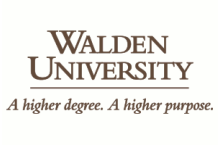

2020

Exploring Strategies for Capturing Requirements for Developing ICT4D Applications

Jonathan Makanjera
Walden University

Walden University

College of Management and Technology

This is to certify that the doctoral study by

Jonathan Makanjera

has been found to be complete and satisfactory in all respects,
and that any and all revisions required by
the review committee have been made.

Review Committee
Dr. Nicholas Harkiolakis, Committee Chairperson, Information Technology Faculty
Dr. Steven Case, Committee Member, Information Technology Faculty
Dr. Jodine Burchell, University Reviewer, Information Technology Faculty

Chief Academic Officer and Provost
Sue Subocz, Ph.D.

Walden University
2020

Abstract

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Jonathan Makanjera

BSc. M & E, Lupane University, Zimbabwe, 2020

BTech. Comp Science, Harare Institute, Zimbabwe, 2014

MSc. IT, Charles Sturt University, Australia, 2011

Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Information Technology

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October, 2020

Abstract

Some software engineers make decisions using applications designed from poorly captured user requirements. The quality of user requirements is crucial in the requirements engineering process, costing 50 times more to remedy the defects of using poorly captured user requirements. Grounded in the socialization, externalization, combination and internalization model of Nonaka theoretical framework, the purpose of this qualitative multiple case study was to explore strategies software engineers in Southern African software houses and IT departments use for capturing information and communication technology for development (ICT4D) requirements. The participants consisted of software 12 engineers who were working in Southern Africa, capturing ICT4D requirements. The data were collected using semistructured interviews. Thematic analysis was used, and four themes emerged: (a) interacting with stakeholders—socialization, (b) transforming interactive knowledge into user requirements—externalization, (c) sharing documented knowledge about user requirements—combination, and (d) applying assimilated knowledge from documented knowledge—internalization. A recommendation is for software engineers to capture their users' needs and experiences to develop reliable ICT4D software that can assist in delivering interventions to marginalized societies. The implications for positive social change include improving the socioeconomic status of marginalized citizens with ICT4D software applications due to potentially improved requirements engineering practices.

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Dedication

I want to dedicate this study to Cynthia Nyasha Makanjera, my wife, who was always there to encourage me. I dedicate this doctoral study to my kids, Craig, Claire, Clara, and Cayne, and all my family and friends whose love and support was always nearby when it was needed most.

Acknowledgments

I want to thank Dr. Nicholas Harkiolakis for being there to assist and give me hope and words of encouragement when I became discouraged and wanted to stop. I want to thank my friends (Angeline, Norest, Priscilla, and Millicent) at UNICEF Zimbabwe and CRS Zimbabwe for their financial support and believing in me that I can do it. I want to extend a special thank you to my committee, committee chair Dr. Nicholas, Harkiolakis, my second committee member, Dr. Steven Case, and university research reviewer (URR), Dr. Jodine Burchell.

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Section 1: Foundation of the study

The demand for software applications is on the increase as humanitarian organizations embrace ICT4D applications to improve service delivery. ICT4D applications are being used in marginalized communities in rural areas to make payments or receive money using mobile phones (Avgerou, Hayes, & Rovere, 2016; Mwantimwa, 2017; Oduor, Neustaedter, & Hennessy, 2016). ICT4D has the potential to minimize service delivery costs while improving efficiency (Haenssgen, 2018). However, not all ICT4D applications have the potential to bring efficiencies. Some ICT4D initiatives are failing to achieve their objectives because they are being developed using the wrong requirements (Cheah et al., 2017). In this study, I examined the relationship between requirements capturing and ICT4D failure. The purpose of this study was to explore the strategies software engineers in Southern African software houses, and IT departments use for capturing ICT4D requirements.

In this section, I discuss the background of the problem, problem statement, purpose statement, nature of the study, research question, interview questions, conceptual framework, the definition of terms, assumptions, limitations and delimitations, the significance of the study, implications for social change, and review of the professional and academic literature.

Background of the Problem

Computers and the Internet have been used in Southern Africa for many years to support the advancement of socioeconomic activities. During these years, researchers have witnessed improvement in data collection (Andreas et al., 2016) and processing into useful information (Ponelis, 2015). Thus, the use of information technology (IT) can

support decision-making (Gavai, Musungwini, & Mugoniwa, 2018). While the advantages of embracing computers and the Internet are apparent, there are also challenges such as issues of exclusion in using IT to access services to advance the socioeconomic position of marginalized communities (Kim & Han, 2017; Rashid, 2017).

Some researchers have revealed that the motivation to fund some institutions to develop ICT4D applications as an effort to support strategies that might improve the socioeconomic conditions of marginalized communities (Bhatt, Ahmad, & Roomi, 2016). However, despite huge investments being spent by humanitarian organizations in developing ICT4D applications, researchers have revealed many cases of ICT4D failures (Mamba & Isabirye, 2015). Talha (2018) revealed that requirements engineering errors cause software failure in addition to other causes such as budgets, costs, and timeframes.

Problem Statement

ICT4D applications designed to improve the lives of disadvantaged people are failing to make an impact as non-governmental organizations (NGOs) make decisions using applications designed from poorly captured user requirements (Águila & Sagrado, 2016). The quality of user requirements is crucial in the requirements engineering process, which is costing 50 times more to remedy the defects of using poorly captured user requirements (Dargan, Wasek, & Campos-Nanez, 2016). The general IT problem is that organizations are developing software without adequate identification of requirements. The specific IT problem is that some software engineers in Southern African software houses and IT departments lack strategies for capturing ICT4D requirements.

Purpose Statement

The purpose of this qualitative multiple case study was to explore the strategies software engineers in Southern African software houses and IT departments use for capturing ICT4D requirements. The targeted population included software engineers in Southern African software houses and IT departments with experience in ICT4D requirements capturing. Exploring strategies for capturing requirements may contribute to the development of robust ICT4D applications. Such applications could contribute to the growth of the regional software houses and, by extension, to the communities they serve. Additionally, software engineers could use the identified requirements gathering strategies to develop ICT4D applications that can be used by NGOs to collect and process data of disadvantaged communities that could guide policymaking and the development of interventions to alleviate poverty.

Nature of Study

I used a qualitative methodology to explore strategies software engineers use for capturing ICT4D requirements in Southern Africa. A qualitative research method allows the flexibility for a more in-depth exploration of the problem, unlike quantitative research that is suitable for deterministic problems (Obamuyi & Oladapo, 2016). Thus, qualitative research methods afford the flexibility to ask open-ended, semistructured questions for an in-depth understanding of requirements gathering strategies. The quantitative research method is used for research efforts that seek to prove or test a hypothesis but does not provide the flexibility to explore deeper through explanations (Mohd et al., 2017). I did not seek to prove or test a hypothesis but to get explanatory or descriptive responses needed to get an insightful understanding of the phenomenon. The mixed research

method is suitable for studies requiring both qualitative and quantitative to provide an all-round investigation as the methods complement the weaknesses of the other (Wong & Cooper, 2016). While mixed methods are useful in studying a problem requiring both qualitative research method to dig into the explanations and a quantitative method to understand the relationships of variables, it is not suitable for this study, which is purely interpretive.

I used a multiple case study research design to collect data from various ICT4D software development houses and IT departments in Southern Africa. According to Ribeiro and Nagano (2018), a case study is a qualitative inquiry that analyzes the phenomenon in its natural setting using multiple sources of evidence. Multiple case studies allow for producing convincing arguments as the data is collected from different sources. The narrative inquiry research design considers stories shared by participants about their life experiences (Astroth & Chung, 2018; Güngör, 2017). The narrative inquiry research design was unsuitable for this study because I was not concerned about the life experiences of software engineers. Rather, I aimed to identify strategies software engineers in Southern African software houses and IT departments use for capturing ICT4D requirements. Mol et al. (2017) referred to ethnographic research as the study of behaviors, culture, ideologies, beliefs, and languages which are shared by a community. As such, ethnographic research was not suitable for this study, which was not exploring sociocultural aspects of a setting but researching on requirements capturing strategies that are used by software engineers. Furthermore, a phenomenological research design is used to explore the lived experiences of the informants (Blackmon, 2017); whereas I was concerned with the exploration of strategies that are used by software engineers in

capturing ICT4D requirements. The multiple case study research design provided an in-depth understanding of strategies that software engineers use to capture ICT4D requirements using multiple data sources.

Research Question

What strategies do software engineers in Southern Africa software houses and IT departments use for capturing ICT4D requirements?

Interview Questions

I asked the informants for this study interview questions that focused on the research question. Below are the interview questions:

Tacit to Tacit - Socialization Section

1. Describe how you capture what a user wants in a new ICT4D software application?
2. Explain how you capture experiences of users who are already using an ICT4D software application?

Collective Tacit Knowledge into Explicit Knowledge - Externalization Section

1. Describe how you express captured user requirements and their experiences to other software engineers to understand the requirements and the experiences of the users?

Joining Components of Explicit Knowledge - Combination Section

1. Describe how you put together the gathered information on user requirements and user experiences to develop a requirements specification and share it with other software engineers?

Explicit Knowledge Back to Tacit Knowledge - Internalization Section

1. Describe the skills that you are using to capture user requirements and experiences?
2. Describe the methodologies or framework that you are using to capture user requirements and their experiences?
3. What is the name of the framework or methodology that you use?
4. How does the framework or methodology help you in the capturing of requirements for ICT4D applications?
5. Describe poorly captured user requirements?
6. Describe the causes for ending up with poorly captured ICT4D user requirements?
7. Do you have any additional information that you would like to share about requirements engineering that you would like to share?

Theoretical/Conceptual Framework

I used the SECI knowledge management theory of Nonaka as the conceptual framework for this study. SECI was promulgated by Nonaka and Takeuchi in 1995 (Nonaka & Toyama, 2003). The theory's dissemination of knowledge takes four routes: tacit to tacit known as socialization, tacit to explicit called externalization, explicit to explicit called combination or explicit to tacit known as internalization (Burnett, Macafee, & Williams, 2017). The SECI model was built upon four fundamental conversion processes described in the succeeding text.

The first mode is *socialization*, which initiates the process of creating knowledge of the organization by putting together practical knowledge from tacit knowledge of an

individual (Laeeque & Babar, 2017). *Externalization* is the second mode, which is the expression of collective tacit knowledge into explicit conceptions that are shareable and applicable in the workplace (Olmos & Rodas, 2014). The third mode is known as *combination*, which involves joining disconnected components of explicit knowledge and putting it into a systematic, logical, and complex collection of explicit knowledge (Laeeque & Babar, 2017). The final mode is known as *internalization*, which transforms explicit organizational knowledge back into individuals' tacit knowledge to form shared mental models (Burnett et al., 2017).

Requirements capturing, on the other hand, is a component of requirements engineering, which is a process of creating knowledge by collecting thoughts and experiences from willing individuals to accomplish a specific task (Prasarnphanich, Janz, & Patel, 2016). The knowledge, thoughts, and experiences of individuals come in different forms. It is then synthesized and formatted in a systematic way, which makes it easier to understand. As such, the four modes of the SECI knowledge management theory of Nonaka, socialization, externalization, internalization, and combination are knowledge creation processes can be used requirements capturing, as shown in Figure 1.

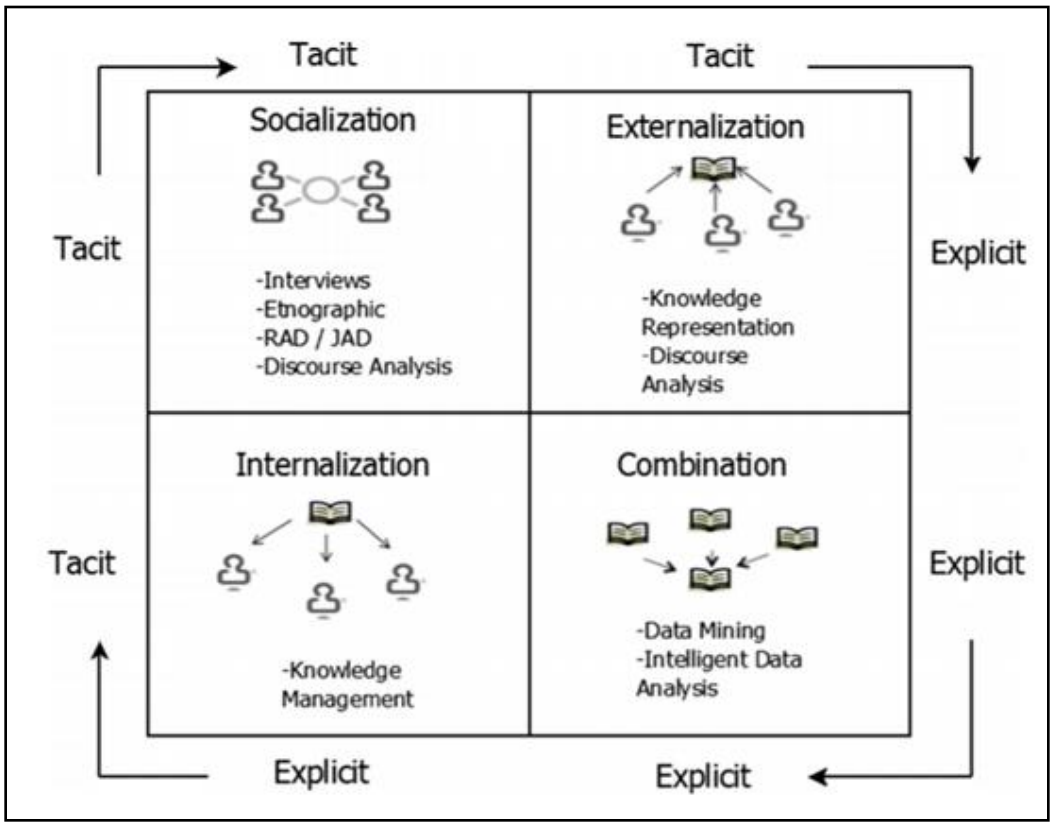

Figure 1. The SECI model of Nonaka. from Olmos and Rodas, 2014

Tacit knowledge comes from the heads of individuals or stakeholders who provide user requirements, and explicit knowledge is shared by stakeholders through writings, drawings, or mathematical models (Bider & Jalali, 2016). As depicted in Figure 1 above, SECI theory was suitable for this study because it has concepts that can draw knowledge from software engineers to expose requirements capturing skills that could be lacking in software engineers who are developing ICT4D software in Southern Africa.

Operational Definitions

Digital Divide: Digital divide is defined in some studies as the inequalities in social, global, and democratic divide or digital rights, which can negatively impact on socioeconomic and education (Chao & Yu, 2016).

Information Technology (IT): IT is referred to as the electronic display, processing, and storage of information, but not necessarily the transmission of the Information (Akuchie, Bulus, & Okwudishu, 2018).

Information and Communication Technology (ICT): ICT is referred to as a diverse set of technological tools and resources used to communicate, create, disseminate, store, and manage information (Manzira, M. F., & Munyoka, W., 2016).

Information and Communication Technology for Development (ICT4D): ICT4D is referred to as diverse ways, including the use of ICTs for socioeconomic development, international development, and human rights (Chao & Yu, 2016; Okewu & Okewu, 2014).

Mobile for Development (M4d): m4d is defined by some researchers as the use of mobile phones' applications to send data using Short Message Services (SMS) or other services in real-time in areas such as agriculture, health, and education (Hudson, Leclair, Plletier, & Sullivan, 2017).

Software Engineering (SE): SE is defined as the application of a systematic, disciplined and quantifiable approach to the development, operation, and maintenance of software, and the study of these approaches (Krishna & Sreekanth, 2016).

Assumptions, Limitations, and Delimitations

Assumptions

In the literature, an assumption is defined as the disposition of taking something for granted without any evidence of verifying that it is true (Schoenung & Dikova, 2016). In this study, I assumed that software engineers would articulate facts as they are prevailing in their work. My other assumption was that software engineers would provide

full and accurate information on how they carry out tasks during the requirements engineering process.

Further, I assumed that the qualitative research methodology using multiple case study research design would be appropriate in providing data for answering the research question. I also assumed that the interview questions were correct and appropriate to collect insightful information for the study. My other assumption was that the sample size for the study was large enough to provide adequate information until saturation is achieved.

Limitations

Limitations are defined as hypothetical and organized faults of a research effort that are beyond the control of the researcher and have minimal impact on the research findings (Busse, Kach, & Wagner, 2016). Limitations of this study were associated with the qualitative research method using the case study design. The limitations, in this case, were my and the participants' biases. Participants' could provide false information about how they capture user requirements to portray a picture that they are following some best practices when capturing user requirements. As a researcher and ICT4D practitioner, I could take the role of a practitioner and misrepresent data by capturing my viewpoint instead of capturing participants' responses. Another limitation was that the study was limited to the capturing of user requirements needed to develop ICT4D software applications, which could limit the generalization of the study findings to other software applications.

Delimitations

Some researchers noted that delimitations are defined at the proposal stage of research to mark the boundaries of the case under investigation (Algozzine & Hancock, 2016). The first delimitation for this research was the scope of the study, which was confined to Southern Africa. The other delimitation was that I collected information from software engineers who were working for software development houses and IT departments of institutions who are developing ICT4D applications. I did not collect information from individuals who develop ICT4D applications but were not employed by any formal institution.

Significance of the Study

The significance of this study is that explored strategies may be used by software engineers in Southern African software houses and IT departments for capturing ICT4D requirements for developing robust applications. These identified strategy gaps may contribute to the body of knowledge of project management specific to Southern Africa and could result in the development of requirements engineering training strategies that will strengthen the skills of software engineers. Moreover, the strategies may be researched further to develop best practices that can be applied in requirements engineering.

The potential positive social change for this study is that explored strategies for capturing ICT4D requirements may assist software engineers in designing complete ICT4D applications. These applications could be enriched with modules for collecting, processing, and generating reliable and accurate information for identifying aid-deserving beneficiaries and supporting appropriate interventions that could alleviate poverty.

Ultimately, statistics generated from accurate and reliable information will inform policy development and implementation to give marginalized communities access to services and resources that will advance their socioeconomic status.

Review of the Professional and Academic Literature

The purpose of this qualitative multiple case study was to explore the strategies software engineers in Southern African software houses and IT departments use for capturing ICT4D requirements. In this literature review, I will discuss the following topics: (a) the challenges found in the development of ICT4D applications, (b) the SECI knowledge management theory and its appropriateness to this study, (c) the role of ICT4D towards bridging the digital divide, (d) the role of M4D in the advancement of socioeconomic status of marginalized populations, (e) the digital divide in terms of access to services through technology, (f) ICT4D failures and successes, and (g) requirements engineering process which includes requirements planning, requirements elicitation, requirements analysis, requirements specification, requirements verification, and requirements management.

I used Walden University's digital library to search for scholarly and professional articles to cover the topics completely. I searched the following databases: ACM Digital Library, Business Source Complete, Computers, and Applied Sciences Complete, Computing Database, ProQuest Central, ProQuest Science Journals, and Science Direct. During the searching, I retrieved articles based on the following criteria; peer-reviewed, full text, less than 4 years old, and scholarly or trade articles to retrieve current and seminal articles that are appropriate for discussing contemporary issues on the outlined topics.

I used different terms, which I combined differently to search for the articles. To get articles for the SECI theory, I used keywords like *ICT theories, theories used in ICT, knowledge management, requirements analysis theories*, and *knowledge exchange theories*. The search for ICT4D literature returned many relevant articles when I used the following phrases: *ICT4D failure, ICT4D success, ICT4D and socioeconomic advancement, technology for development,* and *the digital divide.* For the extraction of requirements gathering, I used the terms *software development process, requirements engineering, requirements elicitation, software engineering, requirements management,* and *software development.*

After retrieving articles using some keywords, I filtered the articles by retaining those that were published after the year 2015. Next, I read the abstracts, research methods, and conclusions sections of the remaining articles and dropped those that were irrelevant to the study. I saved the remaining articles on my computer, naming them according to the topics covered in the literature. For example, those with definitions I saved them as Literature Review – definitions. Naming files this way makes it easier to locate the articles when I want to use them.

In total, I reviewed 400 articles and selected 300 as the other 100 journals were outdated. Of the 240 remaining articles, I dropped 30, which had repeating content. Of the 270 articles that I finally ended up with, 85% of them are from the years 2015 and 2019. The articles older than 5 years constitute less than 15% of all articles that I used for the study. One hundred and seventy of the 270 articles I reviewed in this study are from peer-reviewed sources.

After the analysis of the SECI Model, I will define ICT4D and M4D concepts and analyze how the concepts are used to support the development of marginalized communities. Further, I will analyze ICT4D failures, successes and the requirements engineering process in terms requirements planning, elicitation, analysis, specification, verification, and management. I will conclude the literature review by exploring how the SECI model had been used to create and share knowledge.

Conceptual Framework

The model I chose for my conceptual framework is the SECI model.

SECI Model

New knowledge is crucial in the creation of innovative products and services. The creation of new knowledge can be achieved through knowledge management theories and frameworks. The SECI model of knowledge conversion in the organization consists of four processes that are used to create new knowledge (Bandera, Keshtkar, Bartolacci, Neerudu, & Passerini, 2017; Bider & Jalali, 2016). Bider and Jalali (2016) and Oihab Allal-Chérif (2016) found that Nonaka and Takeuchi promulgated the SECI model in 1995, which is made up of four components, namely: socialization, externalization, combination, and internalization. Researchers refer to these four components by different names, including modes, constructs, or processes; in this study, I referred to them using any of these names.

Figure 1 depicted the explanation provided by Halim, Halim, and Hebrard (2017) that during socialization, people share knowledge as they socialize to create tacit knowledge, and Gilchrist (2016) found that these people are brought together from the same domain. Halim et al. (2017) found that externalization is the concretization of tacit

knowledge. Gilchrist (2016) found that combination involves the creation of new documents by collating, analyzing and synthesizing existing information, or combining different aspects of explicit knowledge, and according to Yang, Hsu, Sarker, and Lee (2017) the information can be changed and shared in a form that people know. Gilchrist (2016), Oihab Allal-Chérif (2016), and Halim et al. (2017) described internalization as the transfer of stored information to individuals who can access, retrieve, and it changes explicit knowledge back to tacit knowledge.

Evolution of the SECI Model

In the 1980s, some researchers sought to understand the role of skills and routines in organizational behavior by following on the debates that were underway, which resulted in the operationalization of tacit and explicit knowledge (Oguz & Sengün, 2011). The work of Polanyi (Oguz & Sengün, 2011; Widjaja & Kuslina, 2018) contributed significantly to the operationalization of tacit and explicit knowledge. Widjaja and Kuslina (2018) defined explicit knowledge as knowledge that can be transferred through formal language and tacit knowledge as knowledge that is difficult to formalize or transfer systematically. This tacit, explicit, dichotomy made it possible to extend the constructs of the SECI model.

The SECI model of knowledge creation went through two phases of development. The first phase was made known by Nonaka in 1994 as the social interaction between tacit and explicit knowledge (Olmos & Rodas, 2014), and in 1995, he worked with Takeuchi (Oguz & Sengün, 2011). During this phase, tacit and explicit knowledge is converted to create new knowledge (Halim et al., 2017). This first phase is the epistemological dimension since knowledge conversion is between individuals, and the

second phase takes an ontological dimension where an individual's knowledge is transformed into the knowledge of the organization (Widjaja & Kuslina, 2018). The model is now widely used in knowledge management studies.

Theories are usually an improvement of other theories. Bejinaru (2016) argued that after the operationalization of the explicit and tacit knowledge 1991, Bider and Jalali (2016) found that Ikujiro Nonaka elaborated on the SECI Model of knowledge in 1994. Olmos and Rodas (2014) and Burnett et al. (2017) shared that the SECI model was based on Polanyi's theory of knowledge. Widjaja and Kuslina (2018) and Burnett et al. (2017) discovered that Polanyi's theory was based on a bifurcated view, namely tacit knowledge, which indwells in people who cannot be articulated and explicit knowledge which can be articulated. Tian, (2017) revealed that Nonaka promulgated the SECI model in 1994, in 1995 Nonaka worked with Takeuchi and Putri, and Argogalih (2016) noted that Nonaka and Takeuchi used the model to study how Japanese companies were becoming innovative and creative. Putri and Argogalih (2016) added that the study concluded the tacit construct of the SECI model was behind the success as of the companies. Theories evolve as other researchers critique them.

The SECI model converts tacit knowledge into explicit knowledge than explicit knowledge back to tacit knowledge. Spraggon and Bodolica (2017) found that there are two dimensions of knowledge: tacit and explicit knowledge. Laeeque and Babar (2017), Bandera et al. (2017), and Bider and Jalali (2016) found that the two dimensions of knowledge can be converted into another form of knowledge using four constructs of the SECI model namely socialization, externalization, combination and internalization. Bandera et al. (2017), Oguz and Sengün (2011), and Tyagi, Agrawal, Yang, and Ying

(2017) found that the constructs convert the knowledge into four formats: socialization converts tacit to tacit; externalization converts tacit to explicit; combination converts explicit to explicit; and internationalization converts explicit to tacit. The process of converting tacit and explicit knowledge from one form into another form makes it easier to understand the process of creating new knowledge.

Contemporary SECI Model

Many contemporary knowledge management theories are a continuous enhancement of tacit-explicit knowledge, which is converted from one form to another. Oguz and Sengün (2011) shared that tacit and explicit knowledge is used extensively in knowledge management studies. Pennec and Raufflet (2018) and Ribeiro and Nagano (2018) found that interaction between organizations, persons, and communities convert tacit to explicit knowledge. Tyagi et al. (2017) found that knowledge is what an individual knows, and knowledge management is the practice of transforming it into a usable format. Goffin and Koners (2011) argued that interactions between internal and external knowledge resources could be used creatively to create knowledge. In addition, Ribeiro and Nagano (2018) found that knowledge creation can be achieved by increasing an individual's knowledge base continuously. The SECI model creates new knowledge by converting either tacit or explicit knowledge into other forms of knowledge by using knowledge conversion processes, as depicted in Figure 1.

Socialization. Most of what individuals know came from interacting with other people and objects that they come in contact with, such as listening to stories, reading books, and seeing or observing things and by doing to learn new things. Laeeque and Babar (2017) found that the socialization construct of the SECI model creates new

knowledge through exchanging knowledge and combining individuals' thoughts at a personal level without set standards. Muthuveloo, Shanmugam, and Teoh (2017) highlighted that in socialization, the exchange of knowledge is through people, not any other media, and defined socialization as a communication and enhancement process of tacit knowledge. Hvorecký, Šimúth, and Lipovská (2015) added that socialization is communication between individuals and/or intrapersonal insights, which is historically the traditional means of learning in every community. The creation of new knowledge among individuals is leveraged through social interaction.

The socialization construct is used to share information between individuals. Tyagi et al. (2017) found that in 2006, the socialization construct of the SECI model was used to analyze performance improvement. Halim et al. (2017) shared a case where the socialization construct of the SECI model was used in the collection of data between patients and doctors to create detailed patient records. Yang et al. (2017) developed ideas of creating knowledge using practical skills using the socialization construct. Similarly, Olmos and Rodas (2014) shared a case study where requirements engineers elicited information from the domain specialists. In the end, requirements engineers understood the requirements for the required software, and the domain specialists also understood how the software would work. The socialization construct can be applied to retrieve the knowledge which is within individuals.

Externalization. Explicit knowledge can benefit more people, unlike tacit knowledge. Laeeque and Babar (2017) and Muthuveloo et al. (2017) noted that externalization is the second construct of the SECI theory of Nonaka and, according to Laeeque and Babar (2017), it is the stage where tacit knowledge is converted into explicit

knowledge for sharing and applying it into practice from theory. Muthuveloo et al. (2017) added that externalization is the articulation of tacit knowledge into explicit knowledge in the form of concepts, metaphors, visuals, and analogies. Olmos and Rodas (2014) argued that the conversion is carried out per some prescribed protocols, approaches, and guidelines. Burnett et al. (2017) and Sedelmaier and Landes (2017) concurred in that the process of converting from tacit knowledge to explicit knowledge loses some knowledge. The new explicit knowledge can be packed in many forms and shared widely.

To be innovative and creative requires more information than before. Halim et al. (2017) found that some doctors interviewed patients and recorded tacit knowledge, which they converted to explicit knowledge. Putri and Argogalih (2016) found that they then used the information to analyze patients' conditions. Yang et al. (2017) used the externalization construct in a study where they had to convert tacit knowledge into explicit concepts by engaging participants and integrating participants' input to produce a report from which they took innovative actions. Bandera et al. (2017) argued that companies apply the externalization construct to create institutional memory, document processes, and for scaling up start-ups. Converted explicit knowledge has more applications than tacit knowledge.

Combination. Combination is the third construct of the SECI model, which adds other knowledge aspects to explicit knowledge to make explicit knowledge more available and usable. Oihab Allal-Chérif (2016) noted that explicit knowledge has been transformed by the combination construct into new complex knowledge using innovative design principles (Bider & Jalali, 2016). Bejinaru (2016) noted the combination construct is viewed as a process that takes outside the internal explicit institutional

knowledge, communicates new explicit knowledge to the members, and finally transforms explicit knowledge to make it easier to use. Laeeque and Babar (2017) found that the combination construct integrates discrete recognized knowledge as a crucial requirement for creating new ideas for advancing creativity (Muthuveloo et al., 2017). The knowledge is integrated and formatted in different ways, which can be applied to many situations.

The combination construct prepares the information in a format that is easy to apply to a situation, to use and to disseminate, unlike tacit and unformatted explicit knowledge. Olmos and Rodas (2014) noted that the combination mode could be applied in the creation of new data models by combining different documents in the field of data mining. Burnett et al. (2017) showed how the combination construct was used to create songs by assembling, comparing, and arranging explicit knowledge. Laeeque and Babar's (2017) study showed that the combination construct is the most crucial construct of the knowledge creation processes where individuals continuously exchange knowledge using different media. Combined explicit knowledge makes information available in one place and format, which makes it simpler to manipulate.

Internalization. The internalization construct is the fourth process in the conversion of knowledge. Laeeque and Babar (2017), Bider and Jalali (2016) and Bejinaru (2016) concur that in the internalization process, individuals absorb explicit knowledge and keep it as tacit knowledge which they can use creatively. Olmos and Rodas (2014) added that during internalization, individuals learn by repeating tasks that apply explicit knowledge, and the knowledge absorbed as tacit knowledge. Muthuveloo et al. (2017) highlighted that during internalization, individuals learn by doing, and the

example given is when individuals read manual policies—explicit knowledge, internalize, and apply in their daily work. Internalized knowledge has many applications, including research, manufacturing, and systems development.

Individuals learn from what they are exposed to and, in the process, come up with new ideas based on the acquired knowledge. Bejinaru (2016) found that internalization is similar to practical learning, which can be used to expand, enhance, and rearrange existing tacit knowledge of individuals. Yang et al. (2017) shared a case where individuals acquired experience through practical learning and used the experience to manage the risks of a bank. Halim et al. (2017) found that some doctors applied the internalization process of the SECI model to analyze a patient's position using internalized knowledge drawn from explicit knowledge. During internalization, acquired knowledge and experiences from explicit knowledge are shared through socialization and, in the process, create new knowledge that can be used to innovate or create products and services.

Supporting Theories

There are many theories in the literature that are used in the creation of knowledge. These theories seek to achieve similar objectives, and they differ in structure. In this section, I will discuss the triple helix model, organizational learning theory, and tacit dimension.

The Triple Helix Model

Most theories or models are made up of many components. Ribeiro and Nagano (2018) found that the triple helix model has three components, which are university, industry, and government, to form the—university-industry-government relationship.

Ribeiro and Nagano (2018) added the triple helix model was first theorized by Leydessdorff and Etzkowitz from 1995 to 2000, and it describes the relationship that exist between university, industry, and government in terms of knowledge creation in knowledge-based economies. According to Sotarauta and Heinonen (2016), the role of universities in the triple helix is innovation, and the government and industries provide the support needed to create knowledge. Afzal et al. (2018) shared that universities provide information, Ribeiro, and Nagano (2018) noted that industries produce goods and services, and the governments provide social functions. The relationship of the triple helix model is more effective if each component performs its responsibilities effectively and share information transparently.

As a knowledge management model, the triple helix model can create new knowledge which can be used by institutions differently. Li and Fang (2019) found that the triple helix model has been widely used in the analysis of the interaction between the university, government, and industry in international comparative studies. Li and Fang (2019) added that the triple helix model has significantly influenced academic research and policy-making and has assisted in achieving several research results such as the evolution of the regional innovation system and the rise of entrepreneurial universities. These developments are a result of knowledge that is being created and provided in a usable format.

Knowledge is fundamental to the development of society. Ribeiro and Nagano (2018) found correlations between theories of knowledge management and the triple helix model in the generation, innovation, and distribution of knowledge, which is crucial in creating and delivering goods and services. Afzal et al. (2018) noted that the triple

helix model has the potential to speed up progress towards innovation-based economics. Afzal et al. (2018) added the three helices—university, industry, and government connections and interconnections can bring about learning based economies. Momeni, Yazdi, and Najafi (2019) concurred by arguing that the triple helix model can support development in some nations to enhance and speed up their development reforms. Same for Li and Fang (2019), who pointed out that modern universities produce and relay knowledge to impact on economic development by working together with private companies and government. Momeni et al. (2019) found that Malaysia used the triple helix model, together with the National Innovation System to speed up its technology-based development efforts. The triple helix model has many applications like other knowledge management theories.

Organizational Learning Theory

Organizational learning theory can be applied in many fields. March (1991) shared that organizational learning theory can be used in many and different domains to explore large scale change. Gutberg and Whitney (2017) found that organizational learning theory can be used to learn about new knowledge. According to Argote and Miron-Spektor (2011), organizational learning theory suggests that factors at individual-level, macro-level, including the knowledge itself, impact on how learners perceive the quality of the gained knowledge. Similar to the SECI model, the organizational theory is applied in knowledge and innovation situations. Luo, Lui, and Kim (2017) found that organizational learning theory is being applied widely in strategies used by institutions to explain how to increase innovation through knowledge.

Organizational learning theory can help with coming up with new ideas during the process of understanding the current state of things. Laursen (2012) noted that organizational learning theory stipulates that when institutions search widely and in-depth for knowledge, they increase innovativeness because of the knowledge that they acquire in the process. Mowery, Oxley, and Silverman (1996) found that organizational learning theory can increase organizations' competencies by learning from each other. The parties involved in learning from each other should establish rules for exchanging the knowledge that each part holds for the exchange to be effective.

Theories are used to have a deeper understanding of phenomena. Brown J. and P. (1991) found that organizational learning theory is highly relevant to understanding knowledge translation phenomena. Conner and Prahalad (1996) noted that organizational learning uses existing knowledge to create new knowledge for directing future actions. Conner and Prahalad (1996) and March (1991) added that institutions could enhance their knowledge by integrating different types of knowledge streams by using existing and exploring new knowledge through organizational learning theory. Integrated knowledge can be used in the creation and delivery of better products and services.

Tacit Dimension

Individuals hold knowledge that can be shared in many ways, including talking and demonstrating. According to Polanyi (1969), all knowledge rests in individuals' minds, and knowledge is understood or implied without being stated, and Nonaka and Takeuchi (1995), individuals' knowledge is shared through socialization. Nonaka (1991) argued that tacit knowledge could be converted to explicit knowledge through externalization. Nonaka and Takeuchi (1995) found that new knowledge is also created

during the conversion of tacit knowledge to explicit knowledge. Once tacit knowledge has been processed through socialization to explicit knowledge, it becomes available for use and sharing by individuals and organizations.

The tacit dimension was proposed by Polanyi in 1962 (Asvoll, 2017). Researchers found that tacit knowing has four parts; the functional structure of tacit knowing (Li, Yuan, Ning, & Li-Ying, 2015), for example, the recognition of objects (target) and how they look like (features). The phenomenal structure of tacit knowing involves understanding (Wood, Rust, & Horne, 2009), for example, being aware that we would recognize objects if we see them again. The semantic aspect of tacit knowing tends to displace all meaning away from ourselves (Rice, 2015), for example, knowing an object by its impact, not its features. The ontological aspect of tacit knowing establishes the relation of what the tacit knowledge is (Oguz & Sengün, 2011) for example, once we recognize someone, we are aware of knowing that person. Tacit knowledge has been integrated with other constructs in other theories like the SECI model, which is widely used in knowledge management.

While knowledge management theories seek to achieve similar objectives, researchers differ in their views. Spender (1996); Sternberg, and Horvath (1999) argued that some tacit components of the tacit knowledge could not all be converted, explicated, and apprehended by individuals other than the holders of that knowledge. Spraggon and Bodolica (2017) revealed that not all researchers agree with the propositions of the tacit dimension, and Tsoukas (2003) disagreed with Nonaka's knowledge creation theory arguing that explicit and tacit knowledge are not different but represent knowledge in different ways. Also, Polanyi M. (1996) argued that Nonaka's conversion model ignores

the potential inexpressibility of tacitness; Spender (1996) further argued that some facets of knowledge might never be converted into explicit knowledge. Despite the disagreements raised about the tacit dimension, especially the conversion of tacit knowledge to explicit knowledge, the theory is still in use.

Contrasting Theories

The creation of knowledge can be achieved through other theories than the SECI model. In this section, I contrasted the SECI model with the observe–orient–decide–act (OODA) loop model, Nissen's knowledge dynamics model, and the Boisot I-Space KM model.

The OODA Loop Model

The OODA loop model is a defense decision cycle that is applied in the combat operations process. The OODA loop was created by Colonel John Boyd in 1960's. Oron-Gilad and Parmet Yisrael (2017) found that Boyd developed the OODA loop as an organizing principle to achieve real-time decision making. The four constructs of the OODA loop model contribute towards knowledge creation. Oron-Gilad and Parmet Yisrael (2017) noted that the observation construct gathers data about the environment. The orientation construct analyzes the gathered data to make conclusions. The decision construct is about how to act based on the analyzed data. The acting construct executes the decision.

The process of observing, orienting, deciding, and acting takes two forms—the command pillar and the inform pillar, which creates knowledge. Ashwell (2017) found that the informal process takes in data and processes it into information, then into knowledge, and eventually understanding. On the contrary, the SECI model converts one form of knowledge to create a new form of knowledge. Olmos and Rodas (2014) noted

that in the first phase of the SECI model, knowledge is created through social interaction between individuals. Halim et al. (2017) noted that in the second phase of the SECI model, knowledge created through the interaction between individuals is converted to explicit knowledge. The OODA loop model creates knowledge by processing data obtained during observation, orientation, decision, and action into knowledge and understanding.

Nissen's Knowledge Dynamics Model

There are other methods of creating new knowledge other than the conversion of tacit knowledge into explicit knowledge. Bejinaru (2016) found that Nissen's knowledge dynamics model is based on the concept of knowledge flows—that is how knowledge moves in an organization. Also, the researchers found that knowledge flowing in organizations can be understood in terms of time and space dimensions. Researchers found that individuals create or acquire knowledge for their development in the time dimension and that knowledge flows to other areas in the space dimension (Bratianu & Orzea, 2010).

It is a common practice for theorists to borrow ideas from existing theories to strengthen their theories. Bratianu and Orzea (2010) found that Nissen borrowed the epistemological and ontological dimensions from Nonaka to create the life cycle and flow time dimensions, respectively. The life cycle is used in the knowledge flow to create, share and use knowledge, and the flow time refers to the time duration required for knowledge to move from individuals, organization, place, or time to another (Nissen, 2006). Contrary to the SECI model, Nissen's knowledge dynamics gives a clearer view of knowledge management to identify the resistances different flows may have within the

organization (Bratianu & Orzea, 2010). Moreover, Nissen's knowledge dynamics has a time dimension that helps to explain the dynamism of the model (Bejinaru, 2016).

The Boisot I-Space KM Model

Some theories are developed based on other theories. Bratianu and Orzea (2010), found that Boisot developed the Boisot's knowledge dynamics model based on the theory of information. Boisot developed the idea that there is an I-Space with three dimensions, namely: codification, abstraction, and diffusion. Codification deals with the categorization of explicit knowledge (Cristea & Capatina, 2009). Data and knowledge bases are created during the codification process (Boisot, 1998). The abstraction dimension reduces the number of categories from which to choose events for codification (Mohajan, 2017). The diffusion dimension is for disseminating information to targeted communities (Haslinda & Sarinah, 2009).

The I-Space shows the direction of knowledge flow as well as possible frictions and hindrances in the consumption of knowledge in communities (Sjarbaini, 2009). Unlike the SECI model, which creates knowledge by converting tacit knowledge into explicit knowledge, Boisot's knowledge dynamics is based on explicit knowledge, which is packaged into categories and disseminated to targeted communities. However, the Boisot's knowledge dynamics model remains more abstract than the SECI model but can be employed to complete the SECI model to understand the dynamics of knowledge within an organization.

Critiques of the SECI Model

Individuals are rational and are bound to understand and perceive the same phenomenon differently. Researchers such as Burnett et al. (2017) argue that tacit

knowledge of the SECI model should not be treated as if it is fully convertible to explicit knowledge because of what they termed somatic element. Burnett et al. (2017) defined a somatic element as skills that are exhibited by the body when acting. Bandera et al. (2017) concurred there are four routes of disseminating knowledge, as was argued by Nonaka and Takeuchi (1995). Bandera et al. (2017) shared the four knowledge converting processes as creating tacit assets from tacit assets which known as socialization; creating explicit assets from tacit assets known as externalization; creating explicit assets from explicit assets known as combination; and creating tacit assets from explicit assets known as internalization. The concept of converting knowledge into different forms makes it applicable to many situations, unlike having it one form.

The SECI model has its challenges. Burnett et al. (2017) argued that knowledge is theoretical, personal and biased, and context-specific (Olmos & Rodas, 2014), making it difficult to convert to explicit knowledge and share with others. Olmos and Rodas (2014) also challenged the conversion of tacit to explicit knowledge, arguing some difficulties are encountered upon communicating tacit knowledge. Nonaka and Takeuchi (1995) found that expressing tacit knowledge requires practice and skill. Moreover, practitioners fail to share it, and it is inarticulate. Yao et al. (2012) criticized the SECI model for leaving out the details of how new knowledge is created in the four constructs and that there is an exaggeration in terms of the roles that are played by individuals in communicating tacit knowledge. Nonetheless, some researchers applaud the SECI model for its appropriateness. Yang et al. (2017) concurred with the claim that the SECI model, as a knowledge management theory, can be used widely. While the claims could be

correct, the SECI model has been applied widely, and those who applied it managed to achieve their objectives.

Application of the SECI Model

Some organizations have used the SECI to create new knowledge and use the knowledge to develop new products and services. Bandera et al. (2017), Muthuveloo et al. (2017), and Oihab Allal-Chérif (2016) found that the SECI model processes—socialization, externalization, combination, and internalization creates new knowledge for advancing innovation and creativity. Bider and Jalali (2016) found some cases where the SECI model was used to support the development of software by comparing agile and non-agile software development processes. Laeeque and Babar (2017), found three telecommunication companies in Pakistan, which applied the SECI model to study how new knowledge is created in organizations. Olmos and Rodas (2014) shared a case where the SECI model was used to study requirements engineering, and the result was that the software engineers and the users managed to learn from each other and created accurate user requirements.

Application of the SECI Model in This Study

When I found that the SECI model can also be applied to requirements engineering research studies, I reviewed the literature and found that I could also use it in this study. Developing ICT4D applications is an innovative initiative of using ICT and uses ICT artifacts to create products and services to improve products and service delivery to underprivileged communities. Creating ICT4D applications requires new knowledge to create those innovative products and services.

Socialization: The socialization process is what software engineers and ICT4D application users can apply during requirements elicitation. Tyagi et al. (2017), during socialization individuals, exchange what they know, and new knowledge is created by each individual as they begin to know what they did not know. Halim et al. (2017) found that during socialization, knowledge is shared as individuals communicate socially. Putri and Argogalih (2016) found that during socialization, knowledge is converted from tacit knowledge to tacit. Hvorecký et al. (2015) found that socialization is achieved through interpersonal communication, and it is a traditional form of learning, which is used widely. Olmos and Rodas (2014) found that during socialization, individuals share what is in their minds and their capabilities, and the flow of information should be both ways.

During socialization, software engineers interviewed users who could articulate what they expect the system do, and software engineers need to be individuals who know ICT4D applications to capture the new knowledge accurately. Software engineers and end users need to create relationships and trust each other to share information openly.

Externalization: Software can apply the externalization process to transcribe information provided by application users into a format that can be shared with other software engineers. Tyagi et al. (2017) found that the externalization mode converts tacit knowledge to explicit knowledge. Halim et al. (2017) noted that externalization makes tacit knowledge clear and certain or changing it in a form that can be seen or felt. Hvorecký et al. (2015) argued that any form of putting tacit knowledge into a required format is externalization. Olmos and Rodas (2014) shared that during externalization, tacit knowledge is converted to explicit by developing some rules. However, Tsoukas

(2003), argued that tacit knowledge dwells in individuals, based on feelings and acquired through practice; thus, it is inarticulable.

For this study, software engineers applied the internalization process as they transcribed user requirements, demonstrations, and observations into a format that is real and clear. The transcribed information can serve many purposes, including giving it back to the users for verification, giving it to other stakeholders such as funders, and sharing it with other software engineers who can use the information to advance the project.

Combination: The combination process can be applied by software engineers when they combine user and system requirements into a requirements specification document. Olmos and Rodas (2014) noted that during the combination process, discrete and different explicit knowledge is integrated to form comprehensive, explicit knowledge. Tyagi et al. (2017) concurred by stating that knowledge is acquired by combining existing and isolated explicit knowledge into a pool of knowledge. Hvorecký et al. (2015) found that for combination to be effective, the pooling together of isolated information needs to conform to some rules—like those acceptable in a community and those converting the knowledge have to have skills to do so. Yang et al. (2017) added that besides integrating explicit knowledge into a system structure, Tyagi et al. (2017) found explicit knowledge is internalized by individuals as tacit knowledge.

The integration process transformed the explicit knowledge—those drawn from users, funders, software engineers, the government, and software professionals into a comprehensive, explicit knowledge structure. The new knowledge is used not only to develop ICT4D applications but also to educate stakeholders about the project.

Internalization: The internalization process is applied by all stakeholders of ICT4D applications to understand how the application works by internalizing the information shared in different forms. Tyagi et al. (2017) noted that internalization is the last process in the conversion of information where comprehensive, explicit knowledge is absorbed by individuals as new knowledge, which is kept as tacit knowledge. Putri and Argogalih (2016) found that in this phase, individuals begin to internalize knowledge from explicit knowledge, thereby enhancing their existing tacit knowledge. Bider and Jalali (2016) found that individuals can use the new knowledge regardless. Hvorecký et al. (2015) added internalization aims to incorporate new knowledge with existing knowledge to make it one-knowledge for the individual, and Yao et al. (2012) found that new tacit knowledge is created by internalization. Internalized knowledge plus existing individuals' tacit knowledge broaden the knowledge of individuals who can use their tacit knowledge to share with others through socialization or to create innovative ICT4Dapplications.

Similarly, for this study, all stakeholders, including software engineers, users, software professionals, and researchers after internalizing new knowledge, used it innovatively. Software engineers can use the knowledge to understand how humanitarian organizations work and to manage requirements engineering processes innovatively so that they can build effective ICT4D applications. Other stakeholders having internalized the new knowledge can use it to refine user and system requirements, and users can use the new information to articulate their requirements.

Analysis of Potential Themes and Phenomena

In this section, I discussed themes found in the literature which are related to strategies used by software engineers to capture requirements for developing ICT4D Applications.

Digital Divide

ICT4D initiatives can provide communities living in rural areas and marginalized communities living in urban areas some means to enjoy the benefits of ICT. Chao and Yu (2016) suggested that ICT4D can be a strategy for solving the digital divide. There is evidence in the literature where ICT has been used to improve the standard of living of people. Still, undeserving communities are being left out from enjoying the benefits because of many reasons.

There are varied definitions of the digital divide. Kim and Han (2017) mentioned that previously, the digital divide was referred to as the phenomenon where there were inequalities in accessing IT infrastructure. With the evolution of technology, Rogers (2016) defined the digital divide as the difference between those who can operate the computer, use the Internet, and those who can use the information and those who cannot. Karabacak (2016) defined it as variations between institutions that are at different socioeconomic levels as a result of using ICT and the Internet. Further, Rogers (2016) noted that the digital divide gap refers to the inequality in the control and proper use of digital production tools and that the gap exists for people of color, the economically deprived, and other underserved groups. Karabacak (2016) refers to the digital divide as the difference between those with the newest information technologies and those without, then those with access to digital technologies, and those without, and finally, those who

can use it and those who cannot. The variations in the definition can be simplified by saying that there is one side—of individuals or companies benefiting from ICT, and the other side is not.

The digital divide is a complex topic. Cumps (2015) found that the digital divide is made up of many components such as the global divide which explores the intensity of Internet access between the first and the third world; social divide which is the exploration of the gap between the rich and the poor in terms of access to information; and the democratic divide which is defined as the gap between users and non-users of digital resources in advancing their lives. Cumps (2015) added that digital divide concerns are not only issues of access to ICT, but also usage of ICT and lack of skills and knowledge. The digital divide components make it easier to identify strategies to overcome it.

ICT is supporting the production and delivery of goods and services efficiently. Chao and Yu (2016) noted that the inequality of digital rights could be a cause for deprivation to services that could advance the socioeconomic status of undeserving communities. Chao and Yu (2016) added that digital divide is mostly felt by the poor who cannot afford to buy ICTs, those who have not received training on how to use ICT, those living in rural areas especially women, and those who cannot physically see or operate ICTs because of disability. Huang and Cox (2016) found that 75.1 percent of the population has access to the Internet for high-income economies and only 5.4% for low-income economies. Huang and Cox (2016) found that the digital gap is not only prevailing between high and low-income economies but also between the rich and the marginalized within an economy. Rogers (2016) argued that despite the omnipresence of

computer devices, the digital divide is still prevailing. The digital divide is a crucial matter for social justice, which requires governments to intervene in different ways to narrow the gap.

The digital divide exists because of many reasons. García, Ferrás, Aguilera, and Ávila (2017) found that some communities do not know how to use ICTs, and others do not have computing devices which they could use to participate actively in the development of ICT4D initiatives. Fife and Pereira (2016) found that lack of adequate electricity infrastructure in rural or remote areas of some nations can also contribute to the digital divide. Haffner, Mathews, Fekete, and FinChum (2018) discovered that some individuals consciously choose not to embrace ICT. Some of the older adults, individuals, and organizations, which were, at some point, victims of cyber-crime, might be skeptical about embracing ICT, and these decisions can also widen the digital divide gap.

Information and Communication Technology for Development

ICT4D is a field that seeks to advance people's lives through ICT. Dobson and Nicholson (2017) refer to ICT4D as the incorporation of information technologies that can work together in environments with challenging developmental problems. Pade-Khene (2015) found that ICT4D explores how information and communication technologies can be embraced to easy the delivery of interventions in poor communities of the third world. Okewu and Okewu (2014) highlighted that the word development from the term (information and technology for development) refers to the development of many social activities. Okewu and Okewu (2014) added that some of the social activities include poverty alleviation, education, agriculture, healthcare, general communication,

gender equality, governance, infrastructure, environment, and sustainable livelihoods. The definition of ICT4D is evolving as the field is maturing.

ICT4D is made up of different components. Pade-Khene (2015) noted that the field of ICT4D has broadened to encompass information systems, computer science, and socioeconomic development studies. Also, Okewu and Okewu (2014) noted that electronic technologies, systems, interventions, and platforms are components of ICT4D. These technologies include computers (Mamba & Isabirye, 2015), mobile devices (Amuomo, 2017), software applications (Bhatt et al., 2016) and the Internet (Singh & Mikkel, 2016). Since ICT4D is made up of many components, the components need to compatible with each other to minimize support issues. Mamba and Isabirye (2015) found that ICT4D technologies specifications should be ideal for rural areas where ICT4D applications are widely used by marginalized communities. Further, Oduor et al. (2016) argued that these technologies need to be easy to use, and Leonardi, Bailey, Diniz, Sholler, and Nardi (2016) should be affordable to buy and maintain. Software engineers should understand the local environment and then develop applications that can work efficiently and effectively in that environment to benefit the local communities.

ICT4D projects can provide marginalized communities the means to access services and advance their lives. Séamas and Camilla (2017) found that ICT4D initiatives are efforts to bridge the gap that exists between the rich and the poor with regards to access to ICT benefits. Chao and Yu (2016) found that communities who cannot access the benefits of ICT are disadvantaged socially and economically. Lin, Kuo, and Myers (2015) found that ICTs are crucial in advancing marginalized communities, and Chao and Yu (2016) found that ICT is being used to increase efficiencies and effectiveness in

agriculture, health, education, poverty alleviation, and electronic commerce. Mamba and Isabirye (2015) found that some potential users of ICT4D applications in the marginalized communities cannot articulate their requirements, and Janu (2017) found that they cannot learn complex systems. Andoh-Baidoo (2016) added most of the disadvantaged communities do not have adequate resources to access ICT benefits. These challenges could be mitigated by involving the communities in the development of ICT4D applications.

ICT4D professionals need to have an appreciation of ICT and social work to understand how to get ICT4D components to work together. Singh and Mikkel (2016) found that ICT4D is an emerging discipline that has not been fully researched, and as an emerging domain, Pade-Khene (2015) found that ICT4D is yet to be studied in the formal education system. Professionals end up implementing the projects anyhow, which may lead to project failures. Kleine (2015) noted that marginalized communities should participate and be active in situations where decisions that affect their lives are made and reject a one-size-fits-all approach. Séamas and Camilla (2017) found that ICT4D implementers are putting more focus on ICT than the social dimension. Stakeholders always have their objectives to achieve, with regards ICT4D, donors, and beneficiaries do not always have similar objectives, and this disparity may lead to ICT4D failures.

Software engineers have a choice to either top-down or bottom-up approaches to implement ICT4D applications. Singh and Mikkel (2016) found that many ICT4D applications are designed using top-down approaches, which were common in the early days of computerization. Sahay (2016) noted that adopting a top-down and non-participatory discourse causes designers to focus on the logic of the system and pay less

attention to the social aspect of the system. Singh and Mikkel (2016) concurred in that ICT4D designing, development, and implementation is using top-down or hierarchical approaches, but which are participatory. Sahay (2016) found that solutions to solve prevailing issues should consider existing resources and, if possible, digitize those using inexpensive solutions. However, Fuger, Schimpf, Füller, and Hutter (2017) revealed that the evolution of ICT and Web 2.0 gave some marginalized communities the opportunity to participate in the development ICT4D initiatives. Since ICT4D is an emerging field that has not been fully researched, there seems to be no dominant approach in the implementation of ICT4D projects.

Most of the funding to implement ICT4D projects is coming from the first world, the United Nations, and other well-wishers who are very active in the implementation of projects. Prasarnphanich et al. (2016) found that ICT4D roll-outs are being dictated by agents with resources and expertise, and Sahay (2016) revealed that local participation is limited in the designing of systems. Also, Singh and Mikkel (2016) also revealed that ICT4D deployments are being implemented without consensus between those providing resources and the beneficiaries of those resources. Walsham (2017) suggested that ICT4D researchers should work with users, practitioners, and policy-makers to enhance the impact of their work. Gulliksen (2017) found that to adapt approaches and tools to local needs and system specifications needs a deeper knowledge of the local culture and how the locals operate as well as involving them in the development of applications. Other researchers revealed that the top-down discourse misses out on the genuine issues that should be addressed by ICT4D applications as implementers lack an in-depth understanding of the communities that will be served by the developed applications.

To implement ICT4D applications successfully, ICT4D stakeholders need to appreciate that there is no formal education for ICT4D and that ICT4D is an emerging and complex field. Walsham (2017) suggested researchers should research more about ICT4D to explore deeper insights with regards to what ICT4D is supposed to accomplish. Canares M. P. (2016) found that to develop new software successfully, stakeholders need to take part in the development process and not perceived as mere users. Also, Walsham (2017) suggested that ICT4D experts should not force ICT4D solutions on beneficiaries; rather, beneficiaries should be given space to actively participate in the development and implementation of their ICT4D applications. While funders and experts of ICT4D could be viewed as imposing on how to implement ICT4D projects, there could nobody with minimum knowledge and skills locally who can implement ICT4D initiatives effectively mobile for development (m4d)

The numbers of ICT4D applications that are using mobile phones are on the increase, and mobile phones are being used mainly for communication, accessing services, and sending data. Loudon (2016) defined m4d as the use of ICTD initiatives to access services through mobile phones to advance the socioeconomic status of marginalized communities. Ariffin, Side, and Mutalib (2018) found that mobile phones can be used to access services such as education and other social services (Kalinic & Marinkovic, 2016). Loudon (2016) found that there is an increase in the number of services that can be accessed through mobile phones. Also, Renteria (2015) noted an improvement in communication amongst community members, efficiency in transportation, and doing other business after community members began to use mobile phones. NGOs in Southern Africa are using tablets and feature phones to collect data

from communities and send it using short message service (SMS), which might be efficient than collecting the data using paper and sending it by courier services. Citizens can avoid or minimize costs by using mobile phones. Renteria (2015) found that some communities in Mexico reduced their households' transport expenditure when community members used mobile phones for their banking transactions instead of commuting to transact at the bank. Renteria (2015) added that the impact of embracing m4d was evidenced by the savings in the community members' bank accounts. Amuomo (2017) and Mwangi and Brown (2015) found that m4d initiatives like Mpesa are making a positive impact where Kenyan communities are using mobile phones to pay for most of their services. In Africa, services such as banking and education are not always within reach, and m4d is being to access some of these services.

Mobile technology has many applications that can improve people's lives, and as such, the government, business community, and the public need to work together in enabling existing services to use mobile technologies. Amuomo (2017) found that that there is an increase in the number of homegrown m4d initiatives with regards to the number of built ICT4D initiatives and the number of ideas under incubation. Rashid (2017) and Palvia, Baqir, and Nemati (2018) found that m4d is being used to advance world-wide strategies for international and socioeconomic development, including human rights. Walsham (2017) found that some African countries are appreciating how ICT is assisting in alleviating poverty, and some of these countries are putting in place policies in support of this development. Mobile phones can provide the convenience to communicate and do business from anywhere, and for communities to continue using this

technology, the infrastructure should be maintained and upgraded to support emerging technologies.

The Role of ICT4D

ICT4D, like other technologies, provides the means to speed up the delivery of interventions to disadvantaged communities. Chao and Yu (2016), Okewu and Okewu (2014), and Rashid (2017) found that project managers can generate reports from ICT applications and use the information on the reports to decide on the best action to take to advance the status of beneficiaries. Dobson and Nicholson (2017) found that ICT4D is a process of harnessing digital technologies that can be used in those nations with problematic development issues. Hudson et al. (2017) gave an example of some smallholder farmers who used radio communication to solve issues of food security by requesting consumers to give them feedback, comments. Qureshi (2015) found that mobile communication is being used in different forms to improve the lives of people, and Hudson et al. (2017) found that m4d is being embraced in socioeconomic domains such as agriculture, health, and education. The field of ICT has evolved to the level where applications are being used to process, analyze, and report information automatically to minimize errors.

Institutions that use appropriate ICTs can achieve growth, market share, maintain competitiveness, and can improve people's lives for the better. Mithas and Rust (2016) argued that some organizations achieved business growth after embracing ICT. Also, Palvia et al. (2018) and Séamas and Camilla (2017) and Avgerou et al. (2016) revealed that substantial efforts had been used to research on how to leverage ICT in developing nations to enhance efficiencies in public health, agriculture, gender, education, and

poverty alleviation. For example, the MPESA project has been widely mentioned in some studies as an example of how ICT has advanced the socioeconomic status of some citizens through mobile technology (Avgerou et al., 2016; Loudon, 2016; Mwangi & Brown, 2015; Rashid, 2017). There is enough evidence to prove the effectiveness of embracing ICTs to achieve specific objectives; however, ICT experts need to design sustainable ICTs for disadvantaged communities who cannot afford high system support costs.

ICT equipment and services are expensive in Southern Africa, especially for disadvantaged people who are mostly residents in rural areas. Rashid (2017) argued that there benefits for embracing information technology, which is crucial for development, and according to Haenssgen (2018), the benefits are being enjoyed by the middle and upper classes. Fife and Pereira (2016) and Ponelis (2015) found that ICT4D has the potential to bridge the digital divide and provide both the poor and the rich the opportunity to participate and advance their welfare and Bhatt et al. (2016) concurred arguing that ICTs can speed the processes of economic and social development. Andreas et al. (2016) and Chao and Yu (2016) and Thomas and Li and Oliveira (2017) and Haenssgen (2018) found that marginalized societies in developing nations lack adequate ICTs for which to participate in the development of their socioeconomic condition. ICT4D stakeholders should consider designing sustainable ICTs so that disadvantaged communities can afford to support and maintain the initiatives.

ICT4D Successes

There are many cases of ICT4D projects that have positively transformed the lives of rural communities who were living under extreme poverty. Amuomo (2017) found a

case where the youth are using their mobile phones to communicate and access some social services. Rislana et al. (2018) found that ICT4D advanced the pass rate of 500 ICT professionals annually between the years 2001 to 2012 in the Jigawa State Government, Nigeria; the training was attained through local and overseas training, including activation of computerization of some government operations. About 3000 graduates were produced each year between 2006 and 2007 (Rislana et al., 2018). Kibere (2016) found that there is an increase in the number of Kenyans who are using the M-Pesa mobile money transfer service. ICT4D projects are increasing potentially because some funders are buying feature phones, smartphones, and tablets for the beneficiaries, and these devices are being used mainly to collect data, capture photos, send SMSs, and viewing reports.

To implement ICT4D projects successfully, the environment needs to be supportive. Mwangi and Brown (2015) found that the success of M-Pesa was attributed to the legislation that was passed by the Kenyan government, which supported the growth of the ICT sector. Kibere (2016) noted that the Kenyan government permitted other telecommunication operators to expand the network for mobile phones. Jolliffe, Poppe, Adaletey, and Braa (2015) found that the successful implementation of DHIS2—a health information system in Ghana was attributed to the availability of the Internet and the provision of technical support from an international university. Jolliffe et al. (2015) found that for ICT4D initiatives to succeed, they require adequate resources, supportive policies, creativity, and credibility during implementation. Funders and implementers of ICT4Dinitiatives need to understand the local ecosystem and use the information to design and develop applications that can be accepted by the users and supported locally.

Reasons for ICT4D failures

Despite the huge investments in ICT4D by donors and implementers, ICT4D projects continue to fail. Mamba and Isabirye (2015) noted that there are many cases of ICT4D projects that have failed to make a positive impact. Bormane, Gržibovska, Bērziša, and Grabis (2016) found that some components of the requirements engineering process are contributing to ICT4D project failures and 50–60% of project failures are a result of poorly inquired user requirements. Bozyiğit, Aktas, and Kiling (2019) and Tibben (2015) found that software developers are sometimes given vague requirements specifications that are difficult to understand, and which may result in the development of applications with bugs. Also, Ouhbi, Idri, Fernández-Alemán, and Toval (2015) found that some requirements engineering experts lack adequate skills and appropriate knowledge required to elicit accurate and complete user and system requirements. Ouhbi et al. (2015) stated that the errors could be a result of errors of conception, which results when analysts fail to understand customers' needs. Identifying and correcting errors can increase the budget of an ICT4D budget, and thus, errors should be avoided at any cost.

There are different types of requirements errors. Talha (2018) stated that some of the common errors that can fail software projects fall under the following categories: standard requirements, incomplete requirements, inexperienced requirements engineers, and inappropriate constraints. Talha (2018) added that there are occasions when developers implement the requirements incorrectly, yet the requirements themselves are correct. According to Talha (2018), requirements errors are divided into inadequate requirements validation, inadequate requirements process, and poor-quality measurement. Talha (2018), there are also errors of visualization, which are errors caused by incorrect

prototypes and errors of requirements management where the errors are a result of tracking and tracing requirements changes inconsistently. Errors can be identified during system development, and there are some errors which are noticeable when the system is in operation in all cases, these errors are failing ICT4D projects. It is, therefore, crucial that stakeholders in the development of ICT4D to consider using some guidelines or best practices in all the processes of developing ICT4D applications to avoid software failures.

There are other reasons why ICT4D projects fail to serve their purpose. Mamba and Isabirye (2015) revealed that the top-down approach to ICT4D implementation could cause ICT4D funders to dictate the type of design for ICT4D initiatives. Also, Canares M. P. (2016) stated that in many cases, some beneficiaries resist embracing the initiatives that were developed without their input. Ferrari, Spoletini, and Gnesi (2016) found that some ICT4D projects fail because implementers sometimes use inexperienced software engineers. Stakeholders should appreciate that effective ICT4D initiatives are those that can make a positive impact on communities by involving local communities in the development of their initiatives.

Lack of appropriate skills to manage a project can cause failures. Mamba and Isabirye (2015) found that lack of capacity to support implemented initiatives and unskilled personnel can contribute to ICT4D failures. Bhatt et al. (2016) and Conger (2015) found that some donors hand over completed projects to the communities for scale-up, but the communities are failing to implement the scale-ups because they don’t have implementation and project management skills. Ponelis (2015) noted that there is a lack of project management skills required to implement ICT4D projects successfully.

Implementation of ICT4D projects requires diverse skills which can be provided by experts from IT, telecommunication, social work, and other disciplines.

Some projects are initiated, and implementers realize much later that the projects are being hindered by issues of politics, economics, or war. Conger (2015) revealed that some donors do not measure the impact made on the community by the ICT4D initiatives they funded. Sahay (2016) found that some donors fund implementation of ICT4D initiatives disregarding their failure elsewhere, which leads to more ICT4D failures. Jolliffe et al. (2015) discovered some cases where donors funded the development of a single component of an ICT4D initiative, which worked satisfactorily as a single component, but it could not be integrated with existing systems. Many ICT4D projects were initiated successfully but were implemented partially, and these projects failed to meet users' needs.

Some ICT4D efforts fail because they are not fully funded. Jolliffe et al. (2015) and Mamba and Isabirye (2015) and Manzira and Munyoka (2016) found that some ICT4D projects fail because of inadequate funding. Bronte-Stewart (2015) found that budget overruns are causing delays in completing projects; Tibben (2015) revealed that implementers are failing to contain costs. Bozyiğit et al. (2019) found that poorly captured requirements engineering processes may cause delays in the delivery of the software, which may increase the overall cost of the project. Mwantimwa (2017) and Mamba and Isabirye (2015) found that some ICT4D initiatives are failing because they require a constant flow of financial support to keep them operational. Stakeholders should implement projects that communities can afford to maintain when donors pull out or hand-over the projects to them.

ICT4D is ICT and social work linked together, and the link should be maintained to avoid ICT4D failures. Furthermore, Mamba and Isabirye (2015) found that poorly developed policies and unclear user requirements, inadequate knowledge of the link between ICT and development, inadequate user participation, poor project management, and lack of frameworks fail ICT4D projects. Conger (2015) found four categories of reasons for ICT4D failures include social-political, stakeholders' involvement, transparency, and development. Dobson and Nicholson (2017) found that ICT4D projects have a high rate of failure due to the technocentric discourse of implementers, which disregards cultural and social dimensions. Diniz, Bailey, and Sholler (2014) found that software engineers paid more attention to what beneficiaries perceived as a satisfactory initiative instead of advising and incorporating their knowledge and user experience to develop a complete ICT4D technology. Implementers should look at the development of ICT4D applications holistically and avoid focusing on the technological dimension and put less focus on the social dimension of ICT4D.

Ecosystems determine the success or failure of some ICT4D projects. Armey and Laura (2016) found that communities living in areas with electricity have managed to embrace ICT compared to those without good electricity infrastructure. Mwantimwa (2017) and Armey and Laura (2016) and Thomas, Li, and Oliveira (2017) found that areas without adequate electricity fail ICTs because the equipment requires electricity to be operational. Naidu and Chand (2018) found that community members living in marginalized areas are technologically illiterate, and Keating and Alam and Wagner (2016) and Keating and Nourbakhsh (2018) found that they cannot articulate user and system requirements clearly that may lead to unsatisfactory ICT4D applications. ICT4D

applications can make a positive impact if the environment is supportive in terms of skilled workforce, accurate user requirements, and adequate funding.

Developing satisfactory ICT4D applications require key stakeholders to be involved. Cheah et al. (2017) found that a lack of active participation by stakeholders during the development of ICT4D initiatives can be a cause for ICT4D failures. Oduor et al. (2016) shared that limited involvement of stakeholders in the development of ICT4D applications can lead to the development of unsatisfactory and difficult to maintain applications. User involvement is critical if implementers' intention is to handover projects to local communities. Otherwise, the communities might resist or reject some of the initiatives if they were not involved in the development of those initiatives.

Proper planning for resources can minimize ICT4D failures. Ghanbari, Vartiainen, and Siponen (2018) found that software development projects which are behind schedule tend to take shortcuts and so often produce poor quality applications that are fraught with errors. Piore, (2018) found that some project managers who hire additional software engineers to assist with getting back on schedule worsen the situation when those newcomers take long to fit in. Lopez-Lorca, Beydoun, Valencia-Garcia, and Martínez-Béjar (2015) concurred in that newcomers in projects sometimes take long to understand the project requirements and end up redoing some of the work, thereby wasting resources. Piore (2018) and Lopez-Lorca et al. (2015) added that newcomers delay projects further as they learn from the documentation and not from end users themselves. Project delays impact negatively on the overall success of a project, in many cases, projects are rarely completed and objectives unachieved.

Cases of ICT4D Failures

There are many ICT4D initiatives that have failed. Rashid (2017) found that the Dwesa and Alice projects in the Eastern Cape of South Africa failed because of issues of sustainability, user involvement, use of PCs instead of mobile phones, and project coordination. Mamba and Isabirye (2015) discovered that the ICT4D initiative required skilled and experienced engineers, and the project was capital and labor-intensive as well as expensive to sustain. Furthermore, Mamba and Isabirye (2015) found that stakeholders of the Dwesa and Alice projects suggested improvements in project coordination and management to minimize the rate of failure of ICT4D projects.

Conger (2015) found that the Siyakhula Living Lab, which sought to develop rural communities by providing them with the Internet and smartphones, and the project failed because the local community resisted the initiative. The resistance of technology is a result of many factors. Alam and Wagner (2016) and Sahay (2016) found that some funders and implementers of ICT4D initiatives have little knowledge about how their beneficiaries live, making it develop ICT4D applications that meet beneficiaries' requirements. The number of projects that failed may be insignificant, but the number of resources wasted may be huge, and this risk can be minimized if stakeholders carry out feasibility studies before embarking on huge investments.

Requirements

User and system requirements are the building blocks of software development. Thakurta (2017) defined requirements as what the system is expected to do in a specific environment, and Thakurta (2017) added, requirements provide descriptions of a system, how it functions, what it serves, its limitations, specifications, and attributes. Thakurta

(2017) found that the IEEE recommended the following categories for user and system requirements; interface requirements, functional requirements, database requirements, derived requirements, and design requirements. Eito-Brun and Amescua (2017) noted that user and system requirements are crucial in the development of satisfactory applications. It is good practice for software engineers to consider working closely with end users who are knowledgeable of capturing appropriate user and system requirements.

Requirements Engineering

Requirements engineering has many processes that are applied when managing user and system requirements. Dermeval, Vilela, Bittencourt, Castro, and Isotani (2016) and Ali and Lai (2017) defined requirements engineering as actions of eliciting, analyzing, specifying, validating, and managing requirements. Dermeval et al. (2016) found that requirements engineering plays a crucial role in enhancing the quality of application development and also in minimizing risks such as budget overruns and prolonged timeframes. Software engineers need to appreciate that all the processes of requirements engineering are important in the development of robust ICT4D applications as such, software engineers need to scrutinize their work at the end of each process before moving to the next.

Requirements Planning

Planning helps with checking whether there are enough resources for the project, whether implementers are ready to embark on the project, and it can serve as a basis for monitoring and evaluating the project. Mukhopadhyay and Ameri (2016) found that despite the significant positive impact of requirements planning, the process does not generate quantifiable measures for evaluating the quality of generated requirements, and

it also lacks structure and formality for representing engineered requirements. However, Mukhopadhyay and Ameri (2016) argued that too much specificity in requirements planning reduces designers' freedom during the ideation process, thus hindering innovation, and on the other hand, poor planning may lead to poorly captured requirements. On the other hand, Talha (2018) found that poorly captured system and user requirements can result in ICT4D applications which are ineffective in terms of advancing people's lives. Software engineers should plan how to carry out all software development activities to identify those that can be done in parallel and deduce how to prioritize requirements engineering activities to collect complete and accurate user requirements.

Requirements Elicitation

Engaging end users to capture requirements is a task with many activities. Vitharana, Zahedi, and Jain (2016) defined requirements elicitation is the process of collecting user requirements by engaging analysts in learning, uncovering, extracting, surfacing, and discovering users' needs. According to Bormane et al. (2016) found that in requirements, elicitation requirements are translated and transformed without distortion into a language that is understood by software engineers. Ferrari et al. (2016) found that requirements are gathered by taking available specifications from different sources of information and engaging stakeholders with influence on the specifications. Also, Talha (2018) found that requirements elicitation and requirements collection exposes, checks, and writes user needs and system constraints. Baldwin, Teh, Baniassad, Rooy, and Coady (2016) defined requirements elicitation from a psychological viewpoint as an act of gathering information which requires those with information to group together and share

the information. The process of eliciting requirements produces valuable information when the process is undertaken by software engineers who can probe deeply with questions and, on the other hand, end users who can articulate their knowledge explicitly.

Requirements elicitation is a difficult task that requires a systematic approach to be effective. Baldwin et al. (2016) shared that the process of eliciting requirements can be done in steps. The first step is activity-based, where the analyst records or observes how the protocols are followed in carrying out some tasks, and this step is called protocol elicitation. The second step is the nominal group technique, which is used to enhance the quality and quantity of requirements during group discussions. Therefore, it directly mitigates the harmful effects of group dynamics. Also, Bormane et al. (2016) found that the requirements elicitation process is a difficult task in the development of software since it requires an understanding of the ecosystem and proper gathering of clients' needs. It is the responsibility of software engineers to ensure that applications satisfy stakeholders, and this can be guaranteed by eliciting complete requirements accurately.

One strategy for eliciting complete and accurate requirements is by using different techniques to collect user and system requirements. Ferrari et al. (2016) revealed that software engineers use different requirements elicitation techniques such as workshops, focus groups, scenarios, prototypes, and interviews. Also, Ferrari et al. (2016) found that factors such as trustworthiness, integrity of the end user, elicitation process, and knowledge of the analyst impact on the interview process. Ferrari et al. (2016) also added that analysts and end users need to communicate effectively to exchange knowledge to ensure the capture of accurate requirements for the system. Also, Emoghene and Nonyelum (2017) argued information gathering techniques should provide conditions

that benefit stakeholders for them to cooperate, be committed, and be sincere, which may lead to the discovery of important information. Software engineers compare requirements collected through different sources to have a better understanding of what the system is expected to do as well as identifying anomalies.

Requirements Analysis

Requirements critiquing helps with identifying new user and system requirements. Saad and Dawson (2018) found that requirements analysis is referred to as the process of finding out user wishes for new software applications, and Talha (2018) noted that requirements analysis or requirements investigation is a process of filtering requirements to retain those that can be implemented into a system. Bormane et al. (2016) found that when end users do not work with analysts on systems and user requirements, they lower the quality of the specifications. Bormane et al. (2016) added that the effect of having weaker requirements at the analysis phase is that the weaknesses might propagate with each next stage of the project, thereby increasing the amount of work required to fix the errors. Software engineers need to avoid weak requirements, which are usually specified inadequately and always fail to meet users' needs.

A systematic approach to system analysis is effective in identifying requirements defects. Taba and Ow (2016) revealed that successful detection of defects in the requirements analysis process reduces costs. Zhou, Liu, and Lee (2018) found that carrying out a requirements analysis help with identifying appropriate attributes besides those that are obvious. Águila and Sagrado (2016) revealed that requirements analysis as a process of software engineering is closest to the users and made up of knowledge-intensive tasks. Águila and Sagrado (2016) also argued that for requirements analysis to

be effective, it should be carried out by people with the knowledge and experience of doing so. Requirements analysis is effective if software engineers analyzing the requirements were also involved in the capturing of those requirements, and they have to be knowledgeable about the field and experienced in requirements engineering.

Requirements Specification

User and system requirements and other inputs from other stakeholders form requirements specifications for a system. Isola, Olabiyisi, Omidiora, Ganiyu, and Adebayo (2018) found the definition of requirements specification as a process of writing user and system expectations in a requirements document and Talha (2018) found that requirements specification or requirement description involves actions to document analyzed requirements. Isola et al. (2018) shared that requirements are written in a software requirements specification (SRS) document, and software engineers use the document to design and develop software applications. Software developers rely on the specifications that are provided in documents because the documents incorporate users and systems requirements, input from experts, and sometimes samples of the expected system.

The purpose of capturing user and system requirements completely and accurately is for designing applications that can perform specific functions satisfactorily. Diamantopoulos, Roth, Symeonidis, and Klein (2017) found that the process of mapping functional requirements to specifications as well as mapping the specifications into software product causes challenges in the development of software. Diamantopoulos et al. (2017) argued that since requirements are commonly written in natural language, they can be prone to ambiguity, incompleteness, and inconsistentency. Barnat, et al. (2016)

found that errors made during requirements specification are costly to correct as the errors might propagate to the whole software development cycle. Generally, in cases where applications do not meet user requirements, software engineers should look for the issues and have them corrected, and if they are major, have the application re-developed.

Requirements Verification

Software engineers expect user and system requirements to be of good quality. Heck and Zaidman (2017) presented the definition of requirements verification as activities that are carried out to check and make requirements specifications and models reach some level of quality. Talha (2018) noted the definition of requirements verification as a process of checking so that all the requirements meet the expected quality, and Heck and Zaidman (2017) found that the criteria for meeting a standard of quality. Accurate, complete, and relevant user and system requirements are preferred by software engineers because they are easier to work with, and they may produce satisfactory applications.

Also, requirements validation serves to check for consistencies in the elicited and specified requirements. Águila and Sagrado (2016) found that requirements elicitation, analysis, specification, and validation are undertaken iteratively, and requirements engineers can only move to the next activities when these processes are complete. Jebreen and Al-Qerem (2017) simplified by saying that requirements validation practices are put in place so that requirements can be verifiable to advance quality standards. Software engineers need to use best practices to avoid anomalies, such as incomplete and inconsistent requirements.

Requirements Management

Requirements management is made up of many activities. De la Hidalga et al. (2016) shared the definition of requirements management as a series of tasks for organizing requirements engineering processes, which include change management, communication, and negotiation of decisions with stakeholders. Talha (2018) defined it as a requirements management stage for managing time, coordinating activities, and documenting requirements engineering. Fourie and de Vries (2017) found that requirements management is a prominent challenge, and Ebad (2017) added it is the crucial component in requirements engineering. Requirements management provides software engineers the opportunity to review requirements that would have been captured from end users and transform them into a format that is easier to understand and share with other stakeholders.

Software engineers encounter some challenges as they capture user requirements, and some of the challenges may warrant making changes to the requirements. Ebad (2017) found that requirements engineering changes are identified during requirements management and that requirements with many changes can become highly volatile. Ebad (2017) also added that the volatility of requirements could be a result of many factors, including the complexity of the institution, experience of the institution in managing requirements, and the software development stage of the project. Tran, Hajmoosaei, Percebois, Front, and Roncancio (2016) commented that badly managed changes could lead to a reworking of the project—a process that may prolong the completion of the project and budget overruns. Software engineers can minimize errors, project delays,

budget overruns, and other requirements engineering challenges by regarding all requirements engineering processes important.

Relationship of this Study to Previous Research

There are many IT and IS and a few cases of ICT4D studies that have been conducted in Southern Africa. Walsham (2017) noted that ICT4D is an emerging field that has not been fully researched. Studies that have been conducted focused on the successes and failures of ICT4D and understanding the field of ICT4D. Conger (2015), found that there are significant successes and disappointing failures in the implementation of ICT4D projects. Many studies found that requirements engineering was contributing significantly to the successes and failures of ICT4D. Mamba and Isabirye (2015) found that ICT4D failures were caused by a lack of frameworks for underpinning the development and implementation of ICT4D projects. Thus, by focusing this study to explore requirements gathering strategies that are being used in Southern Africa the study will provide more information with regards ICT4D successes and failures.

South Africa conducted most ICT4D studies in Southern Africa. Some of the studies include the Alice (South African rural town) project where an ICT infrastructure had been established (Mamba & Isabirye, 2015) and the Living Labs in South Africa (LLiSA) (Conger, 2015). Generally, researchers sought to understand the field of ICT4D with regards to its benefits to marginalized communities and understanding its level of success or failure. Ponelis (2015) found that some beneficiaries of the LLiSA project were trained on how to use the Internet and smartphones. However, some studies revealed that poor requirements engineering strategies are contributing to ICT4D failure.

Lopez-Lorca et al. (2015) found that poor requirements engineering may cause project delays, unsatisfactory products, and budget overruns.

While the literature has many studies researching different aspects of ICT4D, the literature has few studies that explored strategies that are used for gathering user and system requirements that are needed for developing ICT4D applications. Some of the studies I found in the literature are not purely ICT4D studies; rather, IT/IS studies, provided me with the relevant literature for this study. Moreover, I did not find studies that researched purely on strategies used in requirements gathering. However, some studies researched some aspects of ICT4D, including requirements engineering. The findings of this study might provide information that is missing in the current literature. Also, this study will increase the number of ICT4D studies in Southern Africa.

Transition and Summary

In this section, I explained some of the reasons why I embarked on this study. Some of the reasons include the realization that huge sums of financial and non-financial investments have been put into developing ICT4D applications, yet after all the effort, some of the ICT4D initiatives are failing to improve the socioeconomic status of marginalized communities in Southern Africa. Researchers found that some ICT4D initiatives were developed poorly because the software engineers lacked appropriate requirements capturing strategies. I also discussed the four constructs of the SECI model: tacit to tacit known as socialization, tacit to explicit called externalization, explicit to explicit called combination or explicit to tacit known as internalization (Burnett et al., 2017). The SECI is applicable to situations where there is a need to share and create new knowledge such as in the designing and development of ICT4D initiatives by software

engineers. I also discussed ICT4D, its successes, and failures, the digital divide, m4d, and requirements engineering process. In the next section, I will discuss the purpose of this study, the role of the researcher, more information about the participants, including the research method and design. I will also discuss how I will address ethical research issues, data reliability and validity as well as data collection and analysis.

Section 2: The Project

In this section, I will begin by reintroducing the purpose of this study and moved on to discuss my role as the researcher. I also justified why I chose to use the qualitative research method and the multiple case study design for this study. Further, I wrote about the participants, the sampling approach, and the population for this study. I explained how to address ethical research issues. I also wrote about how to collect and analyze the data. Towards the end of the section, I shared how to deal with the issues of data reliability and validity.

Purpose Statement

The purpose of this qualitative multiple case study was to explore the strategies software engineers in Southern African software houses and IT departments use for capturing ICT4D requirements. The targeted population consisted of software engineers in Southern Africa software houses and IT departments with experience in ICT4D requirements capturing. Exploring strategies for capturing requirements will contribute to the development of robust ICT4D applications. Such applications could contribute to the growth of the regional software houses and benefit the communities they serve. Additionally, the ICT4D applications that will be developed using identified requirements gathering strategies could be used by NGOs to collect and process data of disadvantaged communities that could guide policymaking and the development of interventions to alleviate poverty.

Role of the Researcher

De Wolf, Vanderhoven, Berendt, Pierson, and Schellens (2017) revealed that the role of the researcher is to gather facts of a phenomenon. Mitchell (2015) noted that the

primary role of researchers is to ask questions and listen to the responses, while the interviewees do most of the talking. In many qualitative studies, researchers are the primary instrument of data collection and analysis (Icel, 2018). In this study, my role was to ask participants some questions, and listen attentively while they articulated their experiences and knowledge about capturing ICT4D requirements. I also guided the participants to stay within the topic and audio, recorded the interviews as well as taking down some notes where it was necessary.

I am an ICT4D expert, and I have been practicing in this field for over 10 years now. During this tenure, I have seen and experienced ICT4D failures and successes. My area of focus is software engineering, specializing in requirements engineering. As such, my relationship with the topic is that I am experienced in requirements engineering. I have gathered user requirements for different ICT4D applications, and I can perform most of the tasks, just like the participants.

My role can raise ethical issues in any or all the three ethical principles which are outlined in the Belmont Report. The Belmont Report provides the ethical ramework for the protection of human subjects of research (Burns, 2008; Preece, 2016). The report outlines three basic principles:

1. Justice in distributing benefits and burdens of research fairly.
2. Beneficence in maximizing the benefits and minimizing the possible harms of research.
3. Respect for persons in acknowledging autonomy and protecting those with diminished autonomy.

The Institutional Review Board (IRB) would like risks minimized, benefits equitable, coercion to participate minimized, and participants to participate in studies through informed consent. I achieved this requirement by providing participants equal opportunities to partake in the study, respect all participants, and by following research processes as prescribed by the IRB.

Some studies revealed that for researchers to capture, evaluate, and analyze data objectively, the researchers need to emotionally detach themselves from those being studied (Takyi, 2016). My involvement in the study as the researcher, as well as an ICT4D expert and practitioner will maximize bias. One of the challenges I foresee is that I will undermine participants' response to the extent of leaving out some information and replacing it with what I perceive to be relevant, correct, and truthful. Studies revealed that researchers face the challenge of getting too deep into the intricacies of the phenomena they are studying to gain an insightful understanding and, in the process, fail to perform the duties of a researcher diligently (Takyi, 2016). To minimize the bias, I conducted the interviews according to plan and audio recorded the interviews to ensure that the responses stay the same as articulated by the participants. I collected the data from more than I case.

In qualitative research, researchers use case studies to gain an in-depth understanding of a phenomenon (Canares M. P., 2016; Oihab Allal-Chérif, 2016; Quimby-Worrell C., 2019). In this study, I used a multiple case study design, which provided the use of detailed descriptions of phenomena in a natural setting. Further, multiple case studies allow for a comparison between cases. It is a recommendation to use multiple case studies in a situation where the social and personal context is important

to understand and interpret (Neuman, 2010; Yin R., 2013). Each case is a unit of focus which can be studied from start to finish. The researcher studies each case using the same questions, protocol, and framework to provide consistency in the collection of data. I used semistructured questions for the interview protocol, as outlined in Appendix A. I used the protocol outlined in Appendix B to annotate notes during the interviews.

Participants

Rook (2018) noted that participant selection is important for studies that explore a phenomenon involving people. I selected the participants for this study using the following criteria: (a) individuals who are employed by a software development house as a software engineer, (b) software engineers employed in the IT department of an organization that implements ICT4D, (c) individuals who have been employed as software engineers for more than 5 years, (d) individuals who are knowledgeable about the work of humanitarian or non-governmental organizations, (e) individuals who have developed or worked on an ICT4D project for over one year, and (f) the software engineers should be working in Southern Africa.

Before engaging potential participants from potential case organizations, researchers must get approval from the IRB. The IRB checks whether human participants will be protected during the study and that the informed consent process exists and will be followed upon studying potential participants (Miller, Burgess et al., 2017; Roper et al., 2018;). I obtained IRB approval from the Center for Research Quality of Walden University before approaching potential participants from my personal network. I emailed the potential participants an overview of my study and the participants' selection criteria to read.

I contacted them to discover those who were interested in the research. Next, I emailed them an invitation to participate in the study and I attached the consent form. In the email, I requested them to read the consent form and to indicate their willingness to participate by replying to the email that I had sent them.

Some researchers found that to elicit complete and accurate data for qualitative research, researchers need to keep good interpersonal relations with the respondents (Guillemin & Heggen, 2009). I established a sound working relationship with participants by exhibiting professionalism. I respected the participants and adjusted my schedules to participants' schedules during data collection. I engaged each participant in planning the interview times and venues. I asked each participant to conceal information they consider private and respected their views. I also explained to the participants that my role in the study was a researcher and that I am skilled, experienced, and knowledgeable about developing ICT4D applications. I highlighted to them that their role was to provide information for the project to be successful.

Researchers' integrity wins the trust of participants (Awad & Amro, 2017; Hart-Johnson, 2017). I also exhibited integrity as a strategy to establish a good working relationship with the participants through honesty and trust, which might have motivated the participants to respond to interview questions objectively by providing complete and accurate information as well as participating actively up to the end of the study.

Research Method and Design

Research Method

Researchers found that a qualitative approach is suitable for studies seeking participants' viewpoints and opinions about a study (Al-dalahmeh, Al-Shamaileh,

Aloudat, & Obeidat, 2018; Mol et al., 2017). I used a qualitative methodology to identify the strategies software engineers use for effectively capturing ICT4D requirements in Southern Africa. In qualitative methods, researchers use open-ended and semistructured questions, which provide participants the opportunity to describe phenomena from their own perspectives (Alibakhshi & Dehvari, 2015). To get a full account of participants' views in depth, researchers use semistructured questions (Bhat et al., 2018; Le et al., 2017). Semistructured questions allow researchers to ask follow-up questions to get in-depth understanding during the interview.

Researchers choose a research approach depending on the research problem. Researchers use a quantitative research method to evaluate or test a hypothesis, to measure observation frequencies, and to find the logical relationship between variables (Qin & Fan, 2016). My study aimed to capture all information participants know about capturing ICT4D requirements by asking participants to describe or explain a phenomenon, demonstrate a process, or observe a phenomenon in their natural setting. Researchers use open-ended questions to allow participants to freely express their opinions (Bhardwaj & Patnaik, 2019). Researchers use closed-ended questions in surveys and open-ended questions in interviews where participants are required to elaborate their responses (Hahn et al., 2017). Software engineers use open-ended questions to ask end users to narrate their experiences of using an ICT4D application or to describe the features that they require in a new ICT4D application when they are capturing requirements.

Mixed research methods use both qualitative and quantitative research methods (Venkatesh, Brown, & Sullivan, 2016). Researchers use mixed methods in cases where

quantitative findings are used to provide implications for a qualitative study as a follow-up to understand the relationship between the variables of a phenomenon (Barr-Walker, Jayaweera, Ramirez, & Gerdts, 2019). The three benefits of mixed methods include the ability to confirm and explain research questions, to provide in-depth understanding than a single method, and to produce broader complementary views (Wunderlich, Veit, & Sarker, 2019). However, this study required only the qualitative research methods where participants are required to explain and describe their experiences with ICT4D requirements capture.

Research Design

Phenomenological, grounded theory, case study, and naturalistic, ethnographic, heuristic, and narrative research designs are used in qualitative research methods (Cruz Robyn & Tantia, 2017). Researchers use case studies to analyze the phenomenon in its real setting based on multiple sources of evidence (Ribeiro & Nagano, 2018). Thus, I used a multiple case study research design to collect data from software engineers who work for software houses and IT departments in Southern Africa. I explored strategies for effectively capturing ICT4D requirements by software engineers, and multiple case studies provided different strategies that are used by different software engineers to help with understanding a situation. Multiple case studies allow for the examination of a phenomenon within its bounded contexts, and researchers compare the cases to have a deeper understanding of the area under study (Leusen, Ottenbreit-Lefwich, & Brush, 2016). The comparison element of multiple case studies helped with identifying and establishing themes in each case and across all the other cases during data analysis. Multiple case study approaches are generally not for comparing the outcomes of various

types of initiatives directly; rather, they provide the information for gauging potential rudimentary differences and impacts (Rashid, 2017). The data I collected and analyzed from different cases gave me an idea of whether there is uniformity or following of best practices in the use of strategies used in the gathering of ICT4D requirements.

Researchers who are studying groups and communities to observe their ideologies, culture, beliefs, behaviors, and language use ethnography research design (Mol et al., 2017). This research design is unsuitable for exploring a phenomenon where participants will be required to provide accounts of their work experiences. It is also an appropriate research design for studies where observation of the phenomenon is crucial to gain an in-depth understanding, which is not the intention of the researcher for this study (Willgens et al., 2016). I deemed the ethnographic research design inappropriate for this study because it is suitable for studies that require observing a phenomenon yet I need to ask open-ended questions to understand a phenomenon in depth. Ethnographic research design is empirical, longitudinal, inductive, interpretive, participant observation oriented, and interventional (Brooks & Alam, 2015). Furthermore, the longitudinal characteristic of this research design made it unsuitable for this study, which has a limited timeframe.

The phenomenological research design is an inductive exploration of the lived experience of a specific phenomenon (Willgens et al., 2016). This research design is limited to lived experiences, yet this study needs in-depth information about how software engineers capture ICT4D requirements. Researchers use phenomenological research design to collectively or individually describe participants' experiences (Alibakhshi & Dehvari, 2015). I deemed the design inappropriate because it will not provide an understanding of strategies that are used in requirements gathering and not

studying. The focus of the phenomenological research design is to observe the effect of the phenomenon using the reports of the participants (Mol et al., 2017). The focus of observing the effect of and experience is not what I am seeking to achieve, as a results, it made the phenomenological research design unsuitable.

Population and Sampling

Purposeful sampling is commonly used in qualitative research to identify and select cases that have adequate information for a phenomenon of interest (Palinkas et al., 2015). Researchers found that purposeful sampling provides the researcher the opportunity to select rich data sources, to use broad interview questions, and to create collaborative relationships (Suri, 2011; Willgens et al., 2016).

Purposeful sampling is made up of different sampling methods, which include: criterion, stratified purposeful, purposeful, combination, theoretical or operational construct, snowball or chain, maximum variation, and extreme or deviant case sampling (Ames, Glenton, & Lewin, 2019). According to (Palinkas et al., 2015), researchers commonly use criterion sampling method to implement a study. Further, the criterion sampling method supports comprehensive understanding, uses predetermined criteria to select cases, and the different cases are combined for analysis.

The population for this study was software engineers who are employed by a software development house or IT department of an organization that implements ICT4D. Also, software engineers should have more than five years' experience in software engineering. They have to be knowledgeable about the work of humanitarian organizations, and they should have worked on an ICT4D project for over one year and are working in Southern Africa. Software engineers who met these criteria were likely to

provide adequate and comprehensive information about the study at the same time, minimizing potential risks and biases.

Saturation can be achieved by collecting as much detail as possible about a phenomenon from participants that have relevant knowledge and experience (Palinkas et al., 2015). I selected 12 software engineers from the population that met the criteria. I did not select more participants from the population because the 12 provided enough information. Thus, in this study, I stopped collecting more information when I realized that the informants were repeating insights that have already been given.

Ethical Research

Research is a public endeavor whose undertaking must be guided by ethics, trust, and people with integrity to produce worthwhile outcomes (Reddy, Raju, Rayudu, Kiran, & Jyothirmai, 2013). In this study, the researcher asked questions, and software engineers provided information without harming anyone to produce results that may benefit society. Researchers defined research ethics as a set of principles that are put in place to assist researchers in making decisions about the best options in reconciling conflicting values (Reddy et al., 2013). The Belmont Report is such a document outlining three basic principles that should be considered when conducting research (Burns, 2008; Guillemin & Heggen, 2009). The three principles are: (a) justice where human subjects should benefit equally and burdened equally according to their contribution (Adashi, Walters, & Menikoff, 2018), (b) beneficence whose expectations are to maximizing the benefits and minimizing the possible harms of a research (Campbell & Morris, 2017; Preece, 2016), and (c) respect for persons in acknowledging autonomy and protecting those with diminished autonomy (MacKay, 2016; Preece, 2016). These principles are

implemented by research institutions through their IRBs who check whether all research proposals conform to ethical standards before implementing the study.

Some research boards and agents are putting pressure on researchers to obey not only methodological research practices but also research ethics (El Hussein, Kennedy, & Oliver, 2017). This research studied software engineers as human subjects. I followed recommendations of the Belmont report as best practices of managing ethical issues, including confidentiality, informed consent, misrepresentation of information, and considering the needs of participants with a disability.

Before engaging potential participants, I obtained IRB approval from the Center for Research Quality of Walden University. As soon as the IRB granted permission to carry out the study, I sent an email with an invitation document and a consent form to the potential participants inviting them to participate in the study. According to Mallia (2019), the informed consent process is about discussing the study, the risks, the requirements from the participant, and issues relating to data protection. The consent form and invitation letter are provided in Appendix C and Appendix E , respectively.

Studies revealed that participants who agree to participate in a study have the right to withdraw at any time (Alahmad, Hifnawy, & Dierickx, 2016; Qamar, 2018; Spillane et al., 2017). The consent form contains detailed information about participating in the study, and I answered any questions participants had before replying to my email. I requested the participants who were interested in participating in the study to reply to my email and indicating that they have read the consent form, and they are willing to participate. The information on the consent form that participants may use to decide on

partaking in the study include consent, right to withdraw, data safety and retention, privacy and confidentiality, and incentives for participating. I will keep the information for five years in a lockable place to preserve it in good condition and safety. Also, signing the consent form will not be an obligation for participants to partake in the study until it ends, rather they can withdraw from the study at any time. The confidentiality agreement form is provided in Appendix D. Researchers replace real names with pseudonyms to protect participants' identity (Spillane et al., 2017). I replaced participants' names with other names and recorded the other names against the real names in Excel, which I have protected with a password. I used these other names in cases where names were required.

Data Collection

Qualitative researchers are the primary data collection tools, besides other duties related to the study (Steward & Gapp, 2017). I engaged with participants, as outlined in the interview protocol, to ensure the collection of relevant and adequate information.

Instruments

I was the primary data collection instrument, and my role was to ask questions, take down notes, and formulate follow-up questions. Researchers use different data collection instruments, which can be divided into seven categories and sub-category (Şimşek & Dündar, 2017). In this research, I used semistructured interviews, structured or focus-groups will not provide detailed descriptions. Some researchers suggest interview questions be phrased in a way that provides participants' the opportunity to articulate in detail what they know about the area under study (Yeong, Ismail, Ismail, & Hamzah, 2018). I was careful in crafting my questions to ensure that the ICT4D component of the responses was clear, and the results of the study reflected ICT4D, not

ICT. Semistructured interviews give researchers control to a study to keep the study focused on the data needs of the study as well as gaining new knowledge about a phenomenon (Gavai et al., 2018). Researchers use observation techniques for studies requiring seeing for a longer period and the results of those processes (De la Hidalga et al., 2016; Ferrari et al., 2016, Hahn et al., 2017) I could have used participative or non-participative observations, but I did not have the time to observe software engineers collecting user requirements. Tests and open-ended, multiple-choice, or Likert-type surveys limit the understanding of the phenomenon.

Researchers use data collection protocols to collect data for a study (Mahmoud & Williams, 2016; Rook, 2018). I used the interview protocol, which is outlined in Appendix A of this document. According to Yin (2003), data protection protocols are procedures and rules for systematically collecting data for a study. The protocol guided my data collection efforts systematically. Some researchers noted that designing a reliable interview protocol helps in obtaining good quality data from an interview (Yeong et al., 2018). As outlined in the interview protocol, I introduced the topic, purpose, participation, touch on ethics, and asked questions and recorded the interviews. The questions were open-ended using semistructured interviews. Researchers use reflective journals and field notes to write about the main issues found or observed during the interviews (Hanson, Craig, & Tong, 2017; Spillane et al., 2017). The interview sheet had bigger margins where I wrote down notes for responses that I got from follow-up questions.

Member checking and triangulation are widely used by researchers to check validity and reliability of a study (Castillo-Montoya, 2016; Yeong et al., 2018), and other

researchers use pilot tests (Fernández-Domínguez, de Pedro-Gómez, Morales-Asencio, Bennasar-Veny, & Sastre-Fullana, 2017). Member checking involves presenting a synopsis description of the researcher's understanding of the participants' responses to check and confirm whether captured responses are correct (Wong & Cooper, 2016).

Data Collection Techniques

My approach to data gathering started by identifying participants from my personal network that I engaged after seeking permission to study human subjects from the IRB. When permission was granted to execute the study, I approached the potential participants. I engaged them one-on-one to give them more information, such as the social impact of the study, and I responded to any questions that they had. I then emailed them consent forms and invitation letters, and those who were interested to participate in the study replied to the email indicating their willingness.

There are different techniques for collecting data from participants, including surveys, interviews, observations, site visits, and video recording (Şimşek & Dündar, 2017). My preferred technique was interviews, which I conducted electronically. Some studies confirm that onsite interviews provide empirical data collection, but they are expensive to conduct (Kumaza, 2018). I did not use this technique because all 12 participants had access to electronic resources. Some researchers use onsite interviews as the principal method for data collection and analysis and then complement their effort with onsite observations and documents (Oghazi & Mostaghel, 2018; Pennec & Raufflet, 2018). The advantage of onsite interviews is the ability to interview participants in their setting as well as the opportunity to observe demonstrations.

Studies revealed that researchers could use digital audio recording devices to record interviews (Kahl, da Cunha, Lanzoni, Higashi, & Erdmann, 2018). I recorded the interviews with Microsoft Skype since the participants since I was not on site. I stored the electronic interviews as MP3 files and protected them using a password and encryption.

Member checking is widely used to maintain validity during qualitative research (Candela, 2019). Responses to initial questions will help to identify new questions that can be directed to the participants as follow up questions to meet the purpose of the study (Kahl et al., 2018). During the transcription phase, I did not develop any follow-up questions because I did not need additional information or clarifications. Studies have revealed that some researchers record interviews, transcribe and analyze the information, and during these processes, notate follow-up questions that they email to the participants (Farooq & de Villiers, 2017). Other researchers use member checking to validate interpretations and check whether participants can approve the use of the direct quotes made by the researcher (Fitch, Ma'ayah, Harms, & Guilfoyle, 2017). I adopted this approach for this study. I sent the transcribed text files to the participants to check whether I had transcribed them accurately from the audio scripts.

Data Organization Techniques

A systematic data organization and archiving is not only done at the end of the project but also when data is being collected (Sherif, 2018). Researchers keep field notes as well as journals to reflect on the study and write memos about the coding and data analysis processes (Pamela Wells, Dickens, & Cleveland, 2019). Also, researchers use software for data organization in qualitative research (Isaac, 2016; Iyer et al., 2017; Mnkandla & Ansie Minnaar, 2017) and NVivo qualitative analysis is an example of

software being used for data organization and coding (Isaac, 2016; Kahl et al., 2018; Lucyk, 2016).

I kept track of the few changes that affected the dataset. The changes were tracked in NVivo. After tracking the changes and incorporating them into the NVivo database, I cataloged and organized the data. The data was saved on a memory stick, and the data will be kept in a lockable drawer for five years.

Data Analysis

Data analysis includes the use of tools and strategies in the organization and studying of data in a dataset to arrive at conclusions (Sun, Strang, & Firmin, 2016). There are different approaches for analyzing qualitative data. Some researchers use content analysis to analyze and code qualitative data (Yildirim, 2018). Other researchers use thematic analysis because of its rigor in identifying and developing themes that help to understand phenomena under study (Lehmann, Murakami, & Klempe, 2019).

Thematic and content analysis may look similar, but they are different approaches. Faith et al. (2018) defined thematic analysis as a process of searching and identifying characteristics that are appearing throughout an entire set of data. Faith et al. (2018) found that the flexibility of thematic analysis supports the development of an in-depth account of a data set. Some researchers defined content analysis as a process of extracting quantitative measures from qualitative information (Mir, Shih-Hao, Cantor, & Hofer, 2018). Also, Singh and Kameswari (2019) noted that content analysis is used in both qualitative and quantitative research approaches. Thematic analysis is used for qualitative data sets (Lehmann et al., 2019).

This research used thematic analysis, where I categorized the information according to the constructs of the SECI model, which is the research framework for this study. Triangulation is a method used to facilitate the validation of data by employing more than one data collection method (Ahmed & Diana, 2016). One aspect of triangulation is the use of participants as member checkers (Candela, 2019). Data triangulation is achieved by collecting data from multiple sources (Pekkola, Saunila, Ukko, & Rantala, 2016). Data for this study was collected using interviews from 12 participants who work different organizations. I captured adequate information from the 12 cases; however, if the research question was not answered, I would have interviewed more participants. Other researchers use investigator triangulation to establish the trustworthiness of the data by comparing themes derived independently by different researchers (Izaryk & Skarakis-Doyle, 2017). I did not use investigator triangulation because I was the only researcher involved in the data analysis, and I did not consider theory triangulation for this study. Researchers use method triangulation, where they employ more than one data collection method to strengthen the validity of the interpretations (Boge & Aliaj, 2017; Sidenius et al., 2017). I did not use method triangulation because this study collected data from 12 participants who work for different organizations.

Prior to analyzing qualitative data following the data analysis process steps researchers follow the following steps: (a) classifying raw data, (b) code the data, (c) categorizing the data, (d) derivation of themes for the study (Arnold, Loughlin, & Walsh, 2016; Sarsar & Harmon, 2018). In qualitative analysis, research members review the transcripts to establish emerging themes and develop the coding structure using some

theory (Iyer et al., 2017). Also, other researchers categorize and conceptualize relations to create categories and subcategories from the transcriptions (Hui et al., 2016).

During the transcription process, I started by identifying some keywords in the raw data and highlight them. In other studies, each interview transcript is open-coded line by line before grouping the codes into categories (Isaac, 2016). I used NVivo software to code the highlighted data into subcategories and finally into their respective categories. After identifying subcategories, researchers' group subcategories under some larger categories (Yamani, Shaterjalali, & Eghbali, 2017). I repeated the process until all the words or phrases were assigned to their respective categories. After data analysis, I took a backup of the information using a memory stick and kept it in a lockable drawer.

I looked out for changes that would come after the development and approval of this proposal. I checked the literature for newer information that could affect the proposal. The areas I focused on were changes in the key themes where I checked for any information needing changes so that the proposal would not contrast the literature. The other area was the conceptual framework, where it would have incorporated any changes if there were changes to be made.

Reliability and Validity

Qualitative researchers go out in the field to collect insightful information about a phenomenon to publish an accurate account (Yackulic et al., 2013). Stakeholders are always skeptical about the validity and reliability of these studies because they expect the studies to be authentic, transferable, dependable, and confirmable. Validity refers to the extent to which a study captures or measures what it claims to examine (Benedetto, Bernhard, & Henriques, 2015). Reliability is the ability to repeatedly perform the

research dependably and accurately (Nikolaidis, Chrysikou, & Alexandris, 2016). Reliability and validity are parallel concepts that in qualitative research are made up of four criteria, namely credibility, transferability, dependability, and confirmability. Qualitative researchers use dependability, credibility, and transferability to evaluate the trustworthiness or rigor of a study (Ang, 2016; Connelly, 2016; Golinski, 2018; Gordon & Gordon, 2017).

In qualitative research, the quality of research findings has been noted as the most considered factor in measuring reliability and validity (Yeong et al., 2018). In this study, I identified several strategies for achieving validity and reliability in qualitative research. The strategies include spending more time engaging stakeholders in the field, using different data sources and methods, and explaining the aim of the study to all stakeholders. Also, I captured some notes, recorded interviews, transcribed the recorded content, and used a systematic coding approach to analyze the transcribed data to produce quality findings.

Creditability

Some researchers noted noted that the credibility of a research's findings is a function of rigor, reliability, and trustworthiness of the findings and their interpretations (Hanson, Craig, & Tong, 2017). Also, qualitative researchers being the primary tools in qualitative studies should exhibit integrity behaviors during the study to promote trustworthiness and credibility (Steward & Gapp, 2017). Other researchers believe that credibility can be enhanced by making the research processes more transparent and replicable (Ang, 2016). I exhibited integrity by following procedures on how to select participants, collect, organize, and analyze data without short-changing any of the

procedures. I provided a full description of the procedures for selecting participants, and for data; collection, organization, analysis, and including the way decisions were arrived at during the study to enhance credibility.

Other researchers use member checking to achieve the dependability and credibility of qualitative studies (Cruz Robyn & Tantia, 2017; Hadi & Closs, 2016). Other researchers revealed that triangulation is used to achieve credibility and confirmability in qualitative research (Ang, 2016; Cruz Robyn & Tantia, 2017; Hadi & Closs, 2016). I discussed the importance of using member checking to check my interpretation of participants' information under the Data Collection section, which I used to achieve credibility for this study.

Confirmability

The meaning of confirmability is provided in one of the studies as the degree from which stakeholders can confirm the results of a study (Viloria, 2018). Some studies defined the confirmability of a study as strategies that are employed in a study to convince the readers that the findings of the study are a result of engaging participants and not the researchers' predetermined assumptions (Hanson et al., 2017). The matter in confirmability is whether the researchers have analyzed the data logically and consistently and if they were transparent in all processes (Nxumalo & Mchunu, 2017). Confirmability evaluates the objectivity of the study, which can be complex in qualitative research because researchers can use their own theoretical position (Nxumalo & Mchunu, 2017). I documented the activities that I performed in the study, emphasizing how I checked, collected, organized, and analyzed the data, including the negative incidences that I encountered and how I solved them. Some studies use reflexibility to ensure

confirmability. Reflexibility is a strategy that is used to systematically review the context of knowledge construction at each stage of the research process in qualitative research (Viloria, 2018).

An audit trail or inquiry audit is another approach that researchers use to establish dependability, credibility, and confirmability (Ang, 2016). An external and experienced qualitative researcher is used to review the processes that were used in data collection, analysis, and interpretation (Ang, 2016). As for this study, the chairman and the Walden dissertation committee assumed the role of the external auditor who reviewed the study to whether it is conforming to Walden University's expectations.

Hanson et al. (2017) argued that transparent reporting can be used by readers to measure credibility, confirmability, dependability, and transferability of a study. I carried out the study transparently, starting with participants' selection, data collection, data organization, data analysis, and reporting. Also, during data analysis and reporting, I worked closely with all interested stakeholders and continuously shared with them any information that they required. During reporting, I also distributed the study findings according to what hadbeen agreed at the beginning of the study.

Transferability

Transferability refers to the extent to which the concepts or themes used in one study can be relevant to other studies (Hanson et al., 2017; Houghton, Casey, Shaw, & Murphy, 2013). Transferability is regarded as the most crucial component of qualitative research (Lincoln & Guba, 1985). Researchers revealed that keeping detailed descriptions of the research process is crucial in helping to achieve the transferability of particular findings to other settings (Parker & Northcott, 2016). Researchers use purposive

sampling, thick descriptions, and active engagement with participants to promote transferability (Cypress, 2017; Gordon & Gordon, 2017). To assist with transferability of the results of this study, I documented the following processes: participants' selection, data collection, data organization, data analysis, and reporting to such a level that interested parties can replicate the study to other settings.

Researchers define data saturation as a point at which the recruitment of new participants does not bring new data but the repetition of the existing data (Andy, 2017; Hayashi, Abib, & Hoppen, 2019; Roper et al., 2018). Data saturation is required for researchers to get an in-depth and non-superficial understanding of the phenomenon (Astroth & Chung, 2018). My approach to achieving data saturation was that I used a purposive sampling method, which assisted with selecting participants who provided adequate information about the phenomenon. Further, I used semistructured interviews to gather information from 12 participants working for different organizations to achieve data saturation.

Dependability

Tamire, Addissie, Skovbjerg, Andersson, and Lärstad (2018) noted dependability as the coherence of the internal research process and how the researcher accounts for changing conditions in the phenomena. Dependability is also defined as the stability of data for a given period and over the condition of the study (Connelly, 2016). Researchers address dependability by member checking where experienced researchers review the design, verify the findings, the analysis of the primary researcher, and check whether the researcher is using appropriate thematic interpretations (Andy, 2017). I maintained an audit trail from the notes on some activities that I performed during the study as well as

documented decisions that I made on the aspects of the study with regards to the participants.

Transition and Summary

In this section, I discussed my role as the data collector with the responsibility to identify participants who will provide information to answer the research question. The research question for this study sought to explore strategies software engineers in Southern African houses, and IT departments are using to capture ICT4D requirements efficiently. I discussed the qualitative research method using the case study research design as a strategy that provided me with an insightful understanding of how software engineers are capturing user and system requirements. Also, I discussed the criterion-based sampling method, purposeful sampling, which I used to select software engineers with skills, knowledge, and experience in developing ICT4D applications.

Moreover, I discussed ethical research in terms of how I l protected participants and other stakeholders of this study. Also, I discussed data collection instruments, data collection techniques, data organization, and data analysis techniques that I used to amass and analyze the data. I also discussed the reliability and validity of the processes of data collection and data analysis.

In the next section I will discuss the findings that were revealed from the data analysis process. I will discuss how the findings were applied to solve IT problems. Further, I will discuss how the findings impacted society. I will also write about the actions that were based on the findings of the study, what the participants and companies benefited as well how the findings were disseminated. The findings revealed some gaps

for further research, and I will share a brief reflection of my experience of carrying out this study and the conclusion of the study.

Section 3: Application to Professional Practice and Implications for Change

In this section, I will present the findings obtained from the data that was collected using the qualitative multiple case study. This section includes the following topics: (a) introduction; (b) presentation of the findings; (c) application to professional practice; (d) implications for social change; (e) recommendations for action; (f) further study suggestions; (g) personal reflections; and the summary and study conclusion.

Overview of the Study

The purpose of this qualitative multiple case study was to explore the strategies software engineers in Southern African software houses and IT departments use for capturing ICT4D requirements. The data were gathered by audio recording semistructured interviews through Microsoft Skype. I recruited 12 participants from individuals who are in my professional network. The participants are individuals who are employed as software engineers by software development houses or working in IT departments of organizations that are implementing ICT4D applications in Southern Africa. These individuals have been employed as software engineers for more than 5 years. The individuals are also knowledgeable about the work of humanitarian organizations and have developed or worked on ICT4D projects for over 1 year.

I transcribed into text files using an online software tool called Otter Plans. The audio files were played several times, and each time the audios were compared with the transcribed text files to verify whether the transcriptions were correct. I used NVivo 12 to analyze the data by performing a thematic analysis revealing four thematic areas. Researchers use software tools to analyze qualitative data (Isaac, 2016; Kahl et al., 2018;

Lucyk, 2016). The categorization of the themes was based on the SECI model of Nonaka constructs, which are: socialization, externalization, combination, and internalization.

The four themes and their subthemes that emerged from the data analysis represent the strategies that software engineers in Southern African software houses and IT departments are using for capturing ICT4D requirements. The strategies included: (a) interacting with stakeholders, (b) transforming interactive knowledge into user requirements, (c) sharing documented knowledge about user requirements, and (d) applying assimilated knowledge from documented knowledge. I synthesized and explained these themes are in the presentation of the findings section.

Presentation of the Findings

The focus for this section of the study will be to answer the research question: What strategies do software engineers in Southern African houses and IT departments use for capturing ICT4D requirements? I collected the data from one participant who is based in Zambia, one is based in South Africa, and the other 10 are based in Zimbabwe. The participants were named Candidate1, Canditate2 up to Candidate12. The naming of participants was according to their position in the sequence of interviews.

The participants responded to almost all the questions in detail, and they were patient enough to entertain follow-up questions. The 12 interviews were conducted within seven days, and each interview session took an average of 45 minutes to one hour for those participants who had more information to share. However, two audio scripts out of the 12 interviews were poorly audio recorded because of the weak internet connection. I listened to the two bad audio scripts and then transcribed them manually as NVivo and Otter Plans had failed to transcribe them from audio to text files.

I transcribed the audio scripts as outlined in the introduction section of this study following the steps for thematic analysis, as outlined in the data analysis section of this study. A total of 34 minor themes emerged from the data. I analyzed the minor themes were analyzed further, and 10 subthemes emerged. Finally, I categorized the the 10 subthemes into the four major themes, which are synonymous with the four constructs of the SECI model of Nonaka (Muthuveloo et al., 2017). Bejinaru (2016) noted that the SECI model has four constructs: socialization is the exchanging of knowledge; externalization is the creation of new knowledge; the combination is the joining of knowledge, and internalization is the learning of knowledge from documented knowledge.

Table 1 shows the four major themes that emerged from the data. All 12 participants indicated that interaction with users and key stakeholders is one of the strategies being used to capture user requirements. According to Park and Jeong (2016), interaction is the most widely used form of communication when there is a need to understand the other person's mind. Interaction is synonymous with the socialization construct of the SECI model of Nonaka (Tyagi et al., 2017). Candidate10 noted that the thinking approach allows business analysts to interact with decision-makers, functional heads as well as the user so that they capture user requirements.

Table 1

Major Themes of Strategies for Capturing ICT4D Requirements

	Participant	
Major Themes	Count	References
The constructs of the SECI model	12	490
Interacting with stakeholders	12	121
Transforming interactive knowledge into user requirements	12	302
Sharing documented knowledge about user requirements	11	50
Applying assimilated knowledge from documented knowledge	10	17

Similarly, all 12 participants transform interactive knowledge into user requirements. Elicited requirements are converted into other formats by a process called modeling (De la Hidalga et al., 2016). The process of modeling is similar to the conversion of tacit knowledge known as the externalization construct of the SECI model of Nonaka (Muthuveloo et al., 2017). Candidate2 indicated that they get the user stories and meet with all the team members to refine the requirements and develop a prototype. They take the prototype to the users for validation then incorporate any changes or additional requirements before developing a user requirements specification document. Eleven participants of 12 participants are combining and then share the combined knowledge resulting in capturing user requirements. De la Hidalga et al. (2016) noted that prototypes allow sharing, negotiating, and exchanging of knowledge during the refinement of user requirements in rapid software development. Candidate4 explained they use various documentation techniques to share user requirements with other users and sometimes involve them in requirements gathering. The combination construct of the SECI model puts together existing knowledge to make it usable (Bejinaru, 2016).

Ten participants of 12 participants indicated that they are capturing user requirements from documented knowledge. The capturing of user requirements from documents is similar to the internalization construct of the SECI model. Muthuveloo et al. (2017) noted that internalization is about learning from doing, for example, reading explicit knowledge in policy manuals. Some participants reported that they read documents written by other software engineers and capture requirements from those documents. Candidate9 explained that they get a concept project note or business requirements specification document from their projects department, which they use to come up with some of the user requirements.

Theme 1: Interacting with Stakeholders

The participants indicated that they interact with stakeholders and end users to understand new user requirements or to understand problems with an existing application. According to Bratianu and Orzea (2010), individuals create new knowledge as they interact directly with others. Further, Emoghene and Nonyelum (2017) concurred with the previous studies that requirements engineers use interactive and unobtrusive methods in gathering user requirements. Candidate11 stated,

> You need to understand what they are saying through interviews and discussions through taking part in their day-to-day work, and understanding what they try to achieve by their old process, and by observation, and by interviews that are listening, engaging.

The SECI model has four constructs, and one of the constructs purports that new knowledge is created when individuals interact with each other to share knowledge. Widjaja and Kuslina (2018) shared that the creation of knowledge starts as individuals

begin to share ideas they have with other individuals through interaction. According to the SECI model, the process of exchanging ideas among individuals is called socialization (Muthuveloo et al., 2017). Thus, the theme of interacting with stakeholders' is one of the strategies the participants are using to create new knowledge—user requirements, as shown in Table 2. All 12 participants noted that they interact with users when capturing user requirements. Eleven of the 12 participants explained that they interact with users when capturing user experiences of using ICT4D applications.

Table 2

Subthemes for Theme 1: Interacting with Stakeholders

	Participant	
Sub/Minor Themes	Count	References
Interacting with stakeholders	12	121
Capturing user requirements	12	35
Interact with users directly face-to-face	9	19
Interact with users directly not face-to-face	4	9
Interact with users indirectly through other people	4	6
Capturing user experiences	12	65
Interact with users directly face-to-face	10	50
Interact with users directly not face-to-face	8	19
Interact with users indirectly through other people	7	19

Subtheme: Capturing user requirements. Software engineers capture user requirements using different strategies such as shown in Table 2. Direct interaction strategies involve sitting down with the users and asking them to describe the kind of application they want. Direct, but not face-to-face, strategies are used when users cannot be available physically; the requirements can be captured over the telephone, from documents and audio recorded scripts. Indirect strategies are used in instances when the stakeholders capture requirements from the users and then interact with the software

engineers to relay the captured requirements. Nine of the 12 participants reported that they interact with the users face-to-face. Four of the 12 participants noted that they interact with the users directly but not face-to-face. Similarly, four of the 12 participants explained that they interact with the users indirectly through other people. Candidate04 stated, "We use interviews, or questionnaires or do face to face interviews with the stakeholders, and also use brainstorming sessions to develop requirements."

Águila and Sagrado (2016) noted that software engineers elicit user requirements through interviews, surveys, and focus groups. Emoghene and Nonyelum (2017) found that business analysts use different techniques such as prototyping, card sorting, laddering, observation, and interviews to capture user requirements. Vitharana et al. (2016) shared that during requirements gathering, the analyst is engaged in learning, exposing, and identifying the needs of the users and that interviews are the widely used techniques.

The socialization construct of the SECI model involves capturing new knowledge, and this is similar to how software engineers capture requirements from users. Bandera et al. (2017) noted that during interaction, individuals capture new knowledge that can be used to develop innovations. Tyagi et al. (2017) found that the SECI model was used to develop knowledge bases using requirements that were captured through the socialization construct. Further, Bider and Jalali (2016) shared that new knowledge is created as individuals interact in meetings, discussions, and when participating in some activity.

Subtheme: Capturing user experiences. Business processes sometimes evolve and which may require software applications to be upgraded in line with evolving processes. One of the duties of software engineers is to interact with users to find out

whether the applications are performing satisfactorily. The interactions may happen in many forms, such as face-to-face discussions, exchanging emails, and discussing with third parties, as shown in Table 2. Ten of the 12 participants reported that they discuss face-to-face with the users. Eight of the 12 participants noted that they discuss with the users directly but not face-to-face. Seven of the 12 participants explained that they discuss with users through other people. Candidate12 stated, "If you sit down with users, they show you where the system could be frustrating to them and where the bottlenecks could be."

Software engineers use different strategies to capture user experiences effectively. Prasarnphanich et al. (2016) found that some techniques for capturing user experiences are effective only if business analysts have the skills, experience, and intelligence to apply the techniques. Further, Bormane et al. (2016) found that software engineers should capture user requirements differently since users have unique tastes for system features. Águila and Sagrado (2016) found that most of the captured requirements are fraught with ambiguities and imprecisions warranting different techniques to guide the capturing process.

The process of capturing user experiences is related to the socialization construct of the SECI model. Conger (2015) noted that organizations use the socialization construct of the SECI model to extract ideas and technical experiences from individuals. Further, Bratianu and Orzea (2010) shared that individuals share their experiences as they socialize. Olmos and Rodas (2014) found that the socialization construct of the SECI model can guide the capturing of adequate user requirements at a minimum cost.

Theme 2: Transforming Interactive Knowledge into User Requirements

Software engineers capture user requirements from different sources, and the information may cause information overload. According to Eito-Brun and Amescua (2017), requirements captured from different sources and of varying complexity should be aggregated and contextualized to meet user expectations. The theme has six subthemes, and each subtheme provides more information about the collected user requirements, which makes it easier to understand individual requirements through interactive methods, are transformed into user requirements.

The second construct of the SECI model is the externalization, which converts tacit knowledge gained from different sources through interaction into explicit knowledge, which is structured and shareable (Tyagi et al., 2017). Thus, the theme provides the sources of tacit knowledge and the methods that can be applied to convert the tacit knowledge into explicit knowledge. Candidate04 stated:

> After gathering the user requirements, there is a process of analysis of the user requirements whereby we will be looking at the functional specifications and non-functional specification and user interface. Then we come up with data flow models; these are the ones that we use to build the system.

Subtheme: Skills for capturing user requirements and experiences. Software engineers need communication, analysis, probing, and sharing skills to capture satisfactory user requirements and experiences. These skills can be categorized into innovative techniques, asking questions, analyzing and extracting requirements from documents, and sharing the requirements as Table 3. Nine of the 12 participants indicated there is a need to use innovative knowledge to capture requirements. Eight of the 12

participants indicated there is a need to ask appropriate questions to capture user requirements. Eight of the 12 participants indicated there is a need to extract user requirements from the presented information. Eight of the 12 participants indicated there is a need to share captured requirements for new requirements. Candidate01 shared that "One of the skills for software engineers is to be able to communicate clearly, whether it's verbal or written communication so that there is no ambiguity in the understanding of given requirements."

Table 3

Subthemes for Theme 2: Transforming Interactive Knowledge into User Requirements

	Participant	
Sub/Minor Theme	Count	References
Transforming interactive knowledge into user requirements	12	302
Skills for capturing user requirements and experiences	12	62
To use innovative knowledge to capture requirements	9	12
To ask aproppriate questions to capture user requirements	8	20
To extract user requirements from presented information	8	15
To share captured requirements for new requirements	8	21
Poorly captured requirements	12	20
Misunderstood user requirements	6	8
Incomplete user requirements	4	4
Vague user requirements	7	8
Causes for poorly captured user requirements	12	66
Lack of the drive to look for user requirements	12	27
Lack of skills for asking the right questions	7	17
Lack of skills for sharing user requirements	7	11
Lack of appreciation of the subject matter	6	10
Lack of skills for interpreting user requirements	2	2
Frameworks or methodologies for capturing user requirements	12	97
Attributes of the new framework or methodology	10	41
Application of the framework or methodology	9	53
Frameworks or methodologies used	12	22
Agile methods	10	18
Other methods	3	4
Uses of frameworks or methodologies	12	33

	Participant	
Sub/Minor Theme	Count	References
A standardized way of capturing requirements	8	19
Innovative way of capturing complex requirements	5	7
Extracting requirements from the presented information	2	2
Capturing of requirements from stakeholders	3	5

Ouhbi et al. (2015) noted that the lack of technical skills in requirements engineering leads to poorly captured requirements and, ultimately, the building of unsatisfactory systems. Yusop et al. (2016) found that the elicitation of exact security requirements for mobile initiatives requires hardworking, skills, knowledge, and experience. A study by Park and Jeong (2016) showed that individuals with good communication skills can catch knowledge floating in their space.

The skills that are needed to capture requirements and experiences effectively can be related to the skills that are needed to interact effectively in the creation of new knowledge. According to Tyagi et al. (2017), individuals use skills to participate in an activity, and in the process, individuals gain new knowledge. The socialization construct of the SECI model uses skills to exchange tacit knowledge between individuals (Muthuveloo et al., 2017). Hvorecký et al. (2015) shared that the exchange of tacit knowledge between individuals is difficult in a non-educational environment but would require individuals with skills to do so.

Subtheme: Poorly captured user requirements. User requirements that produce unsatisfactory applications can be termed poorly captured requirements. Software engineers interpret poorly captured requirements in different ways, as shown in Table 3. Seven of the 12 participants described poorly captured, vague user requirements. Six of the 12 participants described poorly captured user requirements as misunderstood user

requirements. Four of the 12 participants described poorly captured requirements as having incomplete user requirements. Candidate09 shared, "vaguely defined requirements; there are certain phrases that product owners or business owners use that can be interpreted differently."

Dargan et al. (2016) noted that poor requirements are those that increase the cost of developing systems and those that hinder the performance of the system. Jebreen and Al-Qerem (2017) found that the processes of classifying, identifying, capturing, and validating user requirements may lead to poorly captured requirements. According to Salini and Kanmani (2016), the process of capturing security requirements focusing on the mechanism instead of security requirements produces poorly specified security requirements.

Poor knowledge is obtained when the process of transforming knowledge is compromised, which is similar to how software engineers end up with poorly captured user requirements. Yao et al. (2012) found that as individuals from the same domain interact using the socialization construct of the SECI model, they create new knowledge that can be used for other purposes. Further, Bejinaru (2016) found that during the sharing of tacit knowledge, some individuals may fail to articulate their knowledge, which may lead to the creation of new but wrong knowledge. Olmos and Rodas (2014) found that when the process of socialization between users and business analysts is unclear, it produces doubtful user requirements.

Subtheme: Causes for poorly captured user requirements. There are many causes for ending up with unsatisfactory user requirements. Some of the causes relate to communication, sharing, knowledge, and interpretation, as shown in Table 3. Twelve of

the 12 participants explained that poorly captured user requirements are caused by the lack of drive to go out and look for user requirements. Seven of the 12 participants noted that poorly captured user requirements are caused by a lack of skills to ask the right questions. Seven of the 12 participants reported that poorly captured user requirements are caused by a lack of skills to share user requirements with other stakeholders. Six of the 12 participants indicated that poorly captured user requirements are caused by a lack of domain knowledge. Two of the 12 participants explained that poorly captured user requirements are caused by a lack of skills to interpret user requirements. Candidate05 stated:

> I think the causes of ending up with poorly captured ICT requirements could be that all stakeholders for a particular project or a particular application are not engaged at an early stage to input their views to input their knowledge and expertise. I think the result of that process will result in poorly captured requirements, whereby domain experts will say were not involved.

Diamantopoulos et al. (2017) argued that since requirements are expressed in people's daily language, they are susceptible to inadequacy, vagueness, and inconsistentency. Further, Bormane et al. (2016) found that poorly captured user requirements can be caused by poor communication, lack of domain knowledge, and different views of users on requirements. According to Dargan et al. (2016), poor requirements have been a problem historically due to the lack of techniques for interpreting and articulating user requirements.

Individuals who fail to develop skills through the socialization construct, and those who fail to learn through the internalization process may capture user requirements

poorly. Mohajan (2017) found that individuals gain skills as they observe, discuss, share experiences, intercommunicate, practice, and partake in apprenticeship and on-job training. The socialization construct of the SECI model converts tacit knowledge into the "know-how"—skills that are internalized during practice (Tyagi et al., 2017).

Subtheme: Frameworks or methodologies for capturing user requirements. Frameworks or methodologies have different features or artifacts that provide software engineers with some means to capture user requirements. Frameworks or methodologies are used for different purposes, such as capturing or validating user requirements, as shown in Table 3. Ten of the 12 participants indicated that they use the attributes of frameworks or methodologies to capture user requirements. Nine of the 12 participants reported hat they use the actual frameworks or methodologies to capture user requirements. Canditate02 stated:

> This methodology we use it for small tasks, small requirements, and shorter development life cycle. It assists a lot in that you can say that I want to get the requirements for one week or two weeks then go back and develop and come back to the user, the user validates, and you get additional requirements, which means that you are not going to take a lot of time without getting new requirements. Users will give feedback when they see something which is being done.

Software users use frameworks or methodologies to guide them in the capturing of user requirements. Falcao (2017) noted that some of the old ways of capturing user requirements are no longer appropriate for capturing complex features of systems compared to some new and innovative ways. Talha (2018) found that some software engineers used the artifacts of agile methodologies to develop a prototype that they used

to validate captured user requirements. According to Eito-Brun and Amescua (2017), some engineers developed a framework they used to improve the requirements processing function by collecting the requirements through interviews and analyzing them as inputs and problem statements.

The constructs of the SECI model can be used to develop frameworks the same way existing information and skills of experts are used to develop frameworks to guide the execution of some processes. Mohajan (2017) and Bratianu and Orzea (2010) found that the externalization construct of the SECI model transforms tacit knowledge into formats like diagrams, models, and concepts that can be referenced by professionals when articulating tacit knowledge. Halim et al. (2017) showed how the combination construct of the SECI model was used to create historical records and how the internalization construct of the model was used to analyze future diseases.

Subtheme: Frameworks or methodologies used. Software engineers use different techniques to capture user requirements. The most used technique is agile methodologies, and other software engineers prefer a combination of methodologies. The frameworks or methodologies subtheme is shown in Table 3. Ten of the 12 participants noted that they use agile for capturing user requirements. Three of the 12 participants explained that they use other approaches, such as a hybrid of contemporary and traditional methodologies. Candidate10 stated:

> So, in the design thinking approach, you go and empathize with users, you ask them a set of questions, and some of them are open-ended, some of them are just direct questions where you want a yes or no some of them are open-ended questions you allow them to describe what they think, how they feel, and

especially capturing their emotional beat when it comes to the frustrations that they are experiencing with the current system.

Salini and Kanmani (2016) found that some software engineers use the model-oriented security requirements engineering—MOSRE framework to guide them in the capturing of security and functional requirements for e-governance systems. Ouhbi et al. (2015) noted that some frameworks, as real or conceptual models, are used to support the development of other useful models. According to Vitharana et al. (2016), frameworks such as the mental model provides a means to investigate the process of capturing requirements in a logical manner, which improves understanding of the required features.

The constructs of the SECI model constitute a model or framework for transforming tacit knowledge to create new knowledge, and this process is similar to how the artifacts of frameworks are used to guide the capturing of user requirements. Bratianu and Orzea (2010) noted that the externalization construct of the SECI model creates metaphors that can be used to develop theories and cognitive models that can be used to study and evaluate the unknown. Bejinaru (2016), found that the socialization, externalization, and combination constructs produce explicit knowledge which individuals learn and practice as experts. According to Oihab Allal-Chérif (2016), individuals internalize knowledge from cognitive models and theories and apply them to solve problems.

Subtheme: The uses of frameworks or methodologies. Frameworks or methodologies are used for different purposes in the capturing of user requirements. Some frameworks are used to guide the capturing of requirements and others for capturing complex requirements. Some make it easier to extract user requirements from presented

information, with some suitable for capturing stakeholders' requirements, not from the users themselves, as shown in Table 3. Eight of the 12 participants indicated that frameworks or methodologies provide a standardized way of capturing user requirements. Five of the 12 participants reported that frameworks or methodologies provide an innovative way of capturing user requirements. Two of the 12 participants explained that frameworks or methodologies are useful tools for extracting user requirements from the presented information. Three of the 12 participants noted that frameworks or methodologies tools used for capturing requirements from stakeholders. Candidate06 shared, "The agile methodology is very helpful in that you constantly have engagements with the users of the system."

Software engineers use frameworks to improve the quality of user requirements. Erich, Amrit, and Daneva (2017) found that some organizations use agile techniques to develop reliable software within short timeframes. Also, Mamba and Isabirye (2015) shared that software development in developed countries is successful because they use frameworks contextually. Also, according to Conger (2015), frameworks can also be used in projects to help with organizing information according to the constructs of the research.

The SECI model is a well-thought-out model with clear constructs for converting tacit knowledge into explicit knowledge, which is similar to how frameworks are designed to guide the capturing of user requirements. Olmos and Rodas (2014) found that the externalization construct of the SECI model changes tacit knowledge into explicit knowledge through the creation of guidelines, procedures, and models. Besides, Spraggon and Bodolica (2017) noted that converted tacit knowledge can be used by

individuals to explain tacit knowledge into intelligible protocols and guidelines. According to Bider and Jalali (2016), the externalization construct of the SECI model creates knowledge which can be applied to analyze other situations.

Theme 3: Capturing of Additional Knowledge

Requirements captured from users are at times combined with requirements from other sources to develop a requirements specification document. According to Bozyiğit et al. (2019), the analysis of the user requirements process converts them into formats that are easy to understand and share. Besides, Diamantopoulos et al. (2017) noted that there is a need to use structured semantic representations to transform user requirements expressed in natural language into formal models to detect problems. Capturing of additional knowledge theme has three minor themes outlining the strategies that can be used to capture additional requirements, as shown in Table 4. Ten participants of eleven participants indicated they capture additional user requirements as they create user requirement specifications. Ten of the 12 participants indicated that they capture additional requirements upon creating system models from different sources with user requirements and experiences. Five of the 12 participants indicated they capture additional requirements and experiences from stakeholders other than the end users.

Table 4

Subthemes for Theme 3: Capturing of Additional Knowledge

	Participant	
Sub/Minor Theme	Count	References
Capturing of additional knowledge	11	50
Capture additional requirements during requirements specification	10	22
Capture additional requirements during system modeling	10	22
Capture additional requirements and experiences from stakeholders	5	8

Halim et al. (2017) found that a health institution in Indonesia applied the combination construct of the SECI model to combine clinical records to form historical health records for patients for future use. The participants explained that they capture additional requirements as they develop system specifications for the systems developers. Candidate03 shared:

> So basically, when we collect the information from the end user, this information is presented in the form of user stories. So, from these user stories, that's where we go on to make the process flows. Once we have the process flows, we can now decompose this process flows into specific use cases, which are the points at which a user would be communicating with the ICT for the required application.

Theme 4: Applying Assimilated Knowledge from Documented Knowledge

Software engineers capture user requirements from existing sources, including documents. Eito-Brun and Amescua (2017) noted that organizations capture additional requirements as they combine user requirements from different sources. Table 5 shows that eight participants of 10 participants indicated that they create new knowledge from different knowledge sources. Similarly, eight participants of 10 participants reported that

they consolidate knowledge from different knowledge sources. Five participants of 10 participants reported that they codify assimilated knowledge into more understandable formats.

Table 5

Subthemes for Theme 4: Applying Assimilated Knowledge from Documented Knowledge

	Participant	
Sub/Minor Themes	Count	References
Applying assimilated knowledge from documented knowledge	10	17
Creating new knowledge from different knowledge sources	8	12
Consolidating knowledge from different knowledge sources	8	15
Codifying assimilated knowledge with existing knowledge	5	6

According to Cristea and Capatina (2009), the internalization construct of the SECI model crystalizes learned experiences acquired through interactions into new knowledge by integrating tacit knowledge with existing tacit knowledge into a new knowledge base. Further, Bratianu and Orzea (2010) and Cristea and Capatina (2009) and Mohajan (2017) noted that individuals' tacit knowledge is socialized with other individuals' knowledge to create new knowledge. The participants indicated that they perform other processes to transform user requirements into knowledge bases to understand the user requirements. Candidate01 stated:

> We also make use of storyboards to explain how the user experience should look like. We also use the persona model whereby we can get one specific needs now with many characteristics that resemble the system, then we capturing experiences for that user. We can also use case models to communicate user requirements to other systems developers in the designers within the organization.

Applications to Professional Practice

This study explored the strategies software engineers in Southern African software houses, and IT departments use for capturing ICT4D requirements. Four themes with several subthemes emerged from the data that I collected from 12 software engineers. The themes showed that there are different strategies software engineers are using to capture ICT4D requirements, and these include direct and indirect interaction with stakeholders. Ferrari et al. (2016) argued that interviews are reliable strategies in requirements elicitation as they assist in transferring knowledge between users and analysts. Clearer user requirements may be easier to understand, document, develop requirements specification document, and share with other stakeholders.

Some participants reported that they are using innovative ways to elicit users' needs and experiences, such as personas, mind maps, prototypes, and diagrams. These innovative ways can be applied in cases where some end users and stakeholders have difficulties in articulating the features that a proposed ICT4D initiative should do. Moreover, the required ICT4D initiative could be the first of its kind, and the users and stakeholders may not be sure of the technological aspects of the new initiative. Software engineers capture basic requirements and use them to develop a prototype that they demonstrate to the users to check if it is in the direction they want. Awad and Amro (2017) argued that prototypes have the potential to exchange knowledge between people in the transformation of knowledge. Thus, ICT4D practitioners can apply prototyping to extract user requirements by interacting with the users. ICT4D practitioners can capture new requirements and make changes to the old requirements. This strategy involves users

in the designing of applications, which could increase user satisfaction and acceptance of the new application by the users.

Some participants are using graphics to show how proposed ICT4D applications are used for collecting, processing, and reporting the data. Others are using personas and storyboards to capture user requirements. These strategies enhance the imagination of both software engineers and users. De la Hidalga et al. (2016) noted that storyboarding and design visualization help users visualize the proposed system. Additionally, storyboards are also used as feedback mechanisms between users and software engineers. Thus, software engineers can apply these strategies to help users to visualize the system in operation and articulate the artifacts of the system.

The management of some organizations can adopt the findings of this study to guide their requirements capturing processes. The results are showing the causes for ending up with poorly captured user requirements, which software engineers should be aware of when they are capturing requirements for their ICT4D requirements. Also, the results revealed that software engineers should interact with users, use frameworks or methodologies, and be capable of sharing captured requirements with software engineers. Organizations can borrow some of the best practices and design a checklist of what should be done during their requirements capturing efforts.

Software engineers should understand that some users and key stakeholders are not always available to provide their system requirements and share their experiences of using an ICT4D application. Some participants indicated that software engineers might have to go and meet the users or stakeholders to get the core features of the proposed ICT4D initiative than reading from documents or other people. Further organizations

require their software engineers to be able to ask appropriate questions, and thus software engineers might require training on how to inquire and capture correct requirements. Some participants noted that they understand the requirements clearer as they are documenting them as well as when they are sharing them in meetings because the process allows for reflection.

The results are showing many software engineers in the sample are using agile methodologies to capture ICT4D requirements in Southern Africa. The participants also indicated that agile is suitable for projects with shorter timeframes, which might not require a lot of planning before software engineers start to develop applications. Organizations can use prototypes when applying agile methodologies for projects that are small, have tight timeframes, require user involvement at each stage of the development phase. The participants shared that when users see a prototype, they see good progress and become motivated to provide more requirements and become part of the project team.

Implications for Social Change

The findings in this study are contributing to the body of knowledge of software engineering. There could be many studies that sought to explore requirements gathering strategies that are used by software engineers in Southern Africa. However, this study focused on the requirements for developing ICT4D software. Researchers and students may use the findings in their studies or carry out further studies on thematic areas that emerged. Few studies have been carried out in Zimbabwe in the field of requirements gathering and ICT4D. Thus, this study may encourage other researchers to contribute to the body of knowledge by carrying out similar studies. Software engineers may use the

strategies to capture requirements to develop systems that may produce accurate and reliable information that can be used to change policies that can lessen the intensity of poverty in marginalized communities.

The study exposed some of the strategies that software engineers are using in capturing user requirements that are needed for developing ICT4D applications. ICT4D practitioners can use any of the strategies identified in this study to capture accurate and adequate user requirements for developing ICT4D applications. Such applications may assist communities to access public services at a lower cost, thereby providing communities with access to public services so that they can improve their lives.
The study also exposed some reasons for ending up poorly with poorly captured user requirements. These reasons may be used to come up with a list of things that should be avoided by software engineering teams and other stakeholders to minimize project failures but develop worthwhile ICT4D applications that will benefit underprivileged communities.

Software engineers should go to the stakeholders, ask for requirements, verify and share them in a format that other software developers can understand. Accurate and adequate user requirements are likely to produce ICT4D initiatives that can benefit marginalized communities. Most of the users of ICT4D applications in Southern Africa are in rural areas, and yet software engineers usually work in urban areas. As such, to elicit user requirements from the end users themselves who are likely to know the core features or have experienced some challenges with an existing ICT4D application, software engineers should go to the rural areas to elicit those requirements.

The study also revealed some skills that software engineers should have so that they can capture user requirements efficiently and effectively. Employers and software engineers can develop these skills and use them for eliciting user requirements from users with difficulties in articulating their requirements. Software engineers with appropriate skills may capture reliable user requirements, which may lead to the development of satisfactory ICT4D applications. These applications can be used by marginalized communities to communicate with other community members, thereby embracing technology and narrowing the digital divide.

The study provided information on the advantages of using frameworks in the capturing of user requirements. ICT4D specialists can use the findings of this study to read about the frameworks that are available in the industry and select the ones that can provide them with the means to capture user requirements effectively. Employers can also use the information in the hiring of software engineers who are familiar with using some frameworks to carry out their work in a standardized manner.

Recommendations for Action

Software engineers should directly interact with users and stakeholders where possible. Doing so would privilege software engineers to see how the users do their work, and they can ask follow-up questions and get responses immediately. Further, users and stakeholders know the core features of the required application or the challenges they are encountering with an existing application. As such, software engineers may read the gestures and emotions as the users and stakeholders respond to questions. Thus, software engineers can quickly gauge the core features of the system from the gestures and

emotions of the users. Also, some users put effort to clearly describe a process by demonstrating how it works to software engineers who are on the ground.

Software engineers must be cautious in the way they ask for user experiences of using existing applications so that users can openly explain the challenges they are facing. If software engineers ask the right questions, users may describe the bottlenecks and the frustrations they are facing with the existing applications. Users should be asked how the existing application can be improved. A series of why questions could help the users and stakeholders to suggest solutions to the problems with the existing applications. The proposed solutions constitute user requirements for improving existing applications. Software engineers can rephrase the questions into layman's terms for the participants to understand what the question is asking for. Incorrect user requirements may cause poorly captured requirements, which in turn could result in the development of unsatisfactory ICT4D applications.

The other recommendation for action is for software engineers to look for users and stakeholders who are knowledgeable about the work who may provide reliable user requirements, not all users and stakeholders can provide reliable information. At times there are different classes of users, those that require applications and those that use the applications. In such a case, there is a need for software engineers to go to the right users to capture correct requirements. Funders or supervisors could be knowledgeable and may articulate the requirements clearly; however, they may not be able to articulate the frustrations that end users could be facing. Software engineers have to be assertive in the scheduling of interviews with busy users who cannot easily avail themselves for interviews. Yet, they might be the ones with the most requirements.

The other recommendation is that software engineers could read existing company documents to capture requirements that may not be known by end users. For example, some company documents contain the mission and vision statements that can guide software engineers to gauge the type of ICT4D applications end users should embrace. In many cases, information like system resilience, sustainability, and data-driven ICT4D applications not be known by the end users but can be found in company documents. Also, some users may not have the time to attend user requirements gathering meetings and may not be available for face-face interviews so that such users can send their requirements through emails, audio-recordings, and documents.

Recommendations for Further Study

I explored the strategies software engineers in Southern African software houses, and IT departments use for capturing ICT4D requirements. I used a qualitative multiple case study to conduct this study, where I interviewed participants through Skype. My recommendation is to have a similar study conducted but using observations and documents for data collection to see whether themes would produce similar findings. Besides, one of the disadvantages of collecting data through interviews is that participants can provide wrong information to please the interviewer. However, when data is collected through observations and documents, the users can do little to change it.

My other recommendation is to conduct a quantitative study to find out the relationships between the themes. Furthermore, the interview questions and data analysis for this study followed the constructs of the SECI model of Nonaka, which is a knowledge management framework. My recommendation is to carry out similar studies

but interviewing different software engineers and using different knowledge management models to check whether similar themes would emerge.

Another limitation is that my study interviewed software engineers who are working in Southern Africa. My recommendation for further studies is to conduct a similar study in another location in Africa other than Southern Africa. Such a study could provide more information about the strategies that are used in capturing user requirements. If the findings of such a study resemble the findings of this study, then maybe the results of such studies can be generalized, which is not the case at this point.

To counter the limitation of interviews where participants prepare to provide ideal responses instead of what they do on the ground, I would recommend future studies where researchers can participate in the capturing, documentation, and sharing of the user requirements. Researchers could also record some of the processes and, in the end, compare the findings such a study with the findings of this study.

Reflections

My decision to embark on a doctoral study was influenced by two things: my academic performance at masters' level; and the need to specialize in developing software for humanitarian and developmental work. I found that pursuing a doctorate would allow me to research how software tools for NGOs are developed. When I started my studies, I enjoyed doing the assignments and participating in the discussions. Still, I later found some difficulties in developing the prospectus and getting approval from the IRB.
The first residence was an eye-opener for me to realize that I needed to work hard; otherwise, I would encounter challenges in the coming semesters. I spoke to those who were ahead of me and realized that I needed to take my education seriously by working

on assignments on time and at the same time compiling some journals for my study. The second residence was somehow demotivating because I struggled with coming up with a convincing research topic. Also, I failed to complete and submit my residence assignment since I did not have a convincing topic for which to draft my prospectus.

I started to work closely with my supervisor, and I began to understand more and more of what was required of me and struggled through to complete my prospectus. When the prospectus was approved, I regained my confidence, and I was putting extra hours on the tasks that I was working on. I managed to relate my research question to what was happening at my workplace, and that helped me to appreciate why it was important to complete my studies. Developing the proposal was somehow easier than developing the prospectus because I had regained my confidence. After the proposal was approved, I had to wait longer before carrying out my study because I failed to follow the IRB instructions.

The data collection phase was an encouraging process because the participants had more time for the interviews and were keen to provide additional information at the end of the interviews. Furthermore, the participants were experienced professionals who gave real-work examples from their own work experiences, and I felt energized to interview all the 12 participants within seven days. Data analysis was simple since I had practiced how to use NVivo, and the theoretical framework made it easier to come up with the major themes and their related sub and minor themes. Reporting the findings was not a simple task because I had to report on what came out of the data, but what I thought were the strategies being used by software engineers to capture user requirements.

Summary and Study Conclusions

The purpose of this qualitative multiple case study was to explore the strategies software engineers in Southern African software houses, and IT departments use for capturing ICT4D requirements. The data for this study were collected from 12 participants who have more than five years of experience performing software engineering tasks in Sothern Africa. I recorded the interviews using Skype and used Otter Plans to transcribe the data from audio scripts to text files. I played and listened to the audio scripts while reading and correcting the textual scripts iteratively until the textual scripts were correct. I then used NVivo 12 to analyze and categorize the data.

The data analysis process was underpinned by the SECI model of Nonaka, which has four constructs whose philosophies I used to create the interview questions for this study. Four themes emerged from the analysis and these: a) interacting with stakeholders; b) transforming interactive knowledge into user requirements; c) sharing documented knowledge about user requirements, and d) applying assimilated knowledge from documented knowledge.

What came out of the study was that software engineers' pry, collect, document, and understand user requirements using different strategies. Some of the software engineers understand user requirements clearer when they interact with users. Also, some software engineers indicated they are using agile methodologies to capture ICT4D requirements. They also indicated that agile methodologies allow them to collect requirements and immediately start developing initiatives without spending too much time planning while technology is changing. Some software engineers indicated they are guided by frameworks in the capturing of user requirements. They shared that some

frameworks and methodologies provide standardized steps for asking questions, capturing responses, documenting, and sharing the requirements with their peers. It also emerged from this study that software engineers need to be innovative to capture appropriate user requirements. The innovativeness is required when users cannot articulate their requirements, experiences, and when they are unsure of what they want.

References

Adashi, E. Y., Walters, L. B., & Menikoff, J. A. (2018). The Belmont Report at 40: Reckoning with Time. *American Journal of Public Health, 108*(10), 1345–1348. doi:10.2105/AJPH.2018.304580

Afzal, M. N., Sulong, R. S., Dutta, S., & Mansur, D. K. (2018). An Investigation on Triple Helix Model and National Innovation Systems: The Case of Malaysia. *Journal of Entrepreneurship Education, 21*(2), 1–15. Retrieved from https://journal.uii.ac.id/ajie/article/view/10305/8711

Águila, I., & Sagrado, J. (2016). Bayesian networks for enhancement of requirements engineering: a literature review. *Requirements Engineering, 21*(4), 461–480. doi:10.1007/s00766-015-0225-3

Ahmed, N., & Diana, J. S. (2016). Does climate change matter for freshwater aquaculture in Bangladesh? *Regional Environmental Change, 16*(6), 1659–1669. doi:10.1007/s10113-015-0899-6

Akuchie, R. C., Bulus, Y., & Okwudishu, C. O. (2018). Information and communication technology literacy level of secondary school teachers in the federal capital territory Abuja, Nigeria. *Computing & Information Systems, 34*(4), 321–333. Retrieved from http://cis.uws.ac.uk/research/journal/vol21.htm

Alahmad, G., Hifnawy, T., & Dierickx, K. (2016). Ethics of children's participation in a Saudi biobank: an exploratory survey. *Genetics in Medicine, 18*(8), 806813. doi:10.1038/gim.2015.164

Alam, M. M., & Wagner, C. (2016). The Relative Importance of Monetary and Non-Monetary Drivers for Information and Communication Technology Acceptance in

Rural Agribusiness. *Information Technology for Development, 22*(4), 654–671. doi:10.1080/02681102.2016.1155142

Al-dalahmeh, M., Al-Shamaileh, O., Aloudat, A., & Obeidat, B. (2018). The Viability of Mobile Services (SMS and Cell Broadcast) in Emergency Management Solutions: An Exploratory Study. *International Journal of Interactive Mobile Technologies, 12*(1), 95–115. doi:10.3991/ijim.v12i1.7677

Algozzine, B., & Hancock, D. (2016). Doing Case Study Research: A Practical Guide for Beginning Researchers (Third Edition ed.). Teachers College Press.

Ali, N., & Lai, R. (2017). A method of requirements elicitation and analysis for Global Software Development. *Journal of Software: Evolution & Process, 29*(9), 1–27. doi:10.1002/smr.1830

Alibakhshi, G., & Dehvari, N. (2015, December 26). EFL Teachers' Perceptions of Continuing Professional Development: A Case of Iranian High School Teachers. *PROFILE Issues in Teachers' Professional Development, 17*(2), pp. 29–42. Retrieved from http://dx.doi.org/10.15446/profile.v17n2.44374

Ames, H., Glenton, C., & Lewin, S. (2019). Purposive sampling in a qualitative evidence synthesis: a worked example from a synthesis on parental perceptions of vaccination communication. *BMC Medical Research Methodology, 19*(26). doi:10.1186/s12874-019-0665-4

Amuomo, N. (2017). Absolute poverty and the desire to emancipate communities driving mobile communication for development (M4D) in Africa. *Journal of Information Systems and Technology Management, 18*(12), 431–438. doi.org/10.4301/s1807-17752017000300008

Andoh-Baidoo, F. K. (2016). Organizational Information and Communication Technologies for Development. *Information Technology for Development, 22*(2), 193–204. doi:10.1080/02681102.2016.1160703

Andreas, K., Waylon, B., Jordan, K., Matthew, P., Javier, R., & Mitchell, S. (2016). A proposed integrated data collection, analysis, and sharing platform for impact evaluation. *Development Engineering, 1*, 36–44. doi.org/10.1016/j.deveng.2015.12.002

Andy, T. (2017). Perceptions of Certified Registered Nurse Anesthetists on Factors Affecting Their Transition from Student. *AANA Journal, 85*(6), 438–444. Retrieved from https://www.aana.com/docs/default-source/aana-journal-web-documents-1/perceptions-of-certified-registered-nurse-anesthetists-on-factors-affecting-their-transition-from-student-december-2017.pdf?sfvrsn=234041b1_4

Ang, C. K. (2016). Enhancing the Quality of the Findings of a Longitudinal Case Study: Reviewing Trustworthiness via ATLAS.ti. *The Qualitative Report, 21*(10), 1855–1867.

Argote, L., & Miron-Spektor, E. (2011). Organizational learning: from experience to knowledge. *Organ Science, 22*(5), 1123–37. doi:10.2307/41303106

Ariffin, S. A., Side, S. F., & Mutalib, M. F. (2018). A Preliminary Investigation of Malaysian Student's Daily Use of Mobile Devices as Potential Tools for STEM in a Local University Context. *International Journal of Interactive Mobile Technologies, 12*(2), 80–91. doi:10.3991/ijim.v12i2.8015

Armey, L. E., & Laura, H. (2016). The centrality of electricity to ICT use in low-income countries. *Telecommunications Policy, 40*(7), 617–627. doi.org/10.1016/j.telpol.2015.08.005

Arnold, K. A., Loughlin, C., & Walsh, M. M. (2016). Transformational leadership in an extreme context: Examining gender, individual consideration, and self-sacrifice. *Leadership & Organization Development Journal, 37*(6), 774–788. doi:10.1108/LODJ-10-2014-0202

Ashwell, M. L. (2017). The digital transformation of intelligence analysis. *Journal of Financial Crime, 24*(3), 393–411. doi:10.1108/JFC-03-2017-0020.

Astroth, K. S., & Chung, S. Y. (2018). Focusing on the Fundamentals: Reading Qualitative Research with a Critical Eye. *Nephrology Nursing Journal, 45*(4), 381–385. Retrieved from https://www.semanticscholar.org/paper/Focusing-on-the-Fundamentals%3A-Reading-Qualitative-a-Astroth/a6961eec1afef4ae60f16e2584a12d2d313022b3.

Asvoll, H. (2017). Developing a Framework of Reflective, Intuitive Knowing in Innovation Management. *Academy of Strategic Management Journal, 16*(2), 1–22. Retrieved from https://nordopen.nord.no/nord-xmlui/bitstream/handle/11250/2490237/Asvoll.pdf?sequence=4&isAllowed=y

Avgerou, C., Hayes, N., & Rovere, R. L. (2016). Growth in ICT uptake in developing countries: new users, new uses, new challenges. *Journal of Information Technology, 31*(4), 329–333. doi:10.1057/s41265-016-0022-6

Awad, I. M., & Amro, A. A. (2017). The effect of clustering on competitiveness improvement in Hebron. *Journal of Manufacturing Technology Management, 28*(5), 631–654. doi:10.1108/JMTM-12-2016-0181

Baldwin, J., Teh, A., Baniassad, E., Rooy, D., & Coady, Y. (2016). Requirements for tools for comprehending highly specialized assembly language code and how to elicit these requirements. *Requirements Engineering, 21*(1), 131–159. doi:10.1007/s00766-014-0214-y

Bandera, C., Keshtkar, F., Bartolacci, M. R., Neerudu, S., & Passerini, K. (2017). Knowledge management and the entrepreneur: Insights from Ikujiro Nonaka's Dynamic Knowledge Creation model (SECI). *International Journal of Innovation Studies, 1*(3), 163–174. doi:10.1016/j.ijis.2017.10.005

Barnat, J., Bauch, P., Beneš, N., Brim, L., Beran, J., & Kratochvíla, T. (2016). Analysing sanity of requirements for avionics systems. *Formal Aspects of Computing, 28*(1), 45–63. doi:10.1007/s00165-015-0348-9

Barr-Walker, J., Jayaweera, R. T., Ramirez, A. M., & Gerdts, C. (2019). Experiences of women who travel for abortion: A mixed-methods systematic review. *PLoS One, 14*(4). doi:10.1371/journal.pone.0209991

Bejinaru, R. (2016). Knowledge Dynamics Impact on Intellectual Capital in Organizations. *Management Dynamics in the Knowledge Economy, 4*(4), 515–534. Retrieved from https://ideas.repec.org/a/nup/jrmdke/v4y2016i4p515-534.html

Benedetto, G., Bernhard, J., & Henriques, L. (2015). *A Systematic Review: Evaluating the Effectiveness of Cognitive Standardized Assessments Following Stroke in Acute Care*.

Bhardwaj, S., & Patnaik, S. (2019). People Analytics: Challenges and Opportunities – A Study Using Delphi Method. *IUP Journal of Management Research, 18*(1), 7–23. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3401757

Bhat, A., Shilpashree, K., Krishnamurthy, A., Manjunath, C., & Shwetha, C. (2018). Adolescent's perception about the introduction of new cigarette packaging and plain packaging of cigarette packs: A qualitative study. *Indian Journal of Community Medicine, 43*(5), 47-5. doi:10.4103/ijcm.IJCM_97_18

Bhatt, P., Ahmad, A., & Roomi, M. (2016). Social innovation with open source software: User engagement and development challenges in India. *Technovation,* 52-53, 28–39. Retrieved from https://doi.org/10.1016/j.technovation.2016.01.004

Bider, I., & Jalali, A. (2016). Agile business process development: why, how, and when--applying Nonaka's theory of knowledge transformation to business process development. *Information Systems and eBusiness Management, 14*(4), 693–731. doi:10.1007/s10257-014-0256-1

Blackmon, S. J. (2017). Phenomenology and digital research. *Journal of Gaming & Virtual Worlds, 9*(3), 193–205. doi:10.1386/jgvw.9.3.193_1

Boge, K., & Aliaj, A. (2017). Facilities. *Albania vs. Norway – FM at two university hospitals, 35*(7/8), 462-484. doi:10.1108/F-07-2016-0079

Boisot, M. (1998). *Knowledge Assets: Securing Competitive Advantage in the Information Economy*. Oxford: Oxford University Press.

Bormane, L., Gržibovska, J., Bērziša, S., & Grabis, J. (2016). Impact of Requirements Elicitation Processes on Success of Information System Development Projects. *Information Technology & Management Science, 19*, 57–64. doi:10.1515/itms-2016-0012

Bozyiğit, F., Aktas, Ö., & Kiling, D. (2019). *Turkish Journal of Electrical Engineering & Computer Sciences, 27*(1), 453–470. doi:10.3906/elk-1803-172

Bratianu, C., & Orzea, I. (2010). Organizational Knowledge Creation. *Management, Marketing Challenges for Knowledge Society, 5*(3), 41-62. Retrieved from https://www.researchgate.net/publication/46542807_Organizational_knowledge_creation

Bronte-Stewart, M. (2015). Beyond the Iron Triangle: Evaluating Aspects of Success and Failure using a Project Status Model. *Computing & Information Systems, 19*(2), 21–37. Retrieved from http://cis.uws.ac.uk/research/journal/V19n2.pdf

Brooks, L., & Alam, M. (2015). Designing an information system for updating land records in Bangladesh: Action design ethnographic research (ADER). *Information Systems Frontiers, 17*(1), 79–93. doi:10.1007/s10796-014-9512-7

Brown, J. (1991). Organizational learning and communities-of-practice: toward a unified view of working, learning, and innovation. *Organ Science, 1*, 40–57. Retrieved from https://www.jstor.org/action/doBasicSearch?Query=Organizational+learning+and+communities-of-practice.

Burnett, S., Macafee, C., & Williams, D. (2017). Applying a Knowledge Conversion Model to Cultural History: Folk Song from Oral Tradition to Digital

Transformation. *Electronic Journal of Knowledge Management: EJKM, 15*(2), 61–71. Retrieved from https://issuu.com/academic-conferences.org/docs/ejkm-volume15-issue2-article805?mode=a_p

Burns, L. (2008). What is the scope for the interpretation of dignity in research involving human subjects? *Medicine, Health Care, and Philosophy, 11*(2), 191–208. doi:10.1007/s11019-007-9107-x

Busse, C., Kach, A., & Wagner, S. (2016). Boundary Conditions: What they are, how to explore them, why we need them, and when to consider them. *Organization Research Methods,* 1–36. doi:10.1177/1094428116641191

Campbell, R., & Morris, M. (2017). Complicating Narratives: Defining and Deconstructing Ethical Challenges in Community Psychology. *American Journal of Community Psychology, 60*(3/4), 491-501. doi:10.1002/ajcp.12177

Canares, M. P. (2016). Creating the Enabling Environment for More Transparent and Better resourced Local Governments: A Case of E-taxation in the Philippines. *Information Technology for Development, 22*(1), 121–138. doi:10.1080/02681102.2015.1121857

Candela, A. G. (2019). Exploring the Function of Member Checking. *The Qualitative Report, 24*(3), 619–628. Retrieved from https://nsuworks.nova.edu/cgi/viewcontent.cgi?article=3726&context=tqr

Castillo-Montoya. (2016). Preparing for interview research: The interview protocol. *The Qualitative Report, 21*(5), 811–831. Retrieved from https://nsuworks.nova.edu/tqr/vol21/iss5/2

Chao, C.-M., & Yu, T.-K. (2016). How to overcome the digital divide? An empirical study of Taiwan's DOCs. *Aslib Journal of Information Management, 68*(5), 628–642. doi:10.1108/AJIM-03-2016-0036

Cheah, W., Puad, A. S., ChinHong, P., & Halim, A. A. (2017). Agent-Oriented Requirement Engineering for Mobile Application Development. *International Journal of Interactive Mobile Technologies, 11*(6), 32–48. doi:10.3991/ijim.v11i6.6760

Conger, S. (2015). Knowledge Management for Information and Communications Technologies for Development Programs in South Africa. *Information Technology for Development, 21*(1), 113–134. doi:10.1080/02681102.2014.89996

Connelly, L. M. (2016). Trustworthiness in Qualitative Research. *Medsurg Nursing, 25*(6), 435–436. Retrieved from http://medsurgnursing.net/archives/16nov/435.pdf

Conner, K., & Prahalad, C. (1996). A resource-based theory of the firm: knowledge versus opportunism. *Organization Science, 7*(7), 477–501. Retrieved from https://www.jstor.org/stable/2635286?seq=1

Cristea, D., & Capatina, A. (2009). Perspectives on knowledge management models. *Economics and Applied Informatics, 15*(2), 355–366. Retrieved from https://ideas.repec.org/a/ddj/fseeai/y2009i2p355-366.html

Cruz Robyn, F., & Tantia, J. F. (2017). Reading and Understanding Qualitative Research. *American Dance Therapy Association, 39*, 79–92. doi:10.1007/s10465-016-9219-z

Cumps, B. (2015). Extending an ICT4D Computer Re-use Model with E-waste Handling Activities: A Case Study. *Information Technology for Development, 21*(4), 677–693. doi:10.1080/02681102.2014.908161

Cypress, B. (2017). Rigor or reliability and validity in qualitative research: Perspectives, strategies, reconceptualization, and recommendations. *Dimensions of Critical Care Nursing*, *36*(4), 253–263. Retrieved from https://journals.lww.com/dccnjournal/Fulltext/2017/07000/Rigor_or_Reliability_and_Validity_in_Qualitative.6.aspx

Dargan, J., Wasek, J., & Campos-Nanez, E. (2016). Systems performance prediction using requirements quality attributes classification. *Requirements Engineering, 21*, 553–572. doi:10.1007/s00766-015-0232-4

Dermeval, D., Vilela, J., Bittencourt, I. I., Castro, J., & Isotani, S. (2016). Applications of ontologies in requirements engineering: a systematic review of the literature. *Requirements Engineering*, *21*(4), 405–437. doi:10.1007/s00766-015-0222-6

De Wolf, R., Vanderhoven, E., Berendt, B., Pierson, J., & Schellens, T. B. (2017). Self-reflection on privacy research in social networking sites. Behaviour & *Information Technology, 36*(1), 459–469. doi:10.1080/0144929X.2016.1242653

Diamantopoulos, T., Roth, M., Symeonidis, A., & Klein, E. (2017). Software requirements as an application domain for natural language processing. Language *Resources & Evaluation, 51*(2), 495–524. doi:10.1007/s10579-017-9381-z

Diniz, E. H., Bailey, D. E., & Sholler, D. (2014). Achieving ICT4D Project Success by Altering Context, Not Technology. *Information Technologies & International*

Development, 10(4), 15–24. Retrieved from https://itidjournal.org/index.php/itid/article/view/1306

Dobson, J. A., & Nicholson, B. (2017). Exploring the Dialectics Underlying Institutionalization of IT Artifacts. *Journal of the Association for Information Systems, 18*(12), 848–871.

Ebad, S. A. (2017). Towards Measuring Software Requirements Volatility: A Retrospective Analysis. *Malaysian Journal of Computer Science, 30*(2), 99–116. doi:10.22452/mjcs.vol30no2.3

Eito-Brun, R., & Amescua, A. (2017). Dealing with software process requirements complexity: an information access proposal based on semantic technologies. *Requirements Engineering*, *22*(4), 527–542. doi:10.1007/s00766-016-0256-4.

El Hussein, M. T., Kennedy, A., & Oliver, B. (2017). Grounded Theory and the Conundrum of Literature Review: Framework for Novice Researchers. *The Qualitative Report, 22*(4), 1199–1210. Retrieved from https://nsuworks.nova.edu/cgi/viewcontent.cgi?article=2661&context=tqr

Emoghene, O., & Nonyelum, O. F. (2017). Information Gathering Methods and Tools: A Comparative Study. *IUP Journal of Information Technology*, *13*(4), 51–62. Retrieved from https://www.academia.edu/37148506/Information_Gathering_Methods_and_Tools_A_Comparative_Study

Erich, F. M., Amrit, C., & Daneva, M. (2017). A qualitative study of DevOps usage in practice. *Journal of Software: Evolution & Process, 29*(6), 1–20. doi:10.1002/smr.1885

Faith, T. D., Flournoy-Floyd, M., Ortiz, K., Egede, L. E., & Oates, J. C. (2018). My life with lupus: contextual responses of African-American women with systemic lupus participating in a peer mentoring intervention to improve disease self-management. *BMJ Open, 8*(11). doi: 10.1136/bmjopen-2018-022701

Falcao, R. (2017). Elicitation of Delightful Context-Aware Features: Challenges and Outlook Extended Abstract. *ACM 39th IEEE International Conference on Software Engineering Companion*, 467–468. doi:10.1109/ICSE-C.2017.23

Farooq, M. B., & de Villiers, C. (2017). Telephonic qualitative research interviews: when to consider them and how to do them. *Meditari Accountancy Research, 25*(2), 291–316. Retrieved from https://repository.up.ac.za/bitstream/handle/2263/61466/Farooq_Telephonic_2017.pdf?sequence=1&isAllowed=y

Fernández-Domínguez, J. C., de Pedro-Gómez, J. E., Morales-Asencio, J. M., Bennasar-Veny, M., & Sastre-Fullana, P. (2017). Health Sciences-Evidence Based Practice Questionnaire (HS-EBP) for measuring transprofessional evidence-based practice: Creation, development, and psychometric validation. *PLoS One, 12*(5). doi:10.1371/journal.pone.0177172

Ferrari, A., Spoletini, P., & Gnesi, S. (2016). Requirements Engineering. *Ambiguity and tacit knowledge in requirements elicitation interviews, 21*(3), 333–355. doi:10.1007/s00766-016-0249-3

Fife, E., & Pereira, F. (2016). The promise and reality: Assessing the gap between theory and practice in ICT4D. *Telecommunications Policy, 40*(7), 595–601. doi:10.1016/j.telpol.2016.05.004

Fitch, N., Ma'ayah, F., Harms, C., & Guilfoyle, A. (2017). Sport, Educational Engagement, and Positive Youth Development: Reflections of Aboriginal Former Youth Sports Participants. *The Australian Journal of Indigenous Education, 46*(1), 23–33. doi:10.1017/jie.2016.23

Fourie, L., & de Vries, M. (2017). Exploring Enhancements to the Agile Approach for Mid-Sized Enterprises in the Services Sector. South *African Journal of Industrial Engineering, 28*(3), 29–39. doi:10.7166/28-3-1837

Fuger, S., Schimpf, R., Füller, J., & Hutter, K. (2017). User roles and team structures in a crowdsourcing community for international development – a social network perspective. *Information Technology for Development, 23*(3), 438–462. doi:10.1080/02681102.2017.1353947

García, Y., Ferrás, C., Aguilera, A., & Ávila, P. (2017). Usability and Feasibility Study of a Remote Cognitive Behavioral Therapy System with Long-Term Unemployed Women. *Journal of Technology in Human Services, 35*(3), 219–230. doi:10.1080/15228835.2017.1345672

Gavai, P., Musungwini, S., & Mugoniwa, B. (2018). Journal of Systems Integration. *A Model for the Adoption and Effective Utilization of ICTs in Commercial Agriculture in Zimbabwe, 9*(4), 40–58. doi:10.20470/jsi.v9i4.356

Ghanbari, H., Vartiainen, T., & Siponen, M. (2018). Omission of Quality Software Development Practices: A Systematic Literature Review. *ACM Computing Surveys, 51*(2), 1–27. doi:10.1145/3177746

Gilchrist, A. (2016). Reflections on Knowledge, Communication, and Knowledge Organization. *Knowledge Organization, 42*(6), 456-469. doi:10.5771/0943-7444-2015-6-456

Goffin, K., & Koners, U. (2011). Tacit knowledge, lessons learned, and new product development. *Journal of Production and Innovation Management, 28*(2), 300–318. Retrieved from https://www.rndtoday.co.uk/managing-the-rd-pipeline/rd-post-project-reviews-lessons-learnt-or-lessons-lost/

Golinski, M. (2018). Identifying Patterns and Meanings Across the AANA Foundation Closed Claim Dataset Using Thematic Analysis Methods. *AANA Journal, 86*(1), 27–31. Retrieved from https://pdfs.semanticscholar.org/81ca/7ebf15cc0390ef37a74ce0508514b8eea882.pdf?_ga=2.204337433.84756096.1595932598-800739819.1595932598

Gordon, P. A., & Gordon, B. A. (2017). The role of volunteer organizations in leadership skill development. *The Journal of Management Development, 36*(5), 712–723. doi:10.1108/JMD-06-2016-0099

Guillemin, M., & Heggen, K. (2009). Rapport and respect: negotiating ethical relations between researcher and participant. *Medicine, Health Care, and Philosophy, 12*(3), 291–9. doi:10.1007/s11019008-9165-8

Gulliksen, J. (2017). Institutionalizing human-computer interaction for global health. *Global Health Action, 10*, 68–73. doi:10.1080/16549716.2017.1344003

Güngör, F. (2017). The tensions between EFL teacher identities and INSET in the Turkish context. *Profile, 19*(1), 13–27. doi:10.15446/profile.v19n1.55110

Gutberg, J., & Whitney, B. (2017). Understanding middle managers influence in implementing patient safety culture. *BMC Health Services Research, 17*, 1–10. doi:10.1186/s12913-017-2533-4

Hadi, M. A., & Closs, S. J. (2016). Ensuring rigour and trustworthiness of qualitative research in clinical pharmacy. *International Journal of Clinical Pharmacy, 13*, 641–646. doi: 10.1007/s11096-015-0237-6

Haenssgen, M. J. (2018). The struggle for digital inclusion: Phones, healthcare, and marginalisation in rural India. *World Development, 104*, 358–374. doi:10.1016/j.worlddev.2017.12.023

Haffner, M., Mathews, A., Fekete, E., & FinChum, A. (2018). Location-Based Social Media Behaviour and Perception: Views of University Students. *Geographical Review, 108*(2), 203–224. doi:10.1111/gere.12250

Hahn, S. R., Bradt, P., Hewett, K. A., & Ng, D. B. (2017). Physician-patient communication about overactive bladder: Results of an observational sociolinguistic study. *PLoS One, 12*(11), 1–12. doi:10.1371/journal.pone.0186122

Halim, E., Halim, P. P., & Hebrard, M. (2017). Indonesia medical knowledge management system: A proposal of medical KMS. International Conference on *Information Management and Technology (ICIMTech)*, 322–327. doi:10.1109/ICIMTech.2017.8273559

Hanson, C. S., Craig, J. C., & Tong, A. (2017). In their own words: the value of qualitative research to improve the care of children with chronic kidney disease. *Pediatr Nephrol, 32*, 1501–1507. doi:10.1007/s00467-016-3526-y

Hart-Johnson, A. M. (2017). Gaining Access to Socially Stigmatized Samples. *The Qualitative Report*, 1550–1564. Retrieved from https://nsuworks.nova.edu/tqr/vol22/iss6/5/

Haslinda, A., & Sarinah, A. (2009). A Review of Knowledge Management Models. *The Journal of International Social Research, 2*(9), 187–198. Retrieved from https://pdfs.semanticscholar.org/373d/e8306d919ac2300bffab88a8a0ddb7ae7b46.pdf

Hayashi, P., Abib, G., & Hoppen, N. (2019). Validity in Qualitative Research: A Processual Approach. *The Qualitative Report, 1,* 98–112. Retrieved from https://nsuworks.nova.edu/cgi/viewcontent.cgi?article=3443&context=tqr

Heck, P., & Zaidman, A. (2017). A framework for quality assessment of just-in-time requirements: the case of open-source feature requests. *Requirements Engineering, 22*(4), 453–473. doi:10.1007/s00766-016-0247-5

De la Hidalga, N. A., Hardisty, A., & Jones, A. (2016). SCRAM-CK: applying a collaborative requirements engineering process for designing a web-based e-science toolkit. *Requirements Engineering, 1*(1), 107–129. doi:10.1007/s00766-014-0212-0

Houghton, C. E., Casey, D., Shaw, D., & Murphy, K. (2013). Rigour in qualitative case-study research. *Nurse Researcher, 20*(4), 12–17. doi:10.7748/nr2013.03.20.4.12.e326

Huang, S.-c., & Cox, J. L. (2016). Establishing a social entrepreneurial system to bridge the digital divide for the poor: a case study for Taiwan. *Universal Access in the Information Society, 15*(2), 219–236. doi:10.1007/s10209-014-0379-7

Hudson, H., Leclair, M., Plletier, B., & Sullivan, B. (2017). Using radio and interactive ICTs to improve food security among smallholder farmers in Sub-Saharan, *41*, 670–684. doi:10.1016/j.telpol.2017.05.010

Hui, S.-k. A., Miller, S. M., Hazuda, L., Engelman, K., & Ellerbeck, E. F. (2016). Novel Method for Recruiting Representative At-Risk Individuals into Cancer Prevention Trials: Online Health Risk Assessment in Employee Wellness Programs. *Journal of Cancer Education, 31*(3), 421–429. doi:10.1007/s13187-015-0927-8

Hvorecký, J., Šimúth, J., & Lipovská, A. (2015). Ways of delivering tacit knowledge in e-learning. *International Conference on Interactive Collaborative Learning (ICL)*, 523–526. doi:10.1109/ICL.2015.7318083

Icel, M. (2018). Implementation of STEM Policy: A Case Study of a STEM-Focused Urban Charter School. *Journal of STEM Education: Innovations and Research, 19*(3), 7–13. Retrieved from https://ezp.waldenulibrary.org/login?url=https://search-proquest-com.ezp.waldenulibrary.org/docview/2137843705?accountid=14872

Isaac, C. (2016). Career Morph: Quantitizing Adversity in Academic Medicine. *The Qualitative Report, 12*(7), 2268–2283. Retrieved from https://nsuworks.nova.edu/tqr/vol21/iss12/7/

Isola, E., Olabiyisi, S., Omidiora, E., Ganiyu, R., & Adebayo, O. (2018). A cognitive approach to measure the complexity of breadth-first search algorithm. *Computer Science Series, 16*(1), 120–125. Retrieved from http://anale-informatica.tibiscus.ro/download/lucrari/16-1-14-Isola.pdf

Iyer, N., Mitchell, H.-R., Zheng, D. J., & Ross, W. (2017). Experiences with the survivorship care plan in primary care providers of childhood cancer survivors: a mixed-methods approach. *Support Care Cancer, 25*, 1547–1555. doi:10.1007/s00520-016-3544-0

Izaryk, K., & Skarakis-Doyle, E. (2017). Using the Delphi Technique to Explore Complex Concepts in Speech-Language Pathology: An Illustrative Example from Children's Social Communication. *American Journal of Speech-Language Pathology*, *26*(4), 1225–1235. doi:10.1044/2017_AJSLP-16-0046

Janu, S. (2017). On-the-Go Settlements: Understanding Urban Informality Through Its Digital Substructure. *Urbanisation, 2*(2), 116–134. doi:10.1177/2455747117740651

Jebreen, I., & Al-Qerem, A. (2017). Empirical Study of Analysts' Practices in Packaged Software Implementation at Small Software Enterprises. *International Arab Journal of Information Technology (IAJIT), 14(*4A), 543–551. Retrieved from https://iajit.org/Special%20Issue%202017,%20no.%204A/26.pdf

Jolliffe, B., Poppe, O., Adaletey, D., & Braa, J. (2015). Models for Online Computing in Developing Countries: Issues and Deliberations. *Information Technology for Development, 21*(1), 151–161. doi:10.1080/02681102.2014.902354

Kahl, C., da Cunha, K. S., Lanzoni, G. M., Higashi, G. D., & Erdmann, A. L. (2018). Referral and counter-referral: repercussions of coronary artery bypass graft in the perspective of Primary Care. Revista *Brasileira de Enfermagem, 71*(5), 2359–2366. Retrieved from http://dx.doi.org.ezp.waldenulibrary.org/10.1590/0034-7167-2016-0598

Kalinic, Z., & Marinkovic, V. (2016). Determinants of users' intention to adopt m-commerce: an empirical analysis. *Information Systems & e-Business Management, 14*(2), 367–387. doi:10.1007/s10257-015-0287-2

Karabacak, K. (2016). Evaluation of Fatih Project in the Frame of Digital Divide. *The Turkish Online Journal of Educational Technology, 15*(2). Retrieved from http://www.tojet.net/articles/v15i2/1527.pdf

Keating, J., & Nourbakhsh, I. (2018). Teaching Artificial Intelligence and Humanity. *Communications of the ACM, 61*(2), 29–32. doi:10.1145/3104986

Kibere, F. N. (2016). The Paradox of Mobility in the Kenyan ICT Ecosystem: An Ethnographic Case of How the Youth in Kibera Slum Use and Appropriate the Mobile Phone and the Mobile Internet. *Information Technology for Development, 22*, 47–67. doi: 10.1080/02681102.2016.1155144

Kim, H. K., & Han, S. H. (2017). Defining and classifying IT interaction disability. *Behaviour & Information Technology*, *36*(4), 422–434. doi:10.1080/0144929X.2016.1240233

Kleine, D. (2015). The Value of Social Theories for Global Computing. *Communications of the ACM, 58*(9), 31–33. doi:10.1145/2804246

Krishna, S. T., & Sreekanth, S. P. (2016). Performance of Ten Software Development Process Models with Principles. *International Journal of Science, Engineering and Computer Technology*, *6*(5), 161–171. Retrieved from http://ijcset.net/docs/Volumes/volume6issue5/ijcset2016060505.pdf

Kumaza, A. (2018). Examining Business innovation in the Social Responsibility and Environmental Accountability Contexts: Empirical Syntheses from Ghana.

Examining Business Innovation in the Social Responsibility and Environmental Accountability Contexts: Empirical Syntheses from Ghana, *20*(3), 193–208. doi:10.5937/ekonhor1803197K

Laeeque, S. H., & Babar, S. F. (2017). Knowledge Creation and Firm Performance: Is Innovation the Missing Link? *Pakistan Journal of Commerce and Social Sciences*, *11*(2), 505–523. Retrieved from http://www.jespk.net/publications/379.pdf

Laursen, K. (2012). Keep searching, and you'll find: what do we know about variety creation through firms' search activities for innovation? *Industrial and Corporate Change*, *21*(5), 1181–1220. doi:10.1093/icc/dts025

Le, H., Koo, F. K., Arambewela, R., & Zutshi, A. (2017). Voices of dissent: unpacking Vietnamese international student experience. *The International Journal of Educational Management*, *13*(3), 280–292. doi:10.1108/IJEM-07-2015-0099

Lehmann, O. V., Murakami, K., & Klempe, S. H. (2019). A Qualitative Research Method to Explore Meaning-Making Processes in Cultural Psychology. *Qualitative Social Research*, *20*(2). doi:10.17169/fqs-20.2.3190

Leonardi, P. M., Bailey, D. E., Diniz, E. H., Sholler, D., & Nardi, B. (2016). Multiplex Appropriation in Complex Systems Implementation: The Case of Brazil's Correspondent Banking System. *MIS Quarterly*, *40*(2), 461–474. Retrieved from https://ezp.waldenulibrary.org/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=iih&AN=115296645&site=ehost-live&scope=site

Leusen, P. v., Ottenbreit-Lefwich, A., & Brush, T. (2016). Interpersonal Consulting Skills for Instructional Technology Consultants: a Multiple Case Study. *Tech Trends, 60,* 253–259. doi:10.1007/s11528-016-0046-3

Li, J., Yuan, L., Ning, L., & Li-Ying, J. (2015). Knowledge sharing and affective commitment: the mediating role of psychological ownership. *Journal of Knowledge Management, 19*(6), 1146–1166. doi:10.1108/JKM-01-2015-0043

Li, R., & Fang, W. (2019). University-industry-government relations of the Ministry of Industry and Information Technology (MIIT) universities: The perspective of the mutual information. *PLoS One, 14(*2), 1–14. doi:10.1371/journal.pone.0211939

Lin, R., Kuo, F., & Myers, M. D. (2015). Extending ICT4D studies: the value of critical research. *MIS Quarterly, 39*(3), 697-712. Retrieved from https://misq.org/extending-ict4d-studies-the-value-of-critical-research.html

Lincoln, Y., & Guba, E. (1985). *Naturalistic inquiry* (Vol. 30). Beverly Hills: CA: Sage.

Lopez-Lorca, A., Beydoun, G., Valencia-Garcia, R., & Martínez-Béjar, R. (2015). Automating the reuse of domain knowledge to improve the modeling outcome from interactions between developers and clients. *Computing,* 609–640. doi:10.1007/s00607-015-0473-6

Loudon, M. (2016). A Platform Studies Approach to the Role of Technology in the ICTD Ecosystem: The SMS in m4d Interventions. *Information Technology for Development,* 22, 7–25. doi:10.1080/02681102.2015.1121858

Lucyk, K. (2016). They Are Not My Problem: A Content and Framing Analysis of References to the Social Determinants of Health within Canadian News Media,

1993-2014. *Canadian Journal of Communication, 41*(4), 631–654. doi:10.22230/cjc.2016v41n4a3034

Luo, B. N., Lui, S. S., & Kim, Y. (2017). Revisiting the relationship between knowledge search breadth and firm innovation: A knowledge transfer perspective. *Management Decision, 55*(1), 2–14. doi:10.1108/MD-07-2015-0327

MacKay, D. (2016). Fair subject selection in clinical research: formal equality of opportunity. *Journal of Medical Ethics, 42*(10), 672–677. doi:10.1136/medethics-2015-103311

Mahmoud, A., & Williams, G. (2016). Detecting, classifying, and tracing non-functional software requirements. *Requirements Engineering, 21*, 357–381. doi:10.1007/s00766-016-0252-8

Mallia, P. (2019). WASP (write a scientific paper): The ethical stages of publishing a research paper. *Saudi Journal of Anaesthesia, 13*(5), 44–47. Retrieved from http://dx.doi.org.ezp.waldenulibrary.org/10.4103/sja.SJA_675_18

Mamba, M. S., & Isabirye, N. (2015). A Framework to Guide Development Through ICTs in Rural Areas in South Africa. *Information Technology for Development*, 135–150. doi:10.1080/02681102.2013.874321

Manzira, M. F., & Munyoka, W. (2016). Unlocking the potential of information and communication technology for business sustainability by small, micro, and medium enterprises in Vhembe district, South Africa. *IADIS International Journal on Computer Science & Information Systems, 11*(2), 41–48. Retrieved from http://www.iadisportal.org/digital-library/unlocking-the-potential-of-

information-and-communication-technology-for-business-sustainability-by-small-micro-and-medium-enterprises-in-vhembe-district-south-africa

March, J. (1991). Exploration and exploitation in organizational learning. *Organ Science*, *2*(1), 71–87. Retrieved from https://www.researchgate.net/profile/Bill_Mckelvey/publication/279654588_Extreme_events_power_laws_and_adaptation_towards_an_econophysics_of_organization/links/58616aef08ae329d61ff2e8f/Extreme-events-power-laws-and-adaptation-towards-an-econophysics-of-organization.pdf?origin=publication_list

Miller, C. J., Burgess, J. F., Fischer, E. P., Hodges, D. J., & Belanger, L. K. (2017). Practical application of opt-out recruitment methods in two health services research studies. *BMC Medical Research Methodology*, *17*(57), 1–12. doi:10.1186/s12874-017-0333-5

Mir, S., Shih-Hao, L., Cantor, D., & Hofer, C. (2018). Content analysis in SCM research: past uses and future research opportunities. *International Journal of Logistics Management, 29*(1), 152–190. doi:10.1108/IJLM-09-2016-0200

Mitchell, G. (2015). Use of interviews in nursing research. Nursing Standard, 29(43). doi:DOI:10.7748/ns.29.43.44.e8905

Mithas, S., & Rust, R. T. (2016). How Information Technology Strategy and Investments Influence Firm Performance: Conjecture And Empirical Evidence1. *MIS Quarterly, 4*0(1), 223–246. Retrieved from https://misq.org/how-informatoin-technology-strategy-and-investments-influence-firm-performance-conjecture-and-empirical-evidence.html

Mnkandla, E., & Ansie Minnaar, A. (2017). The Use of Social Media in E-Learning: A Metasynthesis. *International Review of Research in Open and Distributed Learning*, *18*(5), 227–248. doi:10.19173/irrodl.v18i5.3014

Mohajan, H. (2017). The Impact of Knowledge Management Models for the Development of Organizations. *Journal of Environmental Treatment Techniques, 5*(1), 12–33. Retrieved from https://mpra.ub.uni-muenchen.de/83089/1/MPRA_paper_83089.pdf

Mohd, Y., Akmal, M. A., Atan, N. A., Mohamad Said, M. N., Mokhtar, M., & Abu Samah, N. (2017). Collaborative Learning in Authentic Environment Apps to Promote Preschool Basic Scientific Process Skills. *International Journal of Interactive Mobile Technologies, 11*(3), 4–15. doi:10.3991/ijim.v11i3.5774

Mol, A. M., Silva, R. S., Rocha, Á. A., & Ishitani, L. (2017). Ethnography and Phenomenology applied to game research: a. Revista de Sistemas e Computação (RSC), 7(2), 110–127.

Momeni, F., Yazdi, A. A., & Najafi, S. M. (2019). Changing economic systems and institutional dimensions of the Triple Helix model. *Journal of Innovation and Entrepreneurship, 8*(1), 1–12. doi:10.1186/s13731-018-0096-1

Mowery, D. C., Oxley, J. E., & Silverman, B. S. (1996). Strategic alliances and interfirm knowledge transfer. *Strategic Management Journal, 17*, 77–91. doi:10.1002/smj.4250171108

Mukhopadhyay, A., & Ameri, F. (2016). An ontological approach to engineering requirement representation and analysis. *Artificial Intelligence for Engineering*

Design, Analysis, and Manufacturing, 30(4), 337–352. doi:10.1017/S0890060416000330

Muthuveloo, R., Shanmugam, N., & Teoh, A. P. (2017). The impact of tacit knowledge management on organizational performance: Evidence from Malaysia. *Asia Pacific Management Review, 22*(4), 192–201. doi:10.1016/j.apmrv.2017.07.010

Mwangi, B. J., & Brown, I. (2015). A Decision Model of Kenyan SMEs' Consumer Choice Behavior in Relation to Registration for a Mobile Banking Service: A Contextual Perspective. *Information Technology for Development, 21*(2), 229–252. doi:10.1080/02681102.2013.874320

Mwantimwa, K. (2017). Use of mobile phones among agro-pastoralist communities in Tanzania. *Information Development,* 1-15. doi:10.1177/0266666917739952

Naidu, S., & Chand, A. (2018). Exploring the Problems, Issues, and Challenges of E-government in Kiribati. *e-Service Journal, 10*(3), 1–23. doi:10.2979/eservicej.10.3.01

Neuman, W. (2010). *Social Research Methods: Qualitative Evaluation and Research Methods* (2nd ed.). London: Sage Publications.

Nikolaidis, D., Chrysikou, S. C., & Alexandris, K. (2016). Testing the relationship between hotel service quality and hotel brand personality. *International Journal of Hospitality and Event Management, 1*(4), 355–369. doi:10.1504/IJHEM.2016.082170

Nissen, M. (2006). *Harnessing knowledge dynamics: principled organizational knowing learning*. London: IRM Press.

Nonaka, I. (1991). The knowledge-creating company. *Harvard Business Review*, 96–104. Retrieved from https://hbr.org/2007/07/the-knowledge-creating-company

Nonaka, I., & Takeuchi, H. (1995). *The Knowledge-Creating Company: How Japanese Companies Create the Dynamics of Innovation*. New York: Oxford University Press.

Nonaka, I., & Toyama, R. (2003). The knowledge-creating theory revisited: knowledge creation as a synthesizing process. *Knowledge Management Research & Practice, 1*(1), 2–10. doi:10.1057/palgrave.kmrp.8500001

Nxumalo, C. T., & Mchunu, G. G. (2017). Exploring the stigma related experiences of family members of persons with mental illness in a selected community in the iLembe district, KwaZulu-Natal. *Health S A, 22*, 202–212. doi:10.1016/j.hsag.2017.02.002

Obamuyi, T. M., & Oladapo, F. (2016). The Nigerian Economy in the Face of Socio-Political Challenges: A Retrospective View and Ways Forward. *International Journal of Finance & Banking Studies*, 2147–4486. doi:10.20525/ijfbs.v5i3.128

Oduor, E., Neustaedter, C., & Hennessy, K. (2016). The design and evaluation of a photograph-sharing application for rural and urban Kenyan families. *Personal & Ubiquitous Computing, 20*(4), 615–633. doi:10.1007/s00779-016-0930-z

Oghazi, P., & Mostaghel, R. (2018). Circular Business Model Challenges and Lessons Learned—An Industrial Perspective. *Sustainability, 10*(3), 1–19. doi:10.3390/su10030739

Oguz, F., & Sengün, A. E. (2011). Mystery of the unknown: revisiting tacit knowledge in the organizational literature. *Journal of Knowledge Management, 15*(3), 445-461. doi:10.1108/13673271111137420

Oihab Allal-Chérif, M. M. (2016). Using serious games to manage knowledge: The SECI model perspective. *Journal of Business Research, 69*(5), 1539–1543. doi:10.1016/j.jbusres.2015.10.013

Okewu, E., & Okewu, J. (2014). European Conference on e-Government. *Curbing Insecurity in Sub-Saharan Africa through ICTs for Development (ICT4D*), 213–222. Retrieved from https://www.researchgate.net/publication/283247639_Curbing_insecurity_in_sub-saharan_Africa_through_ICTs_for_development_ICT4D

Olmos, K., & Rodas, J. (2014). KMoS-RE: knowledge management on a strategy to requirements engineering. *Requirements Engineering; London, 19*(4), 421–440. doi:10.1007/s00766-013-0178-3

Oron-Gilad, T., & Parmet, Y. (2017). Close Target Reconnaissance: A Field Evaluation of Dismounted Soldiers Utilizing Video Feed from an Unmanned Ground Vehicle in Patrol Missions. *Journal of Cognitive Engineering and Decision Making, 11*(1), 63–80. doi:10.1177/1555343416675077

Ouhbi, S., Idri, A., Fernández-Alemán, J., & Toval, A. (2015). Requirements engineering education: a systematic mapping study. *Requirements Engineering, 20*(2), 119–138. doi:10.1007/s00766-013-0192-5

Pade-Khene, C. (2015). Curriculum Development of an ICT4D Module in the South African Context. *Issues in Informing Science & Information Technology*, 111–140. doi:10.28945/2236

Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K. (2015). Purposeful Sampling for Qualitative Data Collection and Analysis in Mixed Method Implementation Research. *Adm Policy Ment Health*(42), 533–544. doi:10.1007/s10488-013-0528-y

Palvia, P., Baqir, N., & Nemati, H. (2018). ICT for socioeconomic development: A citizens' perspective. *Information & Management, 55*(2), 160–170. doi:10.1016/j.im.2017.05.003

Pamela Wells, K. N., Dickens, J. S., & Cleveland, R. E. (2019). "If I don't laugh, I'm going to cry": Meaning Making in the Promotion, Tenure, and Retention Process: A Collaborative Autoethnography. *The Qualitative Report, 24*(2), 334–351. Retrieved from https://nsuworks.nova.edu/cgi/viewcontent.cgi?article=3379&context=tqr

Park, J., & Jeong, S. R. (2016). A Study on the Relative Importance of Underlying Competencies of Business Analysts. *KSII Transactions on Internet & Information Systems, 10*(8), 3986–4007. doi:10.3837/tiis.2016.08.031

Parker, L. D., & Northcott, D. (2016). Qualitative generalising in accounting research: Concepts and strategies. *Accounting, Auditing & Accountability Journal, 29*(6), 1100–1131. doi:10.1108/AAAJ-04-2015-2026

Pekkola, S., Saunila, M., Ukko, J., & Rantala, T. (2016). The role of performance measurement in developing industrial services. *Journal of Quality in Maintenance Engineering, 22*(3), 264–276. doi:10.1108/JQME-01-2015-0004

Pennec, M. L., & Raufflet, E. (2018). Value Creation in Inter-Organizational Collaboration: An Empirical Study. *Journal of Business Ethics, 148*(4), 817–834. doi:10.1007/s10551-015-3012-7

Piore, M. (2018). Economic Policy in the Time of Reactionary Populism. *Issues in Science & Technology, 34*(3), 24–29. Retrieved from https://search.ebscohost.com/login.aspx?direct=true&db=iih&AN=129399637&site=ehost-live&scope=site

Polanyi, M. (1969). *Knowing and Being*. Chicago: The University of Chicago Press.

Polanyi, M. (1996). The tacit dimension. New York: Doubleday & Co.

Ponelis, S. R. (2015). ICT in Africa: Enabling a Better Life for All. *Information Technology for Development, 21*(1), 1–11. doi:10.1080/02681102.2014.985521

Prasarnphanich, P., Janz, B. D., & Patel, J. (2016). Towards a better understanding of system analysts' tacit knowledge: A mixed-method approach. *Information Technology & People, 29*(1), 69–98. doi:10.1108/ITP-06-2014-0123

Preece, J. (2016). Citizen Science: New Research Challenges for Human-Computer Interaction. *International Journal of Human-Computer Interaction, 32*(8), 585–612. doi:10.1080/10447318.2016.1194153

Putri, N. K., & Argogalih, H. (2016). Knowledge management model for telemedicine. *International Conference on Information Management and Technology (ICIMTech)*, 133–138. doi:10.1109/ICIMTech.2017.8273525

Qamar, B. K. (2018). Research Ethics. *Pakistan Armed Forces Medical Journal, 7*(3), 1503–1504. Retrieved from https://www.pafmj.org/index.php/PAFMJ/article/view/2381

Qin, C., & Fan, B. (2016). Factors that influence information sharing, collaboration, and coordination across administrative agencies at a Chinese university. *Information Systems and eBusiness Management, 14*(3), 637–664. doi:10.1007/s10257-015-0298-z.

Quimby-Worrell, C. (2019). Health Literacy and Type 2 Diabetes in Barbados. *The Qualitative Report, 24*(2), 319–332. Retrieved from https://nsuworks.nova.edu/cgi/viewcontent.cgi?article=3762&context=tqr

Qureshi, S. (2015). Are we making a Better World with Information and Communication Technology for Development (ICT4D) Research? Findings from the Field and Theory Building. *Information Technology for Development, 21*(4), 511–522. doi: DOI: 10.1080/02681102.2015.1080428

Rashid, A. T. (2017). Inclusive Capitalism and Development: Case Studies of Telecenters Fostering Inclusion Through ICTs in Bangladesh. *Information Technologies & International Development, 13,* 1–14. Retrieved from https://researchgate.net/publication/314869091

Reddy, R. R., Raju, M. A., Rayudu, G., Kiran, C. H., & Jyothirmai, K. (2013). Knowledge, awareness, and attitudes about research ethics among dental professionals in a dental institution of south India. *Journal of Education and Ethics in Dentistry, 3*(1), 34–39. Retrieved from http://dx.doi.org.ezp.waldenulibrary.org/10.4103/0974-7761.126942

Renteria, C. (2015). How Transformational Mobile Banking Optimizes Household Expenditures: A Case Study from Rural Communities in Mexico. *Information Technologies & International Development, 11*(3), 39–54. Retrieved from https://idl-bnc-idrc.dspacedirect.org/bitstream/handle/10625/55843/IDL-55843.pdf

Ribeiro, S. X., & Nagano, M. S. (2018). Main dimensions that impact knowledge management and university-business-government collaboration in the Brazilian scenario. *REGE, 25*(3), 258–273. doi:10.1108/REGE-05-2018-0074

Rice, J. (2015). Para-Expertise, Tacit Knowledge, and Writing Problems. *College English, 78*(2), 117–138. Retrieved from https://search-proquest-com.ezp.waldenulibrary.org/docview/1987371158?accountid=14872

Rislana, K., Good, A., Adams, C., & Scott, P. (2018). The Role of ICT Education and Training in Poverty Reduction and Economic Empowerment: A Case Study of Jigawa State Government ICT4D Intervention. *Electronic Journal of E-Government: EJEG, 16*(1), 1–17. Retrieved from https://ezp.waldenulibrary.org/login?url=https://search-proquest-com.ezp.waldenulibrary.org/docview/2094369627?accountid=14872

Rogers, S. (2016). Bridging the 21st-century digital divide. *TechTrends, 60*(3), 197–199. doi:10.1007/s11528-016-0057-0

Rook, M. M. (2018). Identifying the Help Givers in a Community of Learners: Using Peer Reporting and Social Network Analysis as Strategies for Participant Selection. *TechTrends, 62*(1), 71–76. doi:10.1007/s11528-017-0200-6

Roper, L., Sherratt, F. C., Young, B., McNamara, P., & Dawson, A. (2018). Children's views on research without prior consent in emergency situations: a UK qualitative study. *BMJ Open, 8*(6), 2–7. doi:10.1136/bmjopen-2018-022894

Saad, A., & Dawson, C. (2018). Requirement elicitation techniques for an improved case-based lesson planning system. *Journal of Systems and Information Technology, 20*(1), 19–32. doi:10.1108/JSIT-12-2016-0080

Sahay, S. (2016). Are we Building a Better World with ICTs? Empirically Examining this Question in the Domain of Public Health in India. *Information Technology for Development, 22*(1), 168–176. doi:10.1080/02681102.2014.933522

Salini, P., & Kanmani, S. (2016). Effectiveness and performance analysis of model-oriented security requirements engineering to elicit security requirements: a systematic solution for developing secure software systems. *International Journal of Information Security, 15*, 319–334. doi:10.1007/s10207-015-0305-x

Sarsar, F., & Harmon, S. (2018). Views of Pre-Service Teachers on Internet Supported Learning. *The Turkish Online Journal of Educational Technology, 17*(2), 68–75.

Schoenung, B., & Dikova, D. (2016). Reflections on organizational team diversity research. Equity, Diversity, and Inclusion: *An International Journal, 35*(3), 221–231. doi:10.1108/EDI-11-2015-0095

Séamas, K., & Camilla, N. (2017). The Doing of Datafication (And What this Doing Does): Practices of Edification and the Enactment of New Forms of Sociality in the Indian Public Health Service. *Journal of the Association for Information Systems, 18*(12), 872–899. doi:10.17705/1jais.00477

Sedelmaier, Y., & Landes, D. (2017). How Can We Find Out What Makes a Good Requirements Engineer in the Age of Digitalization? *International Journal of Engineering Pedagogy, 7*(3), 245–257. doi:10.3991/ijep.v7i3.7424

Sherif, V. (2018). Evaluating Preexisting Qualitative Research Data for Secondary Analysis. *Qualitative social research, 19*(2). doi:10.17169/fqs-19.2.2821

Sidenius, U., Nyed, P. K., Lygum, V. L., & Stigsdotter, U. K. (2017). A Diagnostic Post-Occupancy Evaluation of the Nacadia® Therapy Garden. *International Journal of Environmental Research and Public Health, 14*(8), 1–26. doi:10.3390/ijerph14080882

Şimşek, M. R., & Dündar, E. (2017). Investigating EFL Coursebook Research in Turkey: Trends in Graduate Theses of the 2001-2013 Period. *Kuram ve Uygulamada Egitim Bilimleri, 17*(3), 969–1014. doi:10.12738/estp.2017.3.0090

Singh, J., & Mikkel, F. (2016). Representing participation in ICT4D projects. *Telecommunications Policy*, 692–703. doi:10.1016/j.telpol.2016.02.003

Singh, V., & Kameswari, V. L. (2019). A Study on Content10t Analysis of ICT Enabled Web Portal (Krishinet). *International Journal of Agriculture, Environment and Biotechnology, 12*(1), 47–54. doi:10.30954/0974-1712.03.2019.8

Sjarbaini, V. (2009). *The knowledge dynamics of organizational innovation*. Groningen, Netherlands: University of Groningen.

Sotarauta, M., & Heinonen, T. (2016). The Triple Helix model and the competence set: human spare parts industry under scrutiny. *Triple Helix, 3*(1), 1–20. doi:10.1186/s40604-016-0038-5

Spender, J. C. (1996). *Competitive advantage from tacit knowledge? Unpacking the concept and its strategic implication. In: Moingeon, B. and Edondson, A., (Eds.): Organizational learning and competitive advantage*. London & OAK: Sage.

Spillane, A., Larkin, C., Corcoran, P., Matvienko-Sikar, K., & Arensman, E. (2017). What are the physical and psychological health effects of suicide bereavement on family members? Protocol for an observational and interview mixed-methods study in Ireland. *BMJ, 7*(3), 1–7. doi:10.1136/bmjopen-2016-014707

Spraggon, M., & Bodolica, V. (2017). Collective tacit knowledge generation through play: Integrating socially distributed cognition and transactive memory systems. *Management Decision, 55*(1), 11–135. Retrieved from https://search-proquest-com.ezp.waldenulibrary.org/docview/1858619857?accountid=14872

Sternberg, R., & Horvath, J. (1999). *Tacit Knowledge in Professional Practice*. Mahwah, NJ.: Lawrence Erlbaum Associates.

Steward, H., & Gapp, R. (2017). Exploring the Alchemy of Qualitative Management Research: Seeking Trustworthiness, Credibility, and Rigor Through Crystallization. *The Qualitative Report, 22*(1), 1–19. Retrieved from https://nsuworks.nova.edu/cgi/viewcontent.cgi?article=2604&context=tqr

Sun, Z., Strang, K., & Firmin, S. (2016). Business Analytics-Based Enterprise Information Systems. *The Journal of Computer Information Systems; Stillwater, 57*(2), 169–178. doi: 10.1080/08874417.2016.1183977

Suri, H. (2011). Purposeful sampling in qualitative research synthesis. *Qualitative Research Journal, 11*(2), 63–75. doi:10.3316/QRJ1102063

Taba, N., & Ow, S. (2016). A New Model for Software Inspection at the Requirements Analysis and Design Phases of Software Development. *International Arab Journal of Information Technology (IAJIT), 13*(6), 51–57. Retrieved from https://iajit.org/PDF/Vol.%2013,%20No.%206/7415.pdf

Takyi, E. (2016). The Challenge of Involvement and Detachment in Participant Observation. *The Qualitative Report, 20*(6), 864–872. Retrieved from https://nsuworks.nova.edu/cgi/viewcontent.cgi?article=2164&context=tqr

Talha, M. (2018). Critical Requirements Engineering Errors Leads to Fails Software Project. *The Educational Review, 2*(2), 2018. Retrieved from http://dx.doi.org.ezp.waldenulibrary.org/10.26855/er.2018.02.003

Tamire, M., Addissie, A., Skovbjerg, S., Andersson, R., & Lärstad, M. (2018). Socio-Cultural Reasons and Community Perceptions Regarding Indoor Cooking Using Biomass Fuel and Traditional Stoves in Rural Ethiopia: A Qualitative Study. *International Journal of Environmental Research and Public Health, 19*(9), 1–15. doi:10.3390/ijerph15092035

Thakurta, R. (2017). Understanding requirement prioritization artifacts: a systematic mapping study. *Requirements Engineering, 22*(4), 491–526. doi:10.1007/s00766-016-0253-7

Thomas, M. A., & Oliveira, T. (2017). Nuances of development contexts for ICT4D research in least developed countries: An empirical investigation in Haiti. *Elematics and Informatics, 34*(7), 1093–1112. doi:10.1016/j.tele.2017.05.001

Tian, X. (2017). Big data and knowledge management: a case of déjà vu or back to the future? *Journal of Knowledge Management, 21*(1), 113–131. doi:10.1108/JKM-07-2015-0277

Tibben, W. (2015). Theory Building for ICT4D: Systemizing Case Study Research Using Theory Triangulation. *Information Technology for Development, 21*(4), 628–652. doi:10.1080/02681102.2014.910635

Tran, H. N., Hajmoosaei, M., Percebois, C., Front, A., & Roncancio, C. (2016). Integrating run-time changes into system and software process enactment. *Journal of Software: Evolution & Process, 28(*9), 762–782. doi:10.1002/smr.1783

Tsoukas, H. (2003). 'Do we really understand tacit knowledge?'. In Easterby-Smith, M., and Lyles, M.A. (Eds), *The Blackwell Handbook of Organizational Learning and Knowledge Management*. Malden, MA; Oxford: Blackwell Publishing Ltd.

Tyagi, S., Agrawal, S., Yang, K., & Ying, H. (2017). An extended Fuzzy-AHP approach to rank the influences of socialization-externalization-combination-internalization modes on the development phase. *Applied Soft Computing, 52,* 505–518. doi:10.1016/j.asoc.2016.10.017

Venkatesh, V., Brown, S. A., & Sullivan, Y. W. (2016). Guidelines for Conducting Mixed-methods Research: An Extension and Illustration. *Journal of the Association for Information Systems, 17*(7), 435–494. Doi:10.17705/1jais.00433

Viloria, D. D. (2018). Exploring a Socially-Constructed Concept and Precursors of Employee Engagement in the Philippine Setting. *Review of Integrative Business and Economics Research, 7*(4), 1–25. Retrieved from

http://buscompress.com/uploads/3/4/9/8/34980536/riber_7-4_01k18-135_1-25.pdf

Vitharana, P., Zahedi, M. F., & Jain, H. K. (2016). Enhancing Analysts' Mental Models for Improving Requirements Elicitation: A Two-stage Theoretical Framework and Empirical Results. *Journal of the Association for Information Systems,* 804–840. Retrieved from http://https://web-b-ebscohost-com.ezp.waldenulibrary.org/ehost/pdfviewer/pdfviewer?pdc-v-sessmgr05

Walden University. (2016, November). *Doctor of Information Technology Doctoral Study Checklist and Research Handbook*. Walden University.

Walsham, G. (2017). ICT4D research: reflections on history and future agenda. *Information Technology for Development, 23*(1), 18–41. doi:10.1080/02681102.2016.1246406

Widjaja, J. H., & Kuslina, B. H. (2018). The Role of Organizational Culture and Knowledge Management to Encourage Innovation in Governance in an Indonesian Private University. *Review of Integrative Business and Economics Research, 7,* 255–265. doi:10.33062/mjb.v5i01.378

Willgens, A. M., Cooper, R., Jadotte, D., Lilyea, B., & Langtiw, C. (2016). How to Enhance Qualitative Research Appraisal: Development of the Methodological Congruence Instrument. *The Qualitative Report, 21*(12). Retrieved from https://nsuworks.nova.edu/cgi/viewcontent.cgi?article=2361&context=tqr

Wong, S., & Cooper, P. (2016). Reliability and validity of the explanatory sequential design of mixed methods adopted to explore the influences on online learning in

Hong Kong bilingual cyber higher education. *International Journal of Cyber Society & Education, 9*(2), 45–56. doi:10.7903/ijcse.1475

Wood, N. W., Rust, C., & Horne, G. (2009). A Tacit Understanding: The Designer's Role in Capturing and Passing on the Skilled Knowledge of Master Craftsmen. *International Journal of Design, 3*(3). Retrieved from http://www.ijdesign.org/index.php/IJDesign/article/view/559/275

Wunderlich, P., Veit, D., & Sarker, S. (2019). Adoption of Sustainable Technologies: A Mixed Methods Study of German Household. *MIS Quarterly, 43*(2), 673–691. doi:10.25300/MISQ/2019/12112

Yackulic, C. B., Chandler, R., Zipkin, E. F., Royle, J. A., Nichols, J. D., Campbell Grant, E. H., & Veran, S. (2013). Presence-only modeling using MAXENT: when can we trust the inferences? *Methods in Ecology and Evolution*, 236–243. doi:10.1111/2041-210x.12004

Yamani, N., Shaterjalali, M., & Eghbali, B. (2017). Educational justice from the perspective of postgraduate students in a medical school in Iran: A qualitative study. *Res Development Medical Education, 6*(1), 23–28. doi:10.15171/rdme.2017.005

Yang, S. O., Hsu, C., Sarker, S., & Lee, A. S. (2017). Enabling Effective Operational Risk Management in a Financial Institution: An Action Research Study. *Journal of Management Information Systems, 34*(3), 727–753. doi:0.1080/07421222.2017.1373006

Yao, W., Chen, J., Hu, J., & Wu, Y. (2012). Diagnosis for Nonaka: The critique of SECI theory. *International Symposium on Management of Technology (ISMOT),* 417–420. doi:10.1109/ISMOT.2012.6679505

Yeong, M. L., Ismail, R., Ismail, N. H., & Hamzah, M. I. (2018). Interview Protocol Refinement: Fine-Tuning Qualitative Research Interview Questions for Multi-Racial Populations in Malaysia. *The Qualitative Report, 23*(11), 2700–2713. Retrieved from https://search-proquest-com.ezp.waldenulibrary.org/docview/2137843705?accountid=14872

Yildirim, G. (2018). Opinions of Secondary School Students on 3D Modelling Programs and 3D Printers According to Using Experiences. *The Turkish Online Journal of Educational Technology*, *17*(4), 9–31. Retrieved from https://search-proquest-com.ezp.waldenulibrary.org/docview/2122463289?accountid=14872

Yin, R. (2013). *Case Study Research: Design and Methods* (5th ed.). Los Angeles: Sage Publications.

Yin, R. K. (2003). *Case study research: Design and method* (3rd ed.). Thousand Oaks: Sage.

Yusop, N., Kamalrudin, M., Yusof, M. M., & Sidek, S. (2016). Meeting Real Challenges in Eliciting Security Attributes for Mobile Application Development. *Journal of Korean Society for Internet Information, 17*(5), 25–32. doi: 10.7472/jksii.2016.17.5.25

Zhou, P.-C., Liu, A., & Lee, C.-J. (2018). A Requirements Engineering Approach to Attribute Selection in a Recommendation System. *Journal of Information Science & Engineering, 34*(5), 1273–1286. doi:10.6688/JISE.201809_34(5).0010

Appendix A: Case Study / Interview Protocol

Topic: Exploring Strategies for Capturing Requirements for Developing ICT4D Applications.

Purpose statement: The purpose of this qualitative multiple case study is to explore the strategies software engineers in Southern African software houses and IT departments use for capturing ICT4D requirements.

Interview Protocol

Date:		Time:
Location:		
Participant ID:		
Step 1	Introduction	I welcome you to this interview session. Let me start by thanking your for sparing some time to participate in this interview. My name is Jonathan Makanjera and I am a student at Walden University studying for a doctorate in information technology. I have been employed as an ICT4D expert for 10 years now.
Step 2	Purpose	The purpose of this study is to explore the strategies software engineers in Southern African software houses and IT departments use for capturing ICT4D requirements.

Step 3	Describe reason for participation	Your role is to provide information as interview responses, documents, what you will show me as demonstrations and any other forms of information will be valuable in supporting my study towards earning the Doctor of Information Technology from Walden University.
Step 4	Describe benefit of participation	The knowledge that we will create might contribute to academic and professional bodies of knowledge and might be used by students, individuals and organizations for different applications especially in software and requirements engineering domains. However, you will not be compensated for your participation.
Step 5	Discuss ethics	I am aware and appreciate the need to observe and maintain ethical standards and in this case to respect your right to privacy. May I request your permission to audio-record the interview conversation and annotate notes for the entire session starting now. If you agree to what I have said so far

		allow me to proceed. I will let you know when I am starting the recording. When I am recording I will use your participant ID and ask you to reconfirm your permission to record and take notes in this session. Show me by raising your hand if you are ready for the recording.
Step 6	Start recording	My name is Jonathan Makanjera, and I am interviewing <participant's ID> today <the date of that day>. Kindly, may you confirm your understanding and agreement to the information that I provided you with, such as the purpose of the study, my role and your role in the study, the benefits for participating and my request to audio-record you and annotating notes during this interview session?
Step 7	Discuss confidentiality	Kindly note that it is your right to decline answering some questions and stop participating at any time; there is no force that will be used in this interview. It is also your right to decline providing information

that you are uncomfortable to disclose. Further, note that all information that you will provide will be treated as confidential and will not be shared with third parties without your consent. In addition, may I request that you conceal organizational or individual names or any indicators that could be used to identify your organization or individuals in your responses? Any names and or comments that will be mentioned in the interview will be removed from the transcripts and will not be included in the final report. Moreover, avoid discussing about the interview with anyone until official results of the study are out. And please note that the information that you will provide will be combined with other information from other participants and other sources and it will be used for this study only. I will keep all the research records in an encrypted and password-protected format locked in a safe for five years, after which time they will be

		destroyed. Only I will have access to this data during that five-year period.
Step 8	Ask if there are any questions and if they want to proceed	May I ask if you have anything that you would like me to explain further from what we have discussed so far? If you do not have anything to be discussed further may I proceed?
Step 9	Transition to the interview	The is interview semistructured and it will help with providing me with what you know about the topic. I have prepared 11 questions and I will be grateful if you could be open and honest in your responses despite any prior relationship with me or the topic. Suppose I later discover that I missed some information I may have to come back to you for more information. Let me thank you in advance for providing your thoughts and perspective.
Step 10	Interview	Describe how you capture what a user wants in a new ICT4D software application? Explain how you capture experiences of users who are already using an ICT4D

software application?

Describe how you express captured user requirements and their experiences to other software engineers to understand the requirements and the experiences of the users?

Describe how you put together the gathered information on user requirements and user experiences in order to develop a requirements specification share it with other software engineers?

Describe the skills that you are using to capture user requirements and experiences?

Describe methodologies or framework that you are using to capture user requirements and experiences?

What is the name of the framework or methodology that you use?

How does the framework or methodology help you in the capturing of requirements for ICT4D applications?

Describe poorly captured user requirements?

		Describe the causes for ending up with poorly captured ICT4D user requirements? Do you have any additional information that you would like to share about requirements engineering that you would like to share? Where are you failing to apply the frameworks?
Step 11	Possible follow up questions	How did you end up with poor requirements?
Step 12	Gathering of secondary information	This is the last part of the interview and our interest is to get any other data besides what we shared in the previous session. May you be kind enough to show or give me any documents, presentations, or an observable demonstration or any other information that can provide an in-depth understanding of what you have provided in the previous session?
Step 13	Ending the interview session	Let me thank you for your time and the information you have provided. May I request to meet you again for a follow-up interview to discuss information that you provided today? If you are in agreement,

may propose that we meet next week the same day and time, otherwise I will call you for re-scheduling. Thank you again.

Appendix B: Invitation to Participate Email Template

Dear <first name>,

My name is Jonathan Makanjera, and I am a student of Walden University studying for a Doctor of Information Technology degree. I have completed all my coursework successfully and as required by the doctoral program, I am undertaking a qualitative multiple case study to explore the strategies software engineers in Southern African software houses and IT departments use for capturing Information and Communication Technology for Development ICT4D requirements.

It is my hope that you can support my education and the principles I am researching by taking part in the research. I have attached herewith the invitation letter a copy of the organizational approval to conduct my research and a consent form with details of my study for your consideration. Kindly, read through the consent form and should be interested to take part, please forward a signed copy of the consent form to me at < researcher's email>, otherwise you do not have to respond to this letter. Please note that your participation in this study is voluntary, you may choose to participate or not and you may also withdraw from the study at any time without going through any processes. I have scheduled to undertake interviews and other data collection activities from mid-July to end of July 2019. I will work with you to schedule participation times that do interfere with your work and already planned activities.

Let me thank you in advance for your consideration and I look forward to working with you.

Jonathan Makanjera
Doctor of Information Technology candidate
Walden University
< researcher's email>