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

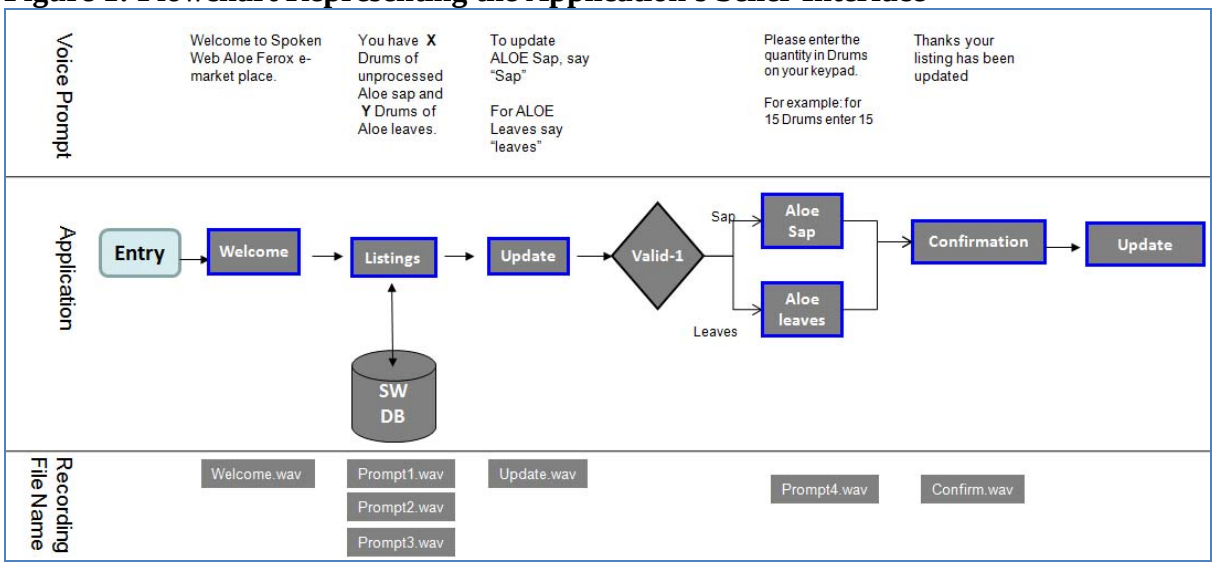
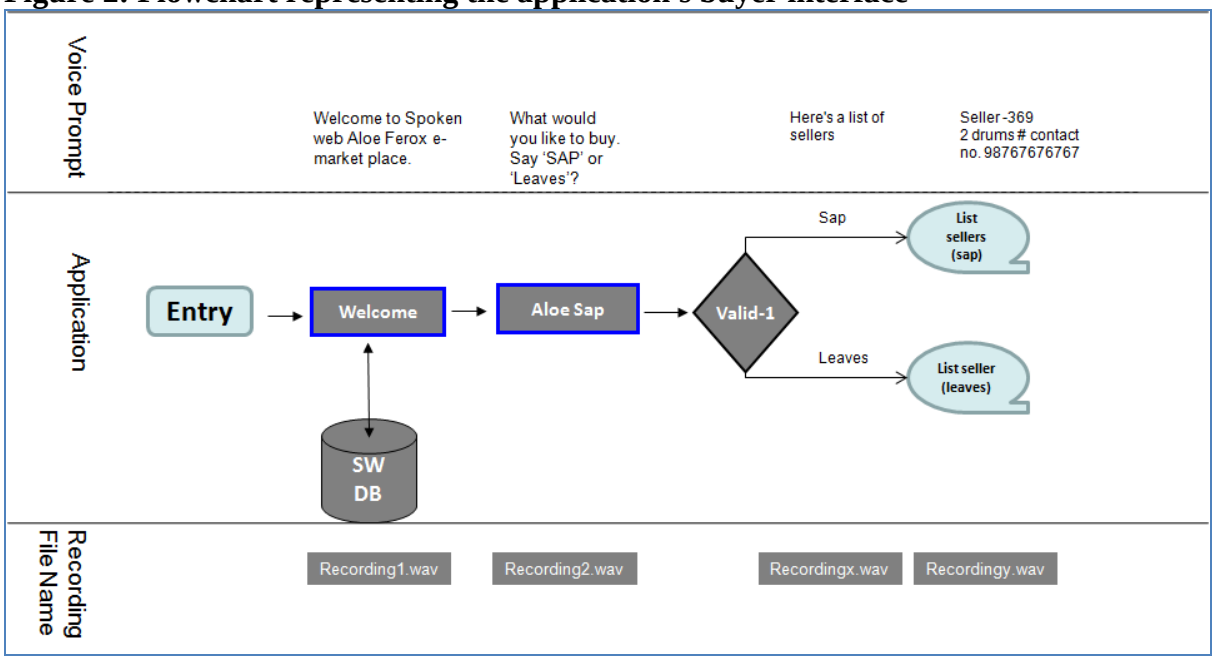


Figure 2: Flowchart representing the application's buyer interface



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.

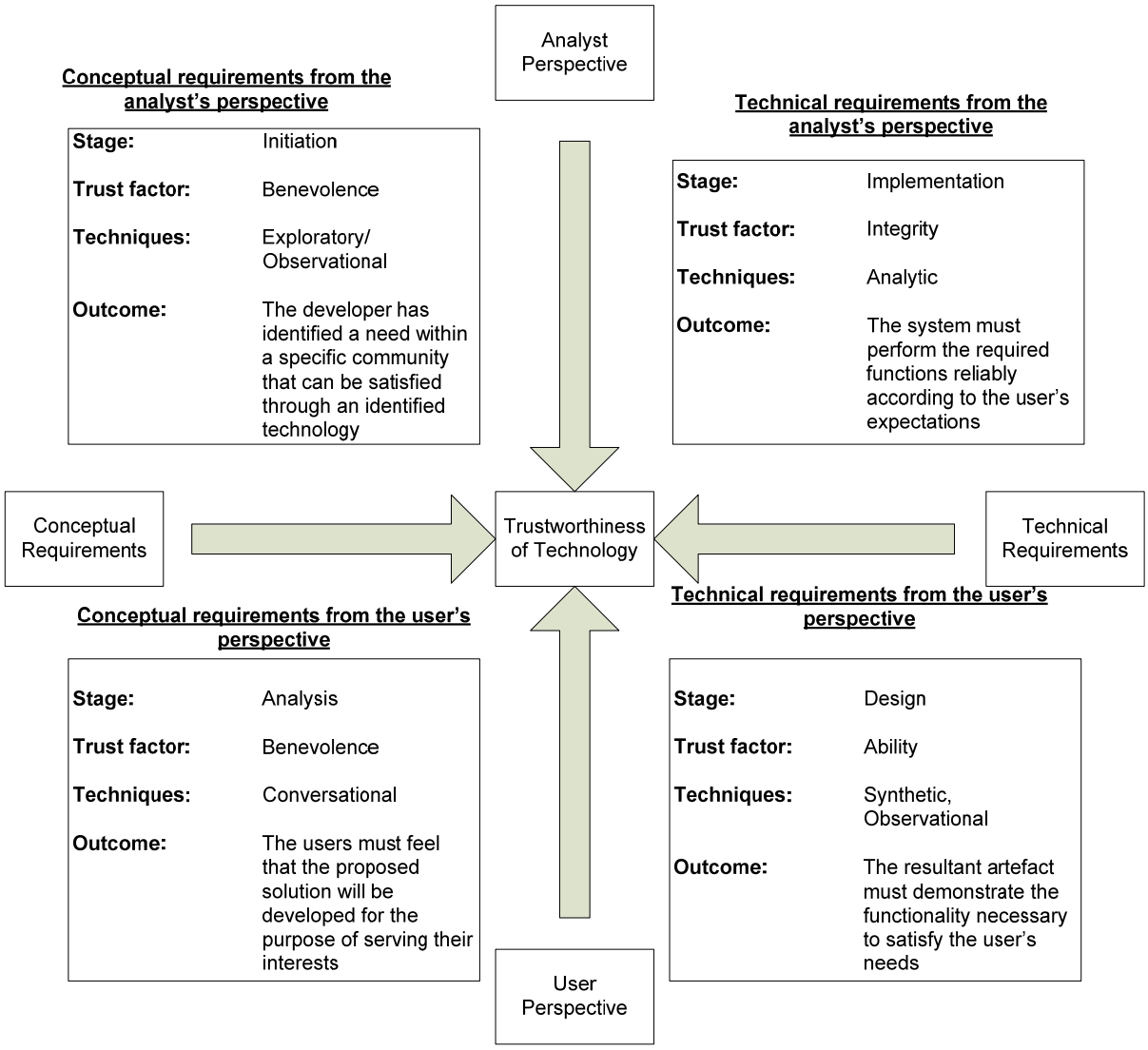


Figure 3: A model for building technology trust through requirements management

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.

8. REFERENCES

Argawal, S.K., Kumar, A., Nanavati, A. and Rajput, N. (2010). *Spoken Web: A Parallel WWW in Developing Regions.* http://www.w3cindia.in/conf-site/Nitendra_rajput_--Spoken Web - A Parallel WWW in Developing Regions.pdf

Avgerou, C. (2010). Discourses on ICT and Development. *Information Technology and International Development* , 6, 3, 1-18.

Azmi, A.A. and Kamarulzaman, Y. (2010). Adoption of Tax E-Filing: A Conceptual Paper. *African Journal of Business Management,* 4, 5, 599-603.

Azzam, Z.A. (2013). Manager's Perspectives towards Perceived Risks Associated with Technology Based Self Services. A Case of Jordan Banks. *Interdisciplinary Journal of Contemporary Research in Business* , 4, 11, 46-64.

Bajpai, N. (2011). *Business Research Methods.* India: Pearson Ed.

Baskerville, R.L. and Wood-Harper, T. (1996). A Critical Perspective on Action Research as a Method for Information Systems Research. *Journal of Information Technology*, 11, 235-246.

Baskerville, R.L. and Myers, M.D. (2004). Special Issue on Action Research in Information Systems : Making IS Research Relevant To Practice - Foreword. *MIS Quarterly*, 28, 3, 329–335.

Canavari, M.F. (2008). The Role of Trust in the Transition from Traditional to Electronic B2B Relationships in the Agri-Food Sector. *4th International Conference on Information and Communication Technologies in Bio and Earth Sciences.*

Christel, M. and Kang, K. *Issues in requirements Elicitation.* Carnegie Mellon Software Engineering Institute.

Davison, R.M., Martinsons, M.G. and Kock, N. (2004). Principles of Canoncial Action Research. *Information Systems Journal*, 14, 1, 65–86.

Delgado-Ballester, E., Munuera-Aleman, J.L. and Yague-Guillen, M.J. (2003). Development and Validation of a Brand Trust Scale. *International Journal of Market Research* , 45 1, 39-44.

Featherman, M.S. and Pavlou, P.A. (2003). Predicting e-Services Adoption: A Perceived Risk Facets Perspective. *International Journal of Human-Computer Studies* , 59, 451-474.

Friedman, B., Kahn, P.H. and Howe, D.C. Trust Online. *Communications of the ACM,* 43, 12, 34-40.

Gefen, D., Karahanna, E. and Straub, D.W. (2003). Trust and TAM in Online Shopping: An Integrated Model. *MIS Quarterly,* 27, 1, 51-90.

Grant, D. (2012). Shortening Requirements Engineering: Dual Imperative Action Research Study. *The Journal of Computer Information Systems*, 53, 2, 1-8.

Heeks, R. (2002). Failure, Success and Improvisation of Information Systems Projects in Developing Countries. *The Information Society: An International Journal,* 18, 2, 101-112.

Humphrey, J., Mansel, R., Paré, D. and Schmitz, H. (2003). *The Reality of E-commerce with Developing Countries.* London School of Economics and Institute of Development Studies. Sussex: UK Department for International Development's Globalisation and Poverty Programme.

International Fund for Development. (2008). *How Agro-Industry Can Help Eradicate Poverty.* New York: UN Commission on Sustainable Development Discussion Paper.

Isabirye, N. (2009). A Model for Requirements Elicitation Specific to Users in Rural Areas. *Masters Thesis*. East London, South Africa: University of Fort Hare.

Isabirye, N. and Flowerday, S.F. (2008). A Model for Eliciting User Requirements Specific to South African Rural Areas. *Proceedings of the 2008 Annual Research Conference of the South African Institute of Computer Scientists and Information Technologists on IT Research in Developing Countries: Riding the Wave of Technology* (pp. 124-130). Wilderness: ACM.

Kaden, R. (2006). *Guerrilla Marketing Research: Marketing Research Techniques That Can Help Any Business Make More Money*. Kogan Page Publishers.

Kamau, M. (2013). Mistrust Slowing Down Uptake of Mobile Money on other African Countries. http://www.standardmedia.co.ke/business/article/2000098039/mistrust-slowing-down-uptake-of-mobile-money-on-other-african-countries

Kenzi, K., Soffer, P. and Hadar, I. (2010). The Role of Domain Knowledge in Requirements Elicitation: An Exploratory Study. *MCIS 2010 Proceedings.*

Lewin, K. (1946). Action Research and Minority Problems. *Journal of Social Issues* , 2, 4, 34-46.

Li, X., Rong, G. and Thatcher, J.B. (2009). Do We Trust the Technology? People? or Both? Ruminations on Technology Trust. Proceedings of the 15th *Americas Conference on Information Systems Proceedings.*

Lim, N. (2003). Consumers' Perceived Risk: Sources versus Consequences. *Electronic Commerce Research and Applications*, 2, 3, 216-228.

Lu, H., Hsu, C. and Hsu, H. (2006). An Empirical Study of the Effect of Perceived Risk upon Intention to Use Online Applications. *Information Management and Computer Security,* 13, 2, 106-120.

Maiden, N.A. and Rugg, G. (1996). ACRE: Selecting Methods for Requirements Aquisition. *Software Engineering Journal,* 11, 3, 183-192.

Mallalieu, L. (2005). An Examination of the Role of Customer Attributions in Understanding Trust Loss and Recovery in Buyer-Seller Relationships. *Supply Chain Forum: An International Journal,* 6, 2, 68-80.

Marakas, G.M., Johnson, R.D. and Palmer, J.W. (2000). A Theoretical Model of Differential Social Attributions toward Computing Technology: When the Metaphor Becomes the Model. *International Journal of Human Computer Studies,* 52, 719-750.

Martin, B. and Hannington, B. (2012). Universal Methods of Design: 100 Ways to Research Complex Problems, Develop Effective Solutions. Rockport Publishers.

Mayer, R., Davis, J. and Schoorman, F. (1995). An Integrative Model of Organizational Trust. *Academy of Management Review,* 20, 3, 709-734.

McKnight, D.H., Carter, M., Thatcher, J.B. and Clay, P.F. (2011). Trust in a Specific Technology: An Investigation of its Components. *ACM Transactions on Management Information Systems*. 2, 2, 12-32

McKnight, D.H. (2005). Trust in Information Technology, in Davis, G.B. (Ed.), *The Blackwell Encyclopedia of Management, Management Information Systems, Malden, MA: Blackwell.* 7, 329-331.

Melrose, M.J. (2001). Maximizing the Rigor of Action Research: Why Would You Want To? How Could You? Field Methods, 13, 2, 160–180.

Mgalama, P.V. (2014). The Role of Agricultural Extension Services in Socio-Economic Development of East Africa: A Critical Review. *Africanus: SA ePublications*, 44, 1, 53-64.

Pavlou, P.A. (2003). Consumer Acceptance of Electronic Commerce: Intergrating Trust and Risk with The Technology Acceptance Model. *International Journal of Electronic Commerce,* 7, 3, 69-103.

Seger, C. A. (1994). Implicit Learning. *Psychology Bulletin,* 115, 2, 163-196.

Shackleton, C.M. and Gambiza, J. (2007). Growth of Aloe Ferox Mill at Selected Sites in the Makana Region of the Eastern Cape. *South African Journal of Botany,* 73, 2, 266-269.

Stebbins, R.A. (2001). *Exploratory Research in Social Sciences.* Sage Publications.

Warfel, T.Z. (2009). *Prototyping.* Rosenfeld Media.

Wilfrid, A. and Edwige, K. (2004). The Role of Agriculture in Economic Development in Developing Countries: Case of China and Sub Saharan Africa. *Journal of Agriculture and Social Research*, 4, 2, 1-18.

Zhang, Z. (2007). Effective Requirements Development- A Comparison of Requirements Elicitation Techniques. *Software Quality Management XV; Software Quality in the Knowledge Society*, 225-240.