A FRAMEWORK FOR ENHANCING TRUST FOR IMPROVED PARTICIPATION IN ELECTRONIC MARKETPLACES ACCESSED FROM MOBILE PLATFORMS

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Abstract

Information and communication technologies (ICTs) have been widely researched as a mechanism for improving the socio-economic status of disadvantaged, rural communities. In order to do this numerous technology-based initiatives have been introduced into disadvantaged, rural communities to assist them in various aspects of their lives. Unfortunately, even when the proposed benefit of a particular technology is clearly evident to its initiators, the adoption by the target users is often uncertain. This has also been the case with e-commerce in agriculture. Despite the numerous benefits of e-commerce for agricultural producers, the uptake has been low. Trust is a critical pre-condition for the adoption of e-marketplaces. E-marketplaces expose consumers to the risk of non-delivery or misrepresentation of goods ordered and the misuse of personal information by external parties. Additionally, the time investment needed to make a shift to e-marketplaces and the opinions of important reference groups affects the user's willingness to trust and depend on an e-marketplace. This study was undertaken to assess the extent to which rural users with limited ICT experience would trust and, consequently, adopt an e-marketplace to support agricultural trade. A pragmatic philosophy was adopted in this study, indicating that the researcher's view of reality is founded on the practical implications and outcomes that are observed. This study used a Canonical Action Research strategy to design, develop and deploy a voice based e-marketplace to assist the trading activities of a Western Cape based aloe community. The community was allowed to utilise thee-marketplace over a period of eight weeks. Thereafter, interviews were held with the participants to investigate their perceptions of the technology. As a result, a model proposing the factors that must be in place for trust to be achieved in a voice based e-marketplace was proposed. The study found that the trustworthiness of a technology results from the technology's technical capability to satisfy the needs of its users reliably. Usability and security were found to be important determinants of the trustworthiness of a technology. Furthermore, the requirements elicitation process was found to be central to achieving trust as it defines the necessary criteria for developing secure, usable, functional, and reliable technologies that meet the needs of their users.

Keywords: e-marketplaces, Spoken Dialogue Systems, model, trust, IT artefacts, e-commerce, agriculture, adoption

Declaration

I, Naomi Isabirye (209202655), hereby declare that the thesis for **Philosophiae Doctor-Information Technology**, is my own work and that it has not previously been submitted for assessment or completion of any postgraduate qualification to another University or for another qualification.

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Naomi Isabirye

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Dedicated in loving memory of my father,

The late Mr John Isabirye

His love, integrity, intellect and wisdom are a light that will never be dimmed.

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List of Acronyms

GSM- Global System for Mobile Communications Network

PSTN-Public Switched Telephony Network

TAM-Technology Acceptance Model

TRA-Theory of Reasoned Action

TPB-Theory of Planned Behaviour

ICT4D-Information and Communication Technology for Development

3G-Third Generation Networks

4G-Fourth Generation Networks

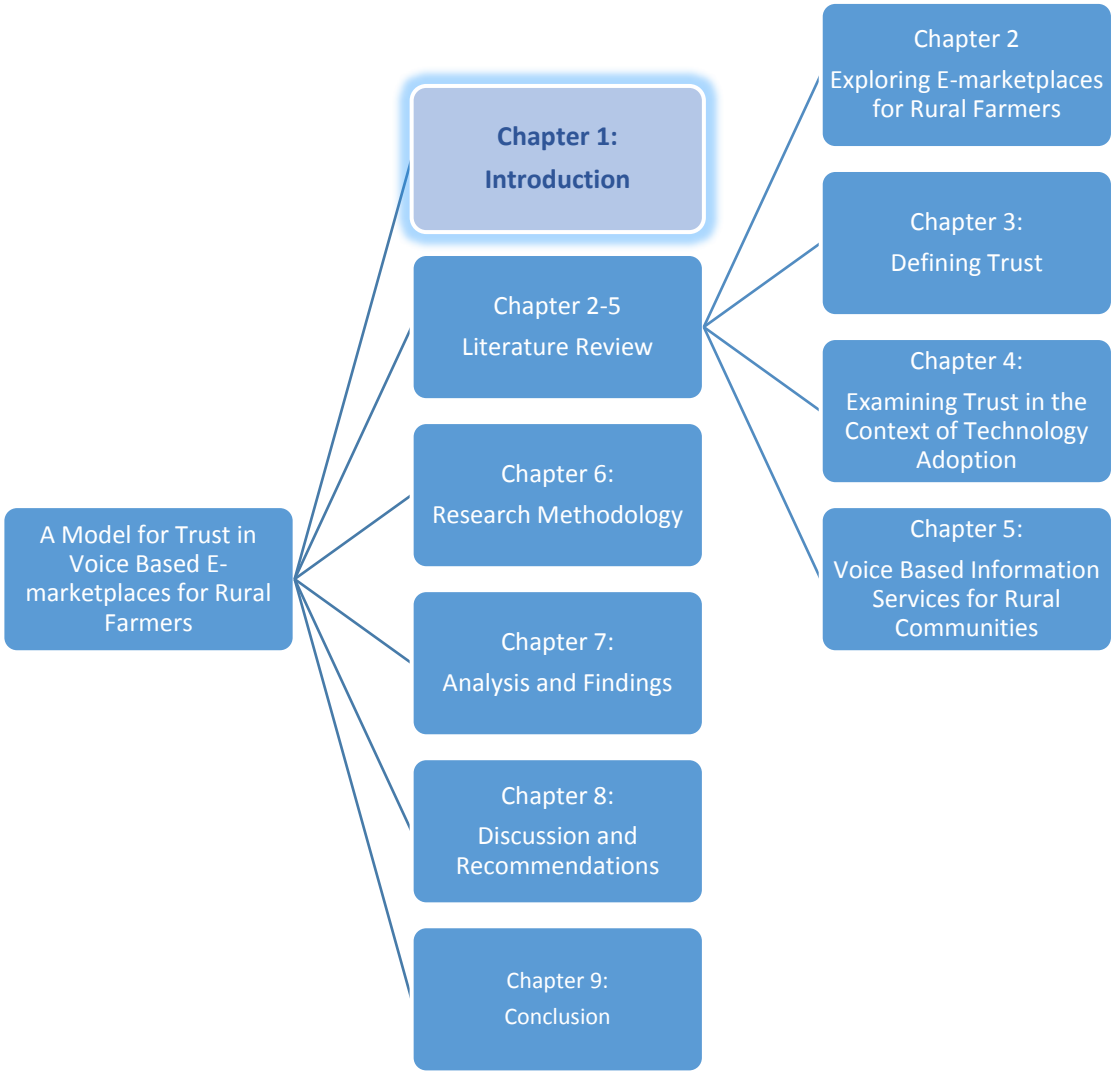
ICT-Information and Communication Technology

GDP-Gross Domestic Products

SDS-Spoken Dialogue Systems

SIP-Session Internet Protocol

Chapter 1: Introduction



1.1 Background

Agriculture forms a major sustaining factor of the economies of many developing countries. A significant number of agricultural activities originate in rural areas (Aker, 2011; Awokuse, 2009). Despite this, the majority of the world's rural population are poor and disempowered. Nevertheless, the demand for the products of rural farmers is vast and widespread and many developing countries' Gross Domestic Product (GDPs) benefit significantly from agricultural exports. However, rural farmers, especially in developing countries, receive the lowest proportion of the final price of the goods they sell (Behera, Panda, Behera, Nayak, Behera, & Jena, 2015). Rural farmers often depend on middlemen to ensure that their goods reach their market while their ability to negotiate the price of products is often constrained by the perishable and time sensitive nature of agricultural products, the lack of access to alternative buyers and the unavailability of sufficient storage facilities. E-commerce provides an opportunity for rural farmers to overcome some of the identified challenges.

Turban, King, McKay, Marshall and Viehland (2008) define e-commerce as the process of buying, selling, exchanging or transferring goods, services or information over telecommunications networks such as the Internet. Turban et al. (2008) further distinguish e-marketplaces from e-commerce, by stating that e-commerce can take place in an e-marketplace. Thus, suggesting that e-marketplaces refer to the virtual spaces in which e-commerce occurs. This study specifically examines how trust can be achieved within a specific virtual space (in this case, a voice based platform for trade of aloe products) therefore this study can be narrowed to the field of e-marketplace research. However, this study also falls within the broader definition of m-commerce, which, according to Turban et al. (2008), describes e-commerce activities that occur over wireless networks. Although e-marketplaces are typically characterised by the existence of multiple buyers and multiple sellers within a competitive environment, this is not always the case as e-marketplaces can take many different forms. These e-marketplace classifications are further expanded in Section 2.3 of Chapter 2.

E-marketplaces have the potential to bridge the gap between rural farmers and buyers as they facilitate the exchange of information amongst parties. According to findings from Jensen's (2007) study, when information becomes more widely accessible, price disparities decrease, waste decreases and consumer and producer welfare increases. This holds

promise in agriculture where farmers are often remotely situated from buyers of their products, and often have to settle for the price that is offered rather than the optimal price. However, the barriers to ICT adoption in rural areas limit the ability of rural farmers to leverage the opportunities presented by e-commerce. The lack of access to Internet enabled devices and the high cost of Internet connectivity are two of the many obstacles that hinder the adoption of e-commerce by rural communities.

Spoken Dialogue Systems (SDSs) address the barriers to ICT adoption associated with the high cost of Internet connectivity and the high cost of Internet enabled devices as they are accessible from the most basic mobile or fixed line telephone handsets (Agarwal, Jain, Kumar, Nanavati, & Rajput, 2010). An e-marketplace delivered over a SDS allows sellers to reach buyers without the need for Internet connectivity or even a computer because SDSs support interaction between users and technology through verbal gestures (Glass, 1999). According to Glass (1999), SDSs are capable of enabling users to obtain information, conduct transactions or process data. Despite the benefits that SDSs present in addressing the barriers to e-commerce adoption facing rural communities, this study suggests that there is a lack of trust in Information Technology artefacts by rural agricultural communities that impedes the adoption of the technologies.

Most researchers who have assessed the influence of trust on technology adoption have done so with respect to technologies that are characterised by marked risks that may, in turn, result in material loss. For example, many studies have found trust to influence the use of online stores, Internet banking and mobile commerce (Gefen, Karahanna & Straub, 2003; Kim, Tao, Shin, & Kim, 2010; Kim & Prabhakar, 2000; Masrek, Omar, Ahmad Uzir, & Khairuddin, 2012; McCord & Ratnasingam, 2004; Pavlou & Fygenson, 2006). In addition, studies that have investigated the influence of trust on e-commerce adoption have emphasised the financial loss that may arise due to the non-delivery of goods, misrepresentation of goods ordered or the accessing and misuse of personal information by parties outside of the e-commerce transactions (McKnight, Choudhury, & Kacmar, 2002). However, there have been a few studies that have recognised that trust may influence e-commerce adoption even in the absence of the risk of material loss. These studies acknowledge that risk may manifest in the form of time lost, reduced performance or disapproval on the part of relevant reference groups (Azzam, 2013). In addition, adopting e-

marketplaces requires investment into aligning the platform with the strategy, resources and processes of an organisation (Pires & Aisbett, 2003). Thus, rural farmers would have to make significant changes in their livelihood strategies to accommodate an e-marketplace. Dercon and Christiaensen (2011) argue that low income farmers do not have the capacity to deal with negative outcomes that may arise from shifting the way in which they operate in order to accommodate new technologies. They state that the loss of income that may arise from adopting new technologies may affect the low income farmers more adversely as compared to their high-income counterparts. Although Dercon and Christiaensen (2011) use this argument with respect to agricultural innovations, the same rule is likely to apply to the activities linked to the marketing of agricultural products. Rural farmers cannot afford to compromise their relationships with reference groups of importance such as agricultural middlemen. In addition, they cannot afford to divert time from their core activities to invest in understanding the paradigm of marketing and technology that e-marketplaces present. As a result, it is clear that trust constitutes a significant barrier to e-marketplace adoption by rural farming communities.

This study seeks to understand how an e-marketplace could become trusted and, thus, adopted in a rural agricultural community. Accordingly, this study uses an Action Research strategy to design, develop and deploy an e-marketplace to support the interaction between buyers and sellers in the aloe industry in Western Cape Province. Exploratory desktop research undertaken on the initiation of the study, revealed that the aloe industry in South Africa is made up primarily of aloe processing plants, cosmetic and healthcare product manufacturing firms and aloe harvesting communities. Thus, the initial scope of this study was to create a platform that engaged the aforementioned stakeholder groups to facilitate trade from the level of the aloe harvesters to the level of the aloe based product manufacturers. The concept of using a voice based platform emerged when the opportunity arose to collaborate with the IBM Speech Technologies Research group in Israel and the IBM Spoken Web Research group in India. This collaboration dictated that the research team focus on voice as a medium of information exchange in e-commerce. Therefore, the scope of this project did not accommodate the evaluation of alternative forms of m-commerce exchange such as Short Message Service (SMS) or Unstructured Supplementary Service Data (USSD).

A conceptual model depicting the potential interactions between the identified stakeholder categories was developed to illustrate how a voice based e-marketplace could possibly function within the aloe industry. This model was compiled based on information obtained from the websites of several aloe processing plants, as well as telephonic interviews with individuals that had operated within the aloe industry. The model formed the basis upon which a voice based e-marketplace could be examined in the aloe industry. The researchers then proceeded to evaluate the feasibility of the model by engaging in interviews with the assistance of two aloe processing plants (One based in the Eastern Cape Province and the other in the Western Cape Province). The interviews held with the two aloe processing plants revealed that the processing plants and aloe healthcare manufacturers were already leveraging e-commerce effectively to trade amongst one another. Accommodating interaction between these two stakeholder groups was therefore of no benefit to them. The conceptual model was thereafter revised to focus the study on enabling the aloe harvesters to sell their harvest to the aloe processing plant more effectively.

The Action Research intervention was centred on cycles of analysis, design and implementation of a voice driven e-marketplace that facilitated the sale of aloe sap from rural aloe harvesters to the local aloe processing plant. The aloe value chain is made up predominantly of aloe harvesters, aloe processing plants and manufacturers of aloe based healthcare and cosmetics. The aloe processing plants refine the aloe sap that is harvested by rural aloe harvesters into aloe gel, crystals, powder or lumps. These products are then sold as raw inputs to the manufacturers of health care and cosmetic products. The aloe industry in South Africa dates as far back as the 1700s. It has been suggested that aloe lumps were among the first processed natural products to be exported from South Africa. The demand for processed aloe raw materials is high throughout the world. According to the representatives of the aloe processing plants who were interviewed for the purposes of this study, the majority of processed aloe is sold to the international market. With clients in Asia, Europe and the USA, the economic growth of the aloe processing plants has benefited rural farming households as the industry is completely dependent on the labour of the rural aloe harvesters. Although there are no official figures indicating the actual monetary value of the industry available, the economic significance the aloe industry, according to the few published studies, is indisputable. More notably, the value of the industry to the rural aloe harvesting households is substantial. In 2007 the industry was estimated to be worth R150

million annually (Shackleton & Gambiza, 2007), contributing R12 to R15 million annually in income for rural aloe harvesters (Shackleton & Gambiza, 2007).

The Western Cape Province's aloe industry is totally dependent on the labour of rural harvesters, who work independently harvesting the aloe that either grows wild in public areas or on private farms. In many cases the revenue earned from aloe harvesting for rural aloe harvesters is in addition to the income earned from their primary employment activities. Although the income from the harvesting of aloes varies greatly the income from aloe harvesting is significantly higher than that earned from most rural agricultural activities and, thus, the industry makes a considerable contribution to the socio economic wellbeing of the communities in question. It has even been stated by the representatives of the aloe processing plants that were interviewed that some aloe harvesters have even managed to pay for their children's higher education from the income earned from aloe harvesting.

Several aloe processing plants in South Africa have successfully leveraged the power of e-commerce to advance their businesses. However, despite the success of the aloe industry, according to an interview conducted with a respondent from one of the processing plants, rural harvesters have been resistant to adopting technology, working as collectives or incorporating greater structure into the way in which they operate. The evidence from this study indicates that there are gaps to be filled in the flow of information and the efficiency of the interaction between the sellers (aloe harvesters) and the buyers (aloe processing plants). The intervention will be described in depth in Chapter 6 and Chapter 7. This chapter describes the problem that this study sought to address, the research objectives and the research questions that are answered in addressing the research problem. The chapter also describes the theories underlying the study and the methodology that was used to find answers to the research questions. The chapter concludes with an overview of the relevant literature in the field and an outline of the subsequent chapters.

1.2 Problem statement

The majority of the world's rural poor depend on agriculture to support them. E-marketplaces have the ability to improve the interaction between rural farmers and prospective buyers of their products. However, the adoption of e-marketplaces in rural agriculture is constrained by factors such as the low levels of literacy and the lack of access

to e-commerce enabling technologies such as computers and the Internet. The wide proliferation of mobile phones amongst the underprivileged presents new opportunities for the delivery of ICT based services to the poor. Spoken Dialogue Systems, in particular, create an opportunity for some of the information services typically delivered over the Internet to be extended to people who lack the connectivity and the devices necessary to access the Internet (Kumar & Agarwal, 2012). Trust has been identified as a significant contributor to the adoption of new technologies. In particular, a lack of trust has been cited as a significant inhibitor of e-commerce adoption. However, much of the research which has examined trust in relation to e-commerce adoption has focused on trust in interpersonal and inter-organisational relationships, as well as trust in the institutional structures supporting e-commerce (Vance, Elie-Dit-Cosaque, & Straub, 2008; Wang & Benbasat, 2005). Research into trust in the technology dimension has been limited primarily to the risks associated with information and transaction security. According to Vance et al. (2008), there has been limited examination of trust with respect to the extent to which users are willing to rely or depend on a technology artefact in order to undertake tasks. For rural farmers the technology related risks associated with e-marketplace adoption extend beyond privacy and security. Adopting e-marketplaces requires investment into aligning the e-marketplace platform with the existing business practices (Pires & Aisbett, 2003). Organisations are forced to make significant changes to their business strategies and processes to accommodate e-marketplaces (Pires & Aisbett, 2003). However, rural farmers do not have the capacity to deal with any negative consequences that may arise from shifting the way in which they operate to accommodate the new technologies (Dercon & Christiaensen, 2007) nor do they possess the resources required to make an effective transition to an online marketplace. If rural farmers are to adopt e-marketplaces, they have to be convinced of the value proposition of the e-marketplace and they should also be willing to depend on the ability of the e-marketplace to achieve the proposed value. As such, understanding the factors that influence a rural farmer's willingness to depend on (in other words, trust) a technology will assist in understanding how their adoption of the given technology may be enhanced.

1.3 Research objectives

This study attempts to develop a model for enhancing the trust of rural farming communities towards a voice based e-marketplace. The model will be based on the interactions which

took place between the researcher and the identified aloe farming community during the process of designing, developing and deploying a voice driven e-marketplace. The factors leading to this trust are critically assessed in order to answer the research question.

The following secondary objectives guided this research study:

i. To determine the factors that impede the ability of rural farmers to benefit from e-marketplaces.
ii. To define the nature of trust and the factors determining trust in relationships.
iii. To adapt the factors determining trust in interpersonal relationships to the context of trust between human beings and technology.
iv. To examine the concept of e-marketplace trust in a rural farming setting.

1.4 Research questions

This study examined the extent to which a rural farming community could trust and consequently adopt an e-marketplace delivered over a voice based platform. In order to address this issue, the researcher conducted a literature review to gain an understanding of the factors that affect the adoption of e-marketplaces by rural communities, the nature of trust and how it influences decision making in relationships and the way in trust is determined when the object of trust is an e-marketplace technology. The literature review was concluded with an examination of SDSs targeted at users from rural areas with the aim of understanding the factors that challenge the use of such SDSs. The main research question and the research sub questions are, therefore, structured as follows:

1.4.1 Main research question

How can trust in voice based e-marketplaces be enhanced to improve their adoption by rural farming communities?

1.4.2 Research sub-questions

The following questions were posed in order to arrive at an answer to the main research question:

i. **What are the barriers facing e-marketplace adoption by rural farming communities?**

   This question recognised the pivotal role which agriculture plays in the quest for socio economic development. Firstly the question focused on examining the role of

ICTs in the empowerment of farming communities and, thereafter, introduced the barriers to ICT adoption by rural farmers. These barriers were related to the adoption of e-marketplaces. It became clear that e-marketplaces have the ability to bridge the gap between the buyers and sellers of agricultural products by facilitating the exchange of information to either directly or indirectly enable transactions. However, it was found that the ICT barriers of a lack of accessibility, lack of context, lack of enabling policy, language and literacy barriers, lack of skills and a lack of understanding of the value proposition of e-marketplaces all impede the adoption of e-marketplaces by rural users.

ii. What are the factors that determine trust in relationships?

This question lay the foundation to understanding the factors which may result in trust in an e-marketplace as a technology artefact. This question required the researcher to evaluate trust from a theoretical perspective. Although the theories examined emerged from the study of trust in interpersonal and inter-organisational relationships, nevertheless, they also formed the basis upon which trust in technology artefacts could be understood. In investigating this question the study found that trust is a judgement made by one party about another's trustworthiness, based on the former's perception of the latter's ability, benevolence and integrity. Trust influences the risk taking behaviour of one party towards another. Additionally, trust is influenced by the outcomes of an exchange where another party is relied upon to achieve a desired result.

iii. **How is the trustworthiness of a technology artefact determined?**

In order to answer this question, the factors defining trustworthiness in interpersonal and inter-organisational relationships were applied to trust in the context of human-technology relationships. It emerged that the trustworthiness of a technology artefact is shaped primarily by the users' perception of the artefact's capability to perform the tasks expected of it, the reliability and dependability with which the intended tasks are performed as well as the utility, value or usefulness the technology provides to its users.

iv. **What factors influence the perceptions of the trustworthiness of Spoken Dialogue Systems in the context of rural users?**

This question explored the technical limitations of interaction with voice based systems, particularly when such systems are used by inexperienced users and users that speak low resourced languages, as is the case with rural users. These limitations were discussed with respect to the users' perception of the trustworthiness of SDSs.

1.5 Research methodology

The study involved a project aimed at designing a voice based e-marketplace system to support trade between the stakeholders of a rural aloe harvesting and processing community. The project activities involved the design, development, training and deployment of the system. The project sought to understand the role of trust in the participants' decision to adopt a voice based e-marketplace technology, and to develop a model for enhancing trust in similar implementations. The next section describes the approach that was adopted to find answers to the research questions.

1.5.1 Research philosophy

This study adopted a pragmatic research philosophy. Pragmatism is rooted in the belief that a proposition is true if the proposition functions satisfactorily and the meaning of the proposition is to be found in the practical implications of accepting such a proposition (McDermid, 2006). Pragmatism is concerned with action and change and seeks knowledge through intervention rather than observation (Goldkuhl, 2012). Goldkuhl (2012) maintains that the construction of knowledge in pragmatism is not restricted to explanations or

understanding but, instead, it recognises other knowledge forms such as prescriptive, normative, prospective and explanatory knowledge.

1.5.2 Research strategy

The study applied a pragmatic approach to understanding how the trust in a voice based e-marketplace targeted at a rural farming community may be enhanced in the interests of the improved adoption of the e-marketplace. In order to address the research question, an Action Research approach was applied to assess the extent to which rural users trust an e-marketplace and, therefore, adopt it in their livelihoods. This study took the form of canonical Action Research as defined by Davison, Martinsons, and Kock (2004). Canonical Action Research is founded on five core principles. The first underlying principle is that there should be mutual agreement between the research team and the client regarding the research objectives and anticipated outcomes. The second principle of canonical Action Research specifies that a cyclical process comprising stages of problem diagnosis, planning, action, observation and reflection are undertaken. It is essential that each phase is suitably documented to ensure that the results are trustworthy. The third principle of canonical Action Research suggests that the research be guided by theory while the fourth principle states that the intervention should result in changes that are directly related to the problems that were initially diagnosed. The fifth principle is that the intervention must result in learning through reflection with such learning reflecting the implications of the research for the community involved, for similar research domains and for the theories underlying the research (Davison et al., 2004).

As described in Davison et al. (2004) the intervention in this study included the cycles of diagnosis, planning, implementation, observation and reflection. These cycles were focused on the collaborative design, development and deployment of a voice based e-marketplace in a rural African aloe harvesting community in South Africa. The stages made use of activities aimed at understanding the problem domain and assessing how an e-marketplace may be applied to support existing activities within the aloe community. During these cycles the researchers engaged with the users to develop an e-marketplace model that supported the interaction processes between the stakeholders in the aloe value chain. An e-marketplace was then developed based on the e-marketplace model and the users were given the opportunity to utilise the e-marketplace independently. Issues relating to trust

and adoption encountered during the intervention formed the basis of the envisaged contribution of this research study.

1.5.3 Research method

The research method used was deemed to be appropriate to the nature of the questions that the research sought to answer. Quantitative measures seek to identify causal relationships, make predictions and create generalisable theories, while qualitative research aims at achieving illumination, understanding and extrapolation of phenomena within similar contexts (Hoepfl, 1997). Accordingly, in view of the research problem at hand, and the purpose and objectives of the study, it was decided to use a qualitative research approach. Thus, the data collection methods used sought to derive a rich insight from the perspective of both the research team and the participants.

1.5.4 Sampling methods

Purposeful sampling seeks information rich cases which may be studied in depth (Patton, 1990). For the purposes of the study a purposeful sample was selected based on the following criteria:

- The geographic proximity of the aloe community to the university where the researchers were based.
- The extent to which an e-marketplace could support the existing business model of the aloe harvesters.
- The level of organisation that existed to support an effective research process.
- The willingness of the respondents to participate in the project.

In view of the fact that the study was qualitative in nature and did not intend to make inferences from the sample to the population, the population size was not deemed to be relevant.

1.5.5 Data collection

The data was collected in accordance with the cycles of the intervention and the nature of the information required. The research was undertaken in cycles in order to understand and model the users' problem space, model an e-marketplace based on the users' problem space, develop and test the e-marketplace with its intended users, provide training and then

deploy the e-marketplace. The primary data collection methods included observation and open ended interviews. In addition, prototyping and observation were used to assess the extent to which the e-marketplace responded to the users' needs while interviews were conducted to evaluate the extent to which the application satisfied the needs of the users and the level of trust of the users in the application.

1.5.6 Data analysis

The data was presented as a critical narrative which reflected evidence from the intervention to support the propositions relating to trust and the adoption of an e-marketplace. Relevant concepts were identified using the processes of open coding, axial coding and categorisation as described by Lichtman (2013).

1.6 Theoretical underpinnings

This study is founded on two theories; the Integrative Model of Organisational Trust (Mayer, Davis, & Schoorman, 1995) and the Technology Acceptance Model (Davis, 1989). The Integrative Model of Organisational Trust (Mayer et al., 1995) views trust as a reflection of the ability, benevolence and integrity of an entity. Ability refers to the capability or competence required to fulfil the expectations of the trustor. Benevolence suggests that the trustee has the trustor's best interests at heart while integrity implies that the trustee is prepared to subscribe to the rules or principles that are acceptable to the trustor. In addition, the Integrative Model of Organizational Trust recognises that trust is also determined by one's propensity to trust, arguing that some people are more inclined to have faith in humanity or assume risk than others. Mayer et al.'s model (1995) separates trust from behaviour, suggesting that the existence of trust leads to risk taking behaviour. The relationship between trust and risk taking is mediated by the perceptions of the risks surrounding the engagement. Finally, Mayer et al.'s (1995) model recognises that the outcomes of the exchange will determine the trustor's perception regarding the ability, benevolence and integrity of a trustee and inform whether the trustee is regarded as trustworthy or not. For the purposes of this study this model was applied to the relationship between users and technology, where the adoption of the technology represented the risk taking. The application of Mayer et al.'s model is discussed further in chapter 3 and chapter 4.

The Technology Acceptance Model (TAM), developed originally by (Davis, 1989) is among the most widely applied theories used to explain the adoption of technologies by individuals. The TAM is founded on the Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975), which explains the influence of acquired attitudes on one's behavioural intention. TRA states that behavioural intention determines actual behaviour. Accordingly, the TAM applies this theory by stating that the attitude that an individual holds towards a technology will determine the individual's intention to use the technology and, ultimately, the individual's actual use of the technology. The TAM's core contribution is in the identification of the factors that influence one's attitudes towards a new technology. The TAM proposes that an individual's perceptions regarding the usefulness and ease of use of a technology will determine his/her intention to use the given technology. In addition, the TAM also recognises that external factors exist and which shape one's perceptions about the ease of use and the usefulness of a technology. Figure 2-2 depicts the original version of Davis' (1989) Technology Acceptance Model.

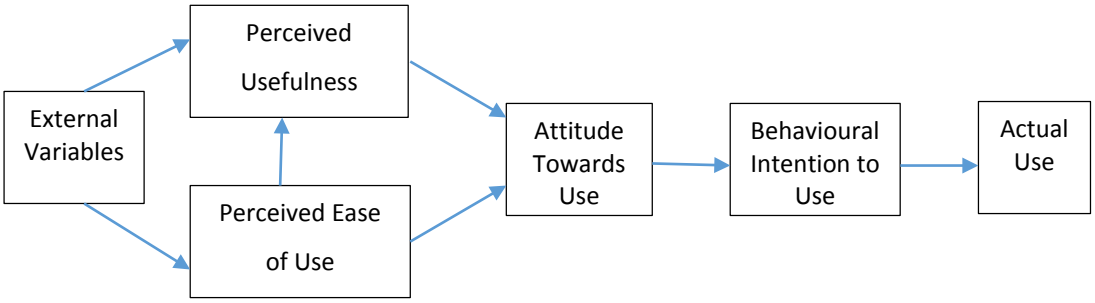


Figure 1.1: The original version of the Technology Acceptance Model. (Davis, 1989)

The proposition suggested by the TAM explains why the adoption of ICTs are often problematic in rural communities. TAM explains that if the technologies are not perceived to be useful by the intended users or the users regard the technology to be too complex to use, they will not demonstrate the behavioural intention to adopt the technology. In this regard, the inherent design-reality gaps (Heeks, 2002) that are prevalent in the technology based solutions intended for rural use as well as the lack of experience, exposure and skills required to utilise these solutions effectively may be considered among the external factors that shape rural user's perceptions of the ease of use and usefulness of technologies.

1.7 Overview of literature

Although the field of ICT4D has grown significantly over the past decade, the challenges involved in implementing ICTs in rural areas have yet to be fully addressed. Research in the field remains vast and uncoordinated. Van Biljon and Alexander (2014, p. 361) describe the state of the discipline as a "fragmented adhocracy" in which multiple intellectual clusters co-exist. Bissyande, Ahmat, Ouoba, Van Stam, Klein, and Le Traon (2013) highlight that numerous conferences on ICT4D have been held with numerous proposals of techniques and approaches being made to resolve ICT problems in the development context. However, as a result of both the vastness of the research and the lack of coordination in the field, researchers are not learning from one another. This was reiterated in the call for papers for the 9th International Development Informatics Association (IDIA) Conference, in which the prevailing disillusionment in the field of ICTD was highlighted. It was argued that little progress had been made as regards the goals of the discipline and that researchers appeared not to be learning from one another's experiences. In addition, it was stated that the field had not progressed from reporting on practical case studies to developing high level theories. As yet, there is no dominant and accepted theory, methodology or framework (Burrell & Toyama, 2009) that inform practitioners on how to implement ICT4D projects sustainably.

According to Toyama (2010), many of the questions asked in the ICT4D have been on the agenda of the Human Computer Interaction (HCI) discipline for decades. The relationship between usability, trust and technology adoption is an obvious relationship in the field of human computer interaction. This was, in fact, the feedback received from an article submitted by the researcher to the IFIP Interact Conference in 2013. Although there have been numerous studies in the HCI discipline which have elaborated on this link between usability, trust and technology adoption, this relationship has, however, rarely been examined as a means of explaining, predicting and/or enhancing the adoption and long term use of ICTs in the context of ICT4D research. Moreover, there is no model or theory that may be used as a point of departure to examine issues pertaining to the adoption of ICTs, thus indicating that the ICT4D domain is not leveraging existing knowledge from the HCI field.

Trust constitutes a critical pre-condition for successful e-commerce adoption because of the extensive dependence on technology to carry out transactions, the anonymity and distance that characterise online exchanges and the privacy and security vulnerabilities associated

with the Internet's openness (Pavlou, 2003). Research into trust in e-marketplaces has focused predominantly on the risks associated with material losses arising from security and privacy breaches or on issues surrounding product delivery and product quality. However, for rural farmers the cost of the time required to familiarise themselves with a new way of doing business is a relevant risk that has seldom been examined in e-commerce adoption literature.

The need for trust implies the perception of risk. Many of the prominent works evaluating the relationship between technology trust and adoption (Baskerville & Myers, 2004; Gefen, 2003; Featherman & Pavlou, 2003; Gefen & Straub, 2000; Kim & Prabhakar, 2000; Li, Hess, & Valacich, 2008) have focused on the relationship between trust and adoption where online risks are prevalent. However, few researchers have recognised that trust in technology has an impact on the adoption of technologies, even in the absence of online risk perceptions. Online risks often have clear financial implications and, as a result, are the subject of intense scrutiny in trust literature. This study is of the view that any circumstance in which technology presents a user with the risk of loss is likely to deter the user from accepting or adopting the technology. For many users, the time and resources required in learning to use the new technology may be perceived as a loss in itself. Various studies (Featherman & Pavlou, 2003; Lu, Hsu & Hsu, 2006) have identified time loss as a risk that users perceive when making adoption decisions. Featherman and Pavlou (2003) and Azzam (2013) further recognise both the perceived performance risk (relating to the technology's ability to deliver what is expected of it) and the social risk (relating to the manner in which the opinions of the adopter's reference groups affect the adopter's decision about the use of a technology) as risks influencing adoption decisions. Other such risks include psychosocial risks, information risks and opportunity cost risks (Azzam, 2013). Rural communities do not invest significant financial resources directly in participating in ICT4D projects while the risks to which they are exposed are not typically financial. Therefore, the time which they invest, the effect of the project on their social status and their resultant psychological state are more relevant aspects to consider when investigating their adoption decisions.

Mayer et al. (1995) maintain that three characteristics determine one's trustworthiness, namely, ability, benevolence and integrity. This study applied these factors of trustworthiness, as defined by Mayer et al. (1995), in defining trust in technology because,

firstly, the factors appear extensively in trust-related literature (Mayer et al., 1995) and, secondly, because they form the foundation of much of the literature on technology trust. These factors also apply to trust in interpersonal relationships. However, when the object of trust is a technology artefact, Li, Rong and Thatcher (2009) and McKnight (1995) define the perception of trustworthiness as the belief in a technology's capability to fulfil an intended task and to perform without errors, delays, conflicts or unexpected results. McKnight, Carter, Thatcher, and Clay (2011) extend this definition by adding that the factor of benevolence as ascribed to a technology may be said to refer to the extent to which the technology is found to be helpful by the user.

1.8 Significance of the study

In his Nobel Prize acceptance speech, Schultz (1979) stated: "Most of the people in the world are poor, so if we knew the economics of being poor we would know much of the economics that really matters. Most of the world's poor people earn their living from agriculture so, if we knew the economics of agriculture, we would know much of the economics of being poor." In addition the Global Donor Platform for Rural Development (2015) recognises that poverty is most prevalent among rural populations and that rural populations depend primarily on agriculture in order to survive. The Global Donor Platform for Rural Development (2015) further argues that addressing poverty requires that investment be made into rural development and that rural communities be provided with a fair opportunity to elevate themselves as well as be given say in how their problems are resolved. This study reveals the viability of an e-marketplace and voice based technologies in a real setting, thus providing an insight into the realities of voice based e-commerce as regards supporting rural agriculture.

1.9 Delimitation and Scope

This study recognises that trust in an e-marketplace may be examined in respect to the interpersonal relationships within the marketplace, the perceptions regarding the e-marketplace as an institution and the security mechanisms in place to protect e-marketplace participants. Although all of these facets of trust are relevant to the decision to participate in an e-marketplace, it was not deemed possible to examine them all in one study. Accordingly, this study focused on trust in the technology artefact. In addition, while the study acknowledges that trust is not the only factor that influences the adoption of new

innovations, the scope of this study was limited to the relationship between trust in a technology and the adoption of such technology.

1.10 Ethical considerations

This study complied with the policy set out by the Nelson Mandela Metropolitan University Ethics Committee. This study would not have been possible without the participation of the aloe community in the Western Cape. It was, thus, the responsibility of the researcher to ensure that the participants would not be exposed to any negative outcomes as a result of their participation in this research study. The cardinal principle of ethics in research is the principle of non-maleficence (Warusznski, 2002). This principle means that the research should not expose the subjects to risk nor should it inflict harm on them. In order to ensure non maleficence, the study applied the principles of informed consent and anonymity. The study did not reveal any identifiable information about the research subjects. Furthermore the respondents were briefed in full about both the nature of the project and the nature of their participation. The respondents were also informed that they were entitled to withdraw from the study if they did not feel comfortable at any point.

1.11 Chapter overview

The study was subdivided into three sections, namely, the introduction, the theoretical framework and the empirical framework.

The first chapter, namely, the introduction, contained a detailed summary of the research conducted. The second section, namely, the theoretical framework followed and comprised a literature review which was subdivided into four chapters related to the sub research questions which had been formulated.

The literature review was subdivided as follows:

The first chapter of the literature review (Chapter 2) defined e-marketplaces and examined these marketplaces in the context of rural agriculture. The chapter then discussed the significance of agriculture to socio economic development before proceeding to outline the

role of ICTs in supporting rural agriculture in developing countries. The chapter concluded by exploring the barriers to the adoption of ICTs by rural farming communities.
The second chapter of the literature review (Chapter 3) contained an in depth theoretical examination into the nature of trust and the factors that determine trust in a relationship. These factors provided a foundation upon which the factors influencing trust between humans and a technology were determined.

Chapter 4 recognised that users trusting an e-marketplace would make trusting decisions based on their level of trust in the organisation or individuals with whom they interacted, the underlying systems or processes as well as their beliefs about the actual technology. Although the study recognised that trust in an e-marketplace is possible only when trust is addressed in all the aforementioned aspects, the study was limited to an investigation into trust in the technology dimension. Accordingly, this chapter focused on those factors that determine trust in a specific technology artefact.

The final chapter of the literature review contained a discussion of voice based ICTs in order to assess their applicability to rural farmers. The barriers to ICT adoption by rural farmers were reviewed from the perspective of voice based e-marketplaces. The literature review concluded with a synthesis of the findings from the four chapters. This, in turn, provided a basis for the empirical section.

The empirical section was preceded by a chapter detailing the research methodology that was applied (Chapter 6). This chapter detailed and motivated the philosophy, strategy and methods which were applied in order to discover answers to the research questions.

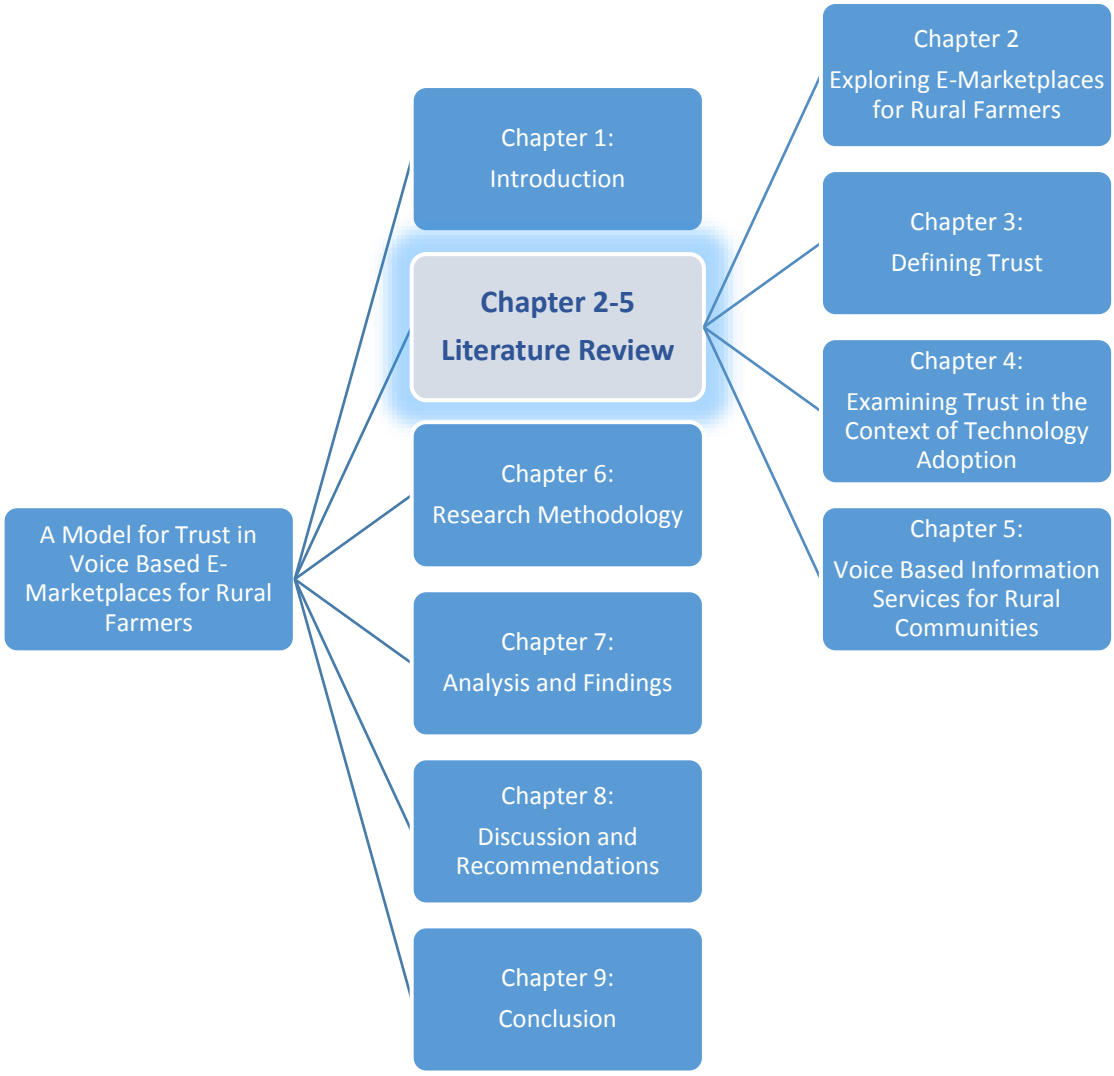
The chapter presenting an analysis of the data analysis (Chapter 7) described the Action Research intervention that was undertaken and presented the findings from this intervention.

The analysis chapter was followed by the chapter elaborating on the findings and offering recommendations. This chapter also presented the study's key research contribution and contained a critical discussion explaining how the model had been derived. The chapter also provided recommendations for the implementation of the proposed model.

Chapter 9 concluded the thesis and, as such, reflected on the entire research process with respect to the research objectives, the research findings and the implications of the findings.

Literature Review

A theoretical examination of technology trust in voice based e-marketplaces for rural farmers


A Model for Trust in Voice Based E-Marketplaces for Rural Farmers
Chapter 1: Introduction
Chapter 2-5 Literature Review
Chapter 6: Research Methodology
Chapter 7: Analysis and Findings
Chapter 8: Discussion and Recommendations
Chapter 9: Conclusion
Chapter 2 Exploring E-Marketplaces for Rural Farmers
Chapter 3: Defining Trust
Chapter 4: Examining Trust in the Context of Technology Adoption
Chapter 5: Voice Based Information Services for Rural Communities

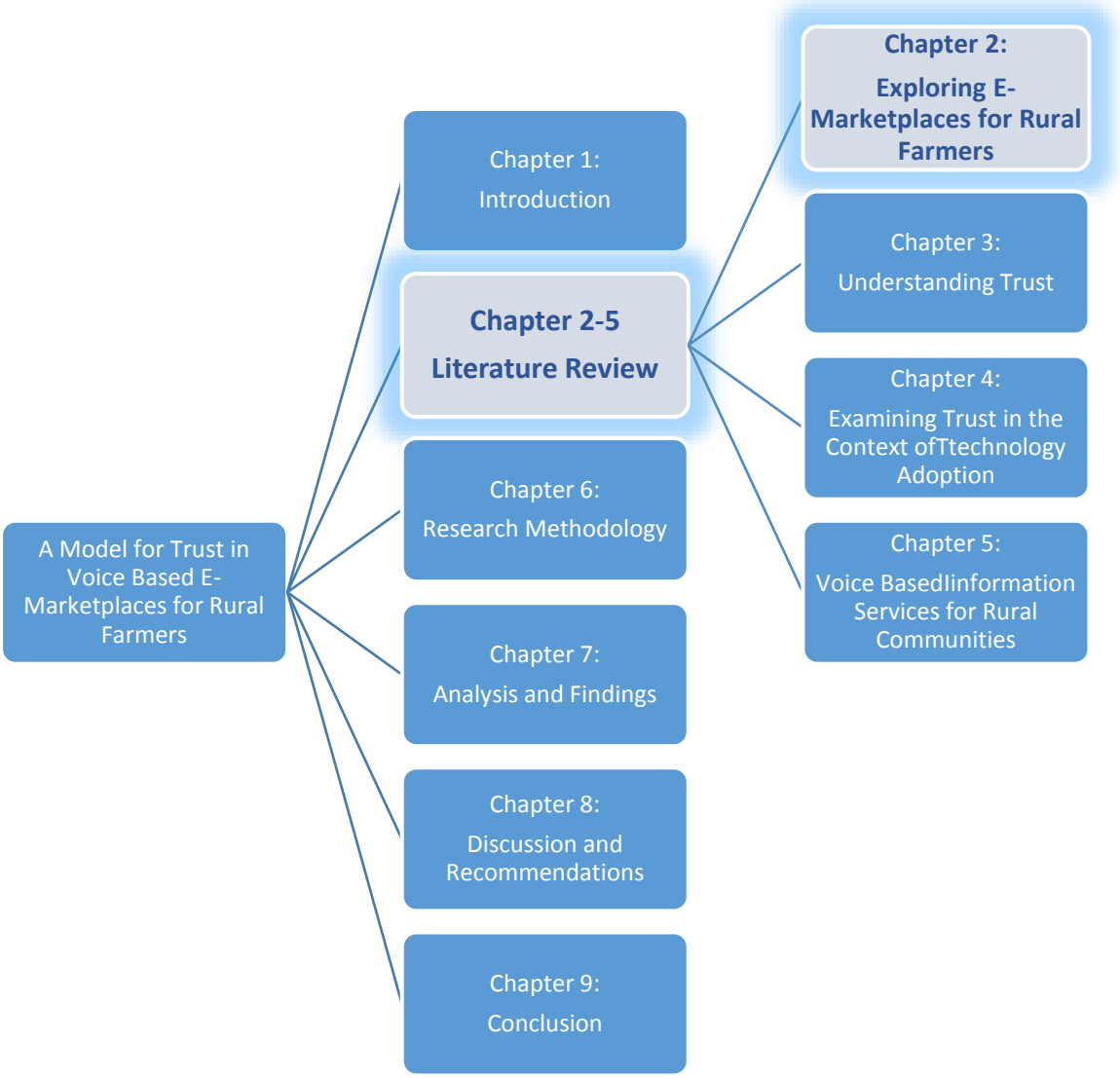
Literature Overview

Technologies that are widely perceived to bring value to users in the context of developed countries are not always readily adopted by rural users in the developing world. E-marketplaces, in particular, have the potential to create immense value for rural farmers and yet there is little evidence of their adoption in this context. Rural users with limited experience of information and communication technologies (ICTs) are particularly sceptical about the role technology may play in their income-generating activities. In addition, they also face numerous barriers in accessing and utilising ICTs to support their livelihoods.

This study seeks to understand how trust in a voice based e-marketplace may be enhanced to ensure user acceptance and adoption. In order to do this a literature review was conducted with the following objectives:

- To determine the factors affecting e-marketplace adoption by rural farming communities
- To define and understand the nature of trust
- To relate the concepts of interpersonal trust to the context of trust in e-marketplace technologies
- To describe how the challenges associated with voice based information services affect the trust of rural farming communities in voice based e-marketplaces.

Chapter 2: Examining e-marketplaces in the context of rural farming communities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Chapter 4: Examining Trust in the Context ofTtechnology Adoption
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2.1 Introduction

E-marketplaces have the potential to support rural farming communities by providing them with improved access to buyers and enabling them to attain higher prices for their produce than may otherwise be the case. There are numerous obstacles that inhibit the ability of rural farmers to achieve the benefits that e-marketplaces offer. The barriers to ICT adoption that face rural communities as well as the lack of bargaining power that rural farmers possess within the agricultural sectors challenge the ability of rural farming communities to emancipate themselves from poverty through e-marketplaces. This chapter argues for the introduction of e-marketplaces for rural farmers. The chapter also discusses the role of agriculture in the development of rural communities. The range of technologies that may be classified as e-marketplaces is extremely broad and, thus, this chapter will also seek to define e-marketplaces in order to add perspective to the scope of the study. This is followed by an overview of the benefits of ICTs, particularly e-commerce technologies, for rural communities. Finally, the chapter contains a review of the factors that challenge the adoption of e-marketplaces by rural farming communities. These factors form the basis for the presentation of trust in technology as a barrier to e-marketplace participation.

2.2 Background

Improving agriculture in developing countries has the potential to improve the quality of life of rural communities. The sections that follow discuss the role of agriculture in addressing poverty and enhancing development. The aim of section 2.2.1 is to highlight the importance of the agricultural sectors of developing countries and also to argue for the use of ICTs, specifically e-marketplaces, in advancing agricultural communities.

2.2.1 The role of agriculture in socio economic development and poverty reduction

In 2008 the agro industry was estimated to account for more than a third of the GDP in Indonesia, Chile, Brazil and Thailand, between 20 and 25% of that of Sub-Saharan countries, and 50% of that of the developing countries collectively (UN Commission on Sustainable Development, 2008). The agro industry is not concerned with only agriculture but extends to include the distribution and trading activities in respect of agricultural commodities. The role of agriculture in addressing the challenges associated with economic development and poverty, particularly in developing countries, has been the subject of much debate over the past few decades. Christiaensen, Demery, and Kuhl (2010) presented two contrasting

schools of thought in this regard. The first such school of thought emerges from the works of Lewis (1954) which regarded the agricultural sector as a backward, economically unproductive subsistence sector. This perspective prioritised the investment of resources in the industrial sector which at the time was more productive and dynamic as compared to the agricultural sector. However, according to Lipton (1977, in Christiaensen et al., 2010), this perspective resulted in over taxation within the agricultural sector as well as the prioritisation of urban development at the expense of rural development. Lewis' (1954) perspective regarding the role of agriculture in economic development is consistent with evidence from the world's weakest economies. Today, some of the poorest countries in the world depend primarily on their agricultural sectors (Aker, 2011).

In contrast, the seminal contributions of Johnston and Mellor (1961) and Schultz (1964, in Awokuse, 2009) recognised that, although economic growth that stems directly from the agricultural sector may be slow, advancements in agriculture stimulate growth in other sectors. Numerous writers have cited significant multiplier effects from the investment in agriculture on growth in other sectors (Awokuse, 2009; Aker, 2010). Moreover, the role of agriculture should not be regarded exclusively in terms of its contribution to GDP and economic growth as, in addition to its contribution to GDP, agriculture also plays a critical role in socio-economic development through its contribution to employment creation and income generation (Andzio-Bika & Kamitewoko, 2004). The Millennium Development Goals (MDGs) recognise that the majority of the world's poor rely on agriculture for their livelihoods and, thus, the MDGs emphasise the role of agriculture in poverty reduction as opposed to overall economic growth (Christiaensen et al., 2010). The MDGs recognise the need for income generating activities that originate from areas in which the poor are able to participate (Christiaensen et al., 2010).

2.2.2 The role of ICTs in empowering rural farming communities

ICTs have been widely researched in the context of rural agriculture as regards agricultural extension initiatives. According to Adeyemo (2013), agricultural extension involves catalysing positive changes in the behaviour of farming communities by both engaging in strategies and programmes of change and by applying advancements in scientific and technological innovation. The concept of agricultural extension emerged from the notion of "extending" the scientific agricultural production knowledge encompassed in the agricultural

education programmes offered at institutions of higher learning to farming communities through the process of informal education activities.

Today agricultural extension is not concerned only with the dissemination of scientific agricultural advancements but, according to Oakley and Garforth (1997) and Adeyemo (2013), it also includes:

- Supporting the application of advanced scientific knowledge to both the farming activities and homes of rural communities.
- The management of land based issues facing farming communities.
- The overall improvement of the quality of life of rural farming communities.

Throughout history, advancements in agricultural technology have been directly linked to the advancement of agriculture and the establishment of rigorous economies (Andzio-Bika & Kamitewoko, 2004). The use of ICTs to support agricultural extension has been the subject of much research over the years. Numerous projects have been initiated to exploit the power of Information Technology to support the goals of agricultural extension. However, despite the fact that agricultural extension includes the improvement of the quality of life of farming communities, many agricultural extension initiatives have focused primarily on the dissemination of farming knowledge, some have focused on providing farmers with access to agricultural commodity stock prices while a very small proportion have examined agricultural extension as a mechanism with which to provide farmers with direct access to the buyers of their products. Kameswari, Kishore, and Gupta (2011) identified the following four broad categories of services delivered by ICT based agricultural extension projects:

- Delivery of information regarding government programmes to rural communities.
- Making real-time agricultural commodity stock prices available, supporting the procurement of farming inputs and facilitating the sale of agricultural produce.
- Training and development of rural farmers through the use of ICT tools such as video conferencing, voice and text-based messaging and interactive community radio broadcasts.

- Provision of offline material relating to agricultural practices and technologies.

In their discussion of a study which surveyed more than 200 ICT based agricultural projects in India, Kameswari et al. (2011) only mention one service aimed at facilitating the sale of agricultural produce for farmers in India. This was the e-Choupal service that was initiated by the India Tobacco Corporation. Farmers using e-Choupal benefited from prices that exceeded what they were receiving from the government markets by 2.5% and, consequently, e-Choupal had over 4 million registered users. The remaining projects discussed focused on the other focus areas of ICT based agricultural extension. However, although the e-Choupal platform resulted in farmers obtaining higher prices for their goods, it did not improve the ability of the farmers to negotiate the prices of their goods as it provided access to one buyer only.

Farmers obtain the lowest proportion of all stakeholders of the final price of the goods they sell. According to Behera et al. (2015), middlemen enjoy margins of more than 60% on the prices paid to farmers and without adding any value to the products. In cases such as cocoa production in West Africa, many rural farmers are never able to afford to experience the end product that results from their labour. Cocoa based products such as chocolates are luxury goods, and the majority of cocoa farming households live below the poverty line, earning less than $2 (US) a day (Fairtrade Foundation, 2011). The cocoa farmer's proportion of the value of the finished product may be as little as 3.5% (Fairtrade Foundation, 2011). Consequently, there is a high demand for child labour on the cocoa plantations as few adults are willing to work for such low returns (Fairtrade Foundation, 2011). The fair trade movement has attempted to respond to the inequities between the amount paid to rural farmers and the market value of agricultural goods. However, the ability of farmers to sell their goods at fair trade prices has been constrained by the prohibitive costs associated with the certification and compliance of their products and, thus, only the more economically empowered farmers are reaping the benefits of fair trade. The geographic isolation of farmers with respect to their market means that they have limited bargaining power and are often forced to accept the prices that the intermediary is willing to pay. Kameswari et al. (2011) add that the perishable and time sensitive nature of many agricultural products, the lack of access to alternative buyers and the unavailability of sufficient storage facilities

constrain the bargaining power of farmers even further. According to Kameswari et al. (2011), rural farmers are also often financially indebted to the middlemen and, thus, they are compelled to sell to these middlemen. Hira and Ferrie (2006) are of the opinion that the nature of the market for agricultural commodities does not favour the rural farmer as there are numerous suppliers while the buyer market is inherently oligopolistic. For example, there are only four major buyers in both the coffee market and the market for cocoa beans (Fairtrade Foundation, 2011; Hira & Ferrie, 2006). E-commerce is, thus, unlikely to gain much support in terms of the relationship between farmers, middlemen, commodity markets and the manufacturers of cocoa based products as it would empower the farmers at the expense of all the other stakeholders. However, although the structure of the current market for agricultural commodities is unlikely to accommodate e-commerce, the same products may still be sold to other consumer markets. For example, the same cocoa beans, for which cocoa farmers were paid $0.88 (US) in the commodity market (according to commodity price data from 2014), are sold on e-marketplaces such as Amazon and E-bay for approximately $33 (US). In this case the only value addition is the packaging, import duties and shipping fees. Similarly, shea butter and cocoa butter, which are used as manufacturing inputs in a very oligopolistic chocolate manufacturing industry, are also highly in demand in the much more competitive cosmetics manufacturing industry as well as in the consumer market for organic unrefined products.

2.3 Defining e-marketplaces

Wang and Archer (2007) state that, despite the rapid emergence of e-marketplaces as a research topic, researchers have, nevertheless, failed to reach agreement on the definition of the term e-marketplaces. Wang and Archer (2007) add that the attempts to narrow the definitions of e-marketplaces by classifying them according to certain criteria have resulted in even more confusion. Although e-marketplaces are recognised by various terms, definitions and classifications, Wang and Archer (2007) argue that the definition and classification that researchers adopt in defining them should be determined based on the topic of the research being conducted. Matook and Vessey (2008) argue that the confusion in the understanding of e-marketplaces stems from the failure to distinguish between the various forms of e-marketplaces. The views of Wang and Archer (2007) and Matook and Vessey (2008) are not in contradiction as both recognise that the e-marketplace will be defined according to the manner in which it facilitates interaction between stakeholders.

It is, therefore, necessary to understand the nature of the interaction between the buyers and sellers within the marketplace's unique context in order to align a study to a particular definition for the concept. In the section that follow, the factors that distinguish one e-marketplace definition from another are discussed.

2.3.1 Dimensions of e-marketplace definitions

According to Wang and Archer (2007), e-marketplaces may be defined based either on the nature of the interaction between the players or on the degree of centralisation of the marketplace. This distinction is clarified in the next sections.

2.3.1.1 E-marketplaces as governance structures or as business models

Wang and Archer (2007) differentiate between e-marketplaces by classifying them as either governance structures or business models. Standing, Love, Stockdale and Gengatharen (2006) recognise this distinction and refer to e-marketplaces as either structures or strategies. Their view of e-marketplace structures is consistent with what Wang and Archer (2007) define as governance structures while their view of e-marketplace strategy is aligned with Wang and Archer's (2007) view of e-marketplaces as business models. Standing et al. (2006) and Baldi and Borgman (2001) list four types of e-marketplace structures:

- **Private marketplaces:** These are e-marketplaces that are operated by individual companies to enable them to interact directly with their buyers or suppliers.
- **Public or intermediary marketplaces:** The e-marketplace is neither a buyer nor a seller, but rather an independent broker of an exchange. Public e-marketplaces may be either vertical or horizontal operations.
- **Consortia marketplaces:** Such e-marketplaces exist when players, who are typically in competition with one another, form a common marketplace in order to interact with suppliers.
- **Community or cooperative e-marketplaces:** Also known as meta-marketplaces, these e-marketplaces are formed when multiple marketplaces collaborate and interconnect their markets so as to increase liquidity.

As opposed to defining e-marketplaces based on their governance structures, e-marketplaces may be also considered according to the economic, relational, service or community value they create for businesses (Standing et al. 2006). According to Wang and Archer (2007), research on e-marketplaces as business models or strategies is not focused only on market efficiency, but also on the optimisation and streamlining of processes.

2.3.1.2 E-marketplace definitions based on the level of centralisation

The level of centralisation of an e-marketplace refers to the degree of control exercised within the marketplace. A highly centralised e-marketplace is one in which numerous controls and structures exist to facilitate the exchange between buyers and seller. In contrast, an e-marketplace that is characterised by a low level of centralisation would simply offer a platform where a buyer may meet a seller. According to this view, even the Internet itself may be considered to be an e-marketplace. Figure 2.1 illustrates the various types of e-marketplaces that occur within each level of centralisation. These range from active operators such as E-Bay, Amazon or consortia that manage their own private e-marketplaces to the entire electronic world outside of the organisation in question. E-marketplaces where the market maker does not offer any controls, protection or support services to enable the transactions are considered to be passive operators. These include operators such as Gumtree and OLX.

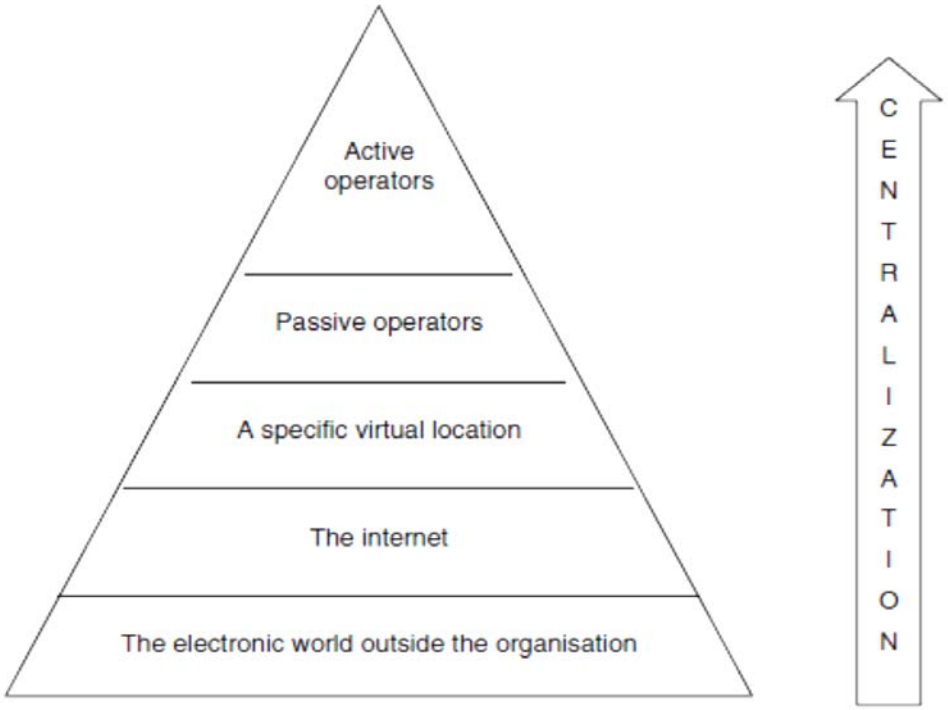


Figure 2.1: E-marketplace centralisation (Wang & Archer, 2005).

Table 2.1 presents a summary of the e-marketplace definitions sourced from Wang and Archer (2007). The table also summarises the key concepts covered in each definition. Based on this summary, this study recognises that the key distinction between the definitions is that certain writers state explicitly that e-marketplaces facilitate transactions while others recognise the role the e-marketplace plays in facilitating the transaction indirectly by enabling the exchange of information. On the other hand, all the writers cited in Table 2.1 recognise e-marketplaces as technology enabled spaces where buyers and sellers meet. Accordingly, this study defines an e-marketplace as a virtual space in which information between buyers and sellers is exchanged through technology with the goal of either directly or indirectly facilitating a transaction.

Table 2-1: Definitions of e-marketplace based on goals (Wang & Archer, 2008).

Author	Definition	Match buyers and sellers	Enable transactions	Information exchange
Malone, Yates, & Benjamin (1987)	Electronically connects several different buyers and sellers through a central database.	√		√
Bakos (1991)	Allows the participating buyers and sellers to exchange information about prices and product offerings	√		√
Bailey (1998);	Exists when a supplier provides goods and services to a customer in a transaction which is partially or fully automated by information technology.	√	√	
Choudhury , Hartzel and Konsynski (1998)	An inter-organisational system through which multiple buyers and suppliers interact to identify and select potential trading partners, as well as to execute the consequent transactions.	√	√	√
Grewal, Comer and Mehta, (2001)	An inter-organisational information system that facilitates electronic interactions among multiple buyers and sellers.	√		√
Grieger (2003)	Brings multiple buyers and sellers together in a virtual sense in one central market place. If it also enables them to buy and sell from each other at a dynamic price which is determined in accordance with the rules of the exchange	√	√	√
(Archer and Gebauer (2002)	A virtual marketplace where buyers and suppliers meet to exchange information about prices and product and service offerings, to collaborate, and to negotiate and carry out business transactions.	√	√	√

2.4 The barriers to the adoption of e-marketplaces in rural communities

In a stakeholder meeting with the Eastern Cape Department of Rural Development and Agrarian Reform (DRDAR) attended by the researcher, it was mentioned that agriculture is a key sector of focus for addressing poverty in rural areas by the Eastern Cape government. As a result, numerous cooperative projects involving rural communities have been initiated. The acting director for ICT for the DRDAR used the example of a regional pineapple farming project that was nearing the harvesting season and, at the time, had not yet identified a suitable market for the produce. He stated that e-commerce had the potential to bridge the divide between the producers and the market and indicated that he was exploring technology based solutions that would serve this purpose.

Given the fact both that the agricultural market is large, with multiple suppliers, distributors and dealers at various levels of the value chain, and the wide geographic dispersion of agricultural stakeholders, e-commerce offers vast opportunities for rural farmers. According to Humphrey, Mansell, Pare, & Schmitz (2003), e-commerce offers a host of advantages to firms in developing countries because the transaction costs associated with e-commerce are less sensitive to distance as is the case with traditional marketing channels while the market channels are both simplified and direct. In addition, e-commerce affords firms in developing countries the ability to retain a larger proportion of the final consumer price than would otherwise be the case. Nevertheless, despite the numerous benefits offered by e-commerce, the agricultural sectors of developing countries have not derived the same competitive advantage from e-commerce as other sectors and have, instead, demonstrated comparatively low adoption rates (Humphrey et al., 2003).

The barriers to the adoption of ICTs by rural communities have been the subject of much research over the recent decades. Consequently, numerous theories and models have been applied in ICT research to explain the issues challenging the adoption of ICTs by rural communities and/or to prescribe ways in which the adoption and use of ICTs by rural communities may be enhanced. Some of the more frequently cited barriers to ICT adoption in rural areas include lack of access to ICT based infrastructure, high communication and connectivity costs, language and literacy barriers, lack of supporting policy for ICT implementation, lack of context of rural ICT based innovations and lack of awareness of the value of ICTS as well as lack of motivation to use them. As an ICT these barriers are relevant

to e-commerce. Accordingly the next section contains an overview of the challenges facing ICT adoption in rural areas and discusses how these challenges relate to e-commerce.

2.4.1 Access to ICT tools and infrastructure

Although the Internet has become an indispensable part of many lives in the developed world, the majority of the world's poor population still does not have access to the Internet (International Telecommunications Union, 2013). Studies indicate that the use of the Internet in developing countries is only slightly more than 25% of global Internet usage. . Early research in the field of ICT4D, referred to by Heeks (2009) as the ICT4D 1.0 paradigm, attempted to bridge the 'digital divide' by availing computers and Internet connectivity to rural communities. Rural telecentres, equipped with PCs and Internet connectivity, were a dominant theme in research at that time. The ICT4D 1.0 paradigm (Heeks, 2009) assumed that the provision of technology and training in the use of technology would result in the adoption and sustained use of ICTs. This did not prove true, and today, there are many abandoned or underutilised telecentres in rural areas.

Trends in the proliferation of mobile phones in developing countries, especially among the poorer communities that historically, have been on the deficient end of the digital divide, have created new opportunities for the use of ICT based services in rural communities. In 2010, Agarwal, Kumar and Manwani (2010) cited that less than 22% of the world's population had Internet access and suggested that most mobile devices with Internet access were unaffordable and did not cater for the levels of illiteracy that characterise the majority of the world's poor. More recent figures indicate that Internet penetration has increased to 42% of the world's population (Internet World Stats, 2015). However, Internet access in the rural areas remains low. In South Africa, in particular, the majority (17.9%) of rural Internet users access the Internet from mobile devices (Statistics South Africa, 2014). As a result, mobile commerce (m-commerce) has emerged as a topical issue in Information Systems research. The ability of m-commerce to revolutionise the impact of e-commerce in developing countries is irrefutable (Heeks, 2009), however, there are many factors in addition to the accessibility of hardware and connectivity that impede the adoption of e-marketplaces in agriculture.

2.4.2 High communication and connectivity costs

Isabirye, Flowerday and von Solms (2013) state that South Africa's telecommunications sector does not create an enabling environment for Internet based ICT services to reach the poor. They argue that the sector lacks competition and that the transformation of the sector that was anticipated following the country's democratisation has never materialised. As a result, South Africa's telecommunications sector performs poorly in relation to its counterparts in Brazil, Russia, India and China (Sutherland, 2012) and the cost of telecommunication is high.

2.4.3 Lack of enabling policy

The high communication costs in South Africa are partly a result of the lack of policy to manage the costs of communication. Isabirye, Flowerday and von Solms (2013) illustrate this point by comparing the South African telecommunications sector to that of India. The Indian telecommunication sector is known to be one of the most notable economic success stories. With an overall growth rate in subscribers of more than 35% over the past decade, it is deemed to have had a significant impact on the country's economic growth (Dhage & Prasad, 2013). Growth in the sector has been influenced significantly by public policies, several of which have contributed to the improved access to ICTs on the part of India's poor. The Indian government's policy regarding enabling the sharing of telecommunications infrastructure by the various service providers has resulted in a reduction in the capital investment required to deliver services and expand the geographical coverage of such services. In addition, infrastructure sharing allows providers to deliver the service at a reduced cost to the consumer but without compromising the quality of the service provided (Dhage & Prasad, 2013). Another noteworthy policy is the Universal Services Obligation Fund (USOF) that was created to ensure that telecommunication services reached rural populations. In view of the fact that the cost of servicing rural areas is high, and the propensity to pay is low, countries such as India, Uganda, Chile and Malaysia have enforced the policy associated with the USOF (Jain, 2012). Jain (2012) highlights that the amended Indian Telegraph Act, 2003 imposes a levy of 5% of the adjusted gross revenue of telecommunication service providers and which the government then reserves for the development of rural telecommunications services. India's telecommunications sector creates an atmosphere that is conducive for the penetration of mobile services. The implementation of policies designed to improve the accessibility of communication channels

in the rural areas would help both to alleviate the lack of access to ICTs and also to foster an enabling environment for e-marketplaces in rural communities.

2.4.4 Language barriers and low levels of literacy

Rural areas in South Africa are characterised by poverty, low levels of literacy and low levels of proficiency in the non-indigenous languages. As a result of these factors the access to ICT based tools in the rural areas is limited due to the high costs (relative to the disposable income of rural communities). In addition, indigenous South African languages are not widely accommodated in computer software interfaces, nor is there sufficient Internet based content available in indigenous South African languages. More importantly, the Internet presents no value to a user who is not able either to read or write and, thus, the illiteracy that characterises rural South Africa constitutes a major barrier to the adoption of Internet based technologies such as e-marketplaces in the rural areas. Although research suggests that the digital divide may be narrowing as a result of the high penetration of mobile phones in developing countries, users have yet to harness the information processing power of mobile phones.

2.4.5 Lack of context

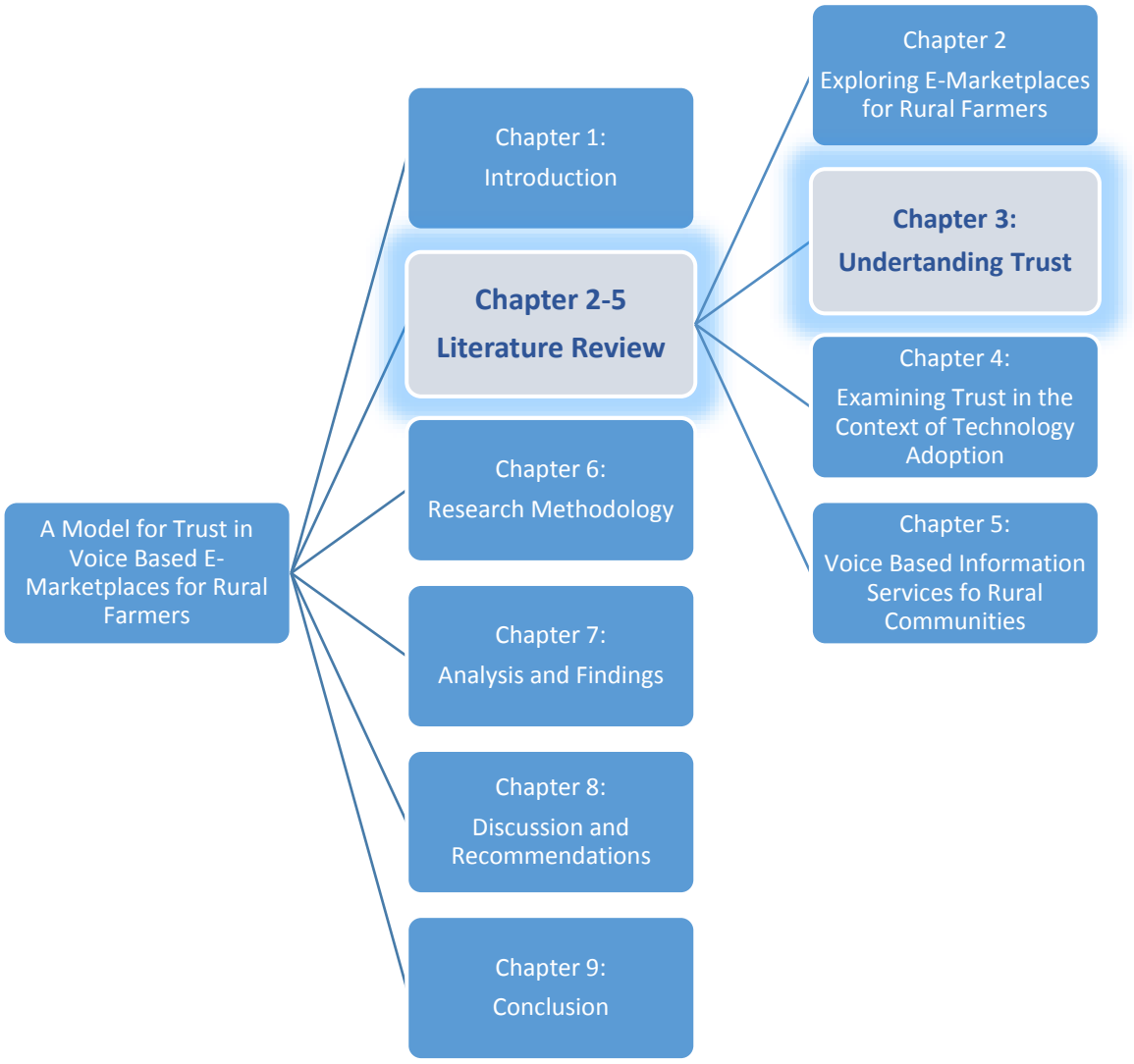
Lack of context is a frequently cited challenge to technology adoption by rural users. According to Heeks (2002), in settings in which the developers are far removed from the reality of the users, the existence of design-reality gaps are all too likely. Such situations, according to Isabirye, Flowerday, Nanavati and von Solms (2015), are typical when ICT solutions are specifically developed for rural communities and often result in a failure of the solution to meet the needs of its users. As a result Avgerou (2010) defined two prevalent orientations which address the issue of context in ICT innovation, namely, the universalistic and the situated orientations. The universalistic orientation is founded on techno-economic reasoning and rationality, and assumes that adoption will be based on the value that the innovations present. However, the universalistic orientation fails to explain why technologies which, are perceived to present value to their intended users, such as e-commerce technologies are poorly adopted in rural areas. In addition, cases in which e-commerce has shown outstanding success in certain developing countries, for example, the case of M-Pesa, the mobile banking technology in Kenya, have not been easily replicated in other developing countries in which they have been launched.

In contrast to the universalistic orientation, the situated orientation emphasises the formation of meaning and practice within the immediate setting in which the innovating organisation exists (Avgerou, 2010). This, suggests that the unique conditions under which an innovation is developed will influence the impact of such innovation. The situated view assumes, therefore, that developing countries will not necessarily achieve the same success with innovations that were developed outside of their context. This orientation emphasises that innovations result in rearrangements in organisations or societies and, thus, the view focuses on the process of innovation within the context of its application, while taking into account the various emotional, cognitive and political influences that underpin the innovation processes. Adopting a situated view of e-commerce in agriculture draws attention to the manner in which agricultural sectors are structured. The influence of agents, middlemen and large corporations in the industry may be among the factors deterring the adoption of e-commerce in agriculture. E-commerce in this regard may be seen as disruptive if it granted farmers direct access to buyer markets.

2.5 Conclusion

The challenges that rural farmers face, specifically as regards finding a market and obtaining a fair price for their products, may be addressed through e-marketplaces. Unfortunately, numerous barriers exist that hamper the ability of e-marketplaces to serve these needs. E-marketplaces depend on ICTs which are, themselves, poorly adopted by rural communities. Challenges such as lack of context, lack of understanding or appreciation of the value proposition, limited access to enabling devices, high connectivity costs and language and literacy barriers all impede the adoption of ICTs. Chapter 3 presents a critical discussion of the concept of trust and will provide a foundation to explore the role trust plays in the decision to adopt an e-marketplace technology by rural farmers.

Chapter 3: Understanding the concept of trust



3.1 Introduction

Trust is a concept that spans disciplines and, thus, there will be no generic definition of the term as it must be considered in each individual context (Deutsch, 1973). This view is supported by Hardin (2000); Mayer et al. (1995); and Watson (2005). Watson (2005) states that trust is defined, conceptualised and measured differently by different disciplines and argues that, although the importance of trust is generally agreed upon, there is little consensus as regards its definition. Rousseau, Sitkin, Burt, and Camerer (1998), on the other hand, argue that, although trust is defined using different words across disciplines, the meaning remains consistent. They argue that there is little disagreement across disciplines on the meaning of trust. However, a common meaning does not necessarily imply that its operationalisation will be the same. In order to illustrate this point, Rousseau et al. (1998) cite definitions of trust as "the willingness to be vulnerable"; "The willingness to rely on another" and "confident, positive expectations". Rousseau et al. (1998) conclude that, although trust may be defined in different ways, they all imply one party's willingness to make his/herself vulnerable to another in the expectation of a positive result. However, the meaning of trust is consistent only in these definitions as far as the definitions refer to risk taking where there is the potential of loss or vulnerability. Some definitions allude to trust as a feeling i.e. "confident, positive expectations" (Lewicki & Bies, 1998), while others perceive it as an intention i.e. "the willingness to be vulnerable" (Mayer et al., 1995). This chapter aims at arriving at a definition for trust that is applicable to the purposes of this study. Thus, the chapter aims to explore the nature of trust, the conditions that underlie trust, the factors determining the trustworthiness of a party and the manner in which trust constructs interact with one another.

3.2 The boundaries within which trust exists: Risk, reliance and expectation

In his inaugural professorial lecture, Flowerday (2013) described trust and risk as two sides of the same coin, arguing that these two concepts depend on one another. If this is true, then the coin may be regarded as the expectation or value that both the trustor and the trustee anticipate. The need for trust arises from the existence and interaction of three conditions, namely, risk, reliance and expectation. According to Rousseau, Sitkin, Burt and Camerer (1998), trust implies the existence of risk or uncertainty, in the absence of which the need for trust would not exist. Secondly, in a trust based relationship, a trustor

demonstrates both an expectation that an outcome will be attained and a reliance on the trustee to ensure this outcome. Again, the need for trust would not exist in the absence of an expectation of a favourable outcome or the reliance of one party on another for the expectation to be fulfilled. Consequently, trust requires an expression of assurance from the trustee that his/her expectations will be met and relates to the level of confidence in the assurance provided. This view is validated by Fu (2004), who states that people will not trust without a certain level of assurance. Such assurance may be expressed in either verbal or tangible gestures. It must be noted that different situations call for different levels of assurance, and also that some trustors will require more assurance than others.

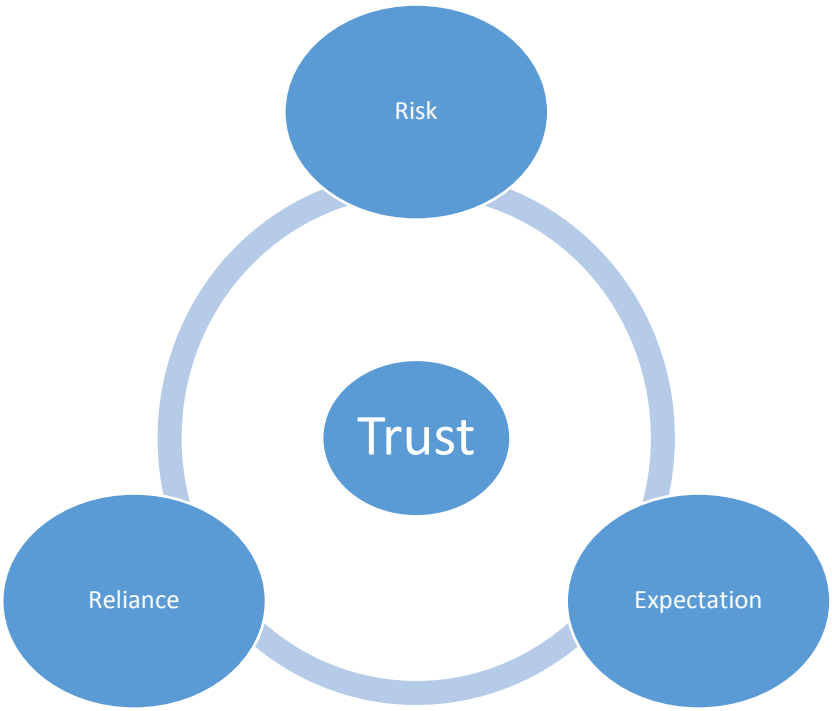


Figure 3.1: The boundaries within which trust exists.

3.3 The nature of trust

Romano (2003) argues that, although the array of trust definitions overlap one another, they do not contain sufficient information to define trust across situations. Romano (2003), therefore, suggests that trust must be meaningfully conceptualised in order to integrate the various aspects of the construct into a comprehensive definition. A failure to adequately define trust will lead to an inability to understand the extent to which a state of trust has been achieved. The contrasting views regarding the nature of trust suggest that some

scholars will recognise the existence of trust when there are positive beliefs or expectations regarding the object of trust, while some will only perceive trust to exist when trusting behaviour is demonstrated. The following scenario serves to illustrate the diverse ways in which trust may be perceived.

> *Mr Basson was an extreme sports enthusiast. He flew planes and went sky diving and bungee jumping for recreation. I had the interesting experience of travelling with him on a long haul flight once and found the level of anxiety he demonstrated upon the aircraft's take-off to be very surprising. At the end of take-off, when he seemed to have settled down, I told him how I found it ironic that the person with the most experience in flying planes, and engaging in high risk aviation related recreational activities, was also the one in the greatest panic. He responded that his fear comes from his knowledge of the level of danger that exists during take-off and landing, and the limits of a pilot's control in a potential crisis occurring within 1000 feet of ascent or descent. It was evident that Mr Basson did not trust the safety of flying. However, despite the high risk that he associated with the flight, this did not deter him from flying. Mr Basson trusted the competence of the pilot, but did not trust that the pilot had full control over the safety of the passengers. He understood that accidents could occur as a result of other issues such as the mechanical state of the aircraft, the actions of the traffic controllers or even the weather conditions. Despite his fear, Mr Basson flew out of necessity, but also for recreation, indicating that his personality was more inclined towards risk taking. Mr Basson was willing to assume the risk of flying (demonstrating trusting behaviour) in order to reap the benefits if offered in terms of transportation and recreation. However, he did not trust that it was safe to fly.*

The example above serves to illustrate that the nature of trust is not fully understood and it is, thus, difficult to measure. There are several perspectives on trust in this regard. Some scholars perceive trust in terms of intentions and behaviour, while others perceive trust in terms of beliefs or attitudes. In the example described above, if trust were defined as "the

willingness to make oneself vulnerable" in a situation of risk, then it could be argued that Mr Basson trusts the act of flying in planes. In this regard, his **actions,** as opposed to his **feelings or beliefs,** would be assessed as a measure of the level of trust.

However, from an attitudinal perspective of trust, if trust were to be defined as "positive confident expectations", the level of trust Mr Basson demonstrates towards a flight situation may be less convincing. In this case, his feelings and emotions would form the basis of determining the extent to which he trusts the circumstances. The challenge of defining trust is probably the most unresolved aspect in the study of trust. Trust is a critical construct in a vast array of disciplines, and has different implications in many fields of study. For example, the economics discipline examines trust in terms of rationality, choices and outcomes and, thus, tends to assess trust in terms of behaviour. Consequently, trust scholars from the economics discipline tend to conceptualise trust through experimental games. Game theory is primarily concerned with cooperation in situations of uncertainty and it places emphasis on the behavioural outcomes of trust.

Contrastingly, in psychology and sociology, the study of trust is concerned with the state of an individual's emotional wellbeing and the interpersonal or inter-organisational relationships that exist between the members of a society. For example, the psychologist, Deutsch (1973) in McKnight and Chervany (1996) defines trust as confidence that one will achieve what is desired as opposed to what is feared. In the case of the scenario described above, Mr Basson feared flying but was, nevertheless, of the expectation that the outcome of flying would be his arrival at the desired destination, rather than a flight accident that could potentially occur. Similarly, Rotter (1967) defines trust in terms of the expectancy that a proposition put forward by another may be relied upon. Kramer and Carnevale (2001) also view trust in terms of expectation, and define it as a set of beliefs and expectations that the actions of another will serve the best interests of the trustor.

According to Romano (2003), trust is not behavioural but, rather, it is attitudinal. This view is consistent with the view of Gambetta (1988) who concurs that trust does not require observable behaviour to exist, nor does observable behaviour imply that trust exists. Behaviour that may be perceived as a reflection of trust may be a result of either coerced compliance or the lack of an alternative. Likewise, one party may trust another part, but not

have the opportunity to demonstrate trusting behaviour for reasons beyond trust itself. Mayer et al. (1995) also concur with the view that trust does not require observable behaviour. Their description of trust as a willingness to assume vulnerability positions trust as an intention, rather than as an act or an attitude. The difficulty with assuming this position is that intentions are difficult to measure until they manifest themselves in behaviour. In addition, many researchers have found low correlations between measured intentions and observed behaviour (Miniard, Obermiller, & Page, 1982). Thus, there is a distinction between trusting attitudes and risk taking, where risk taking is influenced by trusting attitudes, but it is not necessarily an indicator of the existence of trust. Instead Romano, (2003) describes trust as attitudinal, reflecting the cognitive, affective and behavioural sentiments that one has towards another. This study adopts Romano's (2003) view of trust as an attitude or feeling that the trustor holds towards the object of trust. However, this study also recognises that trust has an impact on intentions and, ultimately, on behaviour. This relationship will be discussed in the next section.

3.4 The relationship between trusting attitudes and trusting behaviour

The previous sections sought to define trust based on definitions from a variety of disciplines. Based on the definitions explored, this study adopts the view of trust as an attitude reflecting the beliefs and expectations that the object of trust will serve one's interests in a positive way. Mayer et al. (1995) emphasise the distinction between trust and trusting behaviour by describing trust as a willingness to assume risk, while trusting behaviour is the actual assumption of risk. McKnight Choudhoury and Kacmar (2002) concur with this view, and defines the willingness to trust as the trusting intention. He further classifies trusting intentions into two subcategories, namely, the willingness to depend on another, and the subjective probability of depending on another.

The Theory of Reasoned Action (TRA) (Fishbein & Ajzen, 1975) is the underlying philosophy assumed by key trust researchers such as McKnight et al. (2002); Mayer et al. (1995); Li et al. (2008) and Pavlou (2003). The TRA posits that, based on a set of existing beliefs, a person will form an attitude towards a subject. This attitude will inform the behavioural intention that the person assumes regarding the subject. Fishbein and Ajzen (1975) argue that the behavioural intention is the primary determinant of the actual behaviour that results. Based on the theory of reasoned action, the beliefs regarding the object of one's trust

determine one's attitude and, consequently, one's intention to behave trustingly towards another.

One's willingness to trust another and the level of assurance that will motivate such trust are influenced by a number of factors. In a trust based relationship, a risk exists because the trustor does not have full control of whether the anticipated outcome will be realised and has to rely on the trustworthiness of the trustee as regards fulfilling his expectation. The section that follows examines the factors determining the trust that one party has in another.

3.5 The factors that determine trust

In the preceding section, trust was described as an attitudinal consequence of cognitive, affective and behavioural sentiments resulting from the interaction between the trustor, the object of trust and the context. This section will discuss the factors that influence the trusting attitudes. In a trust based relationship, a party (the trustor) must make him/herself vulnerable to the actions of an object of trust (the trustee) in order to gain the desired outcome. Mayer et al. (1995) separate the characteristics that determine trust according to the trusting roles played by the parties in a relationship. They classify these roles into trustee and trustor characteristics. Trustee characteristics determine the trustworthiness of a party in a relationship while the characteristics of the trustor influence the degree to which the trustor is capable of trusting.

3.5.1 Trustor characteristics

Mayer et al. (2005) identify propensity to trust as the only characteristic that influences the level of trust from the trustor's perspective. Arguing that some people are generally more trusting than others, they describe propensity to trust as a trustor's individual inclination to trust the trustee in the absence of evidence (information) regarding the trustee's trustworthiness. Hofstede (1980) and Deutch (1973) both believe that propensity to trust is mediated by factors such as developmental experiences, personality traits and cultural backgrounds. Propensity to trust may be categorised into attitudinal qualities (faith in humanity) and behavioural qualities (trusting stance). Faith in humanity refers to positive beliefs in the ability, benevolence and integrity of others (McKnight & Chervany, 2001;

Davis & Schoorman, 2005, while trusting stance refers to the inclination to assume risk, regardless of the beliefs about the risks involved (McKnight & Chervany, 2001).

3.5.2 Trustee characteristics

In a trust based relationship, the trustee will demonstrate characteristics that provide the trustor an indication of how worthy the trustor is of trust. According to Mayer et al. (1995), the trustworthiness of the trustee is a reflection of the perception the trustor has of the trustee's ability, benevolence and integrity. Mayer et al. (1995), describe ability in this context as the trustee's capacity to fulfil what is required of him/her in terms of aspects such as skills and expertise. Benevolence, on the other hand, refers to the extent to which the trustee is believed to have good intentions towards the trustor. Finally, integrity relates to the belief that the trustee will conform to the principles to which the trustor subscribes. Mayer et al (1995) argue that, although all three factors contribute to trust, the factors are, in fact, separable and that a deficiency in one factor does not necessarily mean that an entity must be deemed to be untrustworthy. Instead, Mayer et al. (1995) argue that trust must be seen as a continuum with varying degrees of trust, rather than as a clear distinction between trust and distrust.

3.5.3 Perceived Risk

In addition to the belief of the trustor in the trustworthiness of the trustee, situational conditions beyond the scope of the relationship may exist to cause uncertainty. Mayer et al. (1995) recognise these situational conditions as risks associated with the context of the relationship, and argue that the trustee's risk perception will be based both on the risks associated with the relationship as well as the risks associated with the context within which the exchange will occur. Sitkin and Pablo (1992) are of the same view, and identify social influences, familiarity of the problem domain and organisational control systems as contextual factors that influence a trustor's risk perceptions.

3.5.4 Experience

Although Mayer et al. (1995) focus primarily on the characteristics of the trustor and trustee as factors determining trust, their model illustrates trust as a dynamic process in which a future state of trust is informed by the outcomes of risk taking. This, in turn, suggests that the experience of both the trustor and the trustee in the engagement has an

influence on the level of trust between them. Figure 3.2 represents trust according to Mayer et al. (1995) and depicts the manner in which the outcome of a trusting action influences the trustor's new perception of the trustee's ability, benevolence and integrity.

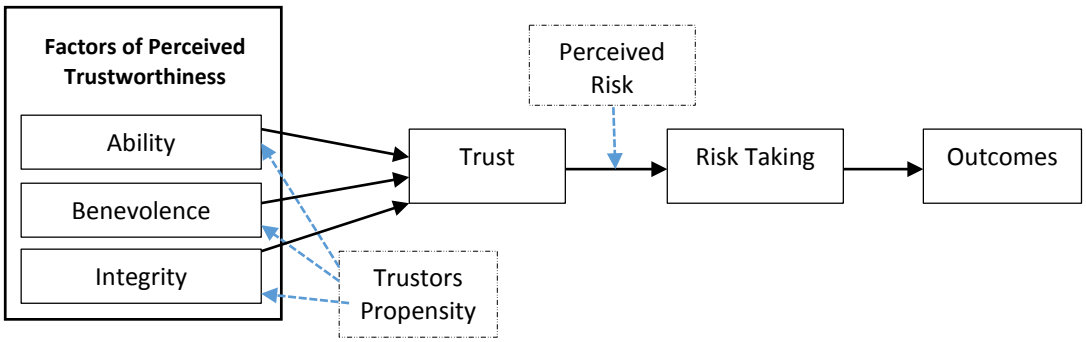


Figure 3.2: An integrative model for trust. (Mayer et al., 1995)

This view of trust as a dynamic concept in which each encounter influences the future state of trust is supported by Jones and George (1998) and by Pavlou (2003). According to Jones and George (1998), trust is an experience that transforms through three different states, namely, distrust, conditional trust and unconditional trust. They argue that the evolution of trust is mediated by values, attitudes, moods and emotions. Jones and George's (1998) model of the evolution of trust indicates that an individual does not simply assume that the other is trustworthy from the onset of an exchange. They add that, within this initial state of trust, some individuals may choose to suspend their feelings of doubt and demonstrate trusting behaviour towards another party, while others may choose to explain their feelings of distrust towards the other party and refrain from initial engagement. This is in line with Mayer et al.'s (1995) view that some individuals are more willing to trust in conditions of uncertainty than others (trustor's propensity). Jones and George (1998) maintain that the attitudes and expectations expressed through exchanges are what propels trust from one state to another, while the moods and emotions experienced during the exchange influence the state of trust that will ensue. Negative moods and emotions perpetuate a state of distrust, while positive moods and emotions result in trust. Jones and George (1998) add that the trust resulting from positive moods and emotions may be either conditional or unconditional, with unconditional trust being a case in which the trust exists as a result of shared values rather than the attitudes and expectations that are exchanged during the interactions.

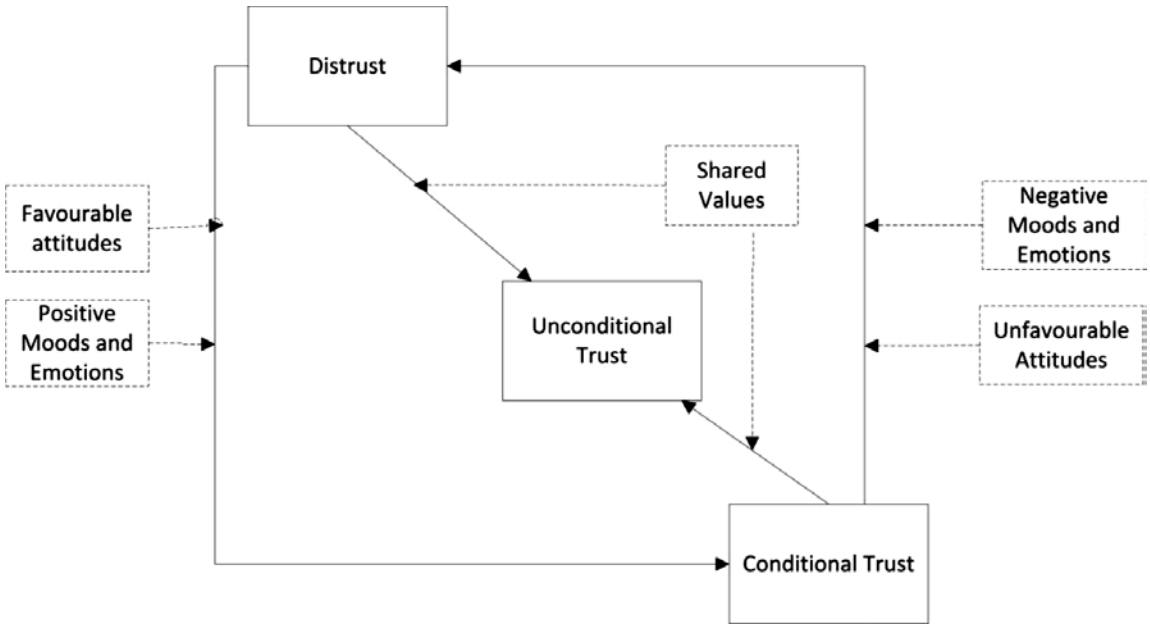


Figure 3.3: A model of the evolution of trust. Adapted from Jones and George (1998)

3.5.5 Knowledge and alternative trust bases

The preceding section discussed the dynamic nature of trust in terms of which each encounter between a trustor and trustee is said to influence the state of trust that develops between them. Jones and George's (1998) model of the evolution of trust recognises that parties do not necessarily trust one another at the onset of a relationship. However, their study offers little explanation as to the factors that determine an individual's intention to trust another individual in the absence of either knowledge or experience. According to Li et al. (2008), in situations in which the trustor has no prior experience with the trustee, the trustor must depend on secondary sources of information to build his/her trust inferences. This stage in a trust based relationship in which the trustor must place his/her trust in an unfamiliar party is defined as initial trust (McKnight, Cummings, & Chervany, 1998). Li et al. (2008) recognise the role of knowledge trusting bases on trusting beliefs. However, they argue that, in the initial trust stage, no direct knowledge exists regarding the trustee and, thus, they do not explore knowledge as a trusting base. They describe four categories of trust bases that inform a trustor's beliefs regarding the trustworthiness of a party, namely, personality trusting bases, cognitive trusting bases, calculative trusting bases and institutional trusting bases. Li et al.'s view is consistent with that of Sitkin and Pablo (1992) who argue that the perception of risk is influenced by factors such as the familiarity with the domain, organisational control systems and social influences. The influence that these

trusting bases exercise on trusting beliefs is illustrated in Figure 3.4 and are described in the subsections that follow.

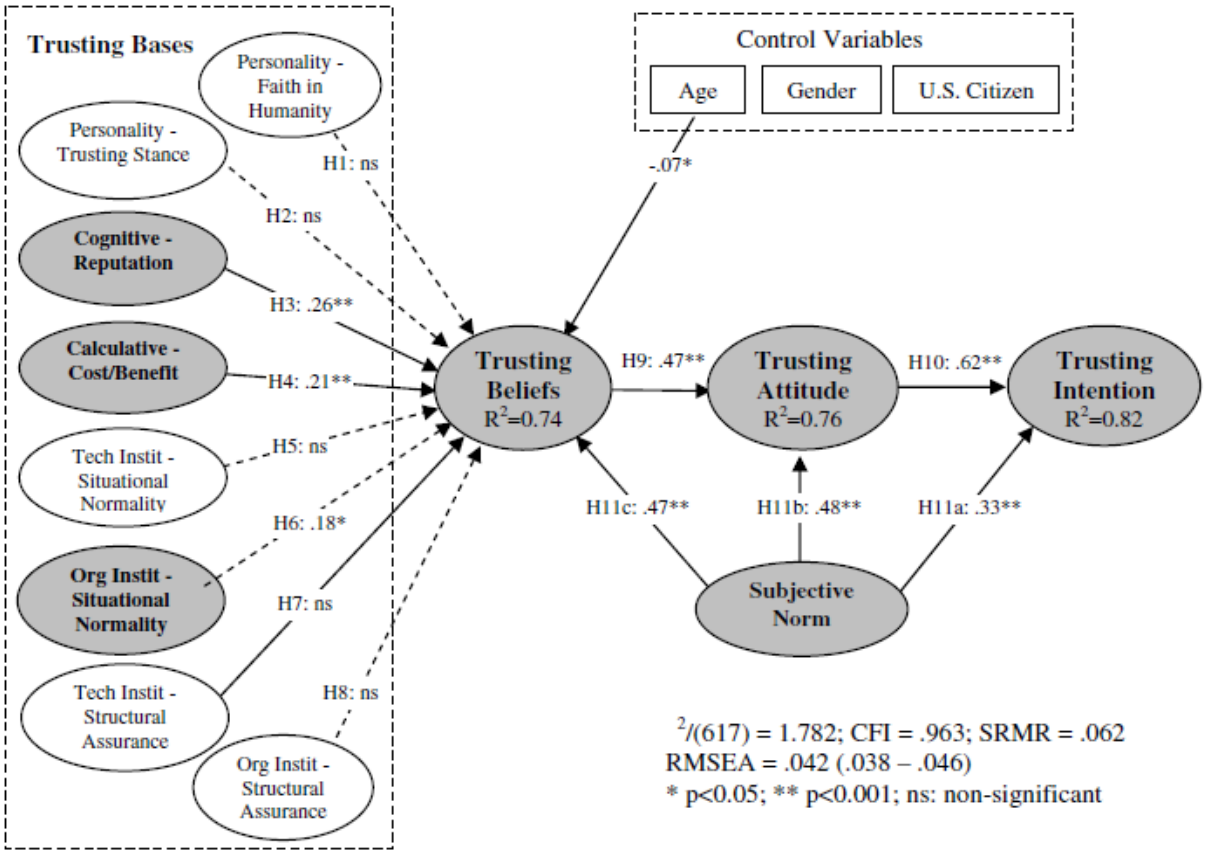


Figure 3.4: Factors affecting initial trust in new technologies. (Li et al., 2008)

3.5.5.1 *Personality trusting bases*

Personality trusting bases are in line with the views of Mayer et al. (1995) and McKnight, Choudhoury, and Kacmar (2002) that some individuals are more inclined to trust than others. The study conducted by Li et al. (2008) found a weak correlation between personality trusting bases and trusting beliefs. However, the study did find that institutional trusting bases had a mediating effect on the relationship between personality trust bases and trusting beliefs and, therefore, it was concluded that personality trusting bases do influence trusting beliefs.

3.5.5.2 *Cognitive trusting bases*

According to Li et al. (2008), the absence of knowledge and experience in the initial trust stages causes the trustor to seek information from alternative sources. Li et al. (2008) are

of the opinion that unit grouping constitutes one basis upon which cognitive trust based decisions are made. This occurs when the trustor associates the trustee with the value system of the social group to which they are both aligned and chooses to trust or distrust them accordingly. Reputation (Li et al., 2008; Pavlou, 2003) and stereotypes (Li et al., 2008) are both examples of the cognitive trust bases that inform initial trust.

3.5.5.3 Calculative trusting bases

According to Li et al. (1998), calculative trusting bases are founded on transaction cost economic theories in terms of which it is believed that individuals act in their own self-interest and they will not behave unfavourably unless such behaviour profits them. From this perspective, a trustor dealing with an unfamiliar trustee will choose to trust if the trustor does not perceive any benefit accruing to the trustee's side as a result of violating the trust.

3.5.5.4 Institutional trusting base

Li et al. (2008), states that trustors are likely to grant trust under conditions where the necessary institutional structures are in place and the social environment is functioning effectively. Li et al. (2008) suggest that institutional trust bases are of particular importance in the context of initial trust where the trustor has limited experience with or knowledge of the trustee. Li et al. (2008) divide institutional trust bases into two categories, namely, situational normality (which points to the existence of normally functioning circumstances) and structural assurance (which refers to the safeguards that institutional structures have put in place to protect the interests of the parties).

3.5.6 Subjective Norm

Subjective norm refers to the opinions of important reference groups. According to the TRA (Ajzen & Fishbein, 1977), people may choose to perform a behaviour, regardless of their own personal beliefs, if they believe their important referents support such behaviour. The study of Li et al. (2008) study found subjective norm to have the most profound effect on the trusting beliefs.

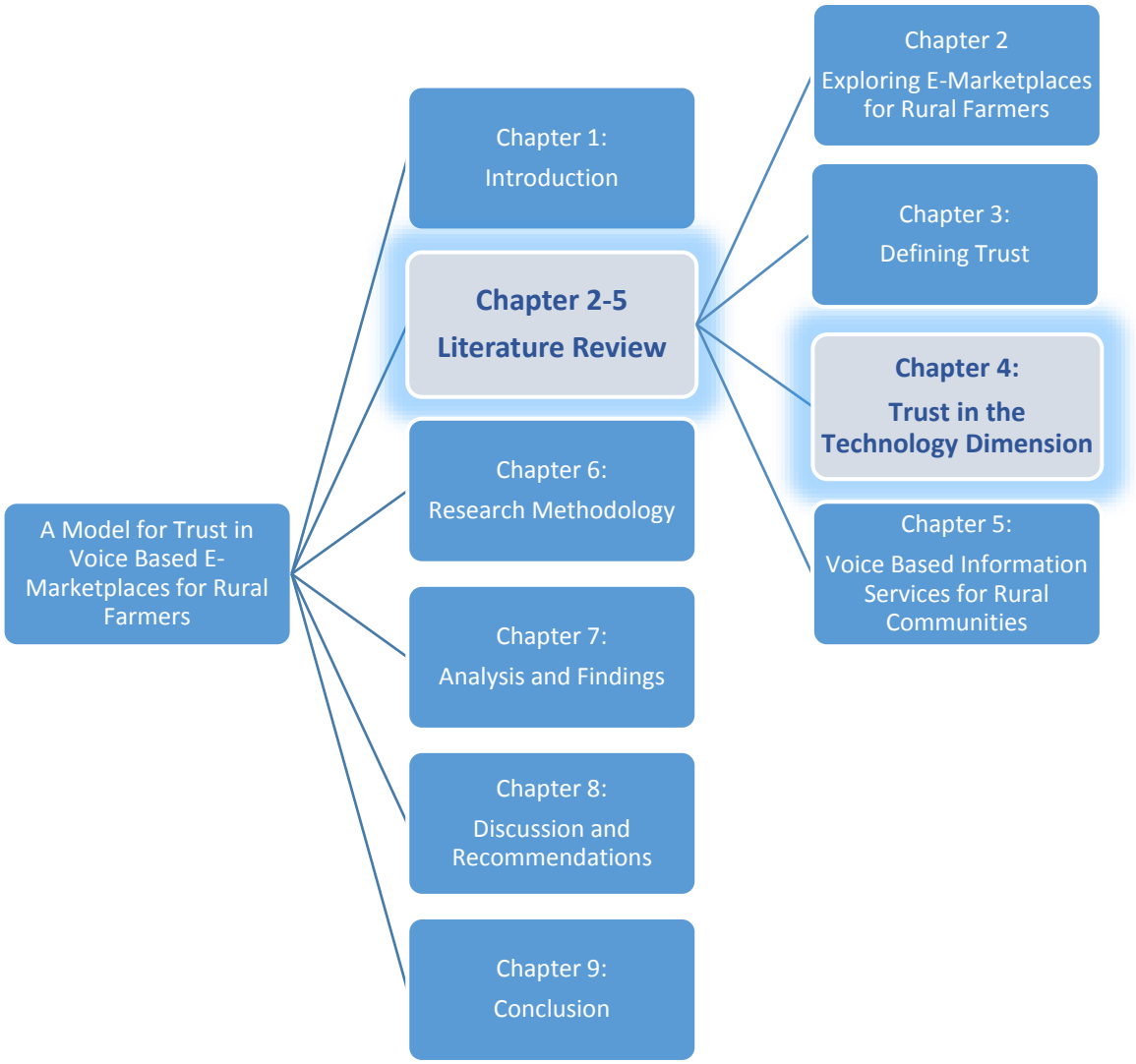
3.6 Conclusion

This study recognises trust as a dynamic process in which the state of trust is influenced by a number of factors. The factors of trustworthiness according to Mayer et al. (1995) were discussed in order to describe the characteristics of the parties in a trust based relationship. The model of Jones and George (1998) model was used to illustrate the dynamic nature of trust and the manner in which an encounter influences the future state of trust while Li et al.'s model described how initial trust is formed in the absence of knowledge and experience relating to the trustee. In addition, a variety of definitions for trust were discussed and a distinction between trust as an attitude as opposed to trust as a behaviour was made.

Based on the theoretical review of trust as discussed by prominent writers, this study concluded that trust is a judgement of trustworthiness that one party makes towards the object of trust and based on the former's beliefs about the object of trust. Trust influences the willingness of a party to make him/herself vulnerable to the object of trust and, consequently, to engage in trusting behaviour. Trust is relevant when the expectation of a positive outcome coincides with risk or uncertainty and also when a positive outcome depends on the cooperative actions of the trustee. Although trust requires the existence of risk or uncertainty, it is possible for trust to exist either with or without knowledge or information regarding the trustee. When the trustor possesses limited knowledge about the trustee, the trustor usually makes use of cognitive and calculative trust bases in order to form judgements about the trustworthiness of the trustee. In addition, some people are more inclined to believe in the trustworthiness of others while others have a higher predisposition to engage in risky behaviour. Trust influences the intention or willingness to take risks. Trusting intentions are also influenced by both the opinions of relevant reference groups (subjective norm) and also the perception of risk (Mayer et al., 1995; Li et al., 2008). Although the factors influencing trusting beliefs that have been identified do not serve as an exhaustive list, they are, however, widely cited in e-commerce literature and, thus, will be the focus of this study. In order to understand trust in the context of e-marketplaces, it is necessary to understand the risks to which e-marketplace participants are typically exposed. In the sections that follow, the concept of trust in technology will be defined and distinguished from other forms of trust. Thereafter, the risks that are prevalent in the technology dimension of e-marketplaces will be described. Finally,

technology trust will be examined in the context of e-marketplace adoption in rural farming communities.

Chapter 4: Trust in the technology dimension of e-marketplaces



4.1 Introduction

Trust is one of the most critical pre-conditions for successful e-marketplaces. The notion that buyers and sellers, who are often unknown to one another, may exchange goods and services between them via a technology platform suggests that a certain level of trust must exist. Mcknight and Chervany (2001) state that, since e-commerce does not allow consumers the opportunity to evaluate the quality of goods through inspection, or to assess the abilities of a professional through interpersonal interaction, it raises the levels of uncertainty. Lee, Kim, and Ahn (2011) highlight that e-marketplaces require trust at both an interpersonal level as well as at an institutional level. This view suggests that e-marketplace participants must trust the people from whom they purchase goods as well as the market-makers that facilitate the exchange. Furthermore, the participants in an e-marketplace must also be assured that the technology platform is secure and that their privacy will be preserved. Pavlou (2003) recognised the uncertainty caused by the following prevalent conditions in an e-commerce situation:

- The extensive dependence on technology to carry out transactions
- The distant and impersonal nature of the web environment
- The uncertainty associated with the inherent openness of the Internet

Thus, Pavlou (2003) suggests that, in addition to the information security risks that face e-commerce users, they are also exposed to the possibility of the nonfulfilment of their purchases by the trustee as well as the additional burden related to the general use of the e-commerce technology. This study is of the view that e-commerce trust and, consequently, e-marketplace trust is built within four dimensions, namely, the trust in the product or service being sold, the trust in the individuals or institutions engaged in the transaction, the trust in the marketplace within which the exchange occurs and the trust in the technology that enables the exchange. In this regard, the technology is the first layer with which the e-marketplace users interact. Accordingly, a lack of trust in the technology layer will discourage users from attempting to make judgements about the trustworthiness of subsequent layers. Although it is not possible to achieve e-marketplace trust unless the issue is addressed in all four dimensions, each dimension of trust is uniquely complex and must be examined independently. Thus, this study focused on trust in the technology dimension with both interpersonal trust and institutional trust coming outside of the scope

of the study. Figure 3 depicts the layers of trust that exist within an e-marketplace. This chapter discusses the risks that are prevalent in the technology layer of an e-marketplace. The chapter then concludes with a discussion on the relationship between trust in technology and technology adoption.

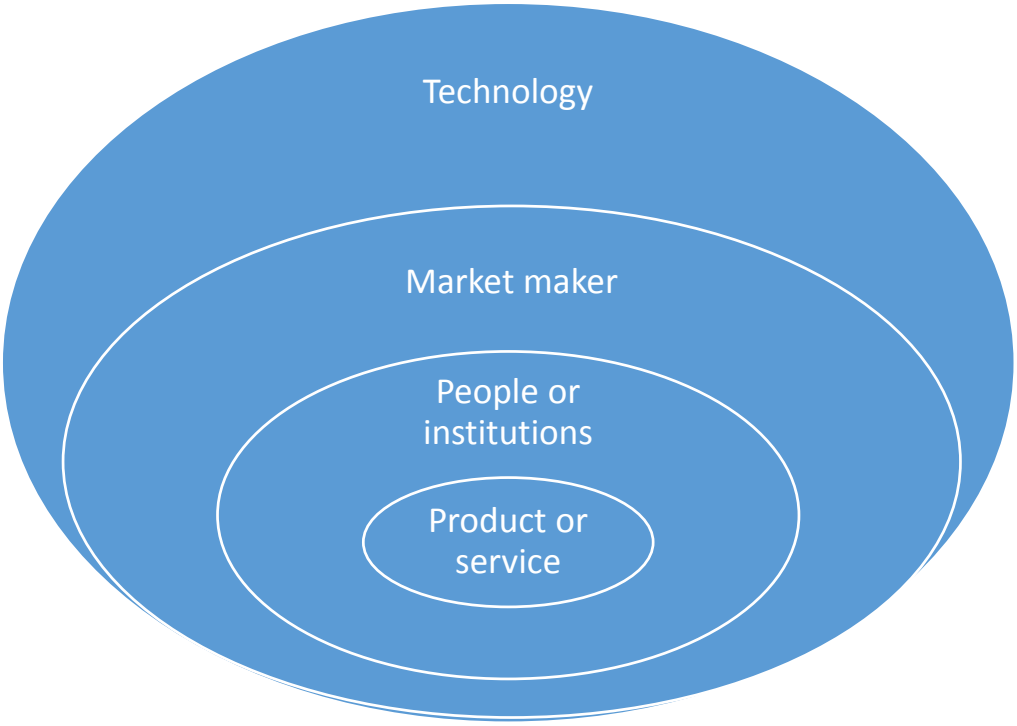


Figure 4.1: An illustration of the layers of trust in an e-marketplace.

4.1.1 Trust in the technology dimension

The concept of trust has traditionally been applied to interpersonal and inter-organisational relationships. It must be admitted that, at the onset of this study, extensive reading, reflection and deliberation were necessary before it became apparent that the evaluation of trust in an artefact was both a relevant and a viable topic. Trust in technology as an artefact is highly relevant in any context in which technology is adopted, particularly should fundamental changes to the technology's domain be anticipated. For example, technology trust has been investigated in respect of the automation of business functions or processes, trust in online recommendation agents, trust in technological innovations in healthcare and medical practices and even trust in the environmental implications of innovations such as nuclear energy and cellular communication towers. In each case, the extent to which the people affected by the technologies trust such technologies will have an impact on the extent to which such technologies will become embedded within communities or organisations.

The next section discusses the contrasting views of key researchers concerned with trust in technology as an artefact.

4.1.1.1 Can we trust technology?

According to Shneiderman (2000), there is no relationship of trust between a human being and a computer. He argues that the relationship that we perceive as trust between a human and a technology is more about reliance than trust. He adds that it is not possible for a human being to trust a technology because a technology cannot be held accountable for an outcome. Similarly, Friedman and Millett (1997) argue that users cannot be completely socially engaged with computers as they do not hold computers responsible for their actions. Friedman, Kahn and Howe (2000) concur with this view, arguing that trust in technology is not possible because technology has no moral volition or free will. (McKnight, Carter, & Clay (2009) oppose the aforementioned views, arguing that numerous definitions of trust exist, many of which do not explicitly consider the will or moral volition of the trustee as a determinant of trust in a relationship. For example, Lewicki et al. defined trust "confident, positive expectations", Mayer et al. (1995) defined it as the "the willingness to be vulnerable", Deutch (1973) defined it as the "confidence that one will achieve what is desired as opposed to what is feared" while Rotter (1967) defined it in terms of the expectancy that a proposition put forward by another may be relied upon. Thus, although the morality and volition of the trustee may be implicitly assumed in these definitions, it has not been confirmed as a determinant of trust. Instead researchers such as Mayer et al. (1995) regard trust as a relationship between expectations, risk and outcomes. Whether a negative outcome is the result of intentional will has not been adequately addressed in the research.

Some researchers have argued that trust may be conferred on technology when technology demonstrates human like characteristics. Reeves and Nass (1996, in Wang & Benbasat, 2005) maintain that people treat computers as social actors and ascribe social rules to them. However, Kiesler and Sproull (1997, in Wang & Benbasat, 2005) regard this phenomenon as a partial attribution or likeness of humanness that does not extend beyond the context in which the user is tested. McKnight, Carter, and Clay (2009) elaborate on this view by stating that, although trust in technology is similar to interpersonal trust, it also involves beliefs about the context and features of technology. In addition, some technology

artefacts demonstrate more humanlike characteristics than others (N. K. Lankton & McKnight, 2008).

4.1.2 The relationship between trust in a technology and the adoption of the given technology

In the 1990s a popular supermarket outlet targeting the lower income earning portion of the population of a small South African city was built on premises that were below ground level. Thus, the owners designed the premises with an escalator to improve the shop's accessibility to its patrons. Unfortunately, the only way in which shoppers could gain access to the store was by making use of an escalator. On frequent occasions a bewildered shopper would be sighted standing at either the top or bottom of the escalator, filled with fear at the prospect of using the escalator. Subsequently the escalators at that store were disabled and the patrons would enter and exit the store using the escalator as a stationary mechanism. Today the escalator has been replaced by a stair case, and an elevator has been installed to cater for customers with limited mobility. The escalator in the store serves as an example of a technology that was unable to achieve its objective due to the distrust or fear experienced by its intended users. A similar fear is the widespread distrust of making cash deposits through Automated Teller Machines (ATMs). According to Singh and Slegers (1997), even in highly developed countries such as the United States and Australia, the majority of ATM transactions are cash withdrawals, with deposits making up about 2-5% only of the total transactions. A more recent study conducted by Gowrisankaran and Krainer (2011) indicated that more than 75 percent of all ATM transactions are cash withdrawals, with the rest being balance enquiries and cash deposits. Despite the value that the ATM Cash Deposit function presents to consumers, the majority of consumers refer to queue up in a bank in order to deposit funds.

When considering the abovementioned examples of technology trust, two issues become apparent; firstly, the fear of a technology is often associated with a lack of exposure to or experience with the said technology (Loyd, Loyd, & Gressard, 1987) and, secondly, the experience while using the technology may either perpetuate or dissipate the associated fear (Jones & George, 1998). Trust is broadly recognised as a dynamic concept that evolves through various states of trust and distrust (Elofson, 1998; Jones & George, 1998) According to Jones and George (1998), trust is an experience that transforms through three different

states, namely, distrust, conditional trust and unconditional trust. They argue that the evolution of trust is mediated by values, attitudes, moods and emotions. According to Jones and George's (1998) model of the evolution of trust, an individual does not simply assume that the other party is trustworthy from the outset of an exchange. Jones and George (1998) view this initial state of an encounter with another party as a state of distrust. They add that, within this state of distrust, some individuals may choose to suspend their feelings of distrust and demonstrate trusting behaviour towards the other party, while others may choose to explain their feelings of distrust towards the other party and refrain from further engagement with the party. Jones and George (1998) are of the opinion that the attitudes and expectations expressed through exchanges are what propels trust from one state to another, while the moods and emotions experienced during the exchange influence the state of trust that will ensue. Negative moods and emotions perpetuate a state of distrust, while positive moods and emotions result in trust. Jones and George (1998) add that the trust resulting from positive moods and emotions may be either conditional or unconditional, with unconditional trust being a case in which where the trust exists as a result of shared values rather than attitudes and expectations that are exchanged during the interactions.

Although Jones and George's model is based on interpersonal trust, certain elements of the model may be related to technology trust. Firstly, the introduction of new technology implementations is often characterised by varying levels of resistance on the part of the intended users. This, in turn, suggests that distrust towards the technology may exist among certain users. However, the users must suspend their feelings of distrust in order to benefit from the potential utility of a technology. Their experience using the technology will stimulate either negative or positive feelings which will, in turn, affect their attitude towards the technology and either confirm or disconfirm whether they may trust the technology or not. This view is supported by Todman and Monaghan (1994), who argue that initial favourable experiences of individuals with computers tend to result in more positive affective attitudes.

4.2 Factors determining the trustworthiness of technology

In chapter two trust was said to exist within the coincidence of risk, expectation and reliance. This description also holds true in the case of technology trust. For a user to trust a given

technology, the user should stand to lose something through the adoption of the technology, there should be an expectation of a certain result from the use of the technology, and there must be a relationship of reliance between the user and the technology if the expected result is to be achieved. Chapter 2 also indicated that trustworthiness is defined by the characteristics of the trustee and the perceptions of risk surrounding the interaction with the trustee. This section will examine both the characteristics that determine the trustworthiness of a technology and also the users' perceptions of the risks involved in adopting the technology.

4.2.1 Trustee characteristics

(Mcknight, Carter, Thatcher and Clay (2011) describe technology trust as a person's beliefs about the trustworthiness of a technology to perform a specific task. Several researchers have attempted to apply the factors of trustworthiness as defined in the literature on interpersonal trust to the trustworthiness of technology. Numerous writers have cautioned against applying interpersonal trust constructs such as benevolence and integrity when defining technology trust, as technology is personified through its ability to model human functions (Li, Rong, & Thatcher, 2009; McKnight et al., 2011; Söllner, Hoffmann, Hoffmann, & Leimeister, 2011). McKnight et al. (2011) argue that the volitional control and morality that may shape constructs such as benevolence and integrity are not often ascribed to technological artefacts. They, therefore, describe a technology's trustworthiness as being dependent on its ability to fulfil an intended task (capability) and to perform without errors, delays, conflicts or unexpected results (reliability). Table 4.1 presents a summary of how McKnight et al. (2011) distinguish technology trust from interpersonal trust:

Table 4-1: Conceptual comparison between trust in technology and trust in people. (McKnight et al, 2011)

		Trust in People	Trust in Technology
Contextual Condition		Existence of risk or uncertainty, dependence on other people for achievement of outcomes	Risk, uncertainty, dependence on technology for achievement of outcomes
Object of Dependence		People (Moral agency, volitional and non-volitional factors)	Technology (Amoral and non-volitional factors only)
Nature of Trustor's Expectations:	**Ability**	The person possesses the **competence** to deliver the expected outcome.	The technology possesses the required **functionality** to fulfil the required tasks.
	Benevolence	The person demonstrates the **will and volition to act caringly** and considerately towards the trustor	The technology is able to **provide effective help when needed** (e.g. through help functionality)
	Integrity	The person demonstrates both ability and benevolence consistently or predictably	The technology functions reliably and consistently, without failing

As demonstrated in the table above, McKnight et al (2011) distinguish between trust in people and trust in technology in terms of ability, benevolence and integrity, as well as the contextual conditions and the objects of dependence. They further differentiate trust in technology from interpersonal trust by defining trust in each context in terms of the factors of trustworthiness. This study partially supports McKnight et al.'s (2011) view regarding the distinction between interpersonal and technology trust. However, this study is of the view that McKnight et al. (2011) underplay the meaning of benevolence with respect to technology trust. Benevolence is defined in the Oxford Dictionary as "the quality of being

well meaning or kind", and in the Merriam Webster dictionary as "a disposition to do good". Definitions of benevolence cited in Mayer et al. (1995) allude to the association between benevolence and altruism or selflessness. This study is of the view that McKnight's perspective of benevolence in the context of technology trust underplays this meaning. Thus, the distinction of benevolence from the technology trust perspective should extend beyond simple helpfulness to perceiving the benevolence of a technology as its purpose in serving the needs of its users. This view is supported by Söllner, Hoffman, Hoffman, and Leimeister (2011) who define purpose as a key factor in determining the trustworthiness of a technology and also by Lippert and Swiercz (2005) who identify the utility of a technology as a determinant of a technology's trustworthiness.

Researchers who have studied trust in the context of information technology artefacts have tended to focus extensively on the factors of a technology's trustworthiness identified by McKnight (2011). Table 4.2 summarises the factors determining the users' perceptions of the trustworthiness of technology according to a variety of researchers. Wang and Benbasat (2005) do not deviate from the factors of trustworthiness in interpersonal relationships because their factors are based on trust in online recommendation agents, which are highly personified. On the other hand Söllner et al. (2011) intentionally deviate from adapting interpersonal trust constructs to technology trust. They approach the trustworthiness of technology from the Human Computer Interaction (HCI) perspective as defined by Lee and Moray (1992). Lee and Moray (1992) and Söllner et al. (2011) define the performance dimension as a reflection of the technology's capability to support the users in achieving their goals. The process dimension is defined as the degree to which the user believes the technology's algorithms are appropriate while purpose defines the perceptions of the users of the technology as regards the designer's intentions.

Table 4-2: Summary of views regarding the factors determining the trustworthiness of technology.

Author	Factors determining trustworthiness of technology
Wang and Benbasat (2005)	Competence, integrity, benevolence
Lippert and Swiercz (2005)	Utility, reliability, predictiveness
Lankton and McKnight (2008)	Functionality, reliability, helpfulness
McKnight et al. (2011)	Functionality, reliability, helpfulness
Li, Rong, and Thatcher (2009)	Capability, reliability

Söllner et al. (2011)	Performance, process, purpose
Lankton, McKnight and Thatcher (2013)	Functionality, reliability, helpfulness

From the perspectives presented in Table 4.2, it is apparent that the ability dimension of trustworthiness is reflected in its functionality, competence or capability as regards fulfilling the intended tasks or goals. The integrity dimension of trustworthiness is measured in terms of the extent to which users may rely on the technology to fulfil the necessary tasks consistently and predictably. Finally, the benevolence dimension addresses the utility, helpfulness and overall purpose that the technology provides with this dimension fundamentally defining the value that the technology creates for the user.

This is partially consistent with Söllner et al.'s (2011) definition of the performance, processes and purpose of technology as attributes of trustworthiness. The key distinction in their definition stems from the fact that they describe the attributes of trustworthiness in terms of first and second order measurements. The first order measurements refer to outcomes that affect the trustworthiness of a technology. These include the performance, processes and purpose of the technology. On the other hand, the second order measurements constitute the factors that contribute to the first order measurements. As regards performance, the second order measurements define the measures of competence, information accuracy, reliability over time and responsibility (the extent to which the necessary functionalities are contained in a technology) as contributors. Similarly, Sollner et al.'s (2011) identify indicators of both the process dimension and the purpose dimension. Table 4.3 provides a summary of these measurements as proposed by Sollner et al. (2011). Their definition of process also includes dependability as an indicator of the trustworthiness of technology. The combination of indicators identified under the technology's purpose allude to the notion that the technology should serve the interests of the users.

Table 4-3: Dimensions of the trustworthiness of technology artefacts (Söllner et al., 2011)

Performance Dimension	Process Dimension	Purpose Dimension
Competence: **The system helps the users achieve their goals.**	**Dependability:** The system behaves in a consistent manner.	**Motives:** The purpose of the system was communicated to the users.
Information accuracy: **The information provided by the system is accurate.**	**Understandability:** The user has a clear understanding of how the system works.	**Designer benevolence:** The designers had a positive orientation towards the users when designing the system.
Reliability over time: **The system may be relied upon over a considerable period of time.**	**Control:** The user has a sense of control when using the system.	**Faith:** The users have a general sense that they may rely on the system.
Responsibility: **The system contains all the necessary functionality.**	**Predictability:** The user knows what to expect from the system.	

Sollner et al.'s (2011) definition of the attributes that contribute to the trustworthiness of a technology are depicted in figure 8 below.

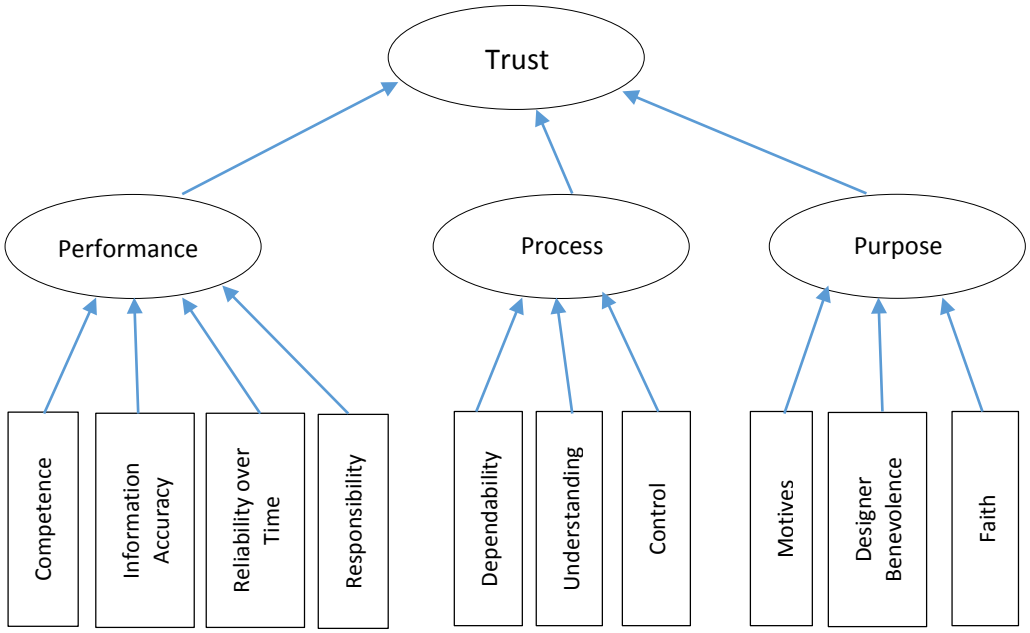


Figure 4.2: First and second order measurements for trust in IT artefacts (Söllner et al., 2011)

4.2.2 Perceived risks

As stated earlier, "Trust and risk are two sides of the same coin". For trust to have relevance in any context, there must be both a clear risk facing the trustee and an expectation of a desirable outcome. In the relationship between e-marketplace users and the e-marketplace technology, the risks associated with Internet security and privacy are clear and are generally well understood. However, there are also some less obvious risks that face prospective users and impede the adoption of e-marketplaces. This section discusses both the obvious risks and the less apparent risks.

4.2.3 Information Security and Privacy Risks

Like trust, privacy is a concept that is relevant to a wide array of disciplines (Schoeman, 2007) and, hence, has many philosophical definitions. Whitley (2009) suggests that privacy is often defined based on the manner in which it relates to the interpretations of the enquirer. Unfortunately, the majority of articles on privacy in the context of e-commerce refrain from defining privacy. Consequently, the distinction between privacy and security is obscure in most e-commerce literature. This section identifies those risks that are classified as information security threats, and those that are categorised as privacy risks with the aim of identifying the risks relating to privacy and security in e-commerce.

The focus in the literature on technology based e-commerce risks has shifted over the years. Early e-commerce technology came in the form of Electronic Data Interchange (EDI). This, in turn, involved closed electronic exchanges where two or more institutions could exchange documents regarding transactions by transmitting data relating to the transactions in standardised formats (Meadors, 2005). Such technology was used as far back as the 1970s by large corporates that already had established relationships between them. Information Security in EDI was focused on ensuring data integrity, non-repudiation, confidentiality and authentication (Meadors, 2005). However, the risks were less pervasive as the transactions took place between a closed group of stakeholders while the communication technologies were understood by a select few only. In the early 1990s, when the Internet become more accessible to the general public, e-commerce emerged and the risks associated with an anonymous, open and accessible platform of exchange became apparent. Numerous studies have discussed individual e-commerce threats but only a few have attempted to classify these threats. However, classifying e-commerce threats is likely to be a more productive approach as new threats are emerging rapidly and it is not possible to document all of them as they emerge (Abbas, El Saddik, & Miri, 2005). Accordingly, Abbas et al. (2005) created a taxonomy of Information security risks with the goal of prescribing how to address the threats that emerge from each category. They classified the threats as follows:

- **Manually Penetrating Threats:** This category includes all methods and techniques which facilitate the manual penetration of a system such as password cracking, social engineering, and masquerading.
- **Data Interception, Interruption and Replaying Threats:**
  This class includes threats that compromise the integrity of data or communication by intercepting information or a sequence of communication processes, tampering or modifying messages in transit or deleting data in transmission.
- **Defeating Mechanisms and Policy Threats:** This involves attempts to evade authentication control mechanisms and policies.
- **Malicious Code:** This includes all threats that emerge from the development of software with the specific intention of causing harm, committing fraud or breaching security.

- **Distributed Communication System Threats:** This class contains all forms of attacks that exploit vulnerabilities in network communication protocols. Distributed Denial of Service attacks fall within this class.

In addition, Abbas et al. (2005) also mention biometrics and physical token threats as a class of threats. However, as biometrics are not yet widely used in e-marketplace transactions, this class will not be discussed in this study.

Antoniou and Batten (2011) list two categories of privacy risks relating to e-commerce. The first category relates to the risks that emerge when information resulting from an online transaction about a buyer is accessed by an external party while the second category refers to the general privacy risks that exist in e-commerce. These risks are summarised in Table 4.4. It is apparent from this categorisation that similarities exist between the risks that are perceived as security risks and those that are perceived specifically as privacy risks. For example, risks 1, 2 and 5 in Antoniou and Batten's (2011) categorisation are identified as privacy risks, although they are also classified as security risks by Abbas, El Saddik and Miri (2005). Based on the classification of privacy risks and security risks in e-commerce, this study makes the distinction that privacy relates to the extent to which an individual's personal information is protected from access and misuse on the part of external parties, while security relates to the measures in place to protect unauthorised access and the use of the confidential information by either company or individuals. Privacy risks may emerge from the wilful or unintentional actions of an e-marketplace vendor, and thus, not all privacy violations are a result of a security breach.

Table 4-4: Categories of privacy risks (Antoniou & Batten, 2011)

	Description
Risk 1	An attacker intercepts the payment information while it is in transit between the purchaser and the seller.
Risk 2	An attacker steals the payment information of the purchaser from the seller and misuses it either: 2a: Before the seller uses the payment information 2b: After the seller uses the payment information
Risk 3	The seller misuses the payment information in the following ways: 3a: Charges the credit card of the purchaser for the goods more than once

	3b: Sells the payment information to other entities 3c: Charges the credit card of the purchaser with more than the agreed amount
Risk 4	The seller may misuse the personal information of the purchaser in the following ways: 4a: The seller may sell/reveal the personal information to other entities. 4b: The seller may make the buyers' personal information public without their consent. 4c: The seller may send spam email to the buyer.
Risk 5	An attacker may steal the personal information of the purchaser from the seller.
Risk 6	The seller does not allow the purchaser to update his/her personal or payment information.
Category 2 risks	
Risk 7	The seller may hide its real identity from the purchaser
Risk 8	The seller may not follow or respect the published privacy policy
Risk 9	The seller may not follow or respect the published policy about the return of products.

4.2.4 Technology adoption risks

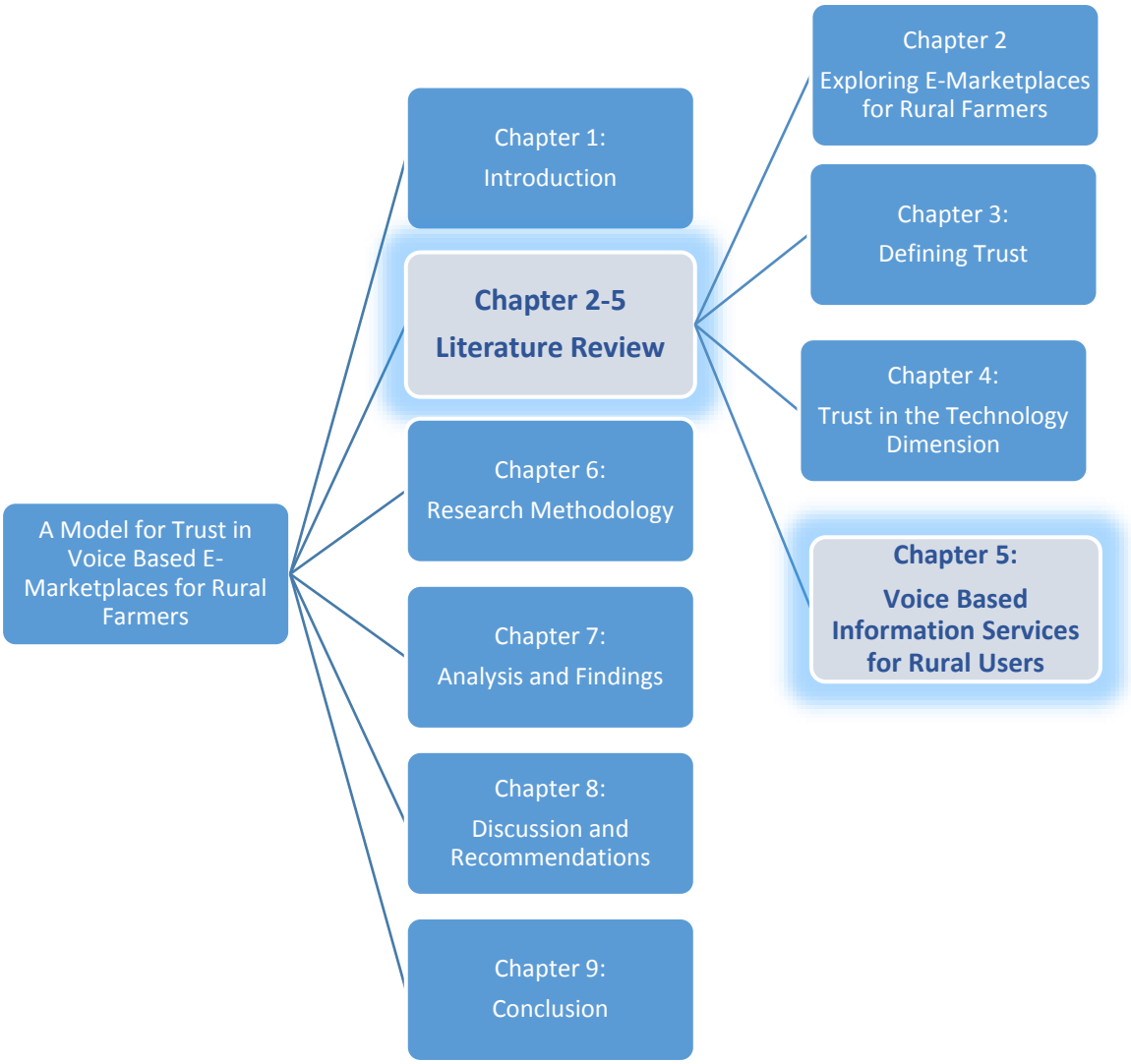
The need for trust implies the perception of risk. Many of the prominent works evaluating the relationship between technology trust and adoption (Gefen et al., 2003; Pavlou, 2003) have focused on the relationship between trust and the adoption of online applications or services. However, few writers have recognised that trust in technology has an influence on the adoption of technologies, even in the absence of online risk perceptions. Online risks often have financial implications and, as a result, are the subject of intense scrutiny in trust literature. This study is of the view that any circumstance where technology presents a user with the risk of loss is likely to deter the user from accepting or adopting that technology. For many users the time and resources involved min learning to use the new technology may be perceived as a loss in itself. Various studies (Featherman & Pavlou, 2003; Lu et al., 2006; Azmi & Kamarulzaman, 2010) have identified time loss as a risk that users perceive when making adoption decisions. Azzam (2013), further recognises the perceived performance risk (relating to the technology's ability to deliver what is expected

of it) as a risk that users consider when deciding whether to engage with a technology. In addition, there is a social risk associated with the adoption of technologies and which relates to the manner in which the opinions of the adopter's reference groups affect the adopter as a result of his/her use of the technology (Azzam 2013). Other categories of risks include psychosocial risks, information risks and opportunity cost risks (Azzam, 2013). In situations in which material losses are not entirely evident, the time invested, the effect of technology acceptance on the users' social status and the users' resultant psychological states are more relevant aspects to consider when evaluating the intentions to trust new technologies.

4.3 Conclusion

This chapter concludes that, although various writers may differ regarding the attributes that define the trustworthiness of technology and some writers are more detailed in their definitions of such attributes than others, there is no fundamental difference in the views of all the writers who have been examined in this study. Technology trust is built on the user's belief that the technology has the functional ability to fulfil the intended goals or tasks, that it is able perform what is expected predictably and reliably, and that the technology is designed to provide help, utility and/or support for the user. The key difference is in the terminology used by the various writers rather than in the meaning. Technology trust is centred on the perception of the risks associated with the use of a specific technology, the expectation that a certain level of utility will be provided by the technology, and the dependence on the technology to achieve such utility. The next chapter examines voice based information systems with the aim of understanding the factors that would result in rural farming communities to trust these systems.

Chapter 5: Voice based Information Services for rural users



5.1 Introduction

In the previous chapters trust was defined and the factors influencing the trustworthiness of technology identified. These factors were categorised as trustee characteristics and trustor characteristics. Trustor characteristics refer to the inclination of one party to have faith in another party or to behave trustingly in situations of uncertainty. On the other hand, trustee characteristics describe the attributes that a party demonstrates and that instil confidence in the trustor about the trustee. The key attributes of a trustee that contribute to the trustor's perception of the trustee's trustworthiness are the ability, benevolence and integrity of the trustee. Other factors contributing to trust in a relationship include the perception of risk and experiences in previous encounters. It was also established that a relationship of trust is not restricted to encounters between human beings but that it may also be considered in the relationship between a human and a technology. In this regard, the trustworthiness of a technology is determined by the extent to which it may fulfil the required task (ability), the degree to which it satisfies the needs of the user or is found to be useful (benevolence), and the level of to which it functions as expected or the consistency and predictability with which it functions (integrity). This study focused on the relationship of trust between the technology and the user. Specifically this study examines how trust in a voice based e-marketplace will influence the adoption or participation in the e-marketplace.

This chapter explores trust in the technology artefact with respect to voice based e-marketplaces. The factors influencing trust will be examined in respect of their influence on the adoption of voice based applications. These factors are reviewed specifically in the context of voice based information service usage in the rural areas of developing countries. In this regard, factors such as the levels of literacy, access to ICT based infrastructure, language barriers, cost and exposure, experience and expertise as regards utilising ICTs will be taken into consideration.

5.2 Spoken Dialogue Systems for rural e-commerce

Information and Communication Technologies (ICTs), as a mechanism through which the economically disadvantaged may advance, have been researched extensively. However, it has been suggested that ICT interventions are failing to achieve their intended development objectives. The Internet has profoundly transformed society socially, economically,

culturally and politically and has become an indispensable part of many lives. However, despite the extent to which much of the developed world depends on the Internet, the majority of the world's population still does not have access to the Internet (ITU, 2013). Studies have highlighted the cost of being on the deficient end of the information divide (Horrigan, 2011), suggested that the inability of the developing world to harness digital technologies such as the Internet to enhance productivity may further widen the chasm between the developed and the developing world (Norris, 2001). Although research suggests that the digital divide may be narrowing as a result of the high penetration of mobile phones in developing countries, rural users are yet to effectively harness mobile devices as tools for increasing their access to information.

E-marketplaces typically require Internet connectivity. Unfortunately, the Internet access in rural areas is limited by factors such as high data costs and a lack of access to enabling infrastructure and devices. Botha, Calteaux, Herselman, and Grover (2012) argue that both the increasing focus on developing ICT solutions for the underserved and the wide proliferation of mobile phones within poor communities have resulted in new opportunities for Spoken Dialogue Systems (SDSs). SDSs are systems that support interaction between users and technology through verbal gestures (Glass, 1999). According to Glass (1999), these systems may be used to obtain information, conduct transactions or perform tasks. Glass (1999) adds that SDSs cover a wide variety of voice based technologies, ranging from simple Interactive Voice Response Systems (IVRs), to complex natural language processing information systems. According to López-Cózar, Callejas, Griol and Quesada (2015), SDSs have evolved over the years from their initial orientation towards completing simple tasks such as the provision of information to more complex uses within intelligent environments, in-car applications, personal assistants, assisted living applications, and interaction with robots. López-Cózar et al. (2015) are of the opinion that SDSs aim at making technologies more usable and accessible when users are confronted with limitations in technology use and at building assistants with which users may maintain long term relations.

SDSs have captured the attention of ICTD researchers because of their ability to deliver information to users through widely pervasive and accessible channels such as fixed line and mobile phones (Botha et al., 2012). In view of the fact that most voice based services may be delivered over even the most basic devices, they may play a significant role in bridging

the information gap facing poor communities (Botha et al., 2012). Voice based information services attempt to address the challenges relating to the comparatively high cost of web-enabled devices, as well as the language barriers and the low levels of literacy that are known to inhibit the adoption of information services by users in the rural areas of developing countries. The Local Speech Language Initiative in Kenya (Nasfors, 2007), the Lwazi Community Communication Service (Grover & Barnard, 2011), the Spoken Web (Agarwal et al., 2010), an HIV Health Information System (Grover, Plauché, Barnard, & Kuun, 2009), the Voices Project (Gyan et al., 2013) and the Tamil Market (Plauché & Prabaker, 2006) are just a few examples of the many initiatives aimed at delivering information services through voice based services to users who do not have Internet access. All these studies have launched pilots that have been extensively adopted by their intended users. Most of the studies identified illiteracy and limited access to the Internet in rural communities in developing countries as the motivating factors for the use of voice services.

5.3 SDS architecture

The past decade has seen a shift in the development of SDSs, from being built on closed proprietary software platforms deployed by large vendors to using open systems and more uniform standards. According to Fabbrizio and Lewis (2004) and Levow (2012), VoiceXML revolutionised the development environment for voice based applications, promoting a standard development environment, portable speech applications and reusable modules. Today, SDSs are generally built using the same components. These components include a speech recognition module, a language understanding module, a dialogue management module, a language generation module and a speech synthesising module. Fabrizzio and Lewis (2004), McTear (2002) and López-Cózar et al. (2015) explain that these modules function as follows:

- An audio signal from the user is transferred to the speech recognition module and translated into a recognition hypothesis (This is the speech recognition module's understanding of the signal)
- The recognition hypothesis is then transmitted to the language understanding component, where a corresponding semantic representation is created

- The semantic representation is then sent to the dialogue manager, where an action is determined based on the meaning held by the input received and the discourse context.
- A language generation module then generates a textual response which is subsequently passed to a speech synthesis module and rendered back to the user as an audio signal.

McTear (2002) adds that SDSs often also include components that interface with external systems such as database systems, expert systems or other computer applications.

The components discussed above are depicted in Figure 5.1.

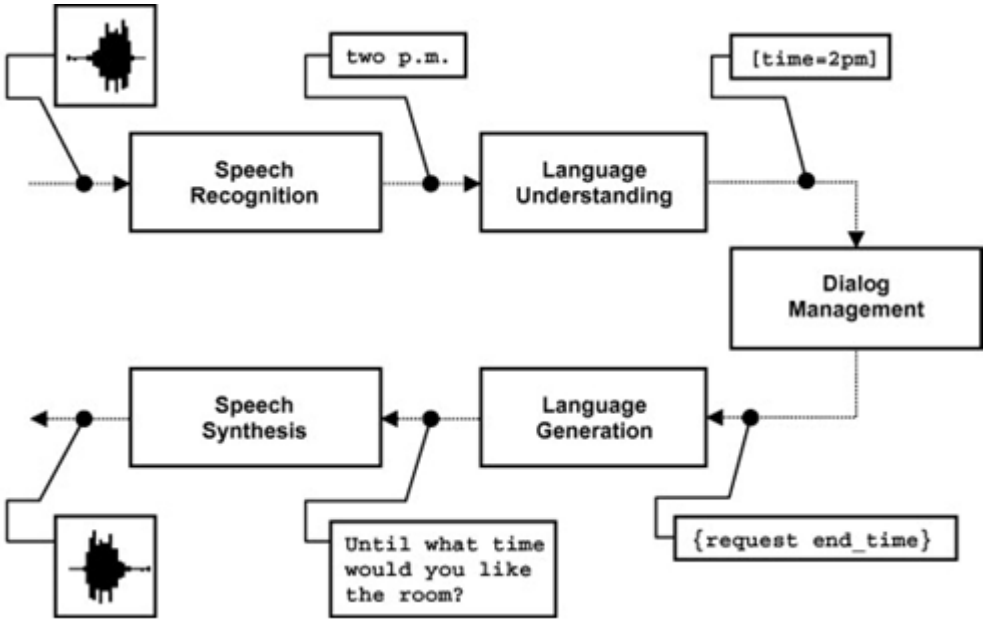


Figure 5.1: Components of a Spoken Dialogue System (Bohus & Rudnicky, 2009)

In addition, these components need to interact with interfaces that allow user input through telephony systems, as well as backend systems for data storage. Pieraccini and Huerta's (2005) illustration of the interaction amongst these components is depicted in Figure 5.3:

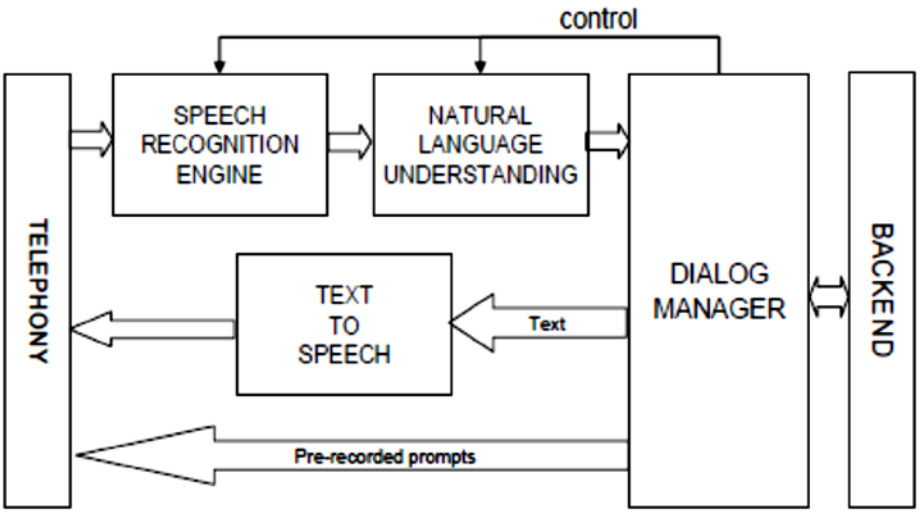


Figure 5.2: Basic architecture of SDS systems (Pierraccini & Huerta, 2005)

5.4 Challenges to the adoption of voice based applications by rural farmers.

Although voice based information services appear to offer a compelling solution to the challenges associated with the information divide facing rural communities, there are, nevertheless, some significant challenges impeding their adoption. Chapter 4 identified six critical barriers to the adoption of ICTs by rural communities. These barriers included the lack of access to ICT based infrastructure, high communication and connectivity costs, language and literacy barriers, lack of supporting policy for ICT implementation, lack of context of rural ICT based innovations and lack of awareness of the value of ICTs and the motivation to use them. This section explores these barriers with respect to ICTs that use voice as an interaction modality.

Voice driven user interfaces are accessible over the most basic and widely pervasive ICTs in developing countries, namely, mobile phones. However, high connectivity and communication costs are likely to hinder the accessibility of these services. Nevertheless, the regulatory environment does have the capacity to influence such costs. This chapter will consider the cost of voice calls and the policies that surround the costs of voice calls. In addition, although literacy is less of a barrier in respect of interaction over voice interfaces, the language barriers become more pronounced. Translating content from one language to another using graphical user interfaces is much easier than doing so on speech interfaces. The reason for this is that a graphical user interface is not expected to understand the new language. In contrast, in the case of speech, the translated content

must be understood by the system if the system is to respond accordingly. Thus, language barriers will be examined as a barrier to the adoption of voice based information services. Finally, because the SDSs implemented for rural use are introduced primarily by external stakeholders, it may be assumed that there are gaps in the understanding of the context of their use, and the consequent possibility of technologies that will not be perceived to be useful to the user. Although the context of use and the users' appreciation of the value proposition of SDSs are relevant to SDSs, they are factors that affect all categories of ICTS and with no specific distinction as regards the types of interfaces. They will, thus, not be covered in this chapter. One factor that was not identified as a barrier to ICT adoption, but which has relevance in the case of SDS implementations, is the complexity inherent in SDS configurations. The abovementioned factors will be reviewed in the sections that follow.

5.4.1 The complexity of the configuration of Spoken Dialogue Systems

The Internet is based on open standards and has a host of development platforms designed to simplify and speed up the process of creating online content. Content Management Systems (CMSs) allow complex interactive systems to be developed without extensive experience or skills. As a result, websites may be created by novices while the cost of configuring and maintaining websites and developing online content is not prohibitive. According to Kumar, Agarwal and Manwani (2010), configuring voice based applications is much more challenging than setting up Internet based web applications as the former requires an understanding of speech recognition hardware and software as well as telephony architectures, networks and communication protocols. According to Facco and Falavigna (2006), in addition to the traditional software development and systems analysis skills required for the deployment of new systems, voice-based information services require the specialised skills of linguists, speech scientists, human factors specialists and business process analysts. Vashistha and Thies (2012) add that, although the expertise necessary to configure voice based services may be accessible to research institutions, such skills are often beyond the reach of organisations serving rural communities such as non-profit organisations (NPOs), non-government organisations (NGOs) and rural cooperative and micro enterprises. Consequently, voice based applications for rural users are not often sustainable or scalable beyond their pilot phases as researchers do not always have access to the funding required to cover the operational costs associated with maintenance and upgrades (Vashistha & Thies, 2012).

5.4.2 The high cost of phone calls for rural users

The cost of voice calls for rural users has been identified as a barrier to the adoption of voice based applications (Grover & Barnard, 2011; Grover et al., 2009; Heimerl, Honicky, Brewer, & Parikh, 2009; Nasfors, 2007). Thus, in order to pilot projects using voice based services, project initiators tend to make the services available and which use toll free numbers to maximise participation (Grover & Barnard, 2011). Voice based information services targeted at rural communities are often initiated by external stakeholders, using external funding. Although this approach encourages participation through the duration of the pilot, it is not known whether rural users would continue to use these services if they were required to pay to access them. Considering that voice calls cost more in the developing countries as compared to the cost in the developed countries, especially relative to the disposable income of rural users, the significance of the cost of voice calls may not overlooked. The dialogue manager component of an SDS controls its logic and flow. It contains the logic that is applied both to process the semantic user input and to determine an appropriate response or course of action (Bohus & Rudnicky, 2009). The dialogue manager depends on the accuracy of other components such as the natural language understanding and the speech recognition components in order to yield the correct results. The more speech recognition errors occur, the longer the dialogue will be with this ultimately impacting on the cost of the call. Thus, the dialogue manager must cater for potential errors that may result from receiving incorrect semantic input, and then address these in a time efficient manner. These challenges make it essential to ensure that the tasks that the SDS seeks to complete are fulfilled effectively within a minimal time.

5.4.3 Language issues related to SDSs

Speech recognition modules have vast limitations in terms of accuracy, even in languages such as English and that are widely catered for in speech software. According to Choularton and Dale (2004), researchers in the early 2000s were reporting Word Error Rates (WERs) between 10% and 40% as normal. By the late 2000s, the majority of IVRs were yielding accuracy results ranging from 82 to 84% (Dean, 2008). Today, Google and Apple are being hailed for their contribution to speech recognition accuracy with Google reporting WERs as low as 8%, and Apple's Siri WER being reported at 5%. These represent considerable advancements, especially in view of the fact that Google's WER was estimated at 23% only

two years earlier. However, bearing in mind that developers may reasonably expect that a system will perform without any errors at all when working with visual interfaces, and that task completion often requires that no errors are encountered in the course of the dialogue, an error rate, even as low as 5%, may constitute a major hindrance. Furthermore, many of the SDSs designed for the developed world are novel interfaces although alternative interaction modalities do exist. For example, Apple's SIRI is a mobile assistant that offers a voice driven approach to achieving the functionality that may otherwise be obtained following non-verbal gestures. This is also true for Google's voice search. However, in situations involving rural use, where voice is proposed in order to provide a dominant modality through which users may interact with a system, an error rate of 5% would be a major concern. Thus, language constitutes a profound challenge to the implementation of SDSs for rural communities in the developing world. In addition, the number of languages catered for by speech technologies and resources is minimal. Besacier, Barnard, Karpov, & Schultz (2014) state that Google Voice Search catered for 29 languages and accents only in 2012, while the SIRI application accommodated eight languages only. According to De Vries, Badenhorst, De Wet and De Waal (2014), there is significant quantities of digitised data for approximately 30 of the world's 6 900 languages, much of which is in text format. Even in languages that are seemingly well resourced, such as English, some dialects may be lacking in resources. For example, South African English is considered to be a dialect of English that is classified as an under-resourced language in terms of Automated Speech Recognition (Davel, Van Heerden, Kleynhans, & Barnard, 2011).

5.4.4 The usability of voice based interfaces

Although one of the goals of SDSs is to enable easy and accessible interaction between humans and machines, this has not been evident throughout the evolution of SDSs. SDSs, particularly IVRs, have gained notoriety as technologies that leave the users with a sense of frustration (Chakraborty, Medhi, Cutrell, & Thies, 2013; Vaishnavi & Ganesh, 2014). Dean (2008) argues that most of the benefits offered by commercial IVRs are directed at companies rather than consumers. He states that IVRs are more focused on cost reduction than on customer satisfaction and that they overlook the fact that most people prefer to receive help from a human being rather than a machine.

One of the underlying philosophies behind the exploration of voice based interaction is that conversation is the most natural form of dialogue. However, speech technologies are plagued with limitations that impede the use of natural language to complete end to end processes. Consequently, many SDSs complement speech with text based input using Dual Tone Multi Frequency (DTMF) or else they utilise long tedious dialogues to accommodate the limitations of natural language understanding (Berg, 2012). Ensuring the usability of speech technologies is critical to overcoming their limitations (Suhm, 2008).

Usability guidelines for visual interfaces are well established while sufficient guidance exists to support the development of usable GUIs. However, usability guidelines for voice based interfaces have not reached the same level of maturity. It is for this reason that this study evaluates the usability guidelines and metrics that were developed specifically for visual interfaces in order to leverage and apply the established knowledge from visual interfaces to the emerging field of speech interfaces. If developers are to build systems that are usable, they need to understand the factors that characterise a usable system. These factors are discussed in the next section.

Seffah, Donyaee, Kline, & Padda (2006) state that, although numerous guidelines and methods for evaluating usability exist, they are not well integrated into a single conceptual framework to support developers with limited Human Computer Interaction (HCI) knowledge. Consequently, according to Seffah et al. (2006), most software developers do not apply usability measurement models appropriately and, instead, they make use of guidelines that are familiar to them. Seffah et al. (2006) add that there is limited guidance on the appropriate selection of usability measurement instruments. In order to overcome the challenge of identifying an applicable set of guidelines from an extensive array of approaches, this study adopted the definition and metrics of usability as defined by the International Organisation for Standardisation (ISO 9241-11, 1998).

According to Bevan, Carter, & Harker (2015), ISO 9241-11 has been highly successful in providing an internationally accepted basis for understanding and applying usability concepts and it is widely referenced in both research and industry. ISO 9241-11 (1998) defines usability as “The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use".

The ISO 9241-11 standard further defines effectiveness, efficiency and satisfaction as follows:

- Effectiveness: The level of accuracy and completeness with which the users' goals are achieved.
- Efficiency: The resources that are expended in relation to the accuracy and completeness with which user goals are achieved.
- Satisfaction: The freedom from discomfort and the positive attitudes towards the use of the product.

Although ISO 9241-11 (1998) is focused specifically on visual interfaces, the measures of usability relate to outcomes that are relevant to all modalities. A revision of the standard is currently underway with the new version anticipated in 2015 (Bevan et al., 2015). According to Bevan et al. (2015), one of the core propositions of the amended ISO 9241-11 standard is that the standard will no longer be limited to products, but it will also cater for systems and services. Accordingly, the standard will also be relevant to voice services.

Based on ISO 9241-11 (1998), a usable SDS is one where the users goals are achieved with accuracy and completeness, resources are used efficiently and the user is left with a sense of satisfaction. The inherent shortcomings of SDSs in respect of speech recognition and natural language understanding problems limit both their accuracy and their task completion ability. This, in turn, impacts adversely on the effectiveness of the services. In addition, the cost of calls and the length of the dialogues result in less than optimal efficiency in terms of the resources expended to achieve the users' goals. Lastly, the users' feelings of frustration when they incur high costs and still fail to achieve their goals impacts negatively on the attainment of user satisfaction. Thus, ensuring the usability of SDSs for rural users in developing countries remains a critical challenge.

5.4.5 Security and Privacy

Security is a challenge that affects any technology that either stores or transmits sensitive information. Chapter 4 discussed the categories of information security threats that apply to ICTs. These included manually penetrating threats such as password cracking, social engineering and masquerading; data interception, interruption and replaying threats; defeating mechanisms and policy threats; malicious code and distributed communication

system threats (Abbas et al., 2005). These threats are all as relevant when an SDS is used to conduct e-commerce transactions as they are to web based systems. An understanding how SDSs function is critical to understanding where the vulnerabilities arise. The section that follows describes the vulnerabilities that emerge from interacting with an SDS.

In order to initiate a dialogue with an SDS, a telephone call is made by a user using either a landline or a mobile phone. The calls are transmitted over a Public Switched Telephone Network (PSTN), Global System for Mobile Communications Network (GSM), Third Generation Networks (3G) or Fourth Generation Networks (4G). In some cases Voice over Internet Protocol (VoIP) is used to transmit the call. At this point the security of the transaction depends on the security of the networks over which the call is being transmitted.

PSTN and GSM calls are then routed through a Session Internet Protocol gateway and the voice signals are converted into data in order to be processed by the various SDS components. This enables the caller to interact with the SDS either to access information or to conduct transactions. Information relating to the transaction may then be stored in the databases associated with the SDS.

During this interaction data may either be intercepted while in transit over the respective networks or stolen from the database. Securing information once it is in the possession of the SDS is the responsibility of the developers and there are numerous mechanisms available to protect data that is stored. However, securing information while it is being transmitted over telecommunications networks presents significant challenges. These challenges are discussed in the next section.

5.4.5.1 Vulnerabilities when initiating the voice call

PSTN is possibly the most secure of the abovementioned networks because, according to Isomaki (1999), it is configured with dumb terminals that utilise large and complex switches. Isomaki (1999) and Landau (2014) add that PSTNs are often operated using closed systems run by large, trusted monopolies and also that the technology has been developed using specifications that are not publically available. In addition, PSTN signals are traditionally transmitted through underground cables as opposed to waves or packets.

Although many developed countries have moved to utilising microwave signals to convey signals through PSTN, in South Africa Telkom still uses copper wire. This, in turn, means that interception requires physical access to the cables or devices (Landau, 2014).

GSM, 3G, 4G and VoIP are far less secure than PSTN. According to Toorani and Beheshti (2008), GSM is characterised by many inherent security flaws. They argue that, although some of these flaws have addressed in subsequent generations of GSM, in developing countries GSM is still widely used. In view of the fact that feature phones are widely used in rural areas and they typically utilise the GSM network, this study focused on the vulnerabilities of GSM. Toorani and Beheshti (2008) list several security breaches that may result from GSM vulnerabilities. These risks are listed in Table 5.1 below.

Table 5-1: Vulnerabilities inherent in GSM networks (adapted from Toorani & Beheshti, 2008)

Vulnerability	Description
Unilateral authentication and vulnerability to the man-in-the-middle attack:	For a call to be authorised, the mobile subscriber must be authenticated, but there is no requirement on the GSM network for the Base Transceiver Station to be authenticated. This creates the opportunity for the spoofing of the network operators. An attacker may create a false Base Transceiver Station (BTS) with the same name as the mobile subscriber's default network and, thus, gain access to sensitive information or be able to modify data in transit.
Flaws in encryption algorithms:	Most encryption algorithms used in GSM have been shown to be easy to decipher and the networks are extremely vulnerable to breaches (Toorani & Beheshti, 2008).
Sim card cloning and over the air attacks:	SIMs contain all the necessary information to access a mobile subscriber's account. Both the International Mobile Subscriber Identity (IMSI) and the Individual Subscriber Authentication Key (Ki) are stored on every SIM. IMSI is a unique sequence of numbers attributed to each individual mobile subscriber in the world. Ki is a random number that contains the root cryptographic key used for generating session keys and authenticating the mobile users to the network. Ki is strictly protected and is stored on the subscriber's SIM. The SIM is protected only by an optional

	Personal Identification Number (PIN). An attacker only needs access to the IMSI and Ki of a SIM to impersonate a legitimate user. Furthermore, transmissions are only encrypted between the mobile subscriber and the BTS. Subsequent communication between the BTS and the Base Station Controller is completely open.
Lack of transparency:	The ciphering is controlled by the BTS and may be deactivated at the discretion of the BTS without notifying the mobile subscriber.

5.5 How the limitations of SDSs impede trust in SDS technologies

The trustworthiness of a party in interpersonal trust is determined by the factors of ability, integrity and benevolence. Chapter 4 described how these factors were translated into functionality or capability, dependability or reliability and usefulness in the context of trusting relationships between human beings and technologies. Trust in technology was, thus, described as a technology's capability of fulfilling the necessary functions consistently, reliably and according to the users' expectations, and the ability of a technology to satisfy the needs of the user. Chapter 3 highlighted that trust was also said to exist between the boundaries of risk, reliance and expectation. Accordingly, a trusted technology is one where a desirable goal is anticipated by the user (expectation), and the user must depend on the technology to achieve that goal (reliance). Furthermore, in order for the goal to be achieved, something of value to the user should be at risk. In the case of SDSs, the risk at stake is the time invested and the costs incurred (airtime) to engage with the system. Moreover, the vulnerabilities that are inherent in mobile networks expose the user to the risk of financial loss as well as the loss of privacy. Although privacy and security risks are less probable as hackers with the expertise required to conducting such attacks are not likely to target small scale rural farming communities, it is, nevertheless, essential that they are not completely overlooked.

A user utilises an SDS with the expectation that the system will provide the necessary functionality effectively, and that the utility expected (information retrieval or transaction processing) will be realised. Challenges as regards speech recognition, and natural language understanding impede the ability of technologies to demonstrate the necessary functionality and to perform according to the users' expectations. Furthermore, the user is not able to recover either the time or the money lost at the end of a dialogue that has not been not successfully concluded. Thus, the challenges associated with SDS described in this chapter have a strong bearing on the extent to which SDSs may be trusted by the user.

Summation of Literature Review

It was clear from the literature review that e-marketplaces have the potential to support rural farmers by enabling access to buyers and facilitating trade. It was also established that factors such as access to e-commerce enabling technologies, the high cost of connectivity, language and literacy barriers, lack of context of ICTs designed for rural use, and limited appreciation of the value proposition of ICTs impact adversely on the ability of rural communities to harness the value of ICTs, specifically e-marketplaces, to support their livelihoods.

The literature review then proceeded to examine the concept of trust. The aim of this was to build the foundation for a further enquiry into the way in which trust influences rural farmers' acceptance of a new technology. The concept of trust was examined and the constructs upon which trust is built explored. It was clear from the literature review that trust may be understood as a dynamic condition that emerges from the coincidence of risk, reliance and expectation. The trustworthiness of an entity was found to be influenced by the trustor's beliefs about the ability, benevolence and integrity of the trustee as well as the trustor's perception of the risks surrounding the interaction with the trustee. Furthermore, in the initial encounter between a trustor and a trustee, the literature suggested that trustors depend on cognitive and calculative cues to make judgements about the trustworthiness of others. Lastly, the degree of trust between parties was also found to be influenced by the opinions of reference groups (subjective norm), the structures in place to provide assurance in situations of risk (situational normality), the inclination of the parties to trust each other and their risk (faith in humanity and trusting stance). These factors were then evaluated in the context of trust in e-marketplace technologies.

In order to understand trust in a specific technology, the factors that influence trust in interpersonal relationships were evaluated in respect of trust between human beings and technology. It was found that trust in technology is influenced by the functional competence that the technology demonstrates, the reliability, consistency or dependability with which the technology functions and the extent to which the technology addresses the needs of the users. The risks associated with the use of e-marketplaces were examined. These risks

include technology adoption risks such as time loss and opportunity cost, as well as the information security and privacy risks associated with e-marketplaces. These risks were found to be linked to the degree of trust that a user places in a specific technology. Based on the theory of planned behaviour and Mayer et al.'s (1995) model of trust, it was concluded that the factors mentioned above determine the extent to which users may trust a technology (such as an e-marketplace) and, thus, incorporate it into their livelihood strategies.

The final chapter of the literature review examined the findings from the preceding chapters in order to determine the applicability of a voice based e-marketplace to the context of rural farming. The challenges that impede e-marketplace adoption were considered in the context of SDSs. SDSs were found to address the challenges of accessibility as they are able to provide information services and transaction processes over the mobile phones that are widely pervasive in rural areas. In addition, SDSs also address the challenges of literacy and language as the services they provide is able to cater for different languages. However, SDSs may also present challenges relating to language as a result of the limited speech recognition and language understanding ability of SDSs when processing poorly resourced languages such as those languages used in South Africa. In addition, the complexity of configuring SDSs, the high cost of voice calls, and the poor usability of SDS were found to constitute further challenges to the adoption of SDSs in a rural farming context. It was also found that there are considerable security flaws in GSM networks that may potentially compromise the confidentiality and integrity of e-marketplace transactions conducted over an SDS.

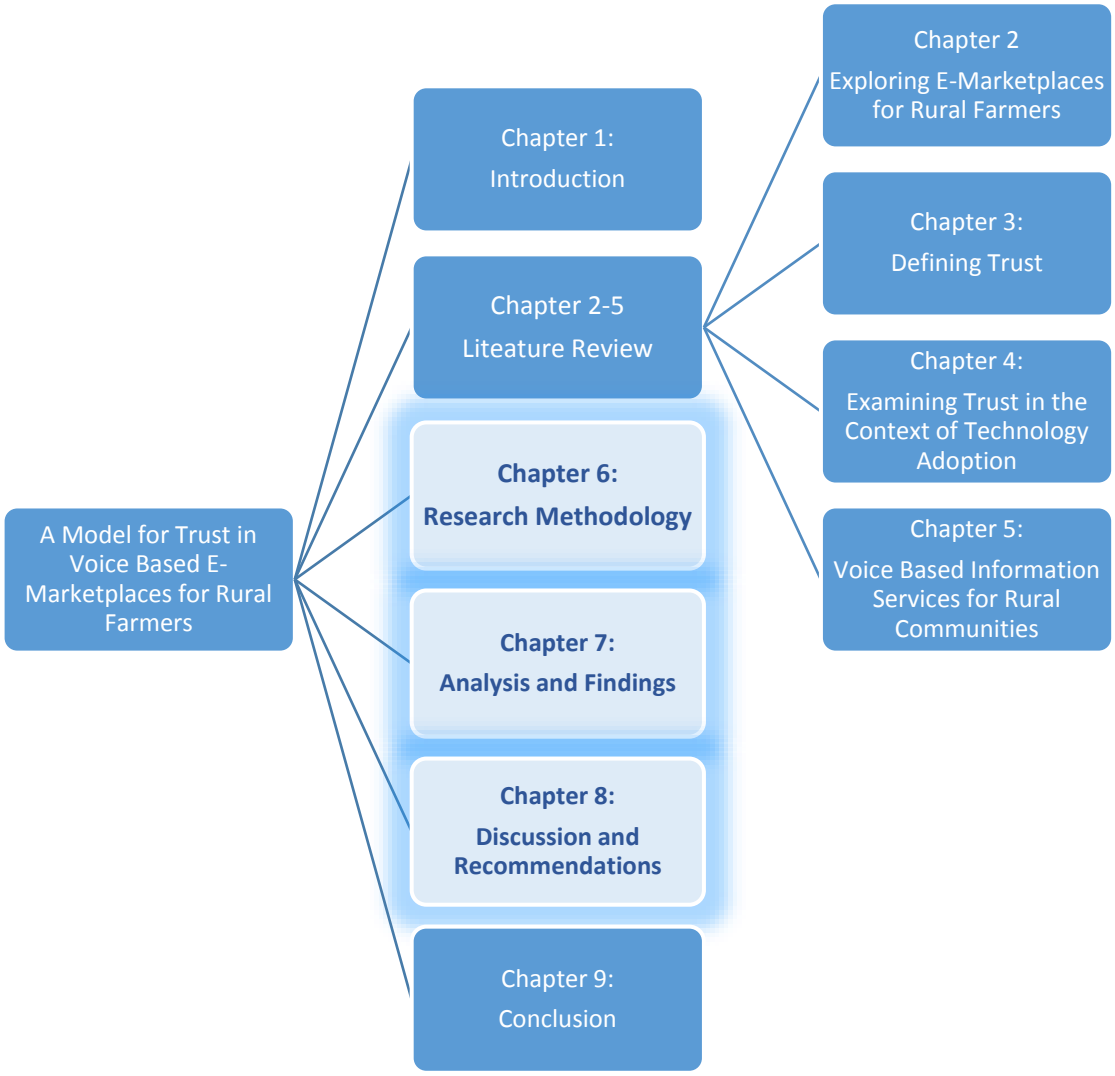
The following findings emerged from the literature:

1. E-marketplaces have the potential to support the livelihoods of rural farmers
2. The accessibility of e-commerce enabling technologies and the cost of connectivity constitute critical barriers to e-marketplace adoption
3. SDSs have the potential to enable e-commerce as they use the mobile phones that are widely pervasive to rural users
4. The speech recognition and language understanding limitations of SDSs for rural users challenge the use of SDSs in rural environments

The abovementioned factors are the focus of the empirical investigation that now follows.

Empirical Framework

An empirical examination into technology trust in voice based e-marketplaces for rural farmers



Overview of Empirical Section

This section of the study comprises an empirical review describing trust in the context of voice based e-marketplace adoption by rural communities. The aim of the study is to establish an understanding of the nature of trust and how trust affects the adoption of voice based e-marketplaces by rural communities. The study further seeks to propose a model for enhancing trust in voice based e-marketplaces in the interests of improved adoption by rural farmers.

This section of the study discusses the methodological approach that was used to provide answers to the research questions in Chapter 6. The study then describes the empirical study which was undertaken and the findings of this empirical study. The section concludes with a critical discussion of the research findings and describes the theoretical contribution of the study based on the study findings.

Chapter 6: Research Methodology

6.1 Introduction

Amongst the most critical measures of the quality of a research project is the manner in which the research is carried out and documented. It is essential that the manner in which the research is presented to its audience must reflect a rigorous process and trustworthy findings. The purpose of the research methodology chapter is to outline the approach that adopted in order to answer the research question. This study sought to understand how trust in voice driven e-marketplaces may be enhanced in the interests of improved adoption by rural farmers. The study adopted the approach proposed by Saunders, Lewis and Thornhill (2012) who divide the research process into the following five key layers, namely, the research philosophy, the research approach, the research strategy, the methodological choice, the time horizon and the data collection and data analysis methods. Figure 6.1 depicts how these layers will be applied in this study.

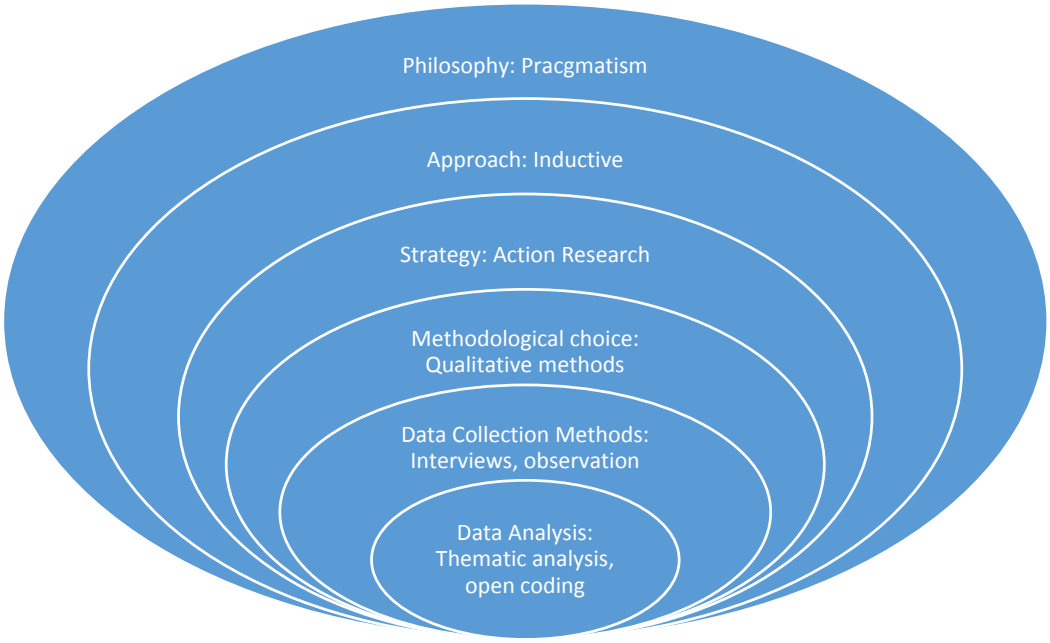


Figure 6.1: Application of research onion to this study. Adapted from Saunders et al. (2012)

Saunders and Tosey (2012) are of the opinion that researchers often incorrectly delve into the more practical inner layers of the metaphorical onion before adequately considering the more philosophical outer layers. They argue that the outer layers inform the researcher's choice of the progressive inner layers and, thus, it is essential that the researcher deliberate on these outer layers first. This view is supported by Walshaw, 2012, p. 62) who state that "designs do not simply arrive out of thin air" and argues that designs are, in fact, founded on theoretical standpoints that shape the way in which we view reality and what we understand

to be 'truth'. Accordingly, in line with the guidance of Saunders et al. (2012) and Walshaw (2012), this chapter begins with a description of the philosophical standpoint upon which the study is founded. Based on the research philosophy adopted the chapter will then describe the research approach, the research methods, research strategy and data collection and data analysis methods used in the study.

6.2 The research philosophy

In view of the fact that several stakeholders with diverse interests were involved in the project undertaken for the purposes of this study, the researcher did not have complete freedom in terms of the research strategy chosen. This research study was part of a funded project with stakeholders from three institutions, namely, The University of Fort Hare's Information Systems Department, IBM's Speech Technology Research Group in Israel, and IBM's Spoken Web Research Team in India. One of the anticipated outcomes of the project was that a software solution would be developed and deployed within the context of rural users from a developing country. As the study involved the development, deployment and use of a voice based e-marketplace, either Action Research or Design Research were possibly the two most appropriate strategies for the study. In the section that follows, the research philosophy that was adopted will be discussed, followed by a discussion on the choice of strategy.

Creswell (2009) cites Guba (1990, p. 17) in defining the research philosophy (or philosophical worldview) as "a basic set of beliefs that guide action". According to Grix (2010) it is imperative to state these beliefs at the onset of a research study for the following reasons:

- It allows one to understand the interrelationships between the key components of the research (including methodology and methods).
- It prevents confusion when presenting theoretical arguments about and approaches to social phenomena.
- It promotes an acceptance of the viewpoints of others, while enabling a researcher to defend his/her own position.

The research philosophy is founded on four core concepts namely, epistemology, ontology, axiology and paradigm. Ponterotto (2005, p. 130) alludes to epistemology, ontology and axiology as "anchors" that are reflected in the research paradigm. Scotland (2012) defines

epistemology, ontology and axiology by explaining that ontology attempts to understand whether knowledge truly exists or is a product of the mind, while epistemology is concerned with how knowledge is constructed. On the other hand, axiology relates to the extent to which the views of the researcher(s) are reflected in the research (Scotland, 2012; Ponterotto, 2005). Ponterotto (2005) adds that rhetoric is also reflected in the research paradigm and that it relates to the way in which findings are presented. Such presentation of the findings may range from subjective and personal first hand narratives to hard, objective facts and formulae.

According to Scotland (2012), the research paradigm seeks to understand how reality is viewed as well as how knowledge is constructed. In addition, the research paradigm reflects the degree to which the values of the researcher(s) are reflected in the research process and outcomes, and also how the research is presented. Thus, the epistemology, ontology, axiology and rhetoric demonstrated in a study must reflect the paradigm within which the study is aligned. This, in turn, will assist the research audience to understand how measures of rigour have been applied. In this regard, two extreme positions exist in terms of research paradigms, namely, positivisms and interpretivism.

According to Ponterotto (2005), positivism emerged as a paradigm shift from a "dark age", in which royal and religious decrees were accepted without question, to an age of enlightenment in which the world was considered to be objectively knowable and truth could be conveyed through language and numbers. Ponterotto (2005) describes positivist methods as systematic scientific processes to develop and either prove or disprove hypotheses using deductive reasoning. He adds that positivists view reality as a concrete truth and which is most often stated in quantitative propositions. Positivism aims at explaining, predicting and controlling phenomena. At the ontological level, positivists believe that reality is objective and measurable and that exists independently of the researcher. Thus, positivists apply a value neutral axiology to research. Thus, the opinions of the researcher do not influence the findings of the research.

On the other hand, according to O'Brien (2001), interpretivism is founded on the belief that reality is socially constructed and subjectively based. As opposed to positivist research, interpretivist research, does not aim either to prove or disprove a theory, but rather to

understand the complex interactions within a given setting (Oates, 2006). Interpretivists believe in the existence of multiple subjective realities (Oates, 2006). Oates (2006) adds that interpretivist researchers are not neutral in the research process and, therefore, their assumptions, beliefs and values inevitably influence the research process. Interpretivist research does not aim to arrive at a single explanation of a phenomenon but, rather, it explores various explanations, while endorsing the strongest of these explanations (Oates, 2006).

Collis and Hussey (2009) state that positivism and interpretivism are at polar ends of the paradigm continuum. Researchers tend to be inclined towards one or the other but they will seldom fall purely into one paradigm. Collis and Hussey (2009) add that several paradigms exist between the extremes of positivism and interpretivism on the continuum. In view of the nature of this research study and its inclination towards active intervention, the paradigm of pragmatism was the only additional paradigm reviewed.

Pragmatism rejects both the positivist and interpretivist views of reality as either a concrete structure (realism) or that reality is socially constructed and founded on the interpretations of the researcher (relativism). From an epistemological perspective, pragmatism is rooted in the belief that a proposition is true if it functions satisfactorily while the meaning of a proposition is to be found in the practical implications of accepting such a proposition (McDermid, 2006). Pragmatism concerns itself with action and change and it is, thus, appropriate to research approaches such as Design Research and Action Research which seek knowledge through intervention rather than observation (Goldkuhl, 2012). Goldkuhl (2012) maintains that the construction of knowledge (ontology) prevalent in pragmatism is not restricted to explanations or understanding but, instead, recognises other knowledge forms such as prescriptive, normative, prospective and explanatory knowledge.

Pragmatism was the paradigm adopted for the purposes of this study. This section discusses the research strategy that was applied to answer the research question. The outcomes of the study were both explanatory (using the researcher's experiences and observations to understand the nature of trust and how it relates to technology adoption in the given context) and prospective (proposing a model to address issues of trust relating to the adoption of voice based e-marketplaces in a rural setting).

The interests of the IBM Spoken Web research group in India were specifically focused on piloting the Spoken Web in a variety of settings in order to improve the group's understanding of the issues relating to the deployment, adoption and use of the platform among its target users. The IBM Speech Technologies group was interested in findings relating to research in speech technologies. Obtaining their PhDs was the primary objective of the researchers from the University of Fort Hare and their main field of interest was trust in e-marketplaces. Thus, the project provided a context within which the concept of e-marketplace trust was practically examined with respect to speech based technologies targeted at rural users. The roles of the stakeholders involved are summarised in Figure 6.2 below.

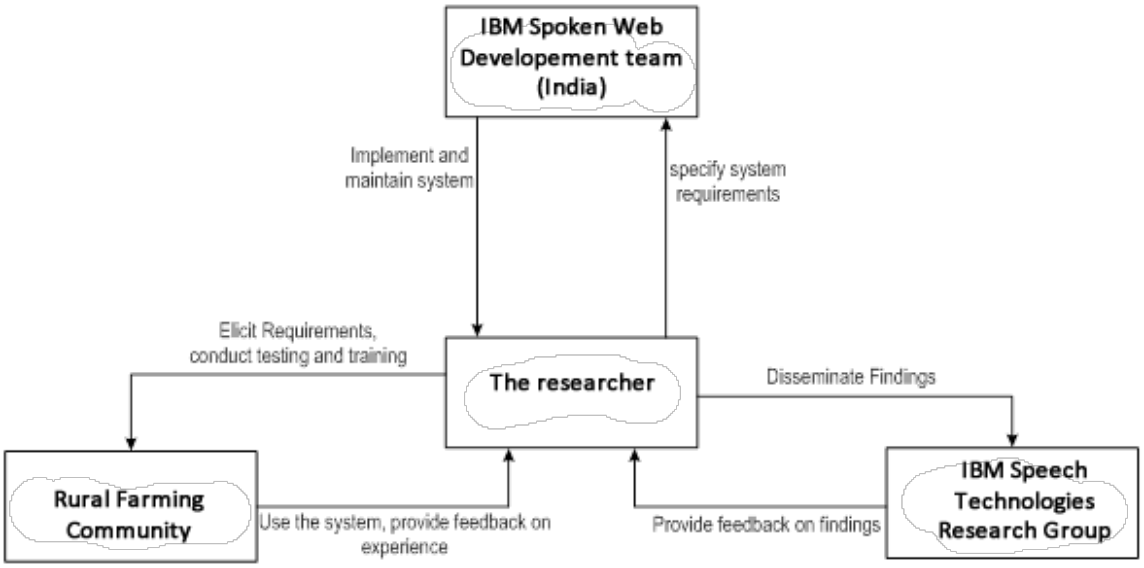


Figure 6.2: Project Stakeholders

In order to address the interests of all the stakeholders, the study attempted to understand how trust in a voice based technology could be enhanced among users within a rural farming context in order to promote the enhanced adoption of voice technologies. The project dictated that an actual voice based application was piloted using the Spoken Web and, thus, the choice of research methods was limited to either design science or Action Research. The philosophical position adopted for the purposes of the study determined the strategy chosen. The following section contains a critical comparison between design science and Action Research. Groenewald (2004) states that, in order to select an appropriate research design, the researcher requires a broad understanding of the relevant designs as well as a

thorough understanding of the design which the researcher chooses to use. In view of the fact that Action Research and Design Research were deemed to be the most relevant strategies within the constraints of this study, these two strategies are discussed in the next section.

6.3 Research strategy

An increasing number of researchers are beginning to recognise the similarities between the Action Research and Design Research strategies, particularly within the Information Systems discipline. Action Research is described by Lewin (1946) as a comparative research on the conditions and effects of various forms of social action". O'Brien (2001) describes Action Research aptly as "learning by doing". Baskerville (1999) adds that Action Research aims at solving a problem while contributing to theory. Design Science, according to Gregor and Hevner (2013), involves the construction of socio technical artefacts. Hevner, March, Park and Ram (2004) describe Design science as a problem solving paradigm that supports the innovation of ideas, practices, technical capabilities, and products. Although innovation and problem solving are key outcomes in both Design Science and Action Research, this study is of the view that Action Research places more emphasis on solving the problem, while Design Science is more inclined towards innovation. The fundamental commonality between the two approaches is that they are both practically oriented and thus, in terms of Information Systems research, they are both understood to contribute to relevant IS research. Järvinen (2007) summarises the similarities between the two strategies in Table 6.1 as follows:

Table 6-1: Similarities between Action Research and Design Research. Adapted from Järvinen (2007)

	Action Research	Design Research
1.	Emphasis is placed on the utility of a proposed system from a user's perspective	Design science products are assessed against the criterion of value or utility.
2.	The knowledge produced guides practice	Produces design knowledge in the form of concepts, constructs, models and methods
3.	Involves both action taking and evaluation	Building and evaluation are the two main foundations of design science.
4.	Carried out collaboratively by both the researcher and the client	Design science research is initiated by the researchers interested in developing technological rules for a certain type of issue. Each individual case is primarily

		oriented at solving the local problem in close collaboration with the local people.
5.	Results in the modification of realities or the development of new systems	Solves construction problems through product innovation or improvement
6.	The researcher intervenes in the problem setting.	
7.	Knowledge is generated, used, tested and modified in the course of the Action Research project.	Knowledge is generated, used and evaluated through the building action

Livari and Venable (2009) concur that similarities exist between Action Research and Design Science although they find these to be merely superficial. They contend that the core principles underlying the two strategies are essentially different. One difference between the two research strategies that was of particularly relevance to this study was the fact that, in Design Science, the resultant product may be artificially evaluated while the prospective beneficiaries of the artefact need not be involved in the production or evaluation of the artefact (Livari & Venable, 2009). However, this difference is also evident in Järvinen's (2007) comparison of the two research strategies. As depicted in Table 6.1 the sixth characteristic which distinguished the two strategies, namely, researcher involvement in the problem setting, was not matched in Design Research. Action Research, on the other hand, is conducted within the problem setting and with the active involvement of the subjects involved. Pragmatism is founded on change through action. The use of a Design Science approach to a study means that the researchers may choose whether to conduct the intervention either in reality or in simulation. In the case of a simulated intervention, there is no direct tangible change to the conditions of the target users. Accordingly, this study used Action Research as a strategy to address the research question.

6.3.1 Principles of Action Research

Information Systems research has been widely criticised as lacking relevance (Baskerville & Wood-Harper, 1996; Davison et al., 2004; Grant, 2012; Straub & Ang, 2011). This lack of relevance stems from the gaps between academic research and professional practice (Straub & Ang, 2011). According to Mckay and Marshall (2001), Action Research represents the coincidence of action and research, or of practice and theory. Thus, according to McKay and

Marshall (2001), Action Research leads to the production of new knowledge through practical solutions or improvements to real world problems. Grant (2012), Baskerville and Myers (2004) and Baskerville and Wood-Harper (1996) are all of the opinion that the ability of Action Research to address the problem of relevance in IS research has led to its rise to prominence in the field.

There are many forms of Action Research – the most prominent in Information Systems are Participatory Action Research and Canonical Action Research. The key difference between the two lies in the role of the researcher in the study. In Participatory Action Research the research takes place within the researcher's environment and, thus, the researcher plays the dual role of participant and researcher. However, a researcher in Canonical Action Research intervenes from the perspective of an outsider. This study assumes the form of Canonical Action Research. Davison et al. (2004) describe the following five core principles upon which Canonical Action Research is founded:

- There should be mutual agreement between the research team and the client regarding the objectives and anticipated outcomes of the research;
- The research must involve an iterative process of problem diagnosis, planning, action, observation and reflection with, each phase being suitably documented in order to ensure trustworthiness.
- The research must be guided by theory.
- The intervention should result in changes that are directly related to the initially diagnosed problems.
- The process must lead to learning through reflection.
- Such learning must reflect the implications of the research for the community involved, for similar research domains and for the theories underlying the research.

Davison et al. (2004) add that the iterations undertaken in Canonical Action Research are not cyclical but rather they follow a spiral pattern, recognising that there is a point of entry and a point of exit. As a point of entry, this study conducted a preliminary exploratory investigation to understand the nature of the aloe industry, the companies involved in the industry, and the value chain within which they operate. This was done in order both to understand the role of an e-marketplace in supporting trade with aloe harvesters and to

identify a community within which to undertake the research study. In addition, the literature review also contributed to this foundational knowledge. Figure 6.2 depicts the canonical Action Research process. The exit stage represents the point at which researchers believe they have obtained sufficient answers with which to address the research question(s).

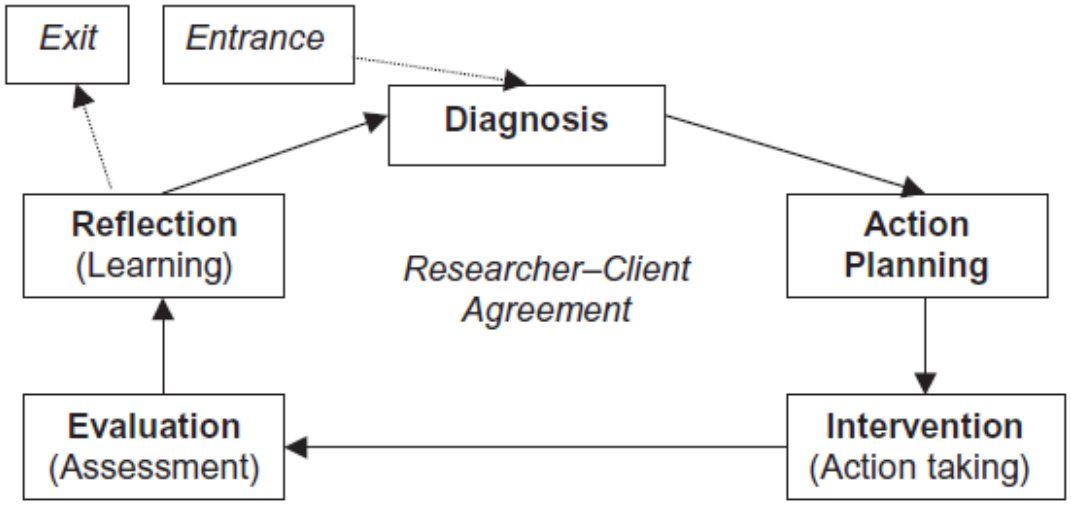


Figure 6.3: Canonical Action Research Process Model (Davison, Martinsons & Kock, 2004)

This research study sought to design, develop and deploy a voice based e-marketplace within a rural aloe harvesting community in order to understand how trust in voice based e-marketplaces may be enhanced in the interests of improved adoption within the given setting. Action Research is an adaptive process and responds to the observations and reflections made at the end of each cycle. As a result, it is often not possible for a researcher to predict the number of iterations that will be undertaken although they are able to plan core cycles according to the objectives they wish to achieve. The cycles involved in this study were centred upon the following core objectives;

- Designing and developing a prototype for a voice based e-marketplace
- Testing the design and refining it into a fully-fledged system
- Deploying the system and observing and reflecting on issues related to technology trust

The cycles involved in achieving these objectives are presented in Tables 6.2, 6.3 and 6.4.

Table 6-2: Entry phase of the Action Research process.

Entry phase **Objective: To define functional and technical requirements for an aloe e-marketplace**		
Stage	**Guideline (Davison et al., 2004)**	**Application**
Diagnosis (Entry phase):	• Understand the nature of the problem that the intervention seeks to address. • Determine the root of the problem. • Understand the societal/ environmental/socio-economic factors surrounding the problem.	• Determine how the ability of rural harvesters to effectively sell their harvest may be enhanced through an e-marketplace. • Determine the factors that challenge the ability to implement an e-marketplace in the context within which the rural harvesters operate. • Determine the functionality that should characterise an e-marketplace in order to support trade for rural harvesters.
Planning:	• Identify and plan the activities necessary for the intervention to be undertaken.	• Design and specify functional and technical system requirements.
Intervention:	• Undertake the planned activities. Make observations.	• Evaluate the proposed design in conjunction with the aloe community
Reflection:	• Reflect on feedback from the aloe community	• Refine functional and technical requirements accordingly.

Table 6-3: First cycle of the Action Research process.

Cycle 1 **Objective: To refine the design to accommodate the identified flaws** **(This cycle may be repeated until all major design flaws have been adequately addressed.)**		
Stage	**Guideline (Davison et al., 2004)**	**Application**
Diagnosis:	• Understand the nature of the problem(s)	• Model an e-marketplace based on the user requirements

	experienced in the previous cycle • Determine the root of the problem(s). • Understand the societal/ environmental/socio-economic factors surrounding the problem.	
Planning:	• Identify and plan the activities necessary for intervention to be undertaken.	• Design a prototype according to the e-marketplace model • Allocate tasks and timeframes to the development team.
Intervention:	• Undertake the planned activities. Make observations.	• Configure and deploy the prototype for testing with real users.
Reflection:	• Reflect on observations made during the intervention.	• Reflect on observations made during the testing phase.

Table 6-4: Second cycle of Action Research process.

Cycle 2: Objective: To develop a voice based e-marketplace that responds to the needs of the users. (This cycle may be repeated until all major design flaws have been adequately addressed.)		
Stage	**Guideline (Davison et al., 2004)**	**Application**
Diagnosis:	• Understand the nature of the problem(s) experienced in the previous cycle • Determine the root of the problem(s). • Understand the societal/ environmental/socio-economic factors surrounding the problem.	• Determine the extent to which the identified flaws have been addressed. • Determine the extent to which the users are equipped to utilise the system independently.
Planning:	• Identify and plan activities necessary for the intervention to be undertaken.	• Provide user training. • Set up structures to provide support remotely.
Intervention:	• Undertake the planned activities. Make observations.	• Deploy the system and observe its use in a real setting.
Reflection:	• Reflect on observations made during the intervention.	• Evaluate and reflect on the users' impressions of the intervention.

6.4 Research Approach

Creswell (2009) distinguishes between inductive research and deductive research as follows: Deductive research begins with a proposition or theory which it then proceeds either to

prove or disprove. The knowledge is generated as a result of this process. On the other hand, theory is the end point in inductive research and is generated through an aggregation and analysis of data. One of the criteria identified for conducting Canonical Action Research is that the study is guided by theory. However, theory in this regard refers to underlying theoretical frameworks or models that inform the study's point of departure rather than a theory that stands to be tested. Thus, Canonical Action Research is not deductive by prescription. The approach adopted is determined by the nature of the question to be answered. In view of the fact that this study sought to understand how trust could be enhanced, the study followed a process of generation rather than reduction. Thus, the study reflected on existing theory, reviewed relevant literature and enquired about and observed related phenomena and the consequences of the research interventions. The outcome of this process was a mode that responded to the research question. In other words, the approach adopted in this study may be regarded as inductive.

6.5 Research Methods

The debate as to whether to approach a study from either a qualitative or a quantitative perspective has been long standing. These two perspectives are closely aligned to the researcher's philosophy as regards the nature and construction of knowledge. Quantitative research follows the positivist paradigm, and uses experimental methods and quantitative measures to test hypothetical propositions (Hoepfl, 1997). Qualitative research, on the other hand, seeks to understand phenomena within their specific settings. According to Hoepfl (1997), quantitative measures seek to identify causal relationships, make predictions and create generalisable theories while qualitative research aims at achieving the illumination, understanding and extrapolation of phenomena within similar contexts.

The criteria which should be used when choosing a method should be methodologically appropriate to the situation. Thus, in view of the research questions and the purpose and objectives of this study the qualitative approach was deemed to be appropriate. Accordingly, the data collection methods used sought to derive rich insights from the perspective of both the research team and the participants.

6.5.1 Sampling methods

In accordance with the principles proposed by Davison et al. (2004) Canonical Action Research involves iterative cycles of problem diagnosis, planning, action, observation and reflection. Thus, the sampling and data collection processes used in this study were executed according to these cycles. During the diagnosis phase the communities involved in harvesting, processing or manufacturing within the aloe industry were identified. In view of the fact that the project sought to develop an e-marketplace in order to facilitate trade, the nature of the interactions between the various stakeholders in the industry determined the number of stakeholder groups included in the study. There are four categories of stakeholders in the aloe industry's value chain:

- Aloe harvesters
- Aloe processing plants
- Aloe health and beauty manufacturers
- Retail stockists of aloe based products

This study was concerned only with interactions between the first three categories as the fourth category does not interact directly with the aloe harvester's raw product. The study used purposeful sampling to delimit the subjects involved in the study. Purposeful sampling seeks information rich cases which may be studied in depth (Patton, 1990). The study adopted an opportunistic or emergent sampling approach as a form of purposeful sampling. According to Patton (1990) this approach allows the researcher to follow new leads during the fieldwork and to take advantage of unexpected phenomena as they arise. This strategy may be used after fieldwork has begun and also as a researcher gains access to new research subjects that are of value to the investigation (Patton, 1990). The criteria used to identify the sample were initially informed by:

- The geographic proximity of the aloe community to the university where the researchers were based.
- The extent to which an e-marketplace could support the aloe harvesters' existing business model.
- The level of organisation that existed to support an effective research process.
- The willingness to participate in the project.

There is no exhaustive list of aloe processing plants in South Africa and, therefore, it was not possible to determine the research population. However, as this research study was qualitative and did not intend to make inferences from the sample to the population, the population size was deemed to be of little relevance and was not considered.

6.5.2 Data Collection

The data required was collected according to both the cycles of the intervention and the nature of information required. The primary data collection methods included observation, conversational analysis and semi structured, open ended interviews. During the first cycle the users were be trained in the operation of the proposed system, and then allowed to operate it under the observation of the researcher. The observations made at this stage were aimed at identifying the system's functional and technical limitations as well as the challenges that the users encountered when interacting with the system. These observations were then discussed with the research team in order to address the system flaws observed. This process was repeated until the target users were able to use the system effectively.

The second cycle was aimed at allowing the user to make use of the system over a period of time to determine the extent to which the users could grow to trust the system as a tool they could incorporate into their livelihoods. The primary data collection methods used during this stage were observation, interviews, conversational analysis and the monitoring of usage logs. A triangulation approach was applied in terms of which the call logs were observed to determine the level of usage, enquiries were made of users to seek explanations regarding the observed usage levels and discussions were held within the research team to enhance the understanding gained from the observations. The cycle was concluded with individual interviews with the participants to determine the extent to which trust in the technology had been achieved.

6.5.3 Data Analysis

Data analysis is the most complex and least understood aspect of the qualitative research process (Lichtman, 2013). Licthman (2013) suggests that the complexity lies in the pursuit of the "right concepts" or in the belief that some findings are superior to others. She claims

that it is essential that researchers rid themselves of the notion that one set of interpretations is more acceptable than another. In qualitative research there is no right or wrong answer but rather acceptable explanations of phenomena based on the researcher's experience. From a pragmatist perspective, qualitative data should demonstrate that the anticipated positive change was achieved through the intervention. The essence of qualitative research is that the data should be used to substantiate and strengthen the researcher's position and not to prove or disprove it. Furthermore, Lichtman (2013) argues against the need for experts to confirm the research's contribution in qualitative research as the researcher is likely to be the closest person to the actual research. On this note Lichtman (2013) argues that, although using software tools to analyse qualitative data makes the process easier, it does not, however, make the findings more believable.

Qualitative data analysis involves organising data into manageable units, synthesising the data to identify patterns, discovering phenomena of importance and communicating them as knowledge (Biklen & Bogdan, 1981). Hoepfl (1997, p. 13) adds that qualitative reports are characterised by direct participant quotes which manifest as a "voice in the text" to support arguments and propositions. Strauss and Corbin (1990) describe two stages of qualitative data analysis, namely, open coding and axial coding. Open coding involves the identification of relevant categories or themes that emerge from the data while axial coding involves the construction of a conceptual model based on the themes which have emerged. Axial coding utilises evidence from the data to support the relationships between the conceptual model's constructs. Hoepfl (1997) highlights the importance of an audit trail to link the information sources to the categories and concepts during the process of coding. Figure 6.3 provides an overview of the coding process according to Lichtman (2013).

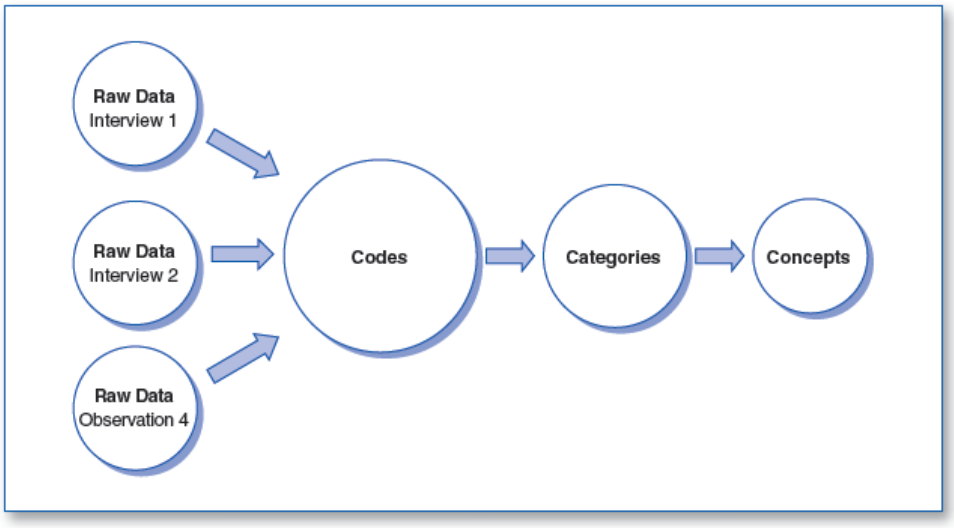


Figure 6.3: The process of coding (Lichtman, 2013)

The data analysis process used in this study was in line with the process as suggested by Lichtman's (2013) and involved the following:

The study was presented as a narrative, detailing each stage in the Action Research cycle. At the end of each cycle, the key phenomena were tabulated into codes. After all iterations had been coded, the codes were classified into themes (categories). The researcher then reflected on the observations, data, literature and underlying theories to determine how the themes related to the issue of technology trust. Thereafter, the interrelationships between the emergent themes that related to technology trust were developed through reflection on both the literature and the evidence from the data.

6.6 Evaluation of the study

Action Research has been widely criticised for its lack of methodological rigor (Davison et al., 2004). However, Melrose (2001, p 164) argues that Action Research is "an unrepeatable journey with unpredictable results and undreamed of conclusions", and adds that its focus on the participants and their specific situation means that it may not often lead to generalisable conclusions. Baskerville (1999) adds that generalisable statements cannot be founded on the number of observations (as is the case with positivist research), but rather according to the extent to which the theory may be expected to apply to similar settings. Baskerville, thus, suggests the following requirements to ensure rigour in Action Research:

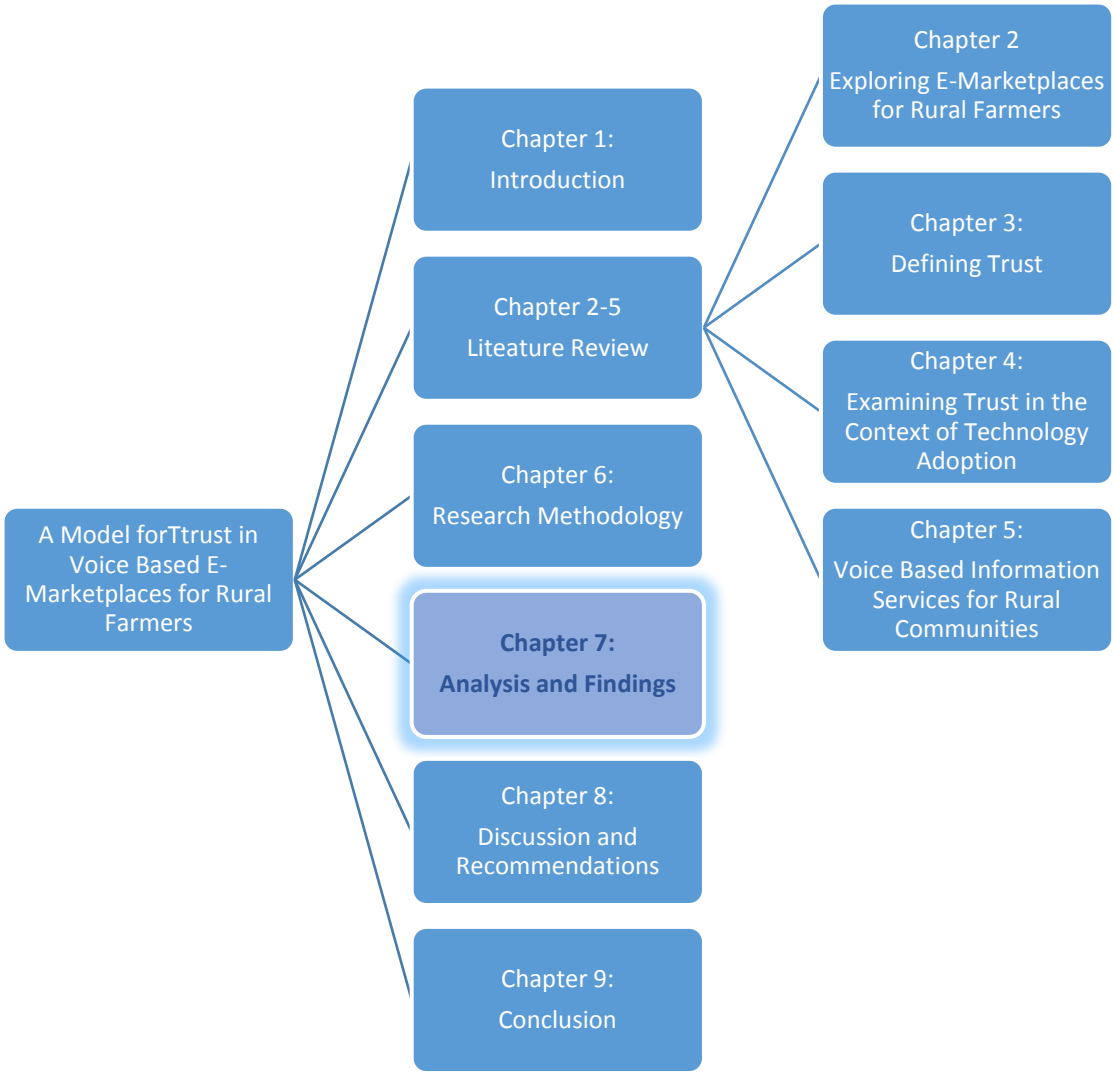
- The researcher must ensure that the Action research method is appropriate to both the research's audience and the subject under investigation
- The researcher must ensure that a formal agreement is maintained with the stakeholders.
- A theoretical problem statement that will result in the emergence of a new theory must be articulated from the onset.
- Data collection methods appropriate to the subject under investigation must be applied.
- The researchers must avoid dominating the planning and action stages
- Iterations to refine the solution must be used.
- The researcher must generalise according to the context of the study.

The extent to which these criteria are met will be discussed in Chapter 9.

6.7 Conclusion

This study adopted a pragmatist philosophy to determine how trust may be engendered within a rural aloe harvesting community to enhance the adoption of a voice based e-marketplace. The underlying principle of pragmatism is that a proposition is true if the proposition functions adequately. Hence, an Action Research approach was adopted to allow the researcher to examine the functioning of trust in a voice based e-marketplace. Qualitative methods, including interviews and observations, were used and an inductive approach followed to arrive at the research contribution.

Chapter 7: Analysis and Findings



7.1 Introduction

The Literature review discussed the factors that impede the adoption of e-marketplaces by rural communities. It was found that lack of context, low rates of literacy, language barriers, limited understanding of the value proposition of ICTs and limited access to Internet enabled technologies were all factors that compromised the ability of e-marketplaces to be successfully applied for the benefit of rural farming communities. The literature review then explored the nature of trust and the influence that trust has on the adoption of new technologies. The literature review then proceeded to explore voice based technologies with respect to their ability to overcome some of the challenges associated with rural ICT solutions. This chapter presents an Action Research intervention that places the relationships between trust and the adoption of voice driven e-marketplaces into perspective. This study adopts the Action Research cycle described by Davison, Martinsons and Kock (2004) which classifies the activities involved in Action Research into three distinct stages. The entry stage marks the start of the intervention. The intervention stage follows the entry stage and involves cycles of diagnosis, planning, action, observation, and reflection. The exit stage occurs at the point when the researchers and participants agree that the objectives have been met and the intervention need not proceed further. This study sought to determine how trust in a voice based e-marketplace can be enhanced for the improved adoption of an e-marketplace by a rural farming community. Thus, this chapter presents an Action Research intervention that deployed an e-marketplace in a rural aloe harvesting community, in order to gain an insight into e-marketplace trust in a rural aloe harvesting community.

7.2 The entry phase

The entry phase represents the stage at which the Action Research process begins. This stage of the study was used to develop foundational knowledge about the aloe industry in order to identify a rural aloe community with which to collaborate on the research project. The steps that were undertaken to identify stakeholders in the aloe industry are discussed in the next section.

7.2.1 Finding participants

The entry phase involved desktop research, telephonic interviews and face to face interviews. The telephonic interviews were held with two individuals who were

knowledgeable about the aloe industry in South Africa. One of the individuals was a researcher from the Environmental Sciences Department of a South African university and who had been involved in research involving aloe harvesting communities. The second individual was a lecturer (and former research colleague) from the African Language Studies Department of the same South African university. Having grown up in a rural home that depended on the income from aloe harvesting, she was able to provide some insight into aloe harvesting from the perspective of rural households.

The unstructured interviews which the researcher held with these two individuals enabled the researcher to identify the various communities in the Eastern and Western Cape Provinces involved in the aloe trade. The researcher also established that aloe harvesting in the Western Cape is a fairly organised process in terms of which long standing relationships have been established between the aloe processing plants and the aloe harvesters. On the other hand aloe harvesting in the Eastern Cape was found to be less structured. These interviews were short and, although the conversations did not generate much information, the researcher was able to obtain a list of organisations in the Eastern and Western Cape that were involved in the trade. The researcher was referred to three processing plants; hereafter referred to as Plant 1, Plant 2, Ikhala Cosmetics, and Khulani Extractions. All of these organisations are aloe processing plants based in the Eastern and Western Cape provinces.

The researcher subsequently viewed the websites of two of the organisations (the other two did not have websites) to identify the products they sold. As a result, two additional entities involved in the aloe industry were identified; Manufacturer 1 and Manufacturer 2. These were both health and beauty manufacturers that used aloe based derivatives as key product ingredients. Both were located in close proximity to Plant 1. Table 7.1 lists the organisations in the Eastern and Western Cape provinces that are involved in the aloe trade. All of the organisations identified can be categorised as SMMEs. Of the three, the smallest is a Khulani Extractions. Khulani Extractions is an Eastern Cape based family owned operation. The rest of the organisations are small to medium Companies. The end of the entry phase was marked by the compilation of the summary presented in Table 7.1.

Table 7-1: Organisations trading in the aloe industry in the Eastern and Western Cape.

Province	Companies	Products	Business models
Western Cape	Plant 1	• Aloe gel, aloe lumps, aloe crystals and aloe powder used as raw materials in cosmetic and healthcare manufacturing.	• Purchases from a closed group of local harvesters. • Sells wholesale to national and international manufacturers • Website is the organisation's main source of trade leads.
	Manufacturer 1	• Health supplements and cosmetics.	• Purchases raw materials from aloe processing plant. • Has an online store and IVR for sales and customer service. • Sells to national retail chains.
	Manufacturer 2	• Health supplements and cosmetics	• Purchases raw materials from aloe processing plants. • Uses a direct selling model to sell the products. • Sales agents provide service wholesale retail clients. • Website provides product information.
Eastern Cape	Plant 2 (Aloe processing plant)	• Aloe gel, aloe lumps, aloe crystals and aloe powder used as raw materials in cosmetic and healthcare manufacturing. • Health supplements and cosmetics	• Purchases aloe sap from a closed group of local harvesters. • Sells wholesale to national and international manufacturers • Website is the main source of trade leads.
	Ikhala Cosmetics (Aloe processing plant)	• Cosmetics	• An internationally funded collaborative initiative • Associated with a corporative aloe harvesting group that supplies the processing inputs • No website

	Khulani Extractions cc (Aloe processing plant)	• Aloe based raw materials	• Purchases raw materials from independent local aloe harvesters. • Sells internationally using online e-marketplaces. • No website.

7.2.2 Modelling an e-marketplace

The researcher developed a conceptual model based on the information obtained about the stakeholders in the aloe industry. This model was first reviewed by the research team and then by the two aloe processing plants and one of the aloe health and beauty manufacturers. The model, depicted in Appendix A, mapped a dialogue for a voice based e-marketplace that accommodated three categories of stakeholders, namely, the aloe harvesters, the aloe processing plants and the aloe health and cosmetic manufacturers.

The proposed e-marketplace was conceptualised to provide a voice based platform that supported the following interactions:

- Allowed aloe harvesters to sell aloe sap to processing plants and manufacturers.
- Allowed aloe processing plants to buy aloe sap from aloe harvesters.
- Allowed manufacturers of aloe based products to buy aloe based raw materials from aloe processing plants.

The conceptual e-marketplace was based on the following assumptions:

- The aloe harvesters would work as cooperatives.
- Multiple aloe harvesting cooperatives would be accommodated on the platform.

Additional functionality was contained in the dialogue to accommodate:

- Voice messaging to convey information to trading partners
- Voice search to search for specific products, buyers or sellers

7.2.3 Feedback on the conceptual e-marketplace from the research team

The e-marketplace model was distributed to the research team members via e-mail. The model was then reviewed by each member of the team. Feedback was then provided in a teleconference phone call involving the two university researchers, two members from the IBM Spoken Web development team in India, and one researcher from IBM's speech technology research group. The following feedback was noted:

- Although the Spoken Web is capable of accommodating all the modelled functionality, the suggestion was that the functionality be initially limited to core functions.
- The user interface should be kept simple and not contain too many branches.
- The system should initially be piloted among a small, intimate group of users in order to create an environment in which faults could be easily identified.
- The system could be scaled up to be more robust at a later stage.

The collaborating aloe processing plants and manufacturers were then presented with the same model and asked 13 questions based on the scenario that the model represented. The first six questions involved an enquiry into the buyer-seller relationships of the organisations and sought to ascertain the relationship between the harvesters processing plants and the manufacturers and also to determine whether e-marketplaces presented any value for the stakeholders. The questions also aimed at developing an understanding of the problem domain.

Question 7 to question 12 were aimed at determining whether there were any issues of trust from the perspective of the participants. The responses are summarised in Table 7.2.
Question 13 related to understanding the problem domain and involved an enquiry into the extent to which the organisations were using e-commerce at the time of the study.

The interviews followed a structured format and were centred on the categories of information that the researcher wished to understand. Accordingly, the responses from the interviews were not coded as they were already organised into themes. Instead, the additional information that was presented outside of the interviews was coded and then categorised into the identified themes. New categories were considered for the information that did not fit within the identified categories.

The structured interviews covered the following categories:

1. The value created by an e-marketplace
2. The value of voice as a medium
3. Understanding the problem domain
4. Trust related concerns

Table 7.2 presents a summary of the response of the participants from the two aloe processing plants and one cosmetic manufacturer.

Table 7-2: Feedback on conceptual model from the participants.

Question	Processing Plant 1 (Western Cape)	Processing Plant 2 (Eastern Cape)	Manufacturing Company 1	Data Category
1. What type of agencies source your products?	Local and international manufacturers from the health and beauty Industry	A few local manufacturers, mainly international clientele	Chain stores, pharmacies, health shops, international customers	1, 3
2. What type of companies do your source products from?	Local aloe harvesters	Local harvesters and commercial farms	All aloe ingredients sourced from a nearby aloe processing plant. Other essential oils sourced from Cape Town.	1, 3
3. How do your buyers access you?	Most new customers come through the company website	Website and e-mail	Sales leads are mainly through the Internet and telephone. Also located at a popular landmark that attracts many national and international tourists. Awareness created through radio, magazine	1, 3

			and newspaper advertisements.	
4. What difficulties do your buyers experience in accessing your service?	None	Most of the contact with customers is electronic as our customers are situated in remote areas	None, available in several outlets nationwide	1
5. What difficulties, if any, do you experience when accessing sellers?	None, have access to an extensive group of harvesters.	None, mobile communication is effective	No difficulties at all	1
6. Do you see potential value for your organisation in a Spoken Web e-marketplace?	Only if buyers are willing to change to a new platform. It is not practical currently	Yes, mainly for publishing information	It could be useful for publishing information about the products (their uses and properties)	2
7. Do you think an e-marketplace on the World Wide Web would offer the same value of an e-marketplace on the Spoken Web?	Yes	Depends on age and level of comfort with technology	E-commerce is already working well. Spoken Web would only be of benefit if it expanded the market reach.	1
8. Is there a market that is not included in the illustrated scenario that you feel would motivate your participation in the e-marketplace?	None	Retailers and agents	All harvesters work with farmers so it would be beneficial to accommodate farmers in the scenario.	1
9. Which target market that you are not already servicing (if	None	Manufacturers of veterinary supplies	Individuals and small businesses (most of the manufacturing company's	1

any) would you wish reach through this ecosystem?			clients are retail chain stores)	
10. Do you have any reservations or concerns with regard to interacting with anonymous buyers and sellers in an e-marketplace?	No, all relationships are initially anonymous.	No, one is able to judge credibility on the surface. All payments are made in advance.	Competitors may be using the system to gain inside information.	4
11. What factors do you think must be considered in order for you to perceive the interactions as trustworthy?	Must know the origin of the enquiry. System should be secured with a password. Hackers should not be able to penetrate it. Banking details should not be misused	Must publish information such as company size, product range and the benefits of aloe. Must allow company to maintain a personal relationship with the customer.	Would need to experience voice prompts first and control what is published. Would need to view proof of ID, bank statements, proof of address	4
12. What potential risks do you think could arise when interacting anonymously in an e-marketplace?	Obtaining information for the purpose of harming the business. Risks from sharing banking details. Viruses	Stealing ideas when too much information is provided. Should be able to prove identity.	Non-payment and reverse engineering	4
13. To what extent do you currently utilise e-commerce to interact with your current or prospective	Company website, Internet, e-mail, telephone	More than 90% of interaction is online.	Currently using the Internet (company website), Facebook and Twitter.	3

customers or suppliers?				

In addition to responding to the questions, the aloe processing and manufacturing plants in the Western Cape provided information relating to the industry in the Western Cape. Table 7.3 presents a coded summary of the important data collected through informal discussions with the participants from the aloe processing plants and the cosmetic manufacturer.

Table 7-3: Coded summary of informal discussions held with processing plant and manufacturers.

Code	Category Code	Category	Concept
It was emphasised by the participants from both the processing plant and the manufacturer that the farmers are a very important stakeholder group in the relationship.	3	Understanding problem domain	User context
The aloe tapping community is made up of primarily middle-aged to mature individuals. The majority are above the age of 50.	5	Information technology use limitations	Usability
Many of the aloe tappers do not have bank accounts and have no desire to open such accounts.	6	Resistance to change	User attitudes
Many of the aloe tappers are either illiterate or semi-literate.	2	Information technology use limitations	Usability
Many of the aloe tappers do not possess mobile phones and are resistant to adopting new technologies.	6	Resistance to change	User attitudes
The majority of aloe tappers have had no exposure to computers, and the few that do have mobile phones possess handsets with the most basic features.	6	Technology accessibility	User context
The homes of the tappers are not electrified and they may	7	Technology accessibility	User context

not always have access to points where their mobile phones may be charged.			
The aloe processing plant in the Western Cape based town buys only from harvesters in his locality.	1	The value created by an e-marketplace	User context
There is enough aloe in the town in which the Western Cape based aloe processer resides to sustain the operations of the Western Cape based town's aloe processing plant.	1	The value created by an e-marketplace	User context
The Eastern Cape based processing plants do not restrict their purchases to sellers from their locality.	1	The value created by an e-marketplace	User context
Afrikaans is the dominant language of the Western Cape aloe tappers.	8	Language issues	User context
IsiXhosa is the language spoken by the aloe harvesters in the Eastern Cape.	8	Language issues	User context
For both these groups, English is the most likely second language.	8	Language issues	User context

Based on the information obtained from both the structured interviews and the informal discussions, three additional categories were added, namely, limitations regarding use of IT, resistance to change and access to technology. The following categories emerged from the first action cycle of the research:

1. The value created by an e-marketplace
2. The value of voice as a medium
3. Understanding the problem domain
4. Trust related concerns
5. IT use limitations
6. Resistance to change
7. Access to technology
8. Language issues

These categories are discussed in the next section

7.2.3.1 The value created by an e-marketplace

E-marketplaces enable trade by supporting the interaction between buyers and sellers. The interviews with the representatives from the aloe processing and manufacturing plants indicated that there was no apparent need to support trade between the aloe processors and the manufacturers as these organisations were all using the Internet effectively to reach their target audience and were selling their products successfully. Although the interviews revealed that a Spoken Web e-marketplace did not offer much value in terms of facilitating sales between processors and manufacturing plants, the representatives from these entities did see value in using a Spoken Web e-marketplace to publish product information. The participants from both Plant 1 and Manufacturer 1 emphasised the fact that the quality of aloe in their region was a major selling point and they saw a need to convey such information to their potential customers. The informal discussions also revealed that Plant 1 was unwilling to buy from harvesters outside of its region. The representatives of both the processing plants interviewed mentioned that they experienced issues of quality when buying from Eastern Cape harvesters and that the aloe sap was sometimes diluted in order to increase the yield. Plant 2 was located in the Eastern Cape and was open to sourcing aloe from outside of its region. The researcher foresaw that Plant 1 had access to enough tappers to supply it with sufficient aloe and, thus, Plant 1 did not stand to gain much from an e-marketplace.

7.2.3.2 The value of voice as a medium

The value of voice as a modality through which an e-marketplace could be implemented was evident only in the relationship between the processing plants and the tappers. The majority of the tappers did not have either computers or Internet access. In addition, most of them were elderly and illiterate or semi-literate. Thus, voice in this context represented a compelling alternative to web based e-marketplaces. Traditional web based e-commerce was supporting the relationship between processing plant and manufacturer effectively and additional stakeholder categories to which they wished to extend their reach were likely to be more accessible over the traditional Internet as compared to voice.

7.2.3.3 Understanding the problem domain

The questions concerning the problem domain related to whether the conceptual model accommodated all the important stakeholders and the requisite activities. One of the respondents from the aloe processing plant mentioned buyer categories that the plant would like to access through the platform. These buyer categories included retailers, agents and manufacturers of veterinary supplies. However, considering that the respondents had all indicated that they were not encountering any difficulties in reaching their target markets, it would appear that adding these buyer categories was more of a novelty than a need. The respondent from the manufacturing plant had indicated that farmers comprised an important stakeholder category not represented in the scenario. The researcher's failure to probe into the role of the farmer was an important omission that was addressed in the narrative of the next iteration.

One point of particular interest was the amount of information describing the problem domain that emerged through the informal discussions as opposed to the information that emerged from the structured interviews. While the structured interviews were able either to confirm or refute certain of the researcher's notions, the unstructured discussions unearthed a wealth of knowledge that the researcher would otherwise not have known. In addition, the researcher found that the diagram representing the conceptual model was not an appropriate way of establishing the requirements of the proposed application. This was probably due to the fact that the audience was presented with three new concepts simultaneously. In reviewing the conceptual model, both respondents from the processing plants were expected to make sense of the processes and logic the model depicted, validate the applicability of e-marketplaces to their businesses and confirm whether voice was a suitable medium of exchange.

7.2.3.4 Trust related concerns

When asked about their concerns regarding interacting anonymously over a trading platform it appeared that all the respondents were seemingly comfortable with the notion. The participant from one of the processing plant was clearly comfortable trading with anonymous buyers because, as he stated*, "All initial encounters are anonymous".* The participant from the other processing plant stated that it is possible to make judgements about credibility *"from the surface".* He added that his organisation required payment in

advance and so there was no risk involved. He did, however, relate an incident that had happened in the early years of the organisation when the organisation had been lured into trusting a buyer and had made the mistake of delivering the goods prior to receiving payment notification. The organisation had never been paid for the consignment.

One key concern expressed by each of the respondents at various stages in the interviews was the fear of queries being made in order to acquire information that could lead either to *"reverse engineering"*, thus causing harm to the business, or to the *"stealing of ideas"* when too much information was given.

Terms such as hackers, viruses and banking details were also mentioned in the context of risk. However, the respondents were not very descriptive or coherent on these issues, thus suggesting that they were aware of the risks that could result from e-commerce although they did not fully understand these risks.

7.2.3.5 Information Technology use limitations

Certain challenges that had the potential to influence the ability of the users to interact with an information technology were mentioned during the informal discussions. For example, the mature age of many members of the aloe tapping community increased the likelihood that the system would be serving a user group with the reduced audio, visual and/or psychomotor functioning commonly associated with old age.

7.2.3.6 Resistance to change

The discussions suggested that the aloe tappers servicing the Western Cape based processing plant were change averse. This may have been the result of the mature age of the majority of the tapper community. Many of them did not possess bank accounts, they did not own mobile phones and they did not welcome the idea of working in structured collectives.

7.2.3.7 Access to technology

The study assumed that introducing voice as a modality through which an e-marketplace could be delivered to rural users would address the challenges associated with access to technology. This was certainly true in the context of the Eastern Cape Aloe processing plant

as the participant from the processing plant had indicated that he was able to communicate quite effectively with the harvesters using mobile communication. However, this was not the case in the context of the aloe processing plant in the Western Cape as it emerged that many of the aloe tappers did not possess mobile phones. Nevertheless, the cost of mobile phones in comparison to other ICTs is relatively low and was, in fact, a cost that the research team was willing to bear. In fact, the research team purchased twelve mobile phones to give to the aloe harvesters in the Western Cape based aloe community. However, the handsets possessed the most basic features only and were not Internet enabled.

7.2.4 Language issues

Determining the language of interaction was the subject of extensive discussion. One challenge was that the Spoken Web's speech recognition was not configured to understand either Afrikaans or isiXhosa. The second challenge was that the project was targeting two provinces in which the populations had different mother tongues. The Eastern Cape tappers spoke isiXhosa as a first language and some were able to speak English as a second language. However, few were likely to speak Afrikaans. In the Western Cape, on the other hand, the tappers spoke Afrikaans as a first language while some of them were also conversant in English as a second language. It was therefore decided to use the application in English as it was felt that English was the most likely language to be understood by both groups as well as by the Speech recognition modules.

7.2.5 Summary of the entry phase

At the end of the entry phase one processing plant in the Eastern Cape and one in the Western Cape committed to participating in the project. At this point the researchers had acquired an insight into the value of voice as a medium in which to access an e-marketplace, a reasonable understanding of the users' context, an awareness of some of the limitations that would affect the users' ability to use the proposed system, knowledge about the lack of mobile devices within the user group and a recognition of the user group's possible resistance to change. The e-marketplace model was still not completely clear at this point. The objective of the next cycle was to refine the conceptual e-marketplace model, to define the functional and technical requirements that had to be met, to develop the prototype, and to test the prototype with real users. The next section details the activities that took place in the second cycle.

7.3 Action cycle 1: Developing and field testing a prototype

This cycle of the intervention is presented as a narrative which reflects on the researcher's experiences during this stage of the process. Evidence from field notes, research group discussions and electronic communication are all considered. During this stage the research team collaborated to define the functional and technical requirements of the proposed system.

At the end of the entry stage of the intervention, only two aloe processing plants had committed to participating in the project. The Western Cape based aloe processing plant already had well established relationships with aloe tappers in close proximity to the plant and was unwilling to purchase from harvesters outside of the town. However, during this stage of the project, the contact from the Eastern Cape based processing plant left his organisation, leaving the project with no liaison person with whom to interact. In addition, the other two Eastern Cape based aloe processing plants that the researcher had been trying to engage in the project had not made any commitment to becoming involved.

This meant that the project only had one processing plant to engage in the project. This plant already had ready access to aloe tappers. Nevertheless, the research team decided to proceed with the design and development of a prototype to support interaction between the Western Cape based aloe processing plant and the tappers that supplied the plant. It was believed that the system would serve to support existing interaction between the two stakeholder groups as opposed to matching sellers with new buyers or buyers with new sellers. The proposed e-marketplace fell within the definition of e-marketplaces as described in chapter 2, namely, "a virtual space where information between buyers and sellers is exchanged through technology with the goal of directly or indirectly facilitating a transaction". Although the proposed system did not allow for buyers to seek new suppliers or suppliers to seek new buyers, it was hoped that subsequent versions of the system could be scaled to accommodate this functionality.

This stage of the project was dominated by ongoing dialogue between the members of the research team to determine the most cost effective configuration, design the call flows, and build the actual prototype. As communication within the research team was primarily electronic, the data from this cycle was collected mainly from e-mails and notes made during

team teleconferences. More than seventy e-mails reviewed in this stage of analysis. The discussion cycles during this stage typically involved the initiation of a verbal discussion during a teleconference, a follow up e-mail that summarised the major points discussed and an e-mail thread deliberating on the issues until they were resolved. Thus, major issues encountered during this stage were traceable to at least one e-mail. E-mail correspondence is usually categorised according to the subject of discussion. Accordingly, there was no coding during this stage of the cycle and, instead, emails were classified into categories based on their subject headings and using the Outlook e-mail client categories tool. Figure 7.1 depicts this process.

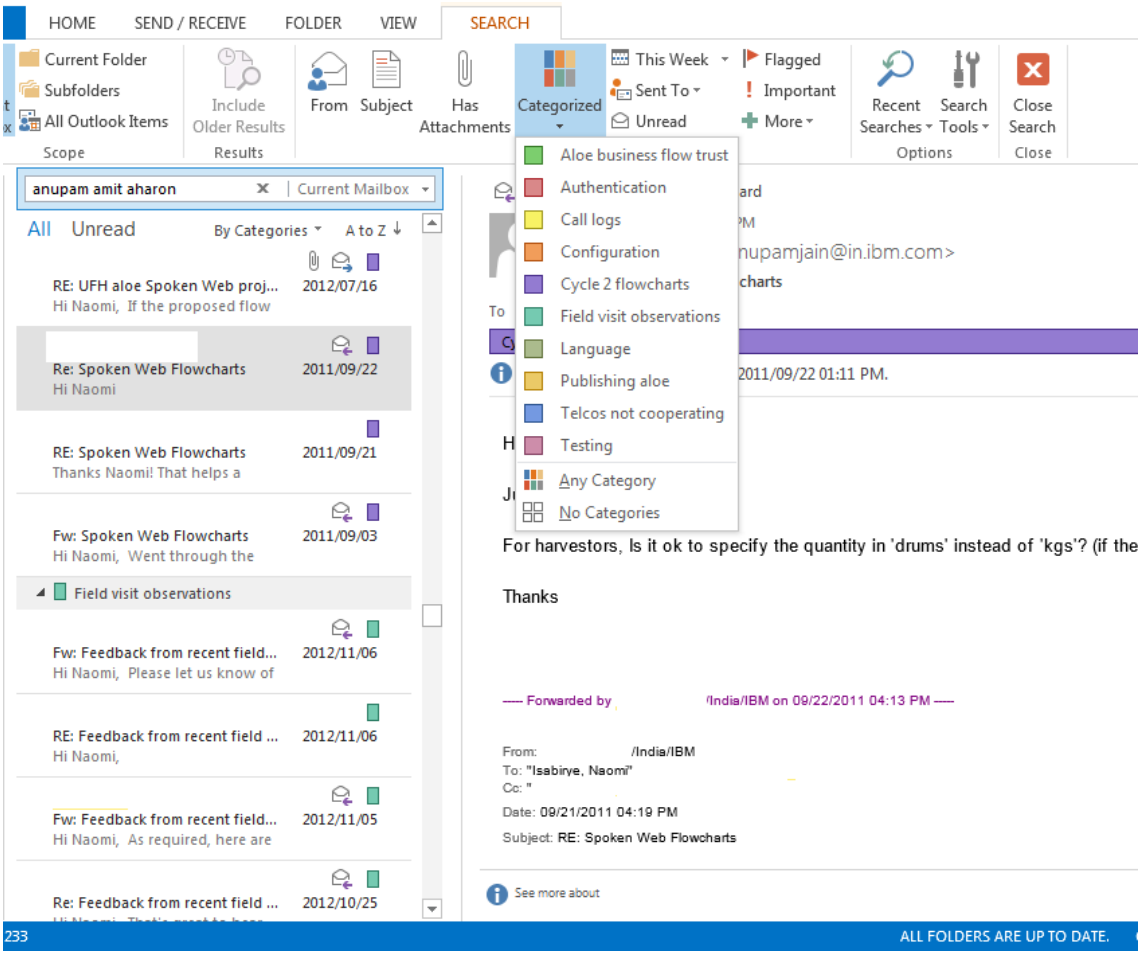


Figure 7.1: Snapshot of categorisation of subjects using Outlook.

Each category was then evaluated independently and related categories were merged. The following important activities contributing to the action cycle emerged:

- Refining the e-marketplace model

- Designing the call flows
- Determining the technical configuration
- Testing the prototype

These activities are discussed in the sections that follows.

7.3.1 Refining the e-marketplace model

It was agreed that the project would proceed with the aloe processing plant in the Western Cape. The main reason for this decision was that the Western Cape plant had cooperated in a committed way throughout the project while the research team had struggled to maintain the commitment of the other processing plants. The research team agreed to work according to the buy and sell relationship that already existed between the tappers and the Western Cape based aloe processing plant. In this regard, the value was not in finding sellers but rather in enabling an information flow between the stakeholders to facilitate transactions. The call flows that enabled the aforementioned exchanges are described in the next section.

7.3.2 Designing the call flows

The design of the call flows responded to the e-marketplace model adopted. Thus, the conceptual model evolved from the complex interface depicted in Appendix A, which had been initially designed to enable many to many relationships between tappers, processing plants and manufacturers into a simple interface that supported a one to many relationship between a single processing plant and multiple aloe tappers. The call flow design matured through several iterations. The call flows were classified into three categories. The first category was for general call flows. This category was used to determine whether the caller would be directed to either the buyer or the seller interface. This process is illustrated in Figure 7.2 below:

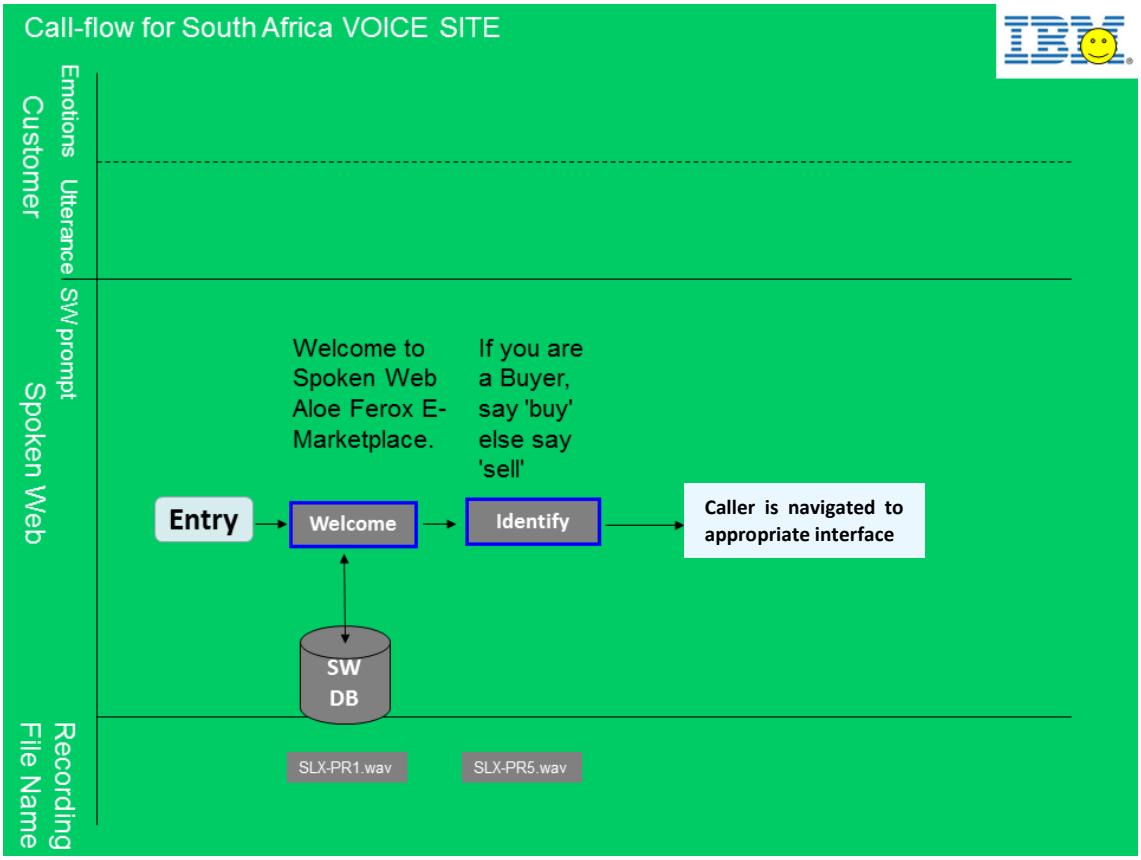


Figure 7.2: Aloe e-marketplace call flow- Welcoming and determining the user role.

Depending on the role selected by the user, the subsequent dialogues authenticated the users and provided the functionality required. In the case of aloe tappers, the authentication was followed by the following interactions:

- Determining the type of products to be updated by the tappers
- Confirming the status of their existing listing
- Updating the specified product

These interactions are depicted in Figures 7.3 and 7.4 respectively.

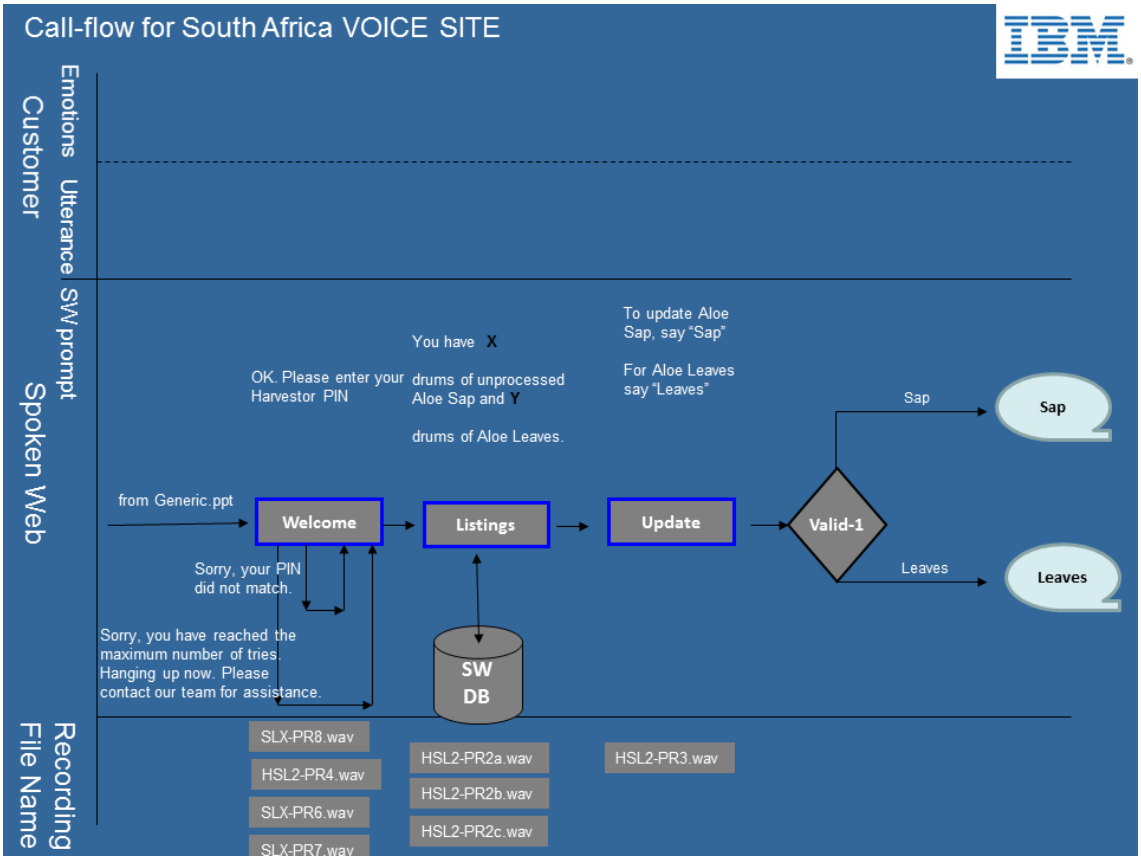


Figure 7.3: Aloe e-marketplace call flow – updating seller products.

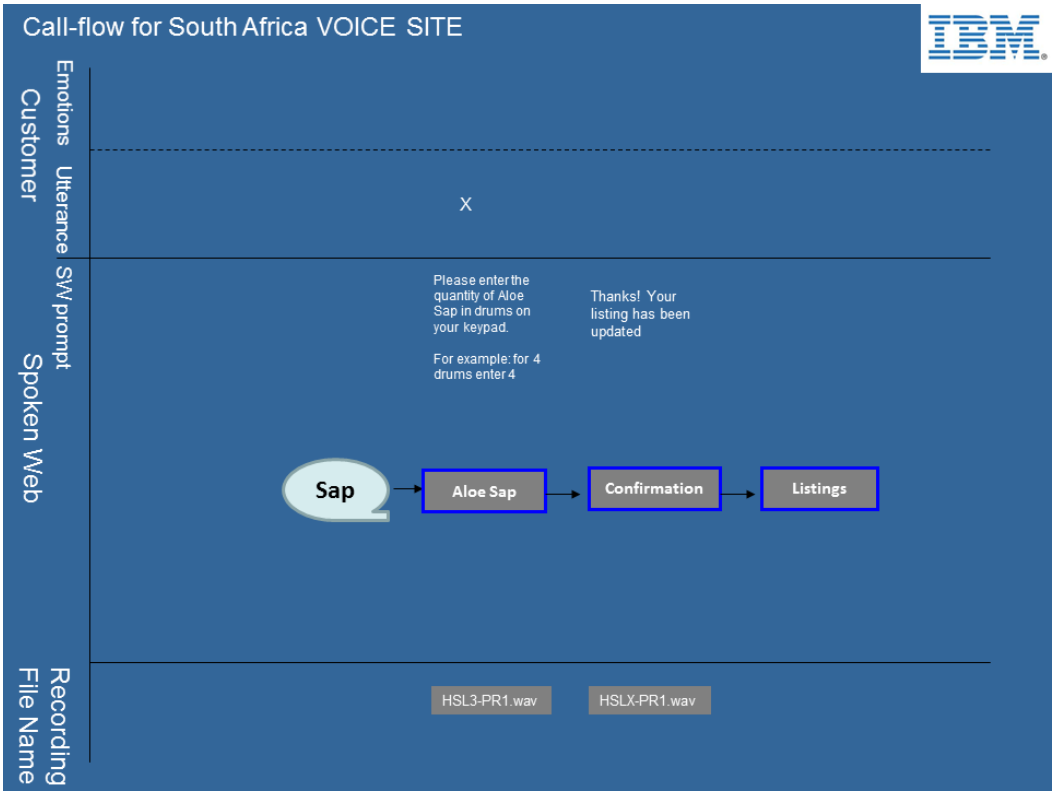


Figure 7.4: Aloe e-marketplace call flow – confirming seller product update.

The call flows that were directed at the aloe processing plant were aimed at determining what the plant wished to procure and providing a listing of suppliers (aloe tappers) who matched the plant's requirement. In this regard, the plant was allowed to choose between procuring aloe sap and aloe leaves. These call flows are illustrated in figures 7.5 and 7.6 below.

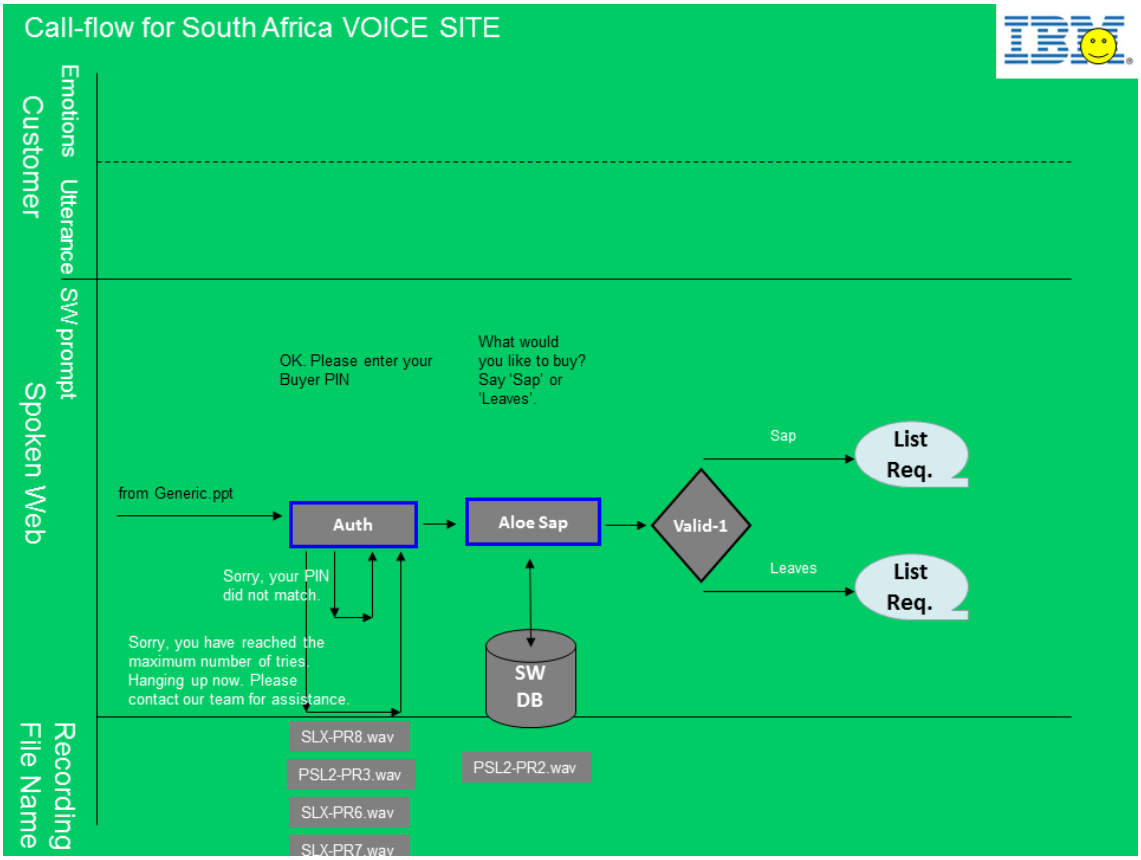


Figure 7.5: Aloe e-marketplace – requesting a list of suppliers of sap or leaves.

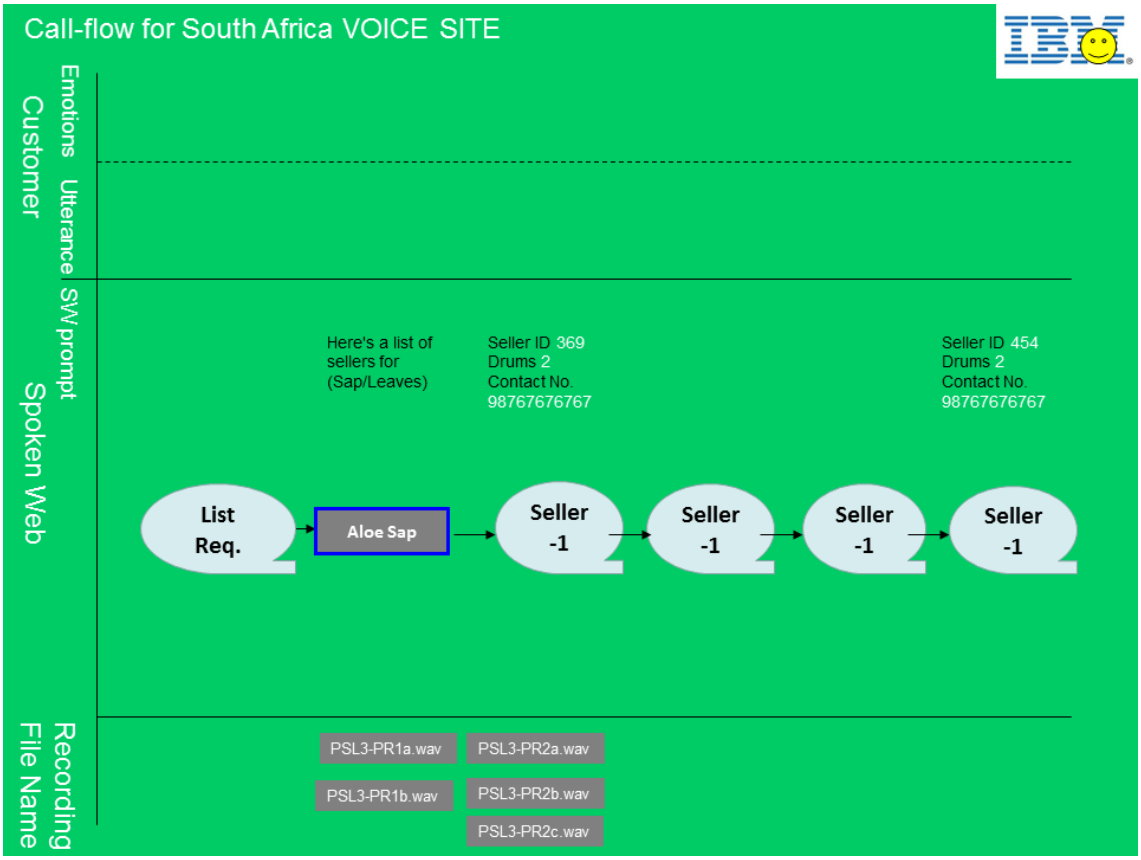


Figure 7.6: Aloe –marketplace – providing the buyer with a list of sellers of the products requested.

7.3.3 Determining the technical configuration

The proposed system was to be built on the Spoken Web platform. Conceptually, the Spoken Web is a voice based platform that has been developed to offer congruence to the Internet in terms of the way in which information and services are delivered. Developed with the goal of bridging the information divide facing the underprivileged, the Spoken Web attempts to make information and services typically found on the Internet available to users who may not have access to laptops, personal computers (PCs), tablets, smartphones or other Internet enabled devices (Kumar & Argawal, 2012). As opposed to the Internet, the Spoken Web is accessed using speech instead of text and graphics as an interaction modality. Thus, the Spoken Web may be accessed from any basic mobile or fixed line telephone handset that supports touch tone input. This is a standard feature for the majority of entry level mobile handsets, thus making the Spoken Web a widely accessible platform for underprivileged users. The following sections describe the Spoken Web architecture and explain the challenges which were experienced in configuring the Spoken Web aloe e-marketplace.

7.3.3.1 The Spoken Web architecture

The Spoken Web platform is designed as a collection of multiple independent items of interest, referred to as VoiceSites (Agarwal, Jain, Kumar, Nanavati & Rajput, 2010). Each Spoken Web deployment may be accessed by dialling a VoiNumber, which is a virtual phone number that either maps onto a physical phone number or to other Uniform Resource Identifiers (URIs) such as a SIP URI (Argawal et al., 2010). VoiceSites may be likened to Internet websites and users are able to navigate from one VoiceSite to another using what are known as VoiLinks (a parallel with Internet hyperlinks).

The Spoken Web enables users to gain access to information or to perform transactions by making a voice call and following a set of prompts in order to complete a specific task. This interaction may suggest that the Spoken Web may be broadly classified as a Spoken Dialogue System (SDS). However, the Spoken Web also possesses some key distinguishing features that differentiate it from other SDSs. These distinguishing features include the ability of users to contribute to the Spoken Web content without their having any sophisticated software, hardware or skills. Chapter 5 indicated that it is a complex task to configure SDSs as specific and advanced development skills are required. In comparison, the Spoken Web has been designed to allow users with no technical background to develop Spoken Web VoiceSites. The Spoken Web also differs from ordinary SDSs in the manner in which it accommodates multiple VoiceSites (Agarwal et al., 2010). In contrast, SDSs are typically developed for a single organisation and in order to serve a specific purpose. Another important distinction between the Spoken Web and normal SDSs is that the Spoken Web Application Framework provides an Integrated Development Environment that supports the rapid development of VoiceSites (Kumar & Agarwal, 2012). Skilled developers may use this platform to develop templates for various categories of applications. Such templates are the basis upon which those users who lack technical skills are able to develop VoiceSites with minimal effort.

Despite the abovementioned differences, the Spoken Web does share many common features with typical SDSs. For example applications on the Spoken Web are constructed using the same basic components of a SDS. Like most SDSs, Spoken Web applications make use of a gateway that converts the audio signals delivered over telephone lines to data using a Session Internet Protocol (SIP). The platform's speech server then makes meaning out of

the input by processing it using the speech recognition and language understanding components. The voice platform is used for dialogue management with the platform making use of database servers to store important data relating to transactions and user interactions. The architecture of the Spoken Web is illustrated in Figure 7.7 below.

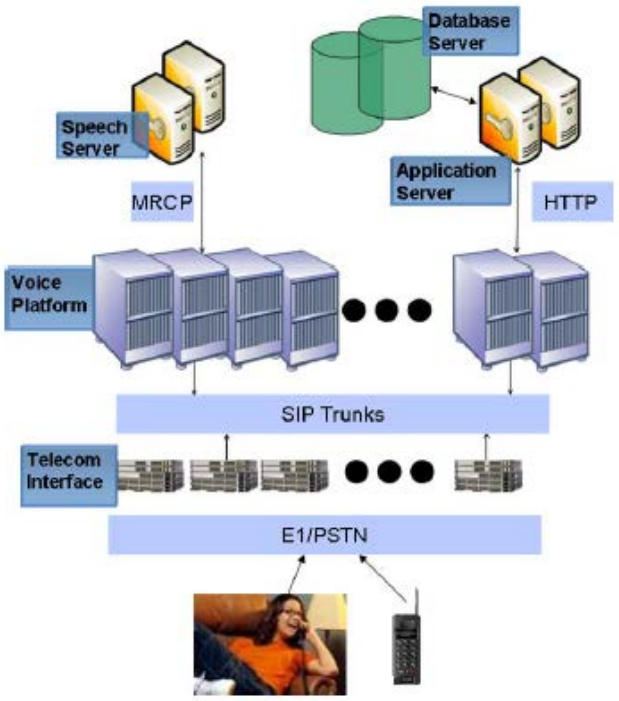


Figure 7.7: The Spoken Web Architecture (Kumar & Argawal, 2012).

7.3.3.2 Challenges involved in configuring the e-marketplace on the Spoken Web

Chapter 2 discussed the high costs of communication and connectivity as well as the lack of enabling policy within the telecommunications sector as some of the barriers to ICT adoption in rural communities. The high cost of voice calls was also cited as a specific barrier to the use of SDSs by rural communities. In addition Chapter 5 highlighted that the process of configuring an SDS is inherently complex. All of these points proved to be true as regards the configuration of the aloe e-marketplace. These challenges in respect of the intervention are discussed in the following sections:

i. Making the calls free for the users

The first challenge encountered was in determining how to make the service free for callers. Chapter 5 cited Grover and Barnard (2011) as stating that most of the SDS pilots targeted at rural users are offered as toll free services in order to maximise participation. This project

also adopted this approach. To do this, three options were considered: The first option involved applying for a toll free line from a telecommunications provider. The research team approached several mobile network operators as well as South Africa's main fixed line operator (Telkom) to acquire this service. The mobile network carriers were unwilling to set up the service unless the project subscribed to a long term contract. This was not, however, an option in view of the procurement policies of the host university. On the other hand the fixed line operator was able to provide a toll free line although the call would be free only if it originated and terminated from the operator's network. This was not possible as the calls would be made from mobile phones using the networks of mobile operators and would terminate on a fixed Telkom line. Therefore, this option would mean that the user would still incur costs associated with the Mobile Termination Rate (MTR).

The second option that was considered involved providing the users with pre-paid calling cards. However, there were two challenges associated with this option. Firstly there was no way in which to ensure that the calling cards would be used to interact with the proposed system and, secondly, the calling cards would still incur a cost to the users as their network provider would charge them for the call to the access the calling card service.

The final option, which was the option that was adopted, was to purchase SIM cards and load them with airtime periodically. The team considered activating the call barring feature on the mobile phones as this would have allowed the research team to restrict the numbers that could be dialled from a specific SIM card. However, the team opted to assume the risk of the users expending the airtime for their own personal use. Assuming this risk meant that the researchers were able to assess adoption in the knowledge that there was an element of choice and rationality on the users' part when they chose to interact with the system. The project also purchased mobile phones that would be used by the pilot group to access the e-marketplace.

ii. Configuring the gateway

The Spoken Web service was to be developed and hosted by the IBM research laboratory in New Delhi, India. Thus, for the voice call to reach the Spoken Web servers, the voice call initiated by the user would need to be directed to the Spoken Web VoiNumber in India and the response from the server would then be routed back to the caller using the same

gateway. However, calling the number in India would incur international calling rates for the users. Accordingly, the research team decided to set up a local number that the users would call. The call would then be routed through a SIP gateway directly to the VoiNumber. As a result, the users were able to interact with the service without incurring international call rates.

Although configuring the gateway was a seemingly straightforward process, the number of phone calls, e-mails and follow ups required to get it running was evidence of the current nature of the telecommunications industry in South Africa. An extract from an e-mail sent to a representative of a South African mobile operator requesting the representative's assistance in configuring the gateway is presented below.

"…We are at advanced stages and we are supposed to be conducting the pilot test now, however, we have been struggling setting up the 'gateway'. Not really due to technical reasons but because we relied on a third party for this and it has not happened. I know ***[Anonymous Mobile telecommunications Operator]*** *offers various services similar to these and thus my contacting you…"*

The recipient of the e-mail was also an advisory board member of the research department at the host university. Despite the e-mail recipient being a professional contact that was closely linked to members of the research project, the mobile operator was still unable to assist in resolving the problem.

Customised services are typically provided to large corporate customers. The responses from the service provider that was responsible for setting up the gateway were slow while requests for customised products were either rejected or ignored by the telecommunication network operators. The telecommunications service provider which had been commissioned to configure and manage the routing of calls from South Africa to the Spoken Web application in India describe themselves on their website as being at the forefront of Internet Protocol-based technologies. According to the service provider's website, the service provider is able to *"build solutions and services tailored to the increasingly complex demands of organisations across the enterprise, public sector, global carrier and growing small-to-medium business sectors".* These services are typically targeted at large corporates

with big budgets. The Spoken Web deployments targeted at poor rural communities do not operate on a scale that attracts prioritisation by telecommunications companies in South Africa. There is no doubt that the service provider appointed possessed the knowledge, skills and expertise required to review the problem at hand, and to propose and implement a solution. However, the research team was forced to deliberate extensively on appropriate solutions without much support from the service provider. The input of the service provider was forthcoming only once an appropriate service had been identified and contracted. Fortunately, the research team possessed the knowledge and expertise required to understand the solution which would best address the problems which had been identified. However, rural projects aimed at developing disadvantaged rural communities will not often have this advantage. Such initiatives are typically initiated by non-government organisations (NGOs), non-profit organisations (NPOs) or academic research organisations that work on limited budgets and which may be operating within non IT domains, such as health and agriculture. In such cases, these organisations may not possess the technical background necessary to understand the configuration, nor will they know how to identify appropriate providers to implement a solution. Furthermore, their budgets are often far smaller than those of the companies served by South African telecommunications companies. Thus, Spoken Web projects targeted at rural communities will probably not receive efficient and specially tailored solutions to accommodate their unique problems. In other words, Spoken Web applications in South Africa will remain a complex task until a critical mass of deployments are undertaken to make them economically viable for telecommunications companies.

iii. Building the prototype

The architecture of the Spoken Web made the task of building the prototype one of the simplest and shortest stages of the deployment. In view of the fact that the IDE provided by the Spoken Web Application Framework allowed the developers to design templates for the various application categories, the developers were able to build the prototype on the template of a previous e-commerce deployment. The template was customised to accommodate the call flows that had been defined. This also enabled the developers to swiftly respond to modifications in the user requirements and to rapidly effect any necessary changes to the application. Once the design of the call flows had been concluded, the actual construction of the prototype involved the following activities:

- Customising the template to accommodate the call flows designed
- Recording the voice prompts associated with the call flows
- Integrating the voice prompts within the system

On conclusion of these activities the system was made available to all the members of the research team to allow for testing prior to presenting the prototype to the prospective users.

7.3.4 Testing

The testing activities were conducted in two stages. The first round of tests were conducted independently by each member of the research team as well as by their colleagues from the respective institutions while the second stage of the testing involved the actual users. The outcome of the two stages of tests are described in the next section.

7.3.4.1 Laboratory testing

In the first stage of testing the activities were unstructured and merely involved allowing individuals to interact with the system and to provide feedback on their interaction. The responses from the testers are summarised below:

- The system expected the user to respond after the "beep" but did not inform the user to wait for the beep. This shortcoming was easily addressed by re-recording the voice prompt to inform the user to wait for the beep.
- After updating the user's stock, the system did not appropriately inform the user that he/she had reached the end of the dialogue. An "Exit" prompt was subsequently included in the dialogue.
- The seller could only enter quantities between 0 and 9. Although this was the range agreed upon by the research team, the prompt that requested this input was phrased as follows:

  "Please enter the quantity of aloe sap in drums on your keypad. For example, for 15 drums, press 'one five' ".

  Thus, the prompt erroneously gave the impression that double digit entries were allowed. However, if the user attempted to enter a value of 15, the system would capture the first input character as a quantity, namely, 1, and then register the

second input character of 5 as an exit channel. In order to resolve this shortcoming, the input range was kept between 0 and 9 but the voice prompt was revised accordingly.

- The listings were presented to the buyer too fast while the amount of information presented was extensive. In addition, the way in which the information was presented was not easy to follow. Each listing returned to the buyer was presented as follows:

  "*Seller no: 558963 Drums: 5"*

  The way in which the information was presented was much more comprehensible when read visually than when it was voiced by the system. Audio presentation has been proven to be more demanding on the cognitive load than visual presentation (Klingner, Tversky, & Hanrahan, 2011). In this case, the users would be presented with a six digit seller code followed by the quantities (drums of aloe sap) that they had in stock. However, this was too much information for them to process, especially as they could be listening to up to ten listings in one phone call. In addition, when information is read, the reader has the benefit of seeing unspoken elements in the dialogue such as punctuations. However, when listening, the user does not have the benefit of 'hearing' the punctuations. Thus, the testers recommended that, instead of identifying the seller by his/her seller ID, which was not a useful reference for the buyer, the sellers would be distinguished according to the sequence in which they were presented. In addition, the grammar would be adapted to be better suited to a spoken dialogue. The voice prompts were, therefore, modified as follows:

  "Seller number 10 has 5 drums"

Figure 7.8 and 7.9 depict the dialogues as they were presented in the field tests

Buyer Interface

System: Welcome to the Spoken Web aloe ferox e-marketplace. If you are a buyer, say 'Buy', or if you are a seller say 'Sell'
User: 'Buy'
<User is directed to the buyer interface>
System: Please enter your buyer PIN
<User enters PIN, system authenticates user>
System: What would you like to buy? Say 'Sap' or 'Leaves'
User: 'Sap'[1]
System: Here is a list of sellers for Sap
<System provides listings as follows: Seller {X} has {Y} drums of unprocessed aloe sap>

Figure 7.8: Dialogue for the buyer interface

Seller Interface

System: Welcome to the Spoken Web aloe ferox e-marketplace. If you are a buyer, say 'Buy', or if you are a seller say 'Sell'
User: 'Sell'
<User is directed to the seller interface>
System: Please enter your seller PIN
<User enters PIN, system authenticates user>
System: To update aloe sap, say 'sap' or for aloe leaves say 'leaves'
User: 'Sap'[1]
System: Please enter the quantity of aloe sap in drums on your key-pad
<User keys in the number of drums available>
System: 'You have' {X} drums of unprocessed aloe sap, and {Y} 'drums of aloe leaves'

Figure 7.9: Dialogue for the seller interface

After all the shortcomings which had been identified had been resolved, the aloe processing plant was approached to schedule a date on which to test the application with the intended users. The plant responded with a date but also enquired whether the interface would be available in Afrikaans as many of the tappers who had agreed to participate in the pilot could not speak English. In order to accommodate this request, several changes to the application had to be made before the field tests were undertaken. Firstly, the dialogue had to be translated into Afrikaans and the prompts recorded accordingly. Secondly, the speech recognition module had to be trained to understand the Afrikaans language. The main challenge in this respect was that none of the researchers on the project were conversant in Afrikaans although the researchers from the South African university had a basic

understanding of the language. However, the research team members in India, where the application was being developed, had no knowledge of Afrikaans. In addition, the accents of the users, the researchers from South Africa and the researchers from India were vastly different. Thus, the research team had to teach the speech recogniser the meaning of specific terms through a process of transliteration. This required that the research team listen to each Afrikaans input phrase, map its meaning within the context of the dialogue, and ensure that the speech recogniser could detect the phrase. However, there was also a strong likelihood that the speech recogniser would not recognise the term in its real context as the accents used by the intended users differed from the accents of the developers. It was felt that the field tests that followed would reveal the extent to which the speech recogniser could understand the users, the ability of the application to add value for the users, the degree to which the call flows represented the users' problem domain and the usability of the solution as a whole. The outcome of the field tests are described in the next section.

7.3.4.2 Field testing

The first meeting between the researcher and the pilot group was attended by eight aloe tappers, two farmers and the managing director of the aloe processing plant. Two tappers that were part of the pilot group were unable to attend the meeting. The researcher was introduced to the pilot group by the managing director of the processing plant and given the opportunity to explain the objective of the project. The managing director of the aloe processing plant recommended that the farmers represent the buyers. He explained that the farmers are usually intermediaries in the relationship between the tappers and the aloe processing plant. In terms of this value chain, the tappers (usually labourers on the farmers' land) harvest aloe sap in their free time from the farm owners' land. In exchange for permission to harvest the aloe sap from the farmers' land, the tappers pay a nominal percentage of their earnings to the farmers in question. The farmers facilitate the--+ sale by transporting the aloe sap to the processing plant and collect payment on behalf of the tappers. Further information on the role of the farmer in the aloe value chain in the Western Cape is summarised and coded in table 7.4 below.

Table 7-4: Summary of factors relating to the role of the farmer in the aloe value chain.

Code	Category Code	Category	Concept
The farms are often extremely large while aloe tapping does not occur at a single location on the farm.	1	Challenges faced in accessing buyers and sellers	Usefulness
The role of the farmer is to facilitate the delivery of the drums of aloe sap to the aloe processing plant. In turn the farmer is paid a portion of the revenue from the sale.	3	Understanding problem domain	Usefulness
The drums of aloe sap are heavy and the tappers often leave them at the harvest sites to be picked up by the farmer.	3	Understanding problem domain	Usefulness
The tappers often walk long distances to reach the farmer in order to notify him/her that they have drums of sap that must be collected.	1	The value created by an e-marketplace	Usefulness
The aloe tappers are often unable to reach the farmer **telephonically** in order to notify him/her of the barrels to be collected as the farmer may be busy with farming activities or at a location with no network coverage.	1	The value created by an e-marketplace	Usefulness
There are often numerous drums of aloe sap located all over the farm and the farmer has to drive around randomly collecting them as he/she sees them. This is both tedious and costly on the farmer's part.	1	The value created by an e-marketplace	Usefulness

As a result of a review of the abovementioned summary, the training of the pilot group involved both the tappers and the farmers, with the farmers interacting with the buyer interface and the tappers making use of the seller interface. All of the participants were

issued with written training instructions, a mobile phone and a SIM card with enough airtime to enable them to interact with the application. In addition, the usage instructions contained a unique PIN for each user. The researcher then demonstrated how the application worked and then allowed the users to interact with the system under her guidance.

7.3.4.2.1 Observations made during field testing

One key observation made regarding the way in which the users interacted with the system was that, when a challenge was encountered, what the user perceived as a technical failure often, in fact, resulted from a usability shortcoming. The challenges observed are summarised in Table 7.5. These challenges are then discussed in the next section.

Table 7-5: Observation made during field tests.

Code	Category Code	Category	Concept
Inability to use the mobile device effectively.	5	Information Technology use limitations	Usability
Too many things for the user to remember	11	User's cognitive load	Usability
Failure of the system to understand the user's verbal input.	9	Errors in interaction	Usability
Failure of user to respond timeously to prompt to enter PIN.	9	Errors in interaction	Usability
Inability of user to proceed beyond authentication stage.	10	Task completion	Usability
Inconsistency in input methods	9	Errors in interaction	Usability
Tappers walk long distances to reach the farmer in order to notify him/her that they have drums of sap that must be collected.	1,2	Understanding the problem domain, the value created by e-marketplaces and the match between the system and the real world	Usefulness
The aloe tappers are often unable to reach the farmer telephonically in order to notify him/her of the barrels to be collected as the farmer may be busy with farming	1,2	Understanding the problem domain, the value created by e-marketplaces	Usefulness

activities or at a location with no network coverage.			
There are often there are numerous drums of aloe sap located all over the farm and the farmer has to drive around randomly collecting them as he/she sees them. This is both tedious and costly on the farmer's part.	1,2	Understanding the problem domain, the value created by e-marketplaces	Usefulness
The pilot group involved two farms with each tapper being associated with one of the two farm owners			

The first observation made was that some of the users had to be taught how to use the device before they were trained in the use of the system. A few of the tappers were receiving their first mobile phone. This, in turn, highlighted the technology resistance described in the entry stage of the intervention. The aloe tappers in the pilot group earned an income from their aloe tapping as well as from their primary occupation as labourers on the farms. Thus, in the main their economic circumstances were more favourable than those of most rural communities in South Africa. However, during the training session the researcher found that, to a few of the members of the pilot group, the mobile handset was completely unfamiliar. In addition, design features on the phone that are universally recognised across handsets were not familiar to a few of the tappers. For example, they had to be instructed how to use of the green "dial" button and the red "hang up" button.

Secondly, the cognitive load imposed by the system was too heavy for easy interaction with the system despite the fact that the system made use of very few simple prompts to support the interaction. However, for a first time user much of the interaction was initially overwhelming. For example, from a developer's perspective, in order for sellers to update their harvests, the tappers only needed to login, follow the prompts and enter the quantity. However, from the perspective of a novice, this interaction involved the following:

- Dialling the number associated with the service
- Gazing at the instructions on how to retrieve their PIN while simultaneously remaining aware of the prompts from the system

- Looking at the keypad to capture the PIN
- Recalling the PIN
- Capturing the PIN

For those tappers who were not regular users of mobile phones, moving past the authentication phase was very difficult as, after three failed attempts to login, they were notified of their failure and the call would be terminated. This, in turn, would deprive the user of the opportunity to experience the system, to learn how to use the system, to complete a task, and to understand the value that the application could provide.

Another observation made was that offering the user an option between responding via voice or DTMF caused further confusion for some users. The fact that the user was given two options to consider added to the cognitive load while there was already a lot to remember.

Although the application had been translated into Afrikaans, the user interface of the mobile phone was still in English. This was an oversight on the part of the researchers as their emphasis had been on the usability of the application and they had not taken into account of the usability of the device used to access the application.

All the challenges identified could be related to a usability heuristic guideline. The next section contains a summary of the most notable observations in relation to the usability heuristics made by Nielsen and Molich (1990) and Shneiderman (1998):

i. Recovery from errors

Nielsen and Molich (1990) and Shneiderman (1998) both emphasise the importance of error prevention. They state that errors must be avoided at all costs. However in the event of an error, it is vital that users are provided with simple, comprehensible mechanisms to recover from the error. Although errors are to be expected in early software releases, their existence impacts on the users' impression of the technology. As regards the prototype presented to the users, there was no way for them to recover from the errors they encountered and, consequently, it seemed that the application was not functioning effectively. When translated into Afrikaans (koper and verkoper) the terms "buyer" and "seller" were not easily distinguishable by the application's speech recognition. As a result, buyers were occasionally

directed to the sellers' interface while sellers found themselves on the buyers' interface. This resulted in an inconsistency between the instructions the users were given, the users' expectations and the actual flow of the dialogue. In some cases the user would not be authenticated at all and, after three failed login attempts, the call would be terminated. In all these scenarios the problem appeared to be technical because, as far as the users were concerned, they had responded appropriately whereas the system had not. The speech recognition was also affected by the background noise generated by all the group members interacting with the system at the same time in a confined space while, in some cases, it failed because the user had responded either too soon or too late. In addition, the users' accents may also have had an effect on the technology's ability to detect the response accurately. This problem was not entirely a speech recognition issue as speech recognition cannot yield the correct results if it is not utilised effectively. However, from the users' perspective, it appeared that the technology was not functioning as expected. Although speech recognition errors are commonplace when using SDSs, the inability to recover from the errors was the biggest challenge encountered.

The users' inexperience with the technology also resulted in some of them responding too slowly to the authentication prompt. When requested to enter the PIN, the user would respond extremely slowly. As a result the application would register only the first 1 or 2 digits of a 3 digit PIN and respond stating that the user had entered an incorrect PIN. Again, the user was left with the impression that the technology did not work, even though the source of the problem was in the manner in which the user was interacting with the technology. A user's failure to move past the authentication stage resulted in the call being ended abruptly. As a result, the user was unable to complete the intended task or realise the purpose of the interaction.

ii. Lack of experience using mobile phones.

Nielsen and Molich (1990) argue that, although it is preferable to design a system that may be used without help and documentation, supporting information should be available when needed. They add that it should be easy to refer to this information and that the information should list all the steps that a user must follow in order to complete the tasks, and be presented in a simple and compact manner. Although the application was simple to use, their lack of experience using mobile phones affected the users' ability to interact with the

application effectively. By default, the mobile phone's interface was in English and had to be switched to Afrikaans with the assistance of the researchers. Some of the users had no experience at all in using a mobile phone and had to be taught how to use even the most basic controls such as the green "dial" key and the red "hang up" key. This was a factor that had been overlooked by the researchers during the usability testing as the focus had been on the usability of the application rather than on the device. However, the need to include instructions in the user manual on how to use the device became apparent.

iii. Inconsistency in responding with different types of input formats.

Both Nielsen and Molich (1990) and Shneiderman (1998) highlight the need for consistency and argue that the meaning of words, situations and actions should not change in different aspects of the system. In addition, Shneiderman's emphasis on the importance of reducing the memory load imposed on users is consistent with Nielsen and Molich's (1990) recommendation that users must be able to recognise aspects of the system rather than recall them.

For some of the prompts the user input was accepted in speech format as well as Dual Tone Multi Frequency responses (DTMF), while some prompts allowed DTMF responses only. In instances in which speech responses were allowed, users were signalled to speak following a "beep", while no "beep" was signalled for the DTMF responses. This proved to be confusing for the users and many of them were slow to respond to prompts because they were waiting for the "beep". Thus, in addition to the fact that they were experiencing a new technology, they were faced with the additional burden of remembering when to wait for the "beep" and when to respond without a "beep".

iv. Need for improved match between the system and the user's context

Nielsen and Molich (1990) highlight the need for a match between the system and the real world and argue that terms used must be familiar to the system's users. Although the managing director had referred to the harvesters as 'tappers', because the interviews were conducted in English, the researcher had assumed that this was a colloquial English term used to describe the harvesters. As a result, when translating the interface into Afrikaans, the term was translated to "stroper" – the direct Afrikaans translation of the term harvester. However, this term was not part of the tappers' everyday vocabulary, and its meaning did

not automatically register with the tappers. In addition, the e-marketplace used the terms 'verkoper' (seller) and 'stroper' (harvester) to represent the same role. It became apparent while the users were engaging with the system that the appropriate term to use was 'tapper'. During the user tests, several more important requirements that had been overlooked emerged and indicated that the 'real world' had not been accurately represented. For example, the importance of the role of the farmer had not been taken into account and, hence, the system design had not accommodated this very important stakeholder. Furthermore, the application had included the sale of aloe leaves but aloe leaves were not traded by the members of the pilot group. In addition, during their experimentation with the application, one of the farmers pointed out that it would be of great value if the application prompted the tappers to indicate the location of their harvests. This requirement was completely unsolicited and would prove to define the application in terms of its ability to find solutions to the real problems faced by the users. Many of the abovementioned omissions could probably have been avoided if the researchers had spent some time observing the users within their own domains. The findings of this cycle of the intervention informed the next cycle which proceeded to address the shortcomings which had been identified.

7.3.5 Summary of findings from action cycle 1: Implications of usability for trust in technology

Chapter 4 described the trustworthiness of a technology as depending on the degree to which the technology addressed the users' needs, the extent to which the users could depend on it to fulfil what was expected and the technical capability of such technology to serve its purpose. It was evident from the observations made while the users interacted with the system that none of the factors that define the trustworthiness of a technology had been satisfied. In view of the fact that the users were not able to use the technology effectively, the technology was perceived to be lacking in its ability to serve its purpose. Furthermore, challenges experienced with speech recognition had resulted in the interaction yielding unexpected results. Thus, the technology was not perceived to be predictable, reliable or dependable. The usefulness of the technology was also not realised as the majority of the users were unable to complete their intended tasks. It was also evident that the most significant limitation of the technology was its lack of usability. This is all

highlighted in Table 7.5 which reveals that most of the issues encountered could be classified in terms of the concept of usability.

7.4 Action cycle 2

It was established during the first action cycle that the Spoken Web aloe e-marketplace had several fundamental limitations. These limitations were mainly associated with the usability of the technology within its specific context. It was also suggested that these limitations could influence the degree of trust that the users had in the technology. Furthermore, several contextual issues regarding the application emerged. These included the need for the application to accommodate the role of the farmer, the need to exclude the sale of aloe leaves from the dialogues and the need to revise the term used to define harvesters from 'stroper' to 'tapper'. Table 7.6 summarises the modifications made, while Figure 7.11 presents the resultant dialogue.

Table 7-6: Summary of modifications made in the second cycle.

Observed shortcoming	Modification
There was a need to modify issues relating to the business context	• Aloe leaves were removed from the scenario. • The farmers were added to the dialogue. • The tappers were mapped to a specific farmer so that the farmer received only listings associated with his own farm.
There was a need to adapt the language used in the dialogue.	• The term used for harvester (stroper) was changed to 'tapper'. • As the researcher now knew the names of the members of the pilot group, the identifier used to represent the tapper was changed to the tapper's actual name. • The term 'aloe sap' was reduced to 'sap'. • The term used for drums (dromme) was changed to 'kanne'. • The term used for the PIN was changed to 'kode'.
There were inconsistent results when the speech recogniser tried to distinguish between buyer and seller.	• The logic of the application was changed so that the distinction between buyer and seller could be

	made from the backend and based on the PIN entered.
Errors had occurred during authentication	• The time allowed for the users to capture their PIN was extended.
There was confusion regarding the way in which to use the two input modalities.	• The ability to respond before the beep was enabled for all prompts. • The two input modalities were retained in all cases to allow an alternative in the event of speech recognition failure.
The user had to remember too many things.	• It was hoped that the more contextually adapted and simplified interface would reduce the cognitive load.

Seller interface

System: Welcome to the Spoken Web aloe e-marketplace. Please enter your tapper PIN.
User: *<Enters PIN. System authenticates user and redirects user to the seller interface>*
System: To update Quantity press 1 or say 'Quantity' or to update the location, press 2 or say 'Location'.
User: 'Quantity'
System: Please enter the quantity of sap in drums on your keypad.
<User keys in the number of drums available>
System: 'You have' {X} drums of sap, located at {Y}.

Buyer Interface

System: Welcome to the Spoken Web Aloe Ferox e-marketplace. Please enter your buyer PIN.
User : *<User enters PIN, system authenticates user and redirects user to buyer interface>*
System: Here is a list of sellers for sap.
<System provides listings as follows: {Tapper name} has {X} drums of aloe sap located at {Y}. Press any key to continue>

Figure 7.10: Dialogue for the aloe e-marketplace-second iteration.

After the modifications had been made the researchers set out to deploy the application. The users were left to interact with the application over a period of eight weeks. During this period the researchers monitored their usage and provided technical support remotely. At the end of the eight week period, the researcher met with the users to obtain their

perspectives of the application. The next section discusses the results from the eight week pilot.

7.4.1 Users' experience during the second action cycle

The call logs were able to indicate the number of calls made to the system, the number of calls that went past the authentication stage and the origin of the authenticated calls. In the first week the usage data indicated that numerous calls had been made to the system, but that many users were still not getting past the authentication stage. Table 7.7 presents a breakdown of the calls made to the application in the first week of the pilot. Despite the large number of calls initiated (93), 22 only went past the authentication stage. As a result, 8 calls from the pilot group only were recognised. Specifically, from the pilot group 72 calls were logged and only 8 authenticated. This was an indication that the users wanted to make use of the system but were failing to do so. Table 7.8 presents a breakdown of the authenticated calls per user.

Table 7-7: Breakdown of the number of calls in the first week of the pilot.

Total calls (SA and India)	93
Less test calls from India research team members	-21
Less test calls from South Africa research team members	-10
Total calls from pilot group	**72**
Total calls that went past the PIN verification	22
Less total calls made using test PIN	-10
Less total PIN verified test calls from IRL using non-test PINs	-4
Total authenticated calls from pilot group	**8**

Table 7-8: Breakdown of usage by pilot group member (first two weeks).

Pilot group member	Number of authenticated calls
Tapper 1	2
Tapper 2	2
Tapper 3	1

Tapper 4	0
Tapper 5	0
Tapper 6	0
Tapper 7	0
Tapper 8	0
Tapper 9	0
Tapper 10	1
Farmer 1	0
Farmer 2	0

The data indicated that, in the first week, neither of the farmers had managed to authenticate themselves successfully. Furthermore, four tappers only made it past the authentication stage successfully. Subsequently, some members of the pilot group were contacted to ascertain what difficulties they were encountering. The managing director of the processing plant indicated that several users had approached him when they were having difficulties in interacting with the application and that he had helped them to resolve the problems. He stated that:

"Some tappers had problems getting through to the system and I have assisted them with that. You get through to the system after a few tries."

One of the farmers had sought help specifically because (according to the farmer) the PIN was not working. The researcher responded by going through all the necessary steps with the farmer and the managing director telephonically and, thereafter, reiterating the steps in an e-mail. The managing director responded as follows:

"Hi Naomi
I have tried this a number of times, without success.
Seems that Japie's code (224) is the problem"

The researcher then attempted to login using the same PIN and was successfully authenticated. After a number of tests had been conducted to understand the problem, the developers resolved the problem. They responded as follows:

"After your email, we studied the logs and found out that on 6th Sep and 10th Sep there were some failed attempts to enter the right PIN. It turned out that every time (among these failed attempts) the PIN had been entered as '2' only. So, it might be that these users, since they are new to the system, take a bit of time between digits (they enter 2 then look at their PIN on a piece of paper and they press 4 and so on). So we have increased the amount of time available between digits before it starts interpreting the result. We have tested it. Hopefully, that should work for them."

After extending the acceptable waiting time between digit entries, the users confirmed that the application was functioning correctly. Despite the fact that this issue had been observed and addressed during the previous cycle, the amount of time required to allow the user to respond had been underestimated. Again, the users were left with the impression that the application was not technically competent. After the problem with authentication had been resolved, the number of authenticated calls began to increase. Table 7.9 and Figure 7.11 summarise the number of calls made over an 8 week period by both the farmers and the tappers. Although the data does not show that large volumes of calls were made, it does show that the application was used consistently over the period. The average number of calls per tapper every fortnight was between 1 and 3. Considering the time it takes to fill a drum with aloe sap, and the fact that the farmers deliver to the processing plant on a fortnightly basis, it appeared that the data was indicating that the users were, indeed, calling to provide information as the need arose. In addition, the developers indicated that, between 5 September and 8 October, the quantity of aloe sap had been updated 14 times, while the location had been updated 17 times. It is likely that most of these updates took place between 19 September and 8 October as users were still becoming accustomed to the application in the first two weeks.

Table 7-9: Summary of authenticated calls by pilot group over eight week period.

05-Sep	19-Sep	08-Oct	26-Oct	Average calls per fortnight
2	8	10	11	3
2	3	4	4	1

1	1	2	2	1
0	0	4	5	1
0	2	3	3	1
0	1	3	3	1
0	2	3	3	1
0	2	5	8	2
0	1	5	5	1
1	2	4	6	2
0	2	2	4	1
0	0	3	4	1

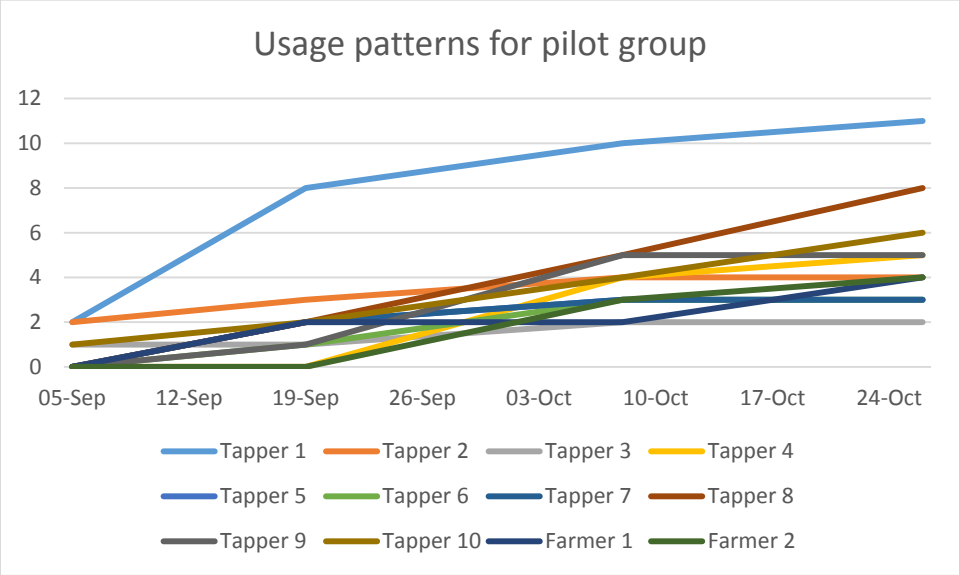


Figure 7.11: Usage patterns for pilot group.

After the pilot had run for eight weeks, the researcher paid a visit to the members of the pilot group in order to obtain an understanding of how the users felt about the system. An interview schedule was prepared using questions from a trust survey designed by Mishra and Mishra (1994). The purpose of the interview was to assess the extent of the users' trust in the system, and to examine whether the users had found the system to be usable.

Using Mishra and Mishra's (2004) survey instrument, questions relating to the technology's competence, reliability and concern (usefulness) were posed to the users. In addition, Lund's (2001) usability satisfaction survey instrument was also used as a reference. According to

this survey instrument, assessing usability requires an enquiry into the usefulness, ease of use, learnability and satisfaction associated with the use of a technology. The instrument measures the overall usability of a technology. The Interview questions presented to the users are included in Appendix B. In addition to the questions directly relating to usability and trust, questions were posed regarding the availability of the system, the openness of the researcher regarding the technology, contextual issues surrounding the attitudes towards and usage of mobile phones and the users' willingness to perform financial e-commerce transactions.

Unfortunately, the day that the interviews were held coincided with the funeral of a prominent community member who was known to the farmers and the tappers. Only five aloe tappers and one farmer presented themselves for the interviews. The Managing Director of the processing plant excused the others, and stated that some had already proceeded to the funeral, and those that were present (including himself) would be attending the funeral after the interviews. Table 7.10 summarises the questions asked to the tappers and their respective responses.

Table 7-10: Summary of final interviews with aloe tappers.

Concept	Question	Tapper 1 (Age: 21)	Tapper 2 (Age: 19)	Tapper 3 (Age:45+)	Tapper 4 (Age: 60+)	Tapper 5 (Age: 23)
Availability	**Was the technology available when it was needed?**	Sometimes in a valley there is no signal, sometimes it rings then disconnects.	Never	Yes	Only yesterday that I couldn't get through	Sometimes early in the morning you can't get through
Competence/ effectiveness	**Could you complete the intended task successfully each time?**	Sometimes I would not finish because of a distraction. I would complete it later.	I figured it out the first time	Yes	Yes	Yes
Competence	**Does the technology do all the things that you need it to do?**	Not really	Yes	Yes	Yes	Yes
Competence/ effectiveness	**Did the technology do what it was supposed to do?**	Yes	Yes	Yes	Yes	Yes

Ease of use	**Is the technology easy to use?**	Yes	Yes, very easy	Yes	Yes	Yes
Ease of use	**Was it easy to fix mistakes made when using the technology?**	Yes	Yes	I haven't made any mistakes	Yes	Yes
Learnability	**Was it difficult to learn how to use the technology?**	No	No	No	At the beginning it was difficult, but my grandchild helped	No
Learnability	**Was it difficult to remember how to use the system?**	No	No	No	Not very difficult	Yes, at first
Learnability	**Was a user manual necessary in order to be able to use the technology?**	No, only necessary when I forgot my PIN.	Only the first time I used it.	No	Yes	Yes
Reliability/ dependability	**Did the technology function the same way each time you used it?**	Yes	Yes, no problems	Yes	Yes	Yes
Reliability/ dependability	**Was the technology reliable?**	Yes, you can depend on it.	Yes	Yes	Yes	Yes
Satisfaction	**Did you enjoy using the technology?**	Yes	Yes	Yes	Yes	Yes
Usefulness/ purpose Efficiency	**Did the technology make your work easier?**	Yes	Yes, before I had to phone the farmer and he was mostly unavailable.	Yes, it's easier	Yes	A lot easier
Usefulness/ purpose Efficiency	**Do you feel that using the technology may save you time?**	Yes	Yes	Yes	Yes	Yes, it saved a lot of time. Had some difficulty updating location at first, but now its fine.
Usefulness/ purpose	**Did you feel that the technology was there to serve your interests?**	Yes	Definitely	Yes, it made life better	Yes	Yes

Satisfaction	**What factors would make you use the platform after the project is concluded?**	I live far from the farm and have to walk for 2 to 3 hours to reach the farmer. I no longer need to do that.	It makes my work easier.	I will always use it.	Yes	It's easier now. I can call and I don't have to walk to the farm. It's a huge distance (1 hour walk).
Satisfaction	**What factors would discourage you from using the technology when the project is concluded?**	None, I would buy my own airtime.	None	None	None, I would buy airtime for it.	I will use it as long as I tap aloe.
General	**What other activities do you use your cell phone for?**	Phone calls, MXit, To Go	Only for calling family	Phone calls	Calling, SMS	MXit, calling
Researcher Openness	**Was it clear what the purpose of the technology was?**	Yes, it was easy and you could call from anywhere.	Yes	Yes	Yes	Yes
Researcher Openness	**Were you provided with the information you needed in order to use the technology effectively?**	Yes	Yes	Yes	Yes	Yes
Researcher Openness	**Was any information regarding the technology withheld from you?**	No	No	No	No	No
Experience	**Did the technology impact negatively on the way in which you work in any way?**	No	No	No	No	No
Experience	**Did the technology impact negatively on the way you feel in any way?**	No	No	No	No	No
E-commerce trust	**Would you use the technology to sell/buy to someone you do not know?**	No	No	Yes	Yes	Not if I don't know the person.
E-Commerce trust	**Would you use the technology to make or**	Yes	Yes	Yes	Yes	No

	receive payments?					

In addition to the interviews held with the tappers, an unstructured interview was held with the farmer who was available and with the managing director of the aloe processing plant. The farmer had found value in the application but, for the most part, it had been mainly his son who had interacted with the application on his behalf. He stated that the application had become useful once all the technical difficulties had been overcome. He also emphasised that he was open to new technologies as long as they were consistent with the way things in which were done within his environment. The managing director saw a lot of scope for the application within agriculture in the Western Cape, and mentioned that the timber industry as well as the ochre mining industry in his town could benefit from such an application. He also added that, as an aloe processing plant, he could benefit from the e-marketplace if he had access to the same information that was reaching the farmers. He mentioned how, at times, he had to visit the bank to make large unplanned cash withdrawals to pay the tappers as he was unable to anticipate beforehand how much the aloe tappers would harvest. He added that obtaining such information in advance would assist him with production planning and the allocation of resources for his factory.

7.4.2 Summary of findings from the second action cycle

The first action cycle of the project suggested that a technology that resulted in the reducing the amount of time, money or effort expended by the user and which functioned as required would lead to task completion and also inevitably lead to an enhanced perception of its technical competence. The first action cycle had also suggested that a technically competent technology would be more likely to be perceived as reliable and useful by its users. In view of the fact that competence, reliability and usefulness are all measures of trust, the study deduced that addressing issues of usability would positively influence the level of trust of the users in a technology. The second action cycle evaluated the extent to which the users had found the technology to be usable and the degree of trust the users had in the technology. These two factors are described in the next section.

7.4.2.1 Usability

The prototype with which the users had first interacted had been fraught with limitations that had hindered the tappers' ability to use it effectively. Following the prototyping exercise, the flaws which had been identified were addressed. In the first week, however, according to the call logs, as summarised in table 15, out of the 72 calls made from the pilot group, only 8 had gone past the authentication phase. Table 7.8 indicated that only 5 of the 12 members of the pilot group had been able to successfully authenticate themselves during this period. The vast number of calls made in relation to the small number of authenticated calls was indicative of the fact that the users had the intention to use the system but that they had not been able to complete their intended tasks effectively. The managing director had assisted the tappers and they had been able to login "after a few tries" although the farmer had struggled to login. When the usability challenges at the authentication phase had been addressed, the number of authenticated calls increased, with all the tappers successfully logging calls. Lund's (2001) user satisfaction survey instrument measures usability in terms of ease of use, learnability, efficiency and satisfaction while ISO 9241-11 (1998) measures usability in terms of effectiveness, efficiency and satisfaction. Based on these two measures, the interviews with the tappers suggested that they had found the modified application to be usable. This is summarised in Table 7.11.

Table 7-11: Summary of users' perception of the usability of the application.

Usability factor	Evidence from data
Ease of use	The tappers who were interviewed unanimously stated that the application was easy to use.
Learnability	Only one of the five tappers interviewed had found the application difficult to learn. However, considering that he was over 60 years of age and did not own a mobile phone, this was to be expected.
Memorability	Three of the five tappers interviewed stated that they had not found it difficult to remember how to use the system. Two stated that they had found this difficult to remember at the beginning. It is worth noting that they were both also the only two who had stated that the user manual was necessary.

Recovery from errors	All five of the tappers indicated that they had found it easy to recover from mistakes they had made while using the system while one of them even stated that she had not made any mistakes.
Satisfaction	The tappers unanimously stated that they had enjoyed using the system.
Efficiency	The users all emphasised that the system had made their work easier and had saved them time.

7.4.2.2 Trust

Chapter 4 described a trustworthy technology as one that functions effectively and reliably, while serving the needs or interests of its users. These criteria had not been met in the first action cycle because the users' inability to use the technology had resulted in the technology being perceived as 'incompetent'. This, in turn, implied that the users were not likely to rely or depend on the technology, nor had they been able to realise its utility. Thus, in this regard, the technology's limited usability had impeded its trustworthiness. In the second action cycle the usability limitations had been addressed and the users were able to use the technology effectively. Based on the factors defining the trustworthiness of a technology, the interviews with the tappers suggested that the users had trusted aloe e-marketplace. This was reflected in their opinions about its reliability, its usefulness and its competence. These opinions are summarised below:

Table 7-12: Factors indicating the trustworthiness of the technology based on interviews with tappers.

Trust factor	Evidence from interviews
Usefulness	All the tappers agreed that the application had made their work easier, and that it had saved them time. Two of the tappers mentioned that they had had to walk very long distances in order to inform the farmer of their harvest, and that the application had relieved them of that burden. Although the farmer and some of the tappers had owned mobile phones prior to the study, one tapper mentioned that the farmer was seldom

	available telephonically. The new system enabled the tappers to convey the necessary information while the farmer could obtain the information at his own convenience.
Competence	All the users agreed that the application had done what it was supposed to do. Only one of the five tappers indicated that there were features that he required but that the application did not provide. In addition, all the tappers stated that they had been able to complete their intended tasks using the application. One tapper stated that, at times, he had not completed an update due to a distraction but that he had always been able to attend to it at a later stage. Thus, the general perception of the tappers was that the application had the competence or capability (technically) to fulfil its role.
Reliability/dependability	The tappers unanimously stated that they had found the application to be reliable and agreed that it had functioned consistently each time they had used it.

7.4.2.3 Additional factors affecting trust in an agricultural e-marketplace.

Although there were certain factors relating to trust that were not extensively evaluated in the action cycles, their relevance must not be overlooked. These factors include confidentiality, information integrity, availability and subjective norm. These factors will be discussed in the proceeding section.

i. Confidentiality

The pilot group was part of a close-knit community in which there was a high degree of trust between all the stakeholders. However, the community appeared to be less trusting towards outsiders. This was evident in the fact that the aloe processing plant that participated in the

project sought aloe sap only from within the community while three out of the five tappers interviewed had stated that they would not use the application to sell to a stranger. During the entry phase of the intervention, when asked about the risks they anticipated from an e-marketplace, all three representatives of the organisations that were interviewed (two aloe processing plants and a cosmetic manufacturing company) had identified the risk of leaking important company or product information to external parties. It was, thus, clear that confidentiality was an important concern for the participants in the pilot group.

ii. Availability

The feedback from the users indicated that the system had not always been available when it was needed. However, at the onset of the pilot, the researcher had explained to the tappers that the calls were directed to a 'computer' in India, and that the complexity of the setup may have meant that it would not always be available. The users were encouraged to try calling again if they failed initially. The aloe e-marketplace supported asynchronous communication. In other words, the sender and the receiver of the information need not exchange information simultaneously. Furthermore, the nature of the aloe tappers' work was not time critical as their harvest was not perishable, neither was it collected immediately. Although the drums were at times left exposed and unattended on the farms for collection by the farmer, there was little likelihood of their being stolen. This was evident from the fact that, according to the farmer that was interviewed, tappers sometimes "borrow" drums from one another. In cases where one tapper had been unproductive during a given period, that tapper may claim payment for another tapper's harvest. This is not considered to be theft as the tappers have an understanding among themselves and compensate each other accordingly. In view of the fact that the farmer only delivers the sap fortnightly, the limited availability of the system did not compromise the ability of the system to serve it purpose because the tappers were, inevitably, able to convey the message to the farmer. However, in other agricultural settings, availability is a critical concern. Chapter two revealed that one of the reasons why rural farmers have limited bargaining power is because they lack storage facilities for perishable goods. As a result, the time sensitivity of their products demands that they accept the price the buyer is willing to pay or run the risk of product decay. E-marketplace availability is of critical importance in such cases as the inability to obtain or convey crucial information required in the exchange of perishable produce can result in material losses for farmers.

iii. Information integrity

The primary purpose of the aloe e-marketplace was to enable the exchange of information between farmers and tappers in order to facilitate the trade process. Needless to say, if the information provided to the farmer was incomplete, incorrect or inaccurate the application would be of little value to any of the stakeholders. During the prototyping exercise one farmer had suggested that the system include a field to add the location of the drums of aloe sap. This was one of the most valuable requirements that emerged. As a result of the location field being added to the call flows, the system was able to demonstrate time and cost saving benefits for both the tappers and the farmers with the location field contributing to the completeness of the information exchanged in the e-marketplace. The accuracy of and reliability of the information conveyed contributed to the usefulness of the information and inevitably to the usefulness of the e-marketplace as a whole. The integrity of the information, thus, had a role to play in the overall trustworthiness of the e-marketplace.

iv. Subjective norm

Subjective norm refers to the influence of important reference groups on the behavioural intention of an individual (Ajzen & Fishbein, 1977). The managing director of the processing plant was a champion of the project. He assisted the research team in the coordination of all the meetings and brought all the pilot members together. He came across as a community member who was respected by farmers and tappers alike. He was also an influential role player in the aloe value chain as he was the main buyer of the aloe sap. Thus, the managing director of the processing plant's attitude towards the e-marketplace was likely to have influenced the beliefs that the aloe tappers and farmers had about the trustworthiness of the e-marketplace, and their intentions to make use of the e-marketplace.

74.2 Exit phase

Although the members of the pilot group who were interviewed had mentioned their desire to continue to use the service, only a few had continued to use it consistently for some months after the pilot phase had ended. Considering that the pilot group had comprised of only twelve participants, sustained usage by even half of them would have been too low to warrant the costs associated with maintaining the service. As a result, the Spoken Web aloe e-marketplace was suspended and the voice platform reallocated to another project. This

was communicated with regret to the pilot group. Although the intention was to re-establish the project at a later stage using the lessons learned from the intervention, the researchers have not, however, been able to secure the funding to do so yet.

74.3 Conclusion

The entry phase of the intervention had aimed at understanding the problem domain of the aloe industry and determining how a voice based e-marketplace could support interaction between the stakeholders in the aloe value chain. Desktop research informed the design of an e-marketplace. A conceptual model of an e-marketplace was developed and evaluated by the research team in collaboration with representatives from two aloe processing plants and a manufacturer of aloe based health and cosmetic products. The information obtained from the interactions with the stakeholders enabled the research team to refine the e-marketplace model and develop a prototype of the e-marketplace. The prototype was found to be lacking in terms of usability and, consequently, the users were unable to use it effectively or efficiently or to gain utility through the application. In addition, it was also apparent that there were some conceptual issues that had not been addressed early in the development process. As a result, a critical stakeholder group (the farmer) had been omitted from the dialogues, the terminology used was not consistent with the language with which the target users were familiar, and issues of usability specific to the target user group had not been addressed. It also emerged that the most valuable information gathered during the entry phase had been from informal, unstructured discussions rather than structured interviews. Presenting an e-marketplace model to the interviewees proved to be impractical. The diagram overwhelmed them with the burden of interpreting the model, and assessing it within the frame of two concepts that had never been applied to their businesses, namely, e-marketplaces and voice based interaction. On the other hand testing the model with a prototype proved to be an effective way of identifying technical requirements pertaining to the specific user group, as well as bringing to light functional requirements and contextual issues that had been overlooked. Further analysis and reflection on the part of the researchers assisted the research team to refine the application and bring it to the point where the users found it to be both usable and trustworthy. Thus, the researcher found that the requirements elicitation process had a role to play in achieving a state of usability and trustworthiness of the technology. The first cycle of the intervention had made use of modelling techniques that were founded on the researcher's preconceived

ideas about how the stakeholders operated and what their needs were. This had resulted in a conceptual model that was, firstly, difficult to communicate and validate with the stakeholders, and secondly, did not reflect the context of use appropriately. Exploratory, semi structured interviews on the other hand, had revealed a richer insight into the users' context and had allowed the research team to refine the e-marketplace model to respond appropriately to the needs of the users. The prototyping exercise had been effective in uncovering technical issues associated with the use of a voice based platform that would not have been articulated verbally by the users.

Chapter 4 argued that the trustworthiness of a technology is determined by its functionality, reliability and the extent to which it addresses the needs of its users. The intervention described in this chapter found that the lack of usability of the voice based e-marketplace had impeded the users' ability to experience the functionality offered by the e-marketplace. As a result of the usability challenges, the technology performed unreliably and inconsistently and had not been found to be useful by the users. The usage logs presented at the end of the first fortnight of the e-marketplace's deployment indicated very low usage. The usage increased after the usability challenges had been addressed. The subsequent interviews with the users at the end of the pilot indicated that the users found the modified version of the e-marketplace to function effectively and reliably. The users also stated that they found the e-marketplace to be useful as it saved them time and effort. Evidence of the trustworthiness of the e-marketplace was alluded to in the users' perceptions of its functionality, reliability and usefulness.

The trustworthiness of the aloe e-marketplace was found to be influenced by the usability of the application. However, it also emerged from the discussion presented in 7.4.2 that availability, information integrity, confidentiality and availability impacted on the users' perception of the aloe e-marketplace's trustworthiness. In addition, subjective norm was found to influence the users' beliefs about the trustworthiness of the e-marketplace as well as the intention to assume trusting behaviour towards the e-marketplace (by adopting the technology). This chapter suggested that subjective norm has a greater influence during the initial stages of trust, when the knowledge about the object of trust is limited.

This chapter concludes that the following factors will have an influence on the level of trust and the intention to adopt voice based agricultural e-marketplaces by rural farmers:

- The requirements elicitation process
- Usability
- Availability
- Information integrity
- Confidentiality
- Functionality
- Usefulness
- Reliability
- Subjective norm

The model depicted in Figure 7.14 illustrates the relationships between the factors that contributed to the trustworthiness of the Spoken Web aloe e-marketplace. Confidentiality, information integrity and availability are all elements of information security, according to the CIA triad. Thus in the chapter that follows, they will collectively be presented as security. In the next chapter, the requirements elicitation process, usability, security, usefulness, functionality, reliability and subjective norm will be discussed as elements contributing to trust in a voice based e-marketplace.

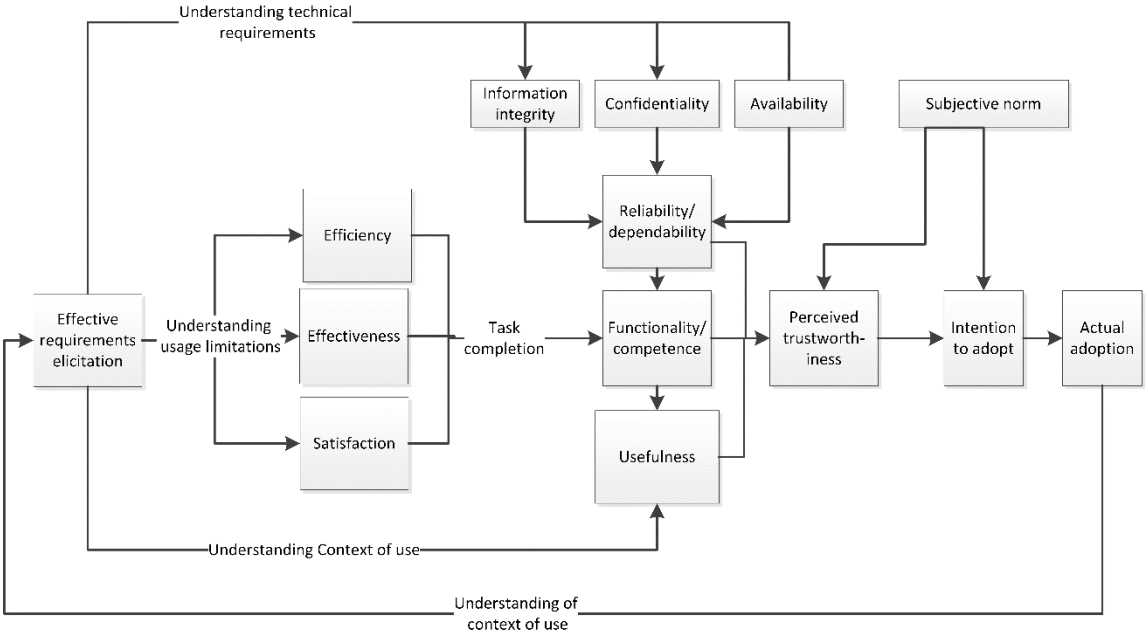
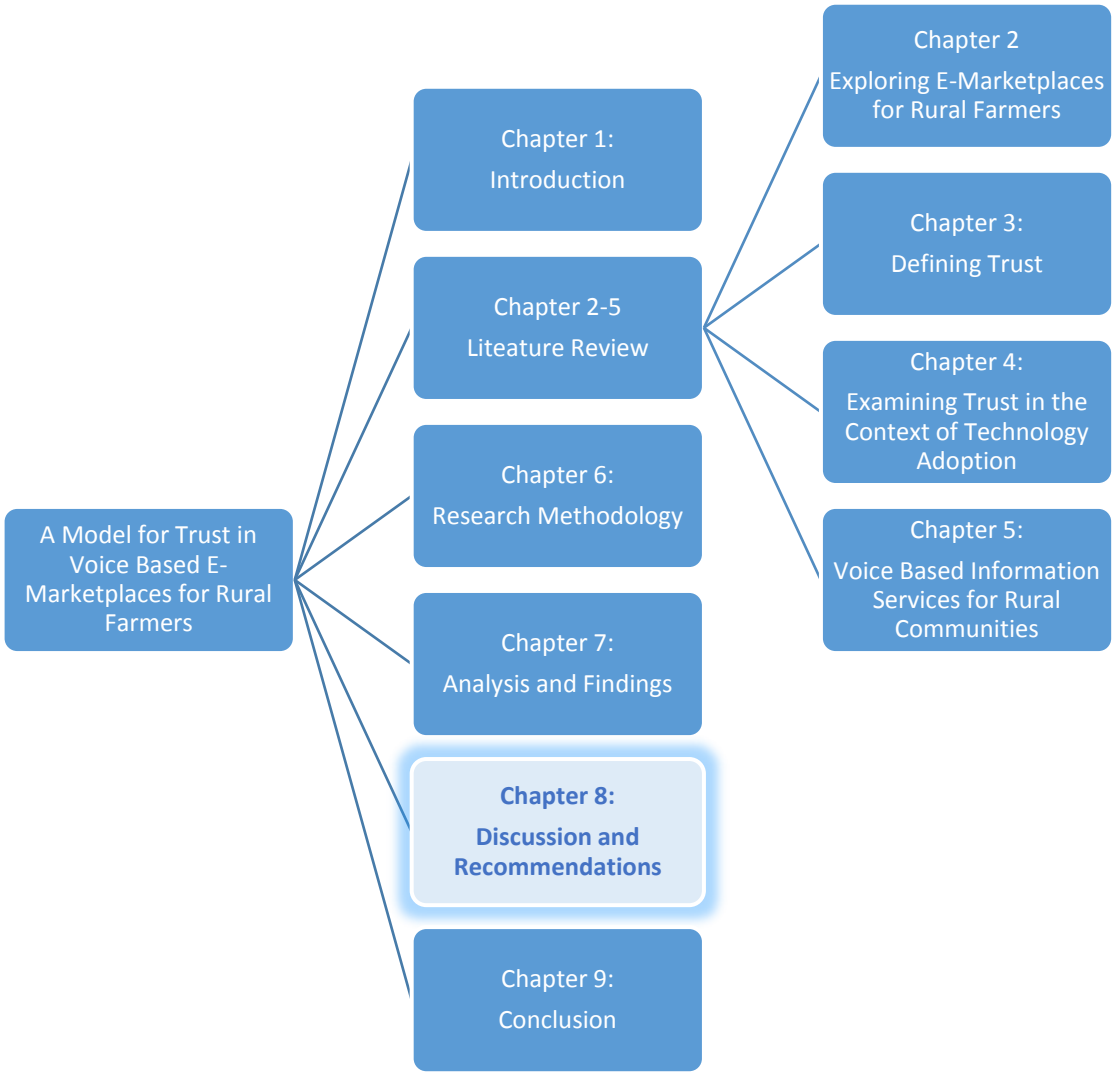


Figure 7.14: A model of trust in the aloe e-marketplace

Chapter 8: Discussion and recommendations



8.1 Introduction

The literature review described the nature of trust, identified the factors influencing a user's decision to trust a technology artefact and the characteristics of Spoken Dialogue Systems that affect trust. In addition, e-marketplaces were discussed in the context of their application to rural farmers. The literature review concluded that trust is a judgement made about a subject, based on one's beliefs about their ability, benevolence and integrity. This judgement influences ones attitudes towards the subject and their willingness to engage in trusting behaviour with the subject. Trust is not static, but rather a dynamic process that is shaped by the outcomes of the exchanges with parties. Many prominent models of trust recognise that the outcomes of the exchange influence the trusting beliefs and consequently affect the resultant state of trust that develops. Trust is only relevant in the presence of risk, reliance and expectation because the need for trust emerges when a desirable outcome can only be achieved when one makes oneself vulnerable to a certain risk.

The nature of trust was then examined in the context of trust in a technology artefact. In the literature review it was presented that there are scholars that do not believe that a relationship of trust can exist between a human and a technology as technologies do not demonstrate free will nor are they capable of moral volition. This study argued that a relationship of trust can exist between humans and technology artefacts as none of the reviewed definitions of trust articulated the will or moral volition of the trustee as a determinant of trust. In this study, trust in technology was established to be based on a person's belief in the technology's ability to fulfil what is expected of it (functionality), the consistency, reliability or dependability with which it fulfils the expected functions and the extent to which the interests or needs of the users are addressed (usefulness).

Based on the definitions of trust in a technology artefact, it could be deduced that trust in a voice based e-marketplace is influenced by the users' belief that the voice based agricultural e-marketplace possesses the necessary functionality to reliably support the needs of buyers and sellers of agricultural products. The Action Research intervention undertaken sought to understand trust in the context of a voice based e-marketplace targeted at a rural aloe farming community. Chapter 7 presented the results of an Action Research initiative to design, develop and deploy a voice based e-marketplace that the intended users can trust and consequently adopt in their trade. The intervention found that trust and the consequent

adoption of a new technology is influenced by the requirements elicitation process, the usability of the technology, the availability of the services offered by the technology, the integrity of information exchanged using the technology, the confidentiality provided by the technology, the functionality offered by the technology, the reliability with which the technology functions and the extent to which the technology is found to be useful by the users. This chapter presents a model for trust in a voice based e-marketplace targeted at rural agricultural communities. The factors that contribute to trust in a voice based e-marketplace will be discussed in the proceeding section.

8.2 A model for trust in voice based e-marketplaces for rural farmers

This section proposes that an effective requirements elicitation process results in a voice based e-marketplace that is usable, secure, and possesses the necessary functionality to fulfil the needs of its users reliably. This chapter further proposes that an e-marketplace that demonstrates the aforementioned qualities will be considered to be trustworthy by its intended users and that the technology's trustworthiness will result in an increased intention to adopt the e-marketplace. Finally this study proposes that the perception of an e-marketplace's trustworthiness will be affected by the opinions of important reference groups. These opinions (subjective norm) will also have an effect on the users' intention to adopt the e-marketplace. This forms the core contribution of this study and the response to the main research question. This contribution is represented in Figure 8.1: A model for trust in voice based agricultural e-marketplaces. The factors leading to trust in and adoption of voice based e-marketplaces will be discussed in the sections that follow.

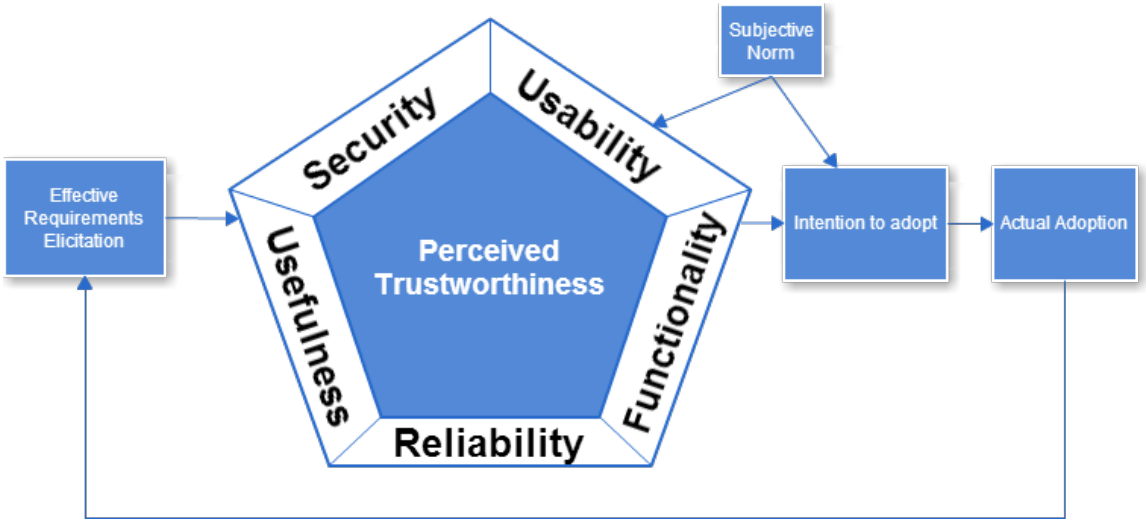


Figure 8.1: A model for trust in voice based agricultural e-marketplaces

8.2.1 Usability, functionality, reliability and usefulness

Chapter 5 described usability according to ISO 9241-11 (1998) as "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use". The context of use refers to the factors related to the users and their environment that constrain their ability to effectively and efficiently interact with a technology. For a technology to add value to a user, it must fulfil the user's needs at a reduced cost. Such cost may be in terms of the time consumed, effort exerted or the monetary cost associated with the use of a system. Users do not expect to expend more time, effort or money to perform a task using technology than they would expend in the absence of such technology.

Findings from the deployment of the aloe e-marketplace suggested that the lack of usability of the e-marketplace at the onset of the eight week pilot period impeded the technology's ability to function effectively and thus the usefulness of the technology could not be realised. The goal of an e-marketplace, as described in Chapter 2, is to facilitate the exchange of information between buyers and sellers for the purposes of directly or indirectly enabling a transaction. Therefore, buyers and sellers that choose to adopt an e-marketplace platform should expect that their ability to exchange information and transact with one another should be more efficient and effective through the use of an e-marketplace. The traditional marketplace model that was in place prior to the intervention was effective, but far from efficient. This was clear from the interviews that were undertaken with the tappers, which revealed that the tappers had, prior to the introduction of the aloe e-marketplace, walked

long distances to communicate their harvests to the farmers. Additionally, the farmers were accustomed to driving around the farms randomly seeking the drums that had been harvested. The interaction processes presented by aloe e-marketplace promised a more efficient means of engagement between the aloe tappers and the farmers. However the lack of usability of the voice medium impeded the ability of the e-marketplace to achieve this goal.

Context of use is a fundamental aspect in the definition of usability. The challenges associated with the usability of the e-marketplace stemmed predominantly from the use of a voice based platform in the context of Afrikaans speaking users who had limited experience with the use of mobile phones and interactive voice response systems. The language spoken by the pilot group (Afrikaans) can be classified as a poorly resourced language, implying that it is not sufficiently accommodated by speech recognition software. As a result, the voice medium, which may have been effective if it had been applied within the context of a well-resourced language, was ineffective in the context of Afrikaans speaking users. Additionally, the users' inexperience with the use of mobile phones and interactive voice response systems imposed further constraints to the efficiency of interaction between the users and the technology. Consequently, the speech recognition was unable to understand the users' verbal gestures and the users were unable to progress through the transaction dialogue.

The study revealed that issues within the users' context constrained their ability to interact with the system efficiently and effectively. In terms of voice interaction, efficiency is of particular importance when considering the cost of the voice calls. During the pilot, efficiency was less of a concern for the users than it may otherwise have been because they were provided with free airtime. However, in a real world setting, if the users repeatedly encountered errors that impeded them from completing transactions and resulted in the depletion of their airtime credit, it would be unlikely that they would be willing to continue to use the application. The length of the dialogues and the failure to complete the intended task was evidence of the lack of efficiency and effectiveness of the technology. Based on the researcher's observations and the definitions of usability and technology trust, the researcher found that the failure of the users to interact with the system efficiently and, effectively had resulted in a negative perception of the technology's capability. Users are

not likely to find a technology useful or dependable if they do not believe that it has the capability to fulfil the required functions effectively. This relationship between trust and usability is depicted in Figure 8.2 below.

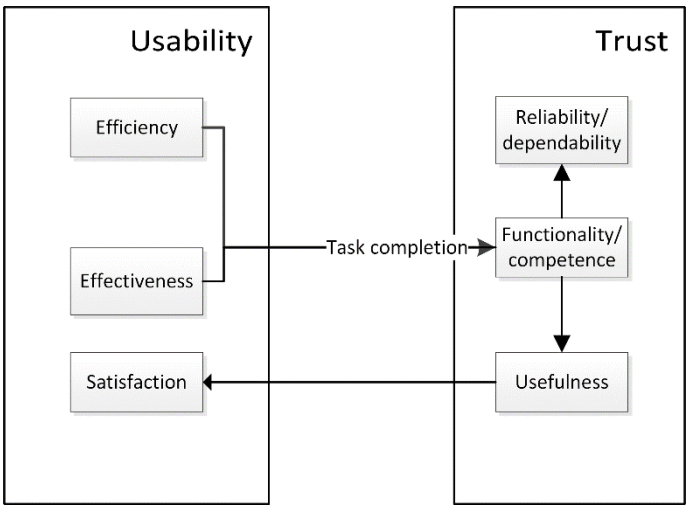


Figure 8.2 The relationship between trust and usability in the Spoken Web aloe e-marketplace.

Figure 8.2 represents usability as a product of efficiency, effectiveness and satisfaction, and trustworthiness as a consequence of competence, reliability and usefulness. Figure 8.2 suggests that a technology that is efficient (resulting in reduced expenditure of time, money and/or effort on the part of the user) and effective (functions as required), will result in task completion and inevitably lead to an enhanced perception of the technology's technical competence. A technically competent technology is more likely to function consistently according to the users' expectation and enhance the users' perception of its dependability. In addition, a technically competent technology is more likely to be found to be useful and lead to the satisfaction of its users.

8.2.2 Security

Trust is irrelevant in the absence of risk, and where risk exists, security provides measures to protect the trustee from those risks. This study recognised that the risks concerned in e-marketplaces can be material risks or intangible risks. Although this study focused on the intangible risks associated with technology trust, it still recognises that any negative outcome that could result from the use of a technology will compromise trust in the specific technology. This view is supported by Mayer et al.'s (1995) model of trust that demonstrates that the outcomes of an encounter feeds back into the beliefs that a trustor has about a

technology. Jones and George's (1998) model of the evolution of trust also articulates the negative effect that a negative encounter has on trust in a relationship. Thus, the material risks cannot be overlooked if trust in an e-marketplace is to be sustained.

Although the need for security did not explicitly manifest in the course of the intervention it was alluded to through the need for confidentiality, information integrity and availability. The CIA Triad defines information security as a set of measures to protect and ensure the availability, confidentiality and integrity of information. Section 7.4.2 of Chapter 7 identified confidentiality, information integrity and availability as factors that contributed to the trustworthiness of the Spoken Web aloe e-marketplace. This section will discuss security as a factor leading to trust, with respect to the concepts of confidentiality, availability and integrity.

8.2.3.1 Confidentiality

Confidentiality refers to the exposure of data to persons that are not privy to it (Elliot, 2010). Respondents from the two aloe processing plants and the healthcare manufacturer of aloe based products that were interviewed all emphasised the fear of revealing important product information to external parties as a trust related concern that they attributed to e-commerce. Thus, a breach of confidentiality resulting from the use of the e-marketplace would have compromised trust in the e-marketplace.

8.2.3.2 Information integrity

The significance of information integrity emerged from the fact that information was at the centre of the value that was provided by the e-marketplace. Information is highly recognised as significant commodity in organisations and the main purpose of Information Systems and Information Technology is to facilitate the communication, processing, storage and use of information to achieve organisational goals. The farmers depended on the system to provide information that was both accurate and complete. In order for the e-marketplace to create value for the farmers, the tapper's updates needed to detail how much aloe sap was available and where it was located. Flowerday and von Solms (2005) state that information integrity exists when there is integrity of data as well as integrity of systems. If the input from the tappers was inaccurate, the farmers would get false information. Similarly, if the tappers provided accurate data and the system processed and communicated it incorrectly

to the farmers, the reliability of the information disseminated would be compromised and the trustworthiness of the e-marketplace would be questioned. In this study, the integrity of the information did not concern security breaches but was rather focused on the quality of data entering the system and the data processing provided by the system. Nevertheless, this study is of the view that placing emphasis on the security of an e-marketplace compels developers to consider the integrity of data exchanged through the e-marketplace.

8.2.3.3 Availability

The fact that the Spoken Web aloe e-marketplace was not always available when the users tried to access it did not compromise the user's trust in the application for several reasons: Firstly, because it had been explained to the users beforehand that they would be times that the system would not be accessible. Secondly, unavailability of the e-marketplace was infrequent and usually for very short periods of time. Thirdly, the tappers sold their harvest in two week cycles, so they were seldom under pressure to update the system immediately. This study did, however, recognise that availability would be a concern in many other agricultural environments. Agricultural products are often based on commodity prices that are time sensitive, therefore, failure to make a sale today may result in lower price yields at a later stage. Furthermore, many agricultural products are perishable, and in many cases, farmers lack storage facilities to preserve them. The immediacy of e-marketplace transactions in agricultural sectors thus demands that emphasis is placed on ensuring the availability of the e-marketplace.

8.2.4 The requirements elicitation process

Westfall (2005) cites Brookes (1995) in stating that the hardest part of building a software system is knowing what to build. Requirements define what a technology must do to add value for its users (Westfall, 2005). According to Westfall (2005), functional requirements define the capabilities required of the technology, while non-functional requirements define the characteristics, properties or qualities that the software product must possess in order to achieve its objectives. As a technology's trustworthiness is dependent on it possessing the functionality to serve the needs of the intended users reliably, the trustworthiness of a technology cannot be attained if the requirements elicitation process is flawed.

An understanding of how to build trust in a specific e-marketplace technology requires an insight into the factors affecting the technology's usability in the specific context, a knowledge of the non-functional (technical) requirements that influence its reliability and competence, an awareness of issues relating to availability, confidentiality and information integrity, an understanding of the nature of exchanges amongst the stakeholders and also a realisation of how the e-marketplace will create value for its intended users. This study argues that the process of bringing to light such requirements is central to achieving trust in the technology in question. This section reflects on the effectiveness of the requirements elicitation activities which were carried out during the various phases of the project.

One of the fundamental sources of the problems encountered during the pilot group's use of the application was the gap between the researcher's understanding of the users' environment, and the reality of the users' context. It had emerged during the entry phase that the modelling exercise was not an effective way of gaining a conceptual view of how an e-marketplace could fit within the aloe value chain. In addition, issues affecting the way in which the users interacted with the technology were only identifiable when the users actually interacted with the technology. The intervention highlighted the need for guidelines to effectively elicit user requirements for situations in which the researchers possess a narrow understanding of the users' context and the users have limited experience with the proposed technology. The previous chapter revealed that the trustworthiness of the aloe e-marketplace had improved after the technology became more usable. The usable technology had successfully provided information that was complete and accurate and it was found to be useful to the users. In addition, the fact that the users had not experienced any negative outcomes through the use of the technology had contributed to the level of trust. An understanding of the specific aspects that make a technology capable, reliable, useful and safe within the specific context of use is critical to the development of trustworthy technology products. The process of determining the relevant requirements is central to acquiring such knowledge and must involve a clear understanding of the users' problem domain if a solution is to be found that assists the users in addressing pertinent problems. Moreover, the process must define the non-functional requirements that contribute to the users' belief in the technical competence of the technology and also influence the users' willingness to depend or rely on the technology.

This study proposes that the stages of the development of voice based e-marketplaces for rural communities should be considered in terms of four distinct stages, namely, initiation, analysis, design and implementation. The contributions of all four stages of development should lead to the development of an application that addresses the needs of its users, and functions effectively and reliably. Figure 7.16 presents an illustration of the role of the requirements elicitation process on achieving technology trust. This model is discussed further in an article published by the researcher and affixed as appendix ….The role of the requirements elicitation activities relating to the various stages of development are discussed in the sections that follow.

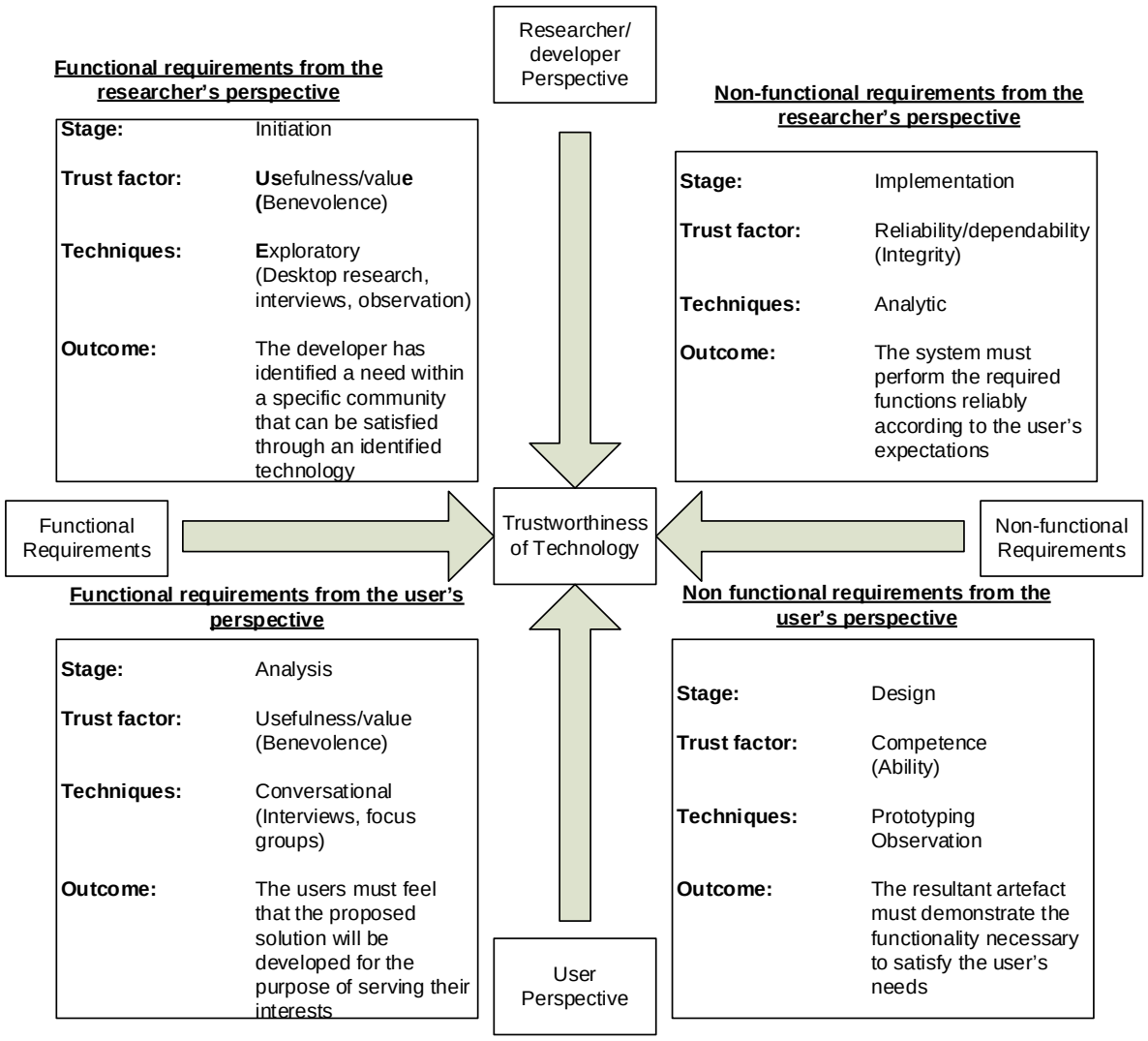


Figure 8.3 The effect of the requirements elicitation process on the trustworthiness of a technology.

8.2.4.1 The initiation stage

The initiation stage is triggered by an idea, proposition or hypothesis. This is the stage at which a researcher or development team identifies a problem and seeks to resolve it. Research targeted at rural communities is often driven by outsiders with a limited understanding of the problem setting. In order to familiarise themselves with the feasibility of an e-marketplace targeted at rural users, it is essential that the researchers conduct an independent exploratory investigation into the value they would be creating for the target user community. E-marketplaces expose the participants to material risks, and also demand an investment in terms of customising their business models to fit into a different paradigm of trade. The time invested by rural farmers to invest in the shift to e-commerce would come at the expense of the time they could have invested in providing for their families. This cost is often overlooked by researchers who believe that they are creating opportunities where none existed before.

By the end of the entry stage of the Action Research intervention the project team had been able to justify the feasibility and value of the project to the project funders. However, the difficulty in gaining buy-in from two of the aloe processing that were approached indicated that the value proposition had not been quite apparent on the part of the processing plants. Despite the fact that the value proposition was not clear, the project team still proceeded to develop an e-marketplace for a community that already had well established trade between its buyers and sellers. This approach was risky and could have resulted in a technology project that did not serve the real needs of the target community.

Heeks (2009) criticises ICT4D projects as being driven by the self-interest of researchers. Heeks (2009) argues that researchers pursue ICT4D initiatives because they present more interesting and novel experiences as compared to addressing corporate problems in the developed world using ICTs. Dearden (2012) cautions that interventionist ICT research (which focuses on efforts to co-develop ICT solutions with the target users in situ) may lead to more harm than good when the solutions are not sustainable and the expectations of the community are, inevitably, not met. The researcher has an ethical responsibility to approach a study with a justified conviction that the study may benefit the users and that the value added would be sustainable. This approach also serves the interests of the funders and demonstrates that the initiative is not driven purely by the researcher or development

team's self-interest. This, in turn, is likely to enhance trust in the long term between the user community and the researchers or developers. The initiation phase may make use of desktop research, document analysis and exploratory interviews to guide the enquirer as to the value proposition of the e-marketplace. At the end of the initiation phase the 'benevolence' of the technology should be evident in the value or usefulness that the researcher perceives.

8.2.4.2 The analysis stage

The requirements activities of development projects involve a diverse range of stakeholders that differ in terms of background, skill, knowledge and status (Coughlan & Macredie, 2002) One of the biggest challenges in gathering requirements is achieving a shared understanding of the problem between disparate stakeholders. Coughlan and Macredie (2003) add that an intense communicative effort is required to surpass the semantic gap that often exists between users and developers. In the deployment of the Spoken Web aloe-e-marketplace, the analysis stage served to develop a conceptual model upon which the e-marketplace would be founded. The researchers developed the conceptual model through telephonic interviews and through desktop research. The actual stakeholders from the aloe industry were then approached to assist with the validation and refinement of the model. The lessons learned from the Spoken Web aloe e-marketplace deployment were that the researchers should not have presented their view of the model to the stakeholders but, rather, they should have co-developed the e-marketplace model with the stakeholders. The researcher must assume the position of enquirer and recognise the stakeholders as domain experts when seeking to understand the problem domain. Evidence from the experience of obtaining functional requirements for the Spoken Web aloe e-marketplace revealed that semi-structured conversational techniques yielded richer insights into the context within which the aloe farmers and harvesters operated. The requirements modelling techniques that were employed, on the other hand, only elicited answers to the questions that the researcher's wanted to validate, but did not uncover new issues that were relevant to the deployment. During the initiation stage of e-marketplace development, conversational techniques should be employed to gain an understanding of the problem setting. Interviews should be semi structured and the interviewer should ask leading questions and probe concepts further as they emerge. The users may also be observed within their natural setting in order to obtain a realistic view of the context in which they function. Maiden and Rugg

(1996) argue that users are not the only source of knowledge in the requirements elicitation process. They state that knowledge already exists in domain objects such as physical artefacts and abstract entities. Maiden and Rugg (1996), Zhang (2007) and Seger (1994) opine that observational techniques are effective in eliciting knowledge that may exist as a result of the practices that are seldom expressed through verbal channels. The end of the analysis phase should result in the perception of 'benevolence' or usefulness of the technology from the perspective of the intended users

8.2.4.3 The design stage

During the design stage the development team needed to translate the e-marketplace model into a functioning system. Many of the non-functional requirements for the Spoken Web e-marketplace could not be identified in the absence of the user. For example, non-functional requirements that affected the usability of the application, such as the time allowed for users to enter their PINs and the inability for the speech technology to distinguish between certain terms, were issues that the technical configuration needed to accommodate. These requirements could not be identified without actually observing the challenges the users experienced when interacting with the technology. According to Warfel (2009), prototypes go beyond explaining or illustrating how the proposed application will function by offering the users the opportunity to experience the technology for themselves. Thus, prototypes allow inexperienced users to understand what the proposed application is capable of and, hence, confirm whether or not the analysts have understood the conceptual requirements. Prototyping and observation were, therefore, essential requirements elicitation methods for ensuring the functionality and reliability of the technology. Unlike the case of visual user interfaces, tasks in spoken dialogues are presented as sequential steps. A failure to proceed past a given step may result in the entire task being terminated before it reaches completion. The fact that the languages that are spoken predominantly in rural areas are not well resourced demands that the users are involved in identifying speech related issues during development in order to uncover the effect of errors in speech recognition as they emerge. The failure to recover from errors has a markedly adverse effect on a voice based platform as the technology becomes ineffective and its value or usefulness is not realised. Prototyping is a synthetic technique that may be applied to ensure that the abovementioned challenges are identified and resolved with the help of the users. This approach ensures that the voice technology is usable and, consequently, the intended tasks will be completed and the

technology perceived as competent. On completion of the design stage, both developers and users should be left with a sense that the proposed technology is technically capable of serving its purpose.

8.2.4.4 The implementation stage

The implementation stage takes place when the system had been fully developed and the users are allowed to utilise it independently. During this stage of the Spoken Web aloe e-marketplace deployment, the challenges experienced, such as the reported difficulties in user authentication, were successfully resolved with minimal input from the user. During the implementation stage, the developer's knowledge and expertise gains importance. During this stage the goal of the developers is to ensure that the e-marketplace is stable, secure and available when needed. In commercial software applications this is the stage at which software patches are usually introduced to respond to unexpected threats, vulnerabilities or flaws in the system. Analytic techniques, such as the monitoring of usage logs and the application of expert knowledge allowed the developers to identify and resolve the problems encountered effectively. Analytic requirements elicitation techniques thus contribute to the users' perception of the reliability and dependability of a technology.

8.2.5 Subjective norm

Subjective norm refers to the influence of important reference groups on the behavioural intention of an individual (Ajzen & Fishbein, 1977). A study of the factors influencing user trust in novel technologies, conducted by Li et al. (2008) found that subjective norm exercises the greatest influence on the intention to assume trusting behaviour towards new technologies. Li et al. (2008) state that subjective norm influences trust, both directly and indirectly. They argue that the direct influence of subjective norm on trust stems from the fact that users tend to believe that a technology is trustworthy when important referents hold the same belief. The indirect influence of subjective norm on trust, according to Li et al. (2008) is related to compliance. Users of a technology may demonstrate trusting behaviour, irrespective of their beliefs, because important referents endorse the behaviour. Subjective norm is of particular significance when considering that rural farmers have very limited bargaining power with buyers of their products. Thus, the decision they take regarding whether or not to engage in an e-marketplace would be affected by the opinions of buyers, agents or middlemen. The findings of this study, with respect to subjective norm,

were consistent with Li et al.'s (2008) explanation. The concept of subjective norm was apparent in the project through the level of influence the managing director had on the participation of the farmers and tappers in the project. As the sole buyer of aloe sap in the town, and a prominent social figure in the community, his endorsement of the e-marketplace was a source of credibility. His attitude towards the e-marketplace was likely to have influenced the beliefs that the aloe tappers and farmers had about the trustworthiness of the e-marketplace and their intentions to make use of the e-marketplace. This study is of the view that subjective norm has a greater influence on trusting beliefs and attitudes during initial trust formation than it does during the later stages of adoption. This is because, as stated by Li et al. (2008), in the initial trust stages, the trustors do not have sufficient information about the object of trust and, thus, must rely on alternative cues to make judgements about its trustworthiness.

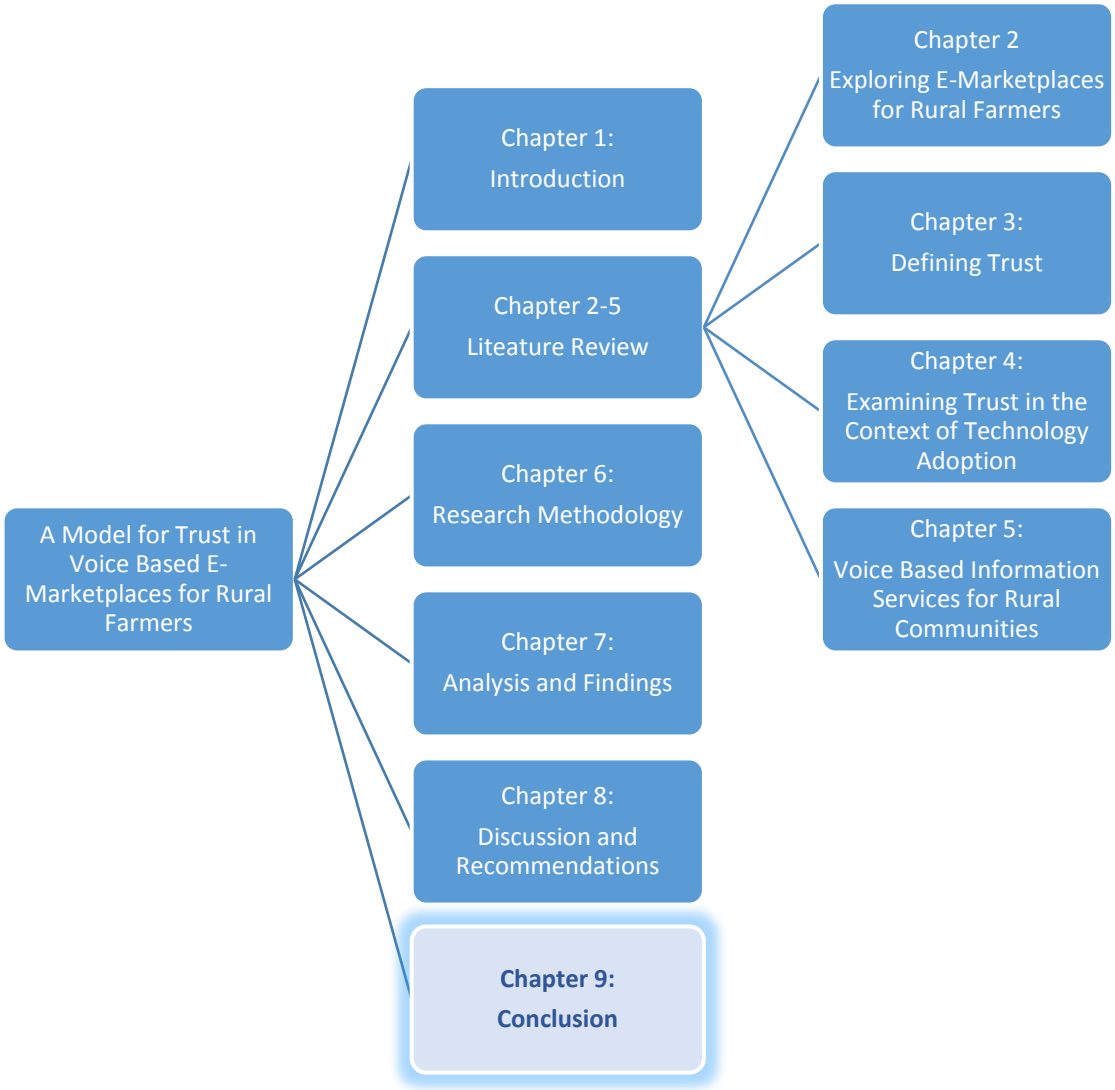
8.3 Conclusion

The process of understanding the users' context, determining their needs and producing a technology solution that effectively addresses the needs which have been identified is critical to building applications that the users deem to be trustworthy and which could be adopted to support the livelihoods of rural farmers. The requirements elicitation and management process plays a critical role in ensuring the trustworthiness of systems. Engaging a user focused approach to understanding the context in which the application will be used also contributes to trust in the given technology by giving the user a perception of the usefulness (benevolence) of the technology. Thereafter, through the use of prototypes, the user is given the opportunity to experience the technology and either recommend additional features or outline technical factors the analysts may have overlooked. In addition, prototyping allows analysts to make observations and identify issues with the technology that the user may not have been able to articulate. Effective prototyping also results in a perception of the technology's competence (ability) from the users' perspective. The observations made by the analyst and the application of his/her professional knowledge and experience to refine the technology based on such observations will enhance the users' perception of the application's reliability (integrity). The proposed model provides a guideline for analysts as regards eliciting and managing user requirements based on the project phases and the nature of understanding required. The model further compels the analysts to place the

emphasis on the views of the users when defining the problem space while highlighting the analysts' professional expertise when refining the technical requirements.

This chapter makes two key contributions to the study. Firstly, the chapter identifies the factors that influenced trust in the aloe e-marketplace. These factors were identified as usability, security, functionality, reliability and usefulness. Although these factors relate specifically to the aloe e-marketplace, the model can serve as a guideline for establishing trust in voice based e-marketplaces in other rural contexts. Secondly, this chapter presented a model for requirements elicitation that suggests the type of techniques to be applied at each stage of the development of a voice based e-marketplace. The model applies the factors of trustworthiness, as described by McKnight et al. (2011), as outcomes of the requirements elicitation activities involved in each stage.

Chapter 9: Conclusion



9.1 Introduction

This study sought to determine how trust in a voice based e-marketplace may be developed in the interests of improved adoption by a rural agricultural community. The literature review began by defining e-marketplaces and then provided an overview of the challenges impeding the adoption of e-marketplaces by rural communities. The limited access to internet enabling technologies, the high cost of technology, the lack of enabling policy, language and literacy barriers and the lack of context of many ICTs solutions aimed at underprivileged communities were all identified as barriers to e-marketplace adoption. Spoken Dialogue Systems were presented as a means of overcoming such challenges as the lack of literacy, accessibility and connectivity. Trust was identified as a barrier to the successful adoption and use of voice based e-marketplaces. A critical discussion of the nature of trust and the factors influencing trust in e-marketplaces was presented.

In order for rural users to trust and, consequently, to incorporate voice based e-marketplaces into their livelihoods, they need to be convinced that the e-marketplace will serve their best interests and that the systems will function effectively and reliably. These conditions reflect the factors of trustworthiness (ability, benevolence and integrity) as defined in Mayer, Davis and Schoorman's (1995) Integrative Model of Trust. In order to understand how trust may be developed in a rural voice based e-marketplace, the study adopted a pragmatic approach to answer the research question. An e-marketplace was collaboratively designed, developed and deployed. The interactions between the users and the technology were observed, thus leading the researcher to a model of trust in rural agricultural e-marketplaces and also to formulating recommendations for enhancing trust.

This study found that trust may be 'built' into technology artefacts through systematic enquiries into the users' needs, the technology's inherent constraints in supporting interaction with the users, and the risks to which the users may be exposed through the use of the technology. An effective requirements elicitation process was, therefore, found to be central to the attainment of trust. The study further found that the trustworthiness of a technology is a measure of its functionality, reliability and ability to serve the needs of its users. Usability and security were found to be core requirements for trust. Finally the study found that the users' impression of the functionality, reliability and ability of a technology to

fulfil their needs (which can be perceived as a user's perception of the trustworthiness of a technology) influences their intention to adopt the technology. This view is supported by the usage logs which depicted low usage when the technology was not functioning effectively, and improved usage when the shortcomings were addressed. Subjective norm was identified as a factor that further influenced the intention to adopt a technology, and the user's beliefs regarding the trustworthiness of a technology.

9.2 Research Contributions

This research study made several key contributions. Firstly, the study provided a critical discussion on the nature of trust. Various models were assessed and the factors shaping the decision of one party to trust another were presented. This discussion provided a rich theoretical foundation for researchers interested in the field of trust.

Secondly, the study presented a detailed overview of Spoken Dialogue Systems and their applicability to rural ICT implementations. Although there has been growing interest in this field of research, few studies have adequately documented or reported on the process of configuring Spoken Dialogue Systems when there is a lack of support from the telecommunications sectors.

Thirdly, the study contributed to the conceptualisation of trust with respect to technology artefacts. Several researchers have attempted to define trust in technology artefacts. However, all the studies cited in this regard have either addressed this subject theoretically or they have applied quantitative measures to explore the relationships between the concepts. On the other hand, this study provided a rich and detailed account of how the concepts manifested and influenced the trustworthiness of the resultant technology in a real setting.

Fourthly, the study made recommendations for the ICT4D domain that emerge from an area (trust) that has not been emphasised in the ICT4D research space. The lack of context (Avgerou, 2010) and the gaps between design and reality (Heeks, 2002) are widely cited criticisms of ICT implementations aimed at the underprivileged. In addition, the majority of trust research that has evaluated the relationship between trust in IT artefacts and technology adoption has fallen within the HCI domain. HCI focuses on satisfaction, utility,

efficiency, effectiveness and context of use. This is evident in the ISO 9241-11 (1998) which defines usability in terms of the degree to which tasks are completed with effectiveness, efficiency and satisfaction in the ***specific context of use.*** It is, thus, essential that ICT4D research take advantage of the progress that the HCI discipline has made into understanding the real reasons why technology implementations are not adopted by users in poorly understood contexts.

Fifth, the study defined security, usability, functionality, usefulness reliability and the effective execution of the requirements elicitation activities as the factors that contribute to the establishment of trust in a voice based e-marketplace. This study then proposed a model for developing trust in voice based e-marketplaces by rural farming communities.

Finally, this study contributed to existing knowledge in terms of methodological approaches to developing software for rural users. The requirements elicitation recommendations for enhancing trust in rural e-marketplaces should guide developers as to the goals and perspectives that should be prioritised at each stage of development to ensure that their practices result in a technology that serves the needs of its users, functions effectively and reliably and leads to end user satisfaction.

9.3 Summary of Findings

This study sought to answer the following research question:

How may trust in a voice based e-marketplaces be enhanced for improved adoption by a rural agricultural community?

The following questions were asked in order to arrive at an answer to the main research question

i. **How do the barriers facing ICT adoption by rural communities inhibit the ability of rural farming communities to reap the benefits of e-marketplaces?**
   This question was answered in Chapter 2 and described the significant role played by agriculture in the quest for socio-economic development in rural areas. E-

marketplaces were identified as a means of bridging the gap between the buyers of agricultural products and rural farmers. The study identified and responded to the following barriers to achieving the utility of e-marketplaces:

Lack of access to enabling technologies: In order to participate in a traditional e-marketplace, users require Internet connectivity as well as Internet enabled devices such as laptops and smartphones. However, these technologies are not widely found in rural areas and, thus, it is not possible to meet the basic requirements for engaging in an e-marketplace. Spoken Dialogue Systems respond to these barriers by making available information as well as data processing and transaction services through spoken dialogues.

Lack of context and limited understanding of the value proposition of ICTs: The proposed model addresses the issue of lack of context by suggesting an approach to software development in terms of which the prioritisation of the views of the user, particularly as regards framing the purpose of the technology, is entrenched within the software development activities. This approach is likely to lead to an appreciation of the value of the technology as the users would have played a role in shaping the purpose of such technology themselves. It is, thus, essential that he e-marketplace model is determined by the users, with the analysts playing a guiding role only.

Lack of skills: The approach advocated in the proposed model ensures usability by making sure that the issues constraining the users' ability to interact effectively with the system are addressed during the prototyping exercise. SDS use natural language and, thus, no special skills are required if they are to be effectively utilised.

Language and literacy barriers: SDSs address the challenges of language and literacy to a certain extent. In order to use a SDS users need not be literate while the dialogue may be presented to the user in any language. However, the challenge of speech recognition in under resourced languages limits the ability to interact effectively using speech exclusively as a mode of

interaction. Speech based interfaces should, therefore, be designed carefully with this limitation in mind and they should accommodate alternative paths to recovering from errors.

Lack of enabling policy: This is a critical barrier and is the barrier over which researchers have the least control. It is, thus, incumbent on researchers to continuously innovate to discover new ways in which to overcome this limitation. The Spoken Web is evidence that researchers can indeed overcome many of the barriers to ICT through innovation when the policy environment is not supportive. By enabling an alternative path to the digital inclusion of the underprivileged, the Spoken Web responds to the challenges of Internet connectivity and reach to rural populations that have yet to be addressed by public policy.

ii. What are the factors that determine trust in relationships?

The study conducted a critical review of trust theories and trust literature. The study concluded that trust is a judgement about a subject that reflects the trustor's perception of the subject's ability to fulfil what is expected of him/her, the extent to which the subject possesses values that are acceptable to the trustor, and the belief that the subject has the trustor's best interests at heart. Trust influences the intention to adopt a behaviour and exists when expectation, risk and reliance coincide. Trust is influenced by factors such as:

- The perceptions of risk surrounding the relationship or encounter
- The opinions of significant reference groups
- Experience arising from previous encounters
- The personal inclination of the trustor to have faith in another
- The personal inclination of the trustor to assume risky behaviour

iii. How is the trustworthiness of a technology artefact determined?

Based on the definition of trust the trustworthiness of technology was translated into the users' belief that the technology will serve their needs in an effective and reliable way. Trust influences a user's willingness to place reliance on a technology to fulfil an objective and is, thus, critical to the decision to adopt a technology.

iv. What factors influence the perceptions of the trustworthiness of Spoken Dialogue Systems in the context of rural users?

Problems with speech recognition and language understanding were found to be the main limitations of SDSs. In view of the fact that the languages used in rural areas are not well resourced in speech recognition modules, the error rate is often high, thus resulting in dialogues that are inefficient and ineffective. The inability to complete tasks when errors are encountered stifles the ability of the system to respond to the needs of the users and, thus, impedes trust.

Based on the above findings, the main research question was answered as follows:

It was found that trust in an e-marketplace may be enhanced by applying a methodical approach to a requirements elicitation that prioritises the role of the user as a source of the requirements in the early stages of development. This, in turn, will ensure that the e-marketplace model supports and enhances the interaction between stakeholders based both on their needs and on existing processes and structures. The researchers' perspective takes priority during the later stages both to provide support and to ensure that the e-marketplace continues to function in a secure and reliable way. This approach ensures that the system is developed to be useful and specifically to address the real needs of the user. Prioritising the views of the analysts during deployment leverages their technical expertise to assess and resolve problems. This, in turn, influences the capability of the technology to perform what is expected of it reliably and predictably. Users are likely to trust and adopt a technology if they feel that it is designed to serve them and it has the technical ability to do so.

The study also found that the trustworthiness of a technology is determined by the user's perception of its functionality, reliability and usefulness. Lack of usability impedes the technology's ability to function effectively and reliably, and thus the technology will not be perceived to be useful. Thus usability also affects the trustworthiness of a technology. Security provides measures to minimise the risks associated with compromised confidentiality, information integrity and availability. Freedom from risk ensures that trust can be sustained and is thus a factor contributing to trust in a voice based e-marketplace.

The study also found that subjective norm bears an influence on a user's beliefs about a technology and their intention to adopt it.

9.4 Evaluation of the research study

The credibility of quantitative research is determined by the measures of validity, objectivity, reliability and validity. Oates (2006) defines a set of equivalent criteria for evaluating qualitative research. These are summarised in Table 7.12:

Table 9.1 : Criteria for evaluating research (Oates, 2006)

Positivism	Interpretivism
Validity	Trustworthiness
Objectivity	Confirmability
Reliability	Dependability
Internal validity	Credibility
External validity	Transferability

The abovementioned criteria were applied to this study as follows:

1. *Trustworthiness*: The cyclical process defined by Susman and Evered (1978) and elaborated upon by Davison et al.(2004) has been specifically identified as a method with to achieve rigour in Action Research. For the purposes of this study this cyclical process was planned, executed and documented extensively to ensure the trustworthiness of the results.
2. *Confirmability*: As this study involved multiple stakeholders with various interests in the project, documentary evidence to support the data presented was available from multiple sources. These sources include the researchers from three institutions, the pilot group, the representatives of the aloe processing plant, the farmers and the tappers.
3. *Dependability*: The study provided a detailed account of the activities which were undertaken throughout the research journey. Information was obtained from multiple sources and the findings were supported by literature, theories and the empirical results.
4. *Credibility*: The study was submitted to four academic outlets and eventually published in two peer reviewed publications. Critical and constructive feedback

from rigorous peer reviews enabled the refinement of the research contribution.

5. *Transferability*: Although the study applies to the adoption of voice based e-marketplaces, the proposed model may, nevertheless, be applied to most situations in which a critical knowledge gap that adversely affects the technology adoption exists between the development team and the intended users.

In addition, this study has satisfied the criteria defined by Davison et al. (2004) for Canonical Action Research as presented in Table 9.2.

Table 9-1: Evaluation of research according to criteria for Action Research.

Criterion	Application
The researcher must ensure that the Action Research method is appropriate to both the research's audience and to the subject under investigation.	This study sought to determine how trust can be enhanced for the use of a technology within a unique and unexplored context of use. By applying an Action Research strategy, the results are more trustworthy as they are founded on real observations. Therefore the approach is appropriate for the subject under investigation. Additionally, The approach is appropriate to its audience because the pragmatic approach to seeking answers responds to the call for relevance in IS research.
The researcher must ensure that a formal agreement is maintained with the stakeholders	The informed consent agreement, as well as a formal letter requesting the participation of the aloe community clearly outlined the details of the project and the nature and extent of their involvement.

A theoretical problem statement that will result in the emergence of a new theory must be articulated from the onset.	The problem statement explained that the lack of trust in technology artefacts impedes the ability of rural communities to leverage the benefits of e-marketplaces. This study addressed the problem by presenting a model for trust in voice based e-marketplaces that was founded on the experience developing and implementing a voice based e-marketplace for rural users.
Data collection methods appropriate to the subject under investigation must be applied.	The data collection methods that were applied were critically assessed in chapter 8, and the majority of them were found to be appropriate to the subject under investigation. The researcher was adaptive in her approach to data collection and modified her data collection methods to suit the circumstances. This approach resulted in a requirements elicitation model which is presented in Chapter 8.
The researchers must avoid dominating the planning and action stages	The researchers involved dominated the entry stage of the project as it was at this stage that they needed to ascertain the feasibility of the study and provide motivation for the funding that was sought. Nevertheless, the entry stage was still shaped by the opinions of the participants, and resulted in the revision of the conceptual model that had been developed in the absence of the participants. The subsequent stages

	were shaped significantly by the inputs of the aloe community.
Iterations to refine the solution must be used.	The artefact that was developed went through clear cycles of refinement based on the feedback and interactions of the users.
The researcher must generalise according to the context of the study.	The findings have been derived according to the context of the study, and hence the profile of the aloe harvesting community is at the core of the model that was developed.

9.5 Limitations of the research study

E-marketplaces are characterised by risks that arise from the use of an open platform, the exchange of personal information and the anonymity of the transactions. This research study was undertaken in an e-marketplace in which the risks typically associated with e-marketplace interactions were not prevalent. Thus, the study focused only on issues pertaining to the design and deployment of an e-marketplace which emphasised trust with respect to the e-marketplace effectiveness in achieving its goal and the value it created for its users. Although this focus was the goal of the research, it must, however, be noted that it is not possible to achieve trust fully without addressing all aspects of risk. A negative encounter that emerges from a different facet of risk that was not addressed by the model will, ultimately, affect the users' perception of the trustworthiness of the system and will influence their decision to continue participating in an e-marketplace.

This study had aimed at developing an e-marketplace that facilitated trade amongst multiple buyers and sellers from different organisations in different localities. Unfortunately, the researchers were unable to solicit participation from multiple aloe communities. Thus the study was limited to the case of a single aloe community with a pilot group of only twelve participants.

9.6 Implications of findings on existing theory

The findings of this study are consistent with the propositions of the Technology Acceptance Model (TAM) (Davis, 1989) as well as the extended version of TAM (Venkatesh and Davis, 1996). TAM posits that the perceived ease of use and the perceived usefulness influence the behavioural intention to adopt a technology. Additionally, TAM recognises the influence of the perceived ease of use on the usefulness of the technology. This was evident in the study as the participants only began to experience the usefulness of the technology when the technology became usable. Furthermore, the extended version of TAM acknowledges the influence of subjective norm on the intention to adopt a technology. This too was made apparent in the project by the influence of the farmers and the aloe processing plant on the initial decision of the aloe tappers to participate in the e-marketplace. Based on the extended version of TAM, a voice based e-marketplace that is easy to use, adds value for its intended users, and is endorsed by important stakeholders should be successful. However the limitations of TAM is that it depicts adoption decisions as though they are once off choices. As a result, TAM fails to account for the sustainability challenges that pervade ICT4D implementations. Further to that, Featherman and Pavlou (2003) argue that consumers evaluate risk either consciously or subconsciously before making adoption decisions. They cite time loss, financial risk, the cost of switching to, setting up or maintaining the new service and privacy risk amongst the factors that are considered when making adoption decisions. All decisions involve a level of rationality where every choice that is made comes at a cost. Therefore, risk cannot be separated from adoption decision. Adopters must believe that the decision to adopt the technology will result in positive outcomes and they should be willing to incur the risk of adoption. For this reason, understanding the role of trust in the decision to adopt a technology is critical to determining how best adoption can be enhanced.

9.7 Directions for future research

At the end of the intervention some questions remained unanswered. The following recommendations for future research are therefore suggested:

9.7.1 Supporting the searching and matching of buyers and sellers

The Spoken Web aloe e-marketplace was implemented within a closed user group. The users had already established close relationships with each other and they had engaged in business

transactions independently of the e-marketplace. Many harvesters in the pilot group worked as labourers for the farmers although the farmers were also buyers of their aloe sap. In addition, the sap sold by the harvesters is derived from the land of the farmers. Thus, the loyalty between buyers and sellers was institutionalised and did not support a competitive ecosystem of supply and demand. An e-marketplace provides a weak value proposition in this regard and this may, in turn, explain the low usage after the pilot.

However, a subsequent exploratory study in the Eastern Cape found that the aloe harvesters in the Eastern Cape do not have the same institutional relationships with their buyers. They harvest independently and are not compelled to sell to any particular buyer. In addition, it would appear that some of the harvesters are disgruntled by the prices they are receiving from the buyers. Thus, their geographic isolation may motivate participation in an aloe e-marketplace. One of the aloe processing plants in the Eastern Cape (a small family owned operation) also indicated that the plant was struggling to succeed in the market for international buyers. This processing plant did not have a website and was not listed in any telephone directory. The researcher had found the processing plant simply because the products are listed on Alibaba, a public business to business (B2B) e-marketplace. It is, therefore, clear that there is more scope and value for an e-marketplace in the Eastern Cape aloe community than there is in the Western Cape.

9.7.2 The exploration of other information services for rural agricultural communities

Studies indicate that literacy rates around the world are improving. In addition, as competition in the market for mobile phone users and data subscribers increases, Internet connectivity is becoming cheaper and more accessible than ever before (Isabirye, Flowerday & von Solms, 2013). This, in turn, is creating new opportunities for text based services. However, it is essential that researchers are both critical and objective when choosing which modality to apply to best address the needs of the users. Future work in developing trustworthy applications should consider the influence of the choice of the modality on trust.

9.7.3 The evaluation of trust with respect to information security in the context of rural communities

This study focused on the intangible risks associated with e-marketplace adoption. However this study maintained that security is an important aspect of trust, and thus, should not be

overlooked. Little knowledge exists regarding trust with respect to communities with limited experience with ICTs and a narrow understanding of the threats associated with e-commerce. Further research in this domain is necessary.

9.8 Conclusion

Rural ICT users function within unique contexts and with unique constraints and needs from which researchers and analysts are often far removed. As a result, the technologies presented to them often do not address their real needs while, at times, these technologies do not function either adequately or reliably. This study proposed a model for enhancing trust by explaining that the manner in which analysts, developers and researchers determine the needs of the users influences the trustworthiness of a technology. In addition, the model identified security, usability, usefulness, reliability and functionality as attributes of a trustworthy technology. The model proposed that, if a technology demonstrates the aforementioned attributes it is likely to be seen as trustworthy. The users' adoption of the technology will be influenced by their perception of its trustworthiness as well as the opinions of reference groups that the users consider to be important.

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9 Appendices

Appendix A: Original conceptual model of aloe e-marketplace.

Appendix B: Journal publication resulting from this study.

Appendix C: Conference proceeding resulting from this study.

Appendix A: Original Concetual Model for e-Marketplace

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1. Scenarios for Aloe harvesters

Scenario 1.1:

User represents an aloe harvesting cooperative, and would like to search for buyers of unrefined aloe ferox.

System: Welcome to the Aloe Ferox Spoken Web e-marketplace. If you represent an aloe harvesting cooperative, press 1. If you represent an aloe processing plant, press 2. If you represent a manufacturer of aloe based products, press 3.

Response: *User presses 1(aloe harvesting cooperative)*

System authenticates user

System: To search for buyers of unprocessed aloe sap, press 1.

To update the price and quantity of your unprocessed aloe sap stock, press 2

To leave a message for a specific buyer, press 3.

To provide feedback from a past transaction, press 4.

To listen to messages from buyers, press 5.

To repeat these options press 6

To return to the main menu press *

Response: User presses 1 to search for buyers of unprocessed aloe sap

System: To have a list of buyers sent to you, press 1

To listen to a list of buyers, press 2

Response: User presses 1 to have the list sent to them

Outcome: A list of buyer enquiries is sent via text, email or fax to the user depending on the contact details on record.

Variations:

a) *Aloe harvesting cooperative searching for buyers can listen to the list of buyers instead of having it sent to them*
b) *User could be an aloe processing plant seeking buyers of processed aloe bitters*
c) *User could be an aloe processing plant seeking sellers of unprocessed aloe sap*
d) *User could be a manufacturer of aloe based products seeking sellers of processed aloe bitters*

Scenario 1.2:

User represents an aloe harvesting cooperative, and would like to update the price and quantity of stock.

System: Welcome to the Aloe Ferox Spoken Web e-marketplace. If you represent an aloe harvesting cooperative, press 1. If you represent an aloe processing plant, press 2. If you represent a manufacturer of aloe based products, press 3.

Response: *User presses 1 (aloe harvesting cooperative)*

System authenticates user

System: To search for buyers of unprocessed aloe sap, press 1.

To update the price and quantity of your unprocessed aloe sap stock, press 2

To leave a message for a specific buyer, press 3.

To provide feedback from a past transaction, press 4.

To listen to messages from buyers, press 5.

To repeat these options press 6

To return to the main menu press *

To exit, hang up

Response: User presses 2 (Update the price and quantity of stock)

System: Please state the quantity available (in litres)

Response*:* User indicates the quantity available

System: Please indicate the price per litre

Response: User indicates the price per litre

System: Thank you; your product details have been updated. To return to the main menu, press *, to exit, please hang up.

Scenario 1.3:

User represents an aloe harvesting cooperative, and would like to leave a message for a specific buyer

System: Welcome to the Aloe Ferox Spoken Web e-marketplace. If you represent an aloe harvesting cooperative, press 1. If you represent an aloe processing plant, press 2. If you represent a manufacturer of aloe based products, press 3.

Response: *User presses 1 (aloe harvesting cooperative)*

System authenticates user

System: To search for buyers of unprocessed aloe sap, press 1.

To update the price and quantity of your unprocessed aloe sap stock, press 2

To leave a message for a specific buyer, press 3.

To provide feedback from a past transaction, press 4.

To listen to messages from buyers, press 5.

To repeat these options press 6

To return to the main menu press *

To exit, hang up

Response: User presses 3 (leaves a message for a specific buyer)

System: *[Requests identifier for buyer]*

Response: *[provides identifier for buyer]*

System*:* Thank you, you have chosen to leave a message for *[Identified buyer].* To continue with the message for this buyer leave your message after the beep, then press # to save the message or * to cancel the message

Response: User leaves a message for *[Identified buyer]*

System: Thank you, your message has been sent to *[Identified buyer].* To return to the main menu, press *, to exit, please hang up.

Variations:

a) *User could be an aloe processing plant leaving a message for a harvester or an aloe processing plant*
b) *User could be a manufacturer of aloe based products, leaving a message for an aloe processing plant*

Scenario 1.4:

User represents an aloe harvesting cooperative, and would like to provide feedback from a past transaction.

System: Welcome to the Aloe Ferox Spoken Web e-marketplace. If you represent an aloe harvesting cooperative, press 1. If you represent an aloe processing plant, press 2. If you represent a manufacturer of aloe based products, press 3.

Response: *User presses 1 (aloe harvesting cooperative)*

System authenticates user

System: To search for buyers of unprocessed aloe sap, press 1.

To update the price and quantity of your unprocessed aloe sap stock, press 2

To leave a message for a specific buyer, press 3.

To provide feedback from a past transaction, press 4.

To listen to messages from buyers, press 5.

To repeat these options press 6

To return to the main menu press *

To exit, hang up

Response: User presses 4 (provide feedback from past transaction)

System: *[Requests identifier for buyer]*

Response: *[provides identifier for buyer]*

System*:* Thank you, you have chosen to provide a review on a transaction with *[Identified buyer].* To continue with the review for this buyer wait for the beep and then give your comments on the transaction. To save your review press # or to cancel, press *

Response: User comments on transaction, presses # to save

System: Thank you for providing feedback on your transaction. To return to the main menu, press *, to exit hang up.

Variations:

a) *All stakeholders (aloe processing plant, manufacturers and harvesters) should follow the same process to review past transactions*

<u>Scenario 1.5</u>

User represents an aloe harvesting cooperative, and would like to listen to messages from buyers.

System: Welcome to the Aloe Ferox Spoken Web e-marketplace. If you represent an aloe harvesting cooperative, press 1. If you represent an aloe processing plant, press 2. If you represent a manufacturer of aloe based products, press 3.

Response: *User presses 1 (aloe harvesting cooperative)*

System authenticates user

System: To search for buyers of unprocessed aloe sap, press 1.

To update the price and quantity of your unprocessed aloe sap stock, press 2

To leave a message for a specific buyer, press 3.

To provide feedback from a past transaction, press 4.

To listen to messages from buyers, press 5.

To repeat these options press 6

To return to the main menu press *

To exit, hang up

Response: User presses 5 (Listen to messages from buyers)

System: *[Lists unheard messages from buyers] Thank you. to return to the main menu press *, to exit hang up*

Variations:

a) *All stakeholders should be able to listen to messages from one another (harvesters, processing plants, manufacturers)*

2. Scenarios for aloe processing plants

Scenario 2.1:

See variations to scenario 1.1

Scenario 2.2:

See variations to scenario 1.1

Scenario 2.3:

User represents an aloe processing plant, and would like to update information on their products

System: Welcome to the Aloe Ferox Spoken Web e-marketplace. If you represent an aloe harvesting cooperative, press 1. If you represent an aloe processing plant, press 2. If you represent a manufacturer of aloe based products, press 3.

Response: *User presses 2 (processing plant)*

System authenticates user

System: To search for sellers of processed aloe bitters, press 1.

To search for buyers of processed aloe bitters, press 2.

To update information on your products, press 3.

To leave a message for a specific buyer, press 4.

To leave a message for a harvester, press 5.

To provide feedback from a past transaction, press 6.

To listen to messages from buyers, press 7.

To repeat these options press 8

To return to the main menu press *

To exit, hang up

Response: User presses 3 (update product information)

System: please indicate the product you would like to update

Response: [*User chooses a product- aloe lumps/crystals/gel/powder]*

System*:* Please indicate the property you would like to update

Response: User states the property to be changed (aloin content, moisture content, preservatives, solids, odour, colour, taste, appearance, consistency, packaging, price/kg, minimum order, quantity on hand)

System: Thank you, you have chosen to update the *[Chosen property].* Please provide the updated value of the *[Chosen property], and then press # to save or *to cancel*

Response: User indicates the new value, saves changes

System: Thank you for updating the property to update a new property press 1, to return to the main menu press * or to exit, hang up.

Variations:

a) *Manufacturer can list their product requirements using the same method-choosing a product; indicating a property and associated value*

Scenario 2.4

See variations to scenario 1.3

Scenario 2.5

See variations to scenario 1.4

Scenario 2.6

See variations to scenario 1.5

3. Scenarios for manufacturers of aloe based products

Scenario 3.1

See variations of scenario 1.1

Scenario 3.2

See variations of scenario 1.3

Scenario 3.3

See variations of scenario 1.4

Scenario 3.4

See variations of scenario 1.5

Scenario 3.5

See variations to 2.3

4. Dictionary of Terms

Aloe Ferox: A medicinal plant that is indigenous to the Eastern Cape and parts of the Western Cape regions of South Africa. It is used in the production of a variety of cosmetic and wellness products

Cooperatives: Aloe harvesters usually work within a body known as a cooperative. Harvests from Individuals are sold by the collective, and profits are distributed accordingly.

Harvesters/Tappers: These are typically rural community members that gather the leaves of the aloe plant and extract the sap for resale to aloe processing plants

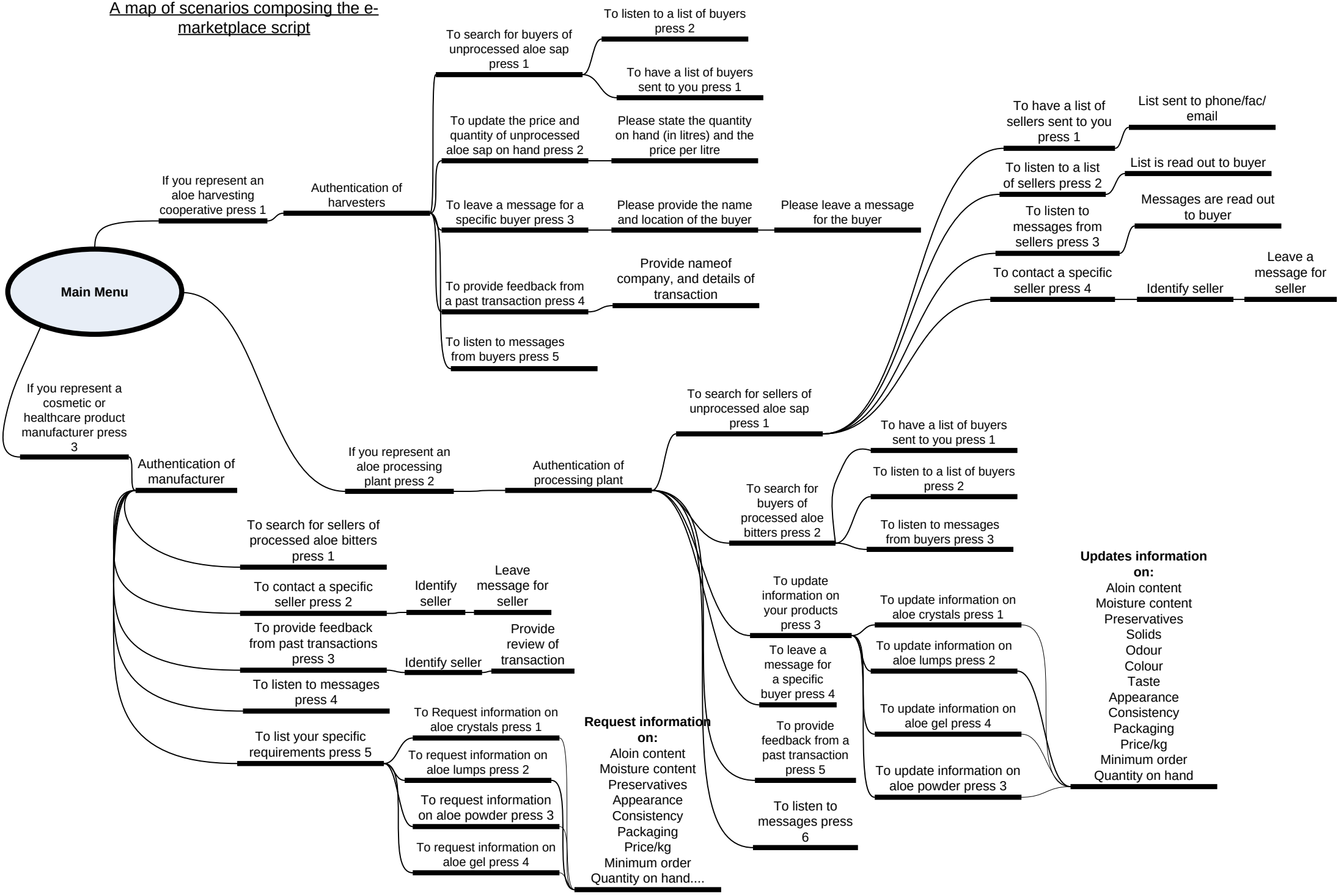
Manufacturers: These are cosmetic and healthcare companies that utilise aloe bitters as raw materials in the preparation of their products

Processed Aloe bitters: The product of the processing of aloe sap to produce raw materials for a range of cosmetic and healthcare products

Processing plants: These are companies that process aloe sap into crystal, gel, solid and powder form for resale to cosmetic and healthcare manufacturers

Unprocessed Aloe Sap: The gel like substance that is extracted from the leaves of an aloe plant

A map of scenarios composing the e-marketplace script



Appendix B: Journal publication resulting from this study

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BUILDING TECHNOLOGY TRUST IN A RURAL AGRICULTURAL E-MARKETPLACE: A USER REQUIREMENTS PERSPECTIVE

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ABSTRACT
Technologies that are widely perceived to bring value to users in the context of developed countries are not always readily adopted in the developed world. This study uses theories from trust literature to propose that, for users to adopt technology to enhance their effectiveness in terms of their livelihoods, they must be convinced that the technology will work in their best interests and will perform its intended purpose reliably or predictably. The user's experience with the technology must result in positive expectations with respect to its functionality, usefulness and reliability. Moreover, the manner in which the technology is conceptualised, designed and implemented will have a strong bearing on the user's perception of its trustworthiness. Rural users with limited experience of information and communication technologies (ICTs) are particularly sceptical about the role technology can play in their income-generating activities. Therefore, if technology is to be adopted successfully by its intended users, it is critical that an approach to software development should be used that enhances users' perceptions of its trustworthiness. This paper presents a model for the development of trustworthy applications for rural users with limited experience with ICTs. The model is based on an action research project involving the deployment of a voice-driven e-marketplace targeted at a rural aloe farming community. The model proposes that the manner in which requirements are defined and managed will influence the extent to which the users can trust the technology.

KEYWORDS: technology trust, user requirements, e-marketplace, adoption, spoken dialogue systems, mobile commerce, rural areas

1. INTRODUCTION

Information and communication technologies (ICTs) have been widely researched as a mechanism for improving the socio economic status of disadvantaged rural communities. To this end, numerous technology-based initiatives have been introduced to disadvantaged rural communities to support them in various aspects of their day-to-day lives. Unfortunately, even when the proposed benefit of a given technology is distinctly evident from the perspective of its initiators, the adoption by its target users is often uncertain. This has been the case with e-commerce, particularly in the agricultural sectors of developing countries, where despite the numerous benefits it proposes as a means of overcoming the challenges of agricultural producers, the uptake has been low. This study was undertaken to assess the extent to which rural users with limited experience with ICTs will trust and consequently adopt an e-marketplace to support their agricultural activities. In this study, a voice-based e-marketplace was developed and deployed in a rural South African aloe farming community. A canonical

action research approach to the development of the e-marketplace was engaged. On conclusion of the development activities, the community was allowed to utilise the service over a period of eight weeks. Thereafter, interviews were held with the participants to understand their perceptions of the technology. This paper presents a description of the project that was undertaken, provides an evaluation of the findings and proposes a user requirements focused model for the introduction, development and deployment of technologies for rural communities. The paper approaches the research problem by defining trust in the context of rural technology implementations, examining the factors that influence rural users' perceptions of the trustworthiness of a technology and, finally, proposing a model to guide the development and deployment of new technologies for rural users.

2. BACKGROUND OF THE PROBLEM

Agriculture plays a critical role in addressing the challenges associated with poverty, particularly in developing countries where a large proportion of the poor live in rural areas (IFAD, 2008; Mgalama, 2014). Wilfrid and Edwige (2004) support this view and add that agriculture plays a critical role in socio-economic development in developing countries through its contribution to employment creation, income generation and Gross Domestic Product (GDP). IFAD (2008) argues that the agro industry, which is not only concerned with agriculture, but extends to cover the distribution and trading activities surrounding agricultural commodities, is estimated to account for more than a third of the GDP in Indonesia, Chile, Brazil and Thailand, between 20 and 25% in Sub-Saharan countries and 50% of developing countries' GDP collectively. Wilfrid and Edwige (2004) state that, throughout history, advancements in agricultural technology have been directly linked to the advancement of agriculture and the establishment of rigorous economies.

Technology initiatives on different levels of the agricultural sector value chain such as e-marketplaces can make a significant contribution to the economic development of developing countries. Given the fact that the agricultural market is large, with multiple suppliers, distributors and dealers at various levels of the value chain and the wide geographic dispersion of agricultural stakeholders, e-marketplaces offer vast opportunities for the agricultural sectors due to the integration of the various actors. According to Humphrey et al. (2003), e-commerce offers a host of advantages to firms in developing countries because the transaction costs associated with e-commerce are less sensitive to distance than with traditional marketing channels and the market channels are simplified and direct. Additionally, e-commerce affords firms in developing countries the ability to retain a larger proportion of the final consumer price. Despite the numerous benefits offered by e-commerce, the agricultural sectors of developing countries have not derived the same competitive advantage from e-commerce as other sectors and have instead demonstrated comparatively low adoption rates (Canavaria et al., 2008; Mansell and Pare, 2005).

In light of the potential value that e-commerce could bring to users in developing countries, this study seeks to understand how innovations that serve to bring about development for their target users should be designed to enhance the likelihood of adoption by their target user groups. Lack of context is a frequently cited challenge to technology adoption by users in developing countries. Avgerou (2010) explains that the developed world's context, from which most ICT trends and business models originate, is widely viewed in ICTD research as different from the developing world's context in which innovations are attempted to be applied. As a result two prevalent orientations addressing the issue of context in ICT innovation are defined by Avgerou (2010); the universalistic and the situated orientations. The universalistic orientation is founded on techno-economic reasoning and rationality and assumes that adoption will be based on the value that the innovations present. This has not been evident in e-commerce research, as numerous studies have

identified the opportunities that e-commerce technologies present, yet the adoption of e-commerce technologies remains low in developing countries. In addition, cases where e-commerce has shown outstanding success in some developing countries, as in the case of M-Pesa, the mobile banking technology in Kenya, have not been easily replicated in other developing countries in which they have been launched (Kamau, 2013).

The situated orientation, in contrast to the universalistic orientation, emphasises the formation of meaning and practice within the immediate setting in which the innovating organisation exists. This suggests that the unique conditions, under which an innovation is developed, will influence its impact. The situated view assumes therefore, that developing countries will not necessarily achieve the same success with innovations that were developed outside of their context. This orientation emphasises that innovations result in rearrangements in organisations or societies and thus focuses on the process of innovation within the context of its application, taking into account the various emotional, cognitive and political influences that underpin the innovation processes.

This study aligns itself with the situated orientation and thus identifies the requirements elicitation process as central to enhancing the fit between the technology, the users and their environment. Requirements elicitation is defined in Christel and Kang (1992) as a means of addressing the constraints of a community by identifying their needs and bridging disparities amongst stakeholders. It is centred on communication and the awareness of both social and technical issues related to an innovation. The requirements elicitation process has been well established in software development environments where the targeted end users are familiar and well understood. However, little guidance exists to support the process when the technology practitioners have a very limited knowledge and understanding of the end users and the context in which they operate. Thus, the needs oriented goal of the elicitation process makes it central to addressing technology adoption challenges from a situated perspective. In addition, this study views the trust that the prospective users have in an innovation as an indicator of the manner in which they will respond to the innovation. In the section that follows, the relationship between trust and the adoption of an innovation will be explored.

3. THE RELATIONSHIP BETWEEN TRUST AND E-MARKETPLACE ADOPTION

Trust forms one of the most critical pre-conditions for successful e-commerce. Pavlou (2003) recognises the uncertainty raised by the following prevalent conditions in an e-commerce situation:

- The extensive dependence on technology to commit transactions
- The distant and impersonal nature of the web environment
- The uncertainty associated with the inherent openness of the Internet

This suggests that in addition to information security and privacy risks that face e-commerce users, they are exposed to the chance of non-fulfilment of the procurement of products or services and the additional perceived burden related to the adoption and use of the e-commerce technology. This study focuses on the dimension of trust that relates to the direct interaction between the users and the technology. The sections that follow will describe how users make technology adoption decisions based on their perceptions of the technologies' trustworthiness. Such knowledge is crucial for research in the Information and Communication Technologies and Development (ICT4D) domain, as the failure to adopt any technology by users in developing countries precludes the opportunities that such technologies can afford them. Therefore, although this study uses the case of an e-marketplace implementation as an example, the model produced for the development of trustworthy applications can be extended beyond the confines of e-marketplaces, to include

any technology developed within the context of users lacking experience and knowledge in the use of ICTs.

3.1 Perceived Risk, Trust and Technology Adoption

The need for trust implies the perception of risk. Many of the prominent works evaluating the relationship between technology trust and adoption (Gefen et al., 2003; Pavlou, 2003) are focused on the relationship between trust and the adoption of online applications or services. However, few authors have recognised that trust in technology has an influence on the adoption of technologies, even in the absence of online risk perceptions. Online risks often have financial implications and as a result are the subject of greater scrutiny in trust literature. This paper is of the view that any circumstance where technology presents a user with the risk of loss is likely to deter the user from accepting or adopting the technology. For many users, the time and resources they must engage in learning to use the new technology may be perceived as a loss in itself. Various studies (Featherman and Pavlou, 2003; Lu et al., 2006; Azmi and Kamarulzaman, 2010; Lim, 2003) have identified time loss as a risk that users perceive when making adoption decisions. Kusma et al. (2007) in Azzam (2013) further recognise the perceived performance risk (relating to the technology's ability to deliver what is expected of it) as a risk that users consider when deciding whether to engage with a technology. Additionally, there is a social risk associated with the adoption of technologies, which relates to the manner in which the opinions of the adopter's reference groups affect the adopter as a result of their use of the technology (Jacoby and Kaplan, 1972; Cho et al., 2006; Melanthiou, 2006, all cited in Azzam (2013). Other categories of risk include psychosocial risks, information risks and opportunity cost risks (Azzam, 2013). Rural communities do not directly invest heavy financial resources to participate in ICT4D projects and the risks they are exposed to are not typically financial. Therefore the time they invest, the effect the project has on their social status and their resultant psychological state are more relevant aspects to consider when evaluating the trustworthiness of new technologies.

3.2 Trust in Technology

Mayer et al. (1995) maintain that three characteristics determine one's trustworthiness: ability, benevolence and integrity. Ability refers to one's capacity in terms of the skills, competencies and resources that enable one to fulfil an intended task or obligation. Benevolence, on the other hand, refers to the extent to which the trustee is believed to have good intentions towards the trustor. Finally, integrity relates to the degree of congruence between the trustee's actions and the principles by which they define themselves and implies that the trustee will subscribe to principles that are acceptable to the trustor. This paper applies the factors of trustworthiness, as defined by Mayer et al. (1995), to define trust in technology; firstly, because the factors appear widely in trust-related literature (Mayer et al., 1995) and, secondly, because they form the foundation upon which much of the literature surrounding technology trust is formed.

Li et al. (2009) caution against transferring interpersonal trust constructs such as benevolence and integrity when defining technology trust and instead describe a technology's trustworthiness to be dependent on its ability to fulfil an intended task (capability) and perform without errors, delays, conflicts or unexpected results (reliability). They therefore describe technology trust as a function of beliefs regarding the capability and reliability of technology. This is consistent with McKnight's (1995) definition, which describes technology trust as a person's belief regarding the trustworthiness of a technology in performing a task. McKnight et al. (2011) distinguish between trust in people and trust in technology in terms of ability, benevolence and integrity, as well as the contextual conditions and the objects of dependence. They further differentiate trust in technology from

interpersonal trust by defining trust in each context in terms of the factors of trustworthiness. This paper partly supports McKnight et al.'s (2011) view of the distinction between interpersonal and technology trust. However, this paper is also of the view that McKnight et al. (2011) underplay the meaning of benevolence with respect to technology trust. Benevolence is defined in the *Oxford dictionary* as "the quality of being well meaning or kind" and in the *Merriam Webster dictionary*, as "a disposition to do good". Definitions of benevolence cited in Mayer et al. (1995) allude to the association between benevolence and altruism or selflessness. This paper is therefore of the view that McKnight's perspective of benevolence in the context of technology trust should extend beyond simple help functionality, to perceiving the benevolence of a technology as its purpose in serving the needs of its users. This paper therefore adapts McKnight et al.'s distinction of trust in technology from interpersonal trust in Table 1 below:

Table 1: Adaptation of McKnight et al.'s (2011) distinction between trust in technology and trust in people

		Trust in people	Trust in technology
Contextual condition		Existence of risk or uncertainty, dependence on other people for achievement of outcomes	Existence of risk or uncertainty, dependence on technology for achievement of outcomes
Object of dependence		People (moral agency, volitional and non-volitional factors)	Technology (amoral and non-volitional factors only)
Nature of trustor's expectations:	Ability	The person possesses the competence to deliver the required outcome.	The technology possesses the needed functionality to achieve the required outcome.
	Benevolence	The person demonstrates the will and volition to act caringly and considerately towards the trustor.	***The technology is designed to serve the needs of the users.***
	Integrity	The person consistently acts in a manner that is acceptable to the trustor.	The technology functions reliably and predictably without failing.

In order for rural communities with limited knowledge and experience with the use of information technology to recognise a technology's benevolence, despite their perceptions of the associated risks, the technology must demonstrate its value by addressing a specific need or improving some aspect of their livelihoods. The technology's benevolence must further be reinforced by a demonstrated ability to fulfil the required functions consistently and reliably. This paper will proceed to describe a project to deploy an e-marketplace to support the commercial activities of buyers and sellers of aloe harvests undertaken in a rural South African town called Albertinia. Steps undertaken by the researchers to establish the trust and adoption of the e-marketplace by the rural community will be described with respect to the manner in which the factors of benevolence, ability and integrity have been addressed.

4. METHODOLOGY

The study sought to answer the following research question: How can the trust and consequent adoption of an e-marketplace be cultivated amongst a user group with limited ICT knowledge and experience in order to support their current trading activities?

To address the research question, an action research approach was selected to assess the extent to which rural users could trust an e-marketplace and consequently adopt it in their livelihoods. Action Research was first described by Lewin (1946) as a series of investigations into the conditions and consequences of various forms of social action. It gained prominence as a method of enquiry in the Information Systems discipline because of its response to the prevalent need for Information Systems research to demonstrate more relevance to Information Systems practice (Grant, 2012; Baskerville and Myers, 2004; Baskerville and Wood-Harper, 1996).

This study assumed the form of canonical action research as defined by Davison et al. (2004). Canonical action research is founded on five core principles. The first underlying principle is that there should be mutual agreement between the research team and the client regarding the objectives and anticipated outcomes. The second principle of canonical action research specifies that a cyclical process comprising of stages of problem diagnosis, planning, action, observation and reflection are undertaken. Each phase must be suitably documented to ensure that the results are trustworthy. The third principle of canonical action research suggests that the research is guided by theory, while the fourth principle states that the intervention should result in changes that are directly related to the problems that were initially diagnosed. The fifth principle is that the intervention must result in learning through reflection. Such learning must reflect the implications of the research to the community involved, to similar research domains and to theories underlying the research (Davison et al., 2004).

In the case of this study, the problem diagnosis took place in the form of desktop research, telephonic interviews and consultative meetings amongst the researchers and the development team. The goal of these fact finding activities was to gain an understanding of e-commerce within the scope of small rural farming communities, to identify a rural farming community that could benefit from e-commerce and to identify the challenges inhibiting the adoption of e-commerce in rural farming communities. This stage resulted in the identification of the aloe farming industry as a context within which to examine the research question. A rural aloe farming community was identified and approached to engage in a research project to introduce e-commerce to their trade. Upon the aloe community's agreement to participate, the planning phase was initiated. The planning phase involved interaction between the researchers, software developers and the aloe farming community members. The planning phase involved requirements elicitation and modelling activities. These activities resulted in the design and development of a voice driven e-marketplace for the community. The intervention involved the introduction of the e-marketplace and included initial user training and ongoing technical support over a period of eight weeks. Observation occurred concurrently during this period and resulted in revisions of the application that were informed by the users' responses to various aspects of the system. A reflection period began at the end of the eight week pilot period. During this time the community members were interviewed and their feedback was documented together with the observations that were made during the intervention. Further data was gathered based on analysis of usage data and reports on technical problems. The stages of the project as well as the knowledge that emerged from the interactions with the community will be discussed in the sections that follow.

5. A STUDY OF TECHNOLOGY TRUST IN AN ALOE E-MARKETPLACE

The literature reviewed suggests that a user's trust in a certain technology is determined by the user's perception of its ability to serve their needs and to function effectively and predictably. The literature also suggests that the requirements elicitation process is central to enhancing the fit between the technology and the needs of the users. These are the two

concepts that will form the theoretical basis for this study. To evaluate the concepts discussed in the preceding sections, the project involving the implementation of an aloe e-marketplace in a rural farming community will be discussed. A discussion on the project and the technology intervention will be provided and the challenges encountered will be detailed. This section aims at outlining the various sources of technology trust related issues that emerged during the project.

5.1 Diagnosing the Problem: The Aloe Industry in South Africa

Albertinia is a rural farming town in South Africa that is known to have the highest quality aloe in the world and is home to an aloe processing plant and two cosmetic and healthcare product manufacturing firms. The aloe industry in South Africa dates as far back as the 1700s, with aloe lumps suggested as being among the first processed natural products to be exported from South Africa. Although no official figures indicating the actual monetary value of the industry exist (pers. comm., 2012), the economic significance of aloe, according to the majority of published studies, is indisputable. More notably, the value to rural aloe harvesting households is substantial. In 2008, the industry was estimated to be worth R150 million annually (Shackleton and Gambiza, 2007), contributing R12 to R15 million annually in income for rural harvesters (Shackleton and Gambiza, 2007). The aloe industry in Albertinia is completely dependent on the labour of rural harvesters (aloe tappers), who work independently harvesting (tapping) the aloe that grows wild in public areas or on private farms in Albertinia. The aloe tapping industry in Albertinia stimulates incomes averaging around R2000 (approximately US $200) a month. In most cases, such revenue is additional to income earned from their primary employment activities. Although the income from this trade is highly varied, it has been stated that in a good month an aloe tapper can earn up to R3000 (approximately US $300) per week. Income from aloe tapping is significantly higher than that earned in most rural agricultural livelihoods and the industry contributes profoundly to the socio economic wellbeing of the community. It has even been stated (pers. comm., 2012) that through aloe tapping income, certain individuals have managed to support their children through higher education. In the section that follows, the steps that were taken to gain an understanding of the needs of the Albertinia community will be described.

Based on the significance of the aloe industry in supporting income generation among rural communities and the understanding of the role technology could play in supporting the activities of rural aloe harvesters, the benevolence of the technology was assumed from the perspective of the researchers. However, to validate the researchers' perception that an e-marketplace could enhance the livelihood of Albertinia's aloe community, requirements elicitation activities were undertaken to evaluate how e-commerce could be used to support the community. This phase involved steps to gain a conceptual view of how the stakeholders of the aloe industry interact with one another. Desktop research and telephonic interviewing were conducted, followed by an iterative joint application design (JAD) process among the collaborating researchers to refine the understanding of the activities. Consequently, an e-marketplace was modelled and a field visit was undertaken to two aloe communities to refine the modelled requirements and elicit the participation of the identified communities. The requirements were subsequently refined and the researchers gained the commitment of the Albertinia aloe community. In the sections that follow, the contextual factors informing the design and development of the resultant technology will be described.

Based on the interaction with the aloe community, it was established that many aloe tappers in Albertinia harvest aloe leaves from privately owned farms. The tappers have long-standing relationships with the farm owners (often generational relationships) whereby they are allocated areas on the farms where they can harvest exclusively. Upon harvesting the aloe leaves the tappers drain the sap from the leaves into 25 litre drums that they then sell to the

local aloe processing plant. The farmers get involved by delivering the drums of aloe sap to the aloe processing plant and are in turn paid a portion of the revenue from the sale. The following factors were determined during extensive interviews with the community:

- The farms are often very large and aloe tapping does not occur in a single location on the farm.
- The drums of aloe sap are heavy and the tappers often leave them at the harvest site to be picked up by the farmers.
- Tappers walk long distances to reach the farmer in order to notify him that they have drums of sap that must be collected.
- The aloe tappers are often unable to reach the farmer in order to notify him telephonically as he may be occupied with other farming activities, or he may be at a location with no network coverage.
- It is common for tappers who have been unproductive during a specific period to "borrow" the drums that are awaiting collection and sell them to other farmers. Although these drums are "borrowed" without their owners' permission, it is not considered to be theft as they are usually replaced at a later stage.
- Often there are numerous drums of aloe sap located all over the farms and the farmer drives around randomly collecting them as he identifies them. This is tedious and costly on the farmer's part.
- The aloe tapping community is largely made up of middle-aged to mature individuals. The majority are between the ages of 45 and 55.
- Many of the aloe tappers do not have bank accounts and have no desire to open accounts.
- Many of the aloe tappers are illiterate or semi-literate.
- Many of the aloe tappers do not possess mobile phones and are resistant to adopting new technologies.
- The majority of aloe tappers have had no exposure to computers and the few that have mobile phones possess handsets with the most basic features.
- The homes of the tappers are not electrified and they may not always have access to points where their mobile phones can be charged.
- The language prevalent in the community is Afrikaans and the majority of the aloe tappers cannot speak English.

The aforementioned factors highlighted the need for improved information flow amongst the various stakeholders in the aloe value chain. The primary need was for the harvesters to effectively report their harvests to the farmers and for the farmer to have ready access to up-to-date harvest information in order to collect and deliver the aloe sap to the processing plant. In addition, factors relating to the low levels of literacy, inexperience with information technology and the predominantly mature age of the harvesting community demanded a deeper insight into appropriate technology based solutions.

5.2 Planning the Intervention

Technology-focused projects in Albertinia are challenged by barriers relating to literacy, language and exposure to technology, among others. To address these challenges, a Spoken Dialogue System was adopted as a platform upon which the concept of an e-marketplace could be tested. Spoken Dialogue Systems respond to challenges such as illiteracy, language barriers, lack of local content, infrastructural challenges and low disposable income (Agarwal et al., 2010). Accessible from any touch tone phone, such platforms are targeted at delivering

the services found on the Internet through voice-driven interfaces to users from poor and underdeveloped communities.

In response to the conditions prevalent in Albertinia's aloe community, a voice-driven e-marketplace was developed to enable a buy-and-sell relationship between the aloe tappers (sellers) and the farmers (buyers). The application allowed aloe tappers to upload information regarding their harvests by dialling the telephone number associated with the service and updating variables such as the type of harvest they wished to sell and the associated quantities. Buyers could then phone the same service and access listings of the respective harvests. The e-marketplace was built using the Spoken Web platform with voice prompts to enable the users to navigate the application's features. The application consisted of two user interfaces; the buyer interface and the seller interface. Each interface was accessed following a set of authentication prompts. Additional prompts and call flows were designed to accommodate situations where the user entered incorrect information or the user input was not recognised by the application. The dialogue was then translated into the Afrikaans language to cater for its intended users and the voice prompts were recorded. As the voice recognition component had not been configured to detect the Afrikaans language, (the language predominantly spoken in Albertinia), the developers engaged a process of transliteration to train the application to understand the user's responses. The application was tested rigorously by users working in the researchers' departments and was then presented to the users in the aloe tapping community. Figure 1 and figure 2 are flowcharts representing the first version of the application that the users encountered:

Figure 1: Flowchart Representing the Application's Seller Interface

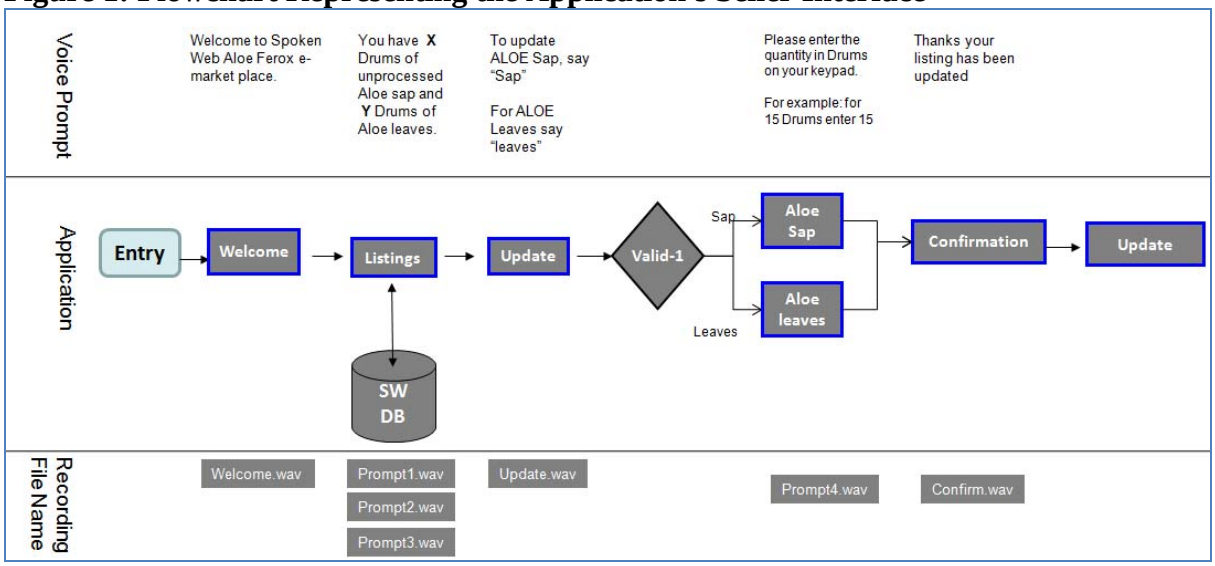
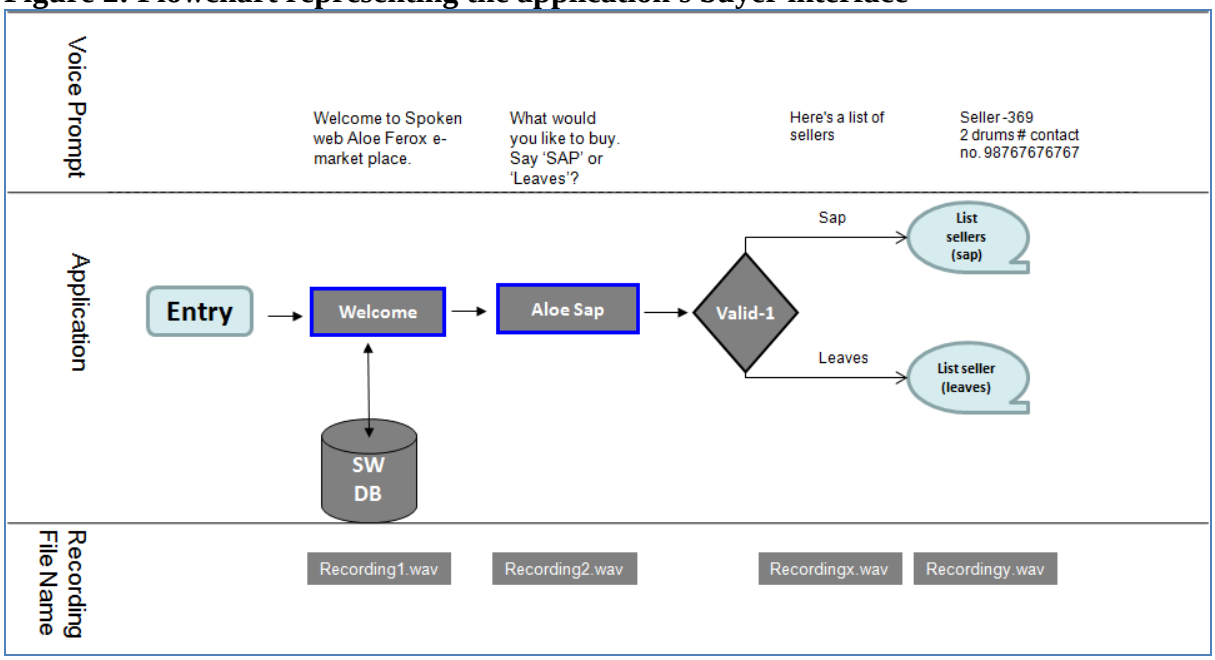


Figure 2: Flowchart representing the application's buyer interface



5.3 The Intervention

A pilot group was identified with the assistance of the CEO of the processing plant based in Albertinia. The group consisted of ten tappers and two farmers; four of the tappers were female, while both farmers were males above the age of 55. About half of the group members were over the age of 40, with one group member being over the age of 60. The pilot group was provided with basic mobile phones loaded with prepaid airtime. The group was then introduced to and trained in the use of the application and then allowed to experiment with the application under the observation of one of the researchers. Thereafter the group was left to make use of the application for a period of eight weeks. The user's initial encounter with the technology was aimed at introducing the pilot group to the technology, providing training in its use and identifying potential shortcomings and problems. During their first interactions with the technology several observations were made. These observations were documented and evaluated and it was discovered that in most cases the users viewed the problem as a technical failure, when the actual problem emanated from the usability of the system. In many cases, the issues could be related to non-functional requirements, particularly usability issues. The following section provides a summary of the most notable observations in relation to the usability of the application:

5.3.1 Challenges with the User Input

The terms 'buyer' and 'seller', when translated into Afrikaans (koper and verkoper), were not easily distinguishable by the application's speech recognition. As a result, buyers were occasionally directed to the sellers' interface, while sellers were finding themselves in the buyers' interface. In some instances the speech recognition failed due to the background noise generated by all the group members interacting with the system at the same time in a confined space and in some cases it failed because the user responded too soon or too late. The users' accents may also have had an effect on the technology's ability to detect the response accurately. The problem was not entirely a speech recognition issue, as speech recognition cannot yield the correct results if not utilised effectively. However, the users' perceptions were that the technology did not appear to be functioning as expected. This ultimately impacted the users' perception of the technology's ability.

The users' inexperience with the technology also resulted in some of them responding slowly to the authentication prompt. When requested to enter the PIN, the user would respond extremely slowly. As a result the application would only register the first one or two digits of a three-digit PIN and respond stating that they had entered an incorrect PIN. Again, the perception of the technology's ability came under question as the user was left with the impression that the technology did not work, even though the source of the problem was the manner in which the user was interacting with the technology.

5.3.2 Lack of Experience Using Mobile Phones

An unusable technology compromises the perceptions of benevolence as the users' needs will inevitably be unmet if they cannot use the technology. Although the application was simple to use, the lack of experience using mobile phones affected the user's ability to interact with the application effectively. By default, the mobile phone's interface was in English and had to be switched to Afrikaans with the assistance of the researchers. Some of the users had never used a mobile phone before and had to be taught how to use even the most basic controls such as the green 'dial' key and the red 'hang up' key. This was a factor that had been overlooked by the researchers during usability testing as the focus had been on the usability of the application rather than the device. The need for a user manual was apparent in this situation.

5.3.3 Inconsistency in Responding with Different Types of Input Format

For some prompts, user input was accepted in speech format as well as Dual Tone Multi Frequency (DTMF) responses, while some prompts only allowed DTMF responses. In instances where speech responses were allowed, users were signalled to speak following a 'beep', while no 'beep' was signalled for DTMF responses. This proved to be confusing for the users and many of them were slow to respond to prompts because they were waiting for the 'beep'. Considering that they were experiencing a new technology, this meant that they were faced with the additional burden of remembering when to wait for the 'beep' and when to respond without a 'beep'. In this situation, the users' perception of the technology's ability was impacted when the same mode of response would be effective for one action and fail for a different action. This further influenced the users' perception of the technology's integrity as it was perceived to not respond predictably or consistently.

5.3.4 Need for Improved Match between the System and the User's Context

Some of the terms used, although translated from English to Afrikaans, were unfamiliar to the users who were accustomed to the more colloquial synonyms. Furthermore, the application accommodated the sale of aloe leaves, which were not traded by members of the pilot group. Additionally, during their experimentation with the application, one of the farmers pointed out that it would be of great value if the application prompted the tappers to indicate the location of their harvests. This requirement proved to bring the most value to the farmers, who stated during the post implementation interviews that they no longer spent excessive time and fuel on searching for the drums of harvested sap. Effectively reflecting the users' context through the technology is likely to give the user an enhanced sense of ownership. Thus, the perception of benevolence may have been enhanced by further tailoring the application to reflect the unique characteristics of the group. The final version of the application presented the users with the following dialogue:

Seller interface

System: Welcome to the Spoken Web Aloe Ferox e-marketplace. Please enter your tapper PIN.
User: *<Enters PIN. System authenticates user and redirects user to the seller interface>*
System: To update Quantity press 1 or say 'Quantity' or to update the location, press 2 or say 'Location'.
User: 'Quantity'
System: Please enter the quantity of aloe sap in drums on your keypad.
<User keys in the number of drums available>
System: 'You have' {X} drums of aloe sap, located at {Y}.

Buyer Interface

System: Welcome to the Spoken Web Aloe Ferox e-marketplace. Please enter your buyer PIN.
User : *< User enters PIN, system authenticates user and redirects user to buyer interface>*
System: Here is a list of sellers for sap.
<System provides listings as follows: Seller {X} has {Y} drums of aloe sap located at {Z}. Press any key to continue>

5.4 Reflection

On conclusion of the eight-week pilot of the application, interviews were held with the pilot group in which eight of the twelve pilot group members participated. The interviews indicated an initial lack of trust in the application by the pilot group as a result of the numerous problems the users had initially experienced with its use. However, the users unanimously stated that once the technical issues had been rectified, they found great value in using the application and cited time saving as the greatest benefit. One of the respondents even stated that the project had opened up a whole new world for them. All the users stated a desire to continue using the application and the aloe processing plant manager even proposed that the application be extended to cater for his information needs. He identified the need for advance information regarding harvests in order to forecast production and allocate resources accordingly, adding that such information would also assist him to budget and make funds available to pay the harvesters timeously.

One of the fundamental sources of the problems encountered during the pilot group's use of the application was the gap between the analyst's understanding of the users' environment and the reality of the users' context. This resulted in the failure to identify functional and non-functional requirements that influenced the users' perceptions of the benevolence, ability and integrity of the technology. The pilot outlined the need for guidelines to effectively elicit user requirements in situations where the analysts have a narrow understanding of the users' context and the users have limited experience with the proposed technology. In the section that follows, a model for the elicitation of user requirements in such environments will be presented.

6. THEORETICAL CONTRIBUTION: A MODEL FOR BUILDING TRUST IN THE ALOE E-MARKETPLACE

Challenges encountered with the use of the e-marketplace were described in the preceding section. This section reflects on the intervention from a theoretical perspective in order to examine how the process of defining the needs of the user can affect the perceived trustworthiness of a technology. The activities engaged in by the analyst to gain an

understanding of the Albertinia aloe community's needs and translating such needs into a software product will be discussed in this section.

Trust has been identified as an important factor influencing the adoption of technologies. Accordingly, the trustworthiness of a technology was defined as its ability to serve the needs of the users and perform the required functions reliably and consistently. In order for a technology to demonstrate such characteristics, the developers must design the technology with a solid understanding of the users' needs and should ensure that all the user requirements are reflected in system features that perform reliably. This is a basic expectation of any software artefact and a wide range of methodologies exist to ensure that the user requirements are elicited, managed and translated into a trustworthy application. However, most existing software development methodologies have been developed and applied in the context of organisations with well-defined processes and a clear understanding of the users and their needs. According to Heeks (2002), in settings where the analysts are far removed from the reality of the users, the existence of design–reality gaps are likely to exist, resulting in applications that do not fit the context of their users. When developing applications for rural users with extremely limited experience in the use of ICTs, the challenge of developing technologies that correctly address their needs can be very complex, especially since the analysts have limited understanding of the users' context.

A study by Isabirye (2009) revealed the challenges faced by users in South African rural areas in articulating their needs. These challenges related to language barriers and a lack of confidence in voicing their own opinions to the developers whom they perceived as more knowledgeable than themselves. Failure to adequately obtain the user's perspective when determining the requirements of a system puts the analysts at risk of omitting critical conceptual requirements. Isabirye and Flowerday (2008) classify user requirements into two categories, conceptual and technical. Zhang (2007) makes the same distinction by classifying user requirements as either a process of problem analysis or product specification, based on the level of abstraction required at the specific project phase.

Eliciting the requirements of a system is an intensive process of interaction between analysts and users and therefore requirements elicitation techniques should be classified according to the manner in which they support this interaction (Zhang, 2007). The user perspective is the most critical source of conceptual requirements, while the analysts play a more crucial role with regards to identifying technical requirements. In order to enhance the trustworthiness of a system, the requirements must be elicited and managed in a manner that emphasises the user's perspective when determining the conceptual requirements and promotes the role of the analysts in identifying and refining the technical requirements. This paper proposes that in order to build software that is trusted by rural users, the analysts must engage extensively with the user to understand the unique context within which the rural user functions. Four categories of requirements elicitation techniques are described in Zhang (2007) conversational, synthetic, observational and analytic. However, this paper extends Zhang's categorisation of elicitation techniques to include a fifth category of elicitation techniques; exploratory elicitation techniques. Each of the aforementioned categories contributes to the establishment of trust by influencing the beliefs the users have of the benevolence, integrity or ability of the technology. In the following sections, the effect these categories of techniques have on trust will be evaluated. Finally, this section presents and justifies a model for building technology trust for rural users. The model, illustrated in figure 3, describes how each stage in the development cycle has an associated trust related outcome based on the nature of the requirements sought and the stakeholder category from whose perspective the requirements are sourced. The model proposes a variety of elicitation techniques that can be applied to effectively yield the desired trust outcomes in each stage of development. A detailed explanation of the model will be provided in the sections that

follow. The model is based on literature relating to requirements elicitation as well as the lessons learned from the aloe e-marketplace project.

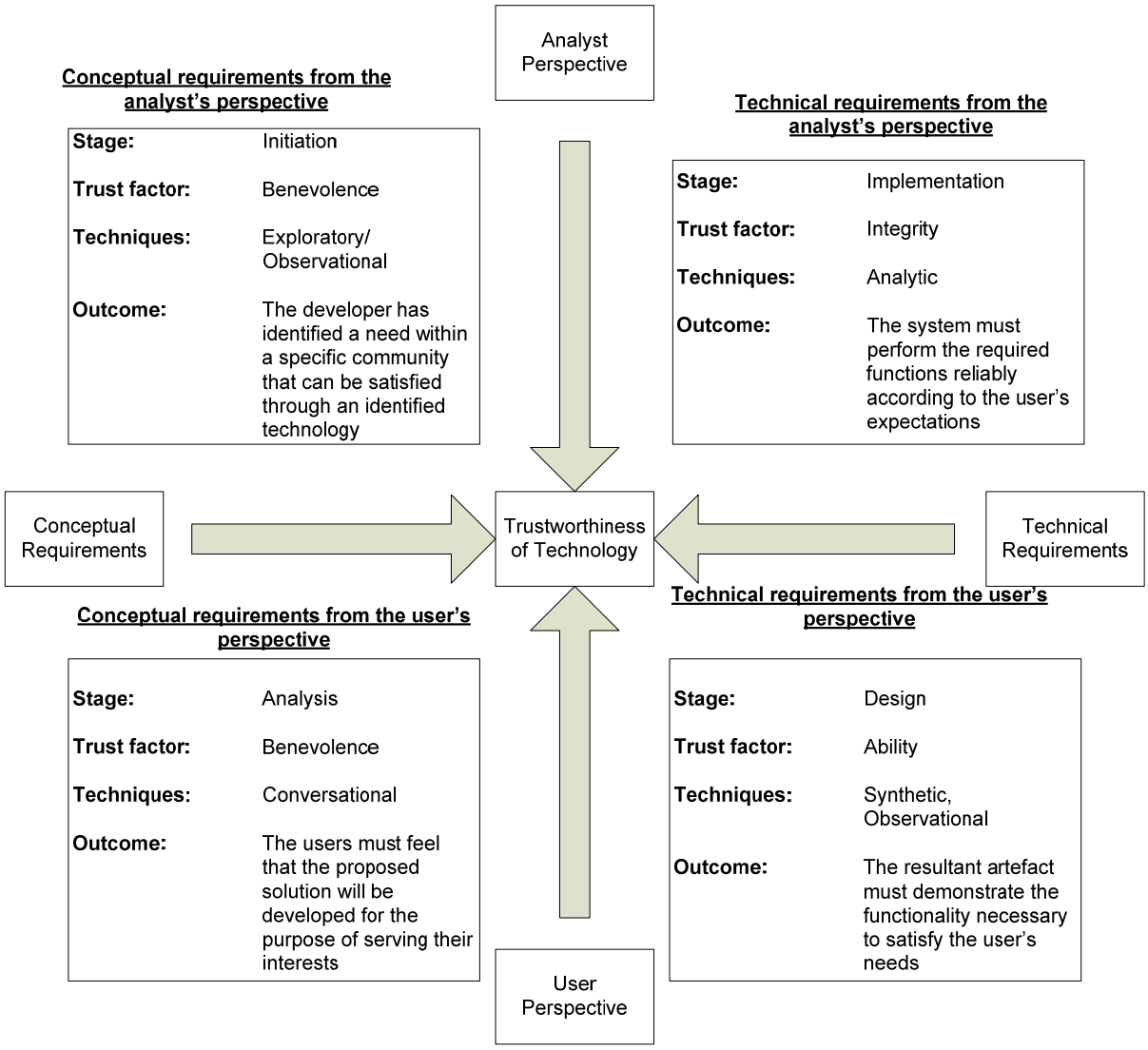


Figure 3: A model for building technology trust through requirements management

6.1 Gaining Conceptual Requirements from the Analyst's Perspective

Benevolence, in the context of trust in technology, has been described in this paper as the belief in the technology's ability to serve the needs of its users. In order to achieve benevolence, analysts must approach the initiation of software projects with this goal in mind. Exploratory techniques enable analysts to identify the potential needs of the users and initiate the project based on their belief in the project's ability to respond to such needs. Exploratory techniques can be reinforced by observational techniques, which allow the analysts to make judgements based on both the physical and abstract aspects that they observe in the user's domain during exploration. Analysts can thus approach the initiation of the software development project with a belief that the software will create value for its intended users. This section will elaborate on exploratory and observational techniques.

6.1.1 Exploratory Techniques

Exploration is triggered by curiosity regarding the unknown and involves a series of fact-finding steps to build theories, hypotheses and research questions (Bajpai, 2011; Martin and

Hannington, 2012). Exploratory research serves two broad purposes: it aids in determining whether or not to commit to a project by identifying outcomes that would be either undesirable or bear minimal impact (Kaden, 2006) and it broadens the researchers' knowledge of the domain being studied. It is generally recognised that the analysts' knowledge of the user's and the application's domain has a strong influence on the outcome of the requirements elicitation process. Although domain knowledge has been associated with the negative outcome of analyst bias during the requirements process, the benefits largely outweigh the shortcomings (Kenzi et al., 2010). Domain knowledge contributes to enhanced communication between analysts and users by affording the analysts the ability to communicate using terms and concepts that are familiar to the users (Kenzi et al., 2010). Furthermore, the analysts' domain knowledge helps to lead the analysts to the questions to be asked during elicitation. Kenzi et al. (2010) argue that the efforts of an analyst without domain knowledge are focused on learning the basics of the domain and generally address issues concerning communication barriers and the completeness of requirements. In contrast, an analyst who has domain knowledge can focus on refining the specific details as they already have an insight on the broader picture. Exploratory research is undertaken when very little knowledge exists about the subject under investigation (Stebbins, 2001; Martin and Hannington, 2012). Exploratory techniques in the context of requirements elicitation should thus include any efforts to gain an understanding of the problem domain prior to engaging with the users. Exploratory elicitation techniques elicit conceptual requirements from the analysts' perspective and include activities such as document analysis, desktop research and exploratory interviews.

6.1.2 Observational Elicitation Techniques

The analysts' view of the user's problem domain can also be informed by observational elicitation techniques. According to Maiden and Rugg (1996) in Isabirye (2009), users are not the only source of knowledge in the requirements elicitation process. They argue that knowledge exists in domain objects such as physical artefacts and abstract entities. Maiden and Rugg (1996) and Zhang (2007) state that observational techniques are effective in eliciting such knowledge. This knowledge can be acquired subconsciously or it may exist as a result of extensive practice or habit that is seldom expressed through verbal channels (Seger, 1994). Observational techniques support the process of eliciting conceptual requirements from within the user' s domain based on the analysts' perspective, as they allow the analysts to observe phenomena that have not been articulated verbally. Exploratory and observational techniques are largely subjective in nature and, thus, subsequent elicitation activities must address the subjectivity of the analysts' domain knowledge by emphasising the user's perspective.

Exploratory techniques applied in this study were successful in providing the researchers with an in-depth understanding of how the aloe industry in South Africa functions. Through the techniques, the research group was able to identify possible aloe communities with whom to interact to refine the concept. The researchers approached the subject by conducting desktop research to identify companies involved in the aloe trade. Through the exploration, researchers that had been involved in earlier studies were identified. These researchers shared their knowledge of the industry and pointed this study to aloe communities of interest. In addition, the study was fortunate to have made contact with an academic staff member from a South African university who had grown up within an aloe harvesting household who provided an in-depth perspective of the industry. Observation supported exploratory techniques as the researchers made use of the websites of aloe processing plants to understand the aloe value chain. Benevolence on the part of the researcher was achieved as they were able to gather enough evidence to justify the need for

an e-marketplace to support the aloe trade. As a result, two aloe communities that could benefit from such an e-marketplace were identified. The analyst's understanding of the proposed e-marketplace application was documented in the form of flowcharts. Aloe processing plants from the identified aloe communities were approached and requested to assist in validating the flowcharts in order to gain the user's perspective on the conceptual requirements. In the section that follows, the efforts made to gain the users' perspective will be discussed.

6.2 Gaining the User's View of the Conceptual Requirements

When seeking to validate their conceptual understanding of the aloe e-marketplace concept, the analyst made use of a combination of synthetic and conversational techniques. The analyst modelled her understanding of the users' problem space through the use of flowcharts. The analyst then presented the flow charts illustrating their understanding of the users' problem space to the heads of two aloe processing plants. The flowcharts were explained to them and thereafter a semi-structured interview was conducted to gain an insight into the extent to which the managers perceived the e-marketplace to be useful. Several observations were made regarding the effectiveness of the aforementioned activities. Firstly, the flowcharts represented a foreign concept to the managers through a communication tool that was also foreign to them. As the proposed e-marketplace was a completely new approach to their business and was proposed to be hosted through unconventional media, the concept itself needed extensive discussion. The flowcharts posed as a communication mechanism that was foreign to the managers and detracted from their understanding of the concept, as their effort was invested in making sense of the flowcharts. The subsequent semi-structured interview that was aimed at evaluating the extent to which the flowcharts represented the users' problem space was thus ineffective in validating the correctness of the analysts' understanding. Although the interviews were concluded with a commitment on the part of both managers to participate in the project, as they perceived the potential of the initiative to add value to their businesses, the requirements defined by the end of the interviews remained largely subjective based on the analyst's perspective.

On gaining conceptual requirements from the analysts' perspective, he or she must ensure that such requirements are consistent with the realities of the users. This is necessary as the benevolence of the technology must be perceived from the user's perspective as well as the analysts'. The analysts must thus seek to engage with the user in a manner that prioritises the user's perspective over that of the analysts. Conversational techniques such as interviews, focus groups and brainstorming sessions make use of verbally expressed natural language and are effective in developing an understanding of the problem domain and defining generic requirements (Zhang, 2007). As this dialogical approach to engaging users is the most natural of all categories of techniques, it is effective in gaining a comprehensive understanding of the users' problem domain. Conversational techniques are thus the most effective means of defining conceptual requirements based on the users' perspective. Zhang (2007) and Isabirye (2009) confirm the effectiveness of conversational techniques in obtaining the users' perspective. Therefore, applying conversational techniques exclusively would have yielded a better outcome than combining them with flowcharts.

6.3 Gaining the Users' View of the Technical Requirements

In addition to benevolence, technology trust is also influenced by ability. Ability refers to the extent to which the identified requirements are translated into system features that function effectively and fulfil the identified needs. This involves the process of translating the conceptual understanding into a technical artefact. Analysts must therefore apply techniques to ensure that conceptual requirements are communicated effectively to all stakeholders and

that there is a unified view of the goals of the technology. Synthetic elicitation techniques, according to Zhang (2007), allow analysts to make judgements on the reality by validating their view of the users' problem space with the users themselves. Synthetic elicitation techniques include methods such as prototyping, use cases, passive or interactive storyboards and JAD sessions. As many of these techniques are likely to be foreign to rural stakeholders, applying them would require their audience to engage in making sense of the models and techniques used, as well as applying the models to define the requirements. This results in problems of understanding, which according to Christel and Kang (1992), emerge when the analysts and the stakeholder community do not share a common background or level of experience. In addition, the language used to communicate between the analysts and stakeholders may not foster mutual understanding. This can lead to requirements that are ambiguous, incomplete, inconsistent or even incorrect as they do not reflect the true needs of the stakeholders (Christel and Kang, 1992). The complexity of using synthetic techniques was evident when attempting to gain conceptual requirements from the managers of the aloe processing plants. Although these were highly skilled professionals, with strong technical abilities, their lack of familiarity with flowcharts as a modelling tool impeded the elicitation process. However, according to Warfel (2009), prototypes go beyond explaining or illustrating how the proposed application will function by offering the users the ability to experience the technology for themselves. Prototypes allow inexperienced users to understand what the proposed application is capable of and hence confirm whether or not the analysts have understood the conceptual requirements. During prototyping activities, the analysts can also apply observational techniques to assess the extent to which the users' needs are met by the prototype. Non-functional requirements that may have been overlooked can also be identified and refined through the use of prototypes, as analysts can observe the users' interaction with the prototype and identify issues relating to usability, flexibility, performance or even security. Prototyping and observation are therefore recommended as a mechanism through which the technical specifications, both functional and non-functional, can be communicated based on the users' perspective.

The first version of the application that was presented to the users was intended to be an almost complete product and the activities surrounding its introduction were mainly aimed at testing and refinement. However, the exercise proved to be more of a prototyping exercise, as numerous requirements were identified and refined during the activities. In addition, numerous non-functional requirements were identified simply by allowing the users to interact with the application. By allowing the user to interact with the application, the analysts were able to make observations that enabled them to enhance their conceptual understanding and outline the technical features that the application had to demonstrate in order to meet the users' needs.

6.4 Refining the Technical Requirements Based on the Analysts' Professional Knowledge

Zhang (2007) states that analytic techniques aim at refining requirements based on deductions that were made as a result of expert knowledge or existing and documented domain knowledge. Analytic techniques applied during the project assisted the analyst to resolve issues that were observed during the users' interaction with the application. Challenges with user input, such as the speech recognition issues, the users' confusion between DTMF and voice input, the inconsistencies associated with waiting for the 'beep' and the authentication challenges are examples of situations where the analyst and the software development team were able to observe and respond based on their professional knowledge and experience. In terms of the experience with the e-marketplace, this paper is of the view that analytic techniques are stimulated by observations of non-functional issues that

are seldom verbalised by the users.

7. CONCLUSION

The process of understanding the users' context, determining their needs and producing a technology solution that effectively addresses the identified needs is critical to building applications that the users deem to be trustworthy and can be adopted to support development. The requirements elicitation and management process is thus a critical contributor to the trustworthiness of systems. Therefore, engaging a user-centric approach to understanding the context in which the application will be used will contribute to trust in the given technology by giving the user a perception of the benevolence of the technology. Thereafter, through the use of prototypes, the user is given the opportunity to experience the technology, recommend additional features, or outline factors the analysts may have overlooked. In addition, prototyping allows analysts to make observations and identify issues with the technology that the user may not be able to articulate. Effective prototyping results in a perception of the technology's ability on the users' part. The observations made by the analyst and the application of his or her professional knowledge and experience to refine the technology based on such observations, will enhance the users' perception of the application's integrity. The proposed model provides a guideline for analysts to elicit and manage user requirements based on the project phases and the nature of understanding required. The model further compels the analysts to place emphasis on the views of the users when defining the problem space and emphasising their professional expertise when refining the technical requirements.

This paper makes two key contributions; firstly the paper adapts the definition of technology trust factors described by McKnight et al (2011) by describing the benevolence of technology as its ability to serve the needs of its intended users. This perspective inclines the model towards addressing the gaps between the goals of new technologies and the needs of the target users. Secondly the paper explains how enhancing trust in innovations can encourage the adoption thereof and provides guidelines as to how trustworthy applications can be built. The paper makes use of literature from the requirements management domain to illustrate the manner in which the interaction between analysts and users determines the trustworthiness of applications. The proposed model aims at ensuring that ICT innovations are driven by the needs of their target users and that they are sensitive to the context of their use. Although the model cannot be generalised to all rural communities, it should be at the very least generalisable to rural communities where the majority of individuals have limited knowledge of and experience with the use of ICTs. Consequently, the proposed model aims at guiding academics and practitioners that are seeking to deploy development driven technologies in terms of how the requirements elicitation activities affect the trust outcomes at each stage of development. The model seeks to ensure that the proposed value of an innovation is perceived by both users and initiators and aims at alleviating the technology adoption challenges arising from the misalignment between the objectives of technology innovators and the prospective users of the innovations.

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Appendix C: Conference Publication resulting from this study

PROCEEDINGS OF THE 15th ANNUAL CONFERENCE ON WORLD WIDE WEB APPLICATIONS

10-13 September 2013
Cape Town
South Africa

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TO WHOM IT MAY CONCERN

The full papers were refereed by a double-blind reviewing process according to South Africa's Department of Higher Education and Training (DHET) refereeing standards. Before accepting a paper, authors were to include the corrections as stated by the peer-reviewers. Of the 86 full papers received, 75 were accepted for the Proceedings (acceptance rate: 87%).

Papers were reviewed according to the following criteria:

- Relevancy of the paper to Web-based applications
- Explanation of the research problem & investigative questions
- Quality of the literature analysis
- Appropriateness of the research method(s)
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A developing country market model for voice-based information services

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Abstract

With much research emerging on the application of voice services for developing countries, this research seeks to determine the extent to which spoken dialogue systems can be successfully adopted to deliver information services to users that do not have access to Internet services, as well as to determine the factors influencing the adoption and use of such systems. This study is founded on the premise that Information Systems research has in the past assessed many developing countries using a single lens. This paper argues that many countries in the developing world face unique conditions which determine the success of a technology within their respective contexts. The study takes the form of a participatory action research project to introduce a voice-driven e-marketplace as a platform on which buyers and sellers of aloe derivatives can interact. In addition, an interpretivist approach to understanding the factors influencing the success of the initiative was adopted. The findings revealed that the effectiveness of voice services as an alternative to the World Wide Web in delivering e-commerce services to marginalised users is dependent primarily on factors relating to levels of literacy and comparative cost, and secondarily dependent on factors of individual adoption, such as the usability and usefulness of the service and the level of alignment between the technology and the users' context. This paper provides an analysis of how these factors influence the adoption and of the technology, and proposes a market model for voice-based information services for developing countries that will enable researchers and organisations to determine the circumstances under which the adoption of voice services can be optimised.

Keywords: Voice services, spoken dialogue systems, developing countries, literacy, telecommunications, diffusion, adoption, market forces, usability, ease of use.

1. Introduction

Information and Communication Technologies (ICTs), as a mechanism through which the economically disadvantaged can advance, have been researched extensively. However, it is broadly suggested that ICT interventions are failing to achieve their intended development objectives. The relevance of the Internet in our daily lives is indisputable. Accordingly, it is said to have profoundly transformed society socially, economically, culturally and politically (Di Maggio, Hargittai, Russell Neuman & Robinson, 2001; Norris, 2001) and today the Internet has become an indispensable part of many lives (Hoffman, Novak, & Venkatesh, 2004). However, despite the extent to which much of the developed world depends on the Internet, the majority of the world's population still does not have access to it (ITU, 2013). Studies have shown that just over a quarter of the developing world's population is using the Internet (ITU, 2013). Further studies have highlighted that the cost of being on the deficient end of the information divide can be dire, and suggest that the inability of the developing world to harness digital technologies such as the Internet to enhance its productivity could further widen the chasm between the developed and the developing world (Norris, 2001). Although research suggests that the digital divide may be narrowing as a result of the high penetration of mobile phones in developing countries, users have yet to harness the information processing power of mobile phones.

Mobile voice applications respond to many of the obstacles associated with e-commerce adoption in developing countries. Botha, Calteaux, Herselmann, Grover and Bernard (2012) suggest that the increasing focus on developing ICT solutions for the underserved, and the wide proliferation of mobile phones within poor communities, has resulted in new opportunities for mobile voice services. Mobile voice applications, often referred to as spoken dialogue systems, focus on the delivery of information to users through telephones and mobile phones (Botha et al, 2012). As most voice services can be delivered over even the most basic devices, they can play a significant role in bridging the information gap facing poor communities (Botha et al, 2012). Voice services attempt to address challenges relating to the comparatively high cost of web-enabled devices, as well as the language barriers and the low levels of literacy that are known to inhibit the adoption of information services by users in developing countries.

This study evaluates the adoption of voice services aimed at delivering information to users in developing countries and seeks to uncover the factors influencing the effective adoption of such services. A participatory action research project introducing a voice-driven e-marketplace in a rural South African aloe farming community is presented as a basis for identifying the challenges facing voice-based information services. The sections that follow provides a description of the project by outlining the project's objectives, describing the challenges encountered throughout the duration of the project and assessing the extent to which the project benefitted its intended users.

2. The aloe e-marketplace

In recognition of the significance of agriculture in developing countries (IFAD, 2008), and the comparatively low adoption rate of e-commerce in the agricultural sectors of developing countries (Canavari, Fritz, Hofstede, Matopoulose & Vlachopouloue, 2008), an ICT project

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was initiated with the intention of evaluating the adoption of e-commerce in a rural agricultural setting. This section describes the processes undertaken and the outcomes of the case study.

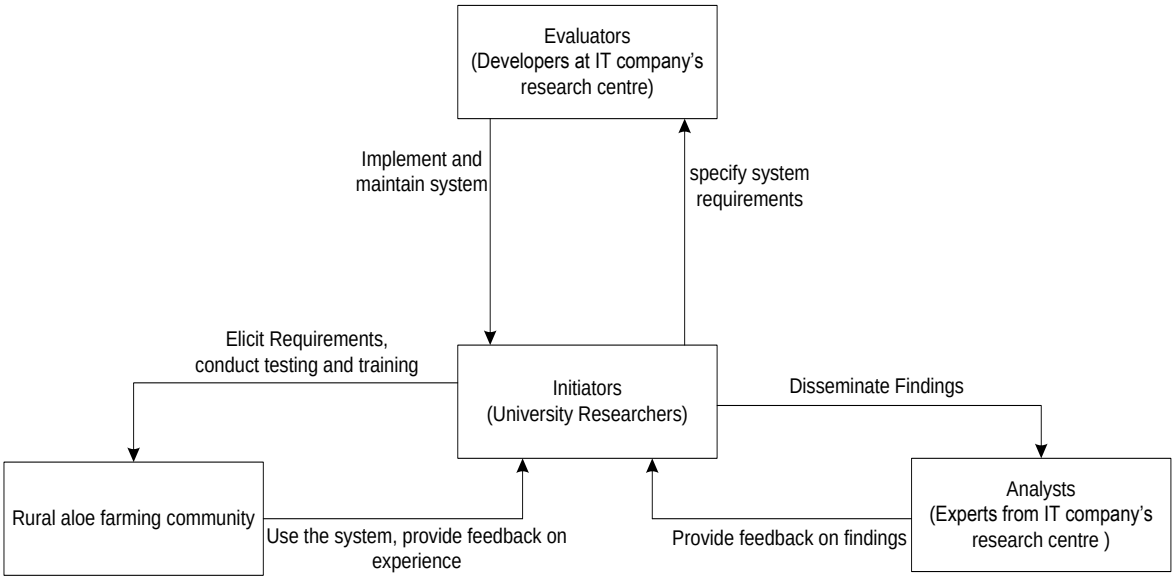
2.1 Identifying the case

Following extensive desktop research and several telephonic interviews, the aloe industry in the Eastern and Western Cape emerged as a subject of interest. It was subsequently found that, according to a number of published studies, the economic contribution of aloe is significant. In 2008, the industry was estimated to be worth R150 million annually (Shackleton & Gambiza, 2007), contributing R12 to R15 million annually in income for rural harvesters (Shackleton & Gambiza, 2007). The aloe industry in Albertinia is completely dependent on the labour of rural harvesters (aloe tappers) who work independently harvesting the aloe that grows wild in public areas or on private farms. The Albertinia aloe community was identified as an ideal community with which to explore the concept of e-commerce because of its physical location, the maturity of its organisational processes and the fact that the town is home to all four categories of stakeholders in the aloe value chain in South Africa (harvesters, farm owners, processing plants, and health and cosmetic manufacturers).

2.2 Development of the e-commerce platform

To address the challenges of illiteracy and lack of experience with ICTs facing the aloe community of Albertinia, a spoken dialogue system was identified as a suitable platform to test the e-commerce concept. The research project was undertaken collaboratively by a South African university research group and two research centres belonging to an international IT Services Company. The model depicted in Figure 1 describes the research stakeholders according to their key objectives.

Figure 1: Project stakeholders



Source: Adapted from Yang, Zhang and Roe (2011)

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2.3 Research methodology

The project sought to understand the factors that influence the adoption and effective use of voice driven e-marketplaces in rural communities. A participatory action research approach was adopted to evaluate the factors influencing the adoption and effective use of the e-marketplace based on the rural context. Action research, according to Lewin (1946), involves investigations into the conditions and consequences of various forms of social action and involves cycles of planning, action, and fact finding about the outcomes of the actions. In the case of this study the introduction of the voice driven e-marketplace was the action, and each revision of the application was informed by the users' response to various aspects of the system. These iterations and the knowledge that emerged through the interactions with the community through the duration of the project will be discussed in the sections that follow.

2.4 Enabling participation by the rural community

Despite the rapid rate at which mobile phones are penetrating the developing world, the community of Albertinia is a rare case of a community where mobile phones have been poorly adopted. This was made evident by the fact that most of the retailers in Albertinia stocked prepaid airtime vouchers of a very limited value. The reason given for this was the low demand for prepaid airtime. It was therefore necessary to provide the participants with basic mobile handsets.

The project stakeholders agreed that the voice application would be hosted in India, at the institution where the developers were based. This raised a number of challenges; firstly, as the system was targeting rural users with limited financial resources, the team felt the international call charges would be prohibitive for the voluntary participation of the users. Furthermore, the team felt that any costs that the users might incur in participating in the project might limit their willingness to participate. The team therefore explored the following options as a means of resolving these issues:

i. Making the service accessible through a toll-free voice call

At the time the project was undertaken, there were only two telecommunications providers offering reverse charge billing. Both these providers still expected the caller to pay a portion of the cost if the call originated or had a destination outside their network. Unfortunately, in this study, the calls would be made from a mobile device to a fixed-line telephone number so it would not have been possible to eliminate the cost to the caller. The telecommunications companies were approached several times to assist in developing custom solutions for the problem. However, the options that the various companies presented the project with were costly and did not accommodate the constraints of the project.

ii. Providing prepaid international calling cards

Another option that was considered was the use of prepaid international calling cards. As the cost of the cards would be covered by the project, the research team felt that using this option might present opportunities for misusing the calling cards as there was no way to control where the participants were calling. Subsequently, it was investigated whether it would be possible to obtain calling cards where the call destination was restricted; however, this too

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was found not to be possible. Moreover, all the South African mobile carriers impose a charge on the caller for accessing the calling card service, so the cost to the user could not be avoided.

iii. Providing SIM cards preloaded with prepaid airtime

The provision of preloaded SIM cards was eventually found to be the most suitable and was therefore adopted. Twelve basic mobile handsets were then provided to members of the pilot group and the fixed dialling feature of the SIM cards was activated. This allowed for outgoing calls to be restricted and the telephone number associated with the service was designated as the only number that could be called from the SIM card. This allowed the project to provide the participants periodically with prepaid airtime based on the call volumes of the specific participant.

2.5 Configuring the application

The voice calls made by the participants were to a local fixed-line telephone number. The calls were then converted and routed through a gateway to the application, which was hosted in India. Configuring the communication line to the application required the services of technical experts and incurred significant costs. However, the configuration also reduced the cost per phone call to the application, because each call was transmitted as data to its international destination and, hence, international call rates were not applied. The calls were routed in real time with no noticeable delays in the connection.

2.6 The voice application

Based on the requirements elicitation process, it was established that many aloe tappers in Albertinia harvest aloe leaves from privately owned farms. The tappers have long-standing relationships with the farm owners (often generational relationships) whereby they are allocated areas on the farms where they can harvest exclusively. Upon harvesting the aloe leaves the tappers drain the sap from the leaves into 25-litre drums that they then sell to the local aloe processing plant. The farmers play their part by delivering the drums of aloe sap to the aloe processing plant and, in return, are paid a portion of the revenue from the sale.

In response to the requirements defined through interaction with Albertinia's aloe community, a voice-driven application was built using voice prompts to enable the users to navigate the features of the application. The application consisted of two user interfaces – the buyer interface and the seller interface. Each interface was accessed by following a set of authentication prompts. After a series of iterations, the final dialogue was structured as follows:

Seller interface

System: Welcome to the Spoken Web aloe ferox e-marketplace. Please enter your tapper PIN.
User: *<Enters PIN. System authenticates user and redirects user to the seller interface>*

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System: To update Quantity press 1 or say 'Quantity' or to update the location, press 2 or say 'Location'.
User: 'Quantity'
System: Please enter the quantity of aloe sap in drums on your keypad.
<User keys in the number of drums available>
System: 'You have' {X} drums of aloe sap, located at {Y}.

Buyer Interface

System: Welcome to the Spoken Web Aloe Ferox e-marketplace. Please enter your buyer PIN.
User : *<User enters PIN, system authenticates user and redirects user to buyer interface>*
System: Here is a list of sellers for sap.
<System provides listings as follows: Seller {X} has {Y} drums of aloe sap located at {Z}. Press any key to continue>

2.7 Piloting the project

A pilot group was identified with the assistance of the CEO of the processing plant based in Albertinia. The group consisted of ten tappers and two farmers. Four of the tappers were female, and both farmers were males above the age of 55. About half of the group members were over the age of 40 with one group member being over the age of 60.The group was introduced to and trained in the use of the application, and then allowed to experiment with the application under the supervision of one of the researchers. Thereafter, the group was left to make use of the application for a period of eight weeks. The users' initial encounter with the technology was aimed at introducing the pilot group to the technology, training group members in its use, and identifying potential shortcomings and problems. Most notably, challenges relating to voice recognition and authentication caused a lot of unease and frustration for the users. The majority of challenges were associated with the usability of the application; however, these usability challenges in most cases were perceived as system malfunctioning by the users. Subsequently, all the usability limitations were addressed and rectified promptly before the software was officially rolled out to the user group. A second round of training was then conducted and user manuals were issued to the group. Again the users were observed while interacting with the application and a vast improvement in their interaction with the system was apparent. This was reflected in the usage logs which indicated a progressive increase in successful authentications and stock updates.

2.8 Feedback from the pilot group

On completion of the pilot study, individual interviews were held with users. The interviews confirmed how their mindsets had shifted during the duration of the pilot from an initial lack of confidence in the technology to a strong sense of satisfaction and fulfilment in its ability to support their livelihoods. One of the interviewees stated that the project had opened up a whole new world for the tappers. The entire pilot group indicated a desire to continue using the service, and all stated a willingness to pay for the associated call costs. The farmers emphasised that a key determining factor for their adoption of the technology was the extent to which it was aligned with their current business practices. Furthermore, the CEO of the aloe processing plant saw great scope for such services in agriculture, and described several

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possible agricultural industries in Albertinia alone that could benefit greatly from an adapted version of the application. The researchers concluded that the usability, the level of alignment between the technology and existing processes and the usefulness of the system were the major reasons for the participants' willingness to adopt the technology.

Challenges encountered during the project led to the realisation that the success of voice services for developing countries is mediated by factors beyond technology adoption. This was highlighted by the apparent distinctions between voice services that project group members had deployed in India, in comparison to the project piloted in Albertinia. The following section evaluates voice services in the light of some of the characteristics that distinguish one developing country from another.

3. Theoretical background

Spoken dialogue systems are increasingly being explored as a mechanism through which information services can be delivered to users in developing countries. The Local Speech Language Initiative in Kenya (Nasfors, 2007), the Lwazi Community Communication Service (Grover &Barnard, 2011), the Spoken Web (Argawal, Jain, Kumar, Nanavati & Rajput, 2010), an HIV health information system (Grover, Plauche, Barnard & Kuun, 2009) and the Tamil Market (Plauché & Prabaker, 2006) are just a few examples out of many initiatives aimed at delivering information services through voice to users who do not have Internet access. All these studies have launched pilots that have been well adopted by their intended users. Additionally, each of the studies have identified illiteracy in developing countries as one of the motivating factors for the use of voice services, and some (Nasfors, 2007; Grover & Barnard, 2011; Grover et al, 2009) explicitly identify the costs of making voice calls as a challenge to the adoption of such systems. Although researchers involved in the development of the Spoken Web have also made reference to the cost of voice calls, they do mention that the call costs are not a significant barrier by stating that a four-minute voice call in India costs less than 4 rupees (US$0,07) (Argawal, Kumar, Nanavati & Rajput, 2010).

This study is of the view that the success of voice services in a given community will be mediated by both adoption factors and diffusion factors. In the case of the pilot that was undertaken in Albertinia, adoption factors, which included ease of use, usefulness and the initial alignment between the application and existing practices, were critical to the adoption of the technology.

Diffusion extends the context of adoption from the individual case (in this case, the Albertinia pilot group) to the level of adoption at a societal level. Surry and Farquhar (1997) define diffusion as the process by which an innovation is adopted and accepted by members of a certain community. The diffusion of voice services would relate to the extent to which voice services permeate a society. This would involve the adoption of different applications by different groups or individuals.

The diffusion of innovations theory (Rogers, 1962 in Rogers, 2003) identifies the factors affecting diffusion as being the innovation itself, the manner in which information about the innovation is communicated, time, and the social system into which the innovation is being introduced (Rogers, 1962, in Rogers, 2003). This theory is effective in mapping the path of established innovations; however, it offers little explanation for technologies that have failed to

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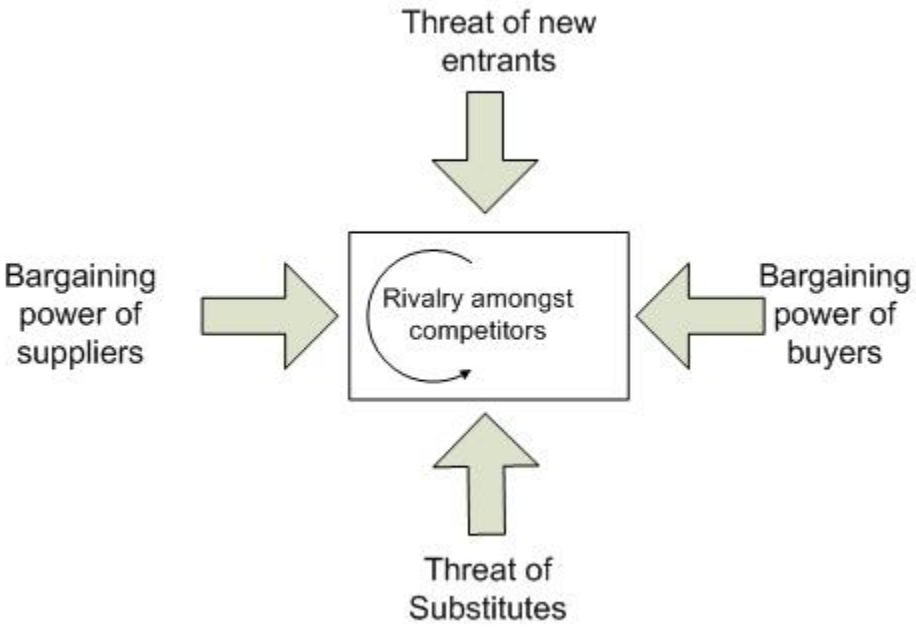
become pervasive in the markets of developing countries. This study proposes that facilitating market conditions must be in place to enable the diffusion of an innovation. This study does not therefore contest the diffusion of innovation theory, but suggests that facilitating market conditions will determine the level of adoption as well as the lifespan of the innovation.

To examine these market conditions, this study adapts Porter's Five Forces Model (Porter, 1991). This model explains the success of firms in terms of factors within their environment. For the purpose of this study, the success of voice services will be considered within the context of their respective environments in developing countries. This is based on the argument that, firstly, generalisations should not be made about the circumstances facing developing countries and, secondly, the unique attributes of each society can have a significant influence on the diffusion of a technology within that society.

Figure 2: Porter's Five Forces model (adapted from Porter, 1991)



Porter's (1991) model explains that success in a market is influenced by five factors. The first four factors (bargaining power of suppliers, bargaining power of buyers, threat of new entrants and the threat of substitutes) contribute to the fifth force, rivalry among competitors. Grundy (2006) lists several strengths of Porter's model. Among these strengths the most relevant for the case of voice services in developing countries are that it allows for the prediction of long-run return in a specific market and aids in determining industry attractiveness. Grundy (2006) also asserts that the model encourages the search for imperfect markets in which a product or service can thrive in the absence of threats, substitutes and intense competition.

Although Porter's (1991) model is widely accepted as a guideline for strategy formation within many organisational contexts, it has also had its share of criticism. Grundy (2006) argues that the model over-emphasises macro analysis as opposed to investigating more specific product market segments. He adds that it fails to prescribe possible management actions in response

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to the identified forces, and encourages the idea that an industry has fixed boundaries instead of recognising the industry as fluid. However, this study proposes adapting Porter's model for use as a guide to understanding the extent to which voice services are appropriate within a given society and suggests that it is not intended to be used to formulate long-term strategy, but rather to guide the choice of information technologies under varying conditions. Furthermore, the emphasis of Porter's model on macro analysis addresses a gap in research on voice services as it drives researchers to assess voice service initiatives individually without following generalisations of the circumstances facing specific environments.

In the sections that follow, the author will explore the way in which the issues of illiteracy and the structure of the telecommunication sector influence the success of voice services in developing countries. In addition, the paper will argue that the high rate of innovation in ICTs demands that initiators of voice services remain aware of technologies that may offer similar advantages or substitute them altogether.

4. The proposed model

Many studies make broad generalisations about the circumstances prevalent in developing countries, and fail to distinguish the countries' uniqueness in issues such as illiteracy and call costs. Furthermore, the economic power of citizens in developing countries can be widely contrasting. This section will examine the way knowledge of some of the factors that distinguish one developing country from another can inform the choice of platforms on which information services can be deployed. A model based on Porter's (1991) Five Forces Model is presented in figure 4, as a mechanism through which the suitability of voice services for an intended market can be evaluated. The proposed model suggests that the suitability of voice services will be influenced by the following factors:

- the economic power of the users
- the levels of literacy in the user population
- government regulations surrounding telecommunication services
- the level of competition among telecommunications service providers
- technological innovations that could potentially disrupt the use of voice services
- the threat of substitute services.

In addition, the model suggests that the demand for specific voice services will be influenced by their level of usability, usefulness and alignment with the context of use. This argument is based on the findings from the aloe e-marketplace that was piloted in Albertinia. In the section that follows, the five forces identified by Porter (1991) will be examined in the context of voice services targeted at developing countries in order to support the proposed model.

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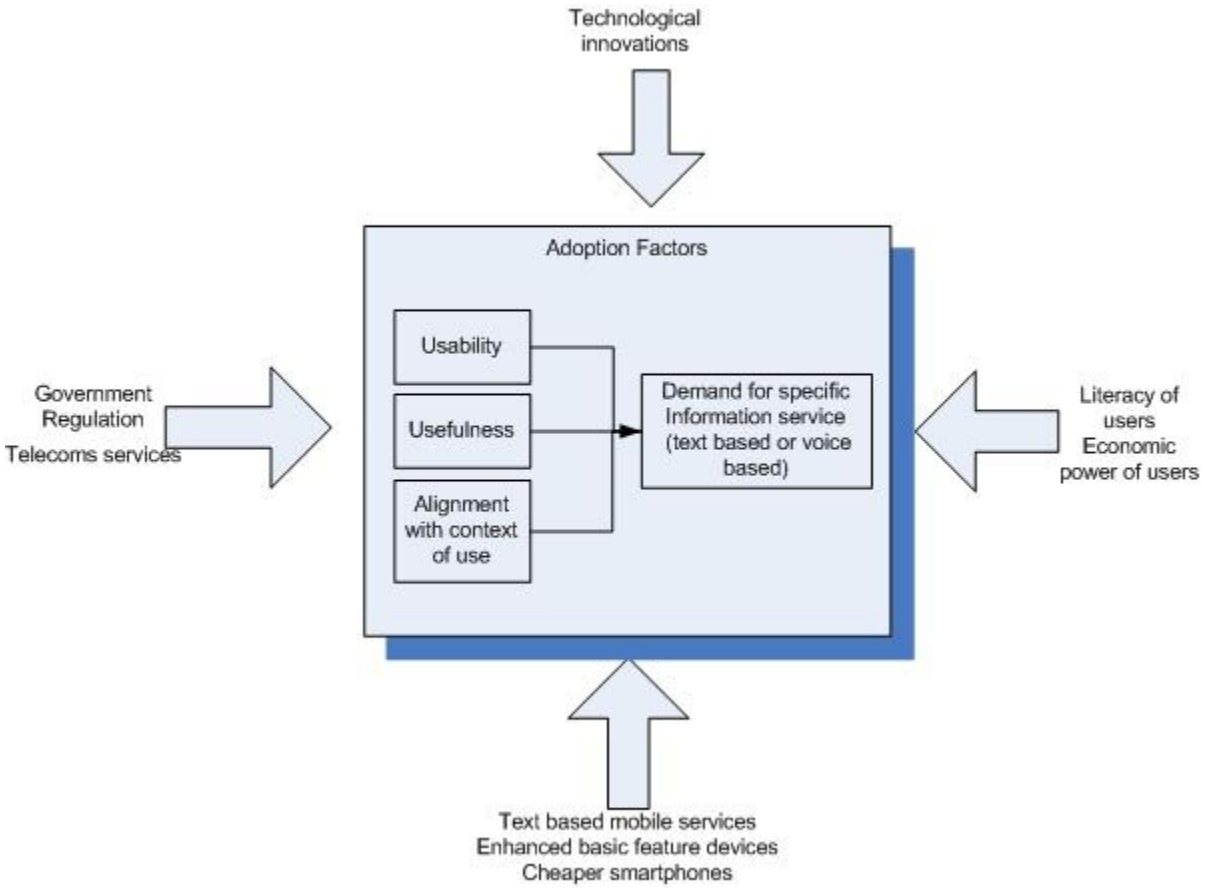
Figure 3: A developing country market model for voice-based information services



a. Bargaining power of consumers: levels of literacy and economic power

Statistics on literacy levels in various parts of the world (UNESCO Institute for Statistics (UIS), 2012) reveal that many developing countries have vastly differing levels of literacy, with countries such as Zimbabwe demonstrating an adult literacy rate of between 90 and 100% and West African countries such as Mali, Niger and Chad exhibiting literacy rates below 50%. Intra-country literacy rates may also be deceptive. Sudan's literacy rate is estimated as being between 70 and 79%.This does not, however, take into consideration the fact that the greater part of Sudan (the newly independent South Sudan) has been historically afflicted by war and poverty, and is likely to account for much of the illiteracy between North and South Sudan. This was brought to light during the discussions held between the researchers from the South African university and the Indian research centre. India's literacy rates are significantly lower than South Africa's, and the impact of their literacy rates on literacy statistics pertaining to the developing world bears much weight, considering the density of their population. However, according to the UIS (2012), India's youth literacy rates are estimated at between 80 and 89%, indicating that the country is making progress in addressing the challenge of illiteracy. The level of literacy in a society influences the bargaining power of consumers of information services within that society. Societies with higher literacy rates have the option of choosing between text-based services and voice services. The success of text-based services in

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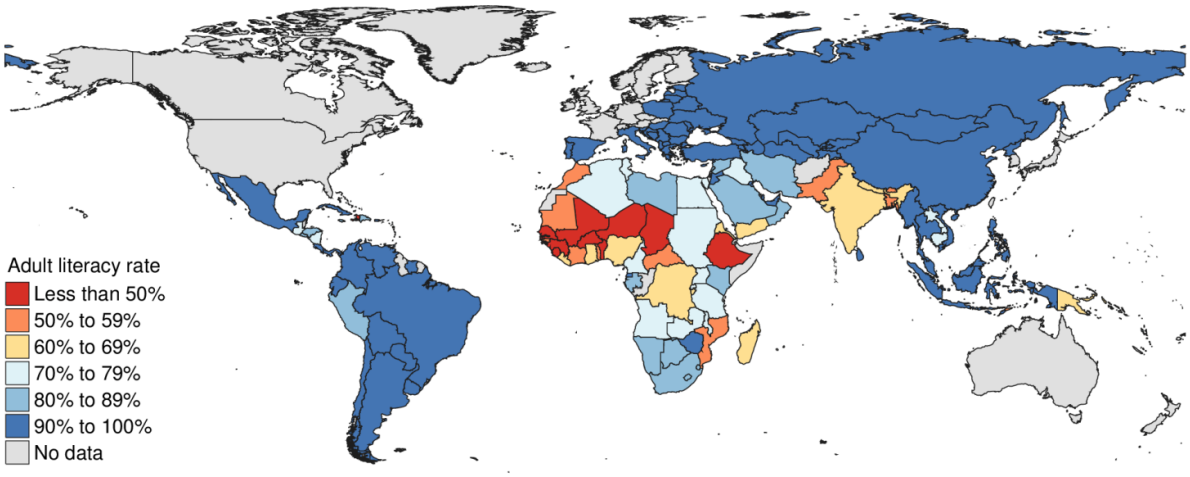
relatively literate societies has been evident in countries such as Kenya, where M-Pesa, a text-based mobile money service, has diffused the market at unprecedented rates.

Figure 4: World adult literacy rates (Enesco Institute for Statistics, 2012)



In addition, the economic power of consumers must be considered. Recently, Brazil's president made a bold statement that "poverty in Brazil will soon be extinct" (*The Economist*, 2013). Although this statement is ambitious, the rising economic power of Brazilians is evident. According to a recent study, Brazil has overtaken the United Kingdom in terms of economic wealth and is ranked as the sixth wealthiest country in the world. Predictions suggest that by the year 2020, India too will have overtaken the United Kingdom.

b. Bargaining power of suppliers: Telecommunications services in developing countries

The Indian telecommunication sector is known to be one of the most profound economic success stories. The sector has registered a consistent overall growth rate in subscribers of more than 35% over the past decade and is suggested to have had a significant impact on the country's economic growth (Dhage & Prasad, 2013).Growth in the sector has been influenced significantly by public policies, several of which have contributed to the improved access to ICTs by India's poor. The Indian government's policy to enable the sharing of telecommunications infrastructure by the various service providers has resulted in a reduction in the capital investment required to deliver the services and expand the geographical coverage of services. In addition, infrastructure sharing allows providers to deliver the service at a reduced cost to the consumer without compromising the quality of the service (Dhage & Prasad, 2013).

Another noteworthy policy is the Universal Services Obligation Fund that was created to ensure that telecommunication services reach rural populations. As the cost of servicing rural areas is high, and the propensity to pay is low, countries such as India, Uganda, Chile and Malaysia have enforced the policy (Jain, 2012). According to Jain (2012) the amended Indian Telegraph Act, 2003 imposes a levy of 5% of the adjusted gross revenue of telecommunication service providers which the government reserves for the development of

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rural telecommunications services. India's telecommunications sector creates an atmosphere that is conducive for the penetration of mobile services.

In contrast to India, South Africa's telecommunications sector has been highly criticised globally. The telecommunications sector has been historically dominated by the previously state-owned operator, Telkom. Following the country's democratisation, the government of South Africa passed legislation to reform the telecommunications sector, placing priority on enabling access to telephone services by previously disadvantaged citizens (Horwitz & Currie, 2007). A five-year period of exclusivity to achieve this objective was simultaneously awarded to Telkom, which, according to Horwitz and Currie (2007), instead abused their monopoly by eliminating competition in the sector. Subsequent attempts at transforming the sector have had little success in enhancing the competition among operators in the sector, and today South Africa's telecommunications sector performs poorly in relation to its counterparts in Brazil, Russia, India and China (Sutherland, 2012).However, some positive prospects do exist for the market, with the intensity of rivalry among existing mobile carriers increasing, resulting in significantly reduced voice and data costs (TechCentral, 2013).Furthermore, there has been a rapid increase in the number of undersea cables servicing the country (MyBroadband, 2012).As voice services depend on the services of telecommunications providers, a market where adequate competition exists in the telecommunications sector will influence the cost and level of service supporting voice service initiatives. The project piloted in Albertinia is evidence of this. Accordingly, the project incurred high communications costs and was given no support by telecommunications providers in tailoring packages that could support the initiative. India, on the other hand, has seen a multitude of successful voice services and is pioneering research on spoken dialogue systems through its development of the Spoken Web. Government regulation will play a key role in changing the bargaining power of suppliers servicing the voice service market.

c. Threat of new entrants and substitutes: Innovations in the technology and services domain

As with most technologies, the mobile technology landscape is dynamic. With research being undertaken on the recycling of smart phones (Li, Ortiz, Browne, Franklin, Oliver, Geyer et al, 2010), comparisons between voice and text-based services in developing countries and even the enhancement of services available to basic feature devices such as Unstructured Supplementary Service Data (USSD), the potential for services and devices that will substitute or compete with voice services cannot be discounted. Furthermore, research into voice services for developing countries must not overlook the idea that the cost of mobile phones with Internet access may decrease over time. Changes, such as new innovations, shifts in the costs of devices, or enhancements that extend the capabilities of existing devices, will have an effect on the demand for voice services, either by competing with the voice services for a share of the user segment, or by substituting the voice servicing market altogether.

5. Conclusion

Spoken dialogue systems show great promise for developing countries in terms of their ability to deliver information services to those that remain underserved by the Internet. Projects that have been undertaken in developing countries have demonstrated a high level of acceptance

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by their users; however, the ability of voice services to become widely adopted without the intervention of researchers requires an evaluation of the context within which the service is implemented. The proposed model does not exhaustively prescribe the exact issues that will influence each force; however, based on circumstances in developing countries it can provide an organisation with a guideline on the fit between voice services and the context within which they are applied. The model suggests that the main factors determining the success of voice-based initiatives include the level of competition among telecommunications operators, the degree and effectiveness of regulation by government, the economic power of the consumer, the levels of literacy within the society, and innovations within the technology domain. In addition, the study found the degree of usability, usefulness and alignment of the service with the context of its application to be factors that will influence the adoption of voice services by individuals or groups.

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