a lack of relevant information accessible through mobile phones (Minkoua Nzie et al., 2018). Cautious farmers might use mobile phone technology to identify potential buyers over larger geographic areas and at crucial moments, thereby reducing price risk and potentially increasing the net benefits of the technology (Minkoua Nzie et al., 2018). Mobile phones can provide other services to local farmers, such as information distribution from a central location for all farmers in the region (Minkoua Nzie et al., 2018). The establishment of vegetable information centers can provide an interface between agricultural stakeholders by channeling adequate and timely information so farmers can reduce the cost of cabbages, which indicates the need for robust mobile technology in rural farming (Minkoua Nzie et al., 2018). Mobile phones can provide benefits in areas where rural farmers experience increased production transaction costs (Minkoua Nzie et al., 2018). The added experiences increase rural farmers' knowledge, which increases production.

Rural India lacks adequate resources to improve farming in poor rural communities. Substantial demand for agricultural information exists in rural India; there is, however, a digital divide between rich and poor farmers (Cole & Fernando, 2016). Wealthier farmers are more likely to use a technology provided by companies that charge higher fees (Cole & Fernando, 2016). If farmers know about informational inefficiencies and lack information, a considerable demand for high-quality agricultural information

will result (Cole & Fernando, 2016). The lack of information may reduce the profitability of rural farmers.

Therefore, it is crucial to have applications in mobile technology easily accessible to rural farmers and herders. Rural farmers and herders need access to technological applications, such as Avaaj Otalo links, that connect farmers with different supporting agencies that provide high-quality agricultural information (Cole & Fernando, 2016). Farmers and herders can use application platforms to access crucial agricultural information without spending extended time calling their local information centers (Cole & Fernando, 2016). Rural farmers and herders benefit from using toll-free mobile phone-based technology to receive timely agricultural information from expert agronomists and the farmers' peers.

Many industries have successfully used smartphone systems, which shows how vital it may be for rural farmers and herders. An efficient, automated smart system prioritizes the environment and animal care and alerts farmers when a problem occurred (Deokar et al., 2018). One available smart technology system could provide almost all animal husbandry requirements, such as feed and water, biogas exhaustion, fire detection, and real-time monitoring. The installed system will use automated sensors (water level, temperature, motion, biogas) connected to a microcontroller to monitor and refill components of the farm (Deokar et al., 2018). If the water level goes down, the water pump turns on to fill the water container; if the level of feed decreases, the motor turns on to refill the feed; if there is an excess of biogas emission, cleanup occurs; and if the fire sensor module detects a fire, it turns on the fire alarm (Deokar et al., 2015). Rural herder

can feed all animals on the farm remotely from anywhere in the world by using a mobile application (Deokar et al., 2018). An essential feature of all smart technology is the ability to send an alert message to the system application when a problem occurs (Deokar et al., 2018). Rural herders could reduce time, energy, and labor costs by integrating smart technology into husbandry facilities (Deokar et al., 2018). Animated instructional videos depicting postharvest technologies can provide low-literate farmers in developing countries with necessary information through mobile devices (Maredia et al., 2018). The videos show rural farmers how to use different applications in technology.

Africa has a shortage of technology to help reduce time, energy, and labor costs. Many African countries lack the resources to utilize modern irrigation systems (Howell et al., 2018). Rain-fed agriculture is the leading resource in many African agricultural societies; rural farmers could improve agricultural outputs with accurate mobile technology to help weather forecasting (Howell et al., 2018). Mobile technology may help rural farmers solve the problem. Mobile technology is also a very affordable alternative for problem-solving. Therefore, mobile business leaders need to educate rural farmers and herders about mobile technology use (Howell et al., 2018). Mobile business leaders and governments should work with rural farmers to simplify the infrastructure and provide rural farmers and herders access to frugal technology. Once the technology is in place, rural farmers and herders can less expensively access information about governmental regulations, new agricultural technology, weather data, and other necessities (Howell et al., 2018). Hence technological infrastructures are crucial for the advancements of farming.

Sub-Saharan Africa is one region that has seen the benefits of mobile technology. Mobile phone usage in sub-Saharan Africa has immensely increased, with small-scale farmers using their devices to connect with diverse stakeholders in the agricultural value chain (Misaki et al., 2016). Young farmers in Chamwino, Tanzania, use mobile phones more than older farmers (Misaki et al., 2016). Buyers and sellers of agricultural products often live great distances from one another (Misaki et al., 2016). Small-scale farmers can use mobile phone technology to hire labor, price intelligence, procure farm inputs, seek technical assistance from the extension or expert agents, and obtain weather information, among other uses (Misaki et al., 2016). Regional rural farmers face technological challenges; accordingly, researchers must work with people in the technology industry to improve technology access to small-scale farmers (Misaki et al., 2016). Once the technology has been advanced, communication with smaller farmers will increase.

The need for improvements in technological infrastructure expands beyond rural farmers and herders. Farmers, traders, and policymakers can use mobile phones to obtain information about efficient markets (Ogbeide & Ele, 2015). However, leaders from some Sub-Saharan countries limit data usage, which makes it difficult for rural farmers and herders to procure knowledge (Ogbeide & Ele, 2015). When they can access data, younger rural farmers benefit more from mobile technology due to curiosity about their farming activities (Ogbeide & Ele, 2015). Young rural farmers in sub-Saharan Africa seek market and weather information more than any other agricultural activity (Ogbeide & Ele, 2015). Being able to check the market and weather within the application saves time.

Artificial Intelligence-Based Control Systems

Artificial intelligence is a type of technology that can benefit rural farmers and herders. Artificial intelligence-based control systems may enable the development and synthesis of a smart climate controller for precision farming in greenhouses (Njoroge et al., 2018). Multiple experts have introduced various technological advancements in the farming sector to improve precision farming activities. Rural farmers and herders may have access to remote farming technologies, such as hyperspectral image analysis using support vector machine and artificial neural network, to detect and classify weeds in cornfields and control nitrogen application for weed management (Njoroge et al., 2018). Rural farmers may use neural network-based algorithms to predict hourly soil moisture requirements, such as the Scaled Conjugate Gradient and Quasi-Newton Broyden–Fletcher–Goldfarb–Shanno, for wireless sensor, network-based precision farming (Njoroge et al., 2018). While these technologies are available, many rural farmers and herders are either unable to afford the technology or the training needed to use the products. The majority of precision technologies are crucial for rural farming activities if farmers implement them quickly and effectively (Njoroge et al., 2018). Rural farmers may use advanced techniques and tools, such as wireless sensor technology and soft computing techniques, to produce resources considered unsustainable solutions (Njoroge et al., 2018). Researching different techniques utilizing technology saves time and makes it easier to compare different strategies.

IoT and cloud computing are crucial tools used by mobile technology business leaders to simplify the integration of the supply chain between modern technology to

farming and husbandry (Pivoto et al., 2018). For example, field experts in Brazil often believe that rural farmers and herders will receive opportunities to use robots and artificial intelligence to increase productivity (Pivoto et al., 2018). Farmers' education, ability, and skills to understand and handle small farming tools may be problems that leaders from both sides of the technology must address. Lower-income rural farmers and herders can adopt technology to connect scientific literature and the integration of supply chain and production system environments to improve farming activities (Pivoto et al., 2018). Improved farming activities help farmers increase production.

Infrastructure in Rural Farming

Mobile Infrastructure concepts. Mobile infrastructure is an essential component of improving productivity and crop yield. Technology infrastructure is a valuable source of agricultural information if farmers and herders have access to adequate mobile technology infrastructure (Aldosari et al., 2017). Rural farmers and herders are recognized as equally weighing forces of innovation in the mobile technology framework; their participation in knowledge sharing is often limited if mobile infrastructure leaders do not provide technical support (Aldosari et al., 2017). Many rural farmers and herders contribute to mobile technology infrastructure to use such technology to produce their products (Aldosari et al., 2017). Dolinska (2017) mentioned that many rural farmers and herders in developing countries are more engaging in mobile technology implementation into their agricultural activities under good leadership than designing such technology or shaping the technology process. Mobile business leaders need to have robust mobile technology strategic policies such as data sharing, easy to

operate devices, and cheaper broadband transmissions to their followers, especially in rural farming communities, because such technology policies will help farmers effectively utilize their mobile devices (Kalaba, 2016). Farmers that can utilize mobile technology may benefit from networking and utilizing the tools.

Networking and technological infrastructure allow rural farmers and herders to discuss strategies with other rural farmers and herders. Rural farmers and herders will be able to send and receive farming information to one another or with their vendors and get access to different agricultural from all around the world through their mobile devices (Aldosari et al., 2017). To determine the area's infrastructural capability is to test the feasibility of that technology (Tomlinson et al., 2009). Mobile phones can be used for geological surveys and data gathering through their application software to help the region's population (Tomlinson et al., 2009). Tomlinson et al. (2009) studied comparative technology use, such as mobile phones vs. personal digital assistants, to measure data loss and upload difficulties in rural South Africa. Tomlinson et al. (2009) noted comparisons between technologies and their usability and a geographic region's ability to sustain the technology's infrastructural requirements. Once the correlation is established, the same technology can improve farmers' and herders' agricultural activities within the region (Tomlinson et al., 2009). The implementation of this mobile technology helps rural farmers and herders focus on their region.

Another way that researchers have utilized technology is score matching. Researchers use propensity score matching as a statistical technique to estimate the effects of a policy or other interventions within an area (Eastwood, 2019). For example,

small rural farmers in Kirinyaga district in Central province, a horticultural export region in Kenya, face various constraints, including limited price information and export market opportunities, lack of reliable production contracts, and limited access to credit (Ogutu et al., 2014). Nongovernmental business leaders introduced a program called DrumNet to provide smallholder rural farmers organize into farmer groups with incentive packages and access to credit and marketing services (Ogutu et al., 2014). Business leaders expanded the DrumNet program to other areas, such as the Bungoma and Migori districts in the Western and Nyanza provinces (Ogutu et al., 2014). Business leaders developed a series of partnerships involving output buyers, a credit provider (commercial bank), several agro-input retailers, and smallholder farmers (Ogutu et al., 2014). However, regional business leaders failed to improve mobile technology infrastructure to provide smallholder farmers access to the information (Ogutu et al., 2014). The lack of information causes rural farmers and herders to fall behind compared to larger farmers.

The Republic of Kenya is another country that has implemented different technological strategies. Ogutu et al. (2018) argued that rural farmers in the Republic of Kenya could increase the adoption of pro-nutrition technologies such as biofortified crops if industry and government leaders are willing to invest in technology that can be used to collect, analyze and utilize data from areas where currently that technology does not exist. Ogutu et al. (2018) focused on increasing nutrients to a wider group of Kenyans but warn that the technology needed for pro-nutrition improvements may not increase farming productivity, which can be problematic to some rural farmers. Farmers tend to adopt any new technology rapidly that will bring them more revenue, biofortified crops

take time to grow, and that can bring a concern to Kenya's farmers (Ogutu et al., 2018). The longer the crop takes to produce, the longer it takes a farmer to show a profit.

Within the broader IT industry, there is the argument of innovative technologies and applications as a new source of sustainability that can lend itself to competitive mobile technology advantages. Baumüller (2017) suggested that competitive mobile technology innovation to develop supply is high to meet the demands of the technology industry's need towards a sustainable future. Baumüller (2017) also used agent-based modeling to discuss components and architectural innovation as inducing hyper-turbulent environments caused by IT-based strategic actions and collective-level inducements that mobile business leaders could use to improve the productivities of their customers. These productivities help enhance farmers' crops and network capabilities.

One way that some farmers have been able to advance is a mobile service system. Zheng et al. (2010) engineered a smart mobile service system using a wireless sensor network called Zigbee technology augmented with GPS and geographic information systems using customized PDAs and a host PC. The host PC monitored several farming PDA terminals, exchanged data, visualized that data, and offered irrigation decision-support based on real-time information and farmland irrigation models through the sensor network. These smart mobile service systems are crucial to agricultural activities worldwide because they simplify an existing process that farmers and herders have to go through to manage their operating costs.

The software has been designed and easily accessible to android and iPhone users. Karkhile et al. (2015) designed an application to increase cultivation and merchandise

using android mobile phones. The software focuses on getting market updates of different products necessary to plan a crop yield. Karkhile et al. (2015) also augmented cell phones with weather forecasting apps and how best to sell their product on the global market. Software like Karkhile et al. (2015) was designed to help many farmers and herders get accurate agricultural information so farmers and herders can make informed decisions about their businesses. The software can aid in different strategies by analyzing different potential outcomes.

Rural Niger has a good example of rural farmers and herders that do not utilize cell phones to their full potential. Aker and Ksoll (2016) mentioned cell phone technology has mixed reviews about improving the lives of rural farmers in Niger. Mobile technology is widely available to many people all around Niger, and farmers utilize that technology to their advantage. Still, many rural farmers and herders have not been benefited from having the technology available to them (Aker & Ksoll, 2016). Industry and government leaders have a duty of teaching rural farmers and herders how to use the technology to benefit people who need it to improve their agricultural activities (Aker & Ksoll, 2016). Educating the rural farmers and herders on using this technology is just one step needed after implementation.

Nigeria is another example of a country that does not take advantage of mobile phone applications. Ogunniyi and Ojebuyi (2016) note that farmers in southwest Nigeria use mobile phone technology for agribusinesses. Rural farmers in that area depend on mobile technology to get information about growing their rice, cassava, maize, and other cash crops (Ogunniyi & Ojebuyi, 2016). Electricity supply has been a big problem that

hindered the effective use of mobile phones business for agribusiness in the area (Ogunniyi & Ojebuyi, 2016). Ogunniyi and Ojebuyi (2016) argued that government leaders should improve infrastructure, especially electricity supply in rural areas, to enable rural farmers to use mobile phone technology effectively for agribusiness activities to ensure sustainable agricultural development. Improving the technology infrastructure is one area of improvement that would benefit farmers and herders.

Qualitative studies often show the impact of strategies implemented over time. Kumar and Shimi (2017) performed a qualitative study to learn about the impact mobile technology can have on environmental sustainability and global climate change in farming communities. Kumar and Shimi (2017) used solar-powered moisture sensors to help manage an automated water pump to cut down on human error and water waste. Kumar and Shimi (2017) discussed how information collected from solar-powered sensors is sent to mobile devices that, when processed, improve water consumption. Engineering of the system includes using the GSM system to allow farmers to control emergencies or perform manual alterations if necessary.

China is an example of a country that has utilized mobile technology and applications to increase crop productivity. Cai and Yan (2019) studied how Chinese leadership has introduced technology to help small wheat, rice, and maize farmers consolidate their farming activities into bigger farms to compete with other middle-income countries like Brazil and Ukraine (Cai & Yan, 2019). Chinese leaders' strategies included temporarily allocating some farmers to different farmlands and provided farming technology to increase efficiency (Cai & Yan, 2019). Chinese leaders were

sending farmers to areas that they were not accustomed to cause perennial problems that were not expected in their farming, which failed the project (Cai & Yan, 2019). Looking at how other countries implement the strategies, mobile technology can help advance farming in Tanzania.

The Republic of Kenya is an example that has utilized mobile technology to improve its husbandry productivity. Gichamba et al. (2012) studied mobile application designs for use in dairy farming in rural Kenya. Gichamba et al. (2012) focused on the implications of mobile systems technology use in agriculture, in this case, dairy farming. Gichamba et al. (2012) also presented their application model for designing such applications and the data security measures taken to maintain accuracy and reliability. Gichamba et al. (2012) suggested that once industry and government leaders direct their attention to implementing mobile system technology, Kenyan rural farmers and herders will benefit significantly by having access to a broader range of information about their farming. Implementing technology infrastructures gives small farmers the ability to expand and develop new strategies.

Cloud-based technology is another area that allows farmers and herders to interact. Narendran et al. (2018) also conducted a qualitative study about a multifunctional engineering system using cloud-based technology for mobile systems that farmers and herders can utilize in their farming activities. The process uses arithmetic logic algorithms and machine learning to automate sensor technology to reduce deficiencies and waste by automating watering, plowing, and seeding. Narendran et al. (2018) utilized technology that did not depend on internet availability at all times. Rural

farmers and herders can input and store all operational commands to mobile devices, and the command will apply to the system once a device receives an internet connection. The synchronization of the commands and results could be stored in cloud technology.

Leadership Strategies and Technological Infrastructure.

Leadership strategies are important to help countries build effective technological infrastructures. Kiani and Seyyedabbasi (2018) suggested that mobile business leaders should embrace the idea of investing heavily in IoT technology to rural poor farming communities because of their cost-effectiveness in the long term. The majority of rural farmers plant different crops on a small farm, and each crop has its irrigation method and scheduling (Kiani & Seyyedabbasi, 2018). IoT technology is about providing a rural farmer an opportunity to monitor all farm activities through sensors installed all around the farms (Kiani & Seyyedabbasi, 2018). Sensors will transmit data about weather requirements, soil classifications, and other surrounding details that farmers will use after passing through computer systems (Kiani & Seyyedabbasi, 2018). The sensors will transmit the information to the application, which allows the farmers to retrieve information quickly.

Information systems (IS) strategies are another software system that mobile business leaders can implement. Organizational leaders regard IS strategies as a significant organizational perspective on the investment, deployment, and use of such systems (Nan & Tanriverdi, 2017). Organizations such as Google and Amazon can grow, and others such as AOL and Nokia can fade due to their strategic execution of strategies in the technology industry (Nan & Tanriverdi, 2017). The competition in the technology

industry influences business leaders to search for the best talent wherever they can find to improve their organizations' portfolios and gain more market share (Nan & Tanriverdi, 2017). Many software options rural farmers and herders need to identify their needs and strategies to determine which software will be the best that fits their requirements.

Farming is crucial to many economies because it helps maintain food sources. Farming is the economic backbone of many developing African countries (Gichamba & Lukandu, 2012). Despite agriculture being the primary source of income for many Africans, lack of adequate data to improve their farming slows down their success (Gichamba & Lukandu, 2012). Agricultural technology becomes critical in developing countries such as Rwanda because there is no adequate leadership structure that could lead the younger generation that is attracted to technology, which will improve farming in their countries (Gichamba & Lukandu, 2012). The rural farmers and herders of the younger generation learn about mobile technology and innovation through their efforts and use that technology available such as cellphones, tablets, and other handheld communication or computing devices to satisfy their technology need while farming (Gichamba & Lukandu, 2012). In developing countries such as Rwanda, the rural younger generation of farmers and herders utilize Short Message Service (SMS) application known as eSoko to help interaction between farmers, agricultural vendors, and other farming stakeholders (Gichamba & Lukandu, 2012). Mobile Technology Industry and business leaders can utilize mobile technology such as M-learning to learn different farming techniques from farming experts who are not readily available for the rural farmers in countries like Rwanda (Gichamba & Lukandu, 2012). Mobile phone

technology provides the opportunity to access, learn, and utilize agricultural information to rural farmers and herders in developing countries such as the Republic of Kenya (Gichamba & Lukandu, 2012). Rural farmers and herders need to have the ability to choose and implement the proper software.

Technological infrastructure in developing countries. Differences in developing countries significantly influence the preferences of farmers interested in advanced techniques and mobile training. Guiné et al. (2016) identified how farmers in different countries obtain information in organic farming and decide who would become trainees for mobile learning techniques. Farmers that qualify for the training tend to be more comfortable with the implementation of technology.

A unique technique for understanding and training suggested by Nakano et al. (2018) is the cost-effective farmer-to-farmer socio-relational sharing of information. In this study, Nakano et al. (2018) selected smallholder rice farmers in the United Republic of Tanzania to monitor their social and geographical networks. Nakano et al. (2018) used agricultural training and diffusing new technology through social networks to increase productivity and increase wealth through mobile techniques.

Sri Lanka is another country that has implemented different types of software. Researchers studied other rural farmers in Sri Lanka for their use and sharing capacity of free and open-source software to promote sustainable farming knowledge (Jayathailake et al., 2017). Jayathailake et al. (2017) studied rural communities interacting collectively to share advanced knowledge of agricultural techniques. Jayathailake et al. (2017) obtained informative results from their study that helped improve the technology that farmers and

herders could use to interact with one another and sell their products to markets with higher profits. IT, a widely utilized tool for progress and development, is a means for rural farmers to improve their businesses (Syiem & Raj, 2015). People may find positive impacts both direct and indirect from the growth of the IT sector if they successfully implement mobile device infrastructures (Syiem & Raj, 2015). Technology is continually advancing, which is why countries need to implement the needed infrastructure.

Applying technology to rural farming has been beneficial to many countries. The majority of farmers in Tharaka Nithi, Kenya, find ways to apply technology to their farming activities (Oduor et al., 2018). Rural farmers need information about soil fertility, water predictability, and market opportunities and would benefit from technology that provides that information. Rural farmers in Kenya desired more knowledge on applying ICT interventions to improve profits (Oduor et al., 2018). Rural farmers in Kenya need to find a software application to help improve technology.

The diversification of technology is another way to improve rural farming and husbandry. Through smart farming or advanced technology farming, technology diversification is key to developing sustainable agriculture now and in the future (Walter et al., 2017). Walter et al. (2017) introduced multiple constraints that need consideration in studying the use of advanced technology in rural farm development. Some of these constraints include the following: (a) who owns the data that is being transmitted across technologies, (b) addressing the responsibility and accountability of new technology, (c) there is also a high cost of advanced technology and its daily use, (d) is to understand that there is limited knowledge of advanced technology and smart farming techniques (Walter

et al., 2017). Walter et al. (2017) mentioned that advanced training could lead to an industry loss of interest as individuals, armed with the knowledge of advanced technology that will take their new skills into a more lucrative industry.

The channels of mobile technology transmission's impact on rural farmers and herders include extension services, adoption of modern technology, and market participation (Issahaku et al., 2018). Mobile phones and rural farmers indicated improved productivity when user-farmers used their phones for more than making calls during production season (Issahaku et al., 2018). In addition, mobile phone ownership and use significantly correlates with improved agricultural productivity (Issahaku et al., 2018). Once rural farmers gain access and understand the software, they see an increase in productivity.

Some communities, however, have implemented the technology but did not see an increase in productivity. Not all technological advancements introduced to poor communities produce the expected results (Das et al., 2016). Although nearly half of the rural farming population has adopted various improved technologies, another half has not yet started benefiting from the techniques. Rural farmers have limited access to improved technologies, such as an enhanced variety of seeds and associated packages (Das et al., 2016). Technology introduction and dissemination initiatives have primarily been campaign bases with little consideration for sustainability (Das et al., 2016). Therefore, it is crucial to give farmers and herders access to technology and train them on those technologies.

Transition

Section 1 includes the fundamental characteristics of a qualitative multiple case study. I established the conceptual framework and the study's nature, next introducing the business problem, the study's purpose, research question, research method and design, assumptions, limitations, and delimitations. The literature review comprised research on the strategies mobile technology business leaders use to improve the mobile technology infrastructure for rural farmers and herders. Section 2 includes the role of the researcher, data collection and analysis process, procedures for a multiple case study, and the study's critical components. Section 3 will present and interpret the findings obtained from the data analysis, as well as contained (a) summary, (b) conclusion, (c) recommendations, and (d) social implications of the study integrated into the conclusion.

Section 2: The Project

Section 2 presents a discussion of the study's purpose statement, the researcher's role, participant selection process, research method and design, and population and sampling. Section 2 also explores the data collection instruments and data collection techniques. I also discuss data organizations and the data analysis process. At the end of this section, I will justify the reliability and validity of my research.

Purpose Statement

The purpose of this qualitative multiple case study was to explore strategies that mobile technology business leaders use to improve mobile technology infrastructure to rural farmers and herders. The targeted population consisted of three mobile technology business leaders from three different mobile technology organizations with successful mobile technology infrastructure strategies in the United Republic of Tanzania. The results of this study may contribute to social change by providing strategies for improving mobile telecommunications services, thus improving communications in and among poor farmers and herders' communities.

Role of the Researcher

In qualitative studies, the researcher is often the primary data collection instrument, and their role is to preserve anonymity and reduce bias in the study. (Yin, 2018). Accordingly, I was the instrument for data collection. As a researcher in this study, my role included identifying the research methodology and design, selecting participants, informing each participant about the research process, and collecting and analyzing data.

The interview process enables a researcher to gain insights from in-depth research on the identified phenomena (Saunders et al., 2015). I used a multiple case study methodology and asked participants open-ended questions with follow-up questions to gather accurate and consistent information. I conducted all semistructured interviews via secured web video chat applications such as Skype, WhatsApp, and Zoom. In addition to semistructured, virtual interviews, I collected data from documents and historical records related to successful strategies for improving mobile technology infrastructure, which ensured a full compilation of data consistent with the research questions used for this study.

I was born and raised in the United Republic of Tanzania. I grew up in areas that lacked mobile technology infrastructure and saw how it affected the businesses of farmers and herders. I understand how farmers and herders from developing countries could benefit from access to modern mobile technology. I avoided any direct interaction with participants outside of the interview sessions to mitigate bias in my data analysis. I also followed the same interview questions with each participant. Further, I took notes and compared them with the interview transcripts, and I asked participants to review the interview summary to confirm that I accurately captured their responses.

One of the responsibilities of an ethical researcher is to handle all sensitive information with the highest standards (Yin, 2018). I implemented strict ethical rules to preserve participants' confidentiality and mitigate bias. I requested and obtained approval from Walden University's Institutional Review Board (IRB) before starting data collection. I also adhered to the *Belmont Report's* protocols and procedures by protecting

participants' confidentiality, following the informed consent process, and treating all participants fairly (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research, 1979). I informed all individuals that collected information would remain private and confidential, that their participation was voluntary, and they could withdraw from the process at any time by sending an email or calling me.

Participants

Participants in this study were mobile technology business leaders from three major mobile technology companies in the United Republic of Tanzania. It is the researcher's responsibility to set clear standards for participant eligibility (Gentles & Vilches, 2017) to obtain reliable and qualified participants for a well-researched qualitative case study (Yin, 2018). The established eligibility criteria were that participants must (a) work within mobile technology infrastructure in the United Republic of Tanzania, (b) be consenting adults 18 years of age or older, and (c) be successful in mobile technology infrastructure strategies in the United Republic of Tanzania. Obtaining a proper sample size was crucial to providing the information needed to draw findings from the study.

Upon receipt of IRB approval, I called each company's representative to ask for a process of contacting their mobile leaders. A homogenous sampling process may be used to get participants for research (Saunders et al., 2015), which I used from the list of participants to ensure that I had appropriate participants for my research study. Then I contacted each participant by e-mail to ask for their consent to participate in my research study. I reached data saturation with the three participants I interviewed. Data saturation

occurs when data collection provides no new information or concepts (Yang et al., 2019). All participants were interviewed through Skype and Zoom online applications. In addition to participants' responses, I used company documents and other publicly available information about mobile technology infrastructure.

Research Method and Design

Research Method

Qualitative, quantitative, and mixed methods are the three standard research methods (Almalki, 2016). I chose the qualitative method to collect information from participants through open-ended interview questions due to their relevant views and experience to my research study. Using qualitative methods provides flexibility, highlighting the interaction between a researcher and the study participants (Antwi & Hamza, 2015). A researcher can use a qualitative method for triangulating participants' opinions and behaviors (Yin, 2018). The qualitative method was the best choice because I did not want to collect information from participants using a survey or standardized questionnaire with predetermined responses.

In contrast, quantitative methodology lacks flexibility in exploring strategies for testing different hypotheses and theories (Saunders et al., 2015). Quantitative methodology was not appropriate for this study because I did not intend to look for correlations or differences among variables nor to test any theory. A mixed-methods approach requires both qualitative and quantitative methods to address more complex research questions that include the statistical analysis of variables (Taguchi, 2018). I did

not plan to test quantitative theories; therefore, mixed-methodology was also not appropriate for my study.

Research Design

Researchers who choose the qualitative method for their studies can select from ethnographic, narrative, phenomenological, and case study designs (Saunders et al., 2015). A single case study design is used by researchers if there are extreme or deviant cases that highlight special circumstances that can point at special problems or the opposite (Gammelgraad, 2017). The single case study was not appropriate for my study because it would have restricted the amount of information I could collect to draw conclusions. Conversely, a multiple case study design is used by researchers to address a situation and provide a rich context for understanding and drawing conclusions about a phenomenon (Llerena et al., 2019). I used qualitative multiple case study for a broader understanding of strategies used by business leaders across multiple organizations.

Ethnographic, narrative, and phenomenological designs were not suitable for this research study. Ethnographic research centers on the lives, cultures, or situations of a particular group or community (Yang, 2017). Ethnography was not appropriate for my study because I did not explore social relationships based on a particular culture. Researchers use narrative design to tell a story about the information they collect, which made that design not suitable for this study (Caron & Belo Reyes, 2018). Finally, scholars use phenomenology to understand experiences, events, and occurrences related to a specific phenomenon (Darvin, 2018). Phenomenology was not a good fit for my

study because I did not explore a unique phenomenon through participants' lived experiences.

Population and Sampling

Researchers study individuals from a sample to generalize a population (Jordan, 2018). The overarching population for this study was three mobile technology business leaders from three mobile technology companies in the United Republic of Tanzania. I used homogenous sampling to select a proper representation of the population (Robinson, 2014). Homogenous sampling is participant selection in which researchers choose individuals who meet the designated criteria and are easily accessible (Callaghen, 2019). Achieving data saturation strengthens the researcher's knowledge and standpoint from various aspects, especially when setting and following the methodological framework of research (Hagaman & Wutich, 2017). But larger samples in a qualitative study do not guarantee data saturation (Yin, 2018). The eligibility for my study was solely based on the level of experience and expertise of participants with successful mobile technology infrastructure strategies in the United Republic of Tanzania. Participants also needed to have experience across various technology platforms.

Ethical Research

A researcher must adhere to ethical principles to protect the dignity, rights, and welfare of participants. Ethical issues are inherent in any research, and it is a researcher's responsibility to understand and address them accordingly (Satalkar & Shaw, 2019). I followed all the ethical rules and standards during my study. After receiving IRB approval to advance to participant recruitment (approval no. 01-12-21-0747561), I

contacted three mobile companies' representatives to ask for permission to contact their mobile business leaders. I sent an introductory email with my contact information and a background of my study to potential participants so they can knowledgeably provide their permission before their interviews. I reminded participants of their rights to withdraw or stop the interview at any time without penalty. There was no compensation for participating in the study. I sent a copy of each participant's transcribed interview data for review to ensure accuracy.

Additionally, the *Belmont Report* provides guidelines for protecting the rights of all research subjects or participants (Miracle, 2016). Accordingly, this was a high-level, ethically sound case study to comply with the IRB and the *Belmont Report*. I protected the confidentiality of all data and participants through their companies' confidentiality agreements by substituting the names of my participants with alphabetical designations to ensure their confidentiality and privacy (see Joslin & Muller, 2016). Researchers who hide participants' identities remove ownership of the study from the person and focus on the topic (Surmiak, 2018).

Data Collection Instruments

I was the primary data collection instrument in this qualitative study. My primary means of collecting information were interviews, observations, and documents requested from participants as well as publicly available materials about mobile technology infrastructure, which followed the typical methods of qualitative data collection (Yin, 2018). I conducted semistructured interviews using open-ended interview questions through web chat applications, recorded each interview, and took notes to capture any

tone or body language changes. I analyzed the notes and materials gathered during the interviews and direct observations, all information received from participants, and other publicly accessible information.

Researchers can use semistructured interviews to collect information, observe, and engage participants in open-ended conversations without room for topic exploration or follow-up queries (Yin, 2018). I scheduled the interview at a place and time that was convenient for each participant. Interview protocol is an important tool a researcher may use to ensure a study's validity and reliability (Yin, 2018). In this study, I went over the interview protocol (see Appendix A) with each participant to enhance the study's credibility. An interview with a participant may cover a broader topic if a researcher allows participants the freedom to share their knowledge and experiences (Quynh & Nguyen, 2015). I started the interviews with the same six questions (see Appendix B) in the same order to all participants to enable participants to share their knowledge and experiences and allow for any follow-up questions if needed for clarifications.

Researchers use direct observation to pick up unspoken cues from participants and improve data collection (Lloyd & Wehby, 2018). I observed and documented physical and nonverbal cues from participants during the interviews. During the interview, I also noted nonverbal behavior and changes in tone. Document analysis is a way for a researcher to collect data by interpreting documents, deepening the meaning, and understanding a topic (Saunders et al., 2015). An example of document analysis was the materials that I gathered during the semistructured interviews and direct observations.

Furthermore, the information that I received from my participants and other publicly available information was reviewed for validity and accuracy.

Data Collection Technique

Semistructured interviews are useful for qualitative researchers to gather crucial information from participants (Yin, 2018). In this study, I conducted semistructured interviews with all three participants from three mobile technology companies beginning with the same six interview questions (see Appendix B). I contacted three mobile companies' representatives and provided a confidentiality agreement to get permission to contact their mobile business leaders. I shared information about my study, process, and benefits to the company with the potential participants via telephone and e-mail. For those who responded, I scheduled interviews at a place and time convenient to each participant. I requested participants' permission to audio record our conversation before beginning the interviews. I reminded participants of their rights to withdraw or stop the interview at any time without penalty. There was no compensation for participating in the study. A productive case study interview should last from 30 to 45 minutes (Yin, 2018). Accordingly, I allotted 60 minutes for each interview to provide participants enough time to relate their experiences and expertise on the topic. I conducted the interviews via Skype and Zoom online chat applications. Following each interview, I conducted member checking by sending each participant their interview summary for their review and confirmation that I captured their answers to questions accurately. The semistructured interview process was advantageous to my study because participants

shared their in-depth knowledge, experience, and expertise that were useful to improving mobile technology infrastructure in rural areas.

Researchers use direct observation to document participants' nonverbal behaviors displayed while speaking (Navarro, 2019). Direct observation techniques are a means to collect more information during interviews (Navarro, 2019). Yin (2018) suggested that researchers use a journal to write down observations during interviews to avoid bias during the analysis. I took notes on what I observed during the interviews. Direct observation may help the researcher learn more about a researched topic from individuals in their natural settings (Rahman, 2020). The advantage of using a direct observation technique was the ability to directly observing and evaluating all unspoken cues from participants when they shared their knowledge, experience, and expertise related to this study. Direct observation may be problematic to a researcher when participants are not used to being watched every move they make while doing their jobs (Renz et al., 2018). A disadvantage was participants feeling uncomfortable with somebody observing their every gesture or facial expression, thus making them not want to provide in-depth elaborations to their responses.

Document analysis is a data collection technique whereby a researcher studies, analyzes, understands, and makes conclusions from all the information collected through semistructured interviews and direct observations (Nugroho et al., 2018). A researcher needs to review the documentation collected during the interviews and direct observations to arrive and findings and themes. I reviewed and analyzed the collected documentation, such as notes taken during interviews, transcripts generated from the

interviews, company documents provided by participants, other publicly available material from companies' websites, and other research sources to establish themes.

Data Organization Technique

Semistructured interviews, direct observation, and document analysis were the three data collection methods selected for this study. I organized all the collected data in various electronic folders for easy access and audits. I scanned handwritten notes and other related paper documents I received from participants into electronic files. Andruszkiewicz et al. (2019) suggested that research data is a tremendous investment and that preservation initiatives should be at the top of a researcher's mind. Yin (2018) recommended safeguarding research data for future use and audits. I stored all paper documents and saved all electronic files on a USB drive in a locked cabinet in my home office. Five years after completing my study, I will shred all paper documents and destroy the USB drive with electronic files per Walden University data retention guidelines.

Data Analysis

I analyzed all the data I collected which includes, mobile technology strategies that business leaders use to improve the technology infrastructure to rural farmers and herders. A researcher has a wide range of analysis tools from which to choose (Yin, 2018). Researchers can use multiple software tools to analyze qualitative research data, such as NVivo, SmartLook, or Dovetail. Scholars can use these analytical tools to explore data, find patterns, ensure eligibility and validity, and ask and answer what-if questions from the collected data (Padgham et al., 2019). Hetenyi et al. (2019) emphasized the importance of analyzing the collected research data because that data is the only link

between the theoretical statements and the reality of the studied topic. I used NVivo 12 to develop a data theme, Microsoft Word, and Excel to perform a data analysis process.

A researcher can use various types of triangulation to facilitate research validity and integrity (Thurmond, 2001). I used data triangulation to analyze the data about the strategies business leaders use to improve mobile technology. Data triangulation happens when a researcher utilizes more than one method of information verification of the findings and results (Jacek, 2015). I utilized data triangulation by using semistructured interviews, direct observation, and document analysis. I used the content analysis method to examine the data I collected during this study. Content analysis is a method of determining research patterns by reviewing documents, videos, or audios (Guo, 2019). Using content analysis in analyzing the collected data is to ensure data saturation (Guo, 2019). I applied content analysis as I reviewed all interview transcripts and participant-provided documents to identify emerging words, themes, or concepts.

Reliability and Validity

Assessing the reliability and validity of results requires a researcher to make decisions about the trustworthiness of the research, the appropriateness of the methods undertaken, and the integrity of the conclusions (Noble & Smith, 2015). I selected a vigorous process to assure the study's reliability and validity. Data reliability and validity are intended to make a qualitative research study trustworthy (Yin, 2018). Data reliability means the data is accurate and consistent across time, meets the intended purposes, and is not subject to inappropriate modification (Emek-Savas et al., 2019). Data validity

depends on whether the study's design and method are appropriate and capture participants' points of view (Carlozzi et al., 2019).

Reliability

Reliability means reaching a level of consistency over a period of time (Noble & Smith, 2015). I chose a qualitative multiple case study design to collect data to answer my research question. Participants were three mobile business leaders from three mobile companies who provided insight into the strategies for the improvement of mobile technology infrastructure in rural areas. I used member checking and data triangulation to ensure the reliability and accuracy of my data. Participants may review copies of the transcribed notes from their interview recordings, provide detailed interview responses, and verify the interpretive accuracy of the data (Birt et al., 2016). After I finished transcribing each semistructured interview, I sent each participant their transcript for review to ensure I accurately captured their responses and intent to the interview questions.

Validity

Validity in qualitative research study means the appropriateness of the processes, tools, and data (FitzPatrick, 2019). Researchers conducting qualitative studies should incorporate credibility, confirmability, and transferability within their studies (Johansson, 2019). I cross-checked participants' responses with the additional materials I received from the mobile companies for validity. Precision supports the establishment of credibility, conformability, and transferability, which makes the study valid (Yin, 2018).

Credibility. A credible research study should have all documents and analytic processes available that a researcher used for participants and peer review (Rosenthal, 2016). Establishing credibility, member checking, triangulation, and data saturations are strategies that can be beneficial to a researcher to increase the credibility of the study (Yin, 2018). Member checking is the process whereby a researcher goes back to research participants to verify the authenticity of the research outcomes (Naidu & Prose, 2018). According to Yang et al. (2019), data triangulation is achieved by utilizing multiple data sources to collect research information accordingly. Apart from data interpretation and transcript reviews, I asked research participants for any additional materials they might have related to the study topic. Data saturation is when a researcher exhausted all available resources, and no more new information can be extracted (Connelly, 2016).

Confirmability. The degree to which other researchers can corroborate the study's results indicates a study's confirmability (Johnson et al., 2019). Yin (2018) suggested that researchers record and safely keep all the documents they will use during a research study. Confirmability means that the data and interpretations of the findings are derived from data and are not biases or misinterpretations of the researcher (Korstjens & Moser, 2017). In my study, I kept a detailed reflective journal to ensure that all information has been preserved from all responses from participants to mitigate my personal bias.

Transferability. The ability to apply results to other populations without affecting the contexts of the study indicates a study's transferability (Malterud et al., 2016). A researcher cannot fully substantiate that findings are appropriate to other studies

(Carnevale, 2016). In my research study, I have documented interview questions, methods, designs, samplings, and techniques that future researchers can use outside of my sample group.

Transition and Summary

The objective of this qualitative multiple case study was to explore the strategies mobile technology business leaders use to improve rural mobile technology infrastructure. In Section 2, I presented information about the researcher's role, participation criteria, and research method and design. I also explained ethical standards, data collection instruments and techniques, and the reliability and validity of my research case study. In Section 3, I will provide my study findings and how these findings could contribute to professional practice implementation, the study's potential impact on social change, a recommendation for action, and the conclusion.

Section 3: Application to Professional Practice and Implications for Change

Introduction

The purpose of this qualitative multiple case study was to explore the strategies mobile technology business leaders use to improve mobile communication infrastructure for rural farmers and herders. To understand these strategies, I conducted interviews with three mobile company business leaders from three different mobile technology businesses in the United Republic of Tanzania. The business leaders were selected with homogenous sampling through business associations and word of mouth.

After I completed collecting data, I compiled all the raw data to identify themes with a coding system. I used NVivo 12 software for data coding and analysis to identify the emergent themes and answer my research question. Based on the triangulation methodology from the data I collected, three thematic categories surfaced regarding strategies that mobile business leaders use to implement mobile technology infrastructure to rural farmers and herders: (a) cost of technology improvements, (b) infrastructure implementation plans, and (c) training and development. In this section, I present my study's findings and explain how the findings apply to professional practices and impact on social change. This section also includes recommendations for action, my reflection, and the conclusion.

Presentation of the Findings

This qualitative multiple case study was based on the overarching research question, “What strategies do mobile technology business leaders use to improve the mobile technology infrastructure to rural farmers and herders?” The conceptual

framework for this research study was the AST. The participants from this study were three business leaders from three mobile technology companies in the United Republic of Tanzania. The participants are identified by the alphanumeric codes of P1, P2, and P3 to ensure confidentiality. The data came from three methods: semistructured interviews, direct observations to validate collected data from the interviews conducted and triangulation of the data by documentation analysis. Each data collection technique was used consistently to improve the quality of the data. I utilized NVivo 12 software to support the data analysis and member checking processes to ensure the accuracy of interpretation and data collection. I identified three strategic themes based on participants interviews that align to the main research question inquiring about business leaders: strategies to improve mobile technology infrastructure for rural farmers and herders: (a) cost of technology improvements, (b) infrastructure implementation plans, and (c) training and development.

Theme 1: Cost of Technology Improvements

The first theme identified from the data was the costs to fund new and improved current mobile technology infrastructure in rural areas. All participants affirmed that the cost it takes to build new and improve rural communities' current mobile technology infrastructure is too high. P1 mentioned that mobile technology companies often need extra funds to cover costs for improving technology infrastructure in rural areas because what exists is insufficient to hold the modern technology demand in the market. P1 provided his company's internal analysis report, which showed that the United Republic of Tanzania is such a humongous country with over 945,087 km² (appx 364,900.1 square

miles) in size, and most villages are so scattered that makes the investment very costly. P1 also indicated that the cost to invest in network coverage leads to mobile companies only investing in business potential areas that may yield returns in shorter times rather than just providing service. But, as P2 emphasized, the cost of not funding rural areas will be significant because it leaves rural farmers and herders suffer by not getting adequate modern technology services for their businesses. P3 underlined the importance of rural farmers and herders having affordable network service because they provide a bulk portion of food consumed by the urban population. Mobile phones are no longer simple voice communication devices and contain many high-tech features in a single handset (Ahmad et al., 2019). But although a mobile phone is considered a necessity in developing countries, in a country like the United Republic of Tanzania that still has many people living well below the world's poverty line's standards, buying a modern mobile device is considered unnecessary (P2).

P3 emphasized the significant need to manage cost and improve mobile technology infrastructure in rural areas across the United Republic of Tanzania. P3 referred to rural areas of the country as being the prime target for new customers, but most companies fail to reach them because of the cost of extending new technology infrastructure to reach these rural areas. P3 and their company's leadership team conducted a business case study to learn the actual cost of capturing the rural market, which has not been accessed for generations, but currently, their plans are on office shelves because of the cost required to acquire new cell phone towers and modern equipment and upgrade old technology, which is almost nonexistent in rural areas. When

asked a follow-up question about the company's strategy to combat the problem customers face currently, P3 responded that the mobile network companies tend to opt for wireless radio technology backhaul mechanisms, which consolidates individual small sites into one main link then transporting it to a different location close to the existing infrastructure to reach these rural areas. P2 was not sure if the consolidation practice was a reliable means in the long run, but companies now use it to provide some services to remote farmers and herders. Trenched or overhead fiber cables approach is too costly to accommodate with an unclear return on investment plan (P2). Overall, both P2 and P3 emphasized that mobile companies need a clear, cost-effective strategy to help rural farmers and herders get modern technology to help with their business activities.

In addition to the importance of technology for rural areas, P2 underscored the importance of modern mobile technology to most Tanzanians to improve lower-income people throughout the country. P2 mentioned that his team's goal is to ensure all Tanzanian's get access to modern technology in the next two decades while increasing efficiency and accountability on the business side, but the problem is his company does not have enough partners who could join them to share the cost needed to help their efforts of improving the lives of rural farmers and herders. Reaching rural farmers and herders requires a substantial investment that many organizations cannot do alone (P1). Joining forces to tackle the cost issue associated with the technology improvement to rural areas is ideal for all parties involved (P2). Still, the industry's competitive nature prevents individual companies from doing so, knowing that industry partners may not agree with whatever terms may be put forward by one company (P1). P1 pointed out that

there is mistrust amongst stakeholders when money is involved. P1 stated, “If mobile technology companies are not trusting one another, then they will not provide their customers with the needed support, which will cause potential customers to suffer.”

Further, when participants were asked about the barriers they encounter when implementing their strategies, all participants responded that the United Republic of Tanzania is one of the African countries where investment cost remains high. Investment costs can be higher in developing countries compared to others. P2 stated that there are few reasons that the United Republic of Tanzania is still struggling to improve its mobile technology infrastructure; one is the high cost of conducting business in the country. Government taxation and license fees are two items pointed out by all participants to cause a struggle for many businesses. And these two items alone can present a heavy burden to improve mobile technology all around the country (P2).

The United Republic of Tanzania is still holding onto 18% Value Added Tax and 17% Excise duty, and both these items make investment costs high (P2). Additionally, P3 mentioned that some selective IT and agricultural items have been exempted from excise duty but do not significantly drop overall costs. A government considers these exempted items related to mobile technology developments as essentials because they improve people's lives (P2). Both P2 and P3 agreed that taxes charged for other items that go along with these "essential items" are astronomical and affect the benefits that have been expected for mobile technology infrastructure improvements.

All participants mentioned that another item that hinders mobile technology improvement for Tanzanian's rural population is license fees. P2 mentioned, “Apart from

taxes that companies are required to pay on an annual basis, there are different licenses and permit fees, when accumulated together, amount to a heavy burden for businesses." A government sets up different license fees structure that must be paid on different government levels (P3). P3 gave an example that companies are required to pay for multiple licenses such as environmental safety and compensating anybody who may claim being affected by the company's equipment installation to improve technological performance. The compensation process gives ways to bribery, which is still a problem at all government levels and causes the overall cost to improve technology infrastructure to get too high (P1). Research suggests that bribery, which is illegal but largely carried out without impunity and perceived as just a cost of doing business in Africa, has heavy costs on developing nations and corporations (Adeyeye, 2017). At a national level, government leaders should go through all tax and fee structures and narrow them down to the necessary ones and combine them to simplify the approval process (P3).

According to P3, tax rates currently being used by the government also need to be revisited and restructured to help both sides of the process. P3 mentioned that politicians' unrealistic tax rates could be negotiated to improve mobile technology infrastructure, especially for people in rural areas. Additionally, P2 suggested that mobile technology companies that can prove to have an adequate plan to provide mobile technology services to rural areas should receive a special tax break for a certain number of years to use those funds to continue investing in such improvements. Government leaders need to facilitate a legislative strategy that can simplify mobile technology infrastructure efforts without enticement. P2 suggested accumulating all fees associated with building the technology

infrastructure into one entity and being managed by one national government agency. P2 continued to state that a national agency can then distribute the fees received to lower municipal governments to reduce bribery costs that companies must navigate through the process. All participants mentioned the one government agency proposal managing the approval process might cut down the bureaucracy that mobile business leaders face when improving mobile technology infrastructure to rural farmers and herders.

To combat these barriers within their business, participants mentioned different strategies. P3 mentioned that mobile technology business leaders are engaging government officials to improve the mobile technology infrastructure and manage costs. P2 stated that their company is seeking government subsidies to help them strategize a better cost-effective mechanism that may help reduce costs that they do not have to pass on to their customers when improving mobile technology infrastructure to rural farmers and herders. P1 and his leadership team are working on agreements with other foreign investors to get funds that may help them speed up buying, import, and send equipment to strategic areas to help them start opening more services. P1 and their company believe that having foreign investors who can work in partnership with them within the country may speed up the construction process and make rural farmers and herders access adequate technology faster. P1 and his leadership team have passed an initial understanding stage of the negotiations, and now they are working on the cost of the project and how to handle challenges they may face with their joint venture.

Theme 2: Infrastructure Implementation Plan

The second key theme identified was the planning and implementing of the mobile technology infrastructure to reach all rural communities. Technology infrastructure is a huge area that mobile technology companies need to invest in to help farmers modernize their agricultural machines (Tchernyshev et al., 2018). All participants emphasized a robust mobile technology infrastructure implementation plan that can operate in all rural areas that lack adequate mobile technology infrastructure. All participants also mentioned the responsibility of mobile technology companies for developing plans to improve mobile technology infrastructure and present them to the government for discussions and approval.

The approval process that currently exists is susceptible to bureaucracy and corruption (P3). Bureaucracy is behind any government's good functioning, but once it is misused, it creates problems that affect intended recipients of services (Khan & Hussain, 2020). P3 mentioned that all mobile technology companies must get approval from a series of government agencies that may slow down the construction process. In a country like the United Republic of Tanzania, getting all required approvals to do anything is a challenge (P1). Furthermore, P1 mentioned that every step of the investment process requires its permit, and a company must get it before any development project can start. A government has distributed the entire approval process among its different agencies to manage mobile technology improvements.

P3 also mentioned multiple challenges mobile companies have when visiting these government agencies asking for their approvals to start a project. Some challenges, among others, could be being told that a signatory officer not being in the office went for

lunch and does not know when that person may come back. But, according to P3, “A company representative cannot move forward with the permit approval process until they get that signature from a missing government official.” P2 suggested that challenges that mobile companies face through the approval process may be rectified if mobile business leaders could sit down with the government leaders and negotiate the process that may help farmers and herders who live in rural areas get adequate technology for their businesses.

When asked about the hurdles P2 experiences with their company when implementing infrastructure plans, a corrupt culture within government officials' ranks emerged as a serious problem. Many African countries have the perceived acceptance of a high level of bribery as a way of life (Adeyeye, 2017). The process of getting permits from all agencies can be daunting at times (P2). Some government officials within these agencies see the approval process as an opportunity to ask for bribes before approving permits that are needed by mobile technology companies (P2). If mobile company representatives do not agree with government officials' bribe advances, their companies may face long delays and unnecessary scrutiny to receive permits (P3). All participants agreed that their companies paid bribes requested to shorten the time it takes to pursue the necessary permits.

All participants mentioned that their companies currently are engaging officials from different government levels, so they understand the importance of reaching rural farmers and herders. Mobile companies’ leaders arrange seminars, field trips, and fliers to promote the importance of technology to rural farmers and herders and involve

government officials in focusing on the need for rural customers to have mobile technology. Building an adequate mobile technology infrastructure that can help rural areas communities requires government and technology companies to work together.

Theme 3: Training and Development

The third key theme identified during a data collection process is the importance of training and development of mobile technology customers. Farmers and herders lack the proper knowledge needed to actively engage in their policy' improving process throughout their communities (Gjorgjieska & Ilic, 2020). P1 mentioned that "Most rural farmers and herders have never been to school, making it challenging to learn modern technology. When a child is old enough for self-realization of the surroundings, they are pushed to farming, grazing, or mining to support the family." P2 emphasized the importance of training customers early within their communities because many children grow up without proper education, making them unable to read or write. P2 continued to mention that when rural people are exposed to technological advancements, they automatically reject them to avoid confusion. All participants agreed that rural families become very hesitant about new things because of their uncertainty over the investors' intentions.

In 2008, the Chinese government established a village educational center in each village across Ningxia province to allow villagers to learn newer technology to improve their farming activities (Sun et al., 2019). When business leaders were asked how to train mobile technology users, P1 stated, "The need to educate rural farmers and herders across the United Republic of Tanzania is enormous because having adequate technology

simplifies their activities." Mobile technology improves access to education to be more accessible, more affordable, more efficient, and more effective in educating the poor in Africa (Oluwatobi & Olurinola, 2015). Additionally, P2 mentioned that mobile technology helps rural farmers and herders in their daily farming activities. Mobile technology also helps farmers and herders make wise financial decisions for themselves and their businesses because they learn about different ways of managing finances.

P3, as an executive leader of a technology company involved in the mobile technology infrastructure, has dispatched personnel called extension officers to these rural areas. Extension officers' responsibilities are building an education network amongst rural farmers and herders in their geographical areas to educate them on the importance of investing in learning simple mobile technology to help them in their farming. Also, P1 stated that their company has invested in rural elementary, middle, high school, and adult learning centers to provide education on utilizing mobile devices such as solar-powered laptops, cell phones, and other mobile devices. All three participants mentioned that having a robust education establishment for all farmers and herders allowed them to interact with their peers from different villages across the country better. When mobile technology education is applied to real-life scenarios, rural farmers and herders tend to hold on to that information to improve their lives.

P1 mentioned that "Training rural farmers and herders about technology, especially from developing countries, helps improve their learning opportunities more about their agriculture." Cultivating new professional farmers through education has been the key to China's agricultural transformation policy and the only way to develop modern

agriculture in the area (Sun et al., 2019). P2 also emphasized the importance of rural farmers and herders to learn about mobile technology because they will need it to move forward with the infrastructure upgrade. Sixty percent of the African population lives in rural areas (Oluwatobi & Olurinola, 2015). The main reason for many Africans not being educated is a lack of proximity to schools (Oluwatobi & Olurinola, 2015). P2 mentioned that the difficulty that rural farmers and herders face could be addressed with the adequate mobile technology infrastructure to cut down the distance farmers and herders have to travel to learn. All participants agree that if mobile technology companies invest heavily in educating rural communities, especially farmers and herders, the importance of mobile technology, the chance of improving peoples' lives will grow exponentially and help such farmers and herders control all aspects of their lives.

Applications to Professional Practice

I revealed three themes shared by 3 mobile technology business leaders in the United Republic of Tanzania used to improve mobile technology infrastructure for farmers and herders in rural areas. Rural farmers and herders could learn mobile technology to maintain their businesses and develop new strategies that lead to long-term sustainability. Other researchers could use these study findings to form their basis for future studies.

Through this study's findings, rural farmers and herders could utilize the technology infrastructure implemented into their areas to help them remain sustainable, thereby adding revenues to their local economies. Future rural farmers and herders could benefit from the technology training and using a technology infrastructure to enhance

their businesses. Future business leaders might find the study's themes helpful when improving mobile technology infrastructure to other businesses such as fishing, construction, or finance in rural areas.

Implications for Social Change

Fifty-seven percent of farmers and 55% of herders in the United Republic of Tanzania lack access to mobile technology services due to the unavailability of adequate mobile technology infrastructure to rural farmers and herders (Echanove & Steffen, 2015). The strategies that mobile technology business leaders shared in my research study could invoke positive social change by providing rural farmers and herders access to mobile technology and enhance their understanding to maintain successful businesses long term. The results of this study could impact positive social change by bringing better technology to farmers and herders that will help them interact amongst themselves easier and knowing they are being a part of the global community and fulfill their need to do work that benefits others.

Recommendations for Action

Mobile technology infrastructure is a problem that impacts the economy in developing countries. Based on the study findings and exhaustive review of literature, I provide recommendations to the business leaders in the mobile technology industry, partnerships and collaboration, incentives, and customer involvement.

Partnerships and Collaboration

Business leaders should join efforts amongst themselves and raise funds to build needed infrastructures in and around rural areas that may help bring mobile technology

infrastructure closer to the rural farmers and herders. Business leaders should engage more and secure an agreement with national government officials to utilize tax reliefs to improve technology infrastructure. I recommend that mobile business leaders should have adequate skills to identify and apply the appropriate strategies to improve mobile technology infrastructure to farmers and herders.

Incentives

Mobile business leaders should offer incentives and opportunities to the local farmers and herders to buy companies' shares. Farmers and herders might engage more in industry expansion if they own the companies' shares in their areas. Local farmers and herders may want to engage more in the technology improvement process when they see their investments improve their local communities and businesses.

Customer Involvement

Business leaders should maintain open communication with local farmers and herders. Business leaders should have a clear and quick response system to all inquiries, recommendations, and feedback from local farmers and herders. Business leaders should engage local communities during social activities such as national or traditional anniversaries. Business leaders should invite local farmers and herders' representatives to participate in companies' internal strategy meetings. Business leaders should schedule frequent strategy meetings with farmers and herders' representatives and discuss future business projections and plans for technology improvements within local communities. Farmers' and herders' representatives should be included in local management positions within mobile companies.

My study has revealed that when technology business leaders engage and strategize their plans, either by joining efforts amongst themselves or involving their customers, mobile technology upgrades may significantly improve.

Recommendations for Further Research

I used a homogenous sample of 3 business leaders from 3 mobile technology companies in the United Republic of Tanzania to explore use to improve mobile technology infrastructure to rural farmers and herders. Three themes emerged from the use of triangulation methodology: (a) cost of technology improvements, (b) infrastructure implementation plans, and (c) training and development. The study had four limitations: first, I depended on participants' availability and willingness to participate and provide their business expertise in my study. I experienced challenges in scheduling meeting times with participants due to differences in time zones which was the second limitation. I encountered some hesitations from participants' willingness to share strategic decisions, fearing disclosing information to their competitors, and lastly, participants had a hard time remembering details of the strategies they used to implement mobile technology infrastructure.

In further research, researchers should focus on expanding their studies to include other rural businesses and accommodate all rural communities. This gap may be an excellent opportunity for future researchers to explore newer technologies that can help other rural communities' business sectors such as fishing, hunting, and weaving. The study was limited to 3 participants. Therefore, future researchers may expand their participants' group and include more business leaders who may have a broader

understanding of rural businesses' aspects. I recommend future researchers to pursue a quantitative approach to examine the number of rural farmers and herders who do not have access to adequate mobile technology due to a lack of mobile technology infrastructure. Numerical findings on these groups may help businesses and government leaders further understand the variables with the greatest impact on business profit and sustainability to people in rural areas. Future researchers could compare mobile technology infrastructure implementation strategies in rural and urban areas to determine the best practices.

Reflections

The doctoral study process at Walden University has taught me to be goal-oriented, ambitious, and to never give up. During the process of completing my doctoral study, I learned a lot about strategies needed by business leaders to improve mobile technology infrastructure for rural farmers and herders. This process was long, exhausting, complex, and at times discouraging and arduous. As a researcher, I learned to balance work, family, and academics, which was easy to become overwhelmed by numerous responsibilities. I learned a deeper understanding of independent research and gained a more in-depth insight into conducting a case study and analyzing research data. The level of attention to detail and the alignment required for scholarly research were not particularly troublesome, but the perception of the process became quite frustrating.

I am an IT enthusiast. I always like to learn different kinds of technology practices that can help simplify peoples' lives. I felt intimidated to interview participants who were extremely knowledgeable of the research topic, but they were very gracious

and helpful in providing me with abundant information for my research study. This study validated some of my initial thoughts about mobile technology infrastructure in rural areas and provided me with a new perspective. I now have a strong appreciation for business leaders who genuinely attempt to improve mobile technology infrastructure for rural farmers and herders. The Doctor of Business Administration degree is a remarkable achievement, and I look forward to facilitating my future ventures.

Conclusion

The purpose of this qualitative multiple case study was to explore the strategies mobile technology business leaders used to improve mobile technology infrastructure for rural farmers and herders. Three mobile technology business leaders from 3 businesses in the United Republic of Tanzania participated in this study. I reached data saturation when no new theme emerged after the third interview conducted and member checking. Since improving mobile technology infrastructure improves the businesses of local farmers and herders, the implementation of efficient mobile technology infrastructure is critical to local businesses' survival. The huge cost of funding technology improvements in rural areas places technology companies at risk of not fulfilling the need of rural customers and may create problems within rural communities. I learned that implementing a mobile technology infrastructure is not a simple business problem that can be resolved with just one or two solutions. The findings from this study indicate that funding for proper mobile technology infrastructure and training end users are an ongoing challenge in the IT industry. Business leaders may engage with other technology industry stakeholders to find meaningful ways to increase innovations and modern techniques.

References

Adams, C., & Manen, M. A. (2017). Teaching phenomenological research and writing. *Qualitative Health Research, 27*, 780–791. https://doi.org/10.1177/1049732317698960

Adeyeye, A. (2017). Bribery: Cost of doing business in Africa. *Journal of Financial Crime, 24*(1), 56-64. https://doi.org/10.1108/JFC-01-2016-0003

Adler, J. H., Manteuffel, T. A., McCeormick, S. F., Nolting, J. W., Ruge, J. W., & Tang, L. (2011). Efficiency-based adaptive local refinement for first-order system least-squares formulations. *SIAM Journal on Scientific Computing, 33*(1), 1–24. https://doi.org/10.1137/100786897

Ahmad, W., Ahmed, T., Ahmad, B. (2019). Pricing of mobile phone attributes at the retail level in a developing country: *Hedonic analysis. Telecommunications Policy, 43*(4), 299-309. https://doi.org/10.1016/j.telpol.2018.10.002

Ajjan, H., Kumar, R. L., & Subramaniam, C. (2016). Information technology portfolio management implementation: A case study. *Journal of Enterprise Information Management, 29*, 841–859. https://doi.org/10.1108/JEIM-07-2015-0065

Aker, J. C., & Ksoll, C. (2016). Can mobile phones improve agricultural outcomes? Evidence from a randomized experiment in Niger. *Food Policy, 60*, 44–51. https://doi.org/10.1016/j.foodpol.2015.03.006

Aldosari, F., Al Shunaifi, M. S., Ullah, M. A., Muddassir, M., & Noor, M. A. (2017). Farmers' perceptions regarding the use of information and communication technology (ICT) in Khyber Pakhtunkhwa, Northern Pakistan. *Journal of the*

Saudi Society of Agricultural Sciences, 2(2), 2–11. https://doi.org/10.1016/j.jssas.2017.05.004

Almalki, S. (2016). Integrating quantitative and qualitative data in mixed methods research, challenges, and benefits. *Journal of Education and Learning, 5*, 288–296. http://www.ccsenet.org/journal/index.php/jel

Almeida, T. R. (2015). The structuration theory of Anthony Giddens: A brief reading of some influences arising from the sociological literature. *Revista Sem Aspas, 1*(1), 20–21. https://www.researchgate.net/publication/285180282

Altamirano, M. A., & van Beers, C. P. (2018). Frugal innovations in technological and institutional infrastructure: Impact of mobile phone technology on productivity, public service provision and inclusiveness. *European Journal of Development Research, 30*(1), 84–107. https://doi.org/10.1057/s41287-017-0115-2

Anand, P. R., & Kumaran, M. (2017). Information seeking behavior of shrimp farmers and their perception towards technology dissemination through mobile phones. *Journal of Extension Education, 29*(1). http://doi.org/10.26725/JEE.2017.1.29.5787-5796

Andruszkiewicz, N., Ogunniyi, C., Carfagnini, C., Branston, A., & Hirji, M. M. (2019). Utilizing public health core competencies to share data effectively with community organizations to promote health equity. *Canadian Journal of Public Health, 1*(110), 303–313. https://doi.org/10.17269/s41997-019-00190-8

Antwi, S. K., & Hamza, K. (2015). Qualitative and quantitative research paradigms in business research: A philosophical reflection. *European Journal of Business & Management, 7*(3), 217–225. https://doi.org/10.1371/journal.pbio.2007054

Asfaw, S., Kassie, M., Simtowe, F., & Lipper, L. (2012). Poverty reduction effects of agricultural technology adoption: A micro-evidence from rural Tanzania. *Journal of Development Studies, 48*(9), 1288–1305. https://doi.org/10.1080/00220388.2012.671475

Aubert, B. A., Schroeder, A., & Grimaudo, J. (2012). IT as an enabler of sustainable farming: An empirical analysis of farmers' adoption decision of precision agriculture technology. *Decision Support Systems, 54*(1), 510–520. https://doi.org/10.1016/j.dss.2012.07.002

Barnard-Ashton, P., Adams, F., Rothberg, A., & McInerney, P. (2018). Digital apartheid and the effect of mobile technology during rural fieldwork. *South African Journal of Occupational Therapy, 48*(2), 20–25. http://doi.org/10.17159/23103833/2018/vol48n2a4

Barnes, A. P., Soto, I., Eory, V., Beck, B., Balafoutis, A. T., Sánchez, B., Vangeyte, J., Fountas, S., Wal, T., & Gómez-Barbero, M. (2018). Influencing factors and incentives on the intention to adopt precision agricultural technologies within arable farming systems. *Environmental Science and Policy, 93,* 66-74. https://doi.org/10.1016/j.envsci.2018.12.014

Barrett, A. K. (2018). Technological appropriations as workarounds. *Information Technology & People, 31*(2), 368–387. https://doi.org/10.1108/ITP-01-2016-0023

Baumüller, H. (2017). Towards Smart Farming? Mobile Technology Trends and their Potential for Developing Country Agriculture. In: K.E. Skouby, I. Williams and A. Gyamfi (eds.): *Handbook for ICT in developing countries: 5G perspectives* (pp. 191–201). https://www.researchgate.net/publication/317579950_Towards_Smart_Farming_Mobile_Technology_Trends_and_their_Potential_for_Developing_Country_Agriculture

Bennett, J. A. (1997). A case for theory triangulation. *Nursing Science Quarterly, 10*(2), 97–102. https://doi.org/10.1177/089431849701000210

Bilali, H. E., & Allahyari, M. S. (2018). A transition towards sustainability in agriculture and food systems: Role of information and communication technologies. *Information Processing in Agriculture, 5*, 456–464. https://doi.org/10.1016/j.inpa.2018.06.006

Birt, L., Scott, S., Cavers, D., Campbell, C., & Walter, F. (2016). Member checking: A tool to enhance trustworthiness or merely a nod to validation? *Qualitative Health Research, 26*, 1802–1811. https://doi.org/10.1177/1049732316654870

Brooks, S., & Bubela, T. (2020). Application of protection motivation theory to clinical trial enrollment for pediatric chronic conditions. *BMC Pediatrics, 20*(1), 123. https://doi.org/10.1186/s12887-020-2014-5

Cai, H., & Yan, T. (2019). Technology efficiency or allocation efficiency. *China Agricultural Economic Review, 11*(2), 237–252. https://doi.org/10.1108/CAER-04-2018-0074

Callaghan, C. T., Rowley, J. J. L., Cornwell, W. K., Poore, A. G. B., & Major, R. E. (2019). Improving big citizen science data: Moving beyond haphazard sampling. *PLoS Biology, 17*(6), 1–11. https://doi.org/10.1371/journal.pbio.3000357

Callon, M. (1999). Actor-network theory-The market test. *The Sociological Review, 47*(1), 181-195. https://doi.org/10.1111/j.1467-954X.1999.tb03488.x

Carnevale, F. A. (2016). Authentic qualitative research and the quest for methodological rigor. *Canadian Journal of Nursing Research Archive, 34*(2), 121–128. https://cjnr.archive.mcgill.ca/article/view/1768/1765

Carlozzi, N. E., Boileau, N. R., Kallen, M. A., Nakase-Richardson, R., Hahn, E. A., Tulsky, D. S., Miner, J. A., Hanks, R. P., Massenga, J. T., Lange, R. A., Brickell, T. M., French, L. A., Ianni, P. M., Sander, A. M. (2019). Reliability and validity data to support the clinical utility of the Traumatic Brain Injury Caregiver Quality of Life (TBI-CareQOL). *Rehabilitation Psychology, 1*(1). https://doi.org/10.1037/rep0000295

Caron, D., & Belo Reyes, P. E. (2018). Design by narratives: Conceptual and methodological contributions to contemporary territories. *Arquitetura Revista, 14*(1), 83–90. https://doi.org/10.4013/arq.2018.141.08

Chin, W., Gopal, A., & Saalisbury, W. (1997). Advancing the theory of adaptive structuration: The development of a scale to measure faithfulness of appropriation. *Information System Research, 8*(4), 342-367. https://doi.org/10.1287/isre.8.4.342

Cole, S. A., & Fernando, A. (2016, April 29). 'Mobile'izing agricultural advice: Technology adoption, diffusion, and sustainability. *Harvard Business School Finance Working Paper,* 13-47. http://doi.org/10.2139/ssrn.2179008

Connelly, L. M. (2016). Trustworthiness in qualitative research. *Medsurg Nursing, 25,* 435-437.

Cunguara, B., & Darnhofer, I. (2011). Assessing the impact of improved agricultural technologies on household income in rural Mozambique. *Food Policy, 36,* 378–390. https://doi.org/10.1016/j.foodpol.2011.03.002

Darvin, L. (2018). Voluntary occupational turnover and the experiences of former intercollegiate women assistant coaches. *Journal of Vocational Behavior.* https://doi.org/10.1016/j.jvb.2019.103349

Das, A., Basu, D., & Goswami, R. (2016). Accessing agricultural information through mobile phone: lessons of IKSL services in West Bengal. *Indian Research Journal of Extension Education, 12*(3), 102-107. https://doi.org/10.1016/j.jvb.2019.103349

Dellinger, M. J., Olson, J., Clark, R., Pingatore, N., & Ripley, M. P. (2018). Development and pilot testing of a model to translate risk assessment data for Great Lakes Native American communities using mobile technology. *Human & Ecological Risk Assessment, 24*(1), 242–255. https://doi.org/10.1080/10807039.2017.1377596

Deokar, A. S., Namrata, N., Pratiksha, N., Nilam, P., & Mitali, G. (2018). Smart animal farm. *International Journal for Research in Applied Science and Engineering Technology, 6*, 1558–1560. http://doi.org/10.22214/ijraset.2018.3239

DeSanctis, G., & Poole, M. S. (1994). Capturing the complexity in advanced technology use: Adaptive structuration theory. *Organization Science, 5*(2), 121-147. https://doi.org/10.1287/orsc.5.2.121

Dolinska, A. (2017). Bringing farmers into the game. Strengthening farmers' role in the innovation process through a simulation game, a case from Tunisia. *Agricultural Systems, 157*(1), 129–139. https://doi.org/10.1016/j.agsy.2017.07.002

Duncombe, R. (2016). Mobile phones for agricultural and rural development: A literature review and suggestions for future research. *European Journal of Development Research, 28*, 213–235. https://doi.org/10.1057/ejdr.2014.60

Eastwood, J. (2019). Big data evaluation of an integrated care initiative for vulnerable families. *International Journal of Integrated Care, 19*(S1), 1–2. http://doi.org/10.5334/ijic.s3084

Echanove, F., & Steffen, C. (2015). Agribusiness and farmers in Mexico: Importance of contractual relations. *Geographical Journal, 2*, 166–169. https://doi.org/10.1111/j.1475-4959.2005.00157.x

Eikebrokk, T. R., & Iden, J. (2017). Strategizing IT service management through ITIL implementation: model and empirical test. *Total Quality Management & Business Excellence, 28*(3/4), 238-265. https://doi.org/10.1080/14783363.2015.1075872

Emek-Savas, D. D., Yerlikaya, D., Yener, G. G., & Tanor, O. O. (2019). Validity, reliability, and normative data of the Stroop test capa version. *Turkish Journal of Psychiatry, 31*(1). http://doi.org/10.5080/u23549

Fitzpatrick, B. (2019). Validity in qualitative health education research. *Currents in Pharmacy Teaching and Learning, 11*(2), 211–217. https://doi.org/10.1016/j.cptl.2018.11.014

Fu, X., & Akter, S. (2016). The impact of mobile phone technology on agricultural extension services delivery: Evidence from India. *Journal of Development Studies, 52*, 1561–1576. https://doi.org/10.1080/00220388.2016.1146700

Furumo, K., Melcher, A. (2006). The importance of social structure in implementing ERP Systems: A case study using adaptive structuration theory. *Journal of Information Technology Case and Application Research, 8*(2), 39-58. https://doi.org/10.1080/15228053.2006.10856088

Gammelgaard, B. (2017). Editorial: The qualitative case study. *The International Journal of Logistics Management, 28*(4), 910–913. https://doi.org/10.1108/IJLM-09-2017-0231

Gelaw, F., Speelman, S., & Van Huylenbroeck, G. (2016). Farmers' marketing preferences in local coffee markets: Evidence from a choice experiment in Ethiopia. *Food Policy, 61*, 92–102. https://doi.org/10.1016/j.foodpol.2016.02.006

Gentles, S. J., & Vilches, S. L. (2017). Calling for a shared understanding of sampling terminology in qualitative research. *International Journal of Qualitative Methods, 16*, 1–7. 160940691772567. https://doi.org/10.1016/j.foodpol.2016.02.006

Gichamba, A., & Lukandu, I. A. (2012). A model for designing M-agriculture applications for dairy farming. *The African Journal of Information Systems, 4*(4), 1–2. https://digitalcommons.kennesaw.edu/ajis/vol4/iss4/1

Golafshani, N. (2003). Understanding reliability and validity in qualitative research. *Qualitative Report, 8*, 597–607. https://doi.org/10.46743/2160-3715/2003.1870

Gopal, A., Bostrom, R. P., & Chin, W. W. (1992). Applying adaptive structuration theory to investigate the process of group support systems uses. *Journal of Management Information Systems, 9*(3), 45–69. https://doi.org/10.1080/07421222.1992.11517967

Global System for Mobile Communications. (2017). Universal access: how mobile can bring communications to all. http://gsmworld.com/documents/universal_access_full_report.pdf

Guiné, R. P., Costa, D. V., Correia, P. M., Costa, C. A., Correia, H. E., Castro, M., Guerra, L., Seeds, C., Coll, C., Radics, L., Arslan, M., Soylu, S., Tothova, M., Toth, P., & Basile, S. (2016). Designing training in organic farming on a multinational basis. *International Journal of Information and Learning Technology, 33*(2), 99–114. https://doi.org/10.1108/IJILT-12-2015-0039

Guo, J. X. (2019). Measuring information system project success through software-assisted qualitative content analysis. *Information Technology & Libraries, 38*(1), 53–70. https://doi.org/10.6017/ital.v38i1.10603

Hagaman, A. K., & Wutich, A. (2017). How many interviews are enough to identify meta themes in multi-sited and cross-cultural research? Another perspective on Guest,

Bunce, and Johnson's (2006) landmark study. *Field Methods, 29*(1), 23–41. https://doi.org/10.1177/1525822X16640447

Hanseth, O., & Lyytinen, K. (2016). Design theory for dynamic complexity in information infrastructures: The case of building internet. *Enacting Research Methods in Information Systems,* 104-142. https://doi.org/10.1007/978-3-319-29272-4_4

Heeks, R., & Stanforth, C. (2015). Technological change in developing countries: opening the black box of the process using actor-network theory. *Development Studies Research,* 2(1), 33-50. https://doi.org/10.1080/21665095.2015.1026610.

Hetenyi, G., Lengyel, A., & Szilasi, M. (2019). Quantitative analysis of qualitative data: Using Voyant tools to investigate the sales-marketing interface. *Journal of Industrial Engineering and Management, 12,* 393–404. http://dx.doi.org/10.3926/jiem.2929

Howell, R., van Beers, C., & Doorn, N. (2018). Value capture and value creation: The role of information technology in business models for frugal innovations in Africa. *Technological Forecasting and Social Change, 131*(1), 227–239. https://doi.org/10.1016/j.techfore.2017.09.030

Hu, Y., Li, B., Zhang, Z., & Wang, J. (2019). Farm size and agricultural technology progress: Evidence from China. *Journal of Rural Studies 11,* 237–252. https://doi.org/10.1016/j.jrurstud.2019.01.009

Isaya, E. L., Agunga, R., & Sanga, C. A. (2016). Sources of agricultural information for women farmers in Tanzania. *Information Development, 34*(1), 77–89. https://doi.org/10.1177/0266666916675016

Issahaku, H., Abu, B. M., & Nkegbe, P. K. (2018). Does the use of mobile phones by smallholder maize farmers affect productivity in Ghana?. *Journal of African Business, 19*, 302–322. https://doi.org/10.1080/15228916.2017.1416215

Jain, L., Kumar, H., & Singla, R. K. (2015). Assessing mobile technology usage for knowledge dissemination among farmers in Punjab. *Journal of Information Technology for Development, 21*, 668–676. https://doi.org/10.1080/02681102.2013.874325

Jayathilake, C. K., Jayasinghe-Mudalige, U., Perera, R., Gow, G., & Waidyanatha, N. (2017). Converging free and open-source software tools for knowledge sharing in smallholder agricultural communities in Sri Lanka. *Journal of Agriculture and Environment for International Development (JAEID), 111*(2), 351–359. https://doi.org/10.12895/jaeid.20172.649

Jacek, K. & Rzeszewski, M. (2015). Methodological Triangulation in movement pattern research. *Quaestiones Geographicae, 34*(4), 25–37. https://doi.org/10.1515/quageo-2015-0034

Jóhannesson, G. T., & Bærenholdt, J. O. (2020). Actor-network theory. *International Encyclopedia of Human Geography*, 33-40. https://doi.org/10.1016/B978-0-08-102295-5.10621-3

Johnson, J. L., Adkins, D., & Chauvin, S. (2019). Quality indicators of rigor in qualitative research. *American Journal of Pharmaceutical Education, 84*(1) 7120. https://doi.org/10.5688/ajpe7120

Johansson, C. B. (2019). Introduction to Qualitative Research and Grounded Theory. *International Body Psychotherapy Journal, 18*(1), 94–99. https://www.ibpj.org/issues/articles/ChristinaBaderJohansson/DepressionandBodyPsychotherapy/AQualitativeStudyfromResiliencePerspective.pdf

Jordan, C. Y. (2018). Population sampling affects pseudoreplication. *PLoS Biology, 16*(10), 1-3. https://doi.org/10.1371/journal.pbio.2007054

Joslin, R. & Muller, R. (2016). Identifying interesting project phenomena using philosophical and methodological triangulation. *International Journal of Project Management, 34*, 1043-1056. https://doi.org/10.1016/j.ijproman.2016.05.005

Kabbiri, R., Dora, M., Kumar, V., Elepu, G., & Gellynck, X. (2018). Mobile phone adoption in the agri-food sector: Are farmers in sub-Saharan Africa connected?. *Technological Forecasting & Social Change, 131*, 253–261. https://doi.org/10.1016/j.techfore.2017.12.010

Kalaba, F. K. (2016). Barriers to policy implementation and implications for Zambia's forest ecosystems. *Forest Policy and Economics, 69*(1), 40–44. https://doi.org/10.1016/j.forpol.2016.04.004

Karkhile, S., & Ghuge, S. (2015). A modern farming technique using an android application. *International Journal of Innovative Research in Science, Engineering*

and Technology, 4(10), 10499–10506. https://doi.org/10.15680/IJIRSET.2015.0410136

Khan, I., & Hussain, S. (2020). Bureaucracy and public management reforms. *Hrvatska I Komparativna Javna Uprava, 20*(1), 57-77. https://doi.org/10.31297/hkju.20.1.3

Kiani, F., & Seyyedabbasi, A. (2018). Wireless sensor network and internet of things in precision agriculture. *International Journal of Advanced Computer Science and Applications, 9*(6), 99–103. https://www.ijacsa.thesai.org

Knapp, M. S. (2016). The practice of designing qualitative research on educational leadership: Notes for emerging scholars and practitioner-scholars. *Journal of Research on Leadership Education, 12*(1), 26–50. https://doi.org/10.1177/1942775116647365

Knol, A., & Yao-hua, T. (2018). The Cultivation of information infrastructures for international trade: Stakeholder challenges and engagement reasons. *Journal of Theoretical & Applied Electronic Commerce Research, 13*(1), 106-117. http://doi.org/10.4067/S0718-18762018000100107

Korstjens, I., & Moser, A. (2017). Series: Practical guidance to qualitative research. Part 4: Trustworthiness and publishing. *European Journal of General Practice, 24*(1), 120–124. https://doi.org/10.1080/13814788.2017.1375092

Kumar, N., & Shimi, S. L (2017). Smart Farming System for Indian Farmers using Arduino-based Technology. *International Journal of Advanced Research, Ideas, and Innovations in Technology, 3*(1) 105-110.

https://www.ijariit.com/manuscript/smart-farming-system-indian-farmers-using-arduino-based-technology/

Latour, B. (1996). On actor-network theory: A few clarifications. *Soziale Welt,* 369-381. https://www.jstor.org/stable/40878163?seq=1

Lee, D. R. (2005). Agricultural sustainability and technology adoption: Issues and policies for developing countries. *American Journal of Agricultural Economics, 87*(5), 1325–1334. https://doi.org/10.1111/j.1467-8276.2005.00826.x

Levitt, H. M., Motulsky, S. L., Wertz, F. J., Morrow, S. L., & Ponterotto, J. G. (2017). Recommendations for designing and reviewing qualitative research in psychology: Promoting methodological integrity. *Qualitative Psychology, 4*(1), 2–22. https://doi.org/10.1037/qup0000082

Llerena, L., Rodriguez, N., Castro, J. W., & Acuña, S. T. (2019). Adapting usability techniques for application in open source software: A multiple case study. *Information and Software Technology*, *107*(1), 48–64. https://doi.org/10.1016/j.infsof.2018.10.011

Lloyd, B. P., & Wehby, J. H. (2018). Developing direct observation systems to measure classroom behavior for students with behavioral disabilities. In T. J. Landrum, B. G. Cook, & M. Tankersley (Eds.), *Emerging research and issues in behavioral disabilities* (pp. 9–27). Emerald Publishing.

Lokers, R., Knapen, R., Janssen, S., Randen, Y. V., & Jansen, J. (2016). Analysis of big data technologies for use in agro-environmental science. *Environmental*

Modelling & Software, 84(1), 494–504. https://doi.org/10.1016/j.envsoft.2016.07.017

Ma, W., Fan, J., Li, Q., & Tang, Y. (2018). A raw milk service platform using BP neural network and fuzzy inference. *Information Processing in Agriculture, 5*, 308–319. https://doi.org/10.1016/j.inpa.2018.04.001

Malterud, K., Siersma, V. D., & Guassora, A. D. (2016). Sample size in qualitative interview studies: guided by information power. *Qualitative Health Research, 26,* 1753–1760. https://doi.org/10.1177/1049732315617444

Maredia, M. K., Reyes, B., Ba, M. N., Dabire, C. L., Pittendrigh, B., & Bello-Bravo, J. (2018). Can mobile phone-based animated videos induce learning and technology adoption among low-literate farmers? A field experiment in Burkina Faso. *Information Technology for Development, 24*, 429-460. https://doi.org/10.1080/02681102.2017.1312245

Marshall, C., & Rosssman, G.B. (2016). *Designing qualitative research* (6th ed.). Thousand Oaks, CA: Sage.

Mavhunduse, F., & Holmner, M. (2019). Utilization of mobile phones in accessing agricultural information by smallholder farmers in Dzindi irrigation scheme in South Africa. *African Journal of Library, Archives & Information Science, 29*(1), 93–101. https://doi.org/10.1016/j.foodpol.2011.03.002

Minkoua Nzie, J. R., Bidogeza, J. C., & Azinwi Ngum, N. (2018). Mobile phone use, transaction costs, and price: Evidence from rural vegetable farmers in Cameroon.

Journal of African Business, 19, 323–342. https://doi.org/10.1080/15228916.2017.1405704

Miracle, V. A. (2016). The Belmont Report: The triple crown of research ethics. *Dimensions of Critical Care Nursing, 35*, 223–228. https://pubmed.ncbi.nlm.nih.gov/27258959/

Miraja, B., Persada, S. F., Prasetyo, Y., Belgrawan, P., & Red, A. (2019). Applying protection motivation theory to understand gen Z students' intention to comply with educational software antipiracy law. *International Journal of Emerging Technologies in Learning, 14*(18), 39-52. https://doi.org/10.3991/ijet.v14i18.10973

Misaki, E., Apiola, M., & Gaiani, S. (2016). Technology for small-scale farmers in Tanzania: A design science research approach. *Electronic Journal of Information Systems in Developing Countries, 74*(1), 1-15. https://doi.org/10.1002/j.1681-4835.2016.tb00538.x

Mittal, S., & Tripathi, G. (2009). Role of mobile phone technology in improving small farm productivity. *Agricultural Economics Research Review, 22*(347), 451-460. https://doi.org/10.22004/ag.econ.57502

Morse, J. M. (1991). Approaches to qualitative-quantitative methodological triangulation. *Nursing Research, 40*(2), 120-123. https://journals.lww.com/nursingresearchonline/Citation/1991/03000/Approaches_to_Qualitative_Quantitative.14.aspx

Muhumuza, R., Zacharopoulos, A., Mondol, J. D., Smyth, M., & Pugsley, A. (2018). Energy consumption levels and technical approaches for supporting development of alternative energy technologies for rural sectors of developing countries. *Renewable and Sustainable Energy Reviews, 97*(1), 90–102. https://doi.org/10.1016/j.rser.2018.08.021

Murray, J. (1999). Methodological triangulation in a study of social support for siblings of children with cancer. *Journal of Pediatric Oncology Nursing, 16*(4), 194–200. https://doi.org/10.1016/S1043-4542(99)90019-X

Mwamfupe, D. (2015). Persistence of farmer-herder conflicts in Tanzania. *International Journal of Scientific and Research Publications, 5*(2), 1–8. doi:10.1.1.736.8785

Nakano, Y., Tsusaka, T. W., Aida, T., & Pede, V. O. (2018). Is farmer-to-farmer extension effective? The impact of training on technology adoption and rice farming productivity in Tanzania. *World Development, 105*(1), 336–351. https://doi.org/10.1016/j.worlddev.2017.12.013

Nakato, G. V., Beed, F., Bouwmeester, H., Ramathani, I., Mpiira, S., Kubiriba, J., & Nanavati, S. (2016). Building agricultural networks of farmers and scientists via mobile phones: a case study of banana disease surveillance in Uganda. *Canadian Journal of Plant Pathology, 38*(3), 307–316. https://doi.org/10.1080/07060661.2016.1230149

Nan, N., & Tanriverdi, H. (2017). Unifying the role of IT in hyperturbulence and Competitive Advantage Via a Multilevel Perspective of IS Strategy. *MIS Quarterly, 41*(3), 937–958. https://misq.org/unifying-the-role-of-it-in-

hyperturbulence-and-competitive-advantage-via-a-multilevel-perspective-of-is-strategy.html

Narendran, V., Edberg, L., & Gandhi, G. M. (2018). Autonomous robot for E-farming based on fuzzy logic reasoning. *International Journal of Pure and Applied Mathematics, 118*(20), 3811–3821. http://www.ijpam.eu

National commission for the protection of human subjects of biomedical and behavioral research. (1979). The Belmont Report: Ethical principles and guidelines for the protection of human subjects of research. Washington, DC: Department of Health and Human Services. http://www.hhs.gov/ohrp/regulations-and-policy/belmont-report/index.html

Navarro, J. M. (2019). Promoting peaceful coexistence in schools: An important role for educators. *Delta Kappa Gamma Bulletin, 85*(5), 9–17. https://www.dkg.org/DKGMember/Publications/Bulletin/Journal/Past_Issues/Bulletin-Journal-85-5.aspx

Niederman, F., Briggs, R., Vreede, G., & Kolfschoten, G. (2008). Extending the contextual and organizational elements of adaptive structuration theory in GSS research. *Journal of the Association for Information Systems, 9*(10), 633-652. https://aisel.aisnet.org/jais/vol9/iss10/4

Njoroge, B. M., Fei, T. K., & Thiruchelvam, V. (2018). A research review of precision farming techniques and technology. *Journal of Applied Technology and Innovation, 2*(1). https://jati.sites.apiit.edu.my/files/2018/07/2018_Issue1_Paper4.pdf

Noble, H., & Smith, J. (2015). Issues of validity and reliability in qualitative research. *Evidence-Based Nursing, 18*(2), 34–35. http://doi.org/10.1136/eb-2015-102054

Nsabimana, A., & Amuakwa-Mensah, F. (2018). Does mobile phone technology reduce agricultural price distortions? Evidence from cocoa and coffee industries. *Agricultural & Food Economics, 6*(1), 1–3. https://doi.org/10.1186/s40100-018-0115-3

Nugroho, P. B., Nusantara, T., & As'ari, A. R. (2018). Critical thinking disposition: Students skeptic in dealing with ill-logical mathematics problem. *International Journal of Instruction, 11*, 635–648. https://eric.ed.gov/?id=EJ1183418

Nyamba, S. Y., & Mlozi, M. R. (2012). Factors influencing the use of mobile phones in communicating agricultural information: A case of Kilolo District, Iringa, Tanzania. *International Journal of Information and Communication Technology Research 2*(7). 558-563. http://www.suaire.suanet.ac.tz:8080/xmlui/handle/123456789/1786

O'Grady, M. J., & O'Hare, G. M. (2017). Modeling the smart farm. *Information Processing in Agriculture, 4*(3), 179–187. https://doi.org/10.1016/j.inpa.2017.05.001

Oduor, E., Waweru, P., Lenchner, J., & Neustaedter, C. (2018, April). *Practices and technology needs of a network of farmers in Tharaka Nithi, Kenya*. https://doi.org/10.1145/3173574.3173613

Ogbeide, O. A., & Ele, I. (2015). Smallholder farmers and mobile phone technology in sub-Sahara Agriculture. *Mayfair Journal of Information and Technology*

Management in Agriculture, 1(1), 1–19. https://www.researchgate.net/publication/272510110_Smallholder_Farmers_and_Mobile_Phone_Technology_in_Sub-Sahara_Agriculture

Ogunniyi, M. D., & Ojebuyi, B. R. (2016). Mobile phone use for agribusiness by farmers in southwest Nigeria. *Journal of Agricultural Extension, 20*(2), 172–187. https://www.ajol.info//index.php/jae/article/view/149367

Ogutu, S. O., Fongar, A., Gödecke, T., Jäckering, L., Mwololo, H., Njuguna, M., Wollni, M., & Qaim, M. (2020). How to make farming and agricultural extension more nutrition-sensitive: evidence from a randomized controlled trial in Kenya. *European Review of Agricultural Economics, 41*(1), 95–118. https://doi.org/10.1093/erae/jby049

Ogutu, S. O., Okello, J. J., & Otieno, D. J. (2014). Impact of information and communication technology-based market information services on smallholder farm input use and productivity: The case of Kenya. *World Development, 64*, 311–321. https://doi.org/10.1016/j.worlddev.2014.06.011

Oluwatobi, S., & Olurinola, O. (2015). Mobile learning in Africa: Strategy for educating the poor. *SSRN Electronic Journal*, 58-62. http://dx.doi.org/10.2139/ssrn.2606562

Oppedahl, D., (2019). Technology's impact on farming and the rural Midwest. *Chicago Fed Letter*, (411), 1-5. http://doi.org/10.21033/cfl-2019-411

Padgham, M., Boeing, G., Cooley, D., Tierney, N., Sumner, M., Phan, T. G., & Beare. R. (2019). An introduction to software tools, data, and services for geospatial

analysis of stroke services. *Frontiers in Neurology, 10*(1). https://doi.org/10.3389/fneur.2019.00743

Pivoto, D., Waquil, P. D., Talamini, E., Finocchio, C. P. S., Dalla Corte, V. F., & de Vargas Mores, G. (2018). Scientific development of smart farming technologies and their application in Brazil. *Information Processing in Agriculture, 5*(1), 21–32. https://doi.org/10.1016/j.inpa.2017.12.002

Poole, M. S., & DeSanctis, G. L. (1992). Microlevel structuration in computer-supported group decision making. *Human Communication Research, 19*, 5–49. https://doi.org/10.1111/j.1468-2958.1992.tb00294.x

Pratkanis, A. R., & Gliner, M. D. (2004). And when shall a little child lead them? Evidence for altercasting theory of source credibility. *Current Psychology, 23*(4), 279. https://doi.org/10.1007/s12144-004-1002-5

Quynh, T., & Nguyen, T. (2015). Conducting semi-structured interviews with the Vietnamese. *Qualitative Research Journal, 15*(1), 35–46. https://doi.org/10.1108/QRJ-04-2014-0012

Rains, S. A., & Bonito, J. A. (2017). Adaptive structuration theory. *The International Encyclopedia of Organizational Communication*, 1–9. https://doi.org/10.1002/9781118955567.wbieoc003

Rahman, M. S. (2020). The advantages and disadvantages of using qualitative and quantitative approaches and methods in language “testing and assessment” research: *A literature review*. *6*(1) 102. http://dx.doi.org/10.5539/jel.v6n1p102

Rehman, A., Jingdong, L., Khatoon, R., Hussain, I., & Iqbal, M. S. (2016). Modern agricultural technology adoption its importance, role, and usage for the improvement of agriculture. *Life Science Journal, 14*(2), 70-74. http://doi.org/10.7537/marslsj140217.10

Roberts, R. K., English, B. C., & Larson, J. A. (2002). Factors affecting the location of precision farming technology adoption in Tennessee. *Journal of Extension, 40*(1), 12-21. https://www.joe.org/joe/2002february/rb3.php

Robinson, O.C. (2014). Sampling an interview-based qualitative research: A theoretical and practical guide. *Qualitative Research in Psychology, 11*(1), 25-41. https://doi.org/10.1080/14780887.2013.801543

Rosenthal, M. (2016). Qualitative research methods: Why, when, and how to conduct interviews and focus groups in pharmacy research. *Currents in Pharmacy Teaching and Learning, 8*, 509–516. https://doi.org/10.1016/j.cptl.2016.03.021

Sandelowski, M., & Barroso, J. (2002). Reading qualitative studies. *International Journal of Qualitative Methods, 1*(1), 74–108. https://doi.org/10.1177/160940690200100107

Satalkar, P., & Shaw, D. (2019). How do researchers acquire and develop notions of research integrity? A qualitative study among biomedical researchers in Switzerland. *BMC Medical Ethics, 20*(1), 72. https://doi.org/10.1186/s12910-019-0410-x

Saunders, M., Lewis, P., & Thornhill, A. (2015). *Research methods for business students* (7th ed.) Essex, England: Pearson Education.

Schmitz, K. W., Teng, J. T., & Webb, K. J. (2016). Capturing the complexity of malleable IT use: Adaptive structuration theory for individuals. *MIS Quarterly, 40*, 663–686. https://doi.org/10.25300/MISQ/2016/40.3.07

Senar, M. (1982). How counselors influence clients. *Personnel & Guidance Journal, 80*(6), 345-349. https://doi.org/10.1002/j.2164-4918.1982.tb00683.x

Shruthi, K., Hiremath, G. M., & Joshi, A. T. (2017). An overview of use of precision farming technologies by the farmers- A case study of North Eastern Karnataka. *Indian Journal of Agricultural Research, 52*(1), 93–96. https://doi.org/10.18805/ijare.a-4889.

Singh, S., Sangwan, O., Meena, B. S., Tuteja, O. P., Singh, H. P., Kumar, R., Pandher, S., Kumar, S., Singh, K., & Rathore, P. (2018). Information communication technology for extension: A Mobile phone-based voice call system for dissemination of cotton production technologies. *Journal of Agricultural & Food Information, 20*(1), 50–58. https://doi.org/10.1080/10496505.2018.1436442

Small, B. (2017). Digital technology and agriculture: Foresight for rural enterprises and rural lives in New Zealand. *Journal of Agriculture and Environmental Science, 6*(2), 54–77. http://doi.org/10.15640/jaes.v6n2a7

Sun, X., Lv, X., & Liu, B. (2019). Study on the ways of training and practice of new type of professional farmers in the perspective of low carbon economy. IOP Conference Series: Materials Science and Engineering, 677, 032047. https://doi.org/10.1088/1757-899x/677/3/032047

Surmiak, A. (2018). Confidentiality in qualitative research involving vulnerable participants: Researchers' perspectives. *Qualitative Social Research, 19,* 393–418. https://doi.org/10.17169/fqs-19.3.3099

Renz, S. M., Carrington, J. M., & Badger, T. A., (2018). Two strategies for qualitative content analysis. *An Intramethod Approach to Triangulation. 28*(5) 824-831. https://doi.org/10.1177/1049732317753586.

Syiem, R., & Raj, S. (2015). Access and usage of ICTs for agriculture and rural development by the tribal farmers in Meghalaya state of northeast India. *Agrarinformatika/Journal of Agricultural Informatics, 6*(3), 24–41. https://doi.org/10.17700/jai.2015.6.3.190

Tadesse, G., & Bahiigwa, G. (2015). Mobile phones and farmers' marketing decisions in Ethiopia. *World Development, 68,* 296–307. https://doi.org/10.1016/j.worlddev.2014.12.010

Taguchi, N. (2018). Description and explanation of pragmatic development: Quantitative, qualitative, and mixed methods research system, *75*(1), 23–32. https://doi.org/10.1016/j.system.2018.03.010

Tchernyshev, N., Sysoev, O., Solovev, D., & Kiselyov, E. (2018). Basic robotecnical platform for the implementation of accurate farming technologies. *Bulletin of electrical engineering and informatics, 7*(4), 522-528. https://doi.org/10.11591/eei.v7i4.920

Thurmond, V. A. (2001). The point of triangulation. *Journal of nursing scholarship, 33*(3), 253-258. https://doi.org/10.1188/14.ONF.545-547

Tomlinson, M., Solomon, W., Singh, Y., Doherty, T., Chopra, M., Ijumba, P., Tsai, A., & Jackson, D. (2009). The use of mobile phones as a data collection tool: A report from a household survey in South Africa. *BMC Medical Informatics and Decision Making,* 9(1), 1–8. https://doi.org/10.1186/1472-6947-9-51

Turner, J. R., Morris, M., & Atamenwan, I. (2019). A theoretical literature review on adaptive structuration theory as its relevance to human resource development. *Advances in Developing Human Resources, 21,* 289–302. https://doi.org/10.1177/1523422319851275

Vanlauwe, B., Coe, R., & Giller, K. E. (2016). Beyond averages: New approaches to understand heterogeneity and risk of technology success or failure in smallholder farming. *Experimental Agriculture, 55*(S1), 1–23. https://doi.org/10.1017/s0014479716000193.

Walby, K. (2015). *Designing qualitative research* (6th ed.). Thousand Oaks, CA: Sage. Publications.

Walls, J. G., Widmeyer, G. R., & Sawy, O. A. (1992). Building an information system design theory for vigilant executive information systems. Information Systems Research, 3(1), 36-59. https://doi.org/10.1287/isre.3.1.36.

Walter, A., Finger, R., Huber, R., & Buchmann, N. (2017). Opinion: Smart farming is key to developing sustainable agriculture. *Proceedings of the National Academy of Sciences, 114*(24), 6148–6150. https://doi.org/10.1073/pnas.1707462114.

Westcott, R., Ronan, K., Bambrick, H., & Taylor, M. (2017). Expanding protection motivation theory: Investigating an application to animal owners and emergency

responders in bushfire emergencies. *BMC Psychology, 5*(1). https://doi.org/10.1186/s40359.017-0182-3

Wright, F. D. (2016). Researching developing countries: a data resource guide for social scientists. Amsterdam: Chandos Publishing/ Elsevier.

Wyche, S., & Steinfield, C. (2016). Why don't farmers use cell phones to access market prices? Technology affordances and barriers to market information services adoption in rural Kenya. *Information Technology for Development, 22*(2), 320–333. https://doi.org/10.1080/02681102.2015.1048184

Xing, Z., Shan, L., Li, W., Yajan, Z., & Jiayin, W. (2019). Mobile health service adoption in China: Integration theory of planned behavior-protection motivation theory and personal health awareness. *Online Information Review, 44*(1), 1-23. https://doi.org/10.1108/oir-11-2016-0339.

Yang, C. L. (2017). Learning to labor while learning to be a man: An ethnographic study of the intersectionality of class and gender in the counter-school culture. *Bulletin of Educational Research*, *63*(4), 1–36. https://doi.org/10.3966/102887082017126304001.

Yang, H., Wang, Z., Xiao, M., Jiang, G.-P., & Huang, C. (2019). Quasi-synchronization of heterogeneous dynamical networks with sampled data and input saturation. *Neurocomputing*. https://doi.org/10.1016/j.neucom.2019.02.023.

Yigezu, Y. A., Mugera, A., El-Shater, T., Aw-Hassan, A., Piggin, C., Haddad, A., . . . Loss, S. (2018). Enhancing adoption of agricultural technologies requiring high

initial investment among smallholders. *Technological Forecasting and Social Change, 134*, 199–206. https://doi.org/10.1016/j.techfore.2018.06.006.

Yin, R. K. (2018). *Case study research and applications: Designs and methods* (6th ed.). Sage.

Zheng, L., Li, M., Wu, C., Ye, H., Ji, R., Deng, X., Che, Y., Fu, C., & Guo, W. (2010). Development of a smart mobile farming service system. Mathematical and computer modelling, 54(3), 1194–1203. https://doi.org/10.1016/j.mcm.2010.11.053

Appendix A: Interview Protocols

Opening Monologue:

Hello, Mr./Ms. [*Name of the Participant*], and welcome to my doctoral research study interview. I would like to inform you that this interview will be recorded in its entirety. First, I would like to take this opportunity to thank you for taking the time to sit down with me for this brief interview on this important topic. I want you to feel comfortable throughout the interview, as there are no right or wrong answers. I need your experience and expertise in the subject.

I would also like to ask you if you have any questions about the consent form I sent you before your interview. If you do not have any questions, would you please do me the honor of responding to the email with the words "I Consent" so we can start the interview?

For the record, my name is Mohamed Ali; I am a doctoral research study candidate from Walden University. The purpose of this interview is to ask you questions about the strategies that mobile technology business leaders use to improve mobile technology infrastructure for rural farmers and herders.

Pose interview questions.

1. What strategies do you use to improve mobile technology infrastructure for rural farmers and herders?
2. How do you select areas to implement your mobile technology infrastructure strategies?

3. What steps do you take to ensure you apply correct and needed mobile technology infrastructure strategies in rural areas?
4. How do you communicate your mobile technology infrastructure implementation strategies to your intended customers?
5. What barriers or restrictions do you experience when implementing mobile technology infrastructure strategies in rural areas?
6. What additional information can you provide on strategies to improve mobile technology infrastructure in rural areas?

Closing Monologue:

Thank you very much, Mr./Ms. [*Name of Participant*] for participating in my doctoral research study. I appreciate it. This study may help improve the lives of farmers and herders in developing countries, such as the United Republic of Tanzania. Leaders like you play a vital role in engineering, mobilizing, strategizing, and implementing important infrastructure to help people who otherwise would still suffer from the lack of adequate technology infrastructure. I will let you know by phone or e-mail when I finish transcribing this interview for your review and feedback.

That concludes our interview. Thank you.

Appendix B: Interview Questions

1. What strategies do you use to improve mobile technology infrastructure for rural farmers and herders?
2. How do you select areas to implement your mobile technology infrastructure strategies?
3. What steps do you take to ensure you apply correct and needed mobile technology infrastructure strategies in rural areas?
4. How do you communicate your mobile technology infrastructure implementation strategies to your intended customers?
5. What barriers or restrictions do you experience when implementing mobile technology infrastructure strategies in rural areas?
6. What additional information can you provide on strategies to improve mobile technology infrastructure in rural areas?