LIGHTWEIGHT FRAMEWORK FOR MOBILE DOCUMENTATION OF VERY SMALL ENTERPRISE BUSINESS TRANSACTIONS

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This dissertation is dedicated to my little' Bees:

Bonolo & Bokang Malesego Ndhlovu

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With heartfelt gratitude,

Brenda *Hunadi* Malese Mashego

DECLARATION

I hereby declare that the dissertation submitted for the degree of Master in Information Technology at the Department of Information Technology, Faculty of Accounting and Informatics at Durban University of Technology, Durban, South Africa, is my original work and has not been previously submitted to any other institution of higher learning by other persons or myself. I further declare that all the sources cited and quoted have been acknowledged accordingly by means of a list of references and footnotes. Furthermore, this research was conducted with continuous inputs from projects conducted under the flagship of SAP Research Pretoria. However, the output of this work and the views portrayed in this research are those of the researcher in the context of this research and do not necessarily reflect the view and opinions of SAP Research, Pretoria.

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List of Abbreviations

Abbreviation	Description
API	Application Program Interface
BSR	Behavioural Science Research
CSE	Computer self-efficacy
CRM	Customer Relationship Management
DSR	Design Science Research
ERP	Enterprise Resource Planning
GDP	Gross Domestic Product
GEM	Global Entrepreneurship Monitor
GUI	Graphical User Interface
HTTP	Hypertext Transfer Protocol
ICT	Information and Communication Technologies
ICT4D	ICT for Development
IS	Information Systems
JSON	JavaScript Object Notation
KM	Knowledge Management
MVCC	Multi–Version Concurrency Control
OECD	Organisation for Economic Co-operation and Development
OMG	Object Management Group
REST	Representational State Transfer
SAP	Systems Applications and Products
SCM	Supply Chain Management
SMME	Small, Medium and Micro Enterprises
SMS	Short Message System
SQL	Structured Query Language
UML	Unified Modelling Language
VSE	Very Small Enterprise (s)

ABSTRACT

In this study, an investigation was conducted to determine an appropriate lightweight framework that could adequately support Very Small Enterprises (VSEs) in documenting their daily business transactions. The VSEs play a significant role in the socioeconomic development of nations by providing employment opportunities. They contribute to the Gross Domestic Product (GDP) and provide a platform for entrepreneurial skills advancement. However, VSEs have very little access to innovative Information and Communication Technology (ICT) that could help to address the unique challenges that prohibit their growth and sustainability. In many instances, the documentation of VSEs business transactions is still lacking. This deficiency promotes insufficient, unreliable and untraceable business transaction records which ultimately affect the smooth growth and sustainability of VSEs. Mobile technology provides the VSEs with a unique opportunity because of its support for mobility and low costs of system procurement. Moreover, mobile technology can enable easy connection, access and retrieval of VSE services even in the resource constrained environments anytime and anywhere. However, the inherent limitations of mobile devices such as device size, storage size, computing power and battery lifespan have forced many of the existing ICT business applications to continually rely on desktop computers. The desktop computer applications are huge, complex and not compatible with the current mobile devices. The Design Science Research (DSR) method was used to understand how VSEs conduct their daily business transactions, discover essential factors that influence the business processes of VSEs and derive a lightweight framework for mobile documentation of VSE business transactions. The lightweight framework was prototyped as ICT artefact and evaluated to determine the adoption of mobile applications by VSEs for documentation of daily business transactions. The evaluation results revealed the developed lightweight framework to be effective for mobile documentation of VSEs business transactions.

CHAPTER 1 : INTRODUCTION

This dissertation reports the original development of a lightweight framework to support Very Small Enterprises (VSEs) in adequately documenting their daily business transactions using mobile devices. The original intention is to provide a prototype model that is lightweight, easy to use and flexible to accommodate the growing small business diversities. In this study, a lightweight framework refers to a software application that is small in size to distribute, simple to use and one that utilizes fewer computing resources to produce the required functionality.[1] The proposed lightweight framework therefore should enable VSEs to record, view, retrieve and conduct business transactions more effectively. The VSEs play a significant role in the socioeconomic development of nations by contributing to the significant fraction of national Gross Domestic Product (GDP). In addition, they provide employment opportunities and a platform for entrepreneurial skills advancement (OECD, 2010; Herrington, Kew & Kew, 2009). More importantly, VSEs provide services and trade products that are needed by the society at large.

The South African National Small Business Act, 26 of 2003 define VSEs as small businesses that employ 20 or less employees (Guarantee Trust Hypertext Systems, 2009) including formal, informal, non-registered and survivalist businesses classified in the Small, Medium and Micro Enterprises (SMME) sector. VSEs are businesses that have unique emerging economic challenges such as limited ICT resources, uncertain financial growth (Herrington, Kew & Kew, 2009; Esselaar, Stork, Ndiwalana & Deen-Swarray, 2007; Al Berry, Cassim, Kesper, Rajaratnam & Van Seventer, 2002), low literacy levels and hard to reach *via* conventional business strategies (Prahalad & Hart, 2009). The VSEs have the capability to decrease unemployment, boost economic development and alleviate poverty in many poor communities (Wolf, 2001). However, many hurdles still hinder successful growth and sustainability of VSEs. Among the obvious challenges that VSEs face, are: lack of institutional support and funding; access to new business opportunities and the required information; skills and efficient ICT infrastructure to ensure longevity; and sustainability of the business (Tlhomola, Rankhumise & Van Niekerk, 2010). Olawale & Garwe (2010) identified the lack of ICT investment and resources as the major factors that hinder the growth and sustainability of small businesses.

[1] http://whatis.techtarget.com/definition/lightweight
http://www.airytec.com/en/

Although ICT plays an important role in business enterprises, VSEs are often marginalized, especially with regard to accessing ICT resources that could address the unique challenges which prohibit their growth and sustainability (Heeks, 2009; Dagdilelis, Satratzemi & Evangelidis, 2003). The benefits that render ICT a major commodity for many enterprises seem less significant to VSE (Dagdilelis *et al*, 2003). The VSEs have little access to relevant and innovative ICTs that are tailored to address the unique challenges that prohibit their growth and sustainability. The business needs and resources of VSEs are not the same for large enterprises. The majority of ICTs found in the market are too complex, expensive and proprietary to accommodate the diverse contexts of the VSEs' business and resources (Kew & Herrington, 2009). There is a lack of suitable software systems currently on the market that adequately support the requirements of small businesses in the first three stages of their life cycles. Once these organizations reach a certain level of maturity, they are better positioned to use traditional desktop based business software systems (Scott & Bruce, 1987; Churchill & Lewis, 1983). However, getting the accurate business transaction information is essential to these organizations especially in their early life cycles. In many instances, VSEs are not formalized in terms of documenting their business transactions. The documentation of VSE business transactions is still lacking especially when focusing on VSEs that are the least digitalized. Proper recording and management of business transactions is critical to ensure efficiency and sustainability of a VSE; however, providing relevant ICT for VSEs also introduces other inherent challenges.

Current ICT business systems are not adopted by VSEs because of inadequate financial capital, lack of basic computer literacy skills and easy access to basic computing technologies among other constraints. Commercial off-the-shelf systems are often too proprietary for the diverse context of VSEs. It is evident that VSEs would not find sufficient value in adopting and utilizing these systems. These application systems are designed with inbuilt presumptions of business practices, policies and logic, thus forcing the enterprise to adhere to the prescribed system and business processes rather than the system catering for the specific needs and business processes of the enterprise. Custom systems are tailored for the particular needs and business practices of the enterprise but their development and deployment often involve huge costs for the small enterprise (Moshapo & Ngassam, 2008). Business Transaction Management (BTM) and Enterprise Resource Planning (ERP) systems are more suited for large enterprises because of high costs and extensive ICT infrastructures required for implementation. Some scaled down computer or web based basic accounting packages may offer basic accounting and administration functionalities, but they require

running on a computer and basic training that may incur more costs and administrative overhead for VSEs. Consequently, VSEs that do not have business accounts or personal computers with reliable internet connection cannot leverage these systems.

Research findings have revealed that many small businesses use mobile devices for connectivity and business purposes because of their high mobility and low costs (Kew & Herrington, 2009; Esselaar *et al*, 2007). Today a number of initiatives can be observed regarding how mobile devices may be used to influence the manner in which small businesses perform their business operations. One of the key advantages of mobile devices is that they require less training to utilize (Brewer, Demmer, Du, Ho, Kam, Nedevschi, Pal, Patra, Surana & Fall, 2005). This accommodates the low literacy population especially those with little or no access to a personal computer (Sinha, 2005). The ubiquitous pervasiveness and wide proliferations of mobile technologies provide a unique opportunity to deliver value added services (Blycroft, 2008) to improve VSEs' business processes. The functionalities, affordability and wireless connectivity of the mobile device makes emerging mobile technologies more directly appropriate especially in resource constrained environments for VSE to flourish. As a result, there is a need to provide innovative ICT systems that focus on the specific conditions and varied challenges (Heeks, 2009) of enterprises in emerging economies.

Mobile application systems provide a unique opportunity to achieve ubiquitous services and have the potential to turn current environments into ubiquitous ones. This can enable the realization of widely accessible and cost effective services anytime, anywhere. Moreover, mobile applications can enable easy connection, access and retrieval of mobile services even in resource constrained environments. It could therefore provide the means to develop simple, effective and affordable mobile systems to seamlessly support the documentation of VSE's business transactions. However, the inherent limitations such as device size, storage size, computing power and low battery life have forced many ICT applications to continuously rely on desktop computers and do not cater for the needs of VSEs. Desktop software applications are huge, often complex and not compatible with the current mobile devices (Kew & Herrington, 2009). Developing novel systems for mobile devices requires flexible and innovative mobile applications that will allow users to not only view, but also to analyse and manipulate data (Baudisch & Holz, 2010). The numerous challenges facing VSEs to access ICT for their daily transactions have motivated the development of a lightweight framework for mobile documentation of VSE business transactions.

1.1 Problem Statement

The most reliable means to support a business is to document the transactions on a regular basis (Giandon, Junior & Scheer, 2002). Timely and accurate data play a paramount role in efficient management of many different forms of business activities (Mourao & Okada, 2010; Esselaar *et al*, 2007). The VSE are often unable to provide accurate information regarding their business operations because of a lack of record keeping (Esselaar *et al*, 2007) especially in the case of those VSEs that are least digital and do not employ effective automated administrative measures in managing their daily business operations. The lack of effective documentation practices promotes insufficient, unreliable and untraceable business transactions and leads to poor utilization and consolidation of business resources. These challenges ultimately hinder the growth and sustainability of the businesses that are conducted by VSEs.

This study posits that VSEs do not properly document their daily business transactions by electronic means because of a lack of effective administrative and record keeping practices and skills. VSEs are mostly accustomed to *ad hoc* business transactions and manual paper based documentation of their business transactions, they therefore cannot effectively manage and keep track of the products and services rendered to their customers. Manual paper based and *ad hoc* business transactions promote huge setbacks as they are prone to a lot of data inaccuracy issues and inconsistencies in managing the daily business transactions (Mourao & Okada, 2010). This study has attempted to solve the following research question: What technology framework can be developed to effectively support the documentation of daily business transactions of very small enterprises?

1.2 Research Goal and Objectives

The prime research goal of this study is to develop a lightweight framework for mobile documentation of business transactions of VSEs. In order to accomplish the research goal and ultimately derive a system for mobile documentation of VSE business transactions, the following are the research objectives.

- To understand how VSEs conduct their daily business transactions together with those factors influencing their business processes.
- To develop a lightweight framework to enable VSEs to remotely document their business transactions through mobile device interfaces.
- To evaluate the efficacy of the developed lightweight framework for mobile documentation of VSE business transactions.

1.3 Research Method

The development of Information Systems (IS) in the business context is deeply rooted in changing the existing situations into preferred ones (March & Storey, 2008). The IS discipline is comprised of two research paradigms, mainly: Behavioural Science Research (BSR), and Design Science Research (DSR). BSR is concerned with the underlying truth and theories that inform researchers of the interactions among people, technology and organizations that must be managed for the IS to improve efficacy of an organization. DSR addresses research through the construction, utility and evaluation of artefacts designed to address the identified problems (Hevner, March, Park & Ram, 2004). Hevner *et al.* (2004) posits that DSR is a problem solving paradigm that seeks to create innovations which define capabilities and products through which the use of IS can be effectively accomplished.

This study was guided by the DSR paradigm using modelling methodology to derive a lightweight framework based on data requirements that are deduced from the preliminary interactions and observation practices (Cooper & Schindler, 2006) with VSEs through the SAP Rustica Project living lab[2] in Sekhukhune, Limpopo province in South Africa. DSR

[2] More on project Rustica at http://scn.sap.com/docs/DOC-26153

focuses on the application of ICT artefacts to solve organizational problems. The validity and utility of the artefact was then evaluated based on whether or not it solved the identified problem or improved the current situation (Hevner *et al*, 2004). In order to form a solid base, a theoretical investigative method was used to understand how VSEs conduct their daily business transactions and those factors that influence their business processes. The rationale was premised on the view that one cannot satisfactorily assume the challenges of an enterprise without taking into cognisance the internal and external factors that influence the nature of the business.

Ellis & Levy (2010) assert the importance of anchoring design and development of artefacts in theory and literature, therefore, in order to develop the lightweight framework, design and development oriented research paradigms were examined (Ellis & Levy, 2010; Peffers, Tuunanen, Rothenberger & Chatterjee, 2007; Hevner *et al.*, 2004; Oates, 2006; Hasan 2003). This was in reference to software engineering and development practices (Bruegge & Dutoit, 2004; Satzinger, Jackson & Burd, 2000). The study method followed a systematic design based process while maintaining a proper scholarly research process. DSR emphasizes the design, evaluation and use of innovative ICT artefacts, however, the process involves a disciplined research investigation rather than product development. Both DSR and product development results in the development of some artefact but the systematic documentation of the design process is one of the factors that distinguishes design based research from product development (Hevner *et al.*, 2004). The DSR is geared towards a technology driven development with a sound focus on problems, how those problems are perceived by those affected, and the context of how these problems manifest themselves (Venable, Pries-Heje, Bunker & Russo, 2011). The process begins with the identification of an appropriate research problem, the design of the system and concludes with an evaluation of the impact of the artefact in addressing the problem.

Crucial to the method of this study, was the adoption of Unified Modelling Language (UML)[3] as a useful tool to model, visualize and represent the blueprint of the conceptual lightweight framework. The motivation was to provide a lightweight mobile system that allows for the transparency of transactions to flow between the end device and backend without the user being exposed to the complexity of the backend infrastructure. The study

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http://euroafrica-ict.org/files/2010/06/Christian-Merz.pdf

[3] http://www.uml.org/
http://www-01.ibm.com/software/rational/uml/

method also incorporated lightweight components that are not heavy for mobile devices to smoothly render recording of business transactions, and the effective capture and display of images. Finally, the lightweight framework was evaluated through implementing a prototype system (Olivier, 2009) to test the efficacy of lightweight framework as a solution to the research problem identified.

1.4 Rationale of the study

The rationale for the study was motivated by the exposure of the researcher in the various research projects under the flagship of the ICT software company: SAP (Systems Applications and Products) Research Africa: Mobile Empowerment Unit. The Unit's research mandate focused on various research projects especially in emerging economies. The researcher became interested in exploring and understanding the context and business environment of VSEs in the retail and service sectors. There is relatively very little research and attention on ICT in the VSE and broader Small and Medium (SMME) business domain. Research regarding understanding the determinants and application of ICT artefacts in the VSE domain is almost overlooked. This has provided an interesting aspect to research a field where the applicability of mobile ICT is not yet prevalent.

1.5 Significance of the study

The significance of this study is in improving the sustainability of VSEs through the application of ICT artefacts. The systematic documentation of the research process, application of the implemented lightweight framework and results of the evaluation of the study will greatly contribute to the ICT knowledge domain. In particular, the significance of this study is obvious in ICT for development (ICT4D) by spreading the viral interest in computing among SMMEs and more especially, the VSEs. The results of this study will promote an interest in research projects that are geared towards addressing various problems in the VSE business domain. This can also pave the way for future research on innovative technologies for VSE especially from an emerging economies perspective.

1.6 Scope of the study

The scope of the study is limited to VSE in the retail sector. The definition of business transaction[4] is provided as an economic activity that initiates the task of recording the transaction in the company's accounting system. In this study, the scope of business transactions is scaled down with a specific focus on in-store sales transactions. All other transactions that are documented are directly related to the sale of a product in the VSE.

1.7 Contributions of this study

The development of a lightweight framework for mobile documentation of VSE transactions is a unique contribution of this study. The study also contributes to promoting the sustainable development of VSEs while introducing ICT skills and computing applications among VSEs. In addition, the study method may aid developers to uniformly build mobile documentation system for small enterprises, thereby promoting the socio-economic impact of ICT on small enterprises. Lastly, the dissemination of the research results will contribute toward knowledge sharing in the ICT field.

1.8 Synopsis

This chapter introduces the background on VSEs to provide the foundation for VSE research, the context of the problem and scope of the study. In particular, Section1.2 outlines the goals and objectives of the study. The study method is introduced in Section 1.3. Section1.4 provides the rationale and motivation for the study. The significance and potential contributions of the study are discussed in Sections 1.5 and 1.6 respectively. The remainder of this dissertation is structured as follows. Chapter 2 discusses the related literature on VSEs and the factors that influence the adoption of ICT among VSE in general. The Chapter further elaborates on the varied ICT software for VSE and including the potential opportunities of the ubiquitous computing through mobile technologies. Chapter 3 provides the systematic documentation of the research design and holistic approach that is followed in modelling the

[4] Definition of Business Transaction available at http://www.businessdictionary.com/definition/business-transaction.html

prototype system for mobile documentation of VSE business transaction. The Chapter further unpacks the theoretical frameworks that guided the research and how the Design Science Research (DSR) Methodology was followed in designing the prototype system. Chapter 4 presents the implementation of the prototype system and presents the design process and the related models. Moreover, the chapter presents the implementation of the prototype from the models. Chapter 5 discusses the evaluation strategy and criteria employed in assessing the utility and validity of the artefact in addressing the research problem and the results thereof. The chapter further elaborates on the insights from the evaluation results. Chapter 6 concludes the research study with discussions and insights from the research process. The chapter also presents the reflections of the research, limitations of the research study and concludes with recommendations further research.

CHAPTER 2 :
OVERVIEW OF ICT ADOPTION AMONG VSES

This chapter provides an overview of literature on the adoption or more specifically, acceptance and use of ICT among VSEs to form a theoretical basis for the study. Literature overview is deemed a critical exercise and important phase of a research process as it allows for theory development and to uncover gaps among the plethora of research (Levy & Ellis, 2006; Webster & Watson, 2002). This chapter elaborates on VSEs and entrepreneurship issues from a broader SMME perspective. The chapter unpacks the concept of VSEs in the study and explores the determinants and challenges that inhibit access to ICTs among VSEs. The rationale is that one cannot satisfactorily assume the operations of an enterprise without taking into consideration the individual characteristics and nature of businesses including those challenges that hinder the smooth growth of small enterprises in general. In order to address some of the challenges that affect VSEs, an exploratory literature study was conducted to understand those essential internal and external factors that affect the smooth growth of VSEs.

This chapter mainly covers four essential sections. Section 2.1 provides the background on VSEs and SMMEs in general and the related challenges that hinder the growth of SMMEs. The emphasis on the critical business processes and business transactions documentation practices throughout the various stages of the business. Section 2.2 covers the determinants of ICT adoption among small enterprises with an emphasis on the drivers of ICT and the related barriers of ICT adoption among small enterprises. Section 2.3 covers the relevant ICT software systems that could be leveraged by VSEs to document their business transactions. The section takes a deeper look at Customer Relationship Management (CRM), ERP and the relevance of mobile technologies in the SMME sector, including the benefits and limitations with respect to their implementation and adoption for the context of VSEs. Section 2.4 concludes by summarising the important issues regarding VSEs.

2.1 Background to VSEs

It is an undisputed fact that small and medium sized enterprises have become the backbone for economic development in most developing regions. These small businesses make up a prominent portion of enterprises in most countries with low *per capita* income and their steady growth and sustainability is critical towards the economic prosperity of nations (OECD, 2010; Herrington Kew & Kew, 2009; Jagun, Heeks & Whalley 2008; Weiner & Rumiany, 2007; Allan, Annerar, Beck & Beveren, 2003). VSE contributes valuable products and services to communities and the global trade industry (Laporte, Alexandre & Renault, 2008). The view that the VSE sector is not a viable market also fails to take into account the prominent role that these small enterprises play by providing numerous employment opportunities especially among the poor communities.

Economic growth for nations lies in the increase in the amount of goods and services produced by an economy over a certain period and is measured as the percentage rate of increase in Gross Domestic Product (GDP). It can be concluded that African economies are growing and this creates opportunities for innovative and economic investments especially in the small businesses sector. For instance, the South African Department of Trade and Industry (DTI) Annual Review Report (Republic of SA DTI Report, 2008) on small enterprises reveals that overall, SMMEs accounted for about 27-34% of the country's GDP by 2006. The growth of the SMME sector was recorded at a steady 27% from approximately 422 000 to 536 000 active SMMEs. VSEs accounted for approximately 46% of the known number of economically active SMME although some VSEs operate in the informal sectors and some are not officially registered and recognized by legislation. In South Africa only, the Statistics SA Integrated Business Register reports the steady growth of 47.9% between 2004 and 2007. The number of registered VSEs increased from 170,338 to 251,920. Table 1 below illustrates the growth of SMMEs by category.

Enterprise category	Integrated Business Register 2004		Integrated Business Register 2007		Percent growth 2004-2007
	Count	Percent	Count	Percent	
Micro Enterprises	212,161	50.3%	200,377	37.4%	-5.6%
Very Small Enterprises	170,338	40.4%	251,920	47.0%	47.9%
Small Enterprises	32,397	7.7%	63,193	11.8%	95.1%
Medium Enterprises	6,748	1.6%	20,750	3.9%	207.5%
Total SMMEs	421,644	100%	536,240	100.0%	207.5%

Table 2-1: SMME population by category.
Adopted from Statistics SA Integrated Business Register, 2007

Despite the steady growth, there is still a huge concern regarding the number of small businesses that fail in their early years of operation (Republic of South Africa-DTI report, 2008; Herrington, Kew & Kew, 2009). Very few achieve sustainable growth as most are short lived (Ping & Debin, 2010). Scott & Bruce (1987) and Churchill & Lewis (1983) outlined the various growth stages of small businesses from inception to survival, expansion, growth and maturity. The Global Entrepreneurship Monitor Report (Herington, Kew & Kew, 2009) and the ICT and Entrepreneurship Report (Kew & Herrington, 2009) revealed that many small enterprises fail to progress beyond the inception and survival phases due to varied contributing factors. These small enterprises do not reach the growth and maturity stages because of various challenges and contributing factors. Some of the challenges that SMMEs are faced with include restrictive policies to register a small business, limited access broader markets especially for the disconnected and informal small businesses (Muto & Yamano, 2009), and lack of institutional support such as micro financing. Other challenges include low skill levels and also lack of appropriate ICTs to process and disseminate information (Herrington, Kew & Kew, 2009, Republic of South Africa- DTI report, 2008). Successful performance of small enterprises in the business environment is influenced by the ability of the business to respond flexibly to customer demands and the ability to produce innovative products and services (Antlova, 2009; Laporte, Alexandre & Renault, 2008; Wadood & Shamsuddin, 2012).

VSEs are businesses that have unique emerging economy challenges and are regarded as high risk because of uncertainty in terms of profit, organisational growth and success. They have limited access to quality ICT resources and often involve owners and service providers with low literacy levels (Prahalad & Hart, 2010). Their nature of business involves a lesser degree of formality because of dynamic, paper based and *ad hoc* business processes and services tailored to meet customer needs and demands. Planning and administration of business processes tend to be informal, sporadic and done in an *ad hoc* manner solely by the business owner or manager. This poses a huge limitation of the aggregation and dissemination of information (Antlova, 2009; Parikh & Lazowska, 2006). They may not keep a record of business transactions and often cannot distinguish between business and personal finances (Prahalad & Hart, 2009; Heeks, 2009; Herrington, Kew & Kew, 2009, Esselaar *et al.*, 2007; Al Berry *et al.*, 2002). This creates a huge gap where there is very little evidence of the business transactions and related financial documentation to support the business (Esselar *et al.*, 2007; Giandon, Junior & Scheer, 2002). Inherently, the lack of documentation and record keeping poses another challenge with legislation and tax authorities. Often those businesses that do not have effective documentation procedures in place are unable to seek financial support from institutions because of lack of supporting documentation. Esselaar *et al.* (2007) study reveals that some entrepreneurs are unable to provide accurate information regarding their business transactions because of a lack of record keeping.

Some VSE entrepreneurs are familiar with most of their customers but they do not capture any details about them or track their individual transactions. The information communicated during and after trading is extremely critical for VSEs to leverage that information to grow their business and also to improve their personalized services and products to their consumers (Jagun, Heeks & Whalley, 2008). This informality which involves no bookkeeping or formal documentation also negatively impacts on customer attraction and retention (Donner, 2007). It becomes very challenging to operate a business or to manage business information and finances without any administrative strategies or systems in place. Those VSEs that lack efficient business administration and management practices are plagued with financial problems like illiquidity and shortage of working capital.

It can also be argued that accurate and timely information can lead to informed decision making and improved performance within the small business (Deakins, Logan & Steele, 2001). However, the nature of VSEs often promotes flexibility to adapt to dynamic business markets and their customers' ever changing needs (Antlova, 2009). According to Allan *et al.* (2003), this is an advantage as they can provide more personalized services and

products to their customers. Their size and dynamic nature also allows for the testing of new business models and processes without adopting formalized business process reengineering regimes as compared to large enterprises. The SMMEs that have the ability to quickly respond to the constant changes and demands in the business environment have a greater competitive advantage compared to those who are unable to be as flexible as other SMMEs or larger enterprises (Antlova, 2009). Some of the characteristics of small and medium sized enterprises include but are not limited to the following (Antlova, 2009):

- They have the ability to work as subcontractors of large enterprises.
- They can adapt quickly to business requirement and changing markets.
- They can work in marginalized areas of the market that are not attractive for larger enterprises.
- Some SMMEs tend to have fewer resources available to implement ICT.

SMMEs have a limited life expectancy and growth is highly dependent on various factors such as human, financial, information and technological advances (Ping & Debin, 2010). Despite many interventions to promote the small enterprise sector, academic research in this field focusing especially on VSE business operations, is relatively scarce. VSEs are plagued by many information management and administrative challenges including the lack of appropriate technologies to adequately manage, consolidate and document their business transactions. In the initial (inception and survival) stages, the business is managed by the owner and strategic decisions are based on intuition rather than on analysis of business insights. At the expansion stage and beyond the seeding phase, the enterprise is more stable in terms of finding its feet, but still operating in a nascent survival mode toward a steady growth with increasing customers or orders. For some SMMEs, the Information Systems in the organizations are usually simple and often the manager might struggle to maintain detailed insights into business transactions and other elements such as employees, customers and suppliers (Antlova, 2009). This shows that SMMEs have to solve problems like large enterprises but often without the supporting knowledge and ICT resources (Antlova, 2009).

2.2 Determinants of ICT adoption among VSEs

The role of ICT in advancing the growth of national economies through enhanced efficiency, productivity and expanded market reach is both undisputed and irreversible (Kim Hak-Su Executive Secretary, UNESCAP foreword in Kotelnikov, 2007). This progression has evolved toward ICT becoming an essential commodity that helps businesses to remain competitive in domestic and global markets (Herrington, Kew & Kew, 2009; Dagdilelis *et al.*, 2003) but because of the digital divide not all businesses have the same opportunities and connectivity resources to leverage the benefits that ICT offers. The digital divide refers to inequalities regarding access and quality of ICTs based on the nature of ICT services and geographic locations. The disparities regarding access to ICTs vary among entities such as emerging economies versus developed countries, individuals in urban and rural communities, and between the various businesses from small, mid-sized to large enterprises (Kelly & Biggs, 2007; Weiner & Rumiany, 2007; Arendt, 2007; Kyem & LeMarie, 2006). In the context of this study, the digital divide refers to the discrepancy in ICT utilization between micro, very small, small, medium and large enterprises. Because of the digital divide, not all businesses have the same opportunities and connectivity resources to leverage the benefits that ICT offers (Kew & Herrington, 2009; Heeks, 2008; Kelly & Biggs, 2007). Small and medium sized enterprises do not take full advantage of ICT like large enterprises and this broadens the gap generated by the digital divide.

The rapid development and plummeting cost of communication bridged the digital divide and created access to global markets for those businesses that were considered disconnected because they operated in isolation (Heeks, 2008). ICT introduced the concept of the information economy (Wolf, 2001) in which information is the critical resource and the basis for competition in all sectors. Knowledge has become a prime facilitator behind the success of global organizations (Jelavic, 2011; Jashapara, 2004). It is through the information generated from the internal business, its customers and neighbouring environments that allow the organization to adapt and employ new business models that will suit the business environment. This information may not often be regarded as critical for some small enterprises; however the introduction of ICT could facilitate the means to codify and analyse critical business transactions into meaningful business knowledge. Olawale & Grawe (2010) highlight the lack of ICT adoption as one of the major factors hindering the envisaged smooth growth and sustainability of small businesses. ICT is at the forefront of an enterprises competitive advantage by enabling businesses to optimise their resources and business

processes. Most VSEs could harness the greatest benefits and profits from integrating ICT in their business. However, many choose existing business models to avoid the risk of transferring to the new models based on ICT (Arendt, 2007). Understanding the various barriers could help in order to provide better and more relevant ICT for small enterprises and to demonstrate the use of ICT among SMEs (Antlova, 2009).

2.2.1 Drivers of ICT adoption among Small Enterprises

ICT provides the potential to improve the enterprises' own internal productivity, profitability and sustainability (Koltenikov, 2007). This makes ICT an essential commodity for entrepreneurial activities such as information sharing, knowledge acquisition and delivery of quality products (Weiner & Rumiany, 2007). Allan *et al* (2003) and Wolf (2001) advocate that the incorporation of ICT in small enterprises could directly impact on the operations of the enterprise by improving efficiency in resource allocation and reducing overall transaction costs for small businesses (Wolf, 2001). However, the benefits that render ICT a major commodity for many large enterprises seem less visible and applicable to VSE (Dagdilelis *et al.*, 2003). According to Antlova (2009), benefits of ICT for SMMEs can be observed in higher productivity and performance of the business and access to new markets including improved efficiency in the core business and services. Antlova (2009) highlights that some small enterprises indicated they adopted certain ICT because of pressure from suppliers, customers and competitors. An advantage of SMMEs is their higher flexibility during implementation of ICT; however the way ICT is accepted in organizations mainly depends on training and experience of both the managers and users. In small enterprises, the training is often insufficient and attitude towards ICT is more sceptical (Antlova, 2009). In regions such as Canada and other mature markets, research reveals that the relative advantage of ICT, pressure of competition and management support are significant predictors of the adoption of ICT based Technologies (Ifinedo, 2011).

Khazanchi (2005) reveals four main factors that determine the appropriateness of ICT among SMMEs as follows:

- The internal and external business and technological environment such as the nature and sector of the business;

- The organizational readiness in terms of financial resources to make such investment in an ICT;
- The financial impact of implementing the ICT in terms of profit or loss thereof and
- The potential of the ICT to improve productivity and internal efficiency on the enterprise.

The SMMEs are cautioned to assess whether implementing ICT is the right thing for their business by focusing on their ICT needs, the appropriateness and potential benefits of the ICT for their business. Khazanchi (2005) highlights that contextual factors which link the appropriateness of the ICT and enterprise performance is not well understood in the design of some ICTs. Allan *et al.* (2003) caution small enterprises against being pressured into adopting ICT by external forces as they might end up implementing a system that is not suited to their business. It is therefore equally important to consider contextual elements in the design of the ICT technologies so that ICT would be more appropriate and directly increase business performance. Ultimately, it is critical for managers to have clear expectations of the outcome and benefit of ICT. Often the investment in ICT requires strategic plans and an in-depth analysis of the current situation of the business (Antlova, 2009).

2.2.2 Barriers to ICT adoption among small enterprises

In the developing world, there are myriad obstacles that have retarded economic growth and human development, and these have made the implementation of ICTs throughout the various sectors rather challenging. The challenges relate to the slow adoption of ICT in small enterprises and the informal sector include lack of skilled technical capabilities, inadequate connectivity and infrastructure, as well as poor understanding of roles and demands of ICT. These are some of the challenges that have crippled very small to micro enterprises from participation in the information and digital knowledge society (Venable *et al.*, 2011; Koltenikov, 2007). Some VSE owners have a poor understanding of the concrete benefits that ICT could bring to their business because of their low limited education and ICT literacy levels (Koltenikov, 2007; Dagdilelis *et al*, 2003). It is also noted that educational levels tend to influence the variety of ICT devices that are used in the business (Herrington, Kew & Kew, 2009; Sinha, 2005). Many studies (Olawale & Grawe, 2010; Antlova, 2009;

Herrington, Kew & Kew, 2009; Kew & Herrington, 2009; Arendt, 2007; Koltenikov, 2007; Khazanchi, 2005) investigated the barriers and drivers of ICT adoption among SMMEs with those critically contributing towards the success of ICT implementation among small businesses. Sinha (2005) indicates that low literacy rates, strong oral traditions and the use of diverse indigenous languages hinder the adoption of ICT. In South Africa and other emerging economies, entrepreneurial activity and ICT adoption are hindered by the poor skills base and severe environmental limitations including poverty, lack of active markets and poor access to resources (Republic of South Africa- DTI report, 2008). VSEs often have an informal structure and face a lot of difficulties regarding growth, development and innovation (Wadood & Shamsuddin, 2012).

VSEs face various ICT challenges as providers and developers of software systems and as consumers of technologies. For those VSEs that develop software systems, it is often difficult to adhere to industry standards as compared to larger enterprise counterparts (Laporte, Alexandre & Renault, 2008). As consumers, they may resist adopting technologies to run their business operations because of financial cost and investment in time and efforts to maintain the technology. As financial capabilities of the business are quite limited, the investment into ICT is also dependant on the size of the enterprise (Olawale & Grawe, 2010; Anltova, 2009). VSEs employ few employees and for some VSEs the business process might not require a full scale technology system. Barriers to ICT adoption vary according to region and economy, but some of the common barriers across the small and medium sectors are discussed below.

- SMMEs do not implement ICT business systems as they feel they do not suit their type of business (Arendt, 2007, Dagdilelis *et al.*, 2003).
- SMMEs usually concentrate on daily operations and do not consider the potential benefits they could gain from implementing ICT in their business strategy (Arendt, 2007).
- The cost associated with implementing and maintaining ICT and infrastructure may be too discouraging (Heeks, 2009; Herrington, Kew & Kew, 2009; Arendt, 2007).
- Size of the enterprise also influences innovation and the degree of ICT implementation (Wadood & Shamsuddin, 2012; Arendt, 2007; Mabert, Soni, & Venkataramanan, 2003).

VSEs need to employ business practices that will improve transparency of their business operations. ICT could contribute towards shaping VSEs from survival enterprises toward more formalized businesses that generate a substantial income. Some small enterprises base their decision to integrate ICT on how much it can directly improve their core business and how the potential benefits outweigh the costs (Koltenikov, 2007). Cost is often an issue especially for those small enterprises that are in the inception and survival stages as they are still establishing ground for business and acquiring a sound customer base. They are often not willing to spend money on technology interventions even if the nature of the business requires a basic customer management system or a simple payroll system. Regardless of the many issues that promote the slow adoption of ICT, VSEs need to adopt ICT as part of their core business strategies to flourish; they do not need to adopt ICT to the same degree of sophistication (Koltenikov, 2007). Given the diverse nature and challenges that affect small businesses, it is not feasible to impose proprietary based ICT enterprise systems on VSEs. Providing ICT to small enterprises, especially those in the bottom billion populations requires a deep understanding of the context and the environment that the small enterprises operate. ICT needs to be provided in culturally sensitive, environmentally sustainable and economically profitable ways (Prahalad & Hart, 2010) while leveraging the existing infrastructure and available resources. Khavanchi (2005) posits that improved performance of businesses using ICT will result if there is a match between IT appropriateness factors that describe the business context of small enterprises, the technological context and internal organizational conditions.

2.3 ICT Software for VSEs

There is a plethora of ICT business applications on the market; however, there are actually insufficient software applications that are suited to the needs of SMMEs (Arendt, 2007). It is evident that the business needs of larger enterprises are not the same as those of VSEs hence those critically efficient applications that are prevalent in large enterprises are not tailored to fit the needs of VSEs. Some literature focuses on the impact and role of ICT in small and medium enterprises, however much research needs to be done on how the various ICTs are suitable for these small enterprises (Jagun, Heeks & Whaley, 2008). According to research by Koltenikov (2007), an SMME decides which type of ICT products to adopt based on the

concrete benefits they can bring to its core business, the ICT capacity of its employees and the financial resources available.

Business models and ICT for large enterprises are built with prescribed business logics and functionalities that often do not accommodate the context of VSEs. These systems may be widely adopted in large enterprises because they fit their overall business strategies and operational practices. Providing ICTs for VSEs require radical innovations in technology and revised business models (Prahalad & Hart, 2009) and ensuring that the infrastructure is tailored to sustain the technology. The fact that current ICT business systems are tailored to large enterprises' business objectives makes it evident that small businesses would not find sufficient value in adopting these systems. As consumers, VSEs are often marginalised with regards to access to appropriate and relevant technologies that suit their diverse contexts. Providing ICTs that are not culturally relevant may be deemed as a wasted effort (Maranto & Phang, 2010). In order to take advantage of the benefits that these systems bring about, it is important to align them to be appropriate to suit the dynamics of small business activities.

Developing software application systems for the small business sector requires simple, affordable, lightweight and flexible technological innovations that are tailored to fit the core business processes of VSEs. The emphasis is not on what technologies can be developed but on how emerging technologies can be used to address the particular challenges facing VSEs. Emerging ICT capabilities are significant factors in determining the strategy that forces organizations to change the ways they do business (Hevner *et al.*, 2004). As advocated by Prahalad & Hart (2009), providing ICT for emerging economies requires radical innovations in technology and tailoring the commercial infrastructure to the needs of emerging economies. Most ICTs found on the market are too complex, expensive and proprietary to accommodate the diverse contexts of the VSEs' business and resources (Kew & Herrington, 2009; Heeks, 2009; Herington *et al.*, 2009). Enterprises of different sizes tend to operate in a different manner, hence the manner in which enterprises document their business transactions depend on the business strategy and technology employed. Even simple applications on the market, require a computer, installation, basic training and maintenance that may incur more costs and administrative overheads for VSEs. Cost, time and employee competencies are important factors in VSEs' operations and overall business strategies.

VSEs often do not get much value from the ICTs on the market because they cannot afford the required investment in resources and training that comes with the implementation of these systems (Moshapo & Ngassam, 2008). Literature reveals that there is inadequate research regarding the actual utilization of ICTs especially in small business sectors in developing countries (Herington, Kew & Kew, 2009; Jagun, Heeks & Whalley, 2008). Jagun *et al.* (2008) argue that most of the studies of technology interventions in developing countries have focused on the social impact rather than its usage in promoting the operational efficiency of small businesses. Donner (2007) recommends that future studies should explore the economic impact of mobile use among small and informal businesses based on measures of productivity and income generation.

Although some small enterprises are using ICT, they still lack the ability to gather, extract and disseminate information to the maximum benefit. However, because of environmental and user constraints, the introduction of computing to automate some business processes is equally challenging (Parikh & Lazowska, 2006). Prahalad & Hart (2009), advocate that it takes tremendous effort and new innovative business models to create a viable market especially in a completely unorganized informal sector. Moreover, it can be a daunting task to accurately capture data in a non-formalized business environment (Mourao & Okada, 2010). Research (SAP Cashew Project, 2011; Koltenikov, 2007) has shown that it can be extremely challenging but feasible to integrate ICT especially in environments with no standardized business processes. Based on findings and evidence from literature, it is undisputed that incorporating ICT business systems to run business operations could benefit small enterprises through improved efficiency and increased profits.

Most SMMEs are familiar with basic ICT such as fixed phone lines, mobile phones, fax facilities, computers and basic document processing software. Recently SMMEs have also adopted far more complex and advanced ICT products such as Enterprise Resource Planning (ERP), Supply Chain Management (SCM), and Knowledge Management (KM) systems to empower their businesses and to improve competitive advantage (Koltenikov, 2007). Most of these advanced software systems however, are not appropriate for managing the business operations of VSEs and most SMMEs that do not have a stable IS or ICT infrastructure. Some VSEs implement some of the functional modules that are deemed critical and do not utilize the rest of the functions available, but they still bear the cost of implementation without getting much value out of the system.

Most ERP, Customer Relationship Management (CRM) and other simple accounting systems are more geared towards addressing the needs of larger organizations and the mature small enterprises. VSEs remain marginalized in terms of the means to access these systems either through the cost associated with these packages, the complex logic of the business process or the infrastructure requirements. In some instances, VSEs use simple office packages such as Excel, simple databases and other independent packages to manage their business transactions and finances. This also poses another challenge as it may be difficult to trace some transactions, analyse customer trends (Loh, Khain Koo & Idrus, 2011), or get historic data from disparate systems. For example, a business may use a manual ledger to write a receipt or invoice for a specific customer but they may not have the means to directly link the invoice to the actual transaction of the sale.

2.3.1 Customer Relationship Management (CRM) Systems

According to Arendt (2007), in the nascent stages, ICT was mostly used in the micro, small and medium enterprises for customer relations. The process entailed maintaining contact with customers for sending pricelists, quotes and invoices while other SMMEs had complex CRM systems. At the nascent stage, the business is still very small and with fewer employees and a small customer base. Therefore it is possible to know their customers personally including their personal preferences (Baumeister, 2002). The various choices of a customer management system could be based on the core business processes and the external parties contributing to the profit of the business. SMMEs need CRM systems that easily adapt to their customers' needs while still being effective (Baumeister, 2002). The motivation to acquire a specific technology and level of complexity of implementation of the technology varies based on needs and whether the business requires a simple or a complex system. For those small enterprises that require deeper insights into their customers' needs, they would get more value out of a CRM system rather than implementing an ERP system. VSEs should therefore implement only the functionality that is applicable to their core needs without being forced to implement the complete offering of a service or a product.

Small enterprises can adopt CRM systems to predict customer behaviour, sales patterns and then use those insights to plan, schedule and manage pre-sale and post-sale activities swiftly (Loh *et al*., 2011). CRM systems help businesses to manage their customer relationships and provide more customized services to their customers but many small enterprises shy away from implementing them because of limited resources such as

implementation costs and lack of sufficient knowledge to implement a CRM (Loh *et al.*, 2011 & Baumeister, 2002). Initiatives like the Caruso project (Baumeister, 2002) introduced the concept of low cost, customized and integrated CRM applications for SMMEs. Some of the envisaged benefits of CRM[5]systems include real-time visualisation of sales, forecasting, managing and connecting with customers, suppliers and employees and other critical processes. It is not ideal for an organization to change their ICT infrastructure to suit a CRM implementation. Baumeister (2002) advises SMMEs to implement CRM systems in several increments to reduce associated costs and efforts.

2.3.2 Enterprise Resource Planning (ERP) Systems

At the expansion stage, the business enterprises require the manager to have experience of planning, management and finance to enact plans for strategic growth. Herewith, small enterprises would typically implement an ERP system to manage increased number of orders, customers, suppliers and finances including a growing number of employees (Antlova, 2009). Often small enterprises need an integrated view of their disparate data for analytical purposes and forecasting. An ERP system would be more appropriate rather than the single financial system or a point of sale system. The aim of an ERP system is to integrate and streamline the enterprise's business processes to be more efficient (Jha, Hoda & Saini, 2008; Mabert *et al.*, 2003). This could facilitate a good means for activity based tracking and provide a clear understanding and transparency of operations, processes and systems across the enterprise.

An ERP system can maximise the capabilities of small and medium sized enterprises by allowing businesses to plan, integrate resources and data; however, ERP implementations are high risk and can be quite costly and complex (Mabert, Soni, & Venkataramanan, 2003). Mabert, Soni, & Venkataramanan (2003) posit that the benefits of employing an ERP system vary based on the size of the company. Larger enterprises employ more ERP functionalities than smaller enterprises and the larger enterprises devote adequate time and effort to training the employees accordingly. Some of the envisaged benefits of an ERP[6] system include the ability to streamline and automate business processes for small enterprises including improved productivity, transparency and financial management. Moreover, ERP systems facilitate informed decision making and organizational growth. Unfortunately, the cost of

[5] http://www.salesforce.com/smallbusinesscenter/smbhome/
[6]http://www54.sap.com/solutions/sme/software/erp/small-business-management/overview/index.html

hardware, software, consulting and training (Mabert, Soni, & Venkataramanan, 2003) associated with ERP systems may be too discouraging for small enterprises. VSEs have limited resources and may not afford the required investment in time, training and cost of implementation for a full scale or standard ERP system. One of the major challenges with ERP systems according to Jha, Hoda & Saini (2008), is the inability to accurately map business processes to the system. For instance if the ERP packages are implemented without adequate knowledge of business processes, it may lead to improper planning and management of the business.

ERP systems are commercial off-the-shelf software products that often do not fit into an organization's business processes (Jha, Hoda & Saini, 2008). Moreover, their implementation involves some complexity that goes beyond just technical software systems; they also transform the business processes and organizational design. The ERP system typically provides a generic representation of how an enterprise does business and provides different but limited implementation options as a means of customizing. However, this flexibility does not accommodate the diverse business processes of some enterprises and it becomes a major challenge for the ERP to fit the context of the enterprises (Mabert, Soni, & Venkataramanan, 2003). This customization could still be restricted or not flexible enough for very small enterprises. Ultimately, this forces the enterprise to either adapt or change their business processes to fit the ERP or to customise the system to fit their system. According to Marbet *et al.'s* (2003) study, small enterprises were found to be more likely to change their processes to fit the system whereas larger enterprises could afford to customize ERP systems. The decision depends on various factors such as cost, time and other resources in place and will ultimately bear associated implications and influence the eventual outcome of the implementation (Jha, Hoda & Saini, 2008; Mabert, Soni, & Venkataramanan, 2003). ERP provides solid Return on Investment (ROI), but it could take a while to get value out of the implementation as the technology matures with the business culture over a period of time and often causes disruptions during the initial phases until it reaches a stabilised state (Jha, Hoda & Saini, 2008). It is therefore deemed rather unnecessary for small enterprises to conform to the prescribed logistics of most commercial off-the-shelf systems as compared to finding appropriate and simple systems that fit their context.

2.3.3 Mobile Technologies

Although many VSEs still struggle to access basic ICT resources such as computers and fixed lines, research reveals that many small businesses use mobile devices for connectivity and business purposes because of their high mobility and low costs (Kew & Herrington, 2009; Esselaar *et al.*, 2007; Donner 2007). Most small enterprises especially those that operate in informal sectors and those based in poor communities have difficulties getting access to fixed lines or could not afford it (Jagun *et al*, 2008). However, mobile telecommunications changed the means of communication and provided connectivity and access even for informal businesses. It can be logically argued that mobile telecommunications have redefined the way enterprises do business. A clear priority for development is towards the conception of new and radical business models and applications that can leverage the emergence of mobiles to create employment and sustainability (Heeks, 2008). Kelly and Biggs (2007) highlighted that the digital divide and disparity in access to ICT might shift focus to being measured by qualitative instead of quantitative of access to ICT. The reality is that those previously disconnected have now been integrated in the digital economy through the most pervasive means of mobile communication.

The ubiquitous nature of mobile devices provides a unique opportunity to engineer innovative business models and systems to deliver value added services (Blycroft, 2008) to improve VSEs' business processes. The researcher is of the opinion that the use of mobile devices could enable many enterprises to improve their business processes while reducing the cost of implementing ICT infrastructure in their business (Koltenikov, 2007). There is much optimism that mobile technologies may provide an opportunity to address the information challenges and alter the characteristics of operations and trade within small enterprises (Kew & Herrington, 2009; Jagun *et al*, 2008). The emergence of mobile technologies has brought about a new and innovative way to providing context aware and appropriate technologies not only to the SMMEs, but also to individuals and large enterprises. Other than providing the means for developing countries to leapfrog to advanced technologies and bypass infrastructure barriers, the unprecedented growth in mobile technologies has brought about many possibilities for potential ICT systems for the SMME sector. The vast growth of mobile telecommunications as a form of ICT in developing regions has provided a new model of information access, one that bridges the traditional barriers to information access and services (Maranto & Phang, 2010).

Recent advances in mobile technologies have shifted the idea of mobile devices as auxiliary devices, to ICT media that can be used to conduct varied business transactions. For instance, to make a phone call, send an SMS or email, or share documents. Moreover, the processing power and memory capacity of mobile devices is being continuously enhanced to increase the computing capacity required to position mobile devices in the forefront of the computing space. Many of the mobile devices lately present rich user interfaces, faster connectivity and features than can be potentially applied for business purposes (Mourao & Okada, 2010). These remarkable advancements in technological innovations have paved way for mobile devices to become the mass computational platform for the future (Baudisch & Holz, 2010; Mourao & Okada, 2010). This also provides many opportunities to deliver more relevant yet advanced systems to small enterprises. Recent research efforts have placed much emphasis on the use of mobile devices to deliver effective, affordable and innovative systems that are tailored to address the particular needs of VSEs (SAP Research 2011; Heeks, 2009; Kew & Herrington, 2009; Blycroft, 2008).

Mobile phones in general have become the dominant ICT in emerging economies (Maranto & Phang, 2010). Contrary to developed countries where mobile devices are an extension of the internet connected desktop computers and fixed line media, for most African populations and those in emerging economies, mobile devices are the first means of ICT and the doorway to the digital world (Jagun, Heeks & Whalley, 2008). Mobile devices were once just auxiliary and lucrative items restricted to a few elite; nowadays there is a phenomenal change in the penetration of mobile devices and their use has rapidly expanded beyond the conventional voice and SMS, especially with the introduction of smart phones and multimedia capable phones (Ahmad & Gabbouj, 2005). As indicated in the GEM Report 2009 (Herrington *et al.*, 2009), a Cape Town based entrepreneur discovered the internet and social networking while browsing his mobile phone. It has been identified that many small enterprises use mobile devices for various business purposes (Kew & Herrington, 2009, Muto & Yamano, 2009; Jagun *et al.*, 2008; Donner, 2007; Esselar *et al.*, 2007). However, very little is known about the actual use of the mobile devices in the business context especially with regards to managing and recording transactions and providing reliable information management for small businesses.

Mobile devices are less expensive computational devices that require less training to utilize than desktop computers. They introduce the phenomena of computing to even the poorest users (Brewer *et al*, 2005). Moreover, they accommodate the low literacy population especially those with little or no access to a personal computer and reliable internet connection (Sinha, 2005). Mobile devices also accommodate roaming individuals to conduct business-on-the-go because of their mobile nature. Considering some of the major advantages of mobile technologies, it is speculated that most ICT based initiatives will be likely to follow the wireless nature. Due to the prevalence of mobile devices among small enterprises, Esselar *et al.* (2007) recommend that ICT systems and applications for small enterprises should be developed for mobile devices to accommodate the low per capita population. However, developing such novel mobile systems require flexible, innovative and lightweight mobile applications that will allow users to not only view, but also analyze and manipulate the data (Baudisch & Holz, 2010). The emergence of wireless computing extends the capabilities of computing to environments that were previously overlooked because the application of ICT was not considered feasible for ICT support (Hevner *et al*, 2004).

Nowadays, research and business related initiatives can be observed in terms of how mobile phones can be used to influence the manner in which VSEs perform their business activities. In some cases mobile devices have reduced the expensive transportation costs in certain African countries. The study by Muto and Yamano (2009) elicit how farmers in Uganda, Africa managed to participate in competitive markets. The use of mobile devices benefited the farmers by reducing travelling and marketing costs and increasing their produce sales. Muto and Yamano's (2009) study validated the need for and relevance of mobile technologies even for informal and remote entrepreneurs. The use of mobile devices also afforded small scale retailers (referred to as "spaza shops") in rural Limpopo, South Africa (SAP Research Rustica Project, 2011) to use their mobile devices through a mobile procurement (M-procurement) system to directly order their products from the suppliers and wholesalers instead of travelling on deteriorated roads through unreliable public transportation to physically buy the goods. The SAP Cashew (2011) project entails the use of smart phones to boost cashew farming co-operatives in Africa to improve efficiency in getting produce to market. This initiative also provided more transparency in the Cashew sales while facilitating entry to global markets. Jagun *et al.'s* (2008) study focused on the role of mobile telephony for Supply Chain Management (SCM) among Nigerian traders. Jagun *et al.'s* (2008) study also posited that mobile penetration encouraged improved business activity

and investment in small and micro enterprises sectors by reducing information failures, risks and related costs by enabling efficient trade amongst small enterprises in Nigeria.

Mobile phones are on their way to becoming the mass computation platform of the future. In order to utilize mobile devices to their full potential, Baudisch and Holtz (2010) recommend that they not only be used as auxiliary communications and entertainment devices, but that they are also used as computational implementations. To some individuals, mobile phones are the only accessible ICT devices that bridge information access between their world and the globe. Many entrepreneurs have leveraged the prevalent state of mobile devices and developed a variety of value added services. They have introduced new business models for the mobile devices (Maranto & Phang, 2010) such as mobile banking, mobile learning and streaming media. Now the emphasis is on making the mobile technologies more affordable for the huge untapped market, namely, the low income population (Prahalad & Hart, 2009; Heeks, 2009; Kelly & Biggs, 2007).

The emerging trends in the mobile and ubiquitous computing technologies have impacted and spiked new business models that are context aware applications. Mobile devices are constantly being improved with new features and functionalities that accommodate new innovative business models through context aware applications (Dhar & Varshney, 2011). In order to offer mobile users an improved mobile experience and relevant systems, there is a need to develop context-sensitive mobile services (Church & Smyth, 2008) that will offer the functionality to inherently accommodate the user. Dey, Abowd & Salber (2001) define context as any information that can be used to characterize the situation of an entity. An entity is a person, place or object that is considered relevant to the interaction between a user and the ICT application.

Advances in mobile technologies allows for more sophisticated operations on mobile devices. However, the inherent limitations of mobile devices such as device size, computing power, small storage size and low battery lifetime provides a challenge when developing a system for the mobile environment. It is challenging to port these conventional desktop applications to a mobile platform because the mobile space requires radical changes in the design and development of mobile systems. The current systems are often huge, complex and not compatible with the current mobile devices (Baudisch & Holz, 2010; Kew & Herrington, 2009; Parick & Lazowska 2006). There is a need to develop simple, lightweight and affordable mobile systems that will provide transparency of business transactions for VSEs and allow flexibility and mobility for the enterprise.

2.4 Conclusions

Although the business nature and culture of VSEs vary according to different geographical regions, the characteristics and challenges seem to be similar among small businesses in general, irrespective of the specific location of the business. From the informal sector to the survivalist enterprises, the biggest concern is the lack of growth and sustainability of these enterprises and the digital divide that is still prevalent amongst small enterprises. The various studies from different regions identified environmental, external and internal factors that hinder the growth and sustainability of small enterprises. Some of these factors are dependent on the specific region especially when it comes to government regulations and access to financial support. The studies from the African and Asian Pacific regions emphasized the lack of reliable infrastructure and limited educational levels as major challenges while studies from Canada and Greece were more concerned with disconnected enterprises and the associated lack of access to markets and the competitive advantage that ICT provides.

Overall, the need for ICT interventions seems relevant to all small enterprises in general but not all small enterprises need to adopt ICT on the same level. There needs to be a clear understanding of the specific needs of the enterprise to implement a system that will meet the need of the business and that will leverage the existing infrastructure and resources of the enterprise. The prevalence of mobile devices and related mobile technologies is one of the biggest success stories especially in the African region and emerging economies. Mobile devices are currently adopted and exploited in more innovative ways than was originally intended. Nowadays, many research and business initiatives are aimed at using mobile technologies to deliver much more sophisticated and computational experiences to mass markets including the poorest segment in the world. Based on the reviewed literature it is also evident that mobile devices are the relevant means of ICT adoption for very small enterprises and roaming enterprises.

CHAPTER 3 :
RESEARCH METHOD

This chapter discusses the Design Science Research (DSR) method (Peffers *et al.*, 2007; Hevner *et al.*, 2004) that was applied in this study to develop a lightweight framework for the mobile documentation of VSE business transactions. The DSR method emphasises the development and evaluation of artefacts which enable individuals to implement information processing capabilities that move organizations to achieve a set of desired goals (Baskerville, Pries-heje & Venable, 2009; March & Storey, 2008). The DSR method is therefore appropriate for the implementation of a lightweight framework for mobile documentation of VSEs' business transactions.

The evolving mobile software artefact resulting from this study is the Mobisales prototype system to support mobile documentation of daily business transactions of VSEs. This system serves as a proof-of-concept to validate that the framework actually serves the intended purpose. The DSR method thereby provides coherent means to answer the research question posed in the study. The DSR allows for the assessment of the capabilities of both the intended user, hereafter called the VSE entrepreneurs (or for simplicity, the VSE) and the enterprise's resources to enable the intended shift towards improving organizational performance. This assessment allows for an understanding of how VSEs conduct their daily business transactions and to discover those factors influencing their business processes. In this chapter, it is important to discuss the DSR method and to demonstrate how it was applied in this study to realize the research objectives. First, the researcher finds it particularly germane to provide some preliminary concepts of problem based research and contextual research as theoretical foundations for the application of the DSR method.

3.1 Problem Based Research

The main research problem entails the search for a technology framework that can effectively support the documentation of daily business transactions of VSEs. The VSEs could lose in their business because they cannot trace their business transactions as a result of improper documentation practice. Inherently, these VSEs are unable to provide accurate information regarding their daily business transactions because of lack of proper record keeping practice (Esselaar *et al.*, 2007). The lack of effective documentation measures inhibits informed decision making and ultimately affects the growth and sustainability of the VSE. For instance, large enterprises enjoy the benefits of managing their business transactions and other resources by implementing various IS such ERP systems and KM systems to document their enterprise information. The same benefits are evidently critical for VSEs, but the main challenge is often the cost of these software systems and the business context of the VSE. This study emanated through the identification of a research problem in the VSE business domain. This posits the research problem as the central point of research and initiation of the research process. Figure 3-1 presents the conceptual map of problem based research which posits the problem as the central point of the study.

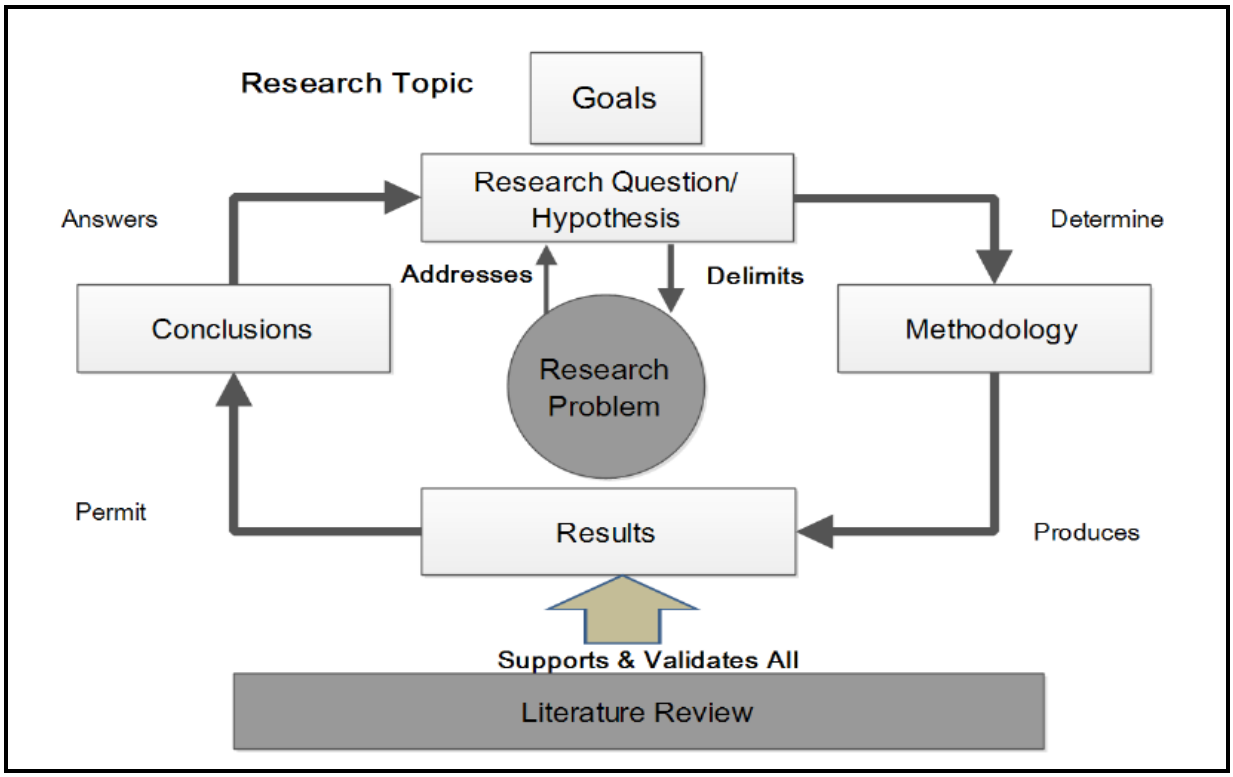

Figure 3-1: Conceptual Map of the Problem–Based Research Cycle (Ellis & Levy, 2008)

Crucial to the study method, it was imperative to understand through the guidance of knowledge management practice (Jelavic, 2011; Jashapara 2004), the reasons why VSEs need to document their business transactions. The premise is that "one cannot place value on research without first understanding why the research needs to be conducted in the first place" (Ellis & Levy 2008; Creswell 2005). An issue of concern is the rising number of VSEs that do not progress beyond the nascent stages of their existence (Herrington, Kew & Kew, 2009). In addition, the obvious expectation is for VSEs to steadily mature as self-sustainable businesses (Scott & Bruce, 1987; Churchill & Lewis, 1983). Even if the technology is provided to address the identified problem, it would not provide much value if it does not provide valuable means to make informed decisions for growing the VSE business. Especially in those environments where ICT was not necessarily used to automate business processes. In this study, the definition of knowledge emanates from the cognitivist notion as described in Table 3-1. "Knowledge is a distinct entity that can be codified and recorded in ICT and physical documentation to allow for future retrieval and dissemination across an organization" (Jelavic, 2011).

Notions of Knowledge	**Cognitivism**	**Connectionism**	**Autopoiesis**
	Knowledge is a distinct, fixed and codifiable entity that can be universally stored in ICT and physical documentation, allowing it to be easily shared across an organization.	Knowledge resides in the self-organized connections of teams, and is dependent on the state of this network of interconnected relationships. There are no universal rules regarding its transfer.	Knowledge resides within the social system and is history and context-specific. It is not easily codifiable or directly shared. It is only indirectly shared through discussions and socialisation.

Table 3-1: Cognitivist, Connectionist, and Autopoietic Notions of Knowledge (Jelavic, 2011)

3.2 Contextual Research

The recent developments in ICT have shifted from technology bound to the integration of technologies in societies for sustainable socio economic development (Venable *et al.*, 2011). This study incorporated contextual research to explore the problem domain in detail and to understand the context and capabilities of the intended user, which is the VSE entrepreneur. The objectives were to conduct preliminary investigations to understand the factors influencing VSE operations and gather requirements to develop a lightweight framework for mobile documentation of VSEs' daily business transactions. There are key contextual challenges such as politics, education, culture and infrastructure that hinder the development of VSEs especially when deploying ICT. The understanding of user contexts may seem underrated but often becomes the vital ingredient that could spur innovative ways to contextualize technology to suit the conditions of the user. Contextual research was inspired by the capabilities approach (Sen, 1999) which emphasises the necessary capabilities that humans need to apply to achieve the intended tasks or goals (Clark, 2005). There is a saying that one cannot throw money at the poor and expect to solve their problems if they do not have the necessary capabilities to manage the money to improve their wellbeing. In terms of technology, it would be irrelevant to develop innovative ICT systems that cannot be utilized because users lack the required literacy skills and technological capabilities.

It is crucial for business enterprises including VSEs to implement strategies that formulate effective business routines to improve organizational efficacies. These strategies define the capacity within an organization to maintain or improve organizational performance based on experience and knowledge (Jelavic 2011; Pan & Scarbrough 1999). Some VSEs in terms of organizational context and business culture tend to be disorganized and dynamic. Moreover, they lack technological capacity to employ effective business routines in their business practices. Contextual research provides holistic insights into the relationship between people in their natural habitat and the multitude of elements that define the user's setting and capabilities. Contextual research was therefore incorporated in the research method to explore the problem domain in more detail to unpack the business setting of the VSEs. Moreover, contextual research enables the researcher to derive a context-aware artefact that caters for the peculiar dynamics of VSEs. Church and Smyth (2008) assert that to offer effective mobile services, it is imperative to understand the environment of the mobile user and the characteristics of mobile information needs in more detail. The understanding of

the user context is therefore essential in the design of relevant software applications that provide value for the user through useful computational services (Zimmer, 2004).

The contextual elements to consider in the design of applications for the VSE domain should include the environment, appropriate technology and skills of the intended users. The researcher is of the opinion that by incorporating contextual research, one could unlock the potential of improving the utility of the artefact. In addition, if the user environment and contributing factors are taken into consideration in the design process, the resulting applications could better serve the user purpose. The contextual research has covered three essential elements which are: environment; technology; and education. These elements were considered significant towards potential adoption of the Mobisales framework.

- *Environment*: this element considers the living and business conditions of the user and the related factors such as basic infrastructure and related constraints.
- *Technology:* this element assesses the user's computing environment such as the network, connectivity, accessible devices and cost of computing.
- *Education:* this element focuses on the socio-economic background, literacy levels and information needs of the VSE user (Church & Smyth, 2008). Education provides the necessary knowledge and skills to conduct business in a highly competitive modern world (Herington, Kew & Kew, 2009). It also enhances the capability of the entrepreneur to assess the business environment more astutely and identify potential opportunities.

The contextual research approach facilitates the exposition to the business environment of VSE and the various challenges that influence their business practices. This was accomplished through the SAP Research Rustica Project living lab[7] in Sekhukhune, Limpopo province in South Africa. The Rustica project provides mobile systems to address those constraints that are experienced by rural entrepreneurs. Some of these constraints are: access to mainstream global supply chains because of physical remoteness; high transport costs; and low economic activity densities. The results from this exercise provided the necessary insights and essential requirements for the development of the proposed lightweight framework. For the research method of this study, contextual research was

[7] More on project Rustica at
http://scn.sap.com/docs/DOC-26153
http://euroafrica-ict.org/files/2010/06/Christian-Merz.pdf

conducted as an exploratory exercise to gather requirements and contextualize the lightweight framework for the VSE domain.

Software engineering practices (Bruegge & Dutoit, 2004; Satzinger, Jackson & Burd, 2000) often follow systematic processes to produce a software product; however, this may lead to certain presumptions that might not necessarily be relevant for the intended users. Through contextual research, the researcher was encouraged to ignore the assumptions about a situation and acknowledge that they are not aware of the current setting of the users. The researcher was then immersed in the user setting to discover profound insights that influenced the outcome of the system. The exposure to the user setting emancipated the researcher in the research process (Krauss & Turpin, 2010). The rationale for the research method was based on the premise that DSR is a paradigm seeking to extend the boundaries of the capabilities of both people and organisations through the application of innovative artefacts (Hevner, 2004). Context therefore plays a significant role in shaping the DSR artefact to suit the intended purpose and users.

3.3 Design Science Research

The nature of this study prompted the researcher to rely heavily on the implementation of the lightweight Mobisales framework to solve the research problem. DSR was nominated as a methodological process to guide the research study through a formalized technology oriented design approach. The DSR process model adopted from Peffers *et al.* (2007) which is shown in Figure 3-2 serves as a reference model for the research method applied. Furthermore, the DSR process model highlights the related research contributions throughout the various stages of the research. The DSR process model follows a nominal sequential process but does not necessarily dictate that researchers should follow the sequential steps (Peffers *et al.*, 2007). Circumstances such as context-specific constraints often influence researchers to develop *ad hoc* processes that are inconsistent with the DSR process model but they are justified to produce valid results (Peffers *et al.*, 2007). The various research entry points direct the form and the iteration of the research process. For this study, the research entry point followed the problem centred orientation because the research study was initiated through the identification of a research problem in the VSE business domain. The outcomes of DSR research are expected to differ from that of the theory based DSR research, hence, the

DSR process model is paramount in providing guidance regarding the process and expected outputs of a DSR oriented study.

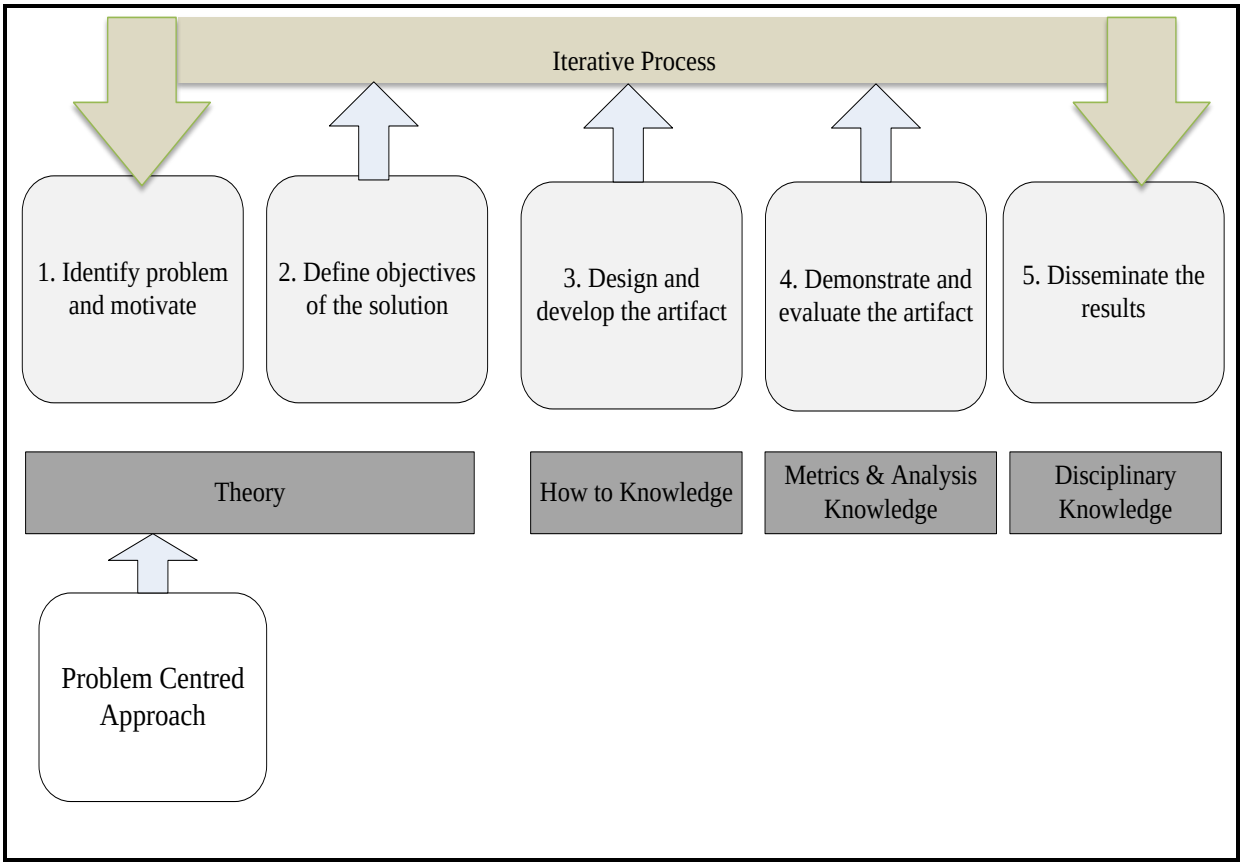

Figure 3-2: DSRM Process Model (Peffers *et al*, 2007)

In a nutshell, DSR strives to "develop new technologies and new uses of technology" (Hevner *et al*, 2004). DSR is inherently rooted in the creation of innovative artefacts to solve human or organizational problems (Hevner *et al*, 2004; Peffers *et al*; 2007). It is important therefore for the study to demonstrate the efficacy and relevance of the proposed lightweight mobile framework in enabling it to document the business transactions of VSEs. This means that DSR contributes to the body of IS knowledge by extending the domain of research beyond examining existing technologies and their interaction with a socio-technical environment. DSR also embraces the development of new innovative technologies to improve the ways in which people do business and conduct simple tasks (Venable *et al.*, 2011, Hevner 2004). The expected outputs of DSR are relevant artefacts that provide solution to the identified of the problem and the efficacy of those artefacts must be rigorously evaluated and communicated to the appropriate audience (Ellis & Levy, 2010; Hevner *et al.*, 2004). The contributions of the artefact would therefore be evaluated in terms of their ability to improve performance in the development of the artefact and how users manage to accomplish their intended tasks and goals (March & Storey, 2008).

Inherently, the lightweight mobile framework should demonstrate that it extends the boundaries of human problem solving and organizational capabilities by providing intellectual and computational tools (Hevner *et al.*, 2004). The research was tackled by following the phases as guided by the DSR process model (Peffers *et al.*, 2007):

- Identify the problem - involves the exposition and understanding of the problem domain and the constraints in the user setting.
- Define objectives of the study - involves gathering and modelling requirements from VSEs.
- Design and develop the artefact - addresses the actual implementation of the artefact which in this study referred to the development and implementation of the Mobisales prototype system.
- Evaluate the artefact- requires the research to demonstrate and evaluate the Mobisales framework in addressing the research problem.
- Disseminate the results - entails communicating of the results of research to the relevant audience.

3.3.1 Problem Identification

This study emanated from the identification of a research problem in the domain of VSE businesses. Seemingly, the prime research goal of this study was to develop a lightweight framework for mobile documentation of VSEs' business transactions. The objective of this phase of DSR was to understand the problem domain and constraints of the intended users. The understanding of the VSE problem domain was accomplished through a living lab approach which facilitated the required platform to conduct preliminary investigation and interaction with the intended system users (Smit, Herselman, Eloff, Ngassam, Venter, Ntawanga, Chuang, Van Greunen, 2011; Van Greunen, Louw & Dörflinger, 2009). The researcher engaged with the VSE retailers through the SAP Research Rustica project living lab in Sekhukhune, Limpopo province in South Africa. The researcher observed the operations of the VSE and conducted informal unstructured interviews (Cooper & Schindler, 2006) to understand some aspect of the VSE that needed more clarity beyond what the researcher could interpret from the observations. The results from this exercise provided the

necessary insights and essential requirements for the development of the proposed lightweight framework. The purpose of the direct engagement with the VSEs was to gather deeper insights into how they conduct their daily business transactions, how they document their business transactions and to discover challenges they are facing in using ICT for business transactions.

3.3.2 Objectives of Mobile Documentation Framework

The information gathered from the exploratory contextual research through interactions with VSEs was analysed to generate requirements for the development of a framework for mobile documentation of VSEs' business transactions. The requirements were deduced from the preliminary interactions with the VSEs through observations studies and informal interviews that were conducted with the VSEs' retailers. This exercise was deemed necessary to accomplish the first objective of the study which required a thorough understanding of the VSE environment, how they document their daily business transactions, and the factors that influence how the VSEs' perform their daily business transaction. The study involved unstructured interviews, observation notes (Cooper & Schindler, 2006) and still photographs to capture the realism of the VSE operations. Moreover, the informal discussions with the VSE entrepreneurs provided clarity regarding the dynamic nature of the VSE operations especially with reference to how the VSEs provide personalized services to each individual customer. The information gathering exercise provided concrete exposure and understanding of the business operations and how the VSE documents each sale transaction whenever they sell a product item to the customers. The focus was primarily on the business needs of the VSEs, not necessarily on any particular technology. This exercise prompted the discovery of critical business processes and system requirements.

The objectives of developing the framework for mobile documentation of VSE business transactions are as follows.

- To understand how VSEs conduct their daily business transactions together with those factors influencing their business process.
- To implement a prototype system that enables VSEs to remotely document their business transactions through mobile device interfaces.

- To evaluate the efficacy of the implemented system for mobile documentation of VSEs' business transactions.

Figure 3-3 below provides some of the still photographs taken from the VSEs during the field interactions to accomplish the first objective of exploring the VSE domain and learning about their business processes specifically how they document their business transactions along with the contributing factors that influence their business processes. The VSE documentation processes involves a manual ledger book and for other VSEs, a separate appointment document. The appointment book serves as a reminder for the VSEs regarding important events such as when to: buy stock; collect items from the general dealers; and when to collect payments from their clients. The manual ledger logbook records the: sale items; date, quantity of the items; and the total of each sale transaction. This process is highly manual and prone to a lot of anomalies but the VSEs mostly are run by close relatives or one key resource who is also the owner of the VSE. For those VSEs that have more than one employee, the person who is responsible for managing the shop is the one who is allowed to capture the sale transactions on the logbook.

Some of the VSEs indicated that they sell their items on credit to their preferred loyal customers. The credit arrangement varied based on the profile of the customers, for instance pensioners have a different payment date and credit limit from teachers, miners and middle aged customers. If customers do not pay for their items within two months, their credit benefits are revoked. The VSE would check from the appointment book on the specified date and call the customers to remind them to settle their debt. Some of the customers who are not loyal would only be allowed to buy cash. The VSEs were of the view that the credit arrangement is a good mechanism to retain a good customer base. It also reflects mutual trust and good faith between both parties, that is, the VSE and the customers.

Figure 3-3: Observation of VSE operations

In this phase of the DSR process, the objectives of the proposed lightweight framework for mobile documentation of VSE business transactions were identified and prioritized based on the important processes and related sub processes. The high level framework for the mobile documentation of VSE business transactions is presented in Figure 3-4. The documentation framework provides a concise representation of the related processes, components and activities that would be triggered by related tasks and conditions in respect of sale transactions of the VSE.

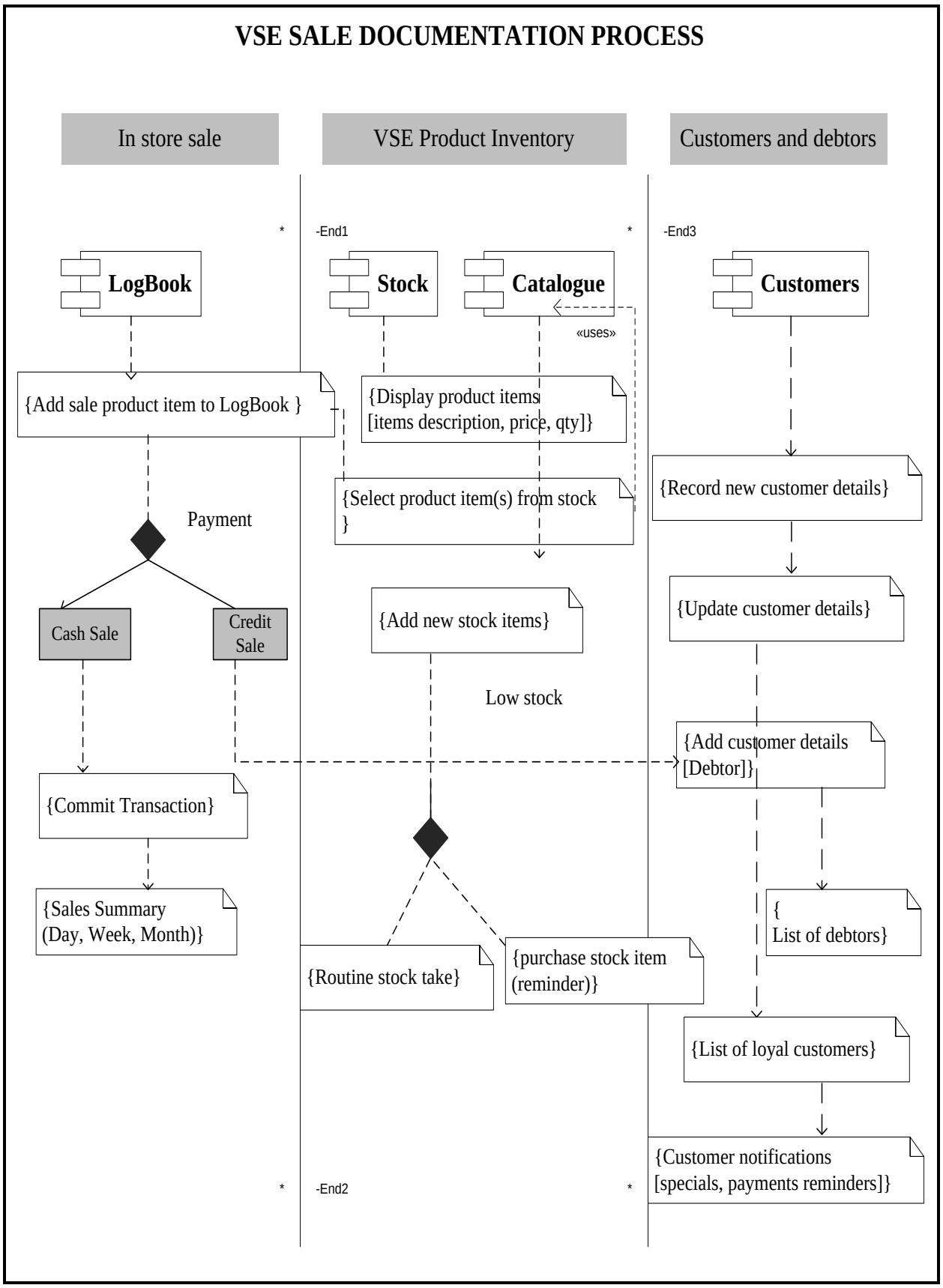

Figure 3-4: High level framework for mobile documentation of VSE business transactions

A high level mobile documentation process was derived with respect to the sale transactions in the VSE domain. For each sale transaction, the sale is captured in a Log Book. The VSEs can either select the item from the catalogue and the quantity per item or proceed to the sale transaction to add the payment amount or allocate as a credit sale. For those items that are not listed on the catalogue, the VSEs can add the items manually and capture the transaction as a sale or credit transaction accordingly. The cash sale transactions are committed and the credit transactions are allocated against a new or existing customer. The customer is therefore flagged as a debtor, based on arrangement and existing relationships between the VSE and the customer as the customer can be allowed to buy certain number of items on credit. The Log Book module also provides record of the transactions over a period of time.

The stock functionality allows VSE to check the stock and to update the quantity of the stock items and the catalogue function provides a visual representation of the stock inventory. These VSEs can be alerted when the stock level drops to the pre-defined threshold. The minimum quantity of the items in stock and the alert criteria varies per VSE and specific stock items. For instance, some items are sold on a regular basis and need to be replenished before the VSE runs out of stock; other VSEs have a small specialized customer base who buys the items in bulk on payday. The Customer module allows the VSEs to add new customers and update details of its existing customers. The customer function also provides a list of the debtors and the amount owed by those customers. For the loyal customers with special arrangement of payment dates, the VSE can set reminders to follow up on the pending payments. Table 3-2 presents the main functions and descriptions of the main functional modules of the Mobisales prototype system.

Function	Description
Log Book	Record the sales transactions (items/products sold) both on credit and cash.
Stock	Enables the VSE to perform stock taking and stock replenishment.
Catalogue	Displays the products that the VSE has sold. This component represents the stock inventory of the VSE.
Customers	Keep track of the VSE's customers.

Table 3-2: High level description of Mobisales functions

3.3.3 Prototype Development

The high level conceptual framework for mobile documentation of VSE business transactions as shown in Figure 3-4 has to be prototyped at this stage of the DSR. In realizing a prototype system from the framework, it is important to first present the system models. In doing this, the use case scenarios, functional requirements, class diagrams and high level system architecture have to be modelled using the Unified Modelling Language (UML). The DSR method guides the development of a purposeful framework that provides the kind of utility to support VSE business transactions but DSR does not explicitly dictate the design techniques for designing a framework or developing a system. The researcher decided to apply UML because it is an accepted Object Management Group (OMG, (http://www.omg.org) standard which is well established and used in industry and research. Models provide a means to articulate the construction of the prototype in system space (Olivier, 2009; March & Storey, 2008; Cooper & Schindler, 2006). The UML is a graphical notation for drawing diagrams of software concepts and can be used for conceptualizing a problem domain, object-oriented software systems visualization, specification, construction and documentation (Bruegge & Dutoit, 2004; Martin, 2003). The VSE mobile documentation framework was modelled using UML to provide clear and concise representation of the VSE's processes and related components that would be triggered by related tasks. The design specifications for the Mobisales prototype system is presented and discussed in further detail in Chapter 4.

3.3.4 Prototype Evaluation

For a DSR study, the evaluation phase allows for the testing of the efficacy of the DSR artefact (Hevner *et al.*, 2004) to address the problem in the context in which it was established (Ellis & Levy, 2010). The evaluation phase presents the evaluation criteria and limitations of the evaluation of the Mobisales system. The evaluation results serve to validate the relevance and merit of lightweight Mobisales framework in documenting daily business transactions of VSEs. This phase could either invoke an iterative process to refine Mobisales system or communicate results of the evaluation process. The evaluation of the Mobisales prototype is presented in Chapter 5. The emphasis is on demonstrating that through the DSR,

the research produced a purposeful Mobisales artefact that could solve real problems experienced by VSEs in real situations (Venable *et al*, 2011).

3.3.5 Dissemination

The dissemination phase entails communicating the results of the implementation of the lightweight Mobisales framework in addressing the research problem. As illustrated in the DRSM process model (Peffers *et al*, 2007), the research emanated from a problem-centred entry point. The research results should therefore clearly communicate if the research problem and objectives were fulfilled. Moreover, the contributions of the DSR artefact known as the Mobisales prototype system are communicated to the relevant knowledge domain. DSR does not focus solely on producing innovation systems but also on how these systems benefit those who use it (Venable *et al*, 2011); the research should therefore provide clear contributions and disseminate them accordingly (Hevner *et al*, 2004). The research results are discussed in detail in chapter 5.

3.4 Limitations

DSR is a relatively less popular yet valuable research paradigm compared to other research disciplines in IS (Peffers *et al.*, 2007; Hevner *et al.*, 2004). According to Peffers *et al.* (2007) there has been a slow adoption and diffusion of DSR in the IS discipline over the past 15 years. The existing knowledge may be insufficient for design purposes and may force designers to rely on intuition, experience and experimentation methods (Hevner *et al.*, 2004; Ellis & Levy, 2010) to produce innovative artefacts. According to Hevner *et al.* (2004), one of the major challenges of DSR is the overemphasis on technological artefacts and a failure to maintain an adequate theory base. This results in well-designed but rather useless artefacts in real life. Other challenges are contextualized to the DSR solving a particular problem and applicable only in the context of the problem (Hevner *et al.*, 2004). For example, a model that solves a particular problem in large organizations may not necessarily be applicable to address similar programs in small unstructured organizations (Ellis & Levy, 2010). For this study, the research method opted for a synergy between the DSR paradigm and guidance from theoretical practices such as problem based research and contextual research to get a deeper understanding of the problem domain and the setting of the intended VSE user. This

was an attempt to derive a relevant conceptual framework that could be easily adopted in other business domains such as startup micro and medium enterprises.

This study does not justify the role of DSR in IS research but merely adopted DSR to shape the study to produce reliable results and to follow an accepted research method that involved rigor in the development and evaluation of the Mobisales system. The lightweight Mobisales framework could be criticized as a product of software development exercise because both DSR and software development produce software artefacts. However, developing a commercial software product or an application for social media does not necessarily meet the criteria for research. The DSR process requires the use of rigorous accepted methods, empirical testing of the artefact and communicating the results to contribute to the body of knowledge (Peffer *et al.*, 2007; Herver *et al.*, 2004).

3.5 Conclusions

This chapter presented the DSR method that was applied to design and implement the Mobisales prototype and the rationale for using the DSR method. Through contextual research, the study was guided to grasp a deeper understanding of the VSE business domain including the conditions influencing the setting of the VSEs. The design of the Mobisales framework adhered to five phases in the DSR process as illustrated in the DRSM process model to ensure that the Mobisales framework was implemented according to a formalized design oriented research method. Done properly, this has a great potential to remedy the identified problem in VSEs through unique and innovative techniques. It was therefore critical to follow the guidance of an appropriate accepted research framework to produce a robust lightweight framework for VSEs. The limitations of the research method were also stipulated to avoid misinterpretations. This study was shaped by DSR paradigm in terms of the design, implementation and evaluation of the Mobisales framework in the context of the identified problem in the VSE business domain. In a nutshell, DSR requires the identification of a relevant organizational ICT problem; moreover, the research should demonstrate that no adequate system exists and that the development of the novel system artefact does indeed address the problem. The lightweight Mobisales framework has to be evaluated and communicated to fulfil both the requirements and contributions of the research.

CHAPTER 4 :
MOBISALES PROTOTYPE SYSTEM IMPLEMENTATION

This chapter presents the design specifications and implementation of the Mobisales prototype system for mobile documentation of VSE's business transactions. The purpose of the design and development of the prototype system is to legitimize the proposed mobile documentation framework for VSEs' business transaction. Section 4.1 presents the design specifications of the prototype system. Further discussion on the Prototype development phase of DSR is presented in Chapter 3. The design specifications section presents the UML models including the related technical components of the Mobisales prototype system. Section 4.2 discusses the implementation of the Mobisales prototype including the relevant GUI for each component of the system.

The use case scenario employed to illustrate the efficacy of the system and the evaluation in chapter 5 covers very small retail enterprises that sell groceries and basic commodities to the VSE customers. Customers purchase basic groceries on a daily basis but the VSE retailer does not always register the sales transactions or check the stock to determine if the items need to be replenished. The retailer often encounters a lot of anomalies in the business such as inability to trace what items were sold to whom. This causes a lot of confusion and maladministration when they balance the books because they are unable to separate their income, expenses and determine how much they need for stock. Most of these VSE retailers end up running the businesses to the ground, hence the high failure rate of businesses in the VSE sector as indicated in previous discussions (Kew & Herrington 2009; Esselaar *et al*, 2007).

4.1 Mobisales Prototype Design Specifications

This section presents the design specifications of the lightweight framework referred to as Mobisales to provide proof-of-concept through a real life prototype implementation. The prototype demonstrates relevance in the VSE business domain. The prime objective of the research was to develop a lightweight framework for mobile documentation of business transactions of VSEs. The proposed system should therefore enable VSE retailer to document their in-store daily sale transactions through a mobile device. The varied transactions provided by the system could be used for business related operations such as inventory, customer management and simple business intelligence to allow informed decision making.

The prototype system provides basic related functions such as capturing sales transactions, managing the stock and customers of the VSEs. The data that is recorded is not only archived but also easily accessible for future retrieval, analysis and use in various planning and decision making processes. The prototype system is relatively easy to use and easily accommodates basic users with very little literacy levels as well as skilled users who were previously exposed to using mobile applications. The design of the prototype took into consideration the context of VSEs in emerging economies, especially those resource constrained VSEs that have no computer or a point of sale system. The system aims to improve efficiency in business activities for the VSEs using appropriate mobile technologies for those VSEs that lack adequate ICT resources. This also supports those VSE entrepreneurs that have limited literacy skills and insufficient financial capital to utilize complex mobile and desktop based software systems. The UML presented below captured the basic requirements of the Mobisales prototype system and the related processes for documenting the VSEs' sales transactions.

Figure 4-1 presents the use case diagram for record transactions that are captured on the Log Book module. The UML use case diagram is applied to describe Mobisales system functions and connections of external actors (VSE in this case) to the use cases. The Log Book module manages the processes that are related to the sales of an item in the VSE. The Log Book captures the sale transactions and allows the VSE to complete the credit transaction at a later stage when the customers paid for their items. This function also allows for viewing the sales transactions over a specified period, for instance daily, weekly or on a monthly basis.

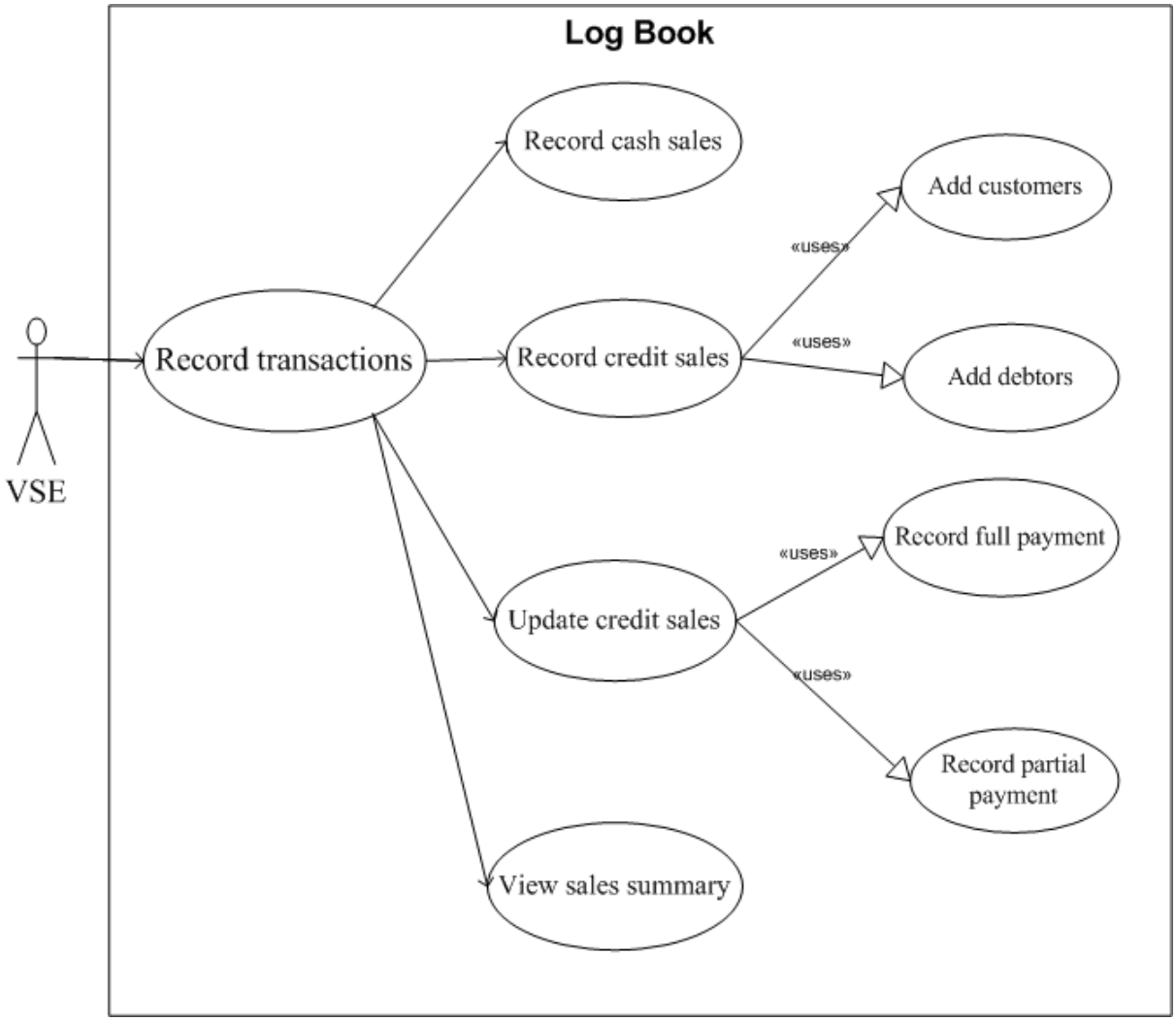

Figure 4-1: Record Transactions Use Case Diagram

Table 4-1 presents the detailed use case narrative of the Log Book including the related sub-processes and data elements. The main processes and sub-processes for the Log Book use case diagram are decomposed to give a clear representation of the interrelated processes of the Log Book function. The record sale transactions use case narrative was unpacked to give a detailed and clear account of the main process of the framework for mobile documentation of VSE business transactions. The other functions of the Mobisales prototype system are described only through the use cases but do not include the related use case narratives because the other use cases are self-explanatory.

Record Sale Transaction	
Description	This function allows VSEs to record item sales, including both credit and cash sales in the database. Users can search for sales and complete a transaction. A summary of sales can be viewed to illustrate periodic sales. Each product sale affects stock levels, so stock levels need to be updated frequently.
Processes	– Record Sale : Cash or Credit sale – Search for item from catalogue – Enter Customer details (credit sale) – View sale summary
Pre-Conditions	Sale payment terms must be defined beforehand for credit sales. Stock for sale must be available. Low stock level will trigger a notification warning. Credit sale customers must provide customer detail and payment dates.
Data Elements	– Customer ID: for credit sale – Sale ID – Item Description – Item Price – Quantity
Post Conditions	Sales transactions are recorded and included in the "sales summary" report. All sales affect cash flow and need to be recorded.

Table 4-1: Record Sale Use Case narrative.

Figure 4-2 presents the use case diagram for the Stock module which manages the inventory of the items sold in the VSE. This function allows the VSEs to manage their inventory efficiently. The VSE can check the stock regularly, add new items to their stock inventory and also discontinue items that are no longer sold. Those items that are discontinued, no longer reflect on the product catalogue of the VSE.

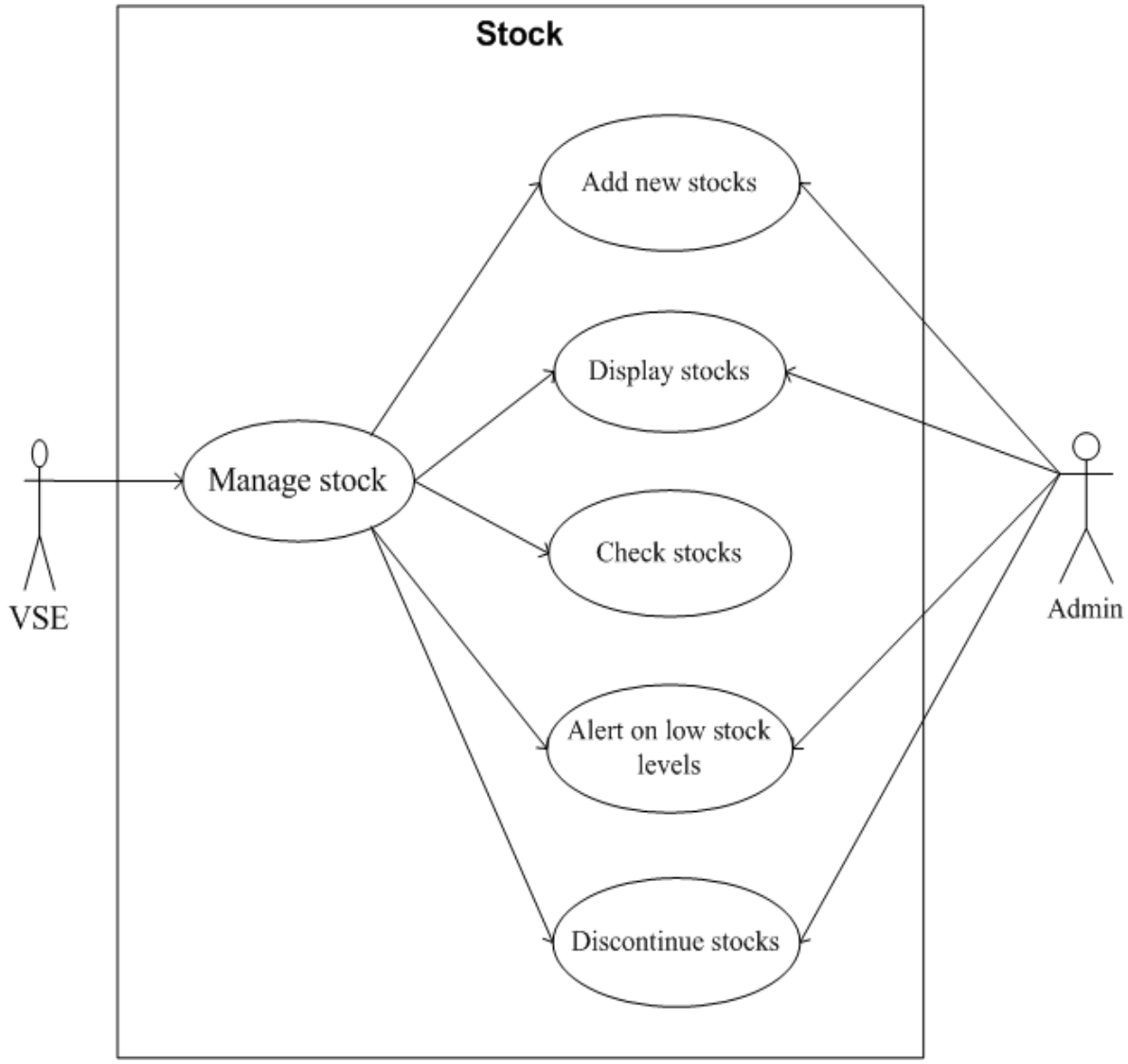

Figure 4-2: Stock Use Case diagram

Figure 4-3 shows the use case diagram for the product catalogue which manages the visualisation of items that are sold by the VSE. These items, their descriptions, prices and quantities are adjusted accordingly on the catalogue and therefore the catalogue should display accurate information. This process is managed by the system administrator (Admin) to ensure data accuracy and that the right pictures are uploaded for the items in the VSE. The VSE user is given access to check items on the catalogue and select items for a sale transaction. The other item specifications are updated and deleted by the administrator who can also delete those items that are discontinued by the VSE.

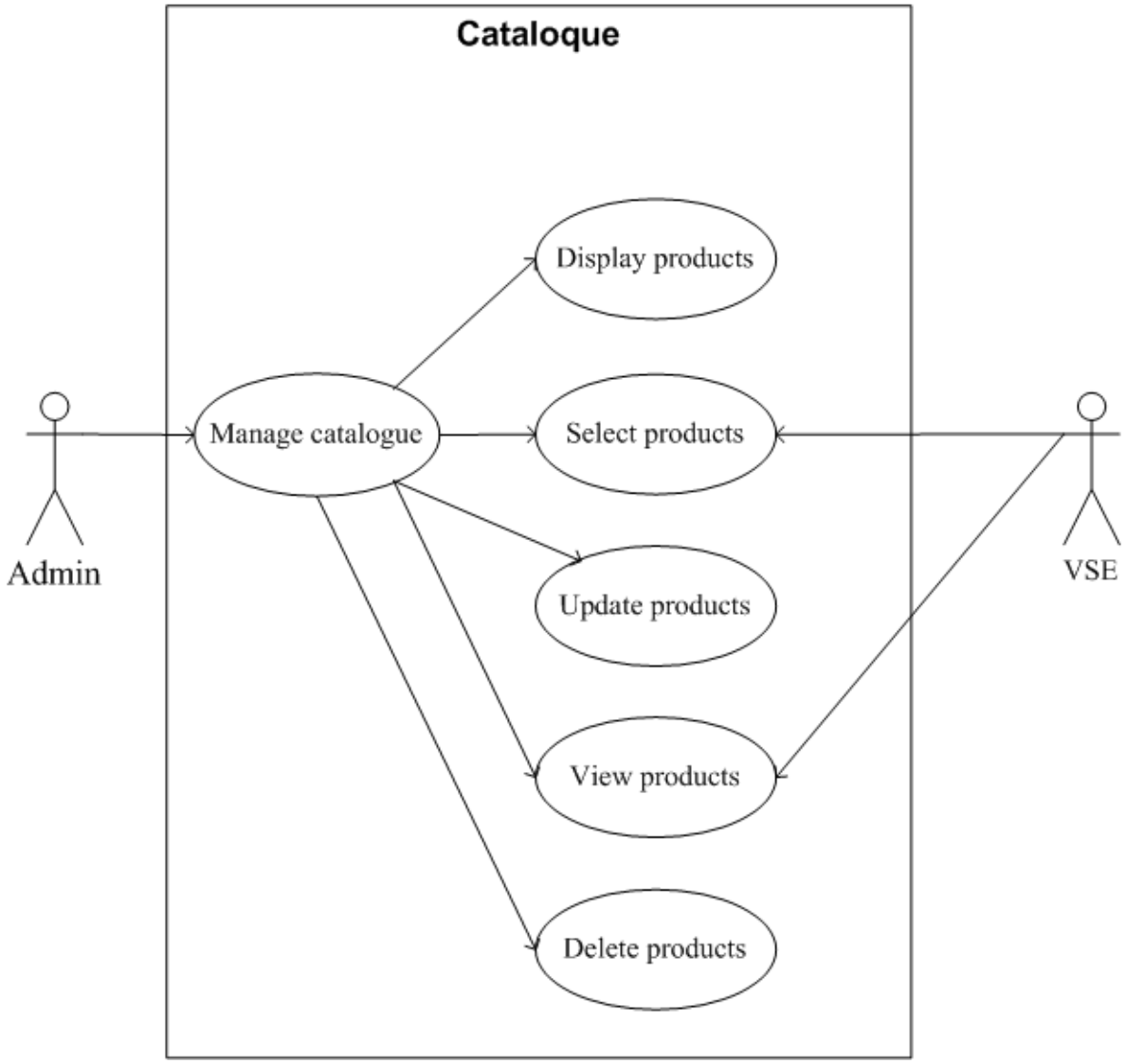

Figure 4-3: Catalogue Use Case diagram

Figure 4-4 presents the use case diagram for the customer module. The customer function allows the VSEs to manage their customer information. The VSEs can record new customer details such as name, address and contact numbers. The VSEs can also change the details of existing customers and delete those customers that they no longer serve. This module is also related to the sale of items on credit as it allows the VSE to view the customer that bought items on credit and the amount owed.

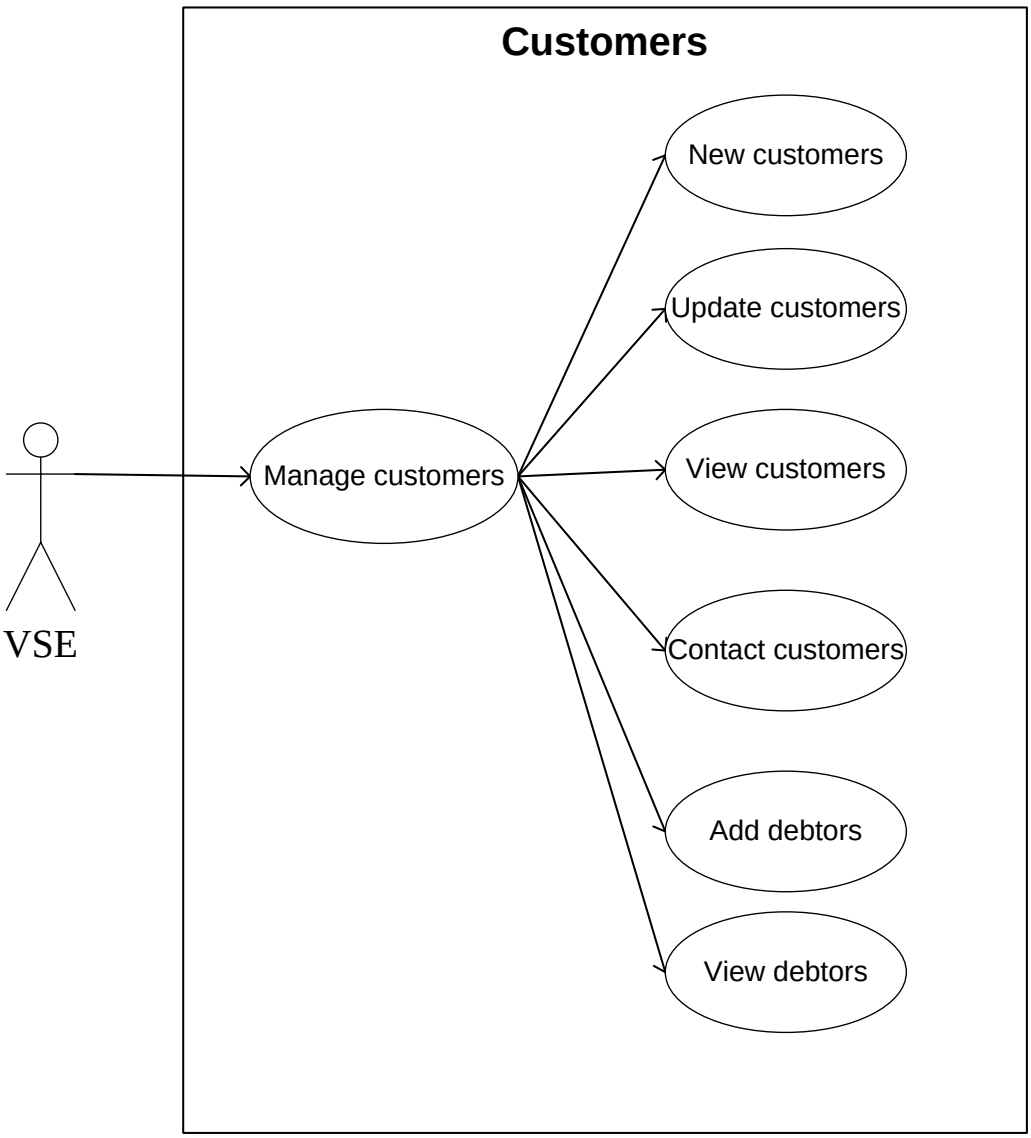

Figure 4-4: Customers Use Case diagram

The mobile documentation entails the implementation (converting user requirements (UML use case diagrams) into system specification (UML class diagram) and coding the specification to realize the Mobisales prototype system. This activity involves translating the modelled UML diagrams and developing the Mobisales prototype in an operational environment (Satzinger, Jackson & Burd, 2000). The evaluation of the implementation of the Mobisales prototype system is discussed in detail in Chapter 4. For this study, the artefact was implemented in the form of a functional prototype system. However, DSR artefacts are not limited to prototypes only, but can also include less obvious results such as the development of previously untested application tools, construction of models and methods of solving a problem in new context (Hevner *et al.*, 2004). From the models, the high level

components such as the technical architecture of the system, databases and user interfaces were developed. The alternative operating technology platforms were also implemented including technical elements such as data structure, programming language and other mobile components that are required for the seamless integration of the Mobisales prototype. Figure 4-5 presents the UML class diagram for the VSE sales processes and the related classes that are invoked for each sales transaction. Specifically, the UML class diagram is used to show the static structure of classes and their possible relationships such as association, inheritance, aggregation and dependency.

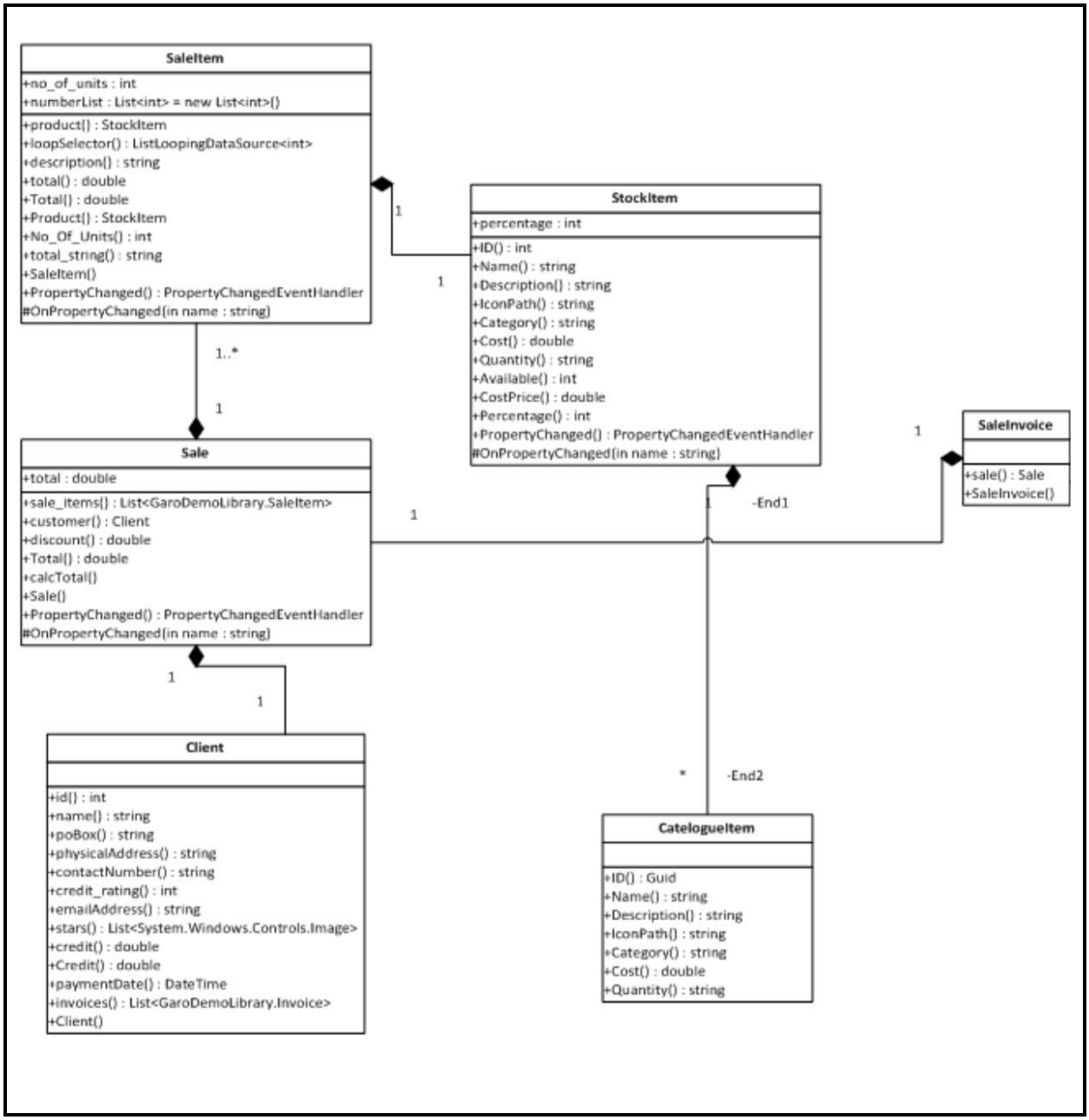

Figure 4-5: VSE sales process Class diagram

Figure 4-6 provides an illustration of the high level technical architecture of the Mobisales prototype system with the various system components of each layer. Architecture relates to the deployment and distribution of software and hardware across the various distributed system components. The technical architecture of the Mobisales prototype is a cloud based system that hosts shared computing infrastructure to optimize effort of delivering an instance of system to different users. The Mobisales system is a 3-layer architecture consisting of the Back-end server running CouchDB, a middle services layer and a mobile Front-end interface layer. Inherently, the CouchDB has direct access to the mobile front-end interface without the need for a middle layer. However, the service layer has to be separated to accommodate the separate application components that could be plugged in later on the system. The Front-end module hosts the mobile user interface and the native applications of the system.

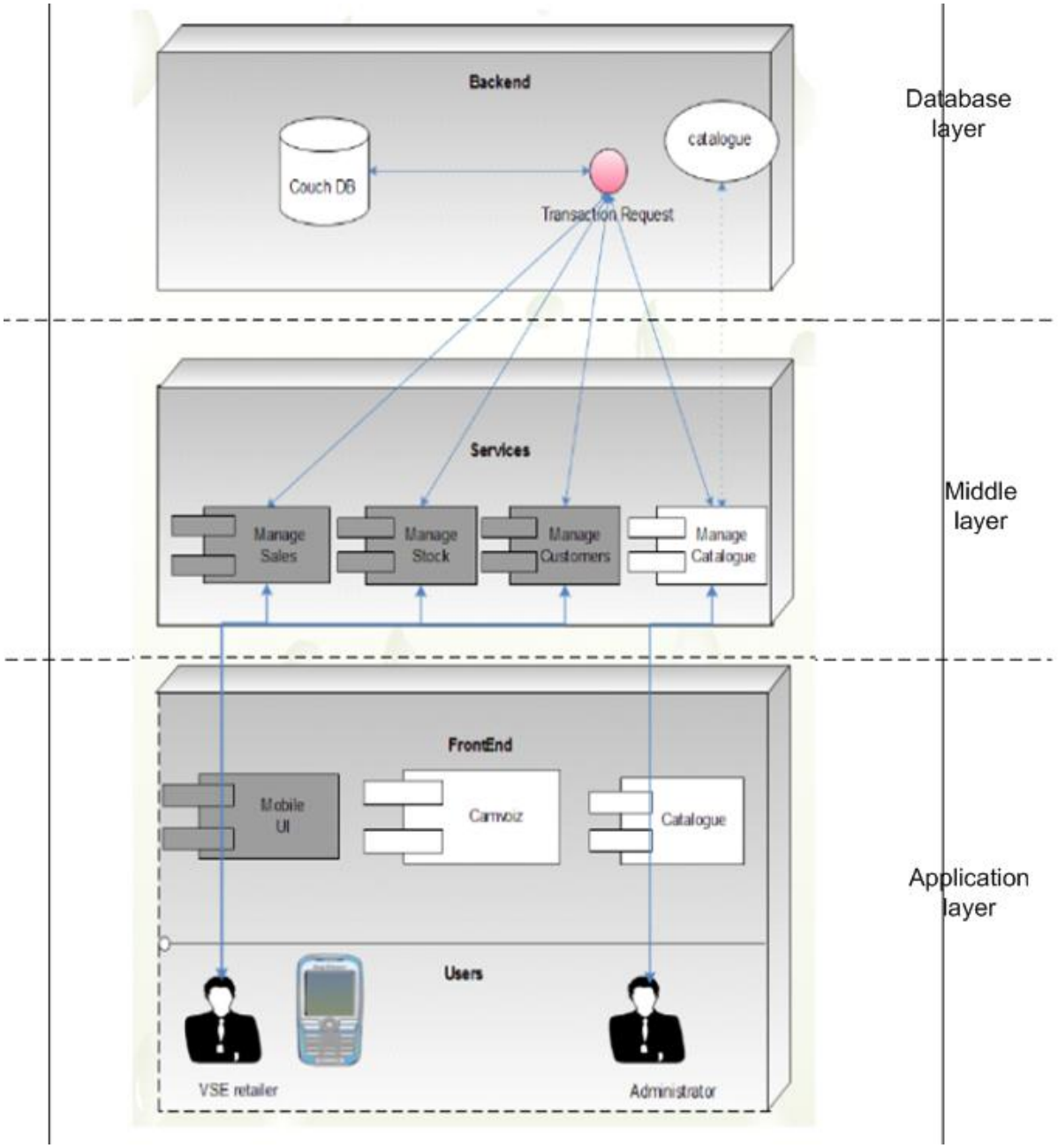

Figure 4-6: High Level Technical Architecture

The lightweight Mobisales system backend server is hosted in the cloud on CouchDB[8], which is a non SQL document oriented database schema that works well for distributed architecture. The backend server hosts the CouchDB database and the resources responsible for capturing, retrieving and analysing data between the client mobile application and the backend server. This accommodates the mobile environment where the backend of the system is hosted in the cloud where mobility is a huge factor and transaction requests are

[8] CouchDb available at http://www.slideshare.net/partlycloudy/introduction-to-rest-couchdb http://wiki.apache.org/couchdb/

not from a fixed point. The means to send and receive data from the server is handled through JavaScript object notation (JSON). CouchDB is a more robust non-SQL database that uses JSON to store data (Lennon, 2009). In contrast to relational databases, CouchDB does not store data and relationships in tables (Cattell, 2011). The database is in essence a collection of independent documents which allows the application to access multiples databases, for example, one stored on a user's mobile phone and another on a server (Cattell, 2011; Lennon, 2009). The CouchDB serves applications directly to the web browser without the need to use any middle tier compared to relational databases shown in Table 3-4. One of the appealing features of CouchDB is the multi master replication ability that uses Multi – version concurrency control (MVCC) in order to avoid locking the database file during write-up (Cattell, 2011).

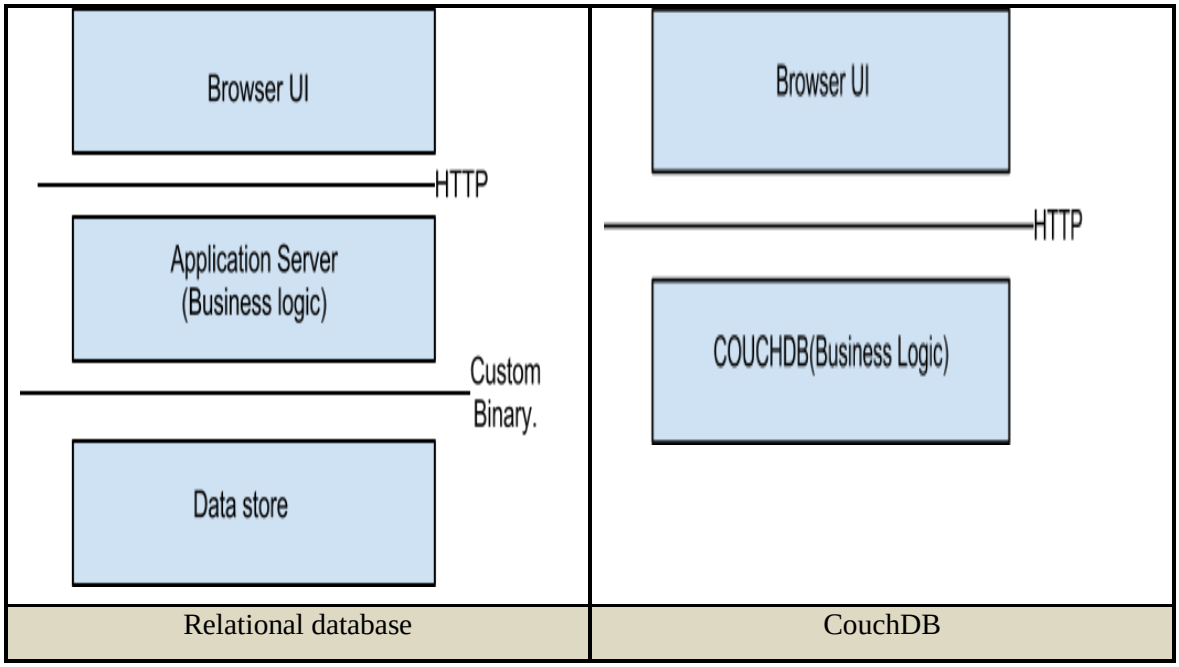

Table 4-2: Comparison of Relational DB and CouchDB

The documents are stored as JSON[9] which is a lightweight JavaScript object notation that uses Restful HTTP[10] API[11]. The mobile application will only need to make a HTTP request to the server and the server will respond with the query results without invoking other services or transactions. The REST[12] services can be accessed from the mobile application by making a REST (HTTP) call that is specific to the service and functionality required. Only the REST services have read and write access to the database. The mobile application will

[9] JavaScript Object Notation
[10] Hypertext Transfer Protocol
[11] Application Programming Interface
[12] Representational State Transfer Java based API

make a call to a REST service to achieve certain functionality which will then read or write to the database as required and return a response message to the mobile application. The request and respond strings are in JSON. This is lightweight because the application is only handling text in JSON format and attaches images to the stock item only when requested by the user as shown in Figure 4-7. This helps to avoid incorporating components that are too heavy to seamlessly render the services and transactions on the mobile device. Figure 4-7 provides a view of the JSON data structure for the Stock item and Customer detail data elements. JSON writes to the data store in plain text, this makes communication between the mobile application and the back-end faster. The character and descriptive text on the images of both the Stock item and Customer details are not error messages; they illustrate the plain text format structure that JSON uses to write instructions to the backend.

Stock Item [JSON plain text]

{"_id":"4c37e898a81254008a819c8f5900446f","_rev":"1-a27f48ecf61b680a1166601faf917564","Description":"dishwashing liquid","date":"2012-07-11 04:50:11","cost":"15","ItemQuantity":"3","selling_price":"18","ItemName":"sunlight liquid"}

_id	[illegible]
_rev	"1-a27f48ecf61b680a1166601faf917564"
Description	"dishwashing liquid"
ItemName	"sunlight liquid"
ItemQuantity	"3"
cost	"15"
date	"2012-07-11 04:50:11"
selling_price	"18"

Customer Details [JSON plain text]

{"_id":"09a404a34a441a35e2b75eb021000450","_rev":"1-5773a25eda353c7453ad8a18379985e9","ClientName":"malese","Created_date":"2012-08-11 08:27:07","ClientAddress":"35 hotel str, pretoria","ClientPhone":"0826148523","ClientGender":"female"}

_id	"09a404a34a441a35e2b75eb021000450"
_rev	"1-5773a25eda353c7453ad8a18379985e9"
ClientAddress	"35 hotel str, pretoria"
ClientGender	"female"
ClientName	"malese"
ClientPhone	"0826148523"
Created_date	"2012-08-11 08:27:07"

Figure 4-7: JSON Data structure

Figure 4-8 provides a glimpse of the Mobisales source code for the main activity module of the Mobisales prototype. The code responds to triggers and task requests from the front end mobile console. The code is considered static until invoked by specific user or system related rest calls. If a user selects a specific function from the front end mobile console, the relevant activity is invoked on the backend. All related services and rest calls for the specific activity will run until the task is completed and all transactions are committed.

```
import android.app.Activity;
import android.content.Intent;
import android.os.Bundle;
import android.view.Menu;
import android.view.MenuInflater;
import android.view.MenuItem;
import android.view.View;

public class MainActivity extends Activity
{
 private static final int OK_MENU_ITEM = 1;

 public void onButtonClicker(View paramView)
 {
  switch (paramView.getId())
  {
  default:
   return;
  case 2131361799:
   startActivity(new Intent(this, LogBookActivity.class));
   return;
  case 2131361800:
   startActivity(new Intent(this, StockActivity.class));
   return;
  case 2131361801:
   startActivity(new Intent(this, CatalogueActivity.class));
   return;
  case 2131361802:
  }
  startActivity(new Intent(this, CustomerActivity.class));
 }

 public void onCreate(Bundle paramBundle)
 {
  super.onCreate(paramBundle);
  setContentView(2130903042);
 }

 public boolean onCreateOptionsMenu(Menu paramMenu)
 {
  getMenuInflater().inflate(2131296256, paramMenu);
  return true;
 }

 public boolean onOptionsItemSelected(MenuItem paramMenuItem)
 {
  switch (paramMenuItem.getItemId())
  {
  default:
  case 1:
  }
  while (true)
  {
   return super.onOptionsItemSelected(paramMenuItem);
   finish();
  }
```

Figure 4-8: Mobisales main activity source code

The Mobisales prototype system is lightweight as it is based on lightweight services and document based techniques that render the capturing and display of information on the mobile device effectively without utilizing too many resources. The user interface and functionalities are also scaled down to incorporate only critical functions and visuals. It does not incorporate fancy features with rich components that only provide an exciting and advanced user experience but rather facilitates a quick and easy means for the VSEs to complete their tasks effectively. The mobisales could fully utilize the capabilities of smart phones and ultimately overcome some of the computational constraints in a mobile environment.

4.2 Mobisales Prototype Functional Specifications

This section presents the implementation of the Mobisales prototype system. The proposed system is an android based cloud mobile application that is accessible through the mobile user interface from the mobile device such as smart phones and tablet devices. When invoked, the application connects to the backend server in the cloud that hosts the VSE database and product catalogue. The application also offers offline capabilities data caching where the data captured can be stored locally on the mobile device until such time they can be synchronized with the hosting database on the server to accommodate cases where there is an intermittent network connection.

The Mobisales mobile application requires the VSEs to register with a VSE user name and password for authentication purposes. User authentication is required for the VSEs to login and use the application on their mobile device as shown in Figure 4-9. The application then authenticates the VSE user and loads the main interface of the application to allow the VSEs to perform specific business transactions such as capturing a sales transaction or managing their stock and customers. Overall, the system allows the user to complete as many transactions as possible without delays and deviation from transactions.

Figure 4-9: User authentication

Once the user is authenticated, the main functions of the application are displayed on user interface to access the VSE services as shown in Figure 4-10.

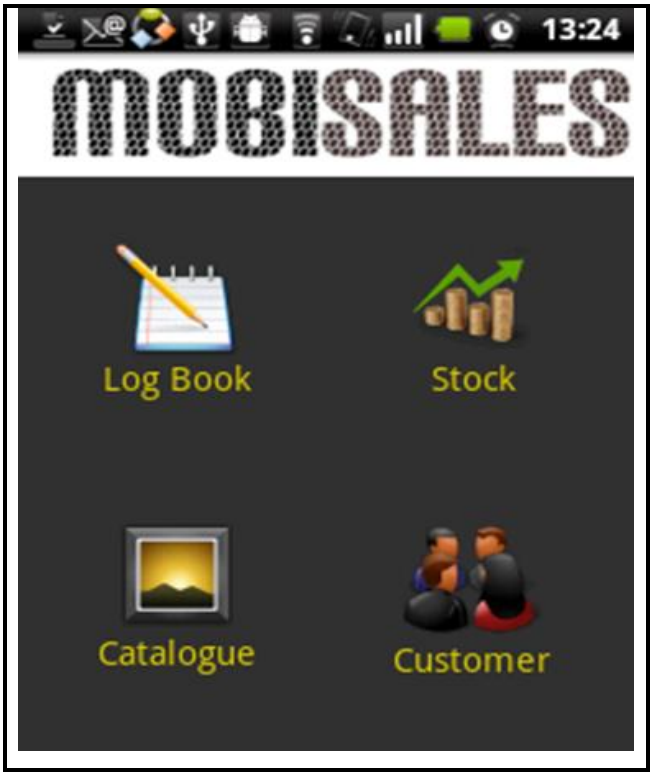

Figure 4-10: Main functions of the Mobisales

The android dashboard design pattern (Fulcher, Nesladek, Palmer & Robertson, 2011) was applied for the main user interface to provide clear and easily accessible navigation of the application's main functionality. This allows users to complete their tasks in a quick and concise manner without navigation through too many controls on the user interface.

4.2.1 Capturing Sale transactions

The sale transactions are recorded through the Log Book function and documented in the sales table for tracing purposes. The Log Book function provides a simple overview and summary of sales transactions and caters for both cash and credit transactions. The system separates the cash sale transactions from the credit sale transactions when calculating the total sale transactions for the day. The credit sale transactions are linked to the customer module and require adding new customer information or selecting from existing customers before the transaction is committed. The VSE selects the Log Book function from the main user interface on the mobile device to record a sales transaction. The VSE selects the required product items and the quantity thereof. Once the user commits the transaction, the total price for the items is calculated. To finalize the transaction, the user proceeds to select the sale as either cash or credit. If the customer pays cash then transaction is complete.

For the credit sale transaction, the system invokes the customer function where the details of the customer are captured for a new customer or selects an existing customer. Thereafter, the transaction is committed and saved in the logbook and the debtors table is updated accordingly. There are various input options available when capturing the sales items. The items can either be scanned using the camera entry as shown in Figure 4-11 or the system also uses the camera on the mobile device as shown in Figure 4-12 to capture those items that do not have barcodes. The barcode scanner (Kato & Tan, 2007; Ohbuchi, Hanaizumi & Hock, 2004) uses the mobile device's camera to read the barcode of the product and add the items to the transaction basket. This feature is relatively easy to implement and constantly improved on mobile devices but this method was often slow and time consuming.

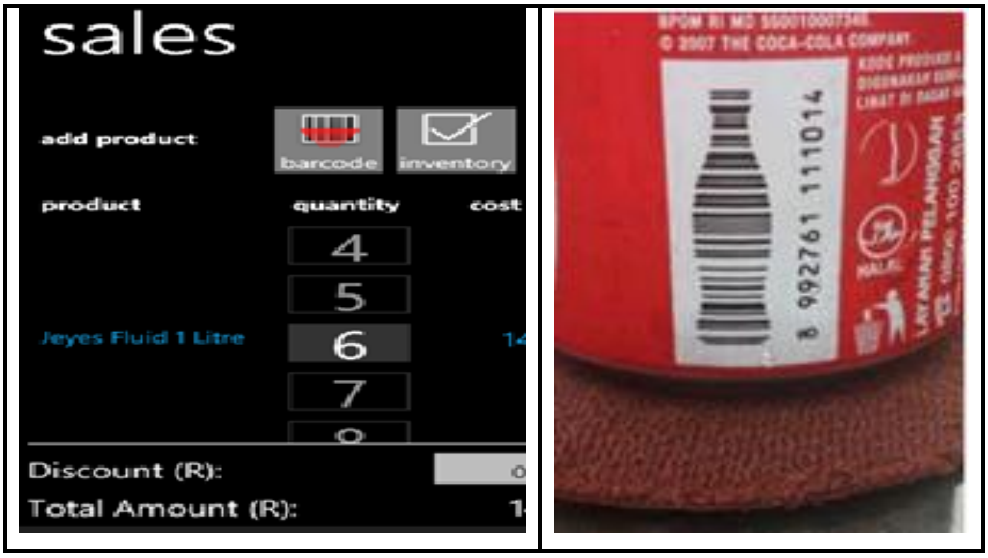

Figure 4-11: Barcode entry

The camera assists to capture the pictures of those items that do not have barcodes as shown below on Figure 4-4. The user captures and adds the image of the item, then enters the name of the product and the price manually.

Figure 4-12: Camera entry

The catalogue function displays the items in stock and the quantity as shown in Figure 4-13. This assists the VSE entrepreneur to verify if they still have enough items in stock before committing a sales transaction. Another option is for the VSE entrepreneur to perform a manual inspection of their stock in the shop (in person) without using the Mobisales application.

Figure 4-13: View items from the product catalogue

4.2.2 Managing Stock

During the initial field interactions and requirement elicitation through the VSE interviews and observation studies, the stock feature was raised as a huge concern for most VSE. Some VSE retailers complained that they did not have a proper system in place to manage their stock. They struggled to compare how many items they sold especially if they needed to balance the books and determine how much money they needed to set aside for the stock. The prototype system incorporated a simple inventory management function to allow the VSE to manage the stock efficiently. The VSE can perform stock taking periodically to check what

quantity they have in the shop, then benchmark this against the quantity reflected in the system. This helps to determine any anomalies between the items and quantity that reflect on the system and those remaining in the shop. The system also allows assigning stock thresholds and alerting the VSE when the stock levels are low so they can purchase items before they run out of stock. A notification trigger was set for each item that had a quantity of below 5 items, the system then notified the VSE retailer to add stock. The easier option was to select the items in stock and adjust the quantity and price if required as shown in Figure 4-14. The VSE can also add items manually as shown in Figure 4-8 for new items.

Figure 4-14: Stock item on the catalogue

For those items that do not have barcodes, the application allows the VSE to manually add the item image, description, category and quantity as shown in Figure 4-15.

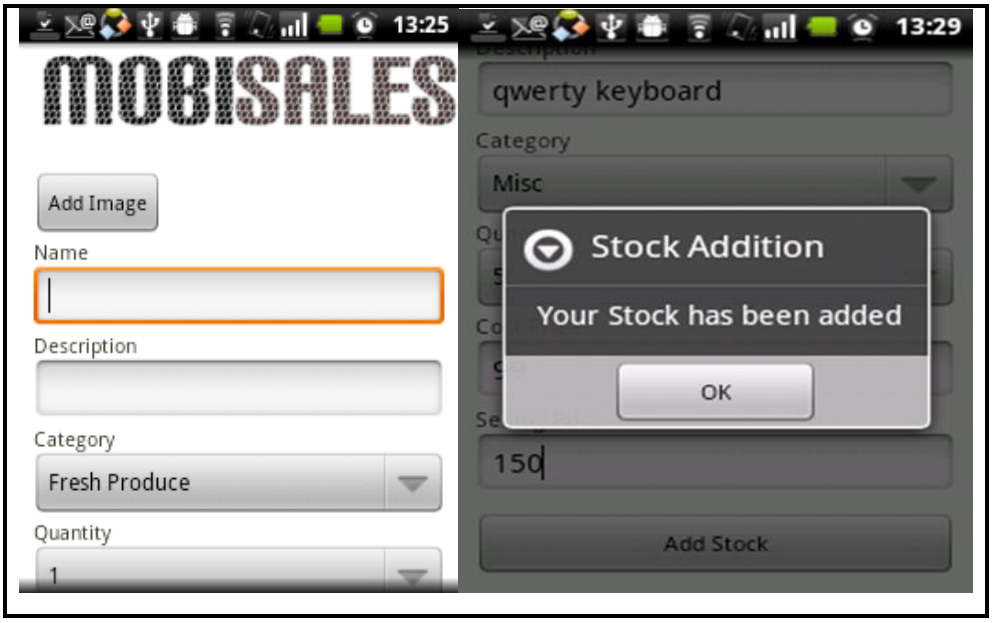

Figure 4-15: Stock item manual entry process

4.2.3 Product Catalogue

The catalogue function displays the items in stock, the quantity and price as sold by the VSE retailer. The catalogue module was managed and implemented by the system administrator. The catalogue component was implemented as a separate native application at SAP Research Pretoria as it serves many useful purposes for mobile services. This component was later integrated into Mobisales for ease of use. The product catalogue as shown in Figure 4-16 displays item picture, quantity and description per item. This mobile catalogue component serves as a product brochure, therefore it is crucial for the catalogue to reflect up to date details of the items. For the purpose of this study, taking into consideration time constraints, limited resources and skills of the VSE entrepreneurs, it was decided that this module would be managed by the system administrator to avoid human and technical errors. The system administrator is responsible for updating and deleting the items based on the requirements of the VSE.

Figure 4-16: The product catalogue

The challenge is that the catalogue hosts vast details of product items. Browsing the product catalogue on the mobile device may often be tedious and challenging because of the inherent constraints of the mobile environment. This requires flexible ways to display only the relevant items per VSE and also seamlessly display items and related services on the mobile device. Combinatorial Optimisation (Du & Pardalos, 1998) provides a suitable means for the optimization of a mobile environment. Combinatorial optimization (Du & Pardalos, 1998) techniques takes into consideration the constraints in the mobile environment and then finds a desirable means to retrieve, render and present catalogue data on mobile devices. Further investigation is required to validate these techniques. For this study, it was still feasible to operate the product catalogue as a native application to overcome the complex issues of the mobile environment.

4.2.4 VSE Customers

The VSE owners are familiar with most of their customers but they do not capture their details. They often do not retain the customer contact details or track individual transactions for each customer. This informality involved no books, and cash only negatively impacts on customer attraction and retention (Donner, 2007). The system provides the option to record customer details especially for those that have arranged to purchase goods on credit as shown in Figure 4-17. The customer function also assists VSEs to inform their customers *via* SMS when they run special discounts on products that do not sell easily. The system also allows for the addition of new customers, updating customer details and also deleting those that can no longer continue on the credit arrangement. This function allows for the VSE retailer to provide specialized services like ordering new products on special request for certain customers and then retrieving their details to contact them when the items are available.

Figure 4-17: Add new customer details

Regular customers can negotiate payment options with the VSE; once the payment is received, the VSE can update sales transaction on the Log Book and change the status from owed to paid and then commit the transaction. Credit transactions are flagged as pending until the paid function is invoked. This accommodates a VSE credit policy which stipulates that the customer can only be offered credit for items on one occasion. The customer is

therefore only legible to buy on credit again once they have paid their debt. Such policies however, are still based on the discretion of the VSE and may vary per individual VSE. In such cases customer loyalty plays a role for eligibility of credit. The debtors' option shown in Figure 4-18 provides a good means for the VSE to keep track on their debtors and to remind the debtors to settle their account on time. The VSE can send the customers reminders to settle their account based on specific payment deadlines. The customers vary per category such as teacher, pensioners, day labourers so the payment terms should be negotiated prior to the transaction; thereafter the system will be triggered when a customer has passed their payment due date and an SMS notification will be sent to the customer's mobile phone or the VSE can call their customers directly to remind them that they need to keep their credit in good standing in order to qualify for another credit sale for the next month.

Figure 4-18: View debtors and amount owed

The lightweight Mobisales system is simple, easy to use and runs efficiently on mobile devices without utilizing too many resources on the mobile device. The ability for mobile devices to deliver information related request relies on flexible, adaptable and robust information retrieval techniques. Whether information is stored locally or in a remote database, if users cannot access what they need on the mobile device, it defies the purpose of the system. The functionality of the system is also scaled down to incorporate only the necessary functionalities that are required to complete basic tasks. The lightweight framework plays a critical role to develop simple, cost effective and reliable systems. The focus is especially on eliminating unnecessary functionalities that are not immediately necessary (Kindler, Krishnakanthan & Tinaikar, 2007; Hanna, 2007). The Mobisales is

responsible for capturing sales transactions, customer details and queries, and displays the information requested by the VSE retailer on the mobile device.

What makes the Mobisales system interesting and relevant is that it could enable VSEs to incorporate effective administrative functions in their day to day business operations. The Mobisales system leverages existing mobile infrastructure to avoid the VSE retailer getting overwhelmed with installations, licensing and maintenance of the system. Although the prototype system served as proof-of-concept, it also demonstrated the feasibility of its implementation in real life. The lightweight Mobisales application runs on a mobile device and leverages the user's existing mobile phone skills. The VSE can operate the application with limited training and supervision. The Mobisales system serves the needs of VSEs with the following challenges:

- Lack of access to affordable and simple software systems
- Inadequate transformation of modern forms of organizational management.
- Lack of information about business, technology and financial services.
- Limited financial resources and ICT skills.

Although the system was demonstrated in the VSE retail sector, the concept can be replicated in other sectors. The Mobisales system could enable the penetration of mobile enterprise system systems in the bottom-billion market (Prahalad & Hart, 2009; Heeks, 2008).

4.3 Conclusions

This chapter described design and implementation of the Mobisales artefact that supports the documentation of VSE business transactions. The chapter covered in detail the design specifications and models and the functional modules of the Mobisales prototype system. VSEs in the retail sector were considered for the context of this study and the business transactions were scaled down to cover only sale business transactions. The Mobisales prototype system was then further refined to incorporate those functionalities that were highlighted as essential and critical. The customer and stock functions were directly related to sales transactions. The requirement of the Mobisales prototype and UML models were translated into the evolving Mobisales prototype in the implementation phase.

CHAPTER 5 :
MOBISALES PROTOTYPE SYSTEM EVALUATION

This chapter presents the evaluation of the Mobisales prototype system for mobile documentation of VSE business transactions. The purpose of the evaluation of the prototype system was to legitimize the idea behind the proposed mobile documentation framework and to demonstrate both utility and validity of the system in the relevant context. The contributions of the DSR artefact were therefore evaluated with respect to its ability to improve performance in the development of the artefact and to show how users manage to accomplish their intended tasks and goals (March & Storey, 2008). This chapter mainly covers three essential sections. Section 5.1 presents the evaluation strategy, the selected criteria and related conceptual measures for each evaluation criteria. Section 5.2 discusses the research finding evaluation phase with respect to the both the interaction and usability of the Mobisales artefact in addressing the research problem. Section 5.3 provides some insights from the evaluation phase and concludes with overall reflections of the evaluation phase of the DSR process. Section 5.4 concludes the evaluation chapter.

Cleven, Gubler & Huner (2009) define evaluation as the process of determining the significance of entities within a given context. The evaluation phase allows for the testing of the efficacy of the DSR artefact (Hevner *et al*, 2004) in addressing the problem in the context in which it was established (Ellis & Levy, 2010). Technology must offer utility for the user and the contribution must clearly provide the capabilities that were previously not available or feasible to achieve (Scholtz & Consolvo, 2004). Efficacy is determined through a set of attributes that bear the relationship between the level of performance of the artefact and the quality of the system in satisfying the user's task requirements under stated conditions (Pries-Heje, Baskerville & Venable, 2008).

5.1 Evaluation Method

Henderson, Podd, Smith & Varela-Alvarez (1995) assert that the validity of the evaluation rests on the validity of the evaluation strategy chosen. Choosing the right evaluation method is critical for the nature of the research (Cleven, Gubler & Huner, 2009) to establish the validity and merit of the of the proposed Mobisales prototype artefact in addressing the research problem. Literature posits the evaluation of DSR artefacts in two perspectives: Ex ante and Ex post evaluation. Ex ante systems are evaluated before they are implemented and those that follow the ex post perspective are evaluated after implementation (Pries-Heje, Baskerville & Venable, 2008). With guidance from literature (Helfert & Donnellan, 2012; Pries-Heje *et al.*, 2008; Hevner *et al.*, 2004), the evaluation of Mobisales was guided by the ex post evaluation perspective to demonstrate the efficacy of the system. The system was evaluated through observing actual use of the Mobisales prototype through field based studies and also by analysing its performance from the backend server to fulfil technical and functional requirements of the prototype system. This approach allowed for the embracing of all the complexities of human practice in real life (Pries-Heje *et al.*, 2008) against specified evaluation metrics and realistic expectations.

For DSR system evaluation, the main focus in on the utility and validity of the system in changing the user's needs or problem domain into a preferred state. The system would be deemed inappropriate if it does not present any potential for addressing the identified research problem. However, DSR involves an iterative process that allows refining the system based on the results from the evaluation. The evaluation process is an important process that provides essential feedback towards improving the quality of the design process (Helfert & Donnellan, 2012). The various phases could be iterated several times to further improve the system until it fulfills the intended requirements (Venable *et al.*, 2011, Hevner *et al.*, 2004). The system is regarded as complete and effective when it satisfies the intended requirements in the constraints of the problem (Simon, 1996). This section presents a discussion of the rationale behind the evaluation strategy and the criteria that were used to assess the system and the results thereof. As previously discussed, the evaluation phase served to demonstrate the utility and efficacy of the system in addressing the research problem. The overall discussion on reflections and lessons learnt from the evaluation phase are presented in Chapter 6.

5.1.1 Evaluation Constructs

The lightweight framework for mobile documentation of VSE business transaction is evaluated through a prototype implementation. Prototyping entails the process of developing a construct that simulates the system for the purpose of clarifying the vague requirements (Bruegge & Dutoit, 2004) and presenting it to the potential users to determine whether the system represents the reality of the user (Baskerville, Pries-Heje & Venable, 2009). Through the prototype implementation, the validity of the implemented system is evaluated in a real world setting using user based evaluation to assess its relevance and utility (Cleven, Gubler & Huner, 2009). The field based evaluation seems more appealing for evaluating the usability of mobile systems; however, time and the issue of consistency in capturing the realism of the dynamic context, are huge factors (Kjeldskov & Stage, 2003). Incorporating real users through field testing can indicate if the system meets the needs of the user, and demonstrating the system can indeed solve real life problems and not just idealistic research. This method provides a means to demonstrate if the lightweight framework addresses the problem identified in the VSE domain and if there is any potential for adoption.

The DSR evaluation process may take two forms, a naturalistic or artificial setting. An artificial evaluation is contrived in a non-realistic manner and uses methods such as laboratory experiments and simulation (Pries-Heje *et al*, 2008). The laboratory evaluation allows more control of the testing procedure and costs are low. However, it lacks the realism of the user's setting as it does not simulate the context and it lacks the desired ecological validity of the user's setting (Kaikkonen, Kallio, Kekäläinen, Kankainen & Cankar, 2005). The naturalistic evaluation involves observing the performance of the system in its real environment, and involves real users to identify real problems. The methods for naturalistic evaluation include case studies, field studies and ethnography. However naturalistic evaluation methods are time consuming and complex to carry out because they are based on the number of users and varied contexts (Pries-Heje *et al.,* 2008).

According to Nielsen, Overgaard, Pedersen, Stage & Stenild (2006); and Kaikkonen *et al.* (2005), field based evaluation often produces more usability problems than laboratory evaluation but is worthwhile for those studies that combine usability with a contextual study where user behavior is investigated in a natural context. This supports this study's method of incorporating contextual studies with DSR to achieve reliable research results. In ubiquitous computing, it is imperative for the evaluation to identify the groups of users who will be affected by the application (Scholtz & Consolvo, 2004). In this study, the choice of

evaluation method was influenced by the fact that the users are based in varied contexts. It is important for mobile systems to be tested in realistic settings, since testing in a conventional usability laboratory might not reveal all problems that users might encounter (Nielsen *et al.*, 2006). This is rather an expensive exercise in terms of time and resources.

For the evaluation phase, VSE users had to be limited to 22 VSEs for financial reasons. Hosting the prototype system on the cloud also presented other challenges such as financial implications that incurred on the user side. For the purpose of this study and for the demonstration of the Mobisales prototype system, these challenges were overcome through using test mobile devices with preloaded data bundles. However, if the prototype were implemented as a full scale software system, it would require thorough investigations and a sound financial model that stipulates the value proposition of such a system. All relevant stakeholders would need to agree on a feasible payment model to afford the network data consumption. Seemingly, it was worthwhile to employ the field based evaluation method to evaluate the use of the Mobisales system in the real user's context. Table 5-1 provides the evaluation criteria and conceptual measures used to evaluate the Mobisales prototype system. The evaluation metrics and conceptual measures associates meaning through applying human judgment (Scholtz & Consolvo, 2004).

Evaluation Criteria	Conceptual Measure	Description
Interaction	Feasibility	Demonstrate that the process can be followed which is done by simply applying the process (Borek, Helfert, Woodall & Parlikad, 2012).
	Task Fitness	Features that provide support to fit the requirements of a task (Larsen, Sorebo & Sorebo, 2009; Dishaw & Strong, 1999; Goodhue & Thomson, 1995).
	Feedback	System generated notifications that are given to the user as confirmation or notification when completing user request or routine tasks (Godbole & Smari, 2006; Erl, 2004).
	Performance	Measure in time from user interaction to feedback for user (Scholtz & Consolvo, 2004).
Usability	Simplicity	Ease of use, controls over the user interface of the system (Zhang & Adipat, 2005).
	Perceived ease of use	Combination of attributes, which provide the greatest satisfaction to a specified user (Bevan, 1995; Davis, 1989).
	Overall user satisfaction	The extent to which the system archives efficiency and satisfaction by the users carrying out the specified task (Bevan, 1995). The VSE user behaviour and attitude after interacting with the system. Suggestions, critiques and personal viewpoints.

Table 5-1: Evaluation constructs

The evaluation of Mobisales was based on the evaluation criteria of Interaction and Usability as shown in Table 5-1. In this study, 'interaction' is defined as how users and systems work together, taking into account that devices in ubiquitous computing can be dynamic rather than static (Scholtz & Consolvo, 2004). The interaction of users with the Mobisales system was evaluated with respect to feasibility, task fitness, feedback and performance of the system to the intended task requirement of the users. In this study, 'usability' is focused on the user interface of the system and the overall user experience of the interaction with the Mobisales system. Usability is an important factor in the continuous strive to develop a purposeful system (Henderson *et al.*, 1995) and critical for those evaluations that involve a number of real users (Shneiderman, Plaisant, Cohen & Jacobs, 2009). Moreover, usability facilitates the opportunity for users to provide their critique and feedback for further improvement of the system. The usability was evaluated with respect to the simplicity, perceived ease of use and overall user experience. The test users were VSE retailers based in both rural and urban communities in South Africa. Table 5-2 provides the number of VSEs that were involved in the testing process and geographical location of those VSEs.

Number of VSE	**Location**
8	Rustic Living Lab, Sekhukhune Limpopo Province
6	Spruitview, Gauteng Province
3	Roodepoort Gauteng Province
5	Kopela Community North-West Province

Table 5-2: VSE Pilot sample

The Mobisales system was loaded on several android based mobile devices that were used as test devices. The users were given a brief training to introduce them to Mobisales concept and the functionalities and navigation controls of the system. The VSEs used Mobisales to record the sales transactions. The user tasks and system operations were performed in real-time and the users provided feedback regarding their interaction using the Mobisales system. The VSE performed the following basic tasks:

- Record a new sale transaction in the system through the Log Book function.
- Add a stock item manually on the system through the Stock function
- Capture the stock items using the camera
- Use the catalogue function to view the stock item details.
- Add a new customer on the system.

The evaluation results are presented in section 5.2 based on each evaluation criteria and conceptual measures.

5.2 Evaluation Findings

This section presents an in-depth discussion of findings with respect to the evaluation criteria of interaction and usability. The Mobisales prototype system served to demonstrate the need and validity of such a system to overcome the detrimental documentation process of VSEs. Section 5.2.1 presents the evaluation results of the Mobisales prototype system with respect to the interaction criteria. Section 5.2.2 covers the usability evaluation criteria.

5.2.1 Interaction

In terms of evaluating the efficacy and utility of the Mobisales system with respect to the feasibility and task fitness conceptual measures, the Mobisales was considered feasible to replicate the existing process of the user and to complete the users' intended task efficiently. The system simulated much of the manual VSE business processes in an automated manner on the mobile device console. The emphasis was on demonstrating that the process can be followed by simply applying the process. The evaluation also assessed if the function provides the necessary capabilities for the user to complete intended tasks. Moreover, the

evaluation also assessed if the user was familiar with the specific functions of the system compared to their existing processes in the VSE. This section emphasizes the varied processes and functionalities of the system including the screen shots of the user interface as the system fulfilled the intended tasks. The system provided feedback through system notifications and requested input from the user to acknowledge whenever a task was completed or committed as shown in Figures 5-1 and 5-2 below.

Figure 5-1: System generated feedback

Figure 5-2: Committing a sale transaction

With respect to the performance of the system, the Mobisales prototype artefact was quite stable but often experienced a few system crashes and continuous bugs were fixed. This section presents the analytics overview of the Mobisales system application with respect to the performance of the system in managing users, devices and response times per transaction. The data was generated from the backend server and reports were exported through Google analytics application. Figure 5-3 presents the overall overview of the Mobisales prototype system. The VSE field testing generated 22 sessions on the server and the 3 testing devices

used were loaded with the Mobisales frontend application and used by 22 VSE test users. The test devices included two Android based LG Optimus L9 and L7 mobile phones and the Samsung Galaxy II smart phone.

Screen Resolution	Sessions	Mobile Input Selector	Sessions	Mobile Device Branding	Sessions
480x800	19	touchscreen	22	LG	20
540x960	3		view full report	Samsung	2
	view full report				view full report

Figure 5-3: Mobisales application overview

Figure 5-4 provides the overview of the users and the sessions on the system over the field testing duration.

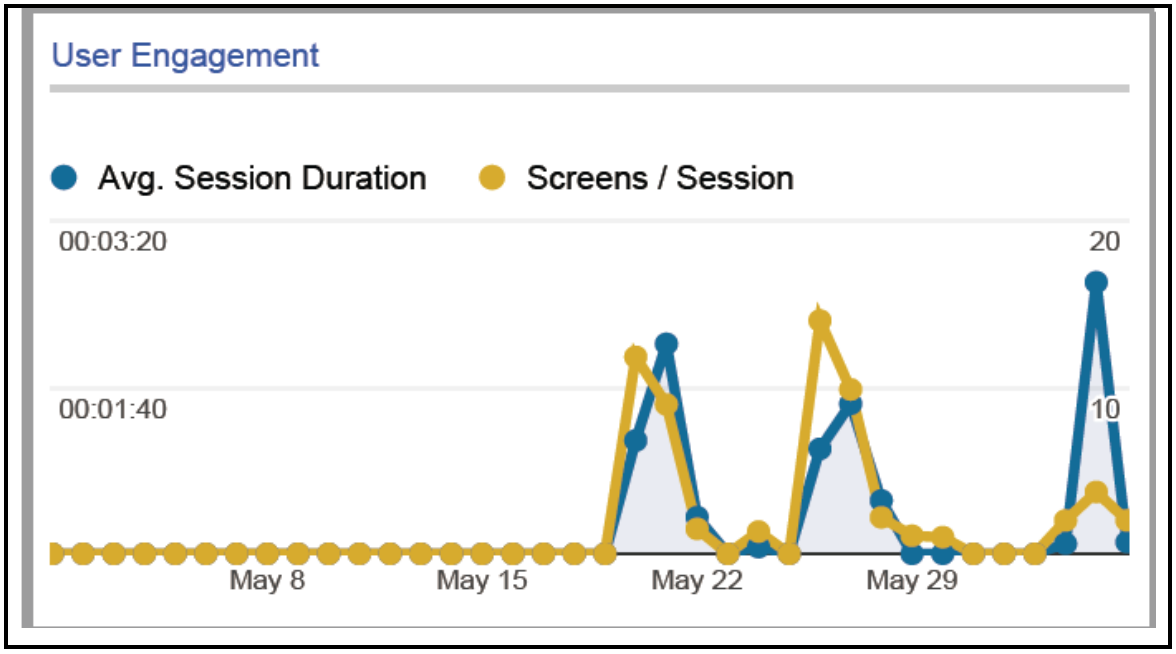

Figure 5-4: Mobisales User engagement

Figure 5-5 presents an overview of the test devices, mobile operating systems and the network. The session log reports the event and system crashes. Some of the sessions reflected on the log were created through continuous use of the Mobisales application through systems diagnostics testing by the administrators. The report also shows the total number of crashes on the specified date.

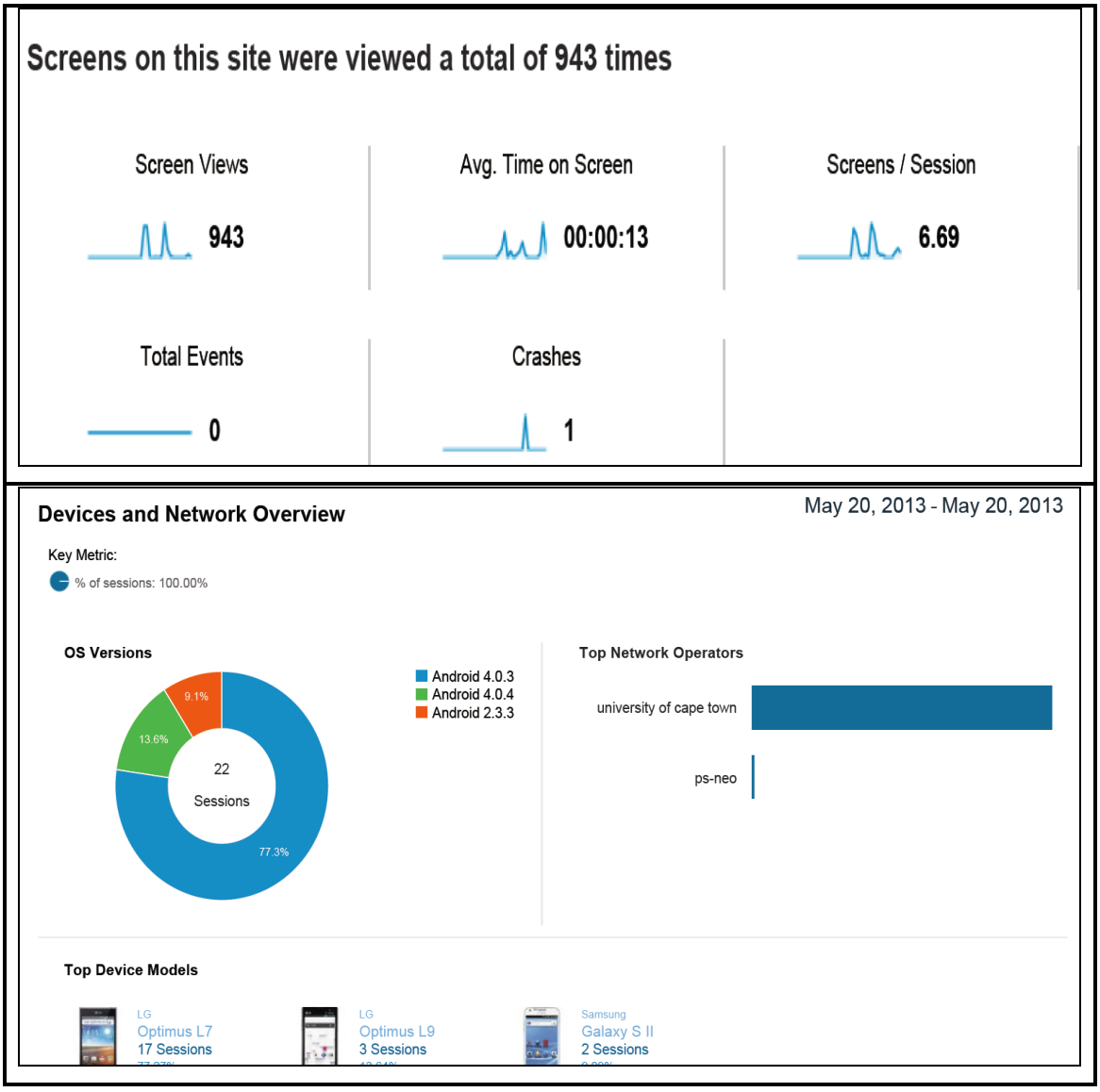

Figure 5-5: Mobisales Data and Network overview

Figure 5-6 shows the performance of the system in handling transactions and the response per activity log. The response time per millisecond per transaction varied depending on the nature of the task and network connections. The activity log shows the description of the transaction, time elapsed per transaction and the date of the transaction.

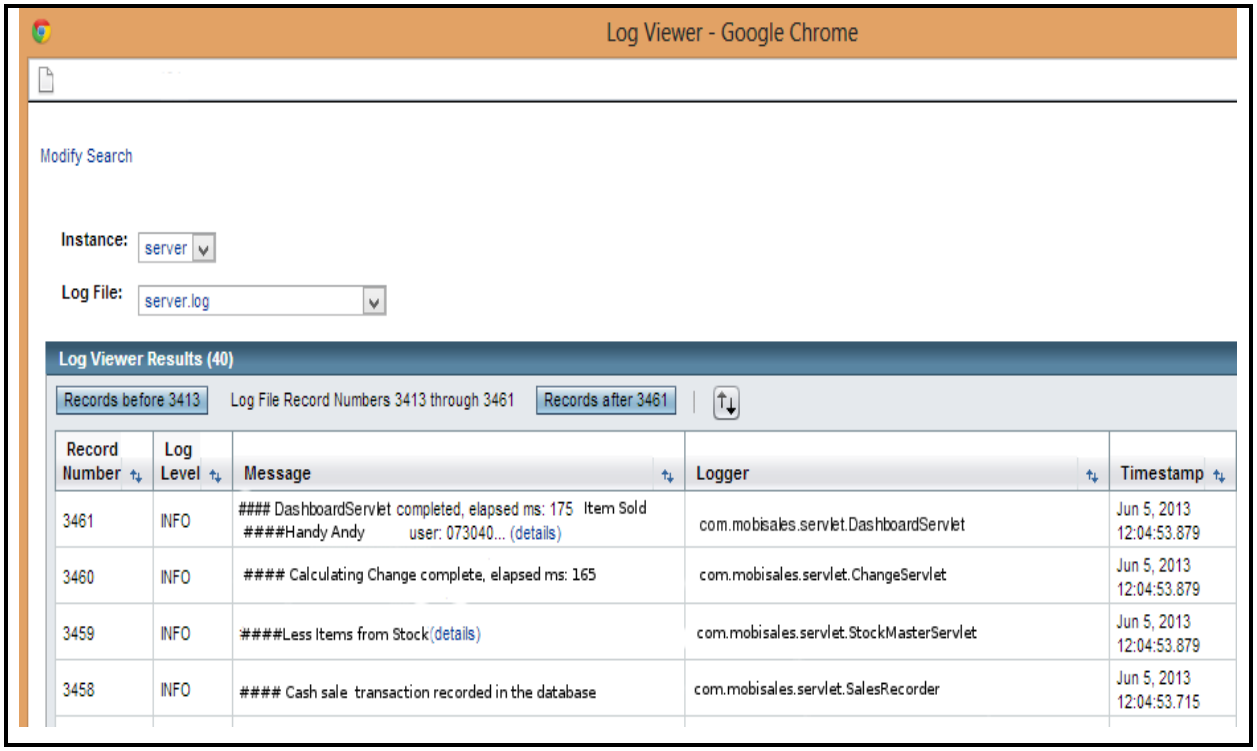

Figure 5-6: Mobisales activity log

Overall, the system had minor bugs and was often reported as being unstable. These challenges were addressed continuously as reported by the users. The system was sometimes randomly logging the user out and returning to the main menu of the system without completing a transaction. Often the images took a while to load, this issues was addressed by loading the native catalogue mobile application on the local mobile device. The bugs were resolved quickly to avoid prolonging the field testing. The system provided confirmation messages to the user when they were about to commit a transaction and after the transaction was confirmed. The same logic was also incorporated for the error and alerts. Users were prompted to take notice of the action that was about to be performed or an error that occurred during a certain transaction. The application also included basic confirmation such as ‘ok’ or ‘cancel’ to give the user permission to complete and exit a specific task. The system also prompted users in cases of erroneous input such as selecting a wrong category for items when entering stock items. For instance users were required to capture stock items manually for those items that were not preloaded on the product catalogue, such as vegetables. Some VSE users needed time to get familiar with the touch screens of the test mobile devices. It is therefore suggested that multiple devices, both traditional keypad based and touch screen be considered to accommodate different users. Overall, the Mobisales system provided limited input methods to avoid human input errors.

5.2.2 Usability

There were various user behavioural aspects that emanated from the user interaction with the Mobisales prototype system. This section presents the usability results evaluated with respect to the simplicity of the Mobisales prototype system, the perceived ease of use and the overall satisfaction feedback provided by the VSE users. The Mobisales system provided a simple and easy to navigate user interface with the main functionalities presented through an android dashboard design. The system displayed the main functionalities of the application through an easy to navigate mobile interface to eliminate unnecessary distractions. Overall the prototype was easy to use and followed the simple business terms of the VSE business context. The prototype system is simple in terms of usability and navigation and therefore accommodates users with basic literacy skills. The system does not use complex business logic but incorporated simple terminologies that is used in the VSEs. The names of the main functions such as Log Book, Stock, Customers and Catalogue were simple and descriptive enough for to use and understand. Moreover, the logic of the processes involved in completing a task was not too complicated to discourage users.

In terms of perceived ease of use, the application was perceived as easy and simple. The users provided some valuable suggestions, critique and personal viewpoints. Although some of their recommendations could not be incorporated in the prototype system, they were considered as requirements for further development. DSR is inherently an iterative process that allows continuous refinement of the system until it satisfies the nature of the given problem (Peffers *et al.*, 2007; Hevner *et al.*, 2004). However, it is difficult to incorporate all users' expectations with regard to suggestions on the functionalities of the system. For instance, the stock functionality was highlighted by some VSEs as an essential component of the system for their business. The Mobisales prototype system was further refined to accommodate those VSEs that highlighted the need for the stock function as a high priority business process.

Some VSE users suggested that the system should also enable the VSEs to order items from the local supplier so that they could only travel to pay and collect their supplies. It is crucial for the VSE to always stock the necessary items to avoid turning their customers back because they are out of stock. Some VSEs were even willing to pay for their items to be delivered to their doorstep for convenience and to save them time so that they could do other critical business operations rather than purchasing stock. This was considered a critical

function for the prototype based on the needs of the VSEs. These findings could be used to further enhance the system.

During the evaluation process, the VSE users were asked through informal discussions to provide their general feeling with regards to perceived ease of use and overall satisfaction regarding their interaction with the system. The VSEs provided positive feedback in terms of the Mobisales prototype system's ability to help remedy some of the documentation problems and also provide them with enough information to help operate their businesses better. Most of the users responded with the view that the Mobisales system was easy to use and user friendly, despite some difficulty in navigating and using the application. One VSE user indicated some reservations based on the fact that it was his first time using the Mobisales prototype. *"The application seems somewhat easy to use, but not very easy. I would feel more confident using it over time*," he said.

One VSE user indicated that although he makes use of a mobile phone, he would not consider himself as an "active phone user" and therefore, the system would not be very useful despite the relevant functionalities. The same VSE user also mentioned that he would use the system to advertise and promote specials in his shop. He would reduce the price of those items that are not moving steadily from stock and sell them before they reach their sell-by date. The customer function was more useful to contact his customers in this regard. If a customer requests an item that was not available in the shop, he would order the item and then make use of the system to contact the customer when the items are in stock. He could also make arrangements to have the items delivered to the customer's address to ensure that the sale is fulfilled. These were indeed some of the valuable insights that emanated from the user based evaluation method (Pries-Heje *et al.*, 2008; Nielsen *et al.*, 2006).

The VSE users learnt quickly how to navigate between different screen and the images were simple to understand, that is, the functions and what each function and icon represented. The VSE users indicated that it would not be easy to use the system at peak times such as weekends as it took time out from attending to their customers. They were concerned that their customers might get anxious and leave. Some VSEs continued to sell as much items without capturing the sales items and later on tried to capture those sales transactions into the system. This introduces more anomalies because humans are also prone to forget and might not capture all the sales transaction on a very busy day.

The VSE users felt that the Mobisales functionalities were somewhat similar to their VSE business processes. The system incorporated simple images and the terminology was easy to understand. The VSE users indicated that the system made it easy to complete various tasks on the different screens. The task flow remained consistent and familiar throughout the various screen of the system. More importantly, the terminology used was appropriate for the basic language used in the VSEs. The Mobisales system was developed in English but the terminology was kept simple to accommodate those with limited literacy skills. Although many VSEs served their customers in their native languages, they had basic literacy skills that enabled to understand the Mobisales system. This accommodated those VSEs based in urban locations where many people come from different backgrounds and ethnic groups. Some of the older VSE users based in rural communities were only familiar with the name of the items in English but not the basic terminology *per se* as they had very little education. However, since the terminology was minimised to the main functionality and confirmation screens when committing a transaction, they could follow the various controls of the system. They indicated that technology is not their best "toy" and that they would prefer to keep using their existing processes to manage their business transactions.

During the field evaluation, five VSE users found the "stock" functionality to be useful but not necessarily valuable in terms of efficiency. This refers to managing their stock regularly because they bought their supplies in bulk and had a lot of stock beforehand. Their stock items were moving steadily and they did not get a good opportunity to see some of the notification prompts on low stock levels. Some of the functionalities had to therefore be simulated to demonstrate how to use them. The VSEs enjoyed capturing the stock through the mobile device camera, selecting the items from the preloaded catalogue and adjusting the quantity of each stock item. The general feeling from the users during the field based evaluation was that the Mobisales prototype system was useful and could benefit the VSE entrepreneur to manage their business more efficiently. The VSEs in general found the application useful. Two VSE entrepreneurs were not enthusiastic about the idea behind the Mobisales prototype system. They said that they would require more time to interact with the system before they would be able to provide an honest opinion of the system. They could be more convinced about the system once they had "wrapped their fingers around the concept". The overall general user experience and personal reflections are summarised below through the quoted narratives of VSE entrepreneurs and their general feeling after interacting with the system. These excerpts from VSE users feedback, gives a clear idea of how some of the VSEs reacted with regards to the potential use of the Mobisales system in real life.

Ben Manguwana, Spruitview, Gauteng: *"The application could help to promote my business especially promoting specials in the shop by sending my customers SMS to inform them about specials and discounts. It can also help me to figure out the buying trends of each customer"*.

Peter Mabuza, Sekhukhune, Limpopo: *"I never imagined using my mobile phone beyond SMS and phone calls. At most I heard my kids talk about the internet but that is something I thought was beyond my generation. Now I can run my business from my mobile phone"*

The feedback from the user based evaluation was positive. The user feedback indicated mixed reactions on the interaction with the Mobisales system in terms of overall user experience. Some of the factors that influenced the results are summarised below:

- The VSEs with a large customer base indicated a preference to use the Mobisales on a tablet device. They indicated the tablet device as a better alternative to a mobile phone.
- Receiving delayed responses when accessing the services on the application. Some VSEs get anxious and assume they selected the wrong functionality.
- Concerns about incorrect product descriptions related to human entry errors.

5.3 Discussion on Evaluation Findings

The field based evaluation revealed some interesting behavioural aspects that emanated from the interaction of the users with Mobisales. Some of these behavioural aspects were not necessarily expected. These behavioural responses towards the Mobisales artefact directly posits the link between the two IS research paradigms, namely: DSR and BSR. One of the user behavioural issues identified from the user based evaluation was related to user confidence. This is directly related to the ICT skills of the VSE user. Some VSE entrepreneurs only utilized mobile phones for phone calls, messaging and in some cases, email. The users were not familiar with the concept of using the mobile device as a computational tool that could provide business systems for VSEs. The Mobisales concept intimidated some users because they felt they needed more training before using the system. A few users were anxious and concerned they will "break the system" and preferred to continue with the manual way of recording their business transactions. It was evident that the

excitement, enthusiasm and energy varied when using mobile devices for social use compared to business use. Some users often get excited and inquisitive to access internet based services such as social media on their mobile phones but the interest and enthusiasm is replaced with anxiety when using business systems on the same mobile devices. To accomplish improved utility of the system, it is critical to train users on the system to increase the level of productivity and confidence when using the system (Satzinger, Jackson & Burd, 2000).

User confidence is closely related to an individual's attitude towards a certain phenomenon. These attitudes are believed to arise through learning whereby a person acquires a reaction to an action over a period of time and once learned, the attitude can be triggered automatically when one is exposed to the action (Bagozzi, Dolakia and Basuroy, 2003; Fazio, 1995). Some VSE users indicated they would not be able to provide their overall satisfaction of the system until they were familiar with using the system. This study therefore posits that users' computer self-efficacy (CSE) also plays a vital role in adoption of any technology system. Computer self-efficacy (Compeau & Higgins, 1995) highlights a person's belief in their ability to accomplish a specific task. CSE applies to generic skills specific to the usage of computer systems. Those users who were not acquainted with any form of computing before being introduced to Mobisales hesitated to use the system, they only agreed to give it a chance when they felt confident after a few demonstrations and training. The Mobisales system is deemed fairly simple and easy to use; however, it took some effort to give users adequate training and ample time to understand the concept.

Age group is a significant factor in the potential adoption of mobile systems. Some of the middle aged and older VSE entrepreneurs were quite adamant that their current administrative practices were better than introducing technology systems in their businesses. These VSE entrepreneurs felt too old to learn new technologies; however, the older VSE entrepreneurs from Spruitview in Gauteng province were enthusiastic to use the Mobisales system. One of the VSE users highlighted that the system should provide a way of capturing and tracking the sale of prepaid airtime and electricity vouchers that he sells through mobile banking. Some VSEs made suggestions for improving the system to incorporate a small financial module to help them manage their cash flow. Some of the younger VSE users especially those with a high financial turnover and customer base, found the Mobisales easy to use and too simple for their VSE. They suggested more functionality such as ordering stock, sending reminders to customers and managing cash flow.

Another behavioural aspect that emanated from the interaction with the Mobisales system was the lack of confidence in the system in terms to security and trust. Trust is explained as the user's belief that the system will use the generated information and user's personal information appropriately and not cause harm (Scholtz & Consolvo, 2004). Some VSE users were concerned about the idea of their critical business information being hosted "somewhere in the cloud". The Users asked several questions in this regard, "What will happen to my critical business information?" and "how can I be sure that my information will be safe?" It was reiterated that realistically, part of the terms and conditions of using any hosted service mobile or on demand system, is that there has to be security measures implemented to avoid unauthorised access to user's information and that their information would not be disseminated to third parties.

5.4 Conclusions

This chapter described in detail the evaluation process of the Mobisales prototype system that supports the documentation of VSEs' business transactions. This chapter also covered the evaluation method and criteria as guided by DSR to demonstrate rigor and evaluation of the system. VSEs in the retail sector were considered for the context of this study and the business transactions were scaled down to cover only sales transactions. The evaluation was carried through a field setting to assess the relevance and efficacy of the lightweight Mobisales framework. The nature of the evaluation involved VSEs in their realm from varied locations in South Africa to draw deeper insights from the different VSE settings. Field based evaluations are time consuming but worthwhile to evaluate both the feasibility of system in the given context of the user and the change in users' behaviour when using the system (Kaikkonen *et al.*, 2005; Nielsen *et al.*, 2006; Henderson *et al.*, 1995). It was very challenging to give users the platform to express their views and perceptions through the feedback discussions without hindrance. There is always a fine line between the user providing feedback that they think the researcher needs to hear and their honest personal viewpoints.

CHAPTER 6 :
DISCUSSION AND CONCLUSIONS

This chapter provides the concluding discussion of the study, the research findings and contributions of the study in both the ICT and VSE domains. The reflections on findings are based on personal viewpoints of the researcher, insights from the research process and existing literature. In addition, the chapter summarizes research contributions, discusses study limitations and suggests recommendations for future work. The suggested recommendations are based on the outcomes of the experience of implementing the lightweight framework as both a design process and the results from the evaluation of the Mobisales prototype system. Section 6.1 discusses the reflections on the research insights. Section 6.2 presents the contribution of the study. Section 6.3 highlights the limitations of the study. Section 6.4 recommends future work based on the findings of the research. The chapter concludes with section 6.5 which highlights the reflections and lessons learnt by the researcher throughout the research.

6.1 Reflections on research findings

The results of the evaluation of the Mobisales prototype system were presented in chapter 5. This section provides an in-depth discussion of those findings that emanated from the overall DSR research process and the evaluation of the DSR artefact. The study presented a great opportunity to explore the VSE business domain and therefore the discussion of findings is directly related to the research context and does not necessarily imply that related studies would produce the same results. The study also referred to existing studies as a means to cross-reference the validity of this study. Overall, the VSEs that were involved in the evaluation were convinced of the validity of the Mobisales prototype system to streamline some of their VSE operations, if it was provided as a commercial product or value added service form one of their suppliers. The critical issue was the cost they would incur for using

the system; however, the cost and business models fall outside the scope of this study. It was clearly stipulated that the system was for research purposes and business models would be considered later if the system moves toward potential commercialization.

Mobile computing has become a reality due to the emergence of wireless devices and better networks (Barbará, 1999) but this does not inherently mean that every system that is provided for mobile devices will be used by default. Literature posits mobile phones as the preferred device of use compared to computers especially in emerging countries. Developing mobile systems for small business systems is therefore beneficial and relevant to the SMME business context. It is quite a challenging but feasible task to automate business processes for small enterprises through the use of a mobile application. Providing mobile solution systems to VSEs can improve business agility as mobile phones seem less intimidating than desktop computers especially for those users with low computer literacy. Yet, there are still issues where system use is stagnant even when the systems are developed through the appropriate technologies and for what is regarded as the users' preferred device. These mobile systems should be developed to suit the needs and contexts of the user.

Because of the constraints in the mobile environment, the introduction of mobile computing to automate VSE business transactions is challenging but feasible (Parikh & Lazowska, 2006). There are challenges and constraints that need to be taken into consideration when developing systems for the mobile environment. The implementation of Mobisales demonstrated the feasibility of providing simple, innovative and lightweight mobile systems to VSEs. This study presents the inherent challenges of a mobile environment in the context of the research. Mobile devices typically have limited displays, small keypads unsuited for lengthy input, less processing power and limited memory capacity as compared to desktop computers (Barbará, 1999); however, the gap is narrowing due to the growth in smart phones and tablet devices. The low feature phones are still prevalent among many VSEs who do not have access to the high end smart phones. The inherent constraints of mobile devices often dictate the development and optimization of mobile applications to suit the mobile environment.

The retrieval and presentation of content on the mobile device is also challenging. Because of varying mobile device specifications, the system needs to include context logic that will optimize the retrieval and presentation of content swiftly. Mobile devices have limited user input options and a small keypad. User preferences vary and users may not find it easy to utilize any mobile device because they not familiar with the specific make and model of the device. For instance, using a low feature mobile phone does not give the same

experience as using a touch screen mobile phone. The Mobisales system provided both keyboard entry and touch based user input to accommodate the varied preferences and to minimize human errors. The use of various input modalities and visuals in mobile applications is highly encouraged. User interfaces should adhere to usability principles as stipulated by the relevant platform guidelines. For the Mobisales system, the Android[13] based guidelines were applied. The user interface should restrict prolonged keyboard entry to limit human input errors. Graphics should be self-explanatory and easy to use to accommodate low-literacy users. In this study, the catalogue function presented various challenges. The catalogue was developed as a separate native mobile application and loaded on the mobile device separately to accommodate users that operate in areas with limited network connectivity. For those with high end smart phones, the Mobisales system used the camera to capture the images and barcodes of product items to populate stock items in the database.

Ideally, mobile systems should be platform independent. This is not fully achieved because of the varied mobile operating system platforms and interoperability issues. It is therefore recommended that a lesser degree of platform dependence be maintained to ensure reusability and extendibility of the major components of the system to other mobile platforms. The Mobisales was developed on the android platform and only tested on android based mobile devices; to successfully deploy the system to other mobile platforms would require some of the instances to be configured accordingly. The decision for android platform was based on affordability and accessibility to android based phones. The rapid development of mobile devices also presents many challenges when developing mobile applications. Mobile devices are constantly upgraded with new features and their plummeting costs provide freedom to the users to acquire new mobile devices easily instead of desktop computers.

Cloud computing provides a versatile and cost effective platform for a plethora of services in mobile computing (Cleverly, 2009). Running the application in the cloud makes it easier to provide users an instance of the system that can easily be installed on the mobile device on request. For the evaluation of the Mobisales system, the users were provided with test devices to overcome financial implications of connectivity and data consumption. However, realistically there is a need accommodate the varying device specifications and constraints of the mobile environment. For a cloud based system, network connectivity can

[13] Android UI guidelines can be found at http://developer.android.com/guide/practices/ui_guidelines/index.html.

also be a huge challenge for those VSEs with limited network coverage. Mobile clients are not always connected to the backend. The limited bandwidth and connection has a huge impact on how transactions will be effectively managed in the mobile environment. Transaction management and data consistency therefore becomes a critical component in mobile computing (Barbará, 1999) and requires a deeper investigation into technologies that address such issues. Mobile connection may often be slower and involve high latency and therefore limit the amount of data that can be transmitted over a certain time frame which may also slow down overall system performance. It is critical to protect authorised access of data in the cloud. Security is therefore an implied prerequisite for cloud based systems and software systems in general.

This study supports the notion presented by Koltenikov (2007) that it is not practical to impose proprietary ICT systems for VSEs. Koltenikov (2007) highlighted issues that affect the adoption of ICT among small enterprises such as the inability to integrate ICT into the business processes. VSEs often do not have standardized practices and are dynamic in their nature. For VSEs, the ultimate decision to integrate ICT systems in their business practices depends on the degree to which the ICT would improve their core business and the cost thereof. Literature (Koltenikov 2007; Allan *et al* 2003) advocates that not all small enterprises need to adopt ICT to the same degree of sophistication because they will bear the cost of implementing systems with very little value. Although there are numerous ICTs on the market, because of the size and nature of the VSE businesses, these systems may be irrelevant to VSEs.

Providing ICT for VSEs requires an understanding of the context and environment they operate in. The same notion can be discussed with regards to mobile technologies. Mobile usage varies based on need, mobility, connectivity, cost and convenience (Jagun *et al.*, 2008). The needs and constraints of the users should therefore be considered when developing mobile systems. It is to understand the underlying motives of user behaviour (Turel, Serenko & Bontis, 2007) to foster the adoption of mobile systems. The proposed framework offers VSEs the capabilities to transform the daunting manual and *ad hoc* business processes into well streamlined automated tasks. Furthermore, the system could provide reliable and accurate information to assist in making informed business decisions. Despite the wide proliferation of mobile technologies and the many value added benefits they provide, there is very little trust associated with the use of mobile applications. With regards to desktop based software systems, if the technology is acquired but not fully utilized, the intended purpose is futile but the user still bears the cost of implementation (Turel, Serenko

& Bontis, 2007). In mobile computing, there is often very little investment associated with using mobile applications especially for those that are free or offered at low cost. Any trigger of security or technical errors could be reason enough to spur an alteration in behaviour. The investment that users make in order to acquire mobile applications is very little if not non-existent.

The mobile environment creates a new class of innovative applications and exciting business models for many enterprises (Barbará, 1999). A plethora of innovative mobile applications are constantly released. Some of the business applications are offered for free or at very low costs. This gives users freedom of choice when utilizing mobile applications. What is relevant and attractive to the user may be a thing of the past in a few days in the mobile market. The user's loyalty and adoption to a specific mobile application is therefore always compromised. Mobile application also requires continuous enhancements as they can be very easily copied by competitors. This is another challenge because it may not necessarily be enough to sustain a basic accurate service, hence the basic service will have to be continuously enhanced to stay ahead of competitors but at the same time maintain the expected functionalities and value for the users.

The sociological acceptance and uptake of mobile devices provides a good platform to provide innovative and simple business systems for VSEs. It was noted though, that when mobile devices are used for essential business purposes, the shift in attitude and perception is apparent. The Mobisales system seemed to be somewhat intimidating especially to those VSEs with limited literacy skills. Bagozzi (2007) posits that emotions play an intervening role in technology acceptance. The users' motivation affects the use of technology whereas anxiety and intimidation by the technology may become direct or indirect determinants of adoption. It seemed the perception of the mobile system might be on the same scale as the desktop based system as there is often some form of intimidation that comes with using the desktop based business applications.

Another determinant of technology acceptance is human agency which is described in Bagozzi (2007) as the decision maker's ability to choose to react in a way that is not impulsive, compulsive or coerced but rather results as an intentional response. Users have the capability to make a reasoned choice to use technology or not. Some of the older VSE entrepreneurs initially resisted using the Mobisales, they felt that technology is for young people. The use of mobile business systems provides a feasible means for small enterprises to adopt the equivalent of business systems for large scale enterprises while overcoming the many barriers such as cost, infrastructure, maintenance and hardware resources. However, the

negative perceptions and views that ICT is not applicable for VSEs could hamper the potential adoption.

6.2 Research contributions

DSR seeks to extend the boundaries of human and organizational capabilities by creating new, innovative and purposeful systems. The contributions of DSR are in the combined novelty and utility of the constructed systems that enable the understanding and development of useful information systems within organizations (Hevner *et al.*, 2004). The contributions of the systems are evaluated with respect to their ability to improve performance in the development and use of information systems (March & Storey, 2008). The contributions of the research study are as follows:

- The study contributes towards both the DSR and ICT knowledge domains.
- The implementation of Mobisales lightweight framework provides enhancing methodologies and foundations to apply DSR to improve the efficiency of VSE.
- The evaluation of the Mobisales system anchors validity of the evaluation method.
- The Mobisales system could enable the penetration of mobile enterprise systems in the bottom-billion market.
- The research results provide relevant insights to future related work in both the VSE research domain and mobile technologies research domain.

In their early stages, VSEs often exhibit characteristics that need to be considered when providing technological systems in the VSE domain. The constraints include limited financial capital, lack of structured business processes, and entrepreneurs with limited skills who have very little interest in establishing ICT infrastructure to manage their business. The documentation of VSE business transactions are perceived to be a hindrance especially if the business is in its nascent stages trying to build a solid customer base. However, as the business grows, challenges such as cash flow management, tracing business transactions, managing stock and forecasting becomes critical. The Mobisales lightweight framework presents a potential to solve some of the challenges. The lightweight mobile framework provides the following envisaged benefits for VSEs:

- Access to simplified and automated business processes.
- Improved operational efficiency through use of system.
- Accurate and timely records of critical business information.

- A simplified, easy to use system that requires minimal training and leverages mobile ICT infrastructure.
- Allows VSEs to run their business from their own mobile device.
- Introduces mobile computing and the required e-skills[14] in the SMME sector.

By introducing computing and access to ICT to a marginalized sector such as that of VSEs, the research contributes toward the continued efforts to promote participation of small enterprises in the knowledge economy. The Mobisales system can also be classified as an ICT computation system that fulfils the mandate of the e-skills strategy. The e-skills strategy strives to improve the effective use of ICTs and produce employment ready e-skilled workers and entrepreneurs. The study contributes towards the advancement of the e-skill strategy with specific focus on literacy and business skills advancement. The study also contributes to the ICT and the DSR knowledge base by communicating both the design process and evaluation of lightweight mobile frameworks in the VSE business domain.

6.3 Study limitations

This section reports on the limitations of the study to avoid generalization and factors that could potentially cause the researcher to draw incorrect conclusions from the study. The requirements for the design and development of the lightweight Mobisales framework were gathered from VSEs in the retail sector. The scope of the study only focused on documenting sales transactions. The functionality incorporated in the Mobisales prototype system was closely related to the sales transactions. Although the lightweight framework could be replicated in other business sectors, all research efforts were addressed in the context of the retail sector. The field based evaluation was also conducted through VSE retailers in varied geographical settings. The evaluation and demonstration of the prototype model involves real VSEs from different locations to avoid localization of context. This approach provided the research with more insights because the findings vary per location as discussed in the research findings. The study was guided by the DSR paradigm and the validity of the Mobisales system was demonstrated through DSR oriented evaluation methods. The nature of the research is for academic purposes and may be criticized as “blue sky” research; however,

[14] National E-skills strategic plan (Nespa) available at http://www.doc.gov.za/doc04/index.php?option=com_docman&task=cat_view&gid=67&Itemid=104

the implementation of the Mobisales prototype demonstrated the validity of the research in solving real life problems. The research results and opinions expressed are therefore limited to the context and nature of the study. For an academic inquiry, resource and financial constraints resulted in a small test sample and the limited evaluation time frames.

6.4 Recommendations for future work

This research recommends further inquiry into understanding aspects of social and behavioural determinants that influence technology adoption in VSEs. Based on the research findings, the results showed a mismatch of the users' behaviour, attitudes and motivations in utilizing the ICT system in the VSE businesses. The VSE users who were eager to use the lightweight Mobisales framework expressed reservations based on their expectations of the functionality of the system. Some VSE users indicated that the cost of the ICT system was a major inhibitor for their business. In the case of mobile systems, the cost factor still emanated from the field based interactions. The nature of the research was a scholarly inquiry and the Mobisales prototype system was presented to the VSEs for free for evaluation purposes. The researcher is of the view that if there were financial implications for the user, the findings would have showed different dimensions.

The determinants of technology adoption in which value trade-offs and behavioural aspects such as price, quality of the system, social and emotion investments (Turel, Serenko & Bontis, 2007; Bagozzi, 2007; Davis, 1984) were highlighted in this study but they are beyond the scope of this research. The research did not attempt to understand why users choose certain ICTs for their business. However, human behavioural aspects became apparent factors that influence the potential adoption of the lightweight Mobisales framework. The study recommends related future work to consider these insights that highlight the human and organizational aspects of ICT adoption. The relationship between users and ICT is a continuous area of interest in IS research. Deeper understandings of human behaviour can assist to closely align IS systems to the needs of the intended user. Such important aspects highlighted by Bagozzi, Dholakia & Basuroy (2003) justify the behavioural aspects of human subjects in exercising a personal decision to use or not to use technology.

6.5 Concluding statements

In this study, the VSE domain was explored to grasp the nature of the retail VSE, and to determine the hurdles in the VSEs especially the factors that inhibit growth and sustainability. The lightweight mobile framework was implemented to introduce mobile computing in the VSE sector while providing the benefits of documenting daily sales transactions, and managing a simplified inventory and customer database. As emphasised by Baudisch & Holtz (2010), there needs to be a shift in perception from mobile devices as auxiliary devices used for communication and messaging toward a mind-set of mobile devices as computational tools. This study demonstrated a lightweight mobile framework that put business software in the hands of many VSE entrepreneurs. However, the argument is not about what technologies can be developed but how the emerging mobile technologies can be used to address the particular challenges of VSEs.

The study emphasises that technology development should be based on a clear understanding of the users' real requirements and needs and should include innovative ideas regarding how the technology can be adapted to meet contextual requirements of the intended user. In order to localize the use of ICT to those that are marginalized or with limited literacy, innovative ICT based information and services should be implemented in a localized context (Heeks, 2008). The technologies must be advantageous form the viewpoint of the users. This study presented research and insightful findings from the field based evaluation of the Mobisales system in the VSE business domain and the potential adoption of mobile systems in the SMME sector. The relevant parties, literature and other sources that contributed toward the content of this research, the dissertation, and personally to the researcher were acknowledged accordingly throughout the dissertation document.

Overall, embarking on this study brought a challenging but exciting experience for the researcher. The interaction with the various stakeholders that contributed to this research cannot be described in words. The experience of interacting with real people, addressing real problems through research was a very rewarding and fulfilling experience. Although the study was conducted through a formal academic process, it gave the researcher the opportunity to learn outside the conventional ICT systems development and management environment and to apply innovative research to real world problems. The insights gathered from the study can support informed arguments and theories in the ICT domain.

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