AN SMS AND USSD MODEL FOR LOCATION-BASED MOBILE ADVERTISING IN MICROENTERPRISES

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A Thesis submitted to the Institute of Postgraduate Studies, Kabarak University, in Partial Fulfillment for the Requirements for the Degree of Doctor of Philosophy in Information Systems.

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DECLARATION

This thesis is my original work and has not wholly or in parts been presented for the award of a degree in any other university.

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RECOMMENDATION

To the institute of Postgraduate studies:

This thesis entitled "***An SMS and USSD Model for Location-based Mobile Advertising in Microenterprises***" and written by Moses Mwangi Thiga is presented to the Institute of Postgraduate Studies of Kabarak University. We have reviewed the thesis and recommend it be accepted in partial fulfillment of the requirement for the degree of **Doctor of Philosophy in Information Systems**.

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'The horse is made ready for the day of battle, but the victory belongs to the Lord'

Proverbs 21: 31 (RSV)

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DEDICATION

To

My Dad, Dr. S.T. Mwangi

My Mum, Mrs. Rachel M. Thiga

My Wife, Mary W. Mwangi

My little angel, Rachel Njoki Mwangi

ABSTRACT

Technological and financial limitations have hampered the effective advertisement of products and services by microenterprises thus limiting their contribution towards national economic growth. Recent advances in mobile technologies makes the use of location based mobile advertising (LBMA) a viable option in addressing this challenge. However, a majority of LBMA are developed for use on smart and feature phones with inbuilt positioning and program execution capabilities thus leaving out a majority of microenterprises who use basic phones. This study therefore examined the use of alternative positioning methods, namely symbolic and network based geo-location, and device independent system access methods; SMS and USSD, for the development of LBMA for use by microenterprises. Functional decomposition and rapid prototyping methodologies were utilized to develop a suitable LBMA application model and system prototype respectively. The prototype utilizing network based geo-location proved to be successful in delivering LBMA services to microenterprises. The delivery of LBMA services to microenterprises using network based geo-location, SMS and USSD was therefore found to be feasible and practical. It is therefore recommended that this approach be scaled up and commercialized whilst addressing emergent adoption issues such as cost and security concerns occasioned by the use of user's real time locations.

Keywords: SMS, USSD, Location-based mobile advertising, microenterprises

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CODE LISTINGS

ABBREVIATIONS

API	Application Programming Interface
ARPU	Average Revenue per User
CDMA	Code Division Multiple Access
GPRS	General Packet Radio Service
GPS	Global Geo-location System
GSM	Global System for Mobile Communications
LBS	Location Based Services
NFC	Near Field Communication
RFID	Radio-Frequency Identification
SIM	Subscriber Identity Module
SMS	Short Message Service
USSD	Unstructured Supplementary Service Data
VAS	Value Added Services
WAP	Wireless Application Protocol

OPERATIONAL DEFINITION OF TERMS

Bluetooth Bluetooth a short-range wireless low-cost and low-energy technology that enables devices to form networks and exchange information based on a master-slave connection model (Labiod, Afifi, & Santis, 2007a; Popovici, 2010)

Wi-Fi Wi-Fi defines any wireless LAN product based on the IEEE 802.11 Standards that allows devices to get wireless access to network resources (Labiod, Afifi, & Santis, 2007b).

Java Java is a general-purpose, concurrent, class-based, object-oriented computer programming language that allows application developers to develop applications that are device independent (Gonzales et al., 1999).

PHP PHP: HyperText Preprocessor (PHP) is a web scripting language that allows for the creation of dynamic web pages (Gilmore, 2010).

Location A place or position (Hornby, 1998). Symbolic location is location information that is expressed using natural language while physical location is information that is expressed in the form of coordinates. (G. Wu & Gao, 2004).

Privacy *'The rights and obligations of individuals and organizations with respect to the collection, use, disclosure, and retention of personally identifiable information'* (AICPA. & CICA., 2009)

Security *'The preservation of confidentiality, integrity and availability of information; in addition, other properties such as authenticity,*

accountability, non-repudiation and reliability can also be involved' (ISO 27001, 2005).

Advertising The display of announcements and messages in various mass media by organizations with the aim of informing or persuading a particular segment of the population about their products, services, ideas or any other information of interest (American Marketing Association, 2014).

Mobile advertising The non-personal presentation of ideas, products and services using mobile devices such as cellular phones or PDA's (Bulander, Decker, Schiefer, & Kölmel, 2007; Mobile Marketing Association, 2013).

Location-based mobile advertising

The use of mobile devices to provide customers with time and location sensitive, personalized information for the promotion of goods, services and ideas in order to generate value for all stakeholders (Dickinger, Haghirian, Murphy, & Scharl, 2004).

Structured SMS

An SMS communication in which the order of the message content or logical fields is predetermined and separated by specific delimiters such as spaces, semicolons or commas in order to facilitate automated interpretation and the subsequent selection of a suitable response (Patnaik, Brunskill, & Thies, 2009).

CHAPTER ONE

INTRODUCTION

1.0 Introduction

This chapter gives a brief background of the main concepts and problems informing this study such as advertising and location-based services. It further proceeds to state the research problem, outline the research objectives, list the research questions, define the scope, assumptions, significance, justification and the expected outcomes of the study.

1.1 Background

Consider the following scenario.

A homeowner has a blocked toilet and wonders where to get a plumber. Where does he start? He/she might decide to walk to a neighbor's house, call a friend or drive to the nearest shopping center to ask where they can get a plumber. On the other hand, a plumber waits at their usual spot waiting for business, a clear disconnect between supply and demand, needs and solutions. The information that the homeowner is seeking might not be available in newspaper, television, radio or internet advertisements. Even if it were, they might not be in a position to access these media in their current contexts. Further complicating the situation is the likelihood that the plumber is probably not in a position to use these marketing media due to access and cost barriers. So, what if the homeowner could send a text "Plumber" to a designated short code and get the mobile numbers of five plumbers within their vicinity? They would then call these providers, give their problem, location details, and probably even negotiate a price. That is, assuming that the plumber has listed on the information service, and shared their contact and location information for access by those in need. That would be great!

But it is not yet happening in real life due a number of reasons. ***The homeowner wonders:*** *Will I get a plumber or a thug? Have these plumbers been vetted? Shall I get accurate information fast enough?* ***The plumber wonders:*** *Can I afford to list on such a service? Can I trust the stranger requesting my services? What if I don't want to be contacted at some hours of the day? Can I specify the kind of people who I want to share my contacts with? If I share my location information will it be used to track me? Will the information I supply be used to profile or track me? How can I be sure that my details will only be used for the intended purpose?*

The plumber in the scenario above belongs to a class of businesses referred to as microenterprises. Businesses of this type also include street vendors, carpenters, tailors, mechanics, taxi operators, electricians and peasant farmers (GDRC, 2008), and they employ less than 10 people, have small amounts of capital and provide goods and services in their local areas (EU, 2003). Among other challenges they face, advertising has been singled out as the single most challenging aspect of their operations (Jakic, 2011; Pharr & Weinrauch, 2007). However, their limited knowledge of and access to technology and information systems, (Roberts & Wood, 2002), has limited their use of advertising methods such as websites, mobile applications and SMS which are greatly enhanced by recent advances in mobile devices, internet and wireless communication technologies (Dhar & Varshney, 2011).

The use of mobile web and mobile applications for advertising has in the recent past received a lot of investor and developer attention due to advances in smart and feature phones that are Java enabled, have WAP, Bluetooth, GPS and GPRS capabilities (Solanki & Hu, 2005). However, the use of these technologies relies on favorable network conditions and user access to compatible devices (Ratsameethammawong & Kasemsan, 2010). These conditions are often not met due to variable network reach and the relatively high cost of feature and smart phones. While these challenges are not new to application and solution developers, the use of SMS and USSD for the delivery of location-based mobile advertisements has not received as much

attention, investment, social acceptance and adoption by businesses even with demonstrated success in the delivery of other services such as mobile money transfer and banking (Gikenye, 2011).

1.2 The problem

There is a critical lack of location-based mobile advertising solutions based on affordable, accessible and easy to use technologies such as SMS and USSD. Majority of existing solutions rely on relatively technologies available on smart and feature phones such as GPS and GPRS for location determination, Bluetooth, RFID and NFC for system access, and JAVA and Android program execution capabilities. These current solutions have not been able to adequately meet user expectations with respect to accessibility and affordability leading to low levels of adoption and utilization by microenterprises. This study therefore examined the delivery of location-based mobile advertising services by use of SMS and USSD for system access, and both symbolic and network based location determination. The solution developed addressed pertinent issues of service access on basic phones which lack advanced geo-location and system access capabilities.

1.3 Objectives of the study

The main objective of this study was to develop an SMS and USSD application model for the provision of location-based mobile advertising services among microenterprises.

The specific objectives of the study were:

1. To establish the level of awareness, utilization and potential for location-based mobile advertising among microenterprises.
2. To develop an application model for the development of SMS and USSD location-based mobile advertising services.

3. To develop a prototype of the SMS and USSD location-based mobile advertising model.
4. To evaluate the performance, limitations and challenges of the SMS and USSD location-based pull mobile advertising prototype.
5. To explore additional application areas for the SMS and USSD location-based pull mobile advertising prototype.

1.4 Research questions

1. What is the level of awareness, utilization and potential for location-based mobile advertising among microenterprises?
2. Which is the most suitable application model for the implementation of an SMS and USSD location-based mobile advertising services?
3. What are the challenges of implementing a prototype for an SMS and USSD location-based mobile advertising application?
4. How does the SMS and USSD location-based mobile advertising prototype perform?
5. What are the additional areas of application of the SMS and USSD location-based mobile advertising prototype?

1.5 Justification of the study

The use of SMS and USSD proposed in this study is a feasible approach for the delivery of LBMA for a number of reasons;

Mobile value added services (VAS) such as mobile wallets, medical advice and LBMA applications have been found to have high energy requirements which, in the Kenyan scenario, effectively limits their access to over 76% of the population who live in rural areas with

unreliable power distribution. This makes the use of power hungry applications very difficult if not impossible (Apoyo Consortia, 2012; Shulist, 2012).

Poor 3G and limited 4G network coverage, currently covering only 3% of Kenya, makes it difficult to access internet based applications. SMS and USSD on the other hand are readily available in 34% of Kenya's geographical area making them better access methods for LBMA services for a majority of the population (Apoyo Consortia, 2012).

The exclusive use of SMS and USSD for the development and deployment of location-based pull mobile advertising services among microenterprises has not been tried before.

The study also fits within the aims and expectations of an Information Systems research by placing an equal emphasis on the development of the IT artifact as well as the studying the context of application (Orlikowski & Iacono, 2001). It examines how SMS and USSD (the technologies) can be applied in the delivery of location-based mobile advertising (the business process) within the context of microenterprises (the organizations).

1.6 Significance of the study

The study cumulated in the development of an enhanced technology acceptance model that captured the significant relationship between key constructs such as the choice of delivery technology and the intention to use a mobile service. Subsequently, a method, a model and a prototype utilizing SMS and USSD to deliver location-based mobile advertisements were developed. Their positive development, testing and evaluation outcomes served to demonstrate the practicality of the proposed approach.

IS research distinguishes itself from other related fields in that its outputs must be immediately applicable in practice (Kock et al., 2002). The key output of the study, the location-based mobile advertising system, and related findings on its applicability in facilitating mobile

contracts, provision of demand and supply statistics, identity verification and information search were found to be immediately applicable in practice.

Additionally, the successful model using SMS and USSD for location-based services and mobile advertising is a significant addition to the body of knowledge in the field of information systems. The working model also sets the stage for the development of affordable and easy to use location-based mobile advertising applications that have the potential to revolutionize the way many businesses, and especially microenterprises, conduct their advertising activities.

1.7 Scope of the study

The microenterprises and users to be involved in the study were drawn from Nakuru County, Kenya. Nakuru County is a cosmopolitan county with a population of approximately 1.6 Million residents 45% of whom reside in urban areas with the rest residing in rural areas. The main economic activities conducted in the county are in the agricultural, tourism, hospitality, retail, and transport sectors. Its main urban center, Nakuru town is the fourth largest urban center in Kenya and is well served by transport and communication networks. The county is thus representative of the country.

This study focused on the development of an application model for location-based mobile advertising purely based on SMS and USSD. It sought to establish whether a location-based mobile advertising service could be offered using only SMS and USSD on the client side (user and provider).

Users were involved in this study in the following ways; (i) In determining the desirable attributes and features of the proposed SMS and USSD location-based pull mobile advertising model, (ii) in evaluating the potential of the prototype developed and (iii) in providing insights

into the potential applications and relevance of the LBMA prototype from the client and microenterprise perspective.

The prototype developed served only as a proof of concept and was a fully fledged commercially applicable system.

The evaluation of the system was done from a technical perspective based on the initial objectives and system requirements.

1.8 Assumptions

The development of the proposed model assumed that user location information would be provided by mobile network service providers for use in geo-location. However, this information was not availed and a symbolic location database was used as the source of location information.

The user registration process also assumed that the registration data would be cross checked against the mobile network service provider's pre-existing database. However, access to this database was not possible and users were then required to provide their personal details afresh for verification in order to use the system. Fortunately, this was not a major hindrance to the development and testing of the technical aspects of the system.

1.9 Expected outcomes

1. A survey report on the awareness, utilization and potential of location-based mobile advertising among microenterprises.
2. An application model for SMS and USSD location-based pull mobile advertising services.
3. An SMS and USSD location-based pull mobile advertising services prototype.

4. An evaluation report of the performance of the SMS and USSD location-based mobile advertising prototype.
5. A proposal on the additional areas of application of the SMS and USSD location-based mobile advertising prototype.

1.10 Conclusion

Chapter one gives a brief background of the main concepts, such as microenterprises, advertising and location-based services, informing this study. It further states the research problem, outlines the research objectives, lists the research questions, and defines the scope, assumptions, expected outcomes, significance and justification of the study

The next chapter presents the current research status with regards to location-based mobile advertising and elaborates on the concepts introduced in this chapter. It also presents the conceptual framework for the study.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter will present a discussion on microenterprises, SMS, USSD, mobile advertising, location-based services and current location-based mobile advertising models. The theoretical basis and conceptual framework for the study will also be presented and discussed.

2.1 Microenterprises and marketing

Microenterprises are businesses that employ less than 10 people, have small amounts of capital and specialize in providing goods and services in their local areas (EU, 2003). They are the street vendors, carpenters, tailors, mechanics, taxi operators, plumbers, electricians and peasant farmers among others (GDRC, 2008).

Their great potential in spurring economic growth, social stability, and equity is rarely realized due to the lack of access to formal financial services, little or no basic business skills, limited knowledge of and access to technology and information systems, and insufficient marketing activities (Bowen, Morara, & Mureithi, 2009; GDRC, 2008; Roberts & Wood, 2002). These challenges have also been found to apply to Kenyan micro and small enterprises that account for close to 75% of total employment and 18% of the country's Gross Domestic Productivity (GDP) (Bowen et al., 2009; NESC, 2007).

In a 1999 Australian study, Huang and Brown established that 40.2% of the 973 small businesses sampled faced significant marketing related challenges such as the lack of market research, low sales, dependence on few clients, lack of public relations, inability to hold promotions, limited advertising and poor distribution channels (Huang & Brown, 1999).

Subsequent studies further revealed that the use of promotional activities and advertising in particular are their weakest points (Jakic, 2011; Pharr & Weinrauch, 2007).

The Kenya Vision 2030 singles out the retail sector, to which a majority of micro-enterprises belong, as one lacking in management and marketing strategies. The marketing challenge is also highlighted with respect to other sectors of the economy such as agriculture, construction and tourism. Consequently, the need for capacity building in marketing is thus discussed extensively in the Kenyan development and industrialization roadmap as a critical step towards improving the competitiveness of not only small businesses but the country as a whole (NESC, 2007).

2.2 Location-based Services

Location-based services (LBS) are services provided by systems that are capable of finding the geographic location of an object and providing services based on this location (Portman et al., 2005). A Location-based service in the context of mobile computing is a mobile information system whose functionality depends on and is greatly enhanced by geo-location information of mobile devices in order to extend spatial and temporal information processing capability to end users through internet and wireless communications (Dhar & Varshney, 2011).

Typical location-based services consists of five major parts as shown in Figure 1 (Steiniger, Neun, & Edwardes, 2006). (1) The **mobile device** that is used by the user to request for information. These devices include PDA's, mobile phones, laptops or navigational units. (2) The **communication network** that transfers user data and service requests from the mobile terminals to the service provider and the requested information back to the user. (3) The **geo-location component** that determines the user's location using handset or network based technologies. If these components are not available on the mobile device then the location can be specified manually. (4) The **service and application providers** who offer a number of

services such as position calculation, finding routes, searching yellow pages or for information on specific objects. (4) The **Data and content providers** who are authorities (mapping agencies) or businesses (yellow pages and traffic companies) that store information such as geographic base data and location information for use by service and application providers.

Location based services are delivered as pull or push services. In the pull type LBS, the user explicitly requests for a service or information such as ordering a taxi, calling an ambulance or looking for the nearest restaurant. In the push type LBS information is not requested or is indirectly requested. The push LBS is triggered when a user enters a given area or by a timer and it is more complex to establish given that it require prior knowledge of the user's needs and preferences (Steiniger et al., 2006). There exists broad range of LBS as depicted in Figure 2

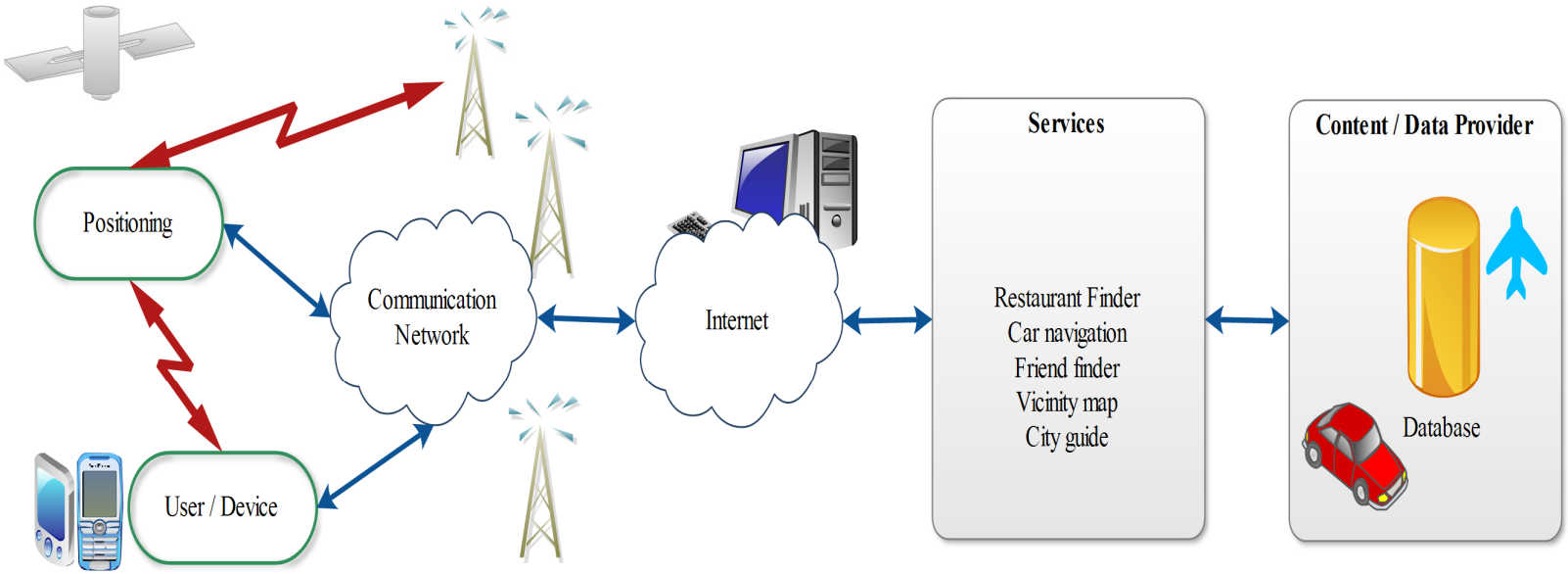

Figure 1: Basic components of an LBS and information flow by Steiniger et al. (2006)

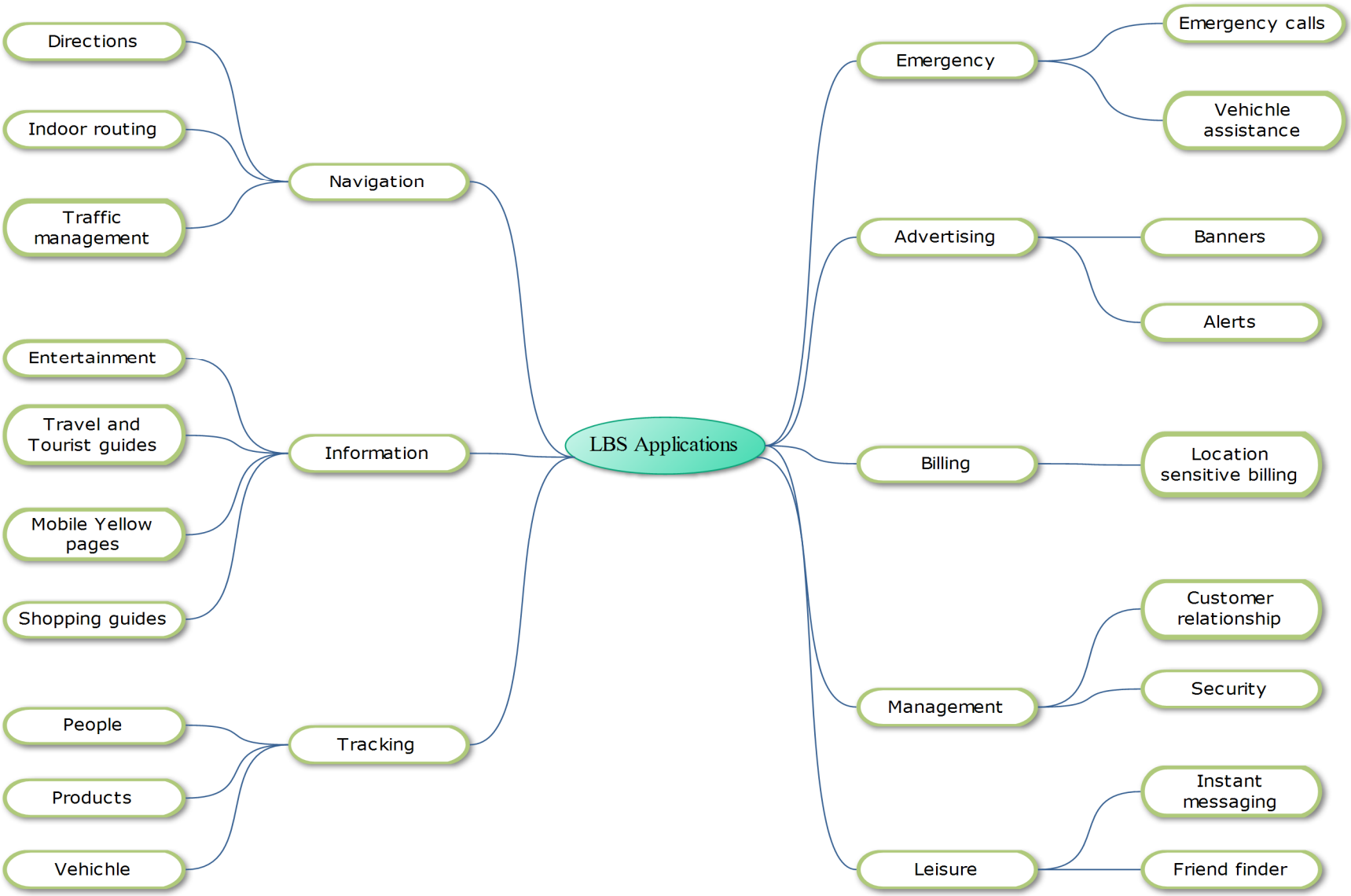

Figure 2: LBS application categories by Steiniger et al. (2006)

2.3 Location determination

There are four main types of location information consumed by LBS; (1) Physical location that is expressed in the form of coordinates, (2) Symbolic location that expresses location using natural language, (3) Absolute location that uses a shared grid reference system such as longitude and latitude and, (4) Relative location information that is based on the proximity to known reference points (Becker & Durr, 2005; Hightower & Borrielo, 2011).

Symbolic location information is obtained from the users of LBS while physical, absolute and relative location types are determined by use of location estimation algorithms. These algorithms take parameters such as time, distance, angle, signal attenuation and content of IP headers from signals such as ultrasound, radio, infrared, visible light or IP packets as their input. There are three main types of location estimation algorithms in use; triangulation, scene analysis and proximity (Hightower & Borrielo, 2011; G. Wu & Gao, 2004);

1. Triangulation uses the geometric properties of triangles to compute the location of an object. Locations are estimated relative to a known framework consisting of fixed terrestrial sites such as base stations or space based satellites. The technique has two deviations: (a) Lateration that locates an object by measuring its distance from multiple reference positions and (b) angulation that locates objects by computing angles or bearings relative to multiple reference positions. The time of arrival (TOA), time difference of Arrival (TDOA) or angle of arrival (AOA) are measured instead of the actual distance and then used to derive it.

2. Scene analysis works by using the features of an image and matching these to the closest previously known features. It is a widely used technique in fields such as human face matching and terrain matching.
3. Proximity establishes whether an object is near a known location. These algorithms provide symbolic and relative location information of an object. The use of this technique does not require the use of specialized sensor infrastructure which makes it more cost effective and faster to use.

Indoor location estimation systems are LBS that have limited coverage areas, high probability estimation accuracy requirements and complex environment setups. They are mainly based on Radio Frequencies (RF), infrared and ultrasound. They comprise of systems that use the proximity and scene analysis location estimation algorithms. Outdoor location estimation systems are LBS use satellites (GPS) and cellular networks. They employ triangulation estimation algorithms to estimate locations based on the location of satellites and mobile base stations (Hightower & Borrielo, 2011; G. Wu & Gao, 2004).

Network-based geo-location refers to the use of mobile position determination equipment hosted by the service provider to obtain device geo-location information. The method is distinguished from handset-based geo-location which utilizes technologies on the device to position a user. Handset-based techniques employ the use of GPS and Assisted-GPS (AGPS) (Adusei, Kyamakya, & Jobmann, 2002). The ability to compute the user position independent of their involvement and knowledge makes network based geo-location useful in cases where users are either unwilling or unable to reveal their locations (Smit, Stander, & Ophoff, 2012). Examples of Network-based geo-location include cell-ID, RxPowerLevels, Angle of Arrival (AOA), Time of Arrival (TOA) and

Observed Time Difference on Arrival (OTDOA) (Clarkson, McCallum, Solhjoo, & Velentzas, 2004).

Cell-ID: In this method the current cell identifier is used to locate the user and its accuracy depends on the radius of the cell. The radius is often smaller in urban areas and bigger in rural areas (Clarkson et al., 2004; Trevisani & Vitaletti, 2004). It is the simplest and least accurate network based geo-location method (Smit et al., 2012).

Cell-ID and RxPowerLevels: This method is faster and more accurate. It involves the collection of information on the current cell and power received from it. This information is then passed on to a server in the mobile network that then calculates the position of the user based on the positions of the base stations and the power they are transmitting (Clarkson et al., 2004; Rutledge, Wong, Smith, & Reinink, 1998).

Angle of Arrival: This method, illustrated in Figure 3, requires the use of at least two base stations with directional antennae. The angle of arrival of signals from the mobile handset is measured and used to calculate the user's position (Clarkson et al., 2004). Despite its potential for high accuracy, its feasibility is limited due to the requirement for expensive antenna arrays (Smit et al., 2012).

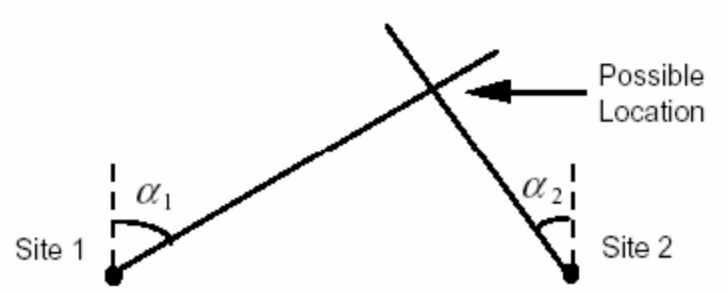

Figure 3: Angle of Arrival by Clarkson, McCallum, Solhjoo, & Velentzas (2004)

Time of Arrival: This method, shown in Figure 4 calculates the position of the mobile device by triangulation using at least three base stations (Clarkson et al., 2004; Trevisani & Vitaletti, 2004).

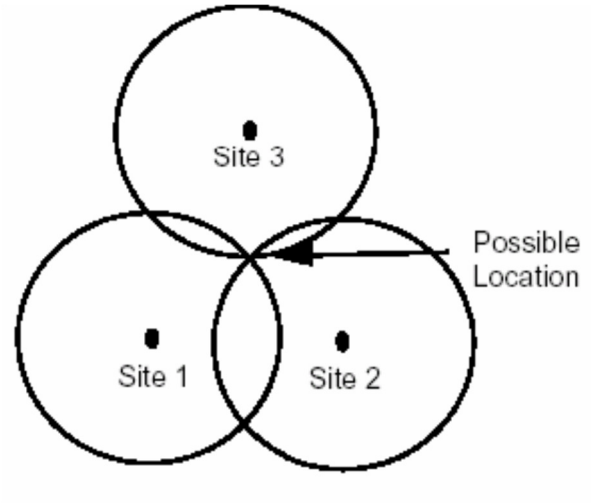

Figure 4: Time of Arrival by Clarkson, McCallum, Solhjoo, & Velentzas (2004)

Observed Time Difference on Arrival (OTDOA): This method uses hyperbolic arcs from three or more base stations to estimate the location of a mobile device (Smit et al., 2012). This method works by measuring the time difference in the reception of a transmitted signal from at least three different base stations. This time difference is then used to calculate the mobile device's relative distance from each of the base stations. This relative distance along with the known positions of the base stations is then used to determine the device's location (Clarkson et al., 2004).

In these and other network-based geo-location methods; the computation of the mobile device position is done relative to the position of the base station. Base station or cell towers locations are known to the mobile service providers. They are stored in the form of coordinates in a central database hosted by the network provider (Smit et al., 2012). The process of determining and assigning these coordinates to base stations in the form of latitude-longitude pairs is referred to as geo-coding. Reverse geo-coding is the opposite; it is the process of finding associated textual

information such as location names from geographic coordinates (Svennerberg, 2010). The process of reverse geo-coding is important to the provision of LBMA given that user's are more likely to understand location names as opposed to coordinates.

2.4 Mobile advertising

Advertising is the non-personal delivery of information to a target audience through mass media by an individual or organization. (Stone & Desmond, 2006). Mobile advertising is the non-personal presentation of ideas, products and services using mobile devices such as cellular phones or PDA's (Bulander et al., 2007; Mobile Marketing Association, 2013). The interactivity and ubiquity of mobile devices makes them the ideal marketing media to provide consumers with personalized information according to where they are, and their needs, thereby persuading them to take some action, at that point in time or in the future, about goods, services and ideas (Saadeghvaziri & Seyedjavadain, 2011).

Mobile advertisements are delivered using mobile web, text messaging (SMS), multimedia messaging (MMS), mobile video and TV, and mobile applications (Mobile Marketing Association, 2011). Mobile advertising is conducted using either the push or pull mode. Push advertising obtains the consumers permission and sends relevant but not explicitly requested messages. Pull advertising adds advertisements to information such as weather and traffic updates that a consumer has requested (Scharl, Dickinger, & Murphy, 2005). The pull advertising approach is preferred over the push for privacy reasons. Permission based mobile advertising aided by consumer profiling is thus critical to the success of mobile advertising (Malik, 2011).

2.5 Location-based mobile advertising

Location-based advertising (LBA) occurs when location is used as a context for the delivery of advertisements. LBA has traditionally been done using billboards and local media located where the information was intended to be utilized. However, recent advances in mobile devices, internet, wireless communication technologies and user mobility have allowed users to be exposed to advertisements in real-time and while on the move. Location-based advertisements are thus part of a new and broader form of innovative communications known as location based services that depend on and are greatly enhanced by the geo-location information of mobile devices in the provision of relevant information (Dhar & Varshney, 2011).

These services have greatly enhanced the ability of businesses to deliver highly personalized and context aware location specific information such as weather and traffic updates, business locations, shopping guides, tracking and navigation systems, directory services, entertainment, emergency services and various mobile commerce applications to their existing and potential clients (S.-y. Wu & Wu, 2006).

Location-based mobile advertising (LBMA) is the use of mobile devices to provide customers with time and location sensitive, personalized information for the promotion of goods, services and ideas in order to generate value for all stakeholders (Dickinger et al., 2004). LBMA delivers context specific information by first establishing the location of users by means of technologies and services such as Bluetooth, Radio-Frequency Identification (RFID), Near Field Communication (NFC), wireless networks or the Global Geo-location System (GPS) (Alexandre et al., 2011; Kurkovsky & Harihar, 2006). This location information is then used to identify relevant information which is subsequently sent to the user using text messages, WAP or delivered

on mobile applications. LBMA systems using the pull approach require users to initiate the communications while those using the push approach send messages without the explicit request of the user (Steiniger et al., 2006).

Placecast, depicted in Figure 5, is a location based mobile advertising platform that incorporates a user's real-time location, user preferences, business rules and advertiser objectives in the delivery of advertisements on various display media such as mobile apps, the web, email, mobile wallets, and SMS/MMS messaging. Advertiser activities such as defining geo-fences, setting up campaigns, managing offers and reporting are done using a web interface. The advertising platform utilizes general location information that is derived from the user's current public IP address (Placecast, 2013).

Figure 5: Placecast mobile advertising platform by Placecast (2013)

The iAd is a mobile advertising platform for the iPhone, iPad and iPod that leverages user demographics, application preferences, music passions, movie and TV interests, location, device (iPhone, iPad and iPod) and network type (Wi-Fi, 3G) to deliver advertisements to users (Apple Inc, 2011). AdMob is a mobile advertisement platform developed by Google that helps mobile app developers to promote their apps and to serve context specific advertisements on them (Google Inc, 2013).

The location-based mobile advertising system proposed by Sammut, Montebello and Camilleri, (2010), uses a Java based mobile application to identify the location of the user which is then used to send them context specific text messages. The system, illustrated in Figure 6, comprises of a website, a mobile application and an SMS messaging system. The website is used by advertisers to subscribe to various categories of adverts, to target their advertisements on a Google map, and for downloading the mobile app by users.

Advertisers target advertisements using a Google map and users subscribe to advertisement categories which are then pushed to them once they meet the set location criteria. However, the need to determine the physical location of the device from satellites and the display of results on a browser requires the use of smart phones that have GPS and WAP capabilities.

A Bluetooth location-based advertising system proposed by Rashid, Coulton and Edwards (2008), targets users with specialized content when they are in the vicinity of a business. The system requires no client side application and the information is sent using simple text messages that the user must consent to. However the system can only work on devices that have Bluetooth and even then, when it is switched on. The push approach used in delivering content is also not very popular with mobile users.

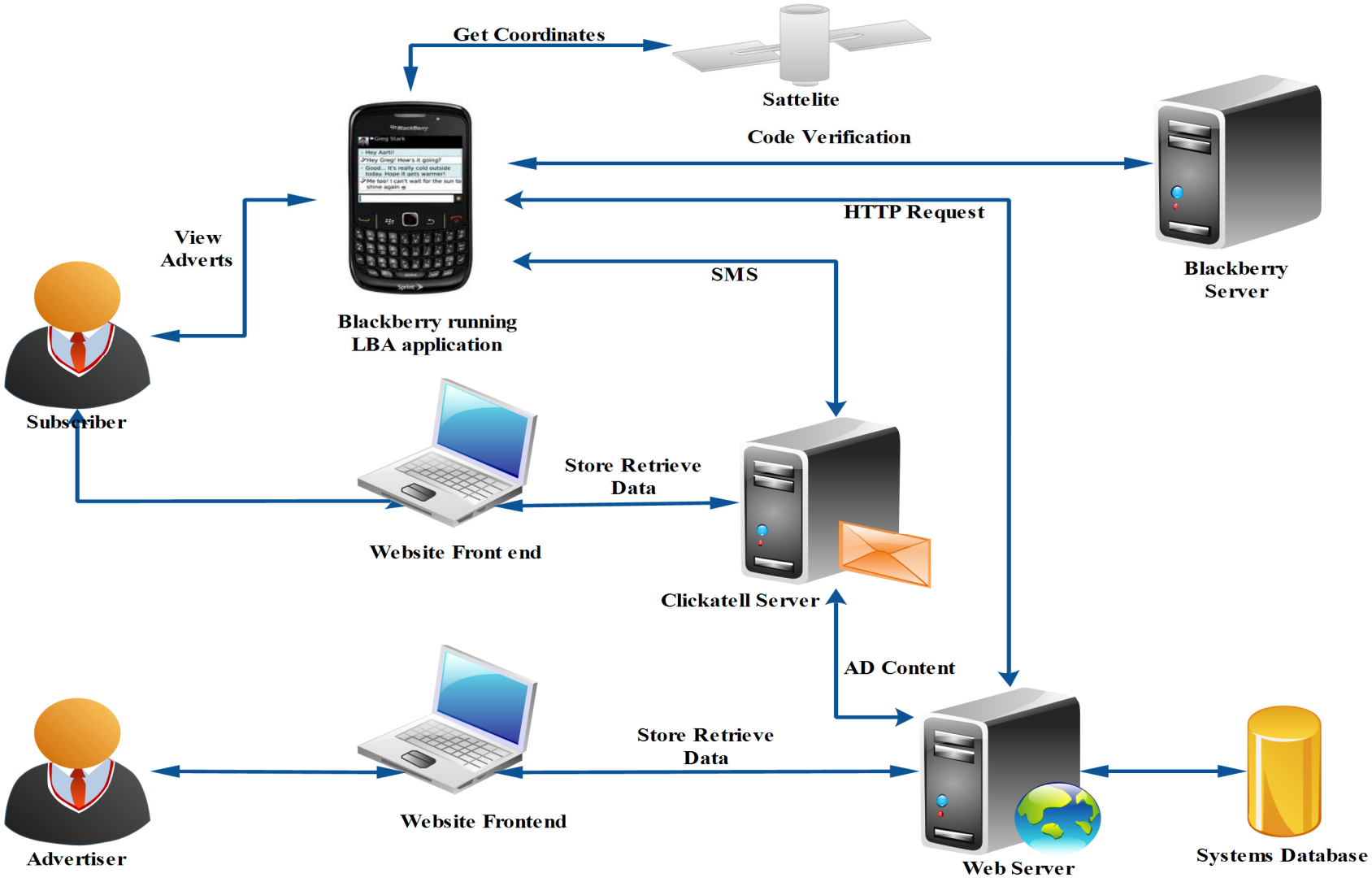

Figure 6: System architecture for the location-based mobile application by Sammut et al (2010).

Alexandre *et. al* (2011), also proposed a Bluetooth mobile context aware system that has three main actors; the user, store and promoter. Personalized promotional and contextualized messages are sent to the user whose consent has been sought and received. Context is tailored to user's profiles which are built from their social network accounts or using an online web platform to capture their personal data. Location and time information is obtained using strategically placed Bluetooth access-points. Stores provide the advertisements and determine the frequency and context within which they are to be sent. The promoter owns the mobile context aware system and avails it to stores as a service. This system is able to take user context into account to a greater extent. However it still pushes messages and works on Bluetooth enabled devices that are activated. Another limitation of the system is that it obtains user profile information using web interfaces and social media profiles that are not universally accessible to all potential users.

Aalto et al (2004) proposed a location-aware mobile advertising system based on Bluetooth geo-location and WAP Push called B-MAD (Bluetooth Mobile Advertising). The system components and operation sequence are illustrated in Figure 7. The Bluetooth sensor discovers the Bluetooth addresses of nearby devices, these addresses are sent over a WAP connection to the Ad server, the Ad server checks if there are advertisements that have not been sent to the devices, it sends the undelivered advertisements to the Push sender for delivery and then the messages are sent as WAP Push Service Indication (SI) messages.

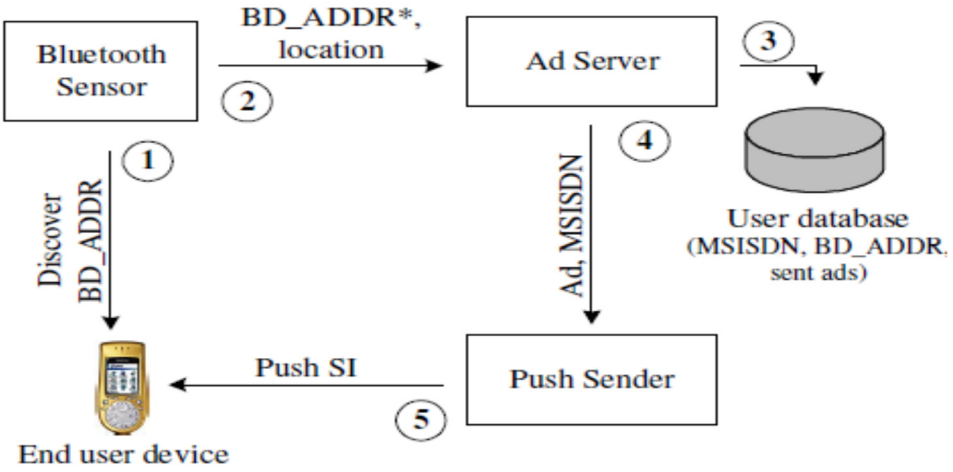

Figure 7: B-MAD Bluetooth-based geo-location and mobile advertisement delivery system by Aalto et al. (2004)

The B-MAD system faced a number of challenges during implementation such as user dissatisfaction with the Push approach, lack of profiling in the selection of advertisements and technical issues on geo-location accuracy. The system did not also address privacy and security issues.

Dawood, Jackson and Yew (2010), proposed a GPS and SMS based vendor tracking system. The vendors are equipped with GSM-based GPS personal tracker and an ID to uniquely identify them. The personal tracker constantly updates the location of the vendor and the system in turn enables them to receive orders, know the location of the orders and to customize their menu on a daily basis. The potential client on the other hand is able to query the real time location of the vendor, to download the vendor's menu and pre-order items on the menu. This functionality depicted in Figure 8 is accessed using structured SMS. The vendor also receives SMS updates on the information requests and orders as they occur.

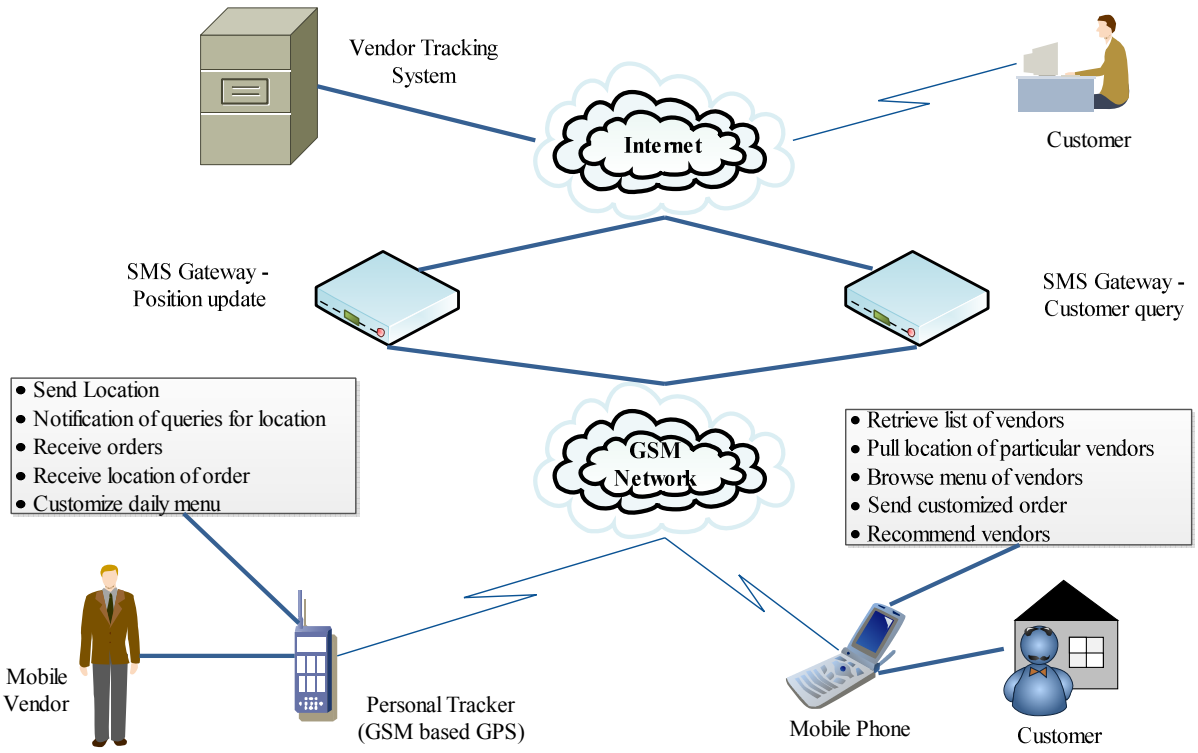

Figure 8: GPS and SMS vendor tracking system by Dawood et al. (2010)

The main advantage of this system is that it is pull based and customers chose when to access the information. It is also available on all types of phones due to the fact that it is purely text based. However it requires the use of an additional GPS device for location tracking and has no provision for profiling of potential clients.

Kurkovsky and Harihar, (2006), proposed a context-aware, adaptive and personalized m-commerce application designed to deliver targeted advertisements to users about products that they like while guarding their identity and protecting them from unsolicited messages. This system called SMMART (*S*ystem for *M*obile *M*arketing: *A*daptive, Pe*R*sonalized and *T*argeted) directs users attention to offers that match their interests based on their shopping habits. The system is accessed by means of a browser and stores user preferences in an XML database on the client device. The server side is accessed using an XML service and comprises of a number of modules

and an inventory database as is depicted in Figure 9. A major limitation of the system is that it is only accessible using devices that support WAP. In addition a user must connect actively to the server in order to access the advertisements.

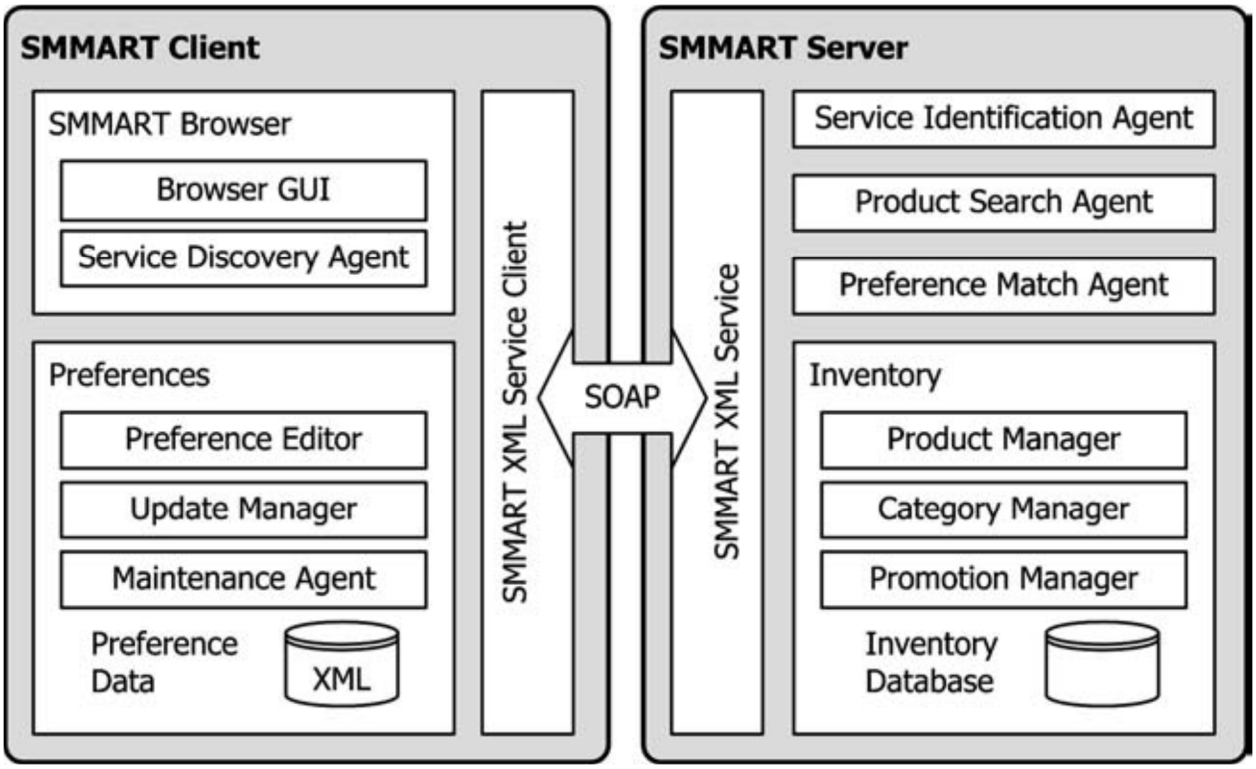

Figure 9: Architecture of SMMART framework by Kurkovsky & Harihar (2006)

eNcentive, an agent based framework proposed by Ratsimor *et al.* (2003), facilitates a peer-to-peer electronic marketing in ad-hoc mobile environments. Advertisers use an *Ad maker agent* to create advertisements and promotions. These advertisements are then pushed to the user devices running the client side *Ad manager*. The need for smart phones, use of the push approach and the lack of user profiling are its main disadvantages.

MobiAd is a personalized, localized and targeted advertising application for smart phones proposed by Haddadi, Hui, and Brown (2010). The application uses device based user preferences to select advertisements from a pool of advertisements broadcast on local mobile base stations or

Wi-Fi hotspots. The main challenges with this approach are (i) the need for smart phones and, (ii) need for the extensive involvement of the mobile service provider in the advertisement dissemination process, report generation and access as well as in locating users.

The Claro SMS-Based Location-Based service was developed by Claro, a leading wireless operator in Guatemala, to provide SMS-based location-based advertising messages to its subscribers. Their solution enables family and friends to locate each other via SMS requests. User privacy is provided for by use of an opt-in mechanism. The users (locators) provide a list of contacts (locatees) whom they want to locate. The locatees are then requested to register by SMS in order to consent to be listed or not. Location information of the contacts is obtained by interrogating the wireless network's Home Location Register (HLR) using the Dialogic (www.dialogic.com) Digital Signaling Interface (DSI SIU). The DSI SIU uses a custom built middleware 'Anytime' in order to establish the real-time position of the device based on its cell location (Dialogic Corporation, 2009). While this approach addresses the issue of privacy it still relies on the cooperation of the network service provider to provide the location information required.

The mLocator service currently provided by Airtel Kenya is a location based application similar to the Claro SMS based location service that was originally intended to help subscribers to find out the location of their family members. With time the application, available on Android, Blackberry and Java enabled phones has found use in diverse areas such as employee tracking. The service is developed to ensure easy user opt-in and opt-out as well as privacy with location information being provided to persons that the subscriber has consented to. Subscribers are also able to know who has requested their location information and the frequency of such requests (Airtel Kenya Ltd, 2014).

There are additional location based mobile marketing services on the Kenyan market provided by Safaricom Kenya Ltd (Safaricom Ltd, 2014). They are discussed briefly below;

1. SMS Sokoni – This service targets small scale traders a platform to buy and sell commodities and agricultural produce.
2. 191 Directory services – This service is a compilation of business telephone numbers, email and postal addresses. The service also offers a number of additional services such as directions, hotel bookings and product and service recommendations.
3. MyMarket – This service enables subscribers access to information on jobs as well as buying / selling services and products using their mobile phones.

It is worth noting that these location based services in the Kenyan market in particular have not yet found widespread application from businesses and their intended consumers.

A summary of the literature discussed is presented in Table 1

Table 1: Summary of LBMA applications reviewed

Title	Author & Year	Concept	User location determination	Information delivery media	Strengths	Limitations
Placecast	Placecast (2013)	Incorporate user real-time location, preferences, business rules and advertiser objectives to deliver ads.	User public IP	Web, Mobile app, email, SMS, MMS	The use of multiple delivery media makes it widely accessible	Requires internet access to place and access advertisements
iAd	Google Inc (2013)	Leverage user demographics and preferences to deliver ads on apple deveices.	User public IP	Mobile apps	Leveraging user preferences and interests	Only available on apple devices.
LBMA	Sammut, Montebello and Camilleri (2010)	Identify user location and send context specific messages.	GPS	Browser and SMS	Use of Google maps to target advertisements	Requires phones that can run java based apps.
Bluetooth location-based advertising system	Rashid, Coulton and Edwards (2008)	Deliver specialized content to users while in the vicinity of a business	Bluetooth	SMS	Content is delivered to only users in the vicinity of a business	Limited to users with Bluetooth enabled devices and uses the intrusive push approach to deliver messages.

Title	Author & Year	Concept	User location determination	Information delivery media	Strengths	Limitations
Bluetooth mobile context aware system	Alexandre *et. al* (2011)	Sends context specific messages to users based on profiles built from social networks or built from web based registration interfaces.	Bluetooth	SMS	Messages are based on detailed user characteristics	Limited to users with Bluetooth enabled devices and uses the intrusive push approach to deliver messages.
Bluetooth Mobile Advertising	Aalto et al (2004)	Detect nearby Bluetooth enabled devices and send messages to the users	Bluetooth	SMS	Delivers advertisements to users within the desired radius	Does not profile users, poor geo-location accuracy, interferes with user privacy and does not address security issues.
GPS and SMS based vendor tracking system	Dawood, Jackson and Yew (2010),	Uses a GPS tracker to update vendor location which allows users to obtain their menus and order items.	GPS	SMS	Connects users and vendors within each other's proximity.	Requires GPS to determine vendor location.
*S*ystem for *M*obile *M*arketing: *A*daptive, Pe*R*sonalized and *T*argeted (SMMART)	Kurkovsky and Harihar, (2006)	A client server application that directs users to offers matching their interests.	Public IP	Browser	Delivers only relevant messages to the user	Requires the use of devices that can support mobile applications and access the internet

Title	Author & Year	Concept	User location determination	Information delivery media	Strengths	Limitations
eNcentive	Ratsimor *et al.* (2003)	Peer to peer marketing for ad-hoc mobile environments.	Bluetooth	SMS	Messages delivered to users within the proximity of the advertiser	Requires the use of smart phones, pushes messages and does not profile users.
MobiAd	Haddadi, Hui, and Brown (2010)	Selects broadcast advertisements broadcast from Wi-Fi hotspots based on user preferences	Wi-Fi	Mobile application	Advertisements received are based on user defined preferences	Requires the use of a smart phone and the involvement of the mobile network in determining user location.
Claro Family finder	(Dialogic Corporation, 2009)	Users request for family and friend location by SMS.	Network based	SMS	User opt-in is required before location information is sent to the user requesting	Requires involvement of the mobile network provider to determine user location.
mLocator	(Airtel Kenya Ltd) (2014)	Subscribers request for family and friend location by SMS.	Network Based	SMS	User opt-in is required before location information is sent to the user requesting	Requires involvement of the mobile network provider to determine user location.
SMS Sokoni	(Safaricom Ltd) (2014)	This service targets small scale traders a platform to buy and sell commodities and agricultural produce.	Network Based	SMS	User opt-in is required before subscriber can advertise commodities	User and trader location is not required.

Title	Author & Year	Concept	User location determination	Information delivery media	Strengths	Limitations
191 Directory services	(Safaricom Ltd) (2014)	This service is a compilation of business telephone numbers, email and postal addresses.	Network Based	SMS	No user registration is required	User location is not required.
MyMarket	(Safaricom Ltd) (2014)	This service enables access to information on jobs as well as buying / selling services and products.	Network Based	SMS	No user registration is required	User location is not required.

2.6 Short Messaging Services (SMS)

SMS was first used commercially in 1992 by Vodafone in the UK to inform its clients about voice mail messages (Harris, Hillebrand, Holley, & Trosby, 2010). It is a basic service offered on GSM, GPRS and CDMA networks that allows mobile devices to exchange messages with a short amount of text limited to 160 characters. SMS utilizes a store and forward approach to transmit messages between mobile phones which allows messages to be stored briefly in case the recipient is not available (Bodic, 2003; Katankar & Thakare, 2010). A typical GSM network architecture with SMS capabilities is presented in Figure 10.

It comprises of three main components (Bodic, 2003);

1. **The mobile station (MS) component:** This is comprises of the terminal device or phone, the Subscriber Identification Module (SIM) card and the Mobile Equipment that contains the radio transceiver, display and digital signal processors.
2. **The base station subsystem component:** This comprises of the Base Transceiver Station (BTS) that has radio transmitters for communicating with the MS and the Base Station Controller (BSC) that receives radio signals from one or more BTS's.
3. **The mobile network component:** This one comprises of (i) the Home Location Register (HLR) that is a database containing information about the registered users. A similar register for users from other networks is referred to as the Visitor Location Register (VLR), (ii) The Mobile Switching Center (MSC) that performs registration, authentication and user location updates among others, (iii) The SMS Center (SMSC) that manages the delivery and storage of messages, (iv) The Email Gateway that enables the interconnection of SMS and the internet.

SMS messages are transmitted over the common channel signaling system 7 (SS7) which is a global standard that defines the procedures and protocols for exchanging control information for call setup, routing and mobility management between wired and wireless telephone networks. Messages are originated by the Mobile Station (MS), received and forwarded by the base station subsystem to the Mobile Switching Center (MSC). The MSC then forwards the message to the SMS center (SMSC). The SMSC with the assistance of the Home Location Register (HLR) and the Visitor Location Register (VLR) identifies the recipients MSC and forwards the messages to it. The recipient MSC then forwards the message to the user's mobile device or stores them in its SMSC in case the recipient is not available. The email gateway enables the Email-to-SMS function by connecting the SMSC to the internet (Bodic, 2003; Katankar & Thakare, 2010).

The general architecture of most SMS applications is depicted in Figure 11 and it comprises of four main components; the mobile users, the SMSC service providers, the aggregator and the content providers.

Mobile users originate and receive messages from each other, using short codes and from email. Short codes are abbreviated numbers that are only valid within networks used to obtain information or participate in competitions. SMSC play the role of storing and forwarding messages. Message aggregators act as an interface between content providers and the SMSC's. They use SMPP to maintain connections with the SMSC and provide access to their servers by means of API's written in Java, PHP and Perl among others. Content providers provide value added content and applications for mobile users (J. Brown, Shipman, & Vetter, 2007).

All GSM handsets can send and receive SMS's which can be sent and received from any network in the same or different country. Its main limitation is the limited message size of 160 characters

as well as its inability to transmit non-text data. Compared to USSD all SMS messages must be explicitly typed before being sent. These challenges limit its wider commercial application (Bodic, 2003).

Typical SMS applications can be classified as (1) Consumer applications that include person to person messaging, interactive information services (obtaining weather forecasts), entertainment services (downloading ringtones) and location based services (restaurant suggestions based on handset locations), (2) Corporate applications that include notification and alert services (product expiry and renewal dates, emergencies), contact, correspondence and appointment management and vehicle tracking, and (3) Mobile service provider applications that include SIM card updates (customer profiles and address book entries) and WAP push with URLs for advertisements to be viewed on the user's mobile browsers (J. Brown et al., 2007). The simplicity and low cost of SMS has made it the most popular mobile messaging method with over 7 trillion messages being sent in 2010 (ITU, 2010).

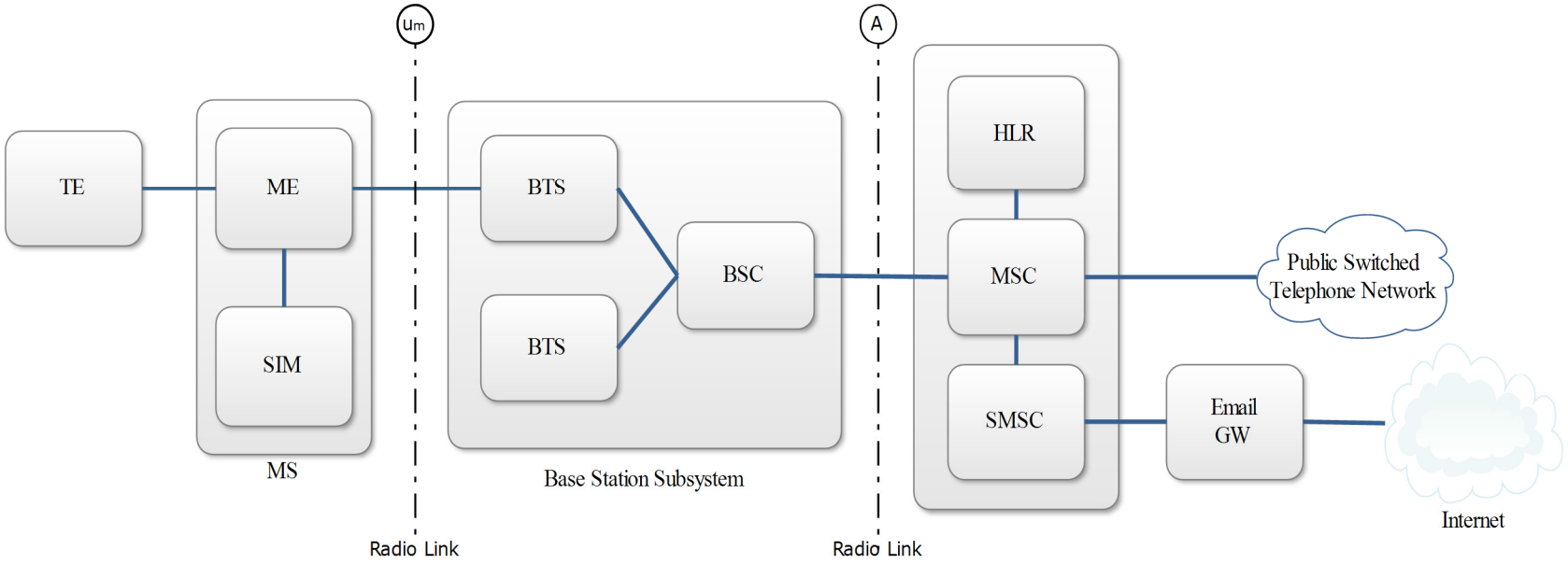

Figure 10: SMS-Enabled GSM network architecture by Bodic (2003)

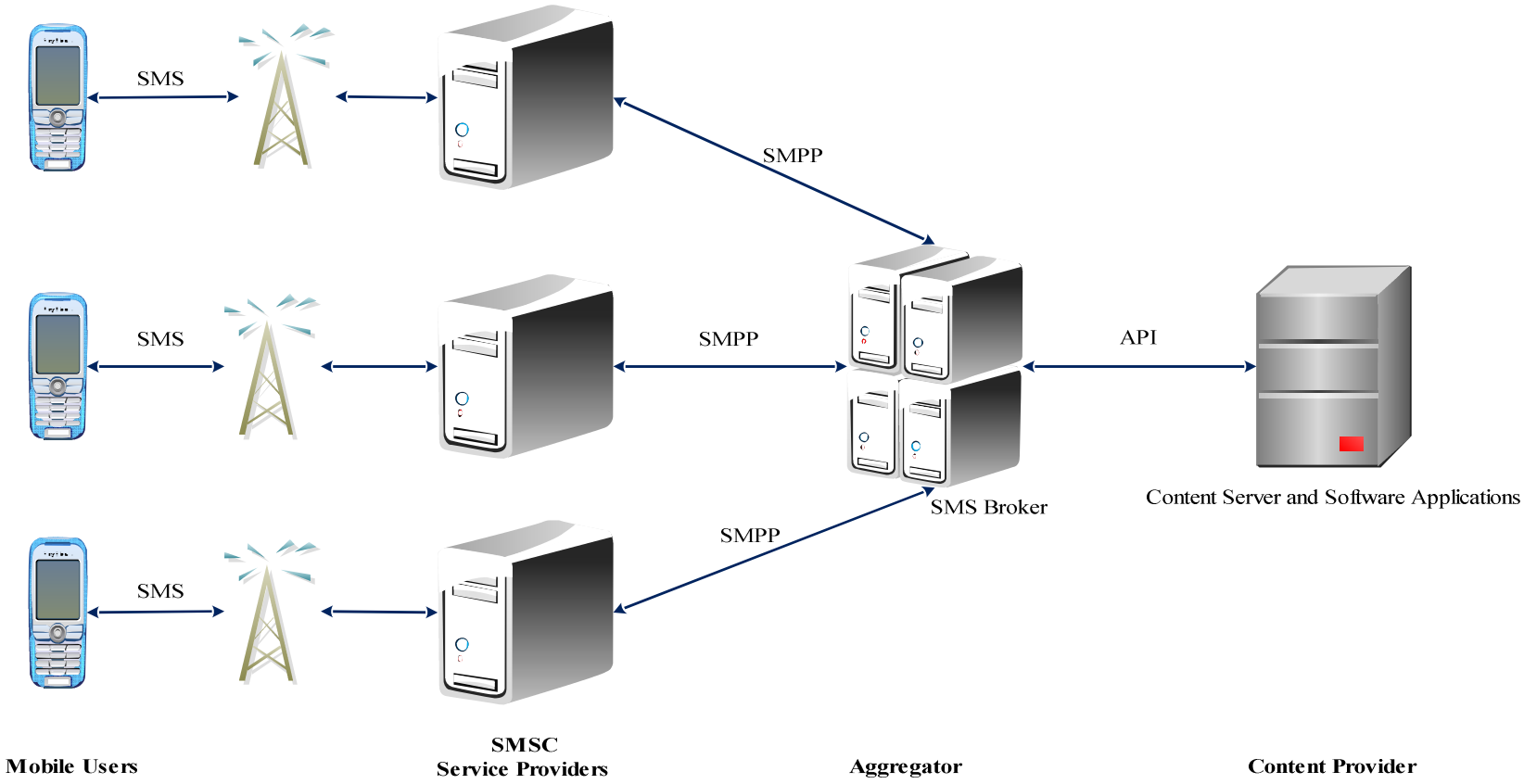

Figure 11: SMS system architecture by J. Brown, Shipman, & Vetter (2007)

SMS was intended for use in sending non-sensitive messages over GSM networks. As a result mutual authentications, text encryption, end-to-end security, non-repudiation and other security measures were not included in the design of the GSM architecture. The only encryption in the transmission process happens between the base transceiver station and mobile station (Wadhe & Sable, 2013).This makes the use of SMS prone to message modification, man-in-the-middle (MITM) attacks, unauthorized message access, identity impersonation and eavesdropping (Medani, Gani, Zakaria, Zaidan, & Zaidan, 2011).

2.7 Unstructured Supplementary Service Data (USSD)

USSD (Unstructured Supplementary Service Data) is a GSM communication technology that is used to send messages between a mobile phone and a network based application server (Gupta, 2010). It is a device and SIM independent and highly cost effective messaging service that is seven times faster than SMS. USSD is able to support interactive menu based applications that make simultaneous voice and data communications possible (Sanganagouda, 2011). A typical GSM network architecture with USSD capabilities is presented in Figure 12.

USSD is used for the development of mobile chatting, m-commerce, pre-paid balance inquiries, callback services, software upgrades and mobile banking services (Gupta, 2010; Sanganagouda, 2011). These services are available as (i) 'pull' based services such as news updates, weather, movie information, sports updates, currency updates, stock market reports, telephone directory and yellow pages, and (ii) 'push' based services that include voting / polling and emergency information services. It is also used for advertising where businesses get listed on menu based USSD systems in order to promote their services (Gupta, 2010).

The use of USSD presents a number of advantages; It is faster with average response times of 2 seconds, is supported by all GSM phones, is phone and SIM card independent, users do not need to type messages or remember short codes to access services, its menu based interaction makes it possible to offer self care applications for VAS, helps network operators to increase ARPU and works well even when users are roaming. On the other hand, USSD keeps resources assigned for the duration of the transactions leading to increased traffic on the communication channels between the MSC's and HLR. In addition messages sent are not stored on the handset for future reference (Gupta, 2010; Sanganagouda, 2011).

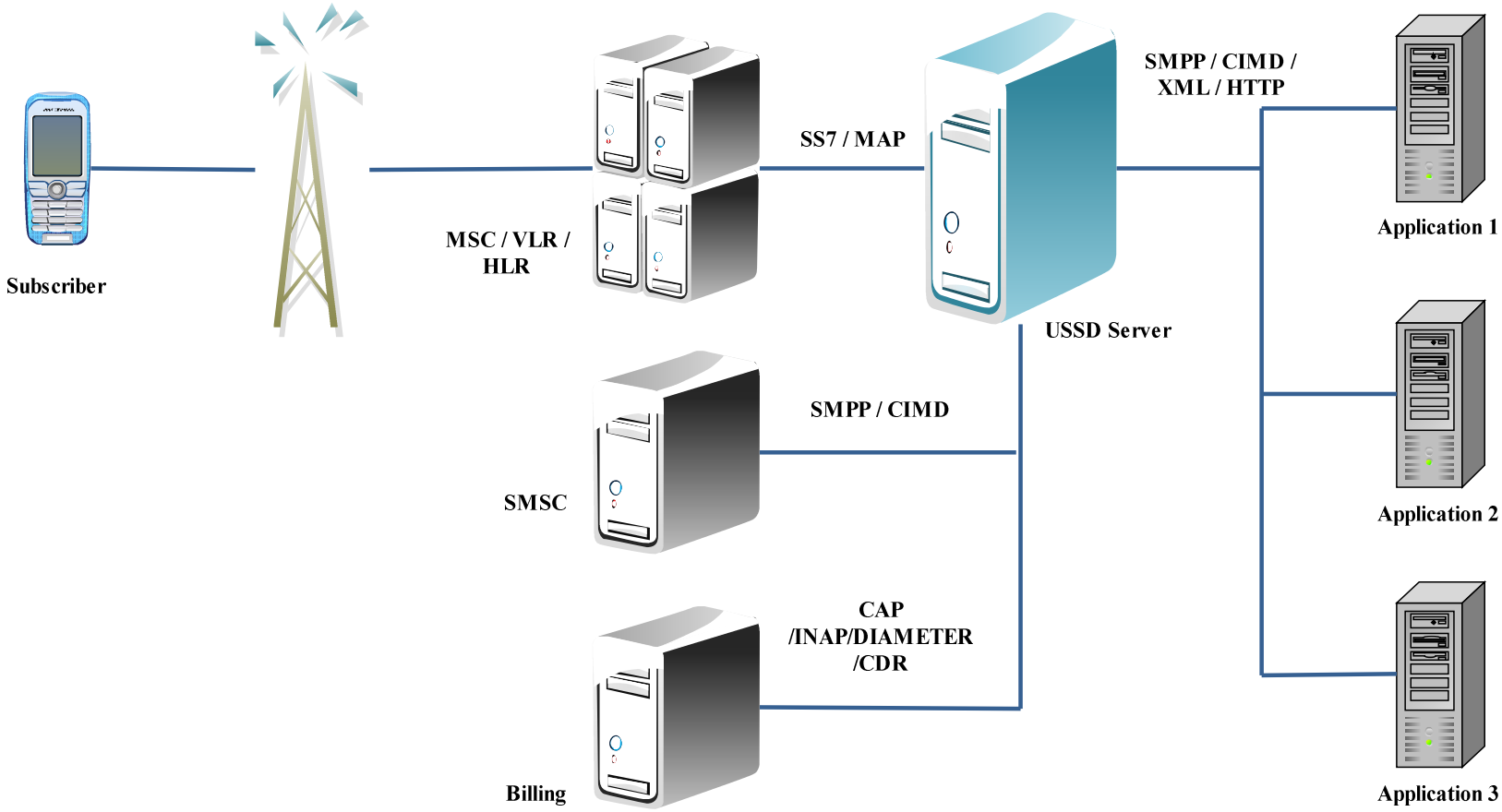

Figure 12: USSD in GSM by Sanganagouda (2011)

2.8 Theories informing the study

2.8.1 Information systems research

An information system is a combination of people, hardware, software, communication networks, procedures and data resources required for information processing and delivery to an organization (Xu & Quaddus, 2013).

Information Systems, the discipline, is concerned with how people and organizations, collect, filter, process, create and distribute data using information technology (Alter, 2002; Laudon, Laudon, & Dass, 2010). The need to inquire into and understand the effects of information systems on the behavior of individuals, groups and organizations thus motivates research in the field of Information Systems. Research activities in the field are categorized into two distinct paradigms; behavioral science and design science. Behavioral science is concerned with the development and verification of theories that explain or predict human or organizational behavior. Design science on the other hand extends the boundaries of human and organizational capabilities by creating new and innovative artifacts (Hevner & Chatterjee, 2010).

This study fits within the design science approach for two reasons; (i) The development of a location-based mobile advertising model using SMS and USSD can be regarded as innovative and, (ii) Its application among microenterprises is a new approach to addressing their advertising challenges.

According to March and Smith (1995), IS research must produce four key outputs;

1. **Constructs** which are conceptualizations used to describe problems within a domain and specify their solutions.

2. **Models** which comprise of a set of propositions or statements expressing relationships between constructs.
3. **Methods** which are a set of steps used to perform tasks and they are based on underlying constructs and models.
4. **Instantiations** that are the realization of artifacts in their environment.

These four outputs can be expected from this study; (i) A number of new constructs will be developed to describe what factors might serve to influence the use of location-based mobile advertising among microenterprises, (ii) a location-based mobile advertising model, the main output of the study, will be developed, (iii) the process and steps or methods required to implement the model will be described and, (iv) an instantiation in the form of a prototype to serve as a proof of concept will be developed and tested.

2.8.2 Systematic innovation

Innovation is defined as the process of creating value by changing the composition of a set of variables in a system (Yezersky, 2007), the use of new ideas or methods (Macmillan Education, 2002), a new process of production (Rosenberg & Kline, 2010) or a process that leads to the generation of new ideas, methods or behaviors (Al-Khasawneh, Al Hosban, & Al-Jammal, 2012). The goal of innovation is to develop new ideas, to refine them into useful forms, develop solutions and to use these solutions to earn profits, increase efficiency and reduce costs in a business operation (Morris, 2011). In this study the use of a different combination of technologies, SMS and USSD, to deliver a location-based mobile advertising solution can be regarded as innovation.

Successful innovation results from the intreaction of five main elements as depicted in Figure 13; an idea without which there is no innovation, a customer whose interest or demand determines the

success of the innovation, a physical or virtual manifestation of the innovation, a means to produce the innovation in an economical manner, and coordination to keep all the elements together at the right place and time (Mann, 2004).

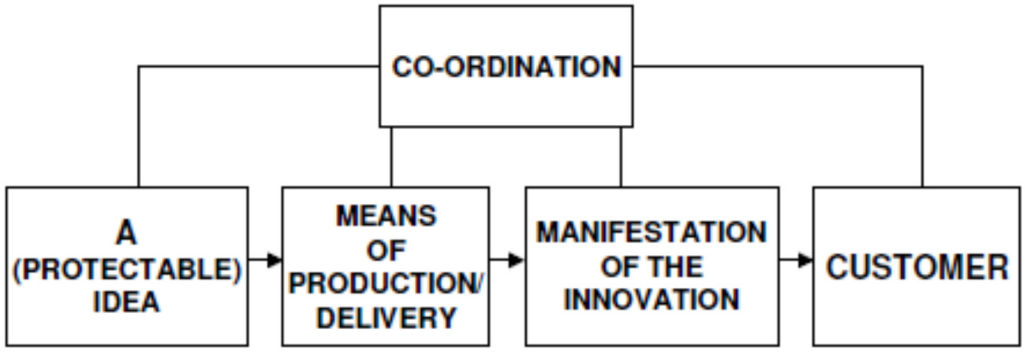

Figure 13: Essential elements of a successful innovation by Mann (2004)

There are three main ways in which innovations may happen; (i) As a flash of genius that occurs to the innovator by chance or accident. This method occurs rarely and is not a primary source of innovative problem solving. (ii) Empirically, through brainstorming or trial and error. This method is highly dependent on luck and does not cover all possible scenarios for the identification of an optimal solution. (iii) Systematically, where an optimal solution is arrived at by a systematic analysis of the entire solution space (Sheu & Lee, 2011).

This study adopted the systematic innovation approach in order to develop a model that will effectively address the advertising challenges faced by microenterprises using location-based services delivered using SMS and USSD. The development of the model will be preceded by a user survey. The model will then be followed by the development and piloting of a prototype. Feedback from the piloting of the prototype was used to improve the model and prototype.

A number of systematic innovation processes have been proposed in the past and informed the conduct of this study. These include;

1. **The systematic innovation process** defined by Sheu and Lee (2011). The process comprises of five phases; (i) opportunity definition (explore, identify and select a problem), (ii) problem definition (explore selected problem), (iii) solution definition (generate and select solution), (iv) project execution (implement selected solution) and, (v) application exploration (examine the performance of the solution). The process is depicted in Figure 14.
2. **The Systematic Creativity Process (SCP)** proposed by Mann (2004). It comprises of four steps, namely; (i) Define - where the process starts with a perceived need and a clear definition of the right problem, (ii) Select Tool – where the right tools are selected to solve the problem, (iii) Generate Solutions – using TRIZ (Teoriya Resheniya Izobreatatelskikh Zadatch' translated as 'Theory of Invenitive Problem Solving' and pronounced 'treez') tools such as function analysis, object analysis, contradiction, resource analysis, inventive principles, ideality, fitting and strong solution methods, (Moehrle, 2005), and finally (iv) Evaluate – where the best solution among those developed is identified.
3. **The value chain process** proposed by Hansen and Birkinshaw (2007). This process comprises of of three phases; (i) Idea generation where ideas are sourced internally and externally, (ii) Idea conversion where ideas are screened and developed into viable products and services and, (iii) Idea diffusion where developed ideas are spread within and outside the company.

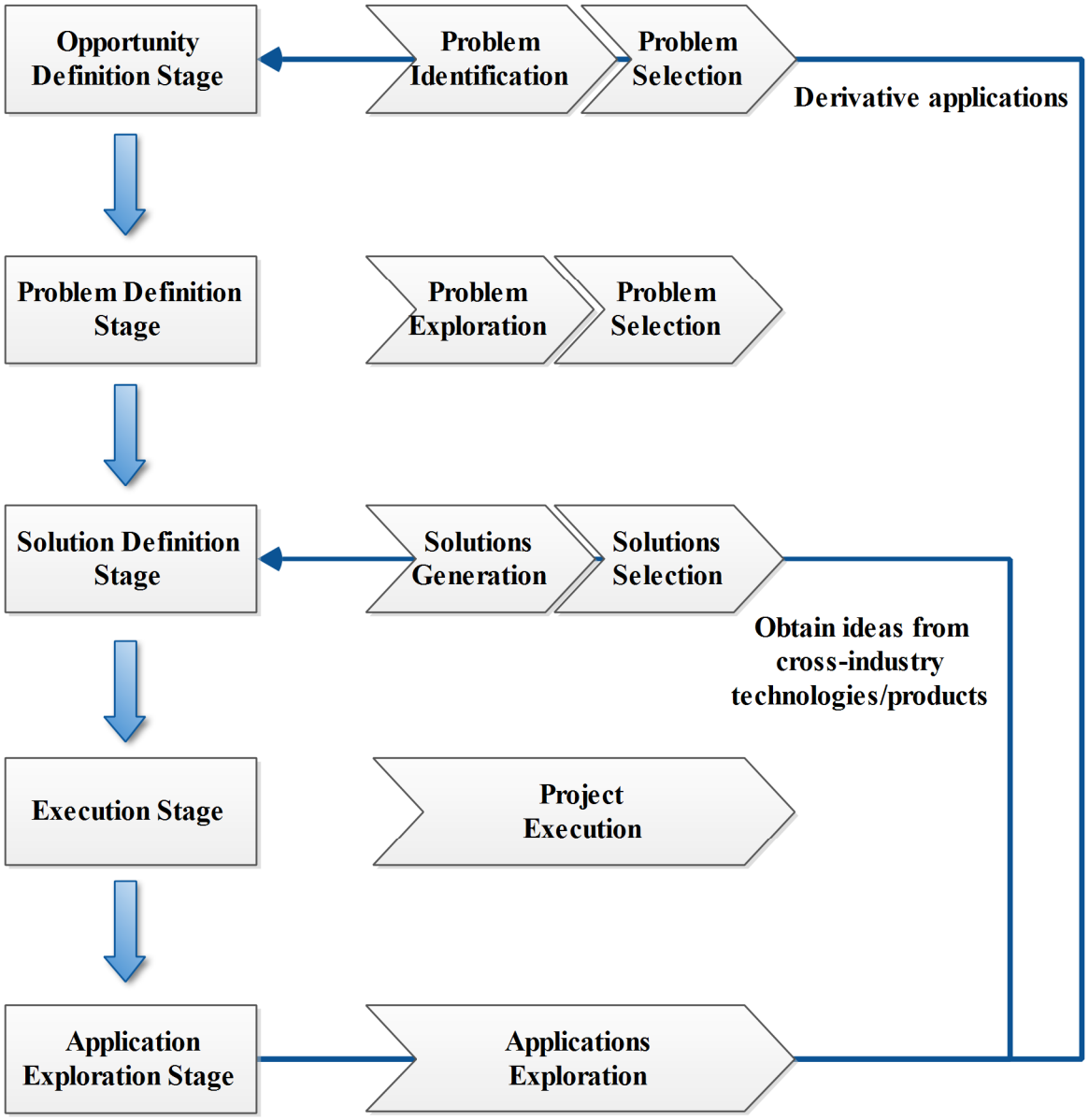

Figure 14: Systematic innovation process by Sheu & Lee (2011)

These systematic innovation methods are applicable in situations where existing systems fail to meet the expectations or set targets of the users, or where no systems exist (Mann, 2004). From the literature it has been established that most of the current location-based mobile advertising systems are predominantly web or mobile application based and use the push approach to deliver advertisements. This limits their access to users who do not have acess to these media. On the other

hand, the use of an SMS and USSD based mobile advertising approach, which is likely to be more acceptable, accessible and affordable has not been considered before.

2.8.3 Technology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) originally proposed by Davis et al (1989) , aims to predict actual system use. It comprises of three main constructs; (i) '*Perceived ease of use*'(PEOU), which is the degree to which a person believes that using a system will be free from effort, (ii) '*Perceived usefulness*', which is the degree to which a person believes that using a system will enhance their job performance, and, (iii) '*Behavioral intention to use*', which is a combined measure of perceived usefulness and perceived ease of use and is an indicator of whether or not a user intends to use a system. In the model, depicted in Figure 15, perceived usefulness and ease of use are the antecedents or predictors of behavioral intention to use which in turn predicts '*Actual system use'*. The theory also postulates that perceived usefulness is influenced by the perceived ease of use (Davis, 1989).

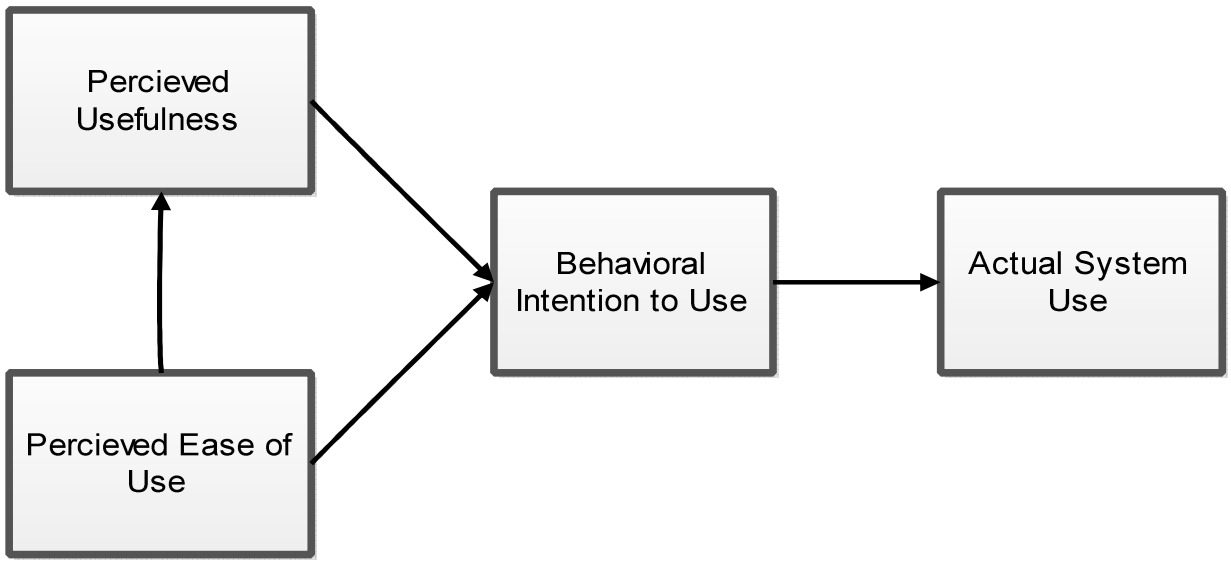

Figure 15: Technology Acceptance Model by Davis et al (1989)

The model has been used in various technology acceptance studies such as in studying consumer acceptance of mobile technology in financial service delivery, (Byun & Feinberg, 2007), in studying gender differences in the use of email, (David Gefen & Straub, 1997), and in evaluating e-commerce acceptance, (McCloskey, 2004), among other applications.

The model has also been used in a number of studies to examine the adoption of various mobile and other technologies such as M-payment adoption by Chandra, Srivastava, & Theng (2010), an internet trust attitude model by Aghdaie, Fathi and Pirman (2011), and a technology trust model by Leppanen (2010). The model was also used by Lee (2008), to study user intention to use online banking services. In addition to validating the influence of the existing TAM constructs, the study by Lee (2008) also identified risk as a factor influencing the intention to use online banking. However the model and its various extensions have not been used in studying user acceptance of location based mobile advertising.

2.8.3.1 Perceived ease of use (PEOU)

"Perceived ease of use refers to the degree to which the prospective user expects the target system to be free of effort."(Davis, 1989).

Previous research has shown that PEOU is a significant influence on user acceptance and usage behavior of information technology (Venkatesh, 2000). For instance, PEOU along with perceived usefulness and attitude have been found to be jointly responsible in determining subscriber's intention to use 3G mobile services (Suki & Suki, 2011).

A 2002 study among 78 first year South African Students established that in a developing country context PEOU was a better predictor of both perceived usefulness and usage (I. T. J. Brown, 2002). PEOU according to Ramayah and Ignatuis (2005), and not perceived usefulness, is one of the two

main influencing factors in a consumers intention to shop online. Interestingly, they also found out that PEOU was a significant predictor of perceived usefulness.

The relative importance of PEOU in relation to perceived usefulness is further emphasized by Gefen and Straub (2000), when they assert that even if a user thinks that an IT artifact or system might be useful often times they fail to adopt it if they perceive that the use is difficult. They theorized that PEOU directly affects adoption when it is an integral part of the service or product being sought for by a user. In other words PEOU is significant when the IT is an end in itself as compared to when it is a means to an end. In their study, ease of learning, flexibility and clarity of the interface are theorized as antecedents to perceived ease of use.

The nature of use, mandatory vs. voluntary, has also been found to impact on the PEOU. Jongepier (2011) observes that the original TAM model was designed for professional work settings where technology use was not optional. However, when the use of a technology becomes optional as is the case with using a Smartphone, the PEOU reduces leading to slower or non adoption of an IT.

2.8.3.2 Perceived usefulness

Perceived usefulness is the degree to which a person believes that using a particular system will enhance their performance in a given task (Davis, Bagozzi, & Warshaw, 1989). Perceived usefulness in combination with convenience have been found to significantly influence subscriber's intention to use 3G mobile services (Suki & Suki, 2011). The role of perceived usefulness with regards to the intention to use messaging technologies (voice and electronic mail) and software applications (WordPerfect, Lotus 1-2-3 and Harvard Graphics) was also examined by Adams, Nelson and Todd, (1992). Their findings indicated that perceived usefulness is an important determinant of system use.

Similar findings with regards to perceived usefulness and adoption of technologies have been found by Wendel, Dellaert, Ronteltap, and Van Trijp, (2013), in consumer's intentions to use health recommendation systems, by Farmani, Kimiaee, and Fatollahzadeh, (2012), in investigating intention to use technology among librarians and by Su, Tsai and Hsu, (2013), in studying the intention to use Telecare Systems.

2.8.3.3 Perceived risk

Perceived risk is the degree to which users believe that using a technology will lead to possible loss of privacy, performance, social status, money or time (J.-H. Lee & Song, 2013; Rose & Fogarty, 2006). It has been found to influence intention to use technology such as the Certified e-Document Authority (CeDA) in South Korea (J.-H. Lee & Song, 2013). As a construct, perceived risk has been used to study the adoption of self service banking technologies among senior citizens, (Rose & Fogarty, 2006); in trying to explain user intentions to use websites, (Belanche, Casaló, & Guinalíu, 2011); in studying consumer intentions to use online channels for making purchases in Jordan, (Faqih, 2013); and in investigating the behavioral intentions of tourism organizations to use e-commerce in Algeria (Belkhamza & Wafa, 2009). In all these studies, perceived risk has been found to have a significant impact on user's intentions to adopt new technology.

2.8.3.4 Choice of technology

The choice of delivery medium has been found to have a significant impact on user's intention to use for technology enabled services. Walker and Johnson, (2006), established that users choose between using the internet and telephone for financial and shopping services based on their sense of personal capacity or capability to use them. In the study by Venkatesh, (1994), the factor

loadings on the ease of use items for the two technologies were different indicating that the user interfaces, less friendly on email and better on gopher, had an influence on perception.

2.8.4 Diffusion of innovations

The diffusion of innovations theory, originally proposed by Rogers (1962), seeks to explain how, why, and at what rate new ideas and technology spread through cultures and society. The theory expounds on the role of four main elements that influence the spread of new ideas; the actual innovation, communication channels in use, time and a social system. The innovation refers to an idea, practice or object perceived as new by an individual (Rogers, 1983). Communication channels are the means by which messages are passed between individuals (Rogers, 1983). Time refers to how long an individual takes to pass through the innovation-decision process (Rogers, 1983). The social system is the set of interrelated groups of individuals engaged in joint problem solving towards achieving a common goal (Rogers, 1983) There are five stages integral to this theory; awareness, interest, evaluation, trial and adoption (Rogers, 1962). Later editions of the theory by Rogers, (1995), changed this terminology to knowledge, persuasion, decision, implementation and confirmation as shown in Figure 16.

The nature and characteristics of the innovation plays a major role in influencing the individual's final decision on adoption. The innovation must present some relative advantage over previous approaches, it must be compatible with the individual's life or activities, it must be of a level of complexity or simplicity that the individual can accept, it must be available for trial or experimentation and its impact must be clearly observable (Rogers, 1995).

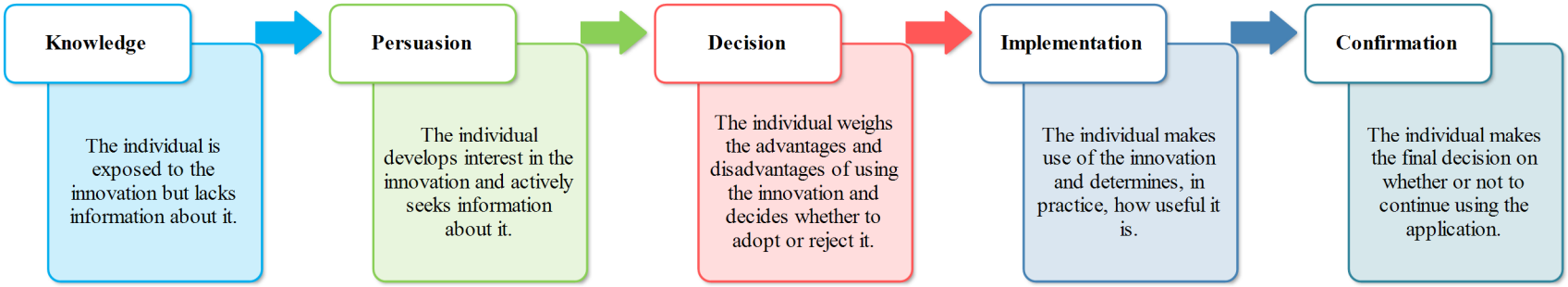

Figure 16: Five stages in the decision innovation process by Rogers (1995)

2.9 Conceptual framework

The conceptual framework for the proposed USSD and SMS location-based pull mobile advertising system presented in Figure 17 comprises of the following major components.

Users: There are two main types of users; (1) The client who is the focus of the system. They make requests for information on which advertisements are delivered and, (2) The advertiser who wishes to make his location, products and services known to potential clients.

Mobile network providers: Their infrastructure is used to transmit SMS and USSD messages. They can also provide location information in the event that physical location is required.

Premium Rate Service Providers (PRSP): They provide the SMS and USSD message aggregation for onward forwarding to the application server. They also provide bulk SMS and short codes for use on the system.

Location-based pull mobile adverting system: This comprises of the following modules; (i) ***User Authentication:*** This module limits access to system functionality to registered users and keeps a record of all transactions for audit and reporting purposes. (ii) ***Client and advertiser registration:*** This module handles the user registration process. (iii) ***Client and advertiser profile management:*** This module allows advertisers and clients to update their profile information such as age and gender in addition to the setting and enforcement of privacy settings such as availability times as well as the type of users who can access their contact information. (iv) ***SMS and USSD modules:*** These modules handle user registration, display the list of services, symbolic locations, service and product availability and inquiry statistics to the client as well as handle the receiving of inquiries and sending responses. (v) ***Advertisement manager:*** This module allows the creation of advertisements, selection of target groups based on location and demographics, identification

of relevant advertisements for the client when information requests are made and the maintenance of the demand and supply statistics for products and services. (vi) ***Location subsystem:*** This module facilitates access to physical location information from the mobile network service provider, presents a list of symbolic locations to the client on the USSD interface and queries symbolic location names from the database. (vii) ***Hardware:*** The system requires mobile devices, an application server for hosting the system logic and database, a USSD server and an SMS server.

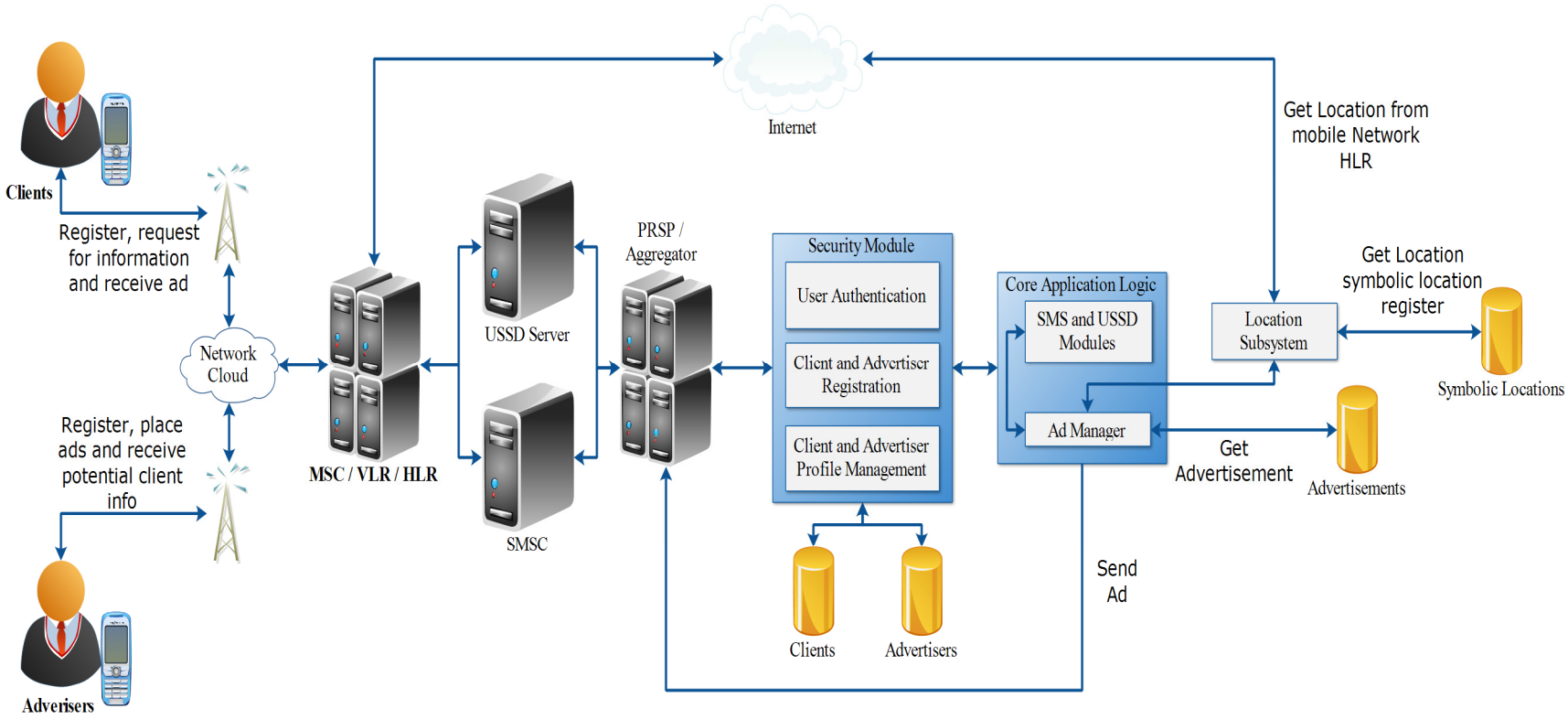

Figure 17: Conceptual framework for the USSD and SMS location-based mobile advertising application

These components interrelate as indicated in Figure 18 to deliver location-based pull mobile advertising services;

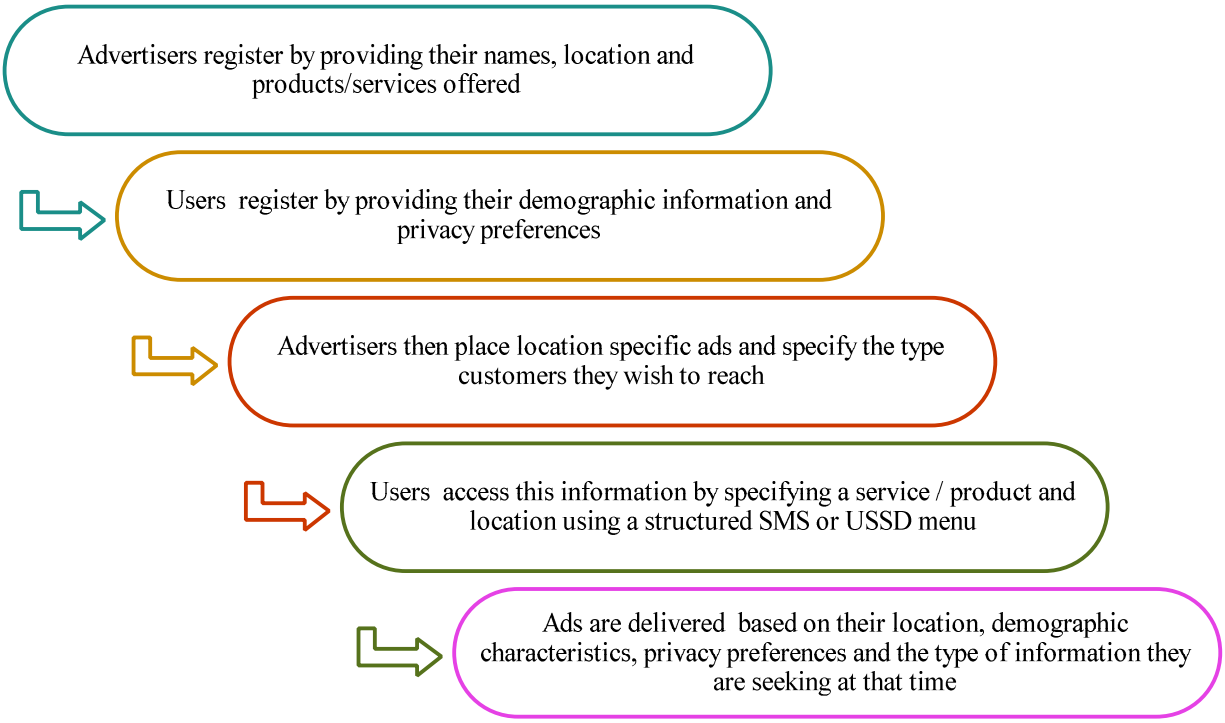

Figure 18: Location-based mobile advertisement delivery process

2.10 Conclusion

This chapter presented a discussion on microenterprises, mobile marketing and location-based services. A number of current location-based mobile advertising applications were also reviewed. The theoretical basis and conceptual framework for the study were also presented and discussed.

The next chapter will outline in detail the methodology to be used in the development, prototyping and evaluation of the SMS and USSD model for location-based pull mobile advertising.

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter discusses the methods that were used in the development, prototyping and evaluation of the SMS and USSD model for location-based mobile advertising.

3.1 Research authorization

As per academic requirements in Kenya, a research permit and an introduction letter were obtained from the National Commission for Science, Technology, Innovation and Communication (NACOSTI), previously known as the National Council for Science and Technology (NCST), before embarking on the fieldwork and model development. They are presented in APPENDIX F.

3.2 Systematic innovation process

The methodology for this study was based on the systematic innovation process defined by Sheu and Lee (2011). It comprised of four stages; customer needs analysis, model development, prototype development and prototype evaluation as depicted in Figure 19.

The original process adopted from Sheu and Lee (2011), did not include the iterations between the stages. However, in practice these iterations were undertaken after the prototype was developed and after subsequent modifications. The specific methodology used to achieve each of the set objectives is described in detail in sections 3.3 to 3.6.

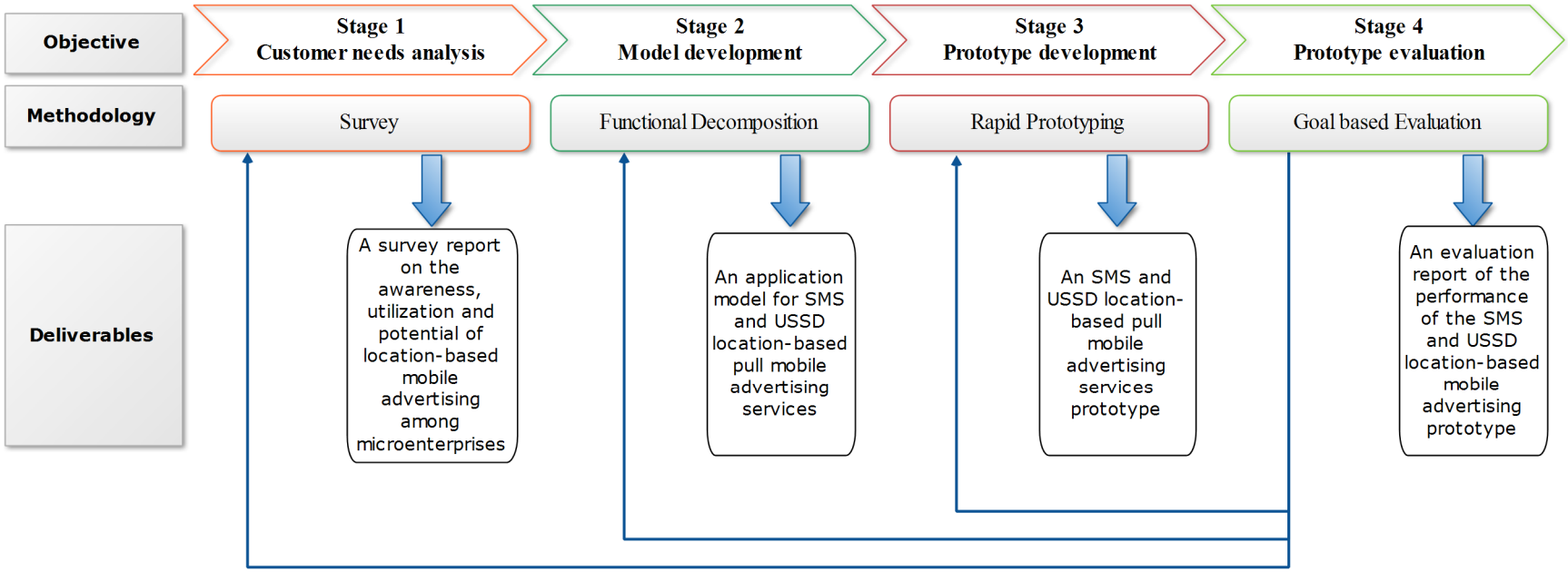

Figure 19: Systematic innovation process for the development of an SMS and USSD location-based pull mobile advertising application

3.3 Customer needs analysis survey

A survey was conducted to establish the level of awareness, utilization and the factors influencing potential use of location-based mobile advertising among microenterprises and their customers.

3.3.1 Objectives of the survey

The objectives of this survey were therefore;

1. To determine the extent to which microenterprises are aware of and utilize location-based mobile advertising.
2. To determine the factors influencing the intention to use location-based mobile advertising among microenterprises.
3. To examine the relationship between choice of technology, perceived ease of use and intention to use location-based mobile advertising among microenterprises.

3.3.2 Research questions

The survey was guided by the following research questions;

1. What is the level of awareness and utilization of location-based mobile advertising by microenterprises?
2. What are the factors influencing the intention to use location-based mobile advertising among microenterprises?

3.3.3 Research hypothesis

The following hypothesis was also tested in the survey;

H_0: There is no statistically significant relationship between choice of technology, perceived ease of use and intention to use location-based mobile advertising among microenterprises.

3.3.4 Research model

The research model, presented in Figure 20, extends the Technology acceptance model by including the choice of technology and perceived risk as additional factors influencing the intention to use a service.

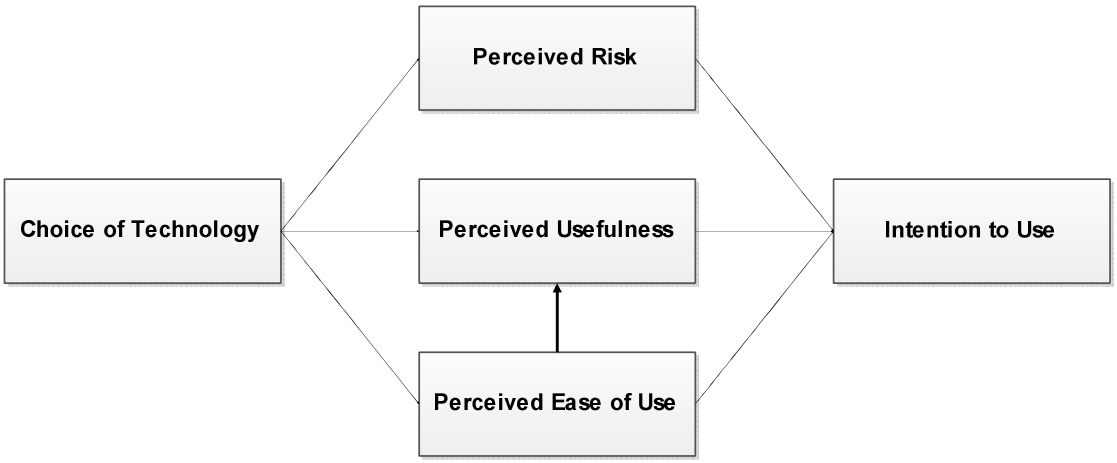

Figure 20: Model for intention to use location-based mobile applications

The model posits that the choice of technology influences perceived risk, perceived usefulness and perceived ease of use which in turn influence the intention to use a service.

3.3.5 Measurement methodology

In keeping with previous literature on mobile advertising, technology trust and technology acceptance measurement items for each construct were developed. They were tested using a three point scale (*Yes, Not Sure, No)* and randomized in the instrument in order to avoid bias.

The following brief description of the proposed location-based mobile adverting solution was presented to the respondents in order to delimit the context within which they were expected to use in responding to the questions asked.

"*The proposed location-based mobile advertising system will store your name, mobile phone number, location and service or product that you offer. This information will be accessed by potential clients to access it using an SMS short code service. The business in turn also gets the mobile contacts of the clients making the inquiry*".

3.3.6 Population

The population for the study comprised of microenterprises in Nakuru County, Kenya. Nakuru County is a cosmopolitan county with a population of approximately 1.2M residents 29.7% of whom reside in urban areas with 70.3% residing in rural areas. The rural urban population distribution differs slightly from the national averages of 19.3% and 80.7% respectively (Kenya National Bureau of Statistics, 1999). Its main urban center, Nakuru town is the fourth largest urban center in Kenya and is well served by transport and communication networks. The main economic activities conducted in the county are in the agricultural, tourism, hospitality, retail, and transport sectors (Foeken & Owuor, 2000), which are similar to those at the national level (Kenya National Bureau of Statistics, 2013). The county is thus representative of the country.

3.3.7 Sample size calculation

A sample size of 300 was determined following the guidelines by Demo *et. al,* (2012). Their guidelines indicate that a sample size of at least 300 subjects or a minimum of 5 subjects per item is required for exploratory factor analysis.

3.3.8 Sampling procedure

Quota Sampling

The quota sampling method was used in this study given that no sampling frame for the microenterprises was available. The subgroups of microenterprises from which the final sample was drawn are listed below.

1. Car hire
2. Carpenters
3. Catering services
4. Motorcycle Taxi (Boda Boda)
5. Breakdown
6. Electrical Repairs
7. Gardening
8. Mechanic
9. Painting
10. Photography
11. Plumbing
12. Hairdressing
13. Taxi
14. Transport Hire
15. Veterinarian
16. Health providers
17. Water Suppliers
18. Agriculture
19. Fuel Suppliers
20. Tailor

Sample size allocation

The number of respondents from each subgroup was computed as shown below.

Sample size per subgroup: = N/H = 300/20 = 15

Sampling method

The distribution of the microenterprises among the population was assumed to be uniform and random sampling within the subgroups was used to select respondents. The number and percentages of the respondents selected from each of the subgroup is presented in Table 2

.

Table 2: Microenterprises sampled

Type of Business	Frequency	Percent
Car hire	12	4.0
Carpenters	15	4.9
Catering services	15	4.9
Chemist	15	4.9
Motorcycle taxi (Boda Boda)	13	4.4
Breakdown	5	1.6
Electrical Repairs	15	4.9
Gardening	13	4.4
Mechanic	15	4.9
Painting	15	4.9
Photography	15	4.9
Plumbing	15	4.9
Hairdressing	15	4.9
Taxi	15	4.9
Transport Hire	15	4.9
Veterinarian	15	4.9
Video Recording	6	2.0
Health providers (doctor, herbalist, ambulance)	15	4.9
Water Suppliers	15	4.9
Agriculture (extension, tractor hire)	16	5.4
Fuel Suppliers (cooking gas, charcoal, firewood)	14	4.7
Tailor	15	4.9
Total	**304**	**100.0**

3.3.9 Instruments

The data for this survey was collected using a questionnaire entitled "**Factors influencing awareness, utilization and potential for use of location-based mobile advertising**" presented in APPENDIX A.

The information for the various elements in the research model was collected using a number of items as indicated below.

Choice of Technology

1. Type of phone used
2. I prefer to use simple mobile phones.
3. I am interested in learning about new technology applications
4. I only use technologies that I am familiar with.
5. I only use technologies that are reliable.
6. I do not use technologies that have failed before.
7. I would prefer to use the application if it is based on a simple technology like SMS
8. I would prefer to use the system if I do not need to learn about new technologies
9. I would use the application if I do not have to change mobile providers
10. I would use the application if it works on the technologies I am already familiar with.
11. I would use it if it was a Java or Android based mobile applications
12. I would use it if it required internet access
13. I would use it if it was SMS based
14. I would use it if it was USSD based.

Perceived Risk

1. Giving out my personal details to unknown clients is risky.
2. Getting calls from new clients might interfere with my performance with the existing ones.
3. Being listed on such a service might associate me with illegal activities or crime.
4. I would prefer to get paid a deposit before going out to meet a client.
5. I fear that some clients might call and not give me business.
6. Getting calls from clients at odd hours might interfere with my privacy.
7. I would use it if it was a Java or Android based mobile applications

Perceived Usefulness

1. The application can help me increase my profits
2. The application can make it easier to get clients.

Perceived Ease of Use

1. I would be comfortable using a new mobile service if there is help.
2. I would be comfortable using a new mobile service if I have enough time to complete a transaction.
3. I am able to learn how to use new phones on my own.
4. I am able to learn how to use new mobile services on my own.
5. I would use the application if it takes a short while to learn.

Intention to Use

1. I would like to use such an application.
2. You can contact me to test the application.
3. I would like to know more about the application.

The questions and scales used in these questionnaires were refined by an extensive literature survey of similar works that have measured attitude with regards to the adoption of mobile technologies. These questionnaires were self administered or administered by the researcher in instances where the respondents were not be able to respond on their own.

3.3.10 Pilot study

A pilot study was conducted in order to collect data for use in reliability analysis as well as to test the validity of instruments developed for use in the study. A total of 30 respondents comprising of boda boda operators were sampled in the pilot. The data collected was used to determine the reliability of the instrument as well as the suitability of the data analysis method

proposed for the study. The instrument was found to be suitable for collecting the data required for the study. However, a number of items in the instrument were removed while others were modified on order to improve on the reliability of the instrument.

3.3.11 Reliability

Reliability is a measure of the internal consistency of a research instrument as well as a measure of the degree of homogeneity among the research items in a construct. It's objective is to assess whether the instrument would give consistent results in repeated tests held at different locations, subjects and times (Wamuyu & Maharaj, 2011). The reliability of the instruments and the scales to be used in the study was established using Cronbach's Alpha (Cronbach, 1951). It is a widely accepted measure of internal reliability and consistency that works by identifying items in the instrument that have low correlations in order to exclude them from further analysis. The scale is considered reliable if alpha is close to 0.7 or higher (Bollen, 1989). A reliability coefficient of 0.607 was obtained for the 'intention to use scale' used in this study.

3.3.12 Data analysis

The exploratory factor analysis approach was used to analyze the data collected in order to help in identifying the structure of the relationships between the variables in the study. This helped in explaining the relationship between them in terms of common underlying dimensions or factors that influence the level of awareness, utilization and potential for the use of SMS and USSD location-based pull mobile advertising services (Everitt & Dunn, 2001). Data entry, descriptive, graphical, reliability and factor analysis was done using SPSS version 20 (IBM, 2013). The insights obtained from the customer needs analysis informed the subsequent development of the SMS and USSD model for location-based pull mobile advertising.

3.4 Model development

The functional decomposition approach for system analysis and design was used to develop the SMS and USSD model for location-based pull mobile advertising. Functional decomposition focuses on the functions and sub-functions that a system needs to perform and the interfaces between them. It is a top-down system development methodology that begins with the abstract and broad description of the system requirements, and works progressively to the particular algorithmic steps that can be translated into code (NASA, 2004). The process followed is outlined in Figure 21

3.5 Prototype development

A prototype is a model of a product or a system in part or in whole. It is used to demonstrate various aspects of the product such as interfaces or functionality. It is used as a 'proof of concept' in order to aid in the development of a product or system where no clear approach is evident. It is used to see if a proposed approach will work and to demonstrate to a user what the intended system will look like, what it will do and how it will work (NASA, 2004). The rapid prototyping approach depicted in Figure 22 was used in the translation of the SMS and USSD model for location-based pull mobile advertising into a functional prototype.

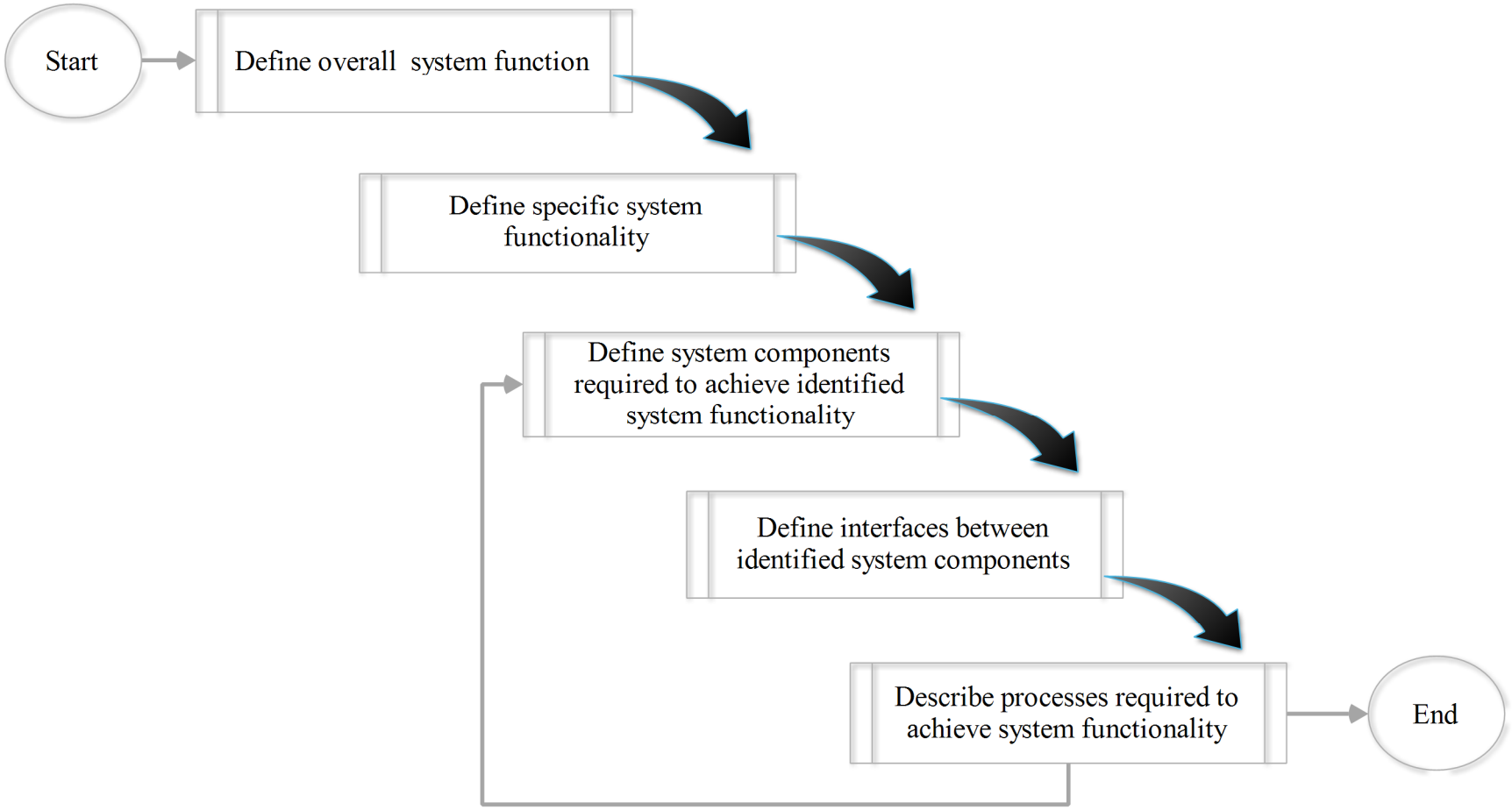

Figure 21: Functional decomposition process by NASA (2004)

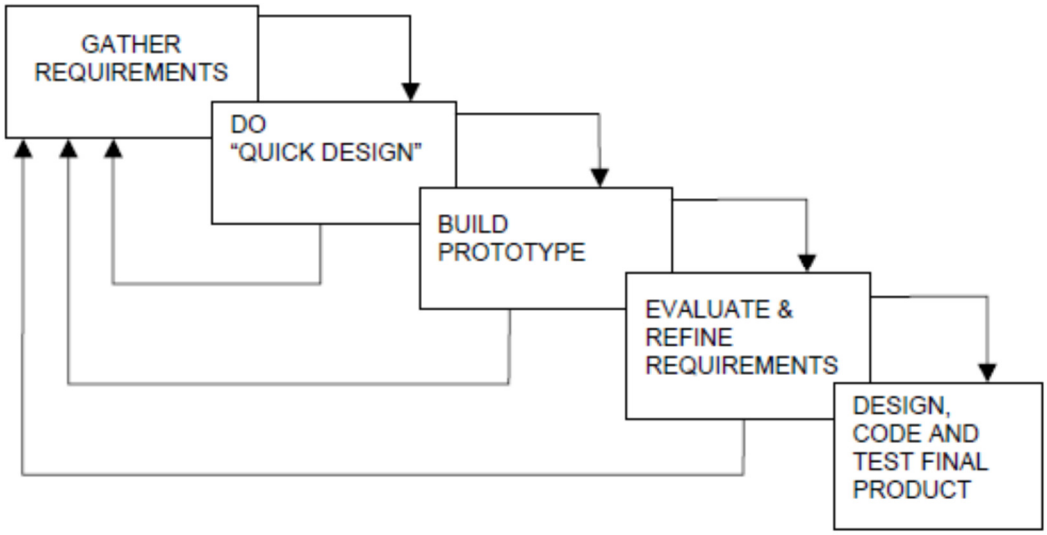

Figure 22: Rapid prototyping by NASA (2004)

3.6 Prototype evaluation

The approach that was used in the evaluation of the prototype is the 'Goal-based evaluation of IT systems as such'. Goal-based evaluation is a technical and economical evaluation method whose main objective is to establish whether the prototype meets the set technical objectives (Patton, 1990). Evaluating a system 'as such' is an evaluation approach that requires only the evaluator and does not involve the end users. The evaluation criteria in this evaluation approach is derived from the systems requirements specification and description presented in section 4.2 (Cronholm & Goldkuhl, 2003).

The SMS and USSD location-based pull mobile advertising prototype was evaluated according to the following objectives.

1. **Advertiser registration using USSD:** The system should be able to capture the name and location of the business, service and products offered, and allow the advertiser to specify their privacy settings.

2. **Client registration using USSD:** The system should be able to capture client demographic information such as name, gender and year of birth, to confirm if the client's mobile number is registered with the mobile network service provider and to generate and send a PIN to the client.
3. **Placement of advertisements using USSD:** The system should allow for the input of an advertisement and selection of the target audience based on location, age, gender or user inquiry type.
4. **Information search**: The system should allow for the initiation of a premium rate SMS from the USSD menu or using a structured SMS with the service/product name and a location. It should obtain the location from the SMS or from the Network service provider and send a response comprising of a list of contacts of identified service providers and a relevant advertisement.
5. **Advertisement selection:** The system should allow for an advertisement to be selected based on the client's location, age, gender or inquiry type.

3.7 Conclusion

This chapter described the approach and methods that will be followed in carrying out the study. The overall methodology is based on the systematic innovation process and utilizes a user needs survey to establish the factors influencing the level of awareness, utilization and potential for SMS and USSD location-based pull mobile advertising, the functional decomposition approach for model development, the rapid prototyping approach for prototype development and the 'Goal-based evaluation of IT systems as such' method for evaluating the prototype against the set objectives.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.0 Introduction

In this chapter the user survey results, model, system design, prototype development process, limitations, challenges, results of the goal based evaluation and possible application areas of the location-based mobile advertising prototype are discussed.

4.1 Factors influencing the intention to use location-based mobile advertising among microenterprises

4.1.1 Introduction

The use of location-based mobile advertising to deliver context specific information to clients has the potential to help businesses increase revenues, personalize offerings and reduce marketing costs. However, there is a lack of adoption of this emergent mode of advertising among microenterprises. This study examined the underlying reasons for this lack of adoption using an exploratory factor analytic study based on an adaptation of the Technology Acceptance Model with the choice of technology as an additional factor. Data was collected in a survey involving 304 microenterprises by means of questionnaires. A majority of microenterprises sampled in the study were not aware of location-based mobile advertising. The study findings validate the technology acceptance model and also reveal that the choice of technology is an important factor influencing the intention to use location-based mobile advertising by microenterprises.

4.1.2 Study findings

4.1.2.1 Demographics

The demographic characteristics of the respondents sampled in the study are presented in Table 3.

Table 3: Demographics

Item	Category	Frequency	Percentage	Notes
Age	Below 19 years	3	1.0	A majority of respondents sampled fell in the 20 – 39 years age bracket.
	20- 29 years	145	47.7	
	30 – 39 years	135	44.4	
	Above 40 years	21	6.9	
Gender	Male	244	80.3	There were more men sampled than women.
	Female	60	19.7	
Level of Education	Class 8	62	20.4	A majority of the respondents had diploma level of education and below.
	Form 4	146	48.0	
	Diploma	60	20.1	
	Degree	31	10.2	
	Masters	4	1.3	
Type of Phone	Basic Phone	148	48.7	Most respondents owned basic and feature phones.
	Feature Phone	148	48.7	
	Smart Phone	8	2.6	

Of particular interest to this study is the observation that a majority of the respondents use basic and feature phones. This validates the observations by Roberts and Wood, (2002), on the access to technology by microenterprises with respect to mobile phones. The lack of access to smartphones also limits their access to location-based mobile advertising applications developed for use on these phones.

4.1.2.2 The level of awareness of location-based mobile advertising among microenterprises

The study established that a majority of respondents, 96.4% were not aware of the concept or term 'location-based mobile advertising' as is indicated in Table 4.

Table 4: Level of awareness of location-based mobile advertising among microenterprises

Response	Frequency	Percentage
Yes	11	3.6
No	293	96.4
Total	**304**	**100**

4.1.2.3 Factors influencing the intention to use location-based mobile advertising among microenterprises

The exploratory factor analysis technique was used to identify the number of constructs and underlying factors in the data collected with regards to the possible adoption intentions of location-based mobile advertising among microenterprises. Exploratory factor analysis is used to explore the underlying structure of a set of related variables without imposing a preconceived structure on the outcome (Child, 2006).

The scale

The 18 variables used in the study are presented and discussed in Table 5.

Table 5: Factor Analysis Variables

	Item	**Description**
v1	I will only try using the application if it does not look complicated	Determine if complication or the lack of it impacts on user intention to use an application.
v2	I would prefer to use the application if it is based on a simple technology like SMS	Determine if respondents prefer technologies perceived to be simple.
v3	I would prefer to use the system if I do not need to learn about new technologies	Determine if respondents prefer to use familiar technologies to access an application.
v4	I would use the application if I do not have to change mobile providers	Determine the extent to which respondents are ready or not to change providers in order to use an application.
v5	I would use the application if it takes a short while to learn.	Determine how patient respondents are likely to be when it comes to learning how to use an application.
v6	I would use the application if it works on the technologies I am already familiar with.	Determine if respondents prefer to use already familiar technologies.
v7	The application can help me increase my profits	Determine if respondents think the application can help them to increase their profits.
v8	The application can make it easier to get clients.	Determine if respondents think the application can make it easier to access clients.

	Item	Description
v9	Giving out my personal details to unknown clients is risky.	Determine if respondents think the application can expose them to risks.
v10	Getting calls from new clients might interfere with my performance with the existing ones.	Determine if respondents fear that existing clients might be inconvenienced by new clients.
v11	Being listed on such a service might associate me with illegal activities or crime if it is misused.	Determine if respondents fear being associated with illegal activities and crime as a result of using the application.
v12	I would prefer to get paid a deposit before going out to meet a client.	Determine if respondents have doubts on the trustworthiness of the clients that they get from the application.
v13	I fear that some clients might call and not give me business.	Determine if respondents have doubts on the reliability of the clients that they get from the application.
v14	Getting calls from clients at odd hours might interfere with my privacy.	Determine if respondents are concerned for their privacy.
v15	I would use it if it was a Java or Android based mobile applications	Determine if respondents are aware of what Java or Android applications are.
v16	I would use it if it required internet access	Determine if respondents are ready to use the application if it requires internet access.
v17	I would use it if it was SMS based	Determine if respondents are ready to use the application if it requires SMS.
v18	I would use it if it was USSD based.	Determine if respondents are ready to use the application if it requires USSD.

Model fitting

The factorability of all 18 items on the scale was examined and it was observed that all items with the exception of one were correlated with a correlation coefficient of at least 0.3 with other items (See Table 13). The uncorrelated item was removed from the scale. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.740, above the commonly recommended value of 0.6, and Bartlett's test of sphericity was significant (χ^2 (136) = 1639.578, $p < .05$) (See Table 14). The diagonals of the anti-image correlation matrix were also all over 0.5 (See Table 15). The communalities of the items were also above 0.3 indicating that the items shared some common variance with other items (See Table 16). Factor analysis was thus deemed suitable for the remaining 17 items.

A total of 6 factors, with an Eigen value of 1 and above, were extracted initially from the resulting scale by means of the principal component analysis. These factors explained 63% of the variance in the intention to use location-based mobile advertising (See Table 6).

Table 6: Initial extracted Eigen values

Component	Initial Eigen values		
	Total	% of Variance	Cumulative %
1	3.989	23.467	23.467
2	2.619	15.405	38.871
3	1.797	10.573	49.444
4	1.230	7.235	56.679
5	1.126	6.626	63.305

The initial factors and factor loadings extracted are presented in Table 17. All 17 items in the scale had a factor loading of above 0.4. However, items v4, v7 and v10 that loaded strongly on factor 4 and 5 were eliminated from the analysis as they did not achieve the minimum of 3 items per factor desired for the study and were difficult to interpret (See Table 17).

Final model

A principal components factor analysis of the remaining 14 items, using Varimax rotation was conducted and three factors, presented in Table 7, explaining 56% of the variance, were extracted.

Table 7: Final extracted Eigen values

Component	Initial Eigen values		
	Total	**% of Variance**	**Cumulative %**
1	3.675	26.254	26.254
2	2.589	18.496	44.750
3	1.637	11.693	56.443

The Varimax rotation provided a good factor structure with a majority of items having a primary loading of 0.5 and above. Only one item, No 3, had a cross loading of above 0.4. The factor loading matrix for the final solution is presented in Table 8.

Factor interpretation

Factor 1:

This factor accounted for 26% of the variance in the intention to use location-based mobile advertising among microenterprises. It appears to be a composite factor that comprises items related to convenience, benefits and risk. (i) **Convenience:** Respondents indicated that they would be willing to use the proposed application if they would not be required to learn about new technologies, change mobile service providers or have their privacy interfered with. (ii) **Risk:** The fear of being called and not getting the business from a client as well as the desire to get a deposit before going out to meet a client imply that microenterprises are concerned about the risk associated with using the proposed service. (iii) **Benefits:** Microenterprises expressed interest if the proposed application could help them increase their profits and not

interfere with service delivery to the existing clients. These items and the factor were collectively labeled '***Perceived Usefulness***'

Factor 2:

This factor accounted for 18% of the variance and it clearly captured the items related to perceived ease of use of the proposed location-based mobile advertising solution. Respondents indicated that they would consider using the application if it did not look complicated, if it was based on a simple technology like SMS and if it worked on technologies that they were familiar with. This factor was labeled '***Perceived Ease of Use***'

Factor 3:

This factor accounted for slightly over 11% of the variance and it relates to the choice of delivery medium. The items in this factor related to the use of various technologies such as Java, Android, USSD and the Internet for the delivery of the proposed solution. Additionally the aspect of risk also emerged in the concern that contact details might be revealed to unknown clients. This factor was labeled ***'Choice of Technology'***.

Table 8: Final rotated factor solution

Item	Factor 1	2	3
I fear that some clients might call and not give me business.	0.811	-0.044	-0.067
I would prefer to get paid a deposit before going out to meet a client.	0.714	-0.056	-0.349
Getting calls from new clients might interfere with my performance with the existing ones.	0.637	0.066	0.420
I would prefer to use the system if I do not need to learn about new technologies	0.551	0.300	0.372
I would use the application if I do not have to change mobile providers	0.547	0.266	0.360
Getting calls from clients at odd hours might interfere with my privacy.	0.523	0.175	0.384
The application can help me increase my profits	-0.612	-0.021	-0.096
I will only try using the application if it does not look complicated	0.050	0.824	-0.082
I would prefer to use the application if it is based on a simple technology like SMS	0.168	0.768	0.024
I would use the application if it works on the technologies I am already familiar with.	0.069	0.728	0.217
I would use it if it was a Java or Android based mobile applications	0.076	-0.064	0.779
I would use it if it was USSD based.	0.146	-0.363	0.707
Giving out my personal details to unknown clients is risky.	0.027	0.188	0.570
I would use it if it required internet access	0.084	-0.628	0.479

Scale reliability

The internal consistency of the overall scale and the individual factors was examined using Chronbach's alpha. A score of 0.669 was obtained for the final scale comprising of 14 items. A score of 0.680 was obtained for perceived usefulness, 0.751 for ease of use and 0.648 for choice of technology. No increases in the alpha values for any of the factors could have been obtained by deleting any of the items from the respective scales (See Table 9).

Table 9: Descriptive statistics for the intention to use location-based mobile advertising scale (n=304)

	No. of items	M (SD)	Skewness	Kurtosis	Cronbach's α
Perceived usefulness	7	10.79(2.72)	1.692	2.413	0.680
Perceived ease of use	3	6.03(2.51)	-0.019	-1.492	0.751
Choice of technology	4	5.54(2.04)	0.233	-1.165	0.648

Tests of normality

The skewness and kurtosis scores for the computed scores with the exception of the Kurtosis for perceived usefulness were within the acceptable limits of +/- 2 for the assumption of normality (See Table 9).

Table 10: Tests for normality

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
Choice of Technology	0.153	304	0.000	0.898	304	0.000
Perceived Usefulness	0.318	304	0.000	0.714	304	0.000
Perceived Ease of Use	0.222	304	0.000	0.822	304	0.000

a. Lilliefors Significance Correction

The Shapiro-wilk and Kolmogorov-Smirnov tests for normality also confirm that the composite scores were normally distributed and thus suitable for parametric statistical analysis (See Table 10).

4.1.2.4 Relationship between choice of technology, perceived ease of use and intention to use location-based mobile advertising among microenterprises

A correlation analysis between the identified factors was also conducted and is presented in Table 11. Significant positive correlations were found to exist between choice of technology and intention to use (0.490, $\alpha = 0.01$), choice of technology and perceived usefulness (0.253, $\alpha = 0.05$), and perceived usefulness and perceived ease of use (0.268, $\alpha = 0.05$). Intention to use and perceived ease of use had a significant weak negative correlation (-0.134, $\alpha = 0.05$). The same applied for the relationship between choice of technology and perceived ease of use (-0.173, $\alpha = 0.05$). The relationship between perceived usefulness and intention to use was not significant.

Table 11: Factor score correlations

		Intention to use	Choice of Technology	Perceived Ease of use	Perceived Usefulness
Intention to use	Correlation	1	0.490**	-0.134*	-0.074
	P value		0	0.019	0.199
Choice of Technology	Correlation	0.490**	1	-0.173**	0.253**
	P value	0		0.002	0
Perceived Ease of use	Correlation	-0.134*	-0.173**	1	0.268**
	P value	0.019	0.002		0
Perceived Usefulness	Correlation	-0.074	0.253**	0.268**	1
	P value	0.199	0	0	

4.1.3 Discussion

4.1.3.1 The level of awareness and utilization of location-based mobile advertising by microenterprises

Majority of the microenterprises in this study were not aware of and did not use any location-based mobile advertising applications. This is in keeping with previous findings on their low level of awareness, access to and utilization of technology and information systems (GDRC, 2008; Roberts & Wood, 2002).

4.1.3.2 Factors influencing the intention to use location-based mobile advertising among microenterprises

Results from the exploratory factor analysis revealed that there are three main factors influencing the intention to use location-based mobile advertising among microenterprises; choice of technology, perceived ease of use and perceived usefulness. However, risk, as proposed in the research model did not emerge as a standalone factor but rather was significantly correlated with convenience (0.349, $\alpha = 0.01$) and benefits (0.186, $\alpha = 0.01$). This could imply that the subjects were willing to take higher levels of risk if the convenience and benefits were significant enough (See Table 20).

These findings concur with those of Forsythe, Liu, Shannon, and Gardner, (2006), and Lee, (2008), with regards to the tradeoff between perceived benefits and risk in the adoption of various technologies. The low correlation between risk and benefits can also be attributed to the inverse relationship between the two factors as established by Slovic, (1994) and Alhakami, (1998).

4.1.3.3 The relationship between choice of technology, perceived ease of use and intention to use location-based mobile advertising among microenterprises

The study sought to establish if there was a statistically significant relationship between choice of technology, perceived ease of use and the intention to use location-based mobile advertising among microenterprises. Correlation analysis conducted between the scores of the items in the various factors revealed that;

- Choice of technology had the highest significant correlation with the intention to use the proposed location-based mobile advertising solution.
- Significant correlations were also found to be present between the choice of technology and perceived usefulness as well as perceived usefulness and perceived ease of use.
- The relationships between choice of technology and perceived ease of use, and that between intention to use and perceived ease of use were negative.
- There was no significant relationship between the perceived usefulness and the intention to use in this study.

The significant correlation between the choice of technology and the intention to use the location-based mobile advertising service confirmed the hypothesis that choice of technology does influence the intention to use a service or product.

The lack of a significant correlation between perceived usefulness and the intention to use is significant and warrants an explanation or a hypothesis. The subjects in the study were only given a description of the proposed system. The questions that followed were mainly testing if they would like to try using the application. With this in mind, they only expressed their desire to investigate or consider if the said application could be useful to them. It is possible that their perception of usefulness could not be fully formed in the absence of an actual use of the system.

A stronger relationship between the perceived ease of use and intention to use as opposed to that between perceived usefulness and intention to use implies that perceived ease of use is a better determinant of the intention to use a system. This finding concurs with that of Ramayah and Ignatuis (2005) who established that perceived ease of use, and not perceived usefulness, is a better determinant of intention to use. The relative importance of perceived ease of use in relation to perceived usefulness is further emphasized by Gefen and Straub (2000) when they assert that even if a user thinks that an IT artifact or system might be useful often times they fail to adopt it if they perceive that the use is difficult. Rose and Fogarty (2006), also found that the relationship between perceived usefulness and intention to use were not significantly related with respect to the adoption of self service banking services.

4.1.4 Enhanced Technology Acceptance Model (E-TAM)

Based on the findings from the study the initial research model was refined and an enhanced technology acceptance model incorporating choice of technology has been proposed. The model is presented in Figure 23.

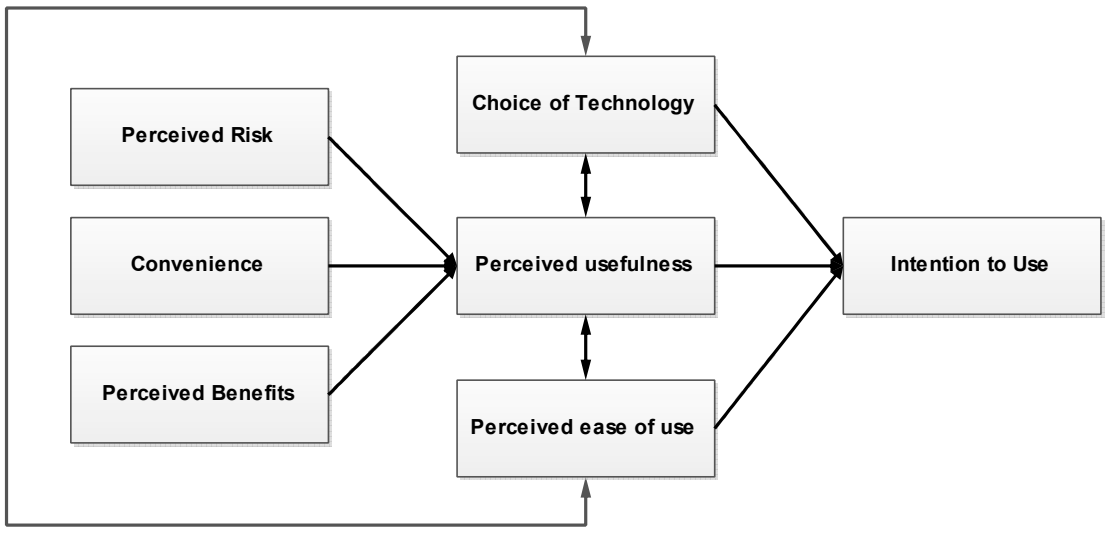

Figure 23: Enhanced Technology Acceptance Model (E-TAM)

The model posits that choice of technology in addition to perceived ease of use and perceived usefulness influence the intention to use a technology based solution. Additionally, perceived ease of use is also influenced by the choice of technology. Perceived usefulness is influenced by perceived risk, perceived benefits and convenience.

4.1.5 Conclusion

The findings of the survey lead to three main conclusions:

1. A majority of microenterprises sampled in the study are not aware of location-based mobile advertising.
2. The intention to use location-based mobile advertising among microenterprises is directly influenced by the choice of technology, perceived ease of use and to a smaller extent, the perceived usefulness of the service.
3. The choice of delivery technology is a significant factor in the intention to use location-based mobile advertising services among microenterprises.

4.2 An SMS and USSD model for location-based mobile advertising

4.2.1 Introduction

This section discusses the process that was followed in the development of the final model for location based mobile advertising using SMS and USSD. The functional decomposition approach comprising of 5 steps described in sections 4.2.2 up to 4.2.6 was followed in the development of the model.

4.2.2 System Objectives

The SMS and USSD LBMA is a platform for linking businesses and potential clients in instances where the only medium of communication is voice, SMS and USSD. This kind of

scenario can be occasioned by the lack of access to advanced geo-location technologies such as GPS and Bluetooth, the lack of phones with capabilities to use these advanced geo-location technologies, and the lack of resources to develop and use LBMA based on these technologies. The proposed solution thus provides an option for businesses who are faced by these kind of circumstances as well as potential clients who may not be able to access LBMA that require either GPS, Bluetooth or internet access.

4.2.3 System functionality

4.2.3.1 User authentication and security

The proposed model will ensure that all users are registered before allowing them to access any of the system functionality. All successful and unsuccessful attempts to access system functionality in addition to all responses sent to the users will also be recorded for reporting purposes.

4.2.3.2 User registration

All users will be required to register prior to accessing any of the system functionality. For potential clients, name, age, national ID number and gender, are required. Businesses will additionally be required to provide their location and products/services offered.

There are two options for the registration process;

(i) ***Self-registration***, where users provide their details and are automatically registered. This approach is prone to abuse if users provide fake or invalid details, and

(ii) ***A mediated registration*** process where users will be required to fill in a registration form and provide a copy of a valid identification document as proof of identity. The signed registration form can also serve as evidence of user opt-in which is important for mobile based services.

Utmost care will have to be taken at the entry point of the system to ensure that those registering provide valid identification details and that they are who they claim to be. To this end, the registration process can also be enhanced to require that users be vetted or recommended by authorities or business associations in the case of service and product providers. The involvement of mobile service providers in the registration process can also be instrumental in verifying the identities of users from their pre-existing user records.

4.2.3.3 User de-registration

The de-registration process can be either voluntary, where the user opts out or forced, where the user is blocked from using the system for various reasons such as crime or user complaints.

4.2.3.4 Information search

The system will allow registered users to search for providers of goods and services at locations of their choice through a USSD drill-down menu. The results of successful information searches will be sent to the users by SMS.

4.2.3.5 Placement of advertisements

The system will allow registered users to place advertisements that will be appended to the SMS sent to users with the results of successful information searches. The system will allow the user to specify the target audience based on their demographic characteristics such as age and gender, their location as well as the nature of the search that they will have conducted.

4.2.4 System components

The system comprises of four main components discussed below and presented in Figure 24.

1. **Users:** There are two main types of users;
    a. **Clients:** These are individuals seeking for services and products from businesses. They are interested in obtaining the mobile contacts of possible

providers in order to contact them. The information they require is preferably location specific. They are also the target of advertisers who profile them based on their age, gender, location and type of inquiry that they are making.

b. **Providers:** These are enterprises who wish to make their location, products and services known to potential clients. They are also able to specify the kind of clients they wish to serve in terms of age and gender as well as the times they wish to be contacted. They also get the contacts of all potential clients to whom their information has been sent.

2. **Mobile network providers:** Their infrastructure is used to transmit SMS and USSD messages.

    a. **Base stations:** These are mobile network components that are relay messages to the system through the mobile network from the user's mobile phone. They also relay the messages from the system through the mobile network to the user's mobile phone.

    b. **MSC/VLR/HLR:** The Message Switching Center (MSC) performs user registration and authentication on the mobile network as well as location updates. The Home Location Register (HLR) and Visitor Location Register (VLR) keeps a record of the mobile networks subscribers as well as those from other networks respectively. These components enable the mobile network service provider to identify and locate the mobile user in order to serve them and deliver messages.

    c. **USSD server:** The USSD server handles the two way transmission of all USSD communications as well as session setup and maintenance between the user and the system.

d. **SMSC:** The SMS Center (SMSC) manages the receipt, storage and delivery of SMS messages.

3. **Premium Rate Service Providers (PRSP):** They provide Application Programming Interfaces (API) to clients to facilitate their access to the SMS and USSD messages aggregated from the mobile network for onward transmission to the application server. They also provide bulk SMS and Short codes for use on the system.

4. **Location-based SMS and USSD mobile advertising system**

This is the core of the architecture and it comprises of the following major components;

a. **User authentication:** This module has two core functions; (i) ensuring that only registered users access system functionality, and (ii) recording all system access activities for reporting purposes.

b. **Client and provider registration:** This module handles the capture and recording of user details at the point of entry as well as provider registrations.

c. **Location module:** This module presents a list of symbolic locations to clients on the USSD interface and queries the symbolic location names from the database. Optionally, the module can also be enhanced to support network based geo-location with the support and cooperation of the mobile network service provider.

d. **Core application logic:** This module contains the logic required to receive and processes user requests, perform database searches and return results in the form of an SMS to the client. It also sends out an SMS with the potential client's contact to businesses whose information has been sent out. The module also handles the presentation of the drill-down menus for the information search and advertisement processes.

e. **Databases:** The system maintains four main databases; (i) The users database that keeps a list of all users registered to access the system, (ii) the providers database keeps a record of all users who provide goods and services and their locations, (iii) the products and services database that keeps a master list of all types of products and services that can be offered, and (iv) the symbolic locations database that keeps a list of location names for use in provider registration and information search. The system has a number of additional transactional databases that keep records of user access and information searches.

4.2.5 Interfaces between system components

There are two main methods that will be used to interface between the system components;

(i) SMS and USSD for two-way communication between the user and the system through the mobile network, and

(ii) An Application Programming Interface (API) for retrieval of messages from the mobile network and PRSP servers by the system. These interfaces and how they relate to the system components are presented in Figure 24.

4.2.6 Processes required to achieve system functionality

The rapid prototyping approach discussed in section 3.5 and depicted in Figure 22 was followed in developing a functional system from the model depicted in Figure 24.

- **Gather requirements:** The requirements for the proposed system were inferred from literature and refined using results from the user survey presented in section 3.3.
- **Quick design:** The system processes described in section 4.2.3 was translated into flow charts. A database was then designed based on the proposed processes and flowcharts.

- **Build prototype:** A prototype was then built using PHP programming language, the MySQL database and hosted online on a domain were acquired as part of the development process. A USSD testbed was then acquired to test the system functionality. A bulk SMS account was setup for use in sending messages during the testing period.
- **Evaluate and refine requirements:** The system requirements were refined on an ongoing basis using feedback from the system development, deployment and testing process.
- **Design, code and test final product:** Once the requirements were found to be satisfactory a final version of the system was completed and tested with real users in a pilot study. Feedback from this stage informed some additional development and refinement of both the model and system.

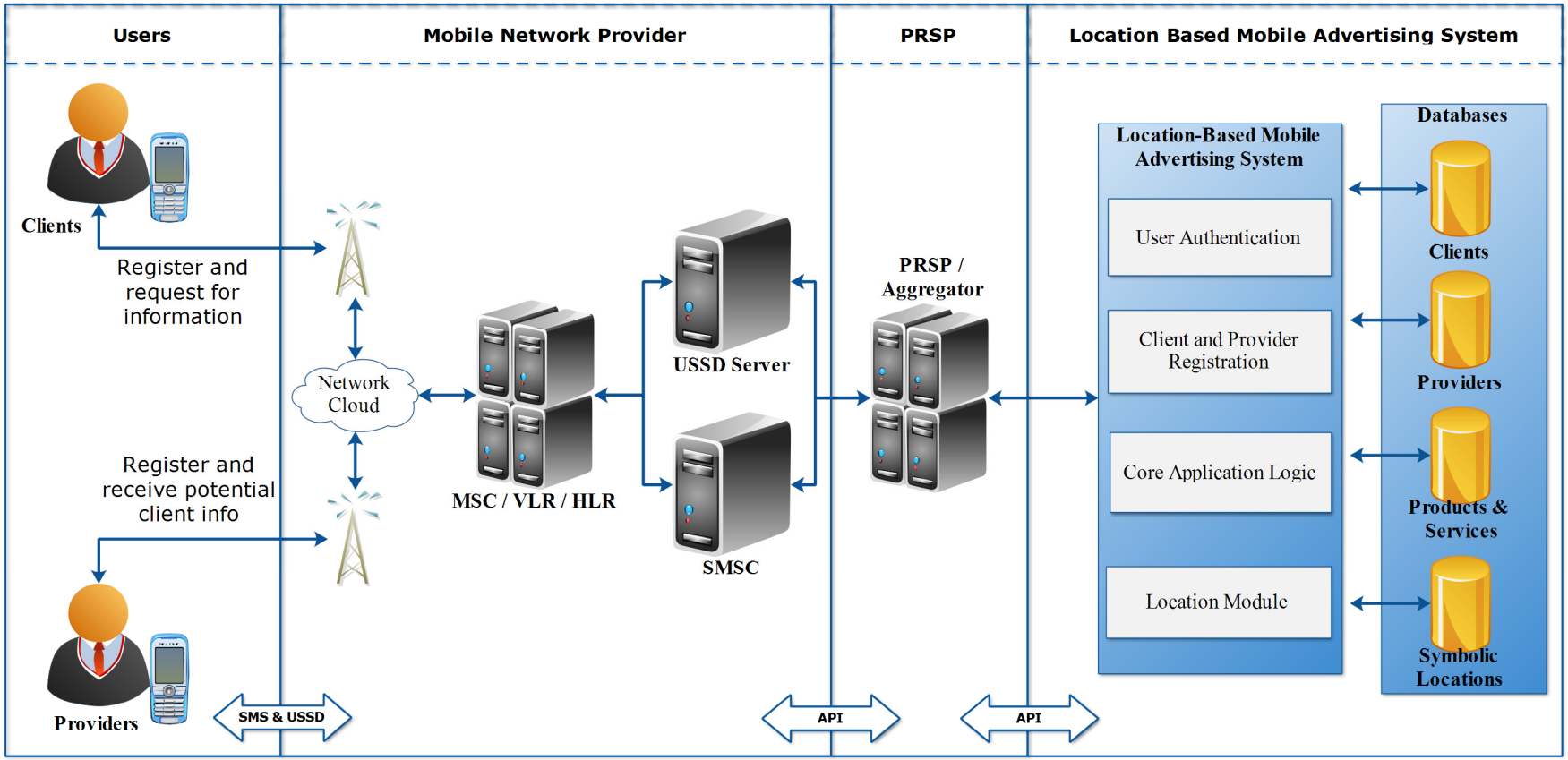

Figure 24: USSD and SMS location-based mobile advertising application architecture

4.2.7 Conclusion

This section discussed the 5 stage functional decomposition process that was followed in the development of the model for location based mobile advertising using SMS and USSD. The process involved the definition of system functionality, the description of the specific components, a discussion on the interfaces between the various components and an outline of the process to be followed in transforming the model to a working application.

4.3 Design and testing of the location-based SMS and USSD mobile advertising system

4.3.1 Introduction

The main objective of this study was to examine the practicability of delivering location-based mobile advertising services using SMS and USSD. A conceptual model to graphically describe the system was developed with input from existing models in literature such as the GPS and SMS based vendor tracking system by Dawood, Jackson and Yew (2010) and SMS Sokoni by (Safaricom Ltd) (2014). The model incorporates four main components; the users, the mobile network service provider, the premium rate service providers and the location-based mobile advertising system. This section presents the system logic and database design. In addition, the testing results and an evaluation report of the prototype are also presented.

4.3.2 System overview

There are four main functions of the system; user registration, provider registration, information search and advertisement. An overview of the system is depicted in Figure 25**.**

4.3.3 User and provider registration process

The registration process is the entry point into the system and caters for the two types of system users, namely; clients and businesses. Clients register by providing their name, age, national ID number, mobile phone and gender. Businesses, in addition indicate the type of product or service that they offer. The user registration process is outlined in Figure 26 and the provider process in Figure 27.

4.3.4 Information search process

The information search process, outlined in Figure 28, is performed using a USSD drill down menu. The USSD menu guides the user in the selection of a location and a product or service before triggering an SMS to the user with the result. The location information used for the system is not real-time; rather, it consists of a list of records in a database that is matched against a user's inquiry. The SMS sent to the user can contain up to 5 contacts of identified and available providers in the form of; *name, mobile number*.

4.3.5 Advertisement placement process

The advertisement placement process, depicted in Figure 29, allows registered users to select the location, type of inquiry and user profile type (age and gender) to send their information to. Once these criteria have been selected then they place their advert.

4.3.6 Advertisement delivery process

The advertisement delivery process in turn checks for matching criteria in terms of user profile (age and gender), location and type of inquiry in order to append an advertisement to outgoing messages sent to users. The process is outlined in Figure 30.

4.3.7 Entity relationship diagram

The entity relationship diagram for the system is presented in Figure 31. It comprises of 11 tables that contain five main types of information;

i. User and provider information: lbs_user, lbs_gender and lbs_providers.

ii. Product and service information: lbs_category and lbs_product.

iii. Location information: lbs_county and lbs_location.

iv. Transactional information: lbs_register and lbs_search.

v. Advertisement information: lbs_advert, lbs_target

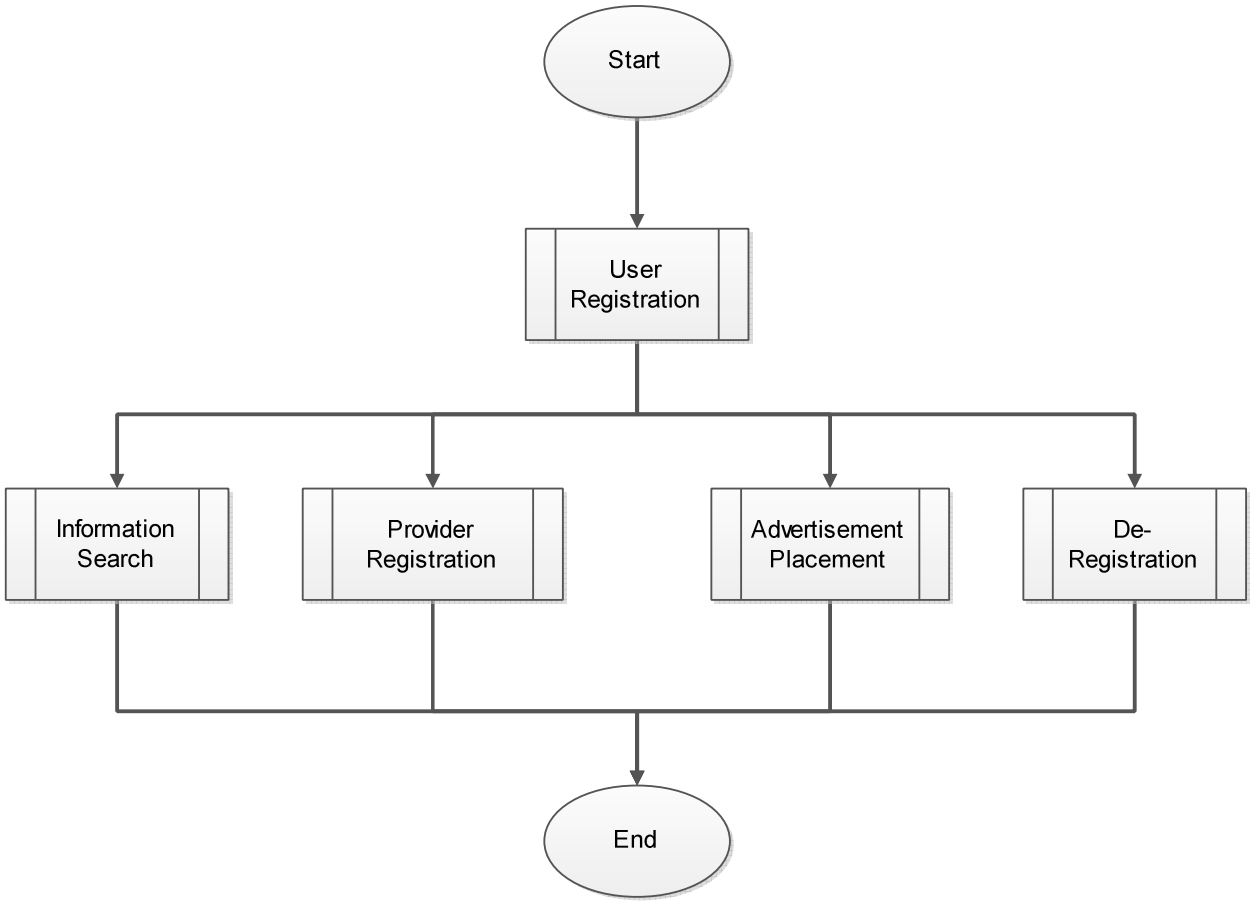

Figure 25: Flow chart of the LBMA system

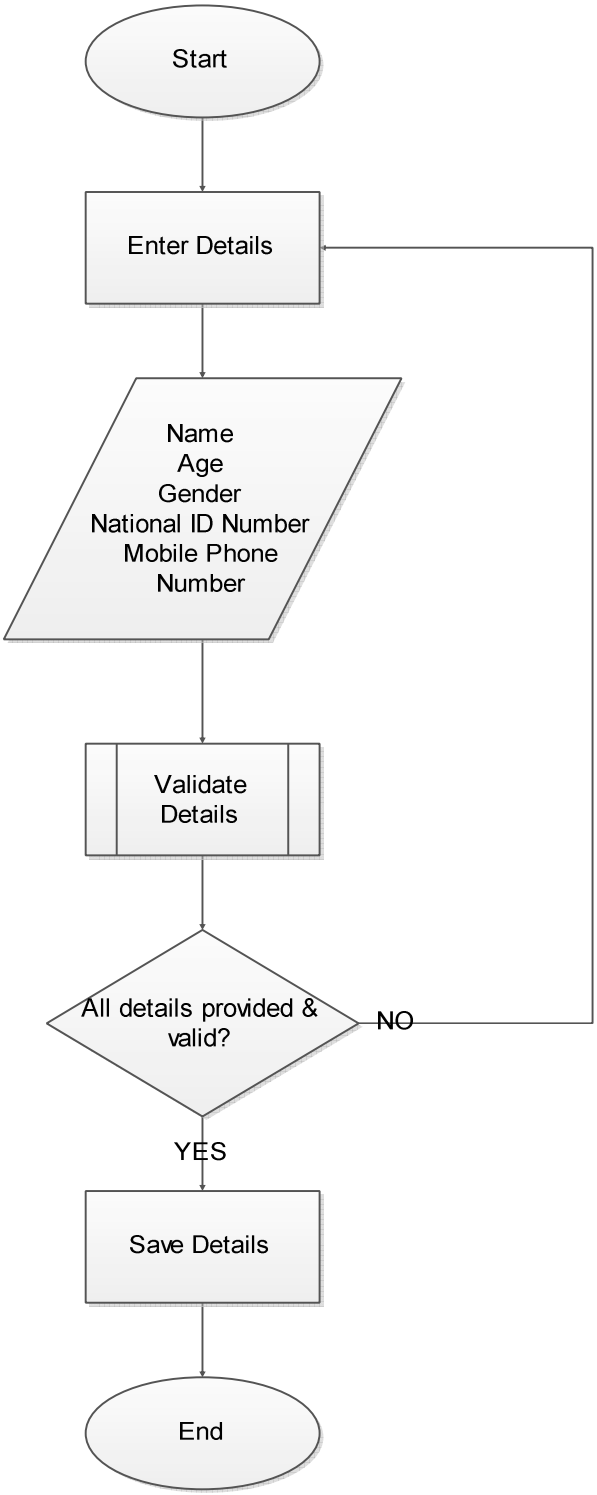

Figure 26: User registration process

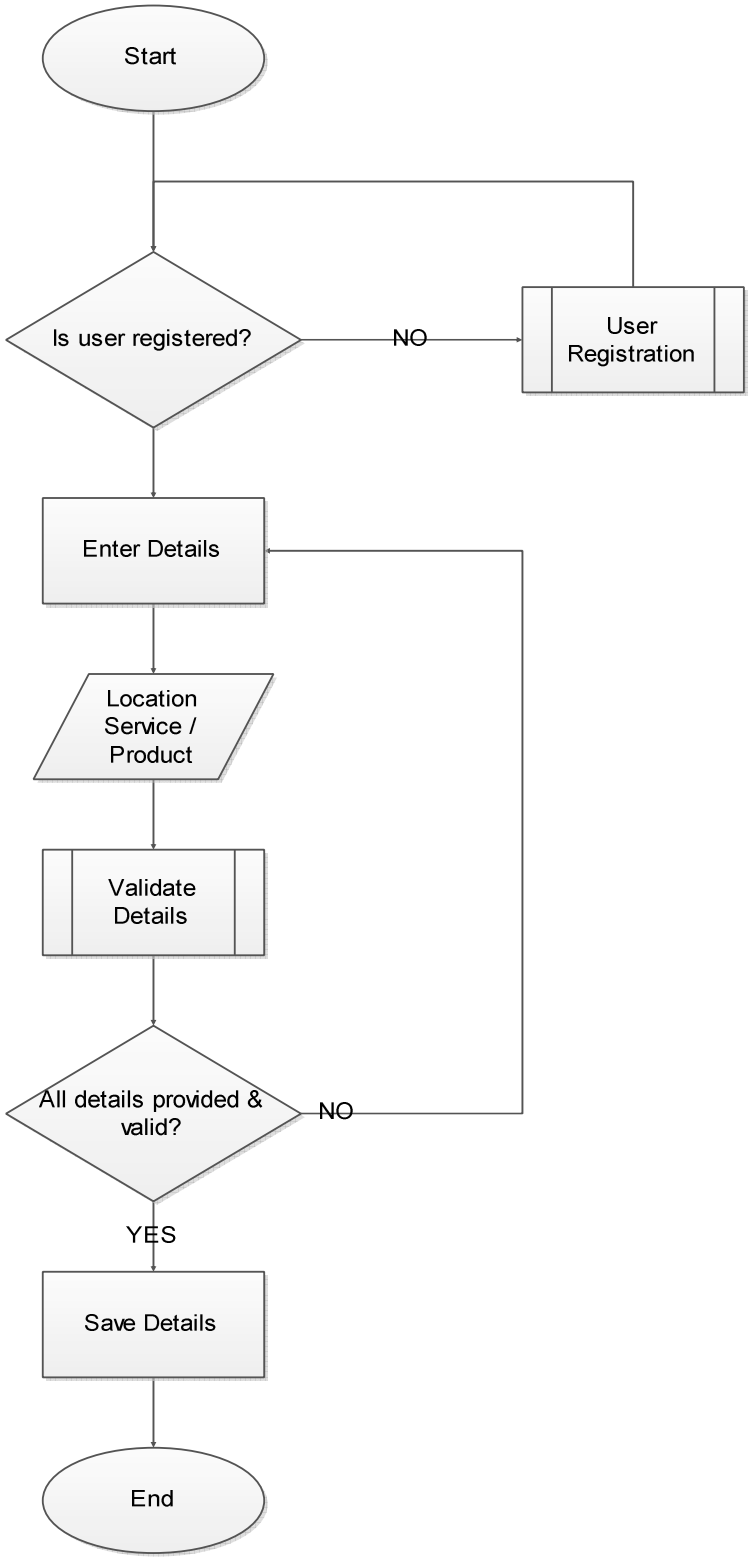

Figure 27: Provider registration process

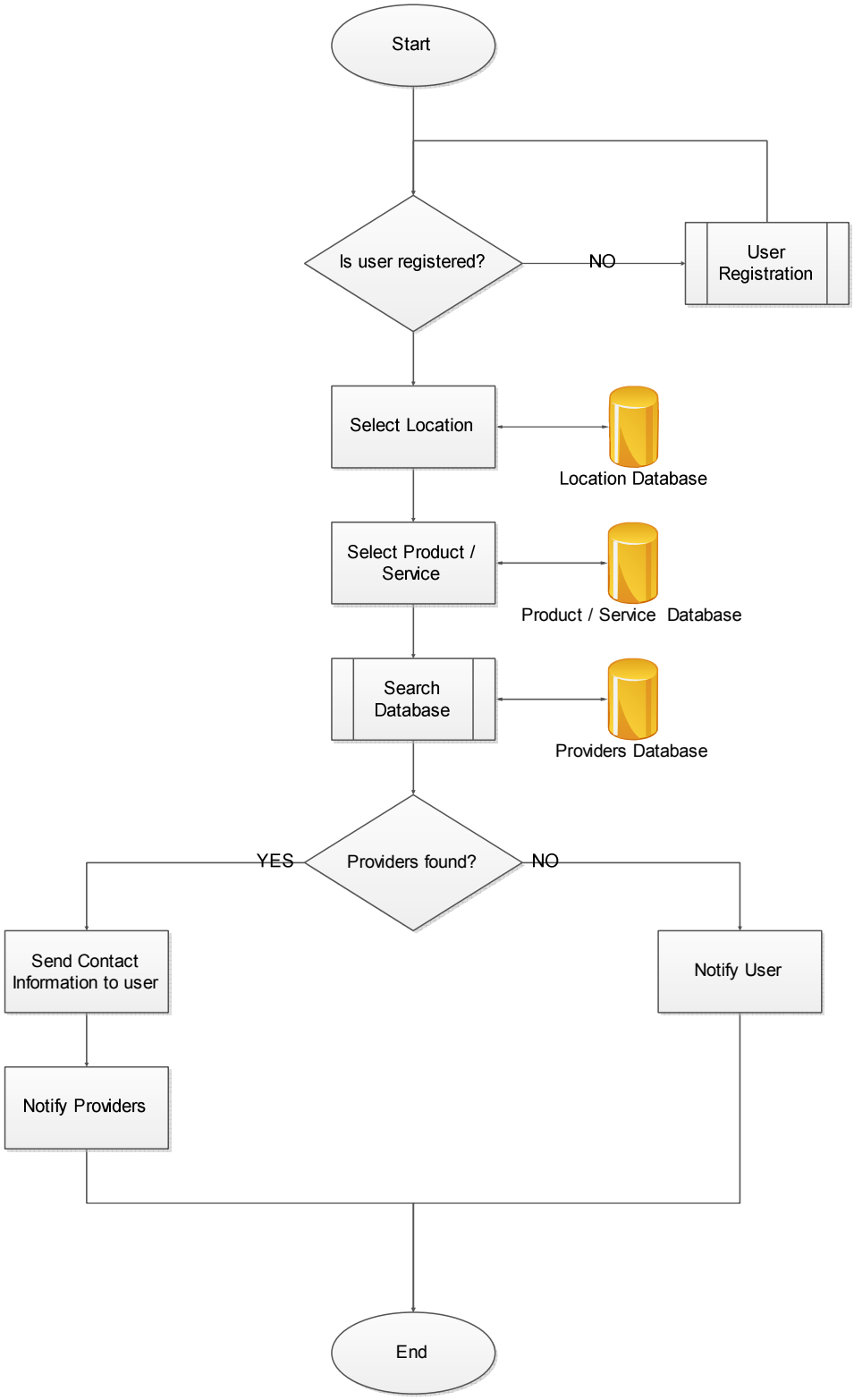

Figure 28: Information search process

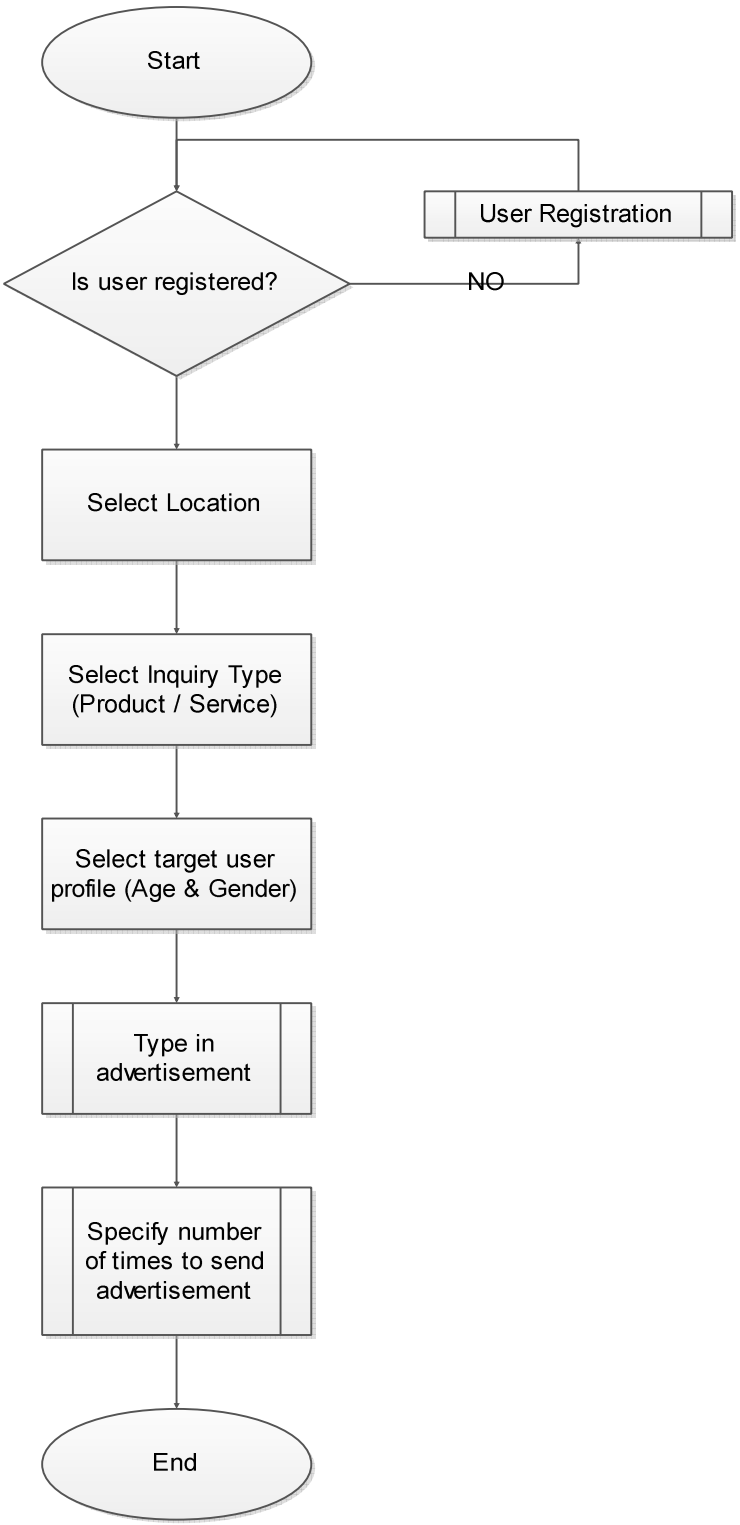

Figure 29: Advertisement placement process

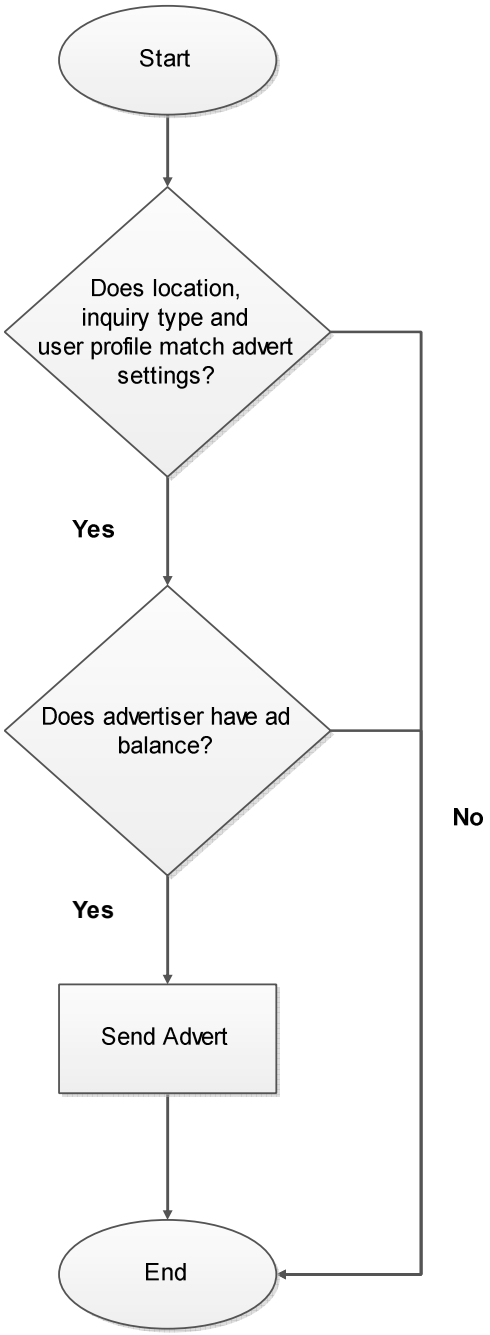

Figure 30: Advertisement delivery process

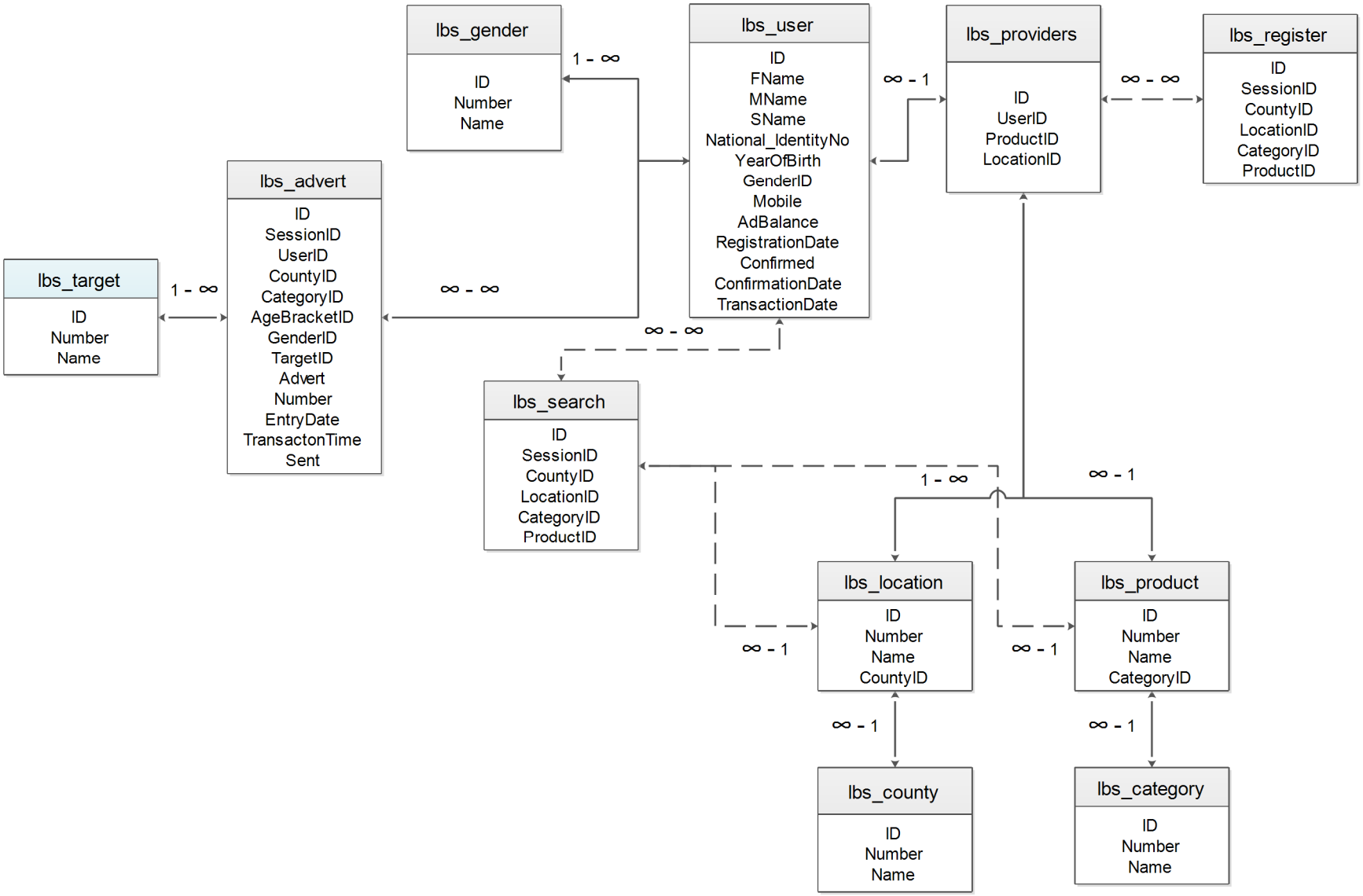

Figure 31: Database schema

4.3.8 Proof of concept

4.3.8.1 Development tools and environment

A program was developed to implement the USSD and SMS model for location based mobile advertising. The program was developed using the PHP programming language and the MySQL database for data storage and retrieval. The development environment was the Windows 7 operating system using the Adobe Dreamweaver CS3 IDE. The Apache web server was used to host and test the system locally.

4.3.8.2 Testing environment

The system was then hosted on www.bespokesystems.co.ke/abiri for testing purposes. A USSD test bed and a bulk SMS account were obtained from www.africastalking.com for live testing of the system. The purpose of the test bed and bulk SMS account was to be able to shield users from incurring any costs during the piloting phase.

4.3.8.3 User registration process

The registration process begins with the capture of user details using a registration form. These details were then keyed into the system using the web interface in Figure 32.

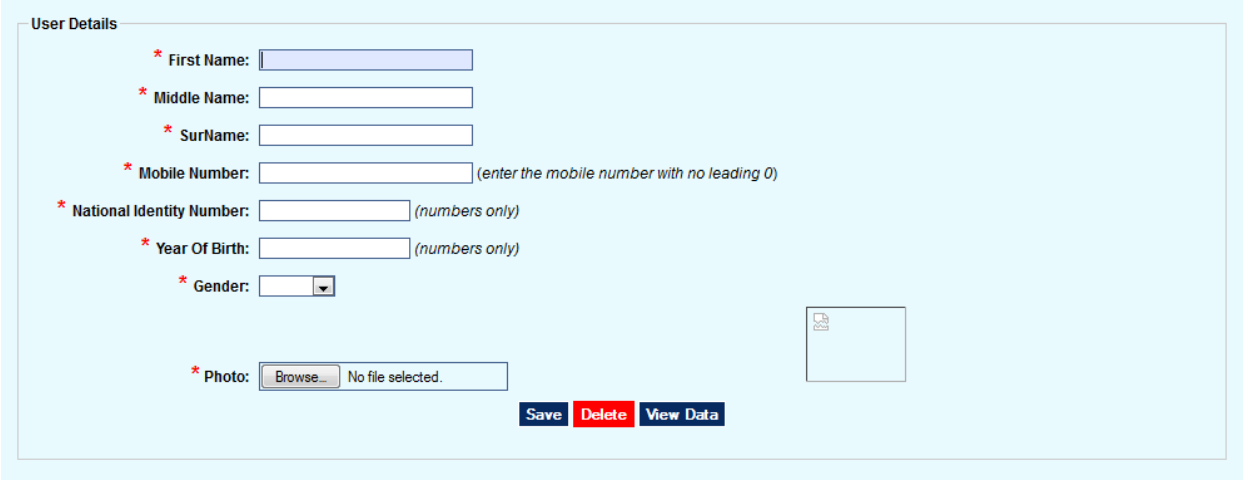

Figure 32: Web interface for user registration

The PHP code that processes the form input is presented in Listing 1

Listing 1: User Registration

```
// Instantiate the user classes
$User = new User($CON);
$Gender = new Gender($CON);

//Format the phone number
$phoneNumber = "254".$_POST['Mobile'];

// Set the class variables with the POST variables
$User->setFName($_POST['FName']);
$User->setMName($_POST['MName']);
$User->setSName($_POST['SName']);
$User->setNational_IdentityNo($_POST['National_IdentityNo']);
$User->setYearOfBirth($_POST['YearOfBirth']);
$User->setGenderID($_POST['GenderID']);
$User->setMobile($phoneNumber);
$User->setRegistrationDate(date('Y-m-d H:i:s'));
$User->setPhoto($filename);
$User->setConfirmed('N');
$User->setConfirmationDate('0000-00-00 00:00:00');

// Save the user details
```

```
$User->Save();

// Compose the user message upon successful registration
$UserMessage = "Hello ".$_POST['FName']."". You have been registered on NIPATE. Kindly Dial *384#9870# and select option 2 to confirm your registration. Thanks";

// Create a new instance of the SMS gateway class
$gateway = new AfricaStalkingGateway($username, $apiKey);

//Send an SMS to the user asking them to confirm their registration
$results = $gateway->sendMessage($phoneNumber, $UserMessage);
```

Once the user details were saved, an SMS was sent to the user asking them to confirm their registration as shown in Figure 33 and Figure 34. A successful registration is confirmed as shown in Figure 35.

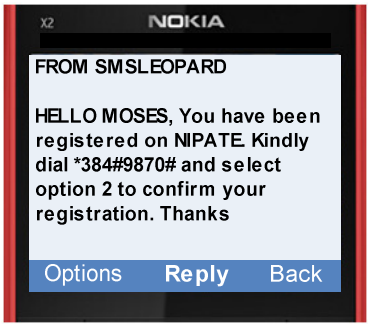

Figure 33: User registration information SMS

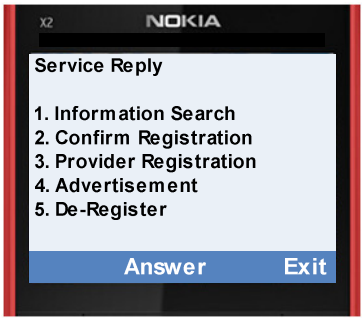

Figure 34: Top level USSD menu

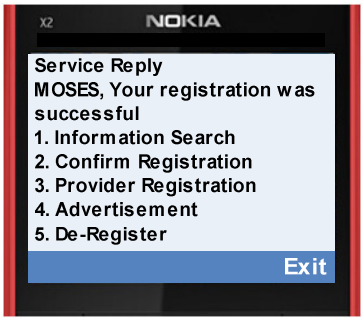

Figure 35: User registration confirmation

Upon confirmation users can then proceed to search for information or register as a provider.

4.3.8.4 Provider registration process

Once a user is registered they then proceed to register themselves to provide a service of their choice as illustrated in Figure 36.

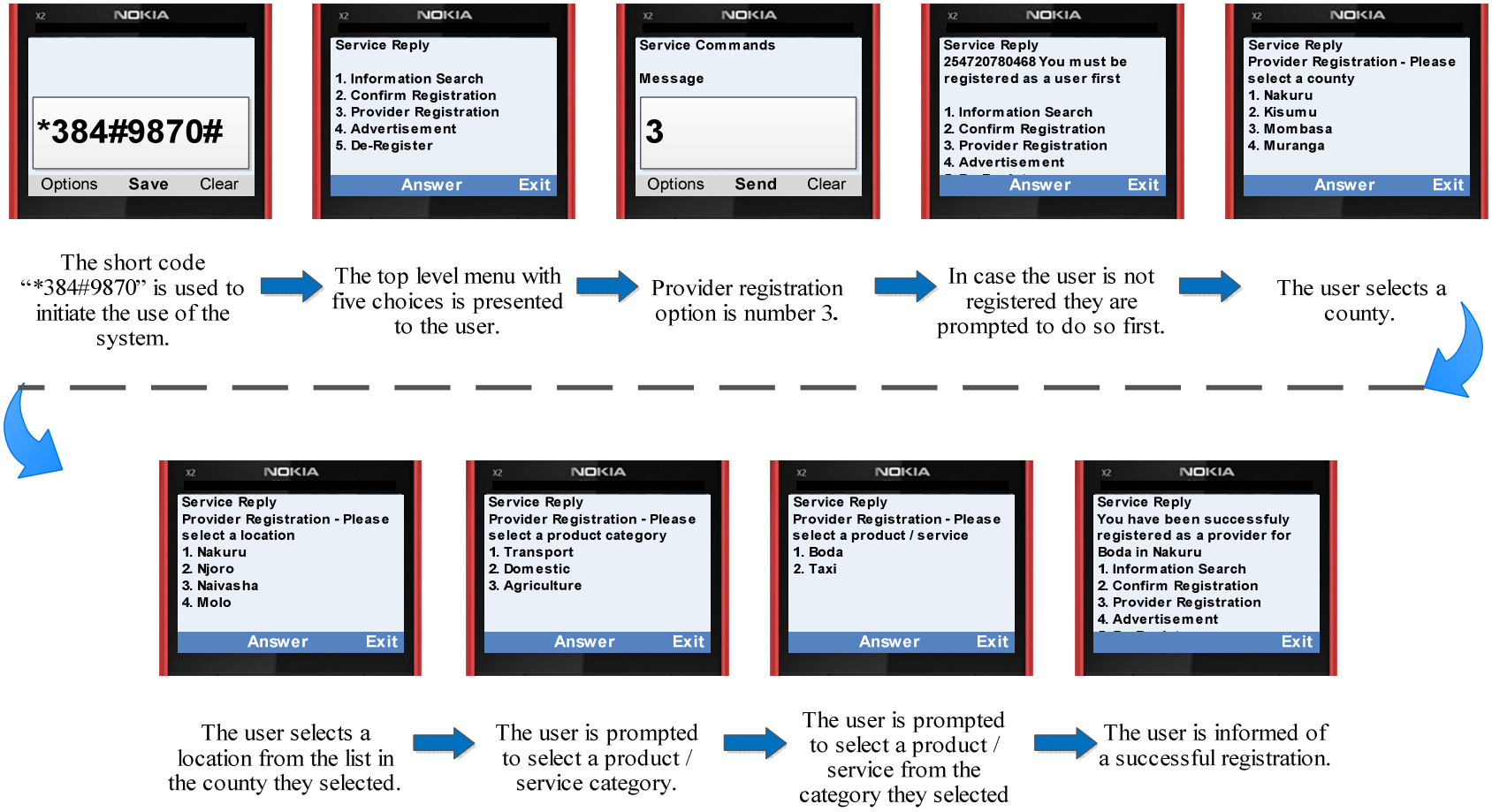

Figure 36: Provider registration process

4.3.8.5 Information search process

Once a user was registered they could then search for information on the system as illustrated in Figure 37.

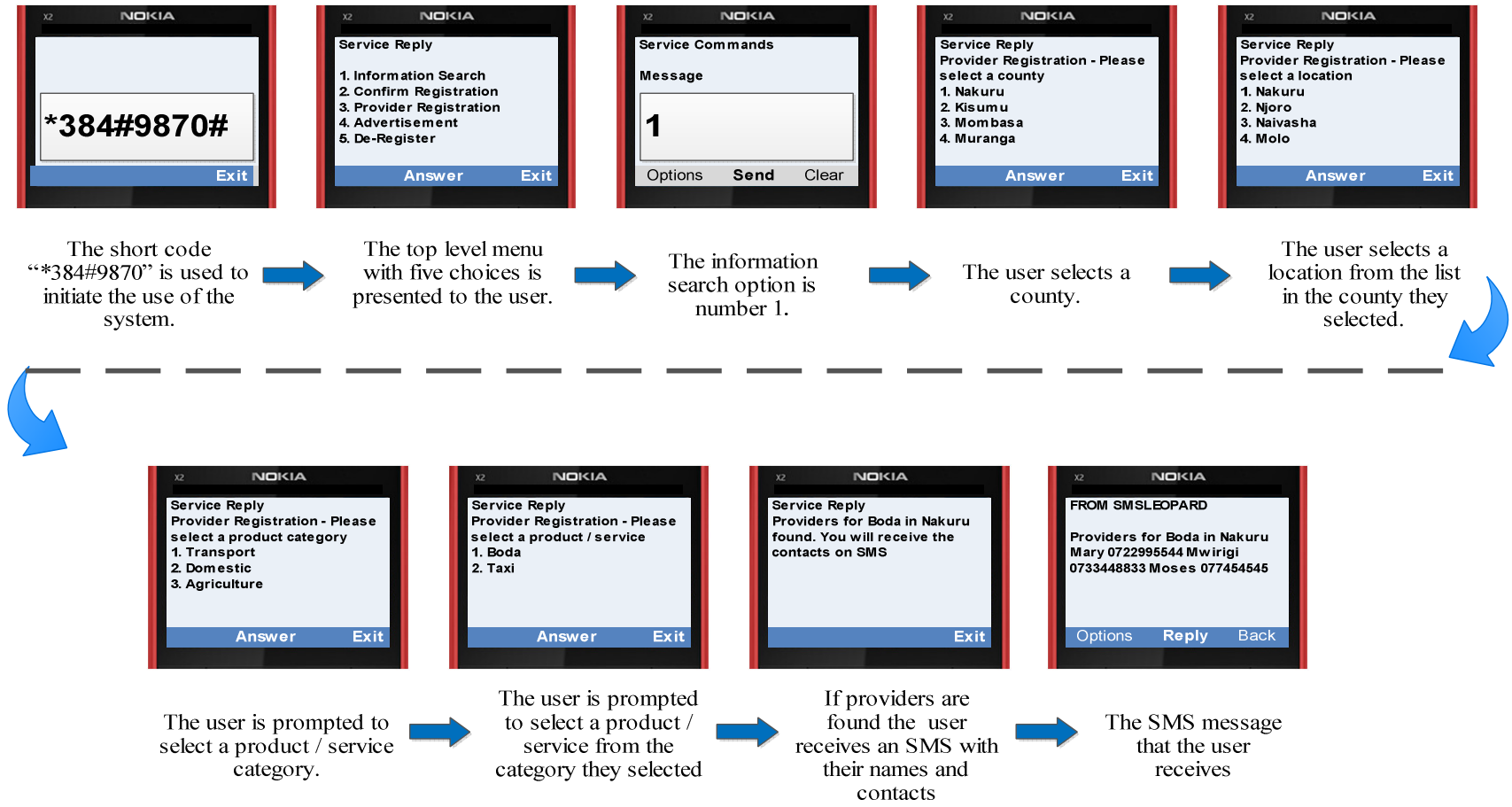

Figure 37: Information search process

The identified providers were also notified about the successful information search as shown in Figure 38.

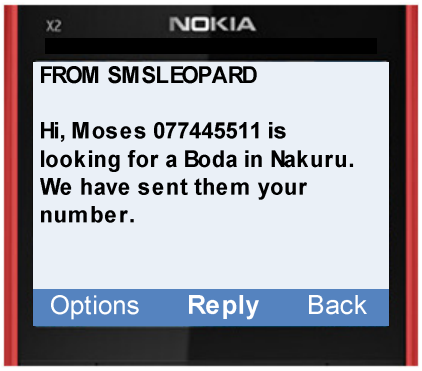

Figure 38: Provider notification

4.3.8.6 Advertisement placement

Registered users can place advertisements using the USSD menu as is described below.

Figure 39: Advertisement placement process

4.3.8.7 Advertisement delivery

The advertisement is selected using the location, inquiry type and user profile settings specified by the advertiser as shown in Listing 2.

Listing 2: Advertisement selection process

```
// Get the user profile
$SQL_User = "SELECT * FROM lbs_user WHERE ID = ".$UserID." ";
$RESULT_SET_User = mysqli_query($CON,$SQL_User);
$RESULT_SET_ARRAY_User = mysqli_fetch_assoc($RESULT_SET_User);

$age = getAgeVal ($RESULT_SET_ARRAY_User['YearOfBirth']);
$agebracketID = getAgeBracketIDUser($CON,$age);

// Get the user inquiry
$SQL_Search = "SELECT * FROM lbs_search WHERE SessionID = ".$SessionID." ";
$RESULT_SET_Search = mysqli_query($CON,$SQL_Search);
$RESULT_SET_ARRAY_Search = mysqli_fetch_assoc($RESULT_SET_Search);

// Get the advert
$SQL = "SELECT * FROM lbs_advert WHERE (CountyID = ".$RESULT_SET_ARRAY_Search['CountyID']." OR CountyID = 'A') AND (CategoryID = ".$RESULT_SET_ARRAY_Search['CategoryID']." OR CategoryID = 'A') AND (AgeBracketID = ".$agebracketID." OR AgeBracketID = 'A') AND (GenderID = ".$RESULT_SET_ARRAY_User['GenderID']." OR GenderID = 'A') AND (TargetID = ".$TargetID." OR TargetID = '3') AND Sent < Number AND EntryDate <> '0000-00-00 00:00:00' ORDER BY EntryDate ASC  ";

$RESULT_SET = mysqli_query($CON,$SQL);
$RESULT_SET_ARRAY = mysqli_fetch_assoc($RESULT_SET);
$RESULT_SET_NUM_ROWS  = mysqli_num_rows($RESULT_SET);

if ($RESULT_SET_NUM_ROWS>0) {
  do {
        if (getAdBalance($CON,$RESULT_SET_ARRAY['UserID']) > 0 ) {
           // Keep count of the number sent so far
           $SQL_UPDATE = "UPDATE lbs_advert SET Sent  = Sent + 1 WHERE ID = ".$RESULT_SET_ARRAY['ID']." ";
          $RESULT_SET_UPDATE = mysqli_query($CON,$SQL_UPDATE);

         // Keep a record of the actual advertisement, the date sent and the recipient
```

```
            $SQL_INSERT = "INSERT INTO lbs_sentads (UserID,AdvertID,DateSent)
VALUES (".$UserID.",".$RESULT_SET_ARRAY['ID'].",'".date('Y-m-d H:i:s')."') ";
            $RESULT_SET_INSERT = mysqli_query($CON,$SQL_INSERT);
            updateAdbalance($CON,$RESULT_SET_ARRAY['UserID']);

            // Return the advert found
             return $RESULT_SET_ARRAY['Advert'];
            break;
           }
    } while ($RESULT_SET_ARRAY = mysqli_fetch_assoc($RESULT_SET)) ;
} else {
        return '';
}
```

The advertisement is appended to the SMS message resulting from an information search as shown in Figure 40.

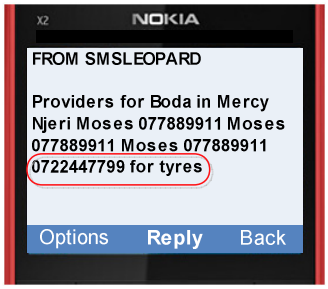

Figure 40: Advertisement delivery

4.3.8.8 User de-registration

The user is allowed to opt out of the service by following the sequence of steps outlined in Figure 41. A successful de-registration takes away their ability to search for information as well and removes any products and services that they have registered to provide.

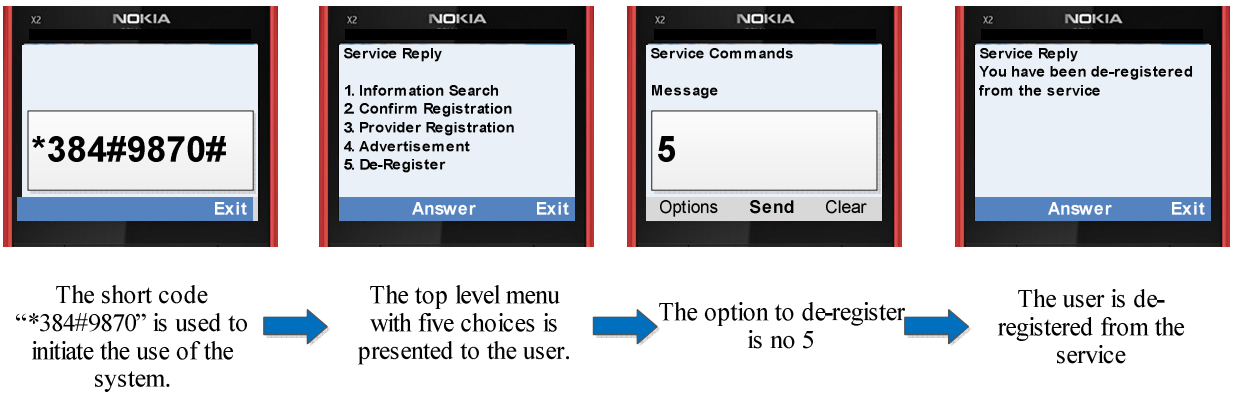

Figure 41: User de-registration process

4.3.9 Performance evaluation

This aspect of the evaluation was purely technical in nature and sought to examine how robust the solution was. Two evaluation measures, system responsiveness and system dependability, adopted from the work of Rahimian and Habibi, (2008), were used to evaluate the performance of the system.

4.3.9.1 System responsiveness

The system responsiveness was tested using the average time it took from when a user initiated the process by dialing the short code up to the time the SMS with the information was received. A total of 100 information search trials were conducted and the system achieved an average process time of 22 seconds. The average hop time was 4.4 seconds which was higher than the average of two seconds indicated by Sanganagouda (2011).

The higher average hop time observed can be attributed to the additional time taken to query the MySQL database for the display of menus and the information search. The database in use for the prototype was not indexed and optimized due to time constraints. The development of a more

optimal and efficient database design can be pursued in the future to improve the response time in light of the higher transaction levels anticipated for commercial applications.

4.3.9.2 System dependability

The dependability of the system was measured by the percentage of times it failed to complete the information search process during the testing exercise. Out of a total of 100 trials 6 did not end successfully constituting 6% failure rate. This rate of failure occurred due to bugs and system errors on the prototype as well as timeouts attributed to the time it took to query the database. Extensive system testing prior to a commercial rollout can help to eliminate errors attributed to programming errors. A more optimized database would help to reduce the query time in order to prevent the USSD session timeouts during information searches.

4.3.10 Conclusion

In this section an SMS and USSD location-based mobile advertising system prototype was designed, implemented and tested successfully. The results from the system test show that it is indeed feasible to deliver location-based mobile advertising without having to use relatively advanced positioning and system access technologies such as GPS, Bluetooth, RFID and WAP.

4.4 Pilot study of the location-based SMS and USSD pull mobile advertising system

4.4.1 Introduction

The purpose of this study was to develop a location-based mobile advertising system based on SMS and USSD. The objective of the proposed system is to enable businesses to register and indicate what products and services they have to offer. Users also register on the system and use a USSD drill down menu to identify products and services at their locations. If the desired

information is found the system sends it to the user in an SMS. The system is accessed purely using a USSD menu for all functions.

4.4.2 Sample selection

A pilot study was conducted to test the system functionality and to explore any issues surrounding user acceptance. An initial target of 50 Boda Boda (Motorcycle) taxi operators were selected to represent service providers. Boda Boda taxis were selected because they are easy to find and their services are in high demand. The locations identified were Mangu and Mercy Njeri in Nakuru county, Kenya. These locations were chosen because they were accessible and had a sizeable number of these boda boda operators. A total of 100 customers were randomly selected from the localities between the two shopping centers for one main reason; they often require the services of the boda boda operators but these operators are often stationed at the shopping center and not in the residential areas.

4.4.3 Piloting procedure

The procedure for the pilot study is outlined below;

1. Interview Boda boda operators on their willingness to participate in the pilot.
2. Perform a system demonstration.
3. Register willing boda boda operators to use the service.
4. Identify and interview customers looking for boda boda taxis on their willingness to use the service.
5. Register those willing to use the service and guide them on how to search for information.
6. Allow them time to search for information and subsequently use the service.
7. Interview the users were later on phone to get post usage feedback on the service.

8. Interview Boda boda taxi operators on phone to get post usage feedback of the service.

The materials used for the pilot study of the system can be found in APPENDIX D.

4.4.4 Pilot study report

4.4.4.1 Duration

The first pilot study was carried out over a period of 2 weeks (1st – 13th July 2013)

4.4.4.2 Clients

A total of 55 potential clients were approached to register for the service. Their views, presented in Table 12, were sought for after a demonstration of the system in action.

Table 12: User views on LBMA prototype

Item	Yes	No
I would like to use the service	98.2%	1.8%
I fear that criminals could pretend to be clients or providers	25.5%	74.5%
I fear that providers / clients might not materialize	12.7%	87.3%
I fear that I might not afford the service	25.5%	74.5%
I am willing to pay for the service	98.2%	1.8%

Most respondents, 98.2%, expressed a willingness to use the service. A majority of them were not afraid of the various risks presented to them. Those who did not fear criminal activities comprised 74.5% of the respondents. The fear of providers or clients not showing up was not a concern to 87.3% of those interviewed and 74.5% did not fear the cost of the service. A majority of them, 98.2%, were also willing to pay for the service with 40% indicating willingness to pay KES 10 (USD 0.1) and 35% willing to pay KES 5 (USD 0.05) as shown in Figure 42.

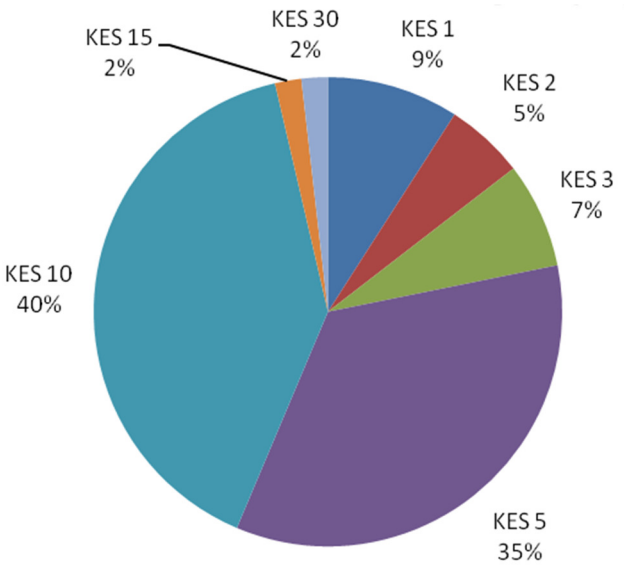

Figure 42: Amount clients are willing pay for the LBMA service

Security: The potential users of the system expressed concern for their security. They were concerned with the providers registered on the system; are they real or could they be criminals in disguise? The users interviewed proposed that persons wishing to provide services be vetted by their various business associations or the government in addition to providing valid identification documents at the time of registration.

Cost: Potential clients did not appear to have great concerns about the cost of the service. The price of the service, according to a majority of them, would have to reflect the value or convenience gained from using the service. The respondents were willing to pay between KES 5 (USD 0.05) and KES 10 (USD 0.1) for the service.

4.4.4.3 Providers

A total of 50 boda boda operators motorcycle taxi operators, otherwise known as Boda boda operators, were interviewed during the pilot study. Of those interviewed only 7(14%) accepted to be registered with the majority 43 (86%) declining. The reasons for this given are outlined below;

Security: This was the main concern of the boda boda taxi providers. Widespread crime involving the theft of their motorcycles and assault on the operators caused them to hesitate. They indicated that the identity of the persons requesting for their contacts and services needed to be verified. They expressed that all persons using the service needed to register and provide a copy of their national identity card. In addition they requested that the operator of the service keep a record of all transactions on the system for purposes of investigation in the event that crime was committed. They also expressed the need to have their association leaders verify their identities as part of the registration process. If a strict registration process was adhered to, then they would be willing to formally register in order to use the system. User concerns for security are not new and have been found to inhibit the adoption of a number of technology enabled services such as internet banking (M.-C. Lee, 2008) and e-banking (Fonchamnyo, 2013).

Based on the feedback on security issues received, a revised registration process involving the filling in of a form and verification by business associations is proposed in Figure 43.

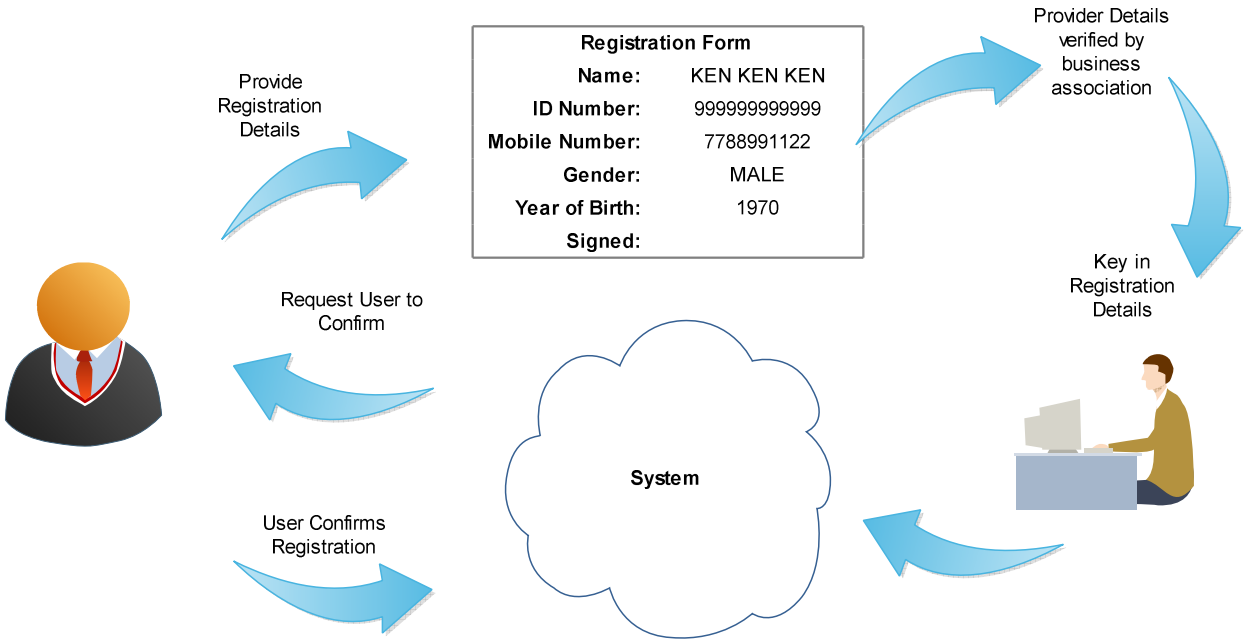

Figure 43: Revised provider registration process

Privacy: The boda boda taxi operators also expressed concerns about being called at some hours of the night and on weekends when they were not at work. This concern is not unique to this particular scenario, application or technology and has been noted in a number of previous studies. Cazier, Jensen and Dave, (2008), found that privacy risk impacted negatively on user intentions to use RFID technology. A negative correlation between consumer trust and perceived risk in the use of online transactions was observed by Thaw, Mahmood and Dominic (2009). Similar concerns regarding privacy as well as credibility and security were also found to impact on the adoption of mobile commerce by Thakur and Srivastava (2013).

Based on the feedback regarding privacy, a specification process allowing the user to indicate the time they wish to be contacted and type of person to contact them with respect to age bracket and gender is proposed in Figure 44.

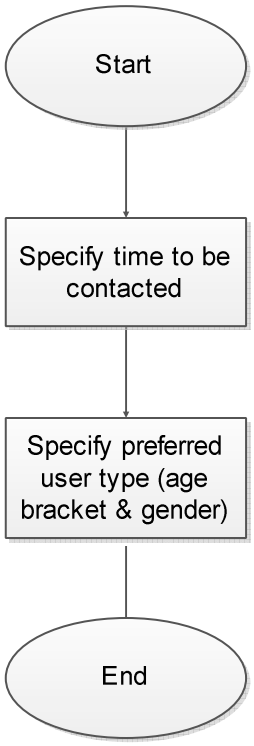

Figure 44: Privacy settings process

Cost: While the boda boda taxi operators did not question the potential value of the proposed system for their businesses, they were concerned about the cost of the service. If the cost was higher than they were able to pay then they indicated that they would not be able to use the service. A majority expressed a willingness to pay between KES 5 (USD 0.05) and KES 10 (USD 0.1) per message received from the proposed service.

Credibility: Once the security concerns were addressed the boda boda taxi operators then expressed concerns about the credibility of the entity offering the service. They explicitly requested that the person conducting the study provide them with details of their registered office. This was an indication that inasmuch as a service looked promising they were also keen to know who was behind it.

User concerns and hesitation to try the system can be explained using the diffusion of innovations theory by Rogers (1995). The presentation of the prototype to both potential clients and boda boda taxi operators served to give them 'knowledge' about the system. At this point they did not have any information about how it worked or its potential benefits. Further discussions drew them into the persuasion stage where they requested for more information and a demonstration. However, the concerns raised about the credibility of the entity offering the service could not be addressed within the scope of the study due to time and financial constraints. The adoption process thus paused before the potential clients and boda boda operators could make a decision to use the system.

4.4.5 Conclusion

This section presented a discussion on the process that was followed in piloting the location-based mobile advertising prototype. The system was hosted on an online test domain, www.bespokesystems.co.ke/lbs_test for the testing period. The USSD and bulk SMS services were obtained from africastalking.com. The piloting procedure involved a demonstration, an interview, registration and then the actual system use. However, system use was not achieved due to user concerns for security, privacy, cost and credibility. A number of solutions were proposed in conjunction with the users to address these concerns.

4.5 Limitations and challenges in implementing location-based mobile advertising services using SMS and USSD

4.5.1 Introduction

A location-based mobile advertising system based on SMS and USSD was developed for use by microenterprises. The objective of the proposed system is to enable businesses to register and indicate what products and services they have to offer. Users also register on the system and use a USSD drill down menu to identify products / services at their locations. If the desired information is identified, the system sends it to the user in an SMS. The system is accessed purely using a USSD menu for all functions. This section presents an evaluation of the performance, limitations and challenges of the SMS and USSD location-based pull mobile advertising prototype.

4.5.2 Limitations of the SMS and USSD mobile advertising system

4.5.2.1 Menu management

The number of characters in a USSD message is limited to 180. This limitation is significant when trying to present a list, such as that of the 47 Kenyan counties listed below.

List of counties

1.Mombasa.	13.Tharaka Nithi.	25.Samburu.	37.Kakamega.
2.Kwale.	14.Embu.	26.Trans Nzoia.	38.Vihiga.
3.Kilifi.	15.Kitui.	27.Uasin Gishu.	39.Bung'oma.
4.Tana River.	16.Machakos.	28.Elgeyo/Marakwet.	40.Busia.
5.Lamu.	17.Makueni.	29.Nandi.	41.Siaya.
6.Taita Taveta.	18.Nyandarua.	30.Baringo.	42.Kisumu.
7.Garissa.	19.Nyeri.	31.Laikipia.	43.Homa Bay.
8.Wajir.	20.Kirinyaga.	32.Nakuru.	44.Migori.
9.Mandera.	21.Murang'a.	33.Narok.	45.Kisii.
10.Marsabit.	22.Kiambu.	34.Kajiado.	46.Nyamira.
11.Isiolo.	23.Turkana.	35.Kericho.	47.Nairobi City.
12.Meru.	24.West Pokot.	36.Bomet.	

The counties in the list comprise of 566 characters and would require at least 4 messages to display. The management of such a menu is likely to be complex given the simple nature of USSD applications. The challenge extends to the list of possible wards within these counties, number of service / product categories and the actual list of services and products.

There are two options in dealing with this challenge; (i) to display several menus that the user can view one at a time in order to select a county or product of their choice. These menus can be navigated by use of an option “N Next list”. While this approach would work it would be cumbersome for the user, and (ii) using the user’s real time location to identify the providers within their proximity. This approach would require extensive involvement of the mobile service provider to avail the user position for the location determination.

4.5.2.2 User registration

The process of capturing user details cannot be adequately performed using the USSD interface. In addition, the safe use of the system requires the capture of user details such as first name, middle name, surname, year of birth, national identity card number, gender, and for service / product providers, the name of the service / product and the location. This great level of detail is cumbersome to capture and validate using a USSD interface. A modified registration process requiring that all users fill in a registration form and confirm their identity is incorporated in the revised provider registration process illustrated in Figure 43.

4.5.3 Challenges facing the SMS and USSD location-based mobile advertising system

4.5.3.1 User acceptance

The main challenge encountered with system testing was user acceptance. This was established from the pilot study that revealed that inasmuch as the providers sampled liked the initial idea, concerns for security overrode the perceived benefits of the system. Rampant crime targeting the boda boda taxi operators caused them to be wary of transacting business with unknown persons and especially at night. Potential clients were however more responsive and less concerned with the issue of security. Minor concerns also revolved around the issues of privacy and cost.

4.5.4 Goal based evaluation

The ‘Goal-based evaluation of IT systems as such’ was also used to evaluate the location-based mobile advertising prototype.

Objective	Evaluation
Advertiser registration using USSD: The system should be able to capture the name and location of the business, service and products offered, and allow the advertiser to specify their privacy settings.	• The system was able to capture the name of the microenterprise owner, the location of the business, the service and products offered. • However the functionality for the specification of privacy settings by advertisers was not developed.
Client registration using USSD: The system should be able to capture client demographic information such as name, gender and year of birth, to confirm if the client's mobile number is registered with the mobile network service provider and to generate and send a PIN to the client.	• The system was able to capture client demographic information such as name, gender and year of birth. • This was first done using the USSD interface and later using a web interface. • Clients were further requested to confirm their registration by SMS when the registration was done using the web interface. • The mobile network service providers were not involved at all in the registration process given that the pilot study feedback indicated that national identity cards were sufficient for identity confirmation. • The use of PIN verification for system access was not implemented.
Information search: The system should allow for the initiation of a premium rate SMS from the USSD menu or using a structured SMS with the service/product name and a location. It should obtain the location from the SMS or from the Network service provider and send a response comprising of a list of contacts of identified service providers and a relevant advertisement.	• The system was able to allow for the generation and sending of an SMS containing of a list of contacts of identified service providers from the USSD menu. • Location information was not obtained from the network service provider but rather from a symbolic locations database. • Bulk SMS and not a premium rate SMS was used for system testing.

Objective	Evaluation
Placement of advertisements using USSD: The system should allow for the input of an advertisement and selection of the target audience based on location, age, gender or user inquiry type.	• The system was able to allow users to place advertisements. • The process involved selecting the target location, product / service category, age bracket, gender as well as the user type (client or provider).
Advertisement delivery: The system should allow for an advertisement to be selected based on the client's location, age, gender or inquiry type.	• The system was able to select a relevant advertisement based on a user's location, type of inquiry, age, gender and user type. • The advertisement was appended to the end of the SMS that the user received.

4.5.5 Conclusion

While it is possible to deliver a location-based mobile advertising service using SMS and USSD, a number of limitations and challenges are likely to hinder its effective utilization by users. The limitation in the number of characters in a USSD message constrains the menu presentation. The lack of data validation capabilities on the user interface makes it difficult to check on the data being passed on to the system. The major challenge in the use of the system lies in the low levels of user acceptance occasioned by security concerns. The prototype was evaluated against the initial objectives and it was found to achieve most of them.

4.6 Using network-based geo-location to deliver SMS and USSD location-based mobile advertising

4.6.1 Introduction

The SMS and USSD LBMA model in Figure 24 relies on the use of symbolic locations to identify service and product providers from a database. This model is limited in that the location of the providers is static as opposed to being dynamic. There is therefore need for a model that can take both user and provider mobility into account in the provision of location-based mobile advertising services. Such a model would have to rely on one of several geo-location techniques available both from the mobile service provider's end and from the mobile device.

4.6.2 The Network-based Geo-location SMS and USSD Location-based Mobile Advertising Model

The proposed model enhances the original model in Figure 24 by making use of network-based geo-location to determine the location of both users and providers. It works on the concept of real-

time location queries and updates advanced by Dawood, Jackson and Yew (2010). The geo-location is achieved by incorporating a network-based Location-based service and reverse geo-coding into the new model. The model introduces one new process; the provider location update, and modifies the information search process to make use of dynamic locations as opposed to static locations.

4.6.2.1 Provider location update

The locations of service and product providers are likely to be dynamic in some instances. In order to be able to provide users with accurate location information, the system must thus be able to constantly update itself on their current locations. The use of SMS and USSD for the delivery of the location-based services in effect limits the options available for location determination to network-based methods such as triangulation and cell based geo-location.

The proposed model illustrated in Figure 45 abstracts the location determination process by incorporating a mobile service provider location based service which receives the user mobile number as an input and returns their position in the form of coordinates (latitude, longitude). These coordinates can then be used in two ways;

1. To obtain actual location names: The coordinates are passed on to a reverse geo-coding module that searches a preloaded geo-codes database in order to return a location name. This location name, if found, is updated in the database as the provider's current location.
2. To update the provider's actual position: The coordinates are recorded as the provider's current position.

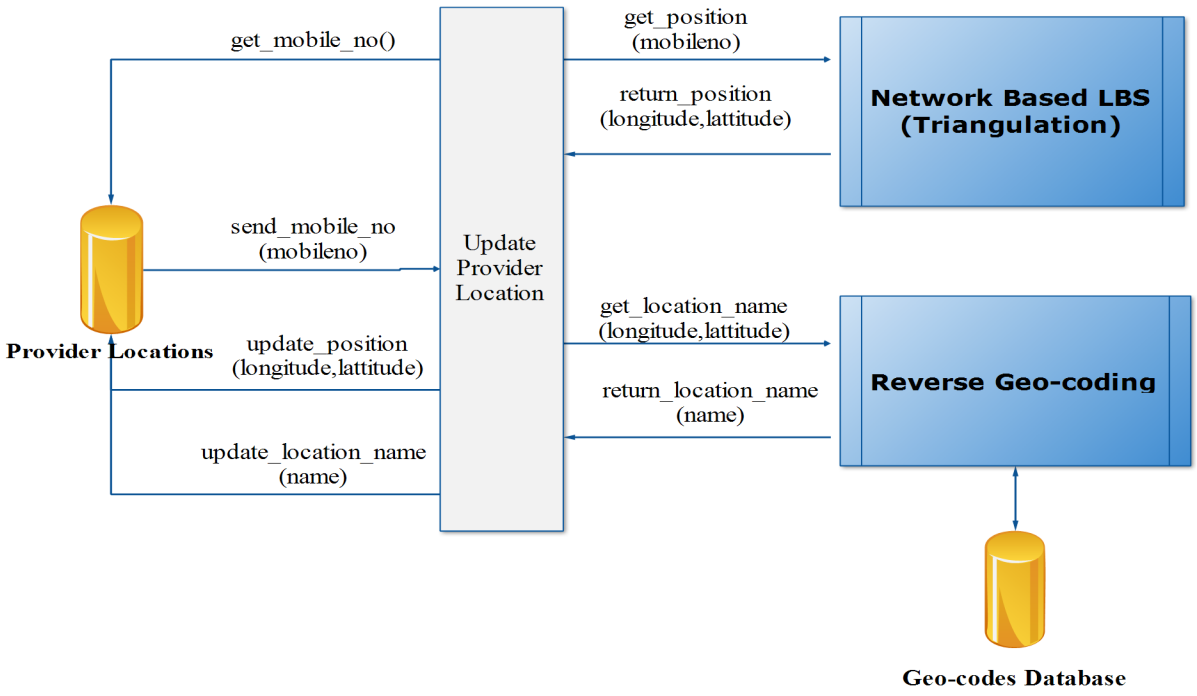

Figure 45: Provider location and position update process

4.6.2.2 Information search process

The information search process is modified to eliminate the selection of the desired provider's location. The process as illustrated in Figure 46 begins with the user's selection of a desired service or product. The system contacts the mobile service provider's location-based service to establish the user's current position. The position, in the form of coordinates, is then used to identify service providers in two ways;

1. For reverse geo-coding: The coordinates are used to get a name for use in searching the database to obtain providers at the current location.
2. For searching: The nearest provider is identified based on their current recorded position in terms of coordinates. The radius of the search is specified in the system in order to return the most relevant results

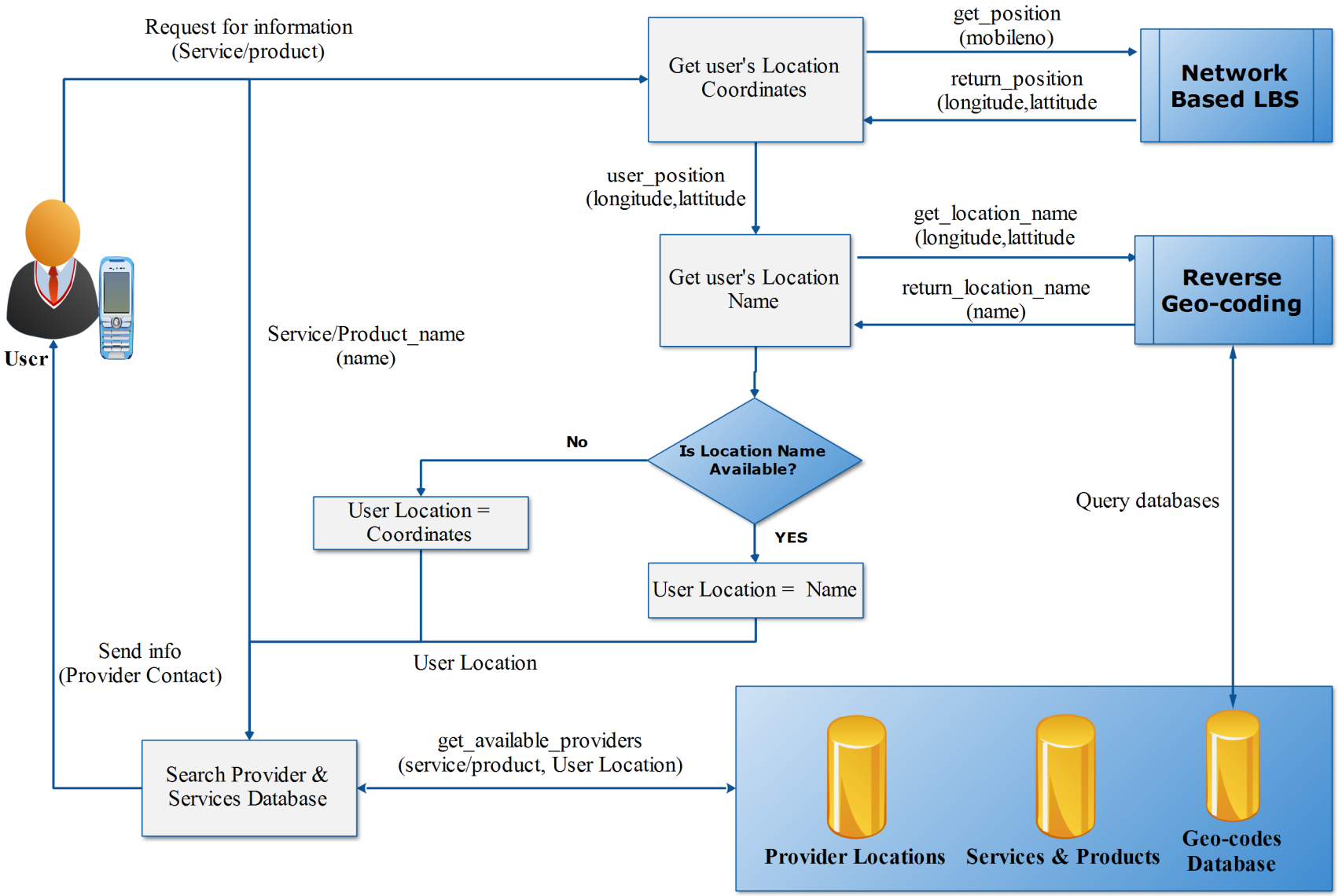

Figure 46: Information search process

4.6.3 Proof of concept

A simulation of the proposed model was conducted as described below.

4.6.3.1 User inquiry process

A dropdown menu was used to select products and services. In the actual use of the system these products and services are selected from a USSD menu. The user interface that simulates this process is presented in Figure 47.

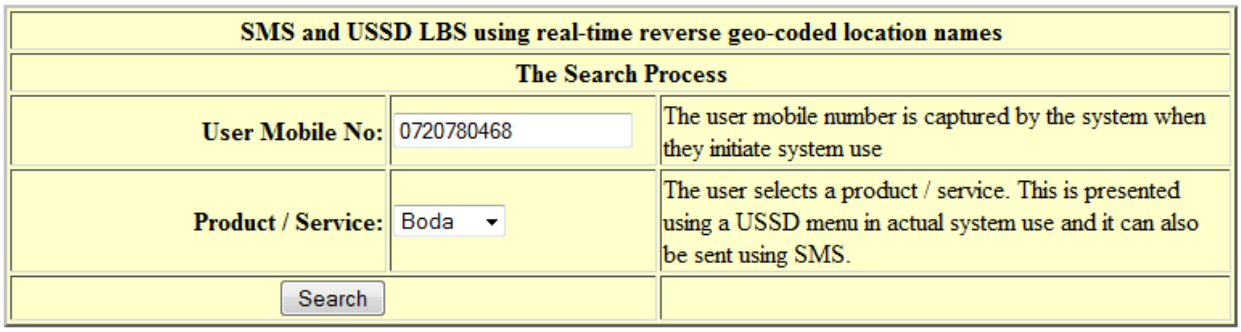

Figure 47: User inquiry process using real-time reverse geo-coded location names

4.6.3.2 User location determination

A sample geo-code database was developed for use in location determination with positions presented in the same format, (*longitude, latitude*) as would be obtained from the mobile network service providers. The sample database is presented in Figure 48.

ID	name	AsText(location)
1	Bungoma	POINT(0.34 34.34)
2	Baringo	POINT(0.47 36.16)
3	El Wak	POINT(2.49 40.56)
4	Embu	POINT(0.32 37.38)
5	Naivasha	POINT(0.4 36.3)
6	Nakuru	POINT(0.15 36.04)
7	Thika	POINT(1.1 37.5)

Figure 48: Sample geo-code database

User positions were randomly selected from this database for use in information search.

Option1 – Using real-time reverse geo-coded location names: The use of location names required that user coordinates be reverse geo-coded in order to obtain the location name. An information search was carried out for providers at the location bearing the name obtained.

The PHP code and SQL statements used to execute this process is presented in Listing 3.

Listing 3: Selecting providers using real-time reverse geo-coded location names

```
// Select a random location for the user
$random_position = rand(1,7);

// Obtain the location information for the random location selected
$SQL = "SELECT * FROM lbs_points WHERE ID = ".$random_position."";
$RESULT_SET = mysqli_query($CON,$SQL) ;
$RESULT_SET_ARRAY = mysqli_fetch_assoc($RESULT_SET);
$RESULT_SET_NUM_ROWS = mysqli_num_rows($RESULT_SET);

$location = $RESULT_SET_ARRAY['name'];
$LocationID = getLocationID_Name($CON,$location);

// Search the database if the category and product have been selected

if (isset($_POST['ProductID']) && $_POST['ProductID']!='' ) {
        $ProductID = $_POST['ProductID'];
```

```
}

// Use the location, and product information to search for providers
if ($LocationID!='' && $ProductID!='') {
    $SQL_FINAL = "SELECT * FROM lbs_providers WHERE ProductID = ".$ProductID."
AND LocationID = ".LocationID." ORDER BY TransactionTime ASC LIMIT 0,3";

    $RESULT_SET_FINAL = mysqli_query($CON,$SQL_FINAL;
    $RESULT_SET_ARRAY_FINAL  = mysqli_fetch_assoc($RESULT_SET_FINAL);
    $RESULT_SET_NUM_ROWS_FINAL  = mysqli_num_rows($RESULT_SET_FINAL);

    $ProductName = getProductName($CON,$ProductID);
    $LocationName = getLocationName($CON,$LocationID);

// Return the results of the information search
   if ($RESULT_SET_NUM_ROWS_FINAL>0) {
      echo "Providers for ".$ProductName." in ".$LocationName." found. ";
      do {
            $Mobile = getUserMobile($CON,$RESULT_SET_ARRAY_FINAL['UserID']);
            $Name = getUserName($CON,$RESULT_SET_ARRAY_FINAL['UserID']);
            $Mobile_Formatted = "0".substr($Mobile,3,9);
            echo $Name." ".$Mobile_Formatted."<br> ";
        }          while          (          $RESULT_SET_ARRAY_FINAL                    =
        mysqli_fetch_assoc($RESULT_SET_FINAL) ) ;
   } else {
      echo "No Providers for ".$ProductName." in ".$LocationName." found. ";
   }
}
```

The output from this process is presented in Figure 49.

SMS and USSD LBS using real-time reverse geo-coded location names		
Search Results		
User Position (Coordinates):	1 ○ 0.34 34.34 2 ○ 0.47 36.16 3 ○ 2.49 40.56 4 ○ 0.32 37.38 5 ○ 0.4 36.3 6 ◉ 0.15 36.04 7 ○ 1.1 37.5	The user's position is obtained a list of sample locations in the spatial database developed. The mobile network provider provides this in the actual sytem use.
User Location:	Nakuru	The user's location is determined from the spatial database by reverse geocoding the user position / coordinates . This database can be used in actual system use with additional information.
Identified Providers:	Providers for Boda in Nakuru found. STEPHEN 0706590532 MARTIN 0700658906 DAVID 0724586155	The system uses the user's location to search for service and product providers. This information is displayed on the web interface here but can be sent out using SMS in actual system use.

Figure 49: Results from information search using real-time reverse geo-coded location names

The random location selected in Figure 49 is number 6, its name is Nakuru and three providers were identified. In the actual system these final results are sent to the user by SMS.

However this approach has its challenges;

a. It requires a very detailed geo-code database of all possible coordinate-position combinations possible.
b. It is possible to have two locations with the same name. This can lead to the delivery of wrong results.

Option 2: Using coordinates: The use of actual provider coordinates to search for information was then considered. In this process the desired provider's position in the database specified using coordinates. An information search is performed from the database to identify providers within a specified radius of the user's current position.

A sample provider's database, presented in Figure 50, with coordinates randomized between 0° S - 1° S and 35° E - 36° E was developed.

UserID	ProductID	Location
3	2	POINT(0.1037 36.4891)
4	2	POINT(0.4443 35.3309)
5	3	POINT(0.2838 35.2449)
6	3	POINT(0.3063 36.3096)
7	1	POINT(0.2408 35.3205)
8	4	POINT(1.5565 36.7976)
9	1	POINT(0.8769 36.4621)
10	3	POINT(1.2378 36.3066)
11	4	POINT(0.8134 36.8844)
12	1	POINT(1.237 36.942)
13	2	POINT(1.14 35.21)
14	4	POINT(1.346 35.1531)
15	1	POINT(1.1653 36.2744)
16	2	POINT(1.4547 36.4829)
17	4	POINT(1.1667 36.7655)
18	1	POINT(0.4153 35.3181)
19	1	POINT(1.1403 35.843)
20	2	POINT(1.6782 35.639)
23	3	POINT(0.5509 35.393)
24	2	POINT(1.5988 36.7701)
25	3	POINT(0.821 35.4079)

Figure 50: Sample provider coordinates database

The PHP code and SQL statements used to execute the information search process using coordinates is presented in Listing 4.

Listing 4: Selecting providers using coordinates

```
// The selected product ID
$ProductID = $_POST['ProductID'];

// Select a random location for the user
// The lattitude is bounded between 0° S - 1° S and longitude between 35° E - 36° E
$random_X_position = rand(0,2).".".rand(0,9999);
$random_Y_position = rand(35,37).".".rand(0,9999);

// Set the center of the search at the user position
$SQL = "SET @center = GeomFromText('POINT(".$random_X_position." ".$random_Y_position .")')";
$RESULT = mysqli_query($CON,$SQL);

// Set the radius desired by the user
$SQL = "SET @radius = ".$_POST["radius"]; // kms
$RESULT = mysqli_query($CON,$SQL);

$SQL = "SET @bbox = CONCAT('POLYGON((',
X(@center) - @radius, ' ', Y(@center) - @radius, ',',
X(@center) + @radius, ' ', Y(@center) - @radius, ',',
X(@center) + @radius, ' ', Y(@center) + @radius, ',',
X(@center) - @radius, ' ', Y(@center) + @radius, ',',
X(@center) - @radius, ' ', Y(@center) - @radius, '))' )";

$RESULT = mysqli_query($CON,$SQL);

// Select the providers within the specified radius where 1 degree = 111 km
$SQL_SEARCH =
"SELECT UserID, AsText(location) AS Location, SQRT(POW( ABS( X(location) - X(@center)), 2) + POW( ABS(Y(location) - Y(@center)), 2 ))*111 AS distance
FROM lbs_provider_position
WHERE Intersects( location, GeomFromText(@bbox) )
AND SQRT(POW( ABS( X(location) - X(@center)), 2) + POW( ABS(Y(location) - Y(@center)), 2 ))*111 < @radius  AND ProductID = ".$ProductID." ORDER BY distance";

$RESULT = mysqli_query($CON,$SQL_SEARCH);
$RESULT_SET_ARRAY_FINAL  = mysqli_fetch_assoc($RESULT);
$RESULT_SET_NUM_ROWS_FINAL  = mysqli_num_rows($RESULT);

// Display the results
if ($RESULT_SET_NUM_ROWS_FINAL>0) {
```

```
    echo
    "<tr><td><strong>Name</strong></td><td><strong>Mobile</strong></td><td><strong>
    Coordinates</strong></td><td><strong>Distance</strong></td>";

   do {
         $Mobile = getUserMobile($CON,$RESULT_SET_ARRAY_FINAL['UserID']);
         $Name = getUserName($CON,$RESULT_SET_ARRAY_FINAL['UserID']);
         $Mobile_Formatted = "0".substr($Mobile,3,9);

        echo
        "<tr><td>".$Name."</td><td>".$Mobile_Formatted."</td><td>".str_replace('POINT',",
        $RESULT_SET_ARRAY_FINAL['Location'])."</td><td>".ceil($RESULT_SET_ARR
        AY_FINAL['distance'])."km</td></tr> ";

          } while ( $RESULT_SET_ARRAY_FINAL  = mysqli_fetch_assoc($RESULT) ) ;
}
```

In this process the user can specify the radius of the search in order to get the providers within their vicinity as illustrated in Figure 51.

SMS and USSD LBS using Coordinates		
The Search Process		
User Mobile No:	0720780468	The user mobile number is captured by the system when they initiate system use
Product / Service:	Boda	The user selects a product / service. This is presented using a USSD menu in actual system use and it can also be sent using SMS.
Radius (Km):	20	The user can specify the radius within which they wish to search
Search		

Figure 51: User inquiry process using coordinates

The results of the information search using coordinates and three different radius, 20km, 40km and 100km, are presented in Figure 52, Figure 53 and Figure 54 respectively.

SMS and USSD LBS using Coordinates				
Search Results				
User Position (Coordinates):	(1.2953 36.8247)		The user's position is selected at random for simulation purposes. The mobile network provider provides this in the actual sytem use.	
Identified Providers:	**Name**	**Mobile**	**Coordinates**	**Distance**
	JUDY	0724884975	(1.237 36.942)	15km
	The system uses the user's position to search for service and product providers. This information is displayed on the web interface here but can be sent out using SMS in actual system use.			

Figure 52: Results from information search using coordinates - Radius 20 km

SMS and USSD LBS using Coordinates				
Search Results				
User Position (Coordinates):	(0.4999 36.2630)		The user's position is selected at random for simulation purposes. The mobile network provider provides this in the actual sytem use.	
Identified Providers:	**Name**	**Mobile**	**Coordinates**	**Distance**
	ELIZABETH	0727895542	(0.5714 36.4863)	27km
	The system uses the user's position to search for service and product providers. This information is displayed on the web interface here but can be sent out using SMS in actual system use.			

Figure 53: Results from information search using coordinates - Radius 40 km

SMS and USSD LBS using Coordinates				
Search Results				
User Position (Coordinates):	(1.3235 35.6794)		The user's position is selected at random for simulation purposes. The mobile network provider provides this in the actual sytem use.	
Identified Providers:	**Name**	**Mobile**	**Coordinates**	**Distance**
	MARTIN	0700658906	(1.1403 35.843)	28km
	GRACE	0724755614	(1.3037 35.978)	34km
	FRED	0722950918	(1.7489 35.9105)	54km
	LEAH	0720225876	(1.8344 35.839)	60km
	LILIAN	0719899085	(1.1653 36.2744)	69km
	JOSEPH	0711118282	(0.6531 35.363)	83km
	The system uses the user's position to search for service and product providers. This information is displayed on the web interface here but can be sent out using SMS in actual system use.			

Figure 54: Results from information search using coordinates - Radius 100 km

4.6.4 Performance evaluation

4.6.4.1 Information search using real-time reverse geo-coded location names

The information search process using real-time reverse geo-coded location names works and its execution requires a number of steps; (i) It begins by obtaining the location of the user in the form of coordinates, (ii) reverse geo-coding the coordinates and (iii) then searching the database for providers with matching location names. The use of similar names for different localities is likely to return multiple results which presents a challenge to the effective use of reverse geocoding (Oddity Software LLC, 2014).

4.6.4.2 Information search using coordinates

The information search process using coordinates is more effective given that the system does not require any reverse geo-coding in order to perform an information search. The actual positions in the form of coordinates for both users and providers are used to get relevant results. In addition, the use of actual coordinates makes it possible to select providers within a desired radius from the current user position. These results can be presented in the order of closeness to the user.

Whilst the simulation of the use of user coordinates for identifying service and providers served to demonstrate the practicability of the approach, a number of mobile network service providers were approached in an attempt to test the concept under actual network conditions. They were however reluctant to provide subscriber's real-time coordinates citing security concerns with regards to user real time location which can be attributed to the unresolved security and privacy issues surrounding the use of user geo-location information (Soper, 2012).

4.6.5 Applications areas for the network based geo-location LBMA

The proposed LBMA using network-based geo-location can be applied in delivering location-specific information from an SMS and USSD based system. The use of network-based geo-location eliminates the need for users and service / product providers to explicitly specify their location when making inquiries as well as when on the move. A user searching for information in a locality would be able to receive contacts of providers currently in their vicinity.

4.6.6 Conclusion

This section explored the utilization of network based geo-location for the delivery of location-based mobile advertising. The approach is an enhancement of the original proposed model that was based on the use of symbolic locations. This approach was simulated and found to be feasible, efficient and more convenient for both users and providers. Major challenges were however highlighted with regards to the lack of detailed geo-code databases as well as the lack of user real-time position information from network service providers.

4.7 Potential spinoff applications of the location-based mobile advertising system

4.7.1 Introduction

The location-based mobile advertising system was initially conceptualized to provide an easy to use and affordable advertising service to microenterprises. This was found to be feasible. In addition, a number of other possible areas of application emerged in the course of the model development, system design and especially the pilot study. These additional application areas proposed by users confirm Kelly's (2007), observations that people often use innovations in ways not originally intended.

4.7.2 Mobile contracts

The idea of 'mobile contracts' was brought about by user concerns for their security. The key question asked by respondents in the pilot study, is how the system could help them, or anyone else for that matter, to identify the particular provider with whom the potential client entered an agreement with. The system can thus be extended to allow two parties to enter into an 'agreement'. The process, shown in Figure 55, incorporates the sending of a confirmation code to all parties in the initial message. These codes are then exchanged and sent to the system which records the 'agreement'.

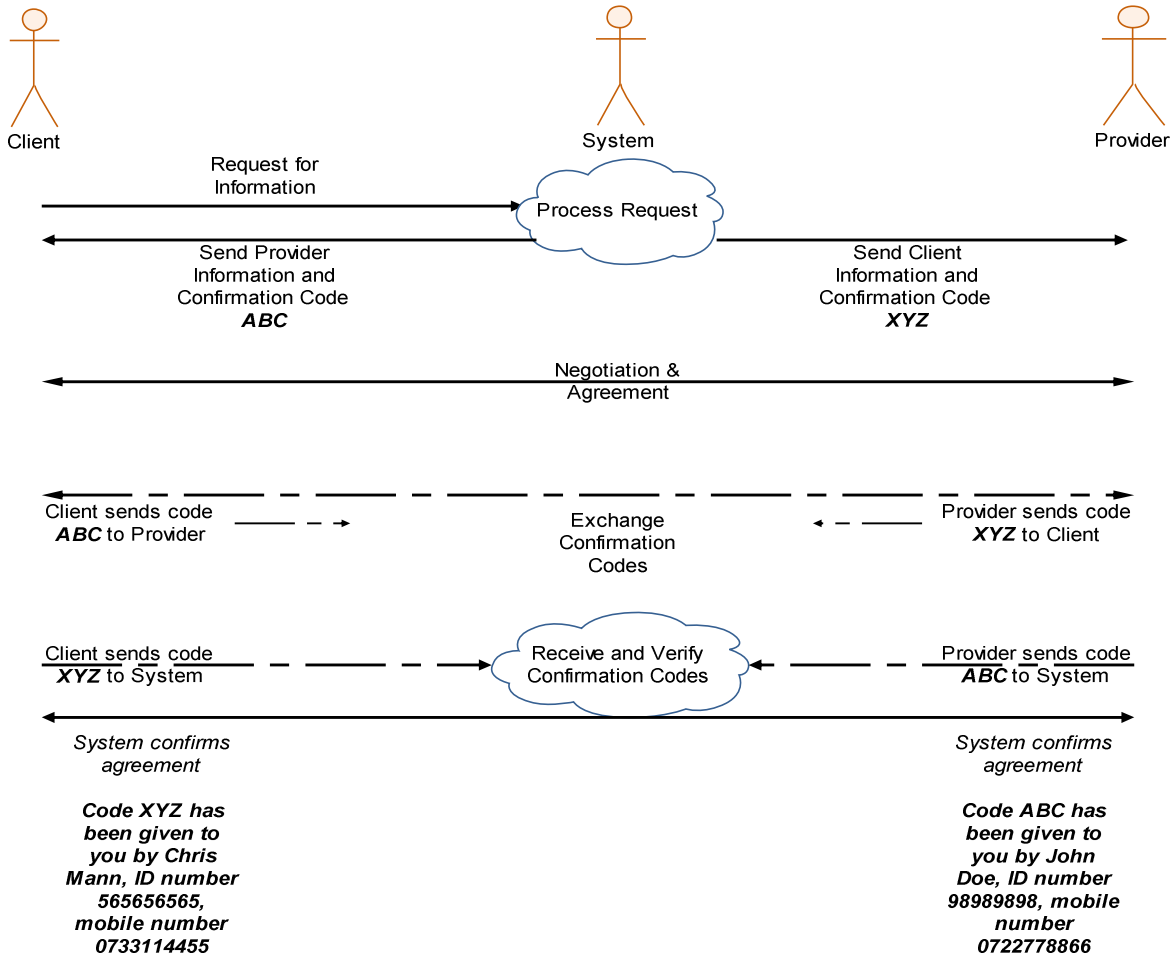

Figure 55: Service / product provision agreement process

4.7.3 Identity verification process

The need to verify both the client and provider identities even if contact was not established through the system was also raised by the respondents in the pilot study. A process is thus proposed whereby each of the parties obtains identity information from the system. The process, depicted in Figure 56, begins with a code request by both parties; the codes are then exchanged and sent to the system which in turn responds with the identification details of the two parties.

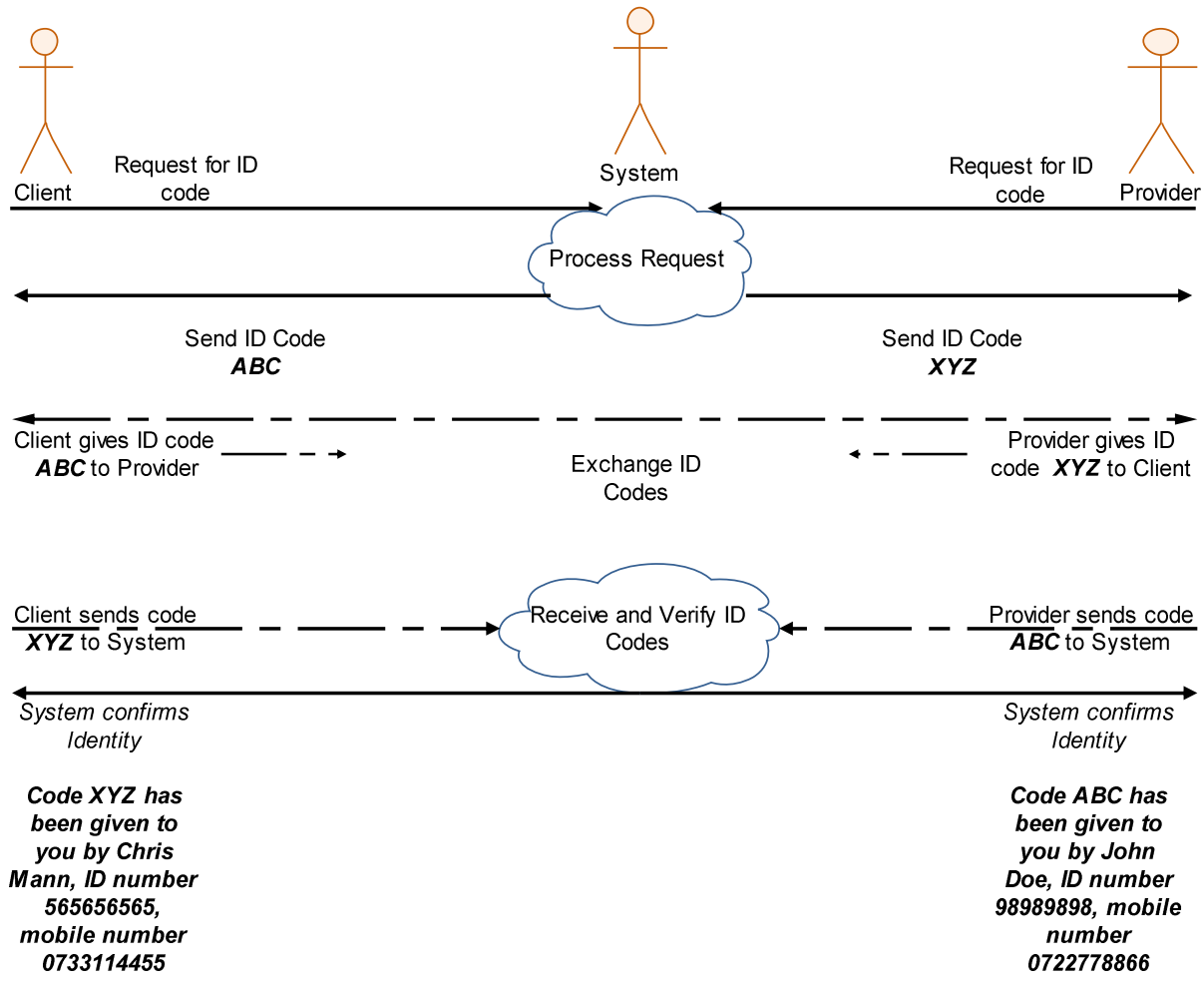

Figure 56: SMS based identity verification process

4.7.4 Targeted advertising

The system captures a lot of information at the point of registration and on an ongoing basis that can be used to target advertisements to all users; clients and providers alike. This information includes age, gender, location, time of inquiry as well as the service / product offered or sought for. Registered users can place advertisements using a USSD menu or web interface and pay in cash or using mobile payments. The proposed advertisement placement and delivery processes are presented in Figure 29 in section 4.3.5 and Figure 30 in section 4.3.6.

4.7.5 Demand and supply statistics

As part of the information search and delivery process the system captures detailed information on all inquiries such as; The location and services / products sought for by potential clients, whether the information sought for has been found or not, and the profile (age and gender) of the users seeking information or providing services / products. In addition, the number of registered providers for the various services and products is also stored by the system.

This information is valuable to both existing as well as new providers of different services and products in a number of ways; It can help them to know the nature of the demand and as well as the level of competition for the specific service and product that they have to offer.

The system can be further developed to avail this information using the USSD menu or a web interface. Examples of questions that can be answered using the system are;

What are people looking for in Nakuru over the last one week?

The sample web interface in response to this type of inquiry is presented in Figure 57.

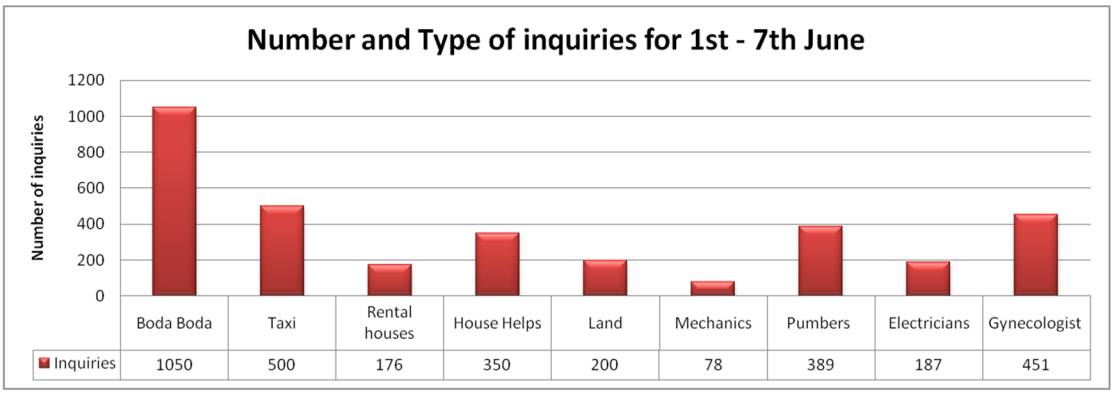

Figure 57: Sample web interface for number and type of inquiries

For SMS and USSD responses the information will be sent as plain text as shown below.

"No & type of inquiries, Nakuru County, 1st – 7th July; Boda Boda,1050, Taxi,500, Rental houses,176,House Helps,350, Land,200, Mechanics,78, Pumbers,389, Electricians,187 Gynecologist,451"

The information can further be filtered based on user profiles, time of inquiry for better understanding of the nature of inquiries

How many tractor operators are registered in Nakuru, Baringo, Kericho and Bomet counties?

The sample web interface in response to this type of inquiry is presented in Figure 58.

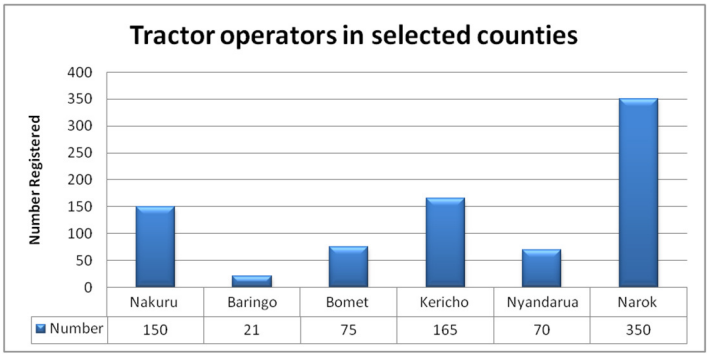

Figure 58: Sample web interface for number of tractor operators in selected counties

For SMS and USSD responses the information will be sent as plain text as shown below.

"Registered Tractors in Nakuru,150, Baringo,21, Bomet,75, Kericho,165, Nyandarua,70,Narok,350"

This information can be further broken down to reveal the nature of the registered providers with respect to their age, gender and specific locality within the county.

4.7.6 Conclusion

The SMS and USSD location-based mobile advertising system has been found to have the potential of a number of spinoff applications in addition to those originally envisioned. These include, but are not limited to, identity confirmation, mobile contracts, targeted advertising and the provision of detailed demand and supply statistics.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.0 Introduction

In this thesis the delivery of location-based mobile advertising services using SMS and USSD is discussed. The SMS and USSD location-based mobile advertising system provides users with a USSD drilldown menu through which they search for service and product provider contact information from a database of services, products and locations. An alternative model using network-based geo-location for user location determination was also developed to address the challenges of using symbolic locations accessed through a USSD menu. In both approaches, i.e. using symbolic and network based location determination, the information sought by the user is sent to them by way of an SMS message. The choice of simple, affordable and universally system access methods for the development of the model and system was informed by the technological and financial limitations experienced by the main target group for the system, the microenterprises. They run small businesses with limited financial and technological resources available to pay for marketing activities and solutions. This chapter presents the conclusions and recommendations from the study that comprised of a survey, model development, prototype development, piloting and a performance evaluation.

5.1 Conclusions

The premise upon which this study was based is the lack of location-based mobile advertising solutions based on affordable, accessible and easy to use system access technologies such as SMS and USSD. An extensive survey of literature and solutions in the market revealed that a majority

of existing solutions are developed using Java and Android, GPS and GPRS for geo-location, RFID, Bluetooth and NFC for system communications, and mobile browsers and applications for system access. These technologies are available to a greater extent on smartphones and to a limited extent on feature phones which effectively limits their use to those who can afford these types of phones. A majority of microenterprises who use basic phones are thus not able to utilize applications that require these advanced technologies.

A location-based mobile advertising model and prototype using SMS and USSD as alternative delivery technologies was thus developed. The solution was able to effectively handle user and provider registration and de-registration, information search and delivery as well as advertisement placement and delivery using SMS and USSD. The use of both symbolic and real-time location information was explored and found to be practical albeit with challenges. Additional concerns regarding privacy and security were also established and addressed through enhancements to the model and prototype.

Conclusions related to the specific objectives are discussed in sections 5.1.1 to 5.1.5.

5.1.1 Research Question 1: What is the level of awareness, utilization and potential for LBMA among microenterprises?

The study established that a majority of microenterprises sampled in the study were not aware of the concept of location-based mobile advertising. As a result the use of LBMA was not reported among them.

Conclusion: Microenterprises are generally not aware of and do not use LBMA.

The intention to use location-based mobile advertising among the microenterprises sampled was directly influenced by the choice of technology, perceived ease of use and to a smaller extent, the perceived usefulness of the service. Choice of technology emerged as a significant factor influencing their intention to use location-based mobile advertising services. Based on this finding, an enhanced technology acceptance model, depicted in Figure 23, to include the choice of technology was developed.

Conclusion: The choice of technology does influence the intention to use LBMA among microenterprises.

5.1.2 Research Question 2: What is the most suitable application model for the development of SMS and USSD location-based mobile advertising services?

A location-based mobile advertising model based on the use of SMS and USSD was developed. The model highlights the roles and interactions of the users, the mobile network provider, premium rate service providers and the system in delivering location-based mobile advertising services. The model relies on the use of a database to store symbolic locations (location names), products, services and providers. The data contained in the database is used for displaying the USSD menu in the information search process.

Conclusion: The delivery of LBMA using SMS and USSD requires the extensive of use of a database to store symbolic locations products, services and providers.

The systematic innovation process that guided the study was not as straightforward as originally proposed and adopted for the study. It instead required a number of iterations between the customer needs analysis, model development, prototyping and evaluation stages. The application

of the iterations helped to incorporate ongoing user feedback into the model and prototype development process.

Conclusion: The innovation process is iterative.

5.1.3 Research question 3: What are the challenges of implementing the SMS and USSD LBMA prototype?

An SMS and USSD location-based mobile advertising system prototype was designed and implemented successfully. The results from the system test show that it is indeed feasible to deliver location-based mobile advertising without having to use relatively advanced geo-location and system access technologies. The system was hosted on an online test domain, www.bespokesystems.co.ke/lbs_test for the testing period. The USSD and bulk SMS services were obtained from africastalking.com. The piloting procedure involved a demonstration, an interview, registration and then the actual system use.

Conclusion: Location-based Mobile advertisements can be delivered using SMS and USSD

An extension to the SMS and USSD model using network-based geo-location was developed and implemented. The model makes use of coordinates to identify the user's current location as well as to identify providers within their proximity.

Conclusion: Location-based mobile advertising can be delivered using network based geo-location

The prototype was presented for use to a number of microenterprises and specifically motorcycle taxi operators. Users were however reluctant to adopt the system due to security, privacy, cost and credibility concerns.

Conclusion: User concerns for security, privacy, cost and credibility can hinder the adoption of LBMA.

5.1.4 Research Question 4: How does the SMS and USSD location-based mobile advertising prototype perform?

While it is possible to deliver a location-based mobile advertising service using SMS and USSD, the limitation in the number of characters in a USSD message constrains the menu presentation. The lack of data validation capabilities on the user interface makes it difficult to check on the data being passed on to the system. The major challenge in the use of the system lies in the low levels of user acceptance occasioned by security concerns.

Conclusion: There are significant challenges in using SMS and USSD to deliver LBMA

Attempts to get user real-time information from the mobile service provider proved difficult due to security and privacy concerns.

Conclusion: The lack of geo-location information from mobile network providers can hinder the delivery of LBMA using real-time location.

5.1.5 Research Question 5: What are the additional areas of application of the SMS and USSD LBMA prototype?

The SMS and USSD location-based mobile advertising system has been found to have several potential spinoff applications in addition to those originally envisioned. These include, but are not limited to, identity confirmation, mobile contracts, targeted advertising and the provision of detailed demand and supply statistics.

Conclusion: There is great potential in the use of SMS and USSD beyond delivering LBMA

5.2 Areas for further study

The positive reception and potential applications of the SMS and USSD LBMA identified during the study point towards the need for further investigation to establish its challenges, limitations, impacts and potential for business transformation among microenterprises.

Additional areas for further study are discussed in detail in sections 5.2.1 to 5.2.14.

5.2.1 The commercialization of the LBMA

The network based geo-location LBMA prototype developed was not subjected to user acceptance testing due to the lack of cooperation from the mobile network service providers. The reasons cited by the operators included the sensitivity of user geo-location information and the lack of research activities within their operations. Their cooperation and involvement will be required in order to undertake an extensive field study.

The findings from this study will therefore serve as a basis for the following future research undertakings with the sole objective of launching it as a commercially viable service.

- Developing partnerships with the mobile network providers for further development, testing and commercialization of the LBMA.
- The field testing of the LBMA to establish the factors influencing user acceptance and mobile network provider's cooperation.
- The development of mobile applications for the LBMA using android and Java to facilitate adoption by smartphone users.
- The development of a business model to ensure the sustainability of the LBMA service.

These activities require significant amount of time and resources and could not be undertaken within the time allocated for this study.

5.2.2 The role of risk, convenience and perceived benefits in influencing user intention to use LBMA

It was established in this study that the respondents were willing to take higher levels of risk if the associated convenience and benefits were significant enough. There is need to further investigate the relationship between the risk involved in using a service or system in relation to the convenience and perceived benefits that can be gained from it. This is a useful direction for further exploration.

5.2.3 The impact of system demonstration versus system descriptions in influencing perceived ease of use

In the study only a hypothetical system was described to the respondents. The findings indicated that there was no significant relationship between the perceived usefulness of the system and their intention to use it. It is possible that perceptions of usefulness were not adequately formed based on the description. It is thus important to empirically establish whether or not perceptions of usefulness are significantly influenced by an actual system demonstration as opposed to a pure description.

5.2.4 Choice of technology, perceived ease of use and user socio-demographic characteristics in the adoption of LBMA

There was a negative correlation between the choice of technology and perceived ease of use. This is worth investigating further to establish which technologies and possible user socio economic characteristics contribute to this relationship.

5.2.5 A security model for the delivery of LBMA using SMS and USSD

The model does not explicitly address the issue of security in the use of the system. Security in this regards refers to the assurance that users want about how genuine the persons that they are dealing with, either as businesses offering services or as clients seeking services, are. There is need to extend this model to factor in security features both in the actual technical aspects as well as in the actual use procedures lying outside the system. These could come in the form of user and business registration processes.

5.2.6 Towards an effective delivery of LBMA using SMS

The system prototype for the SMS and USSD location-based mobile advertising system works through the use of a USSD menu to search for information which is then sent by SMS to the user. The reason for the use of a USSD menu is to standardize the inquiry parameters given that the user does not have to type location and service / product names. It would be worthwhile to investigate how the same information search process can be achieved using SMS only. The challenge here would be how to ensure that users send a structured SMS, which will inevitably have spelling mistakes and variations, and how to process these inconsistent messages in order to provide the information sought for.

5.2.7 Investigating the user trust development process for LBMA

Significant barriers were found to exist in the process of piloting the system prototype. It is therefore important to examine the role of security, privacy, cost and credibility in the adoption of mobile services in general and location-based mobile advertising in particular. The order in which trust is built is also a fruitful area of investigation. Respondents in the study began by understanding the service, questioning the security of the system and then the credibility of the provider. The issue of cost did not arise but would probably be the next issue in the sequence of concerns once they agree to sign up.

5.2.8 A business model for the sustainable delivery of SMS and USSD LBMA among microenterprises

The lack of suitable business models has in a number of instances caused businesses offering innovative IT solutions to close down in the first few months or years of operation. In order to make the proposed SMS and USSD LBMA sustainable, a suitable business model will be required to ensure that the service is affordable for users and profitable for the providers.

5.2.9 An intelligent and efficient USSD menu management system for the delivery of LBMA

The delivery of location-based mobile advertising services can be further enhanced by addressing the limitations and challenges identified through the development of an intelligent menu system capable of handling the long lists of locations and products required in the use of the system.

5.2.10 A model for the secure utilization of user real-time location in the delivery of LBMA

The hesitation and outright refusal, in some cases, to share real-time user location by mobile service providers is a major hindrance to the successful development of location based services that require it. This is informed by concerns for mobile subscriber's security and privacy. There is thus need to develop a model or solution that can make use of a user's real-time position without compromising security and privacy.

5.2.11 Using an SMS and USSD identity confirmation model to address security challenges among microenterprise public transport operators

A major challenge experienced by the motorcycle taxi operators who were interviewed during the pilot study was that of security. This arises in cases where passengers hire these taxis only to assault the operators and steal their motorcycles. In a good number of these incidents, according to the motorcycle operators, the victims have been murdered. Investigations are often difficult to initiate and conclude given that the identity of the passenger is unknown to the taxi operator. As a result these operators opt to serve only known clients, especially in the evening hours, for fear of their safety. The use of the SMS and USSD identification model can be explored to see if the exchange of confirmation codes leading to ID confirmation can help to deter and reduce crime or identify abductors.

5.2.12 Using an SMS and USSD identity confirmation model for passenger identification and manifest in public service transport

SMS and USSD identity verification can be used to build an accurate record of people's interactions through the exchange of confirmation codes. This proposed functionality has possible applications in public sector transport that faces challenges in insurance claims processing or crime

investigation due to the lack of accurate passenger manifests. The actual adoption process as well as the impact of such a technology application in a sector largely regarded as lawless and informal would be a very fruitful area for further investigation.

5.2.13 Using SMS and USSD for mobile contracts

Microenterprises are often challenged on how to enter into and enforce contracts with their clients occasioned by the lack of knowledge or resources to do so. An extension of the proposed identity verification process can be used to send messages with collaborating figures and details sent to the system to serve as evidence of agreements. Possible collaboration with money transfer services to get deposits from both parties can also be examined. These deposits can be used to compensate aggrieved parties in the event of contract violation or pay providers for services / products delivered. User perception, actual adoption rates and challenges, and the impact on contract enforcement in informal business setups are thus important areas for further investigation.

5.2.14 Demand and supply mapping using SMS and USSD LBMA

The process of searching for services and products will yield a lot of data on the number of providers registered within various localities as well as the number of positive and negative results found. This information can be very useful for persons seeking to establish businesses within various areas.

5.3 Recommendations

5.3.1 National integrated identity management system

The lack of access to existing user identity information led to the proposal for the fresh capture of user identity information as part of the mandatory registration process in this study. This exercise

has been done before by many other bodies and organizations such as all the leading mobile phone operators during the Subscriber Identity Module (SIM) cards registration process as well as by the Independent Electoral and Boundaries Commission (IEBC) during voter registration. The national registration bureau also maintains a database of all Kenyan citizens at birth and when they obtain national identity cards or passports. However, all these different organizations treat the data they collect as confidential and thus do not share it with each other or anyone else for that matter. This causes each of them to incur costs collecting the same information afresh when they need it. This is a costly and tedious affair which many smaller organizations cannot afford to undertake.

There is thus need for a government mediated effort to integrate these different databases for consistency and cost savings. The availability of such a database, accessed through the right legal channels can go a long way in encouraging the development of solutions such as location-based mobile advertising applications whose credibility is derived from accurate and verifiable user identities.

5.3.2 Development of a mechanism for safe and acceptable access and use of user's real-time location information

The development of the location-based mobile advertising application required access to mobile user's real-time locations. This information either in the form of coordinates or cell ID's is collected and stored by all mobile network service providers as part of their service delivery mechanisms. However, both users and mobile network service providers regard this information as sensitive given the potential for its abuse in criminal activities. The lack of a suitable and acceptable approach to sharing this information has led to the lack of its commercial application in many settings.

The growing need for location-based applications by the same users is making it necessary for such information be accessed by application developers and solution providers. It is therefore necessary that mobile network service providers develop appropriate technical and legal frameworks for the commercial access and utilization of this information with all stakeholders concerns in mind. Such a solution would have to specify what constitutes legitimate access and use as well as a clearly spelt out user opt-in policy and process.

References

Aalto, L., Göthlin, N., Korhonen, J., & Ojala, T. (2004). *Bluetooth and WAP push based location-aware mobile advertising system.* Paper presented at the Proceedings of the 2nd international conference on Mobile systems, applications, and services.

Adams, D. A., Nelson, R. R., & Todd, P. A. (1992). Perceived Usefulness, Ease of Use, and Usage of Information Technology: A Replication. *MIS Quarterly, 16*(2), 20.

Adusei, I. K., Kyamakya, K., & Jobmann, K. (2002). *Mobile geo-location technologies in cellular networks: an evaluation of their performance metrics.* Paper presented at the MILCOM 2002.

Aghdaie, F. a.-A., Fathi, S., & Piraman, A. (2011). Factors affecting the attitude of trust in Internet purchasing from the perspective of consumers. *Interdisciplinary Journal of Contemporary Research in Business, 3*(5), 14.

AICPA., & CICA. (2009). Generally accepted privacy principles: American Institute of Certified Public Accountants.

Airtel Kenya Ltd. (2014). Airtel Kenya - mLocator. Retrieved 30th May, 2014, from http://africa.airtel.com/wps/wcm/connect/africarevamp/Kenya/home/Personal/Voice-and-text/services/mlocator/

Al-Khasawneh, A. L., Al Hosban, A. A., & Al-Jammal, H. R. (2012). Innovation and Creative Thinking as a Systematic Approach. *Research Journal of International Studies*(24), 13.

Alexandre, G., Adao, T., Goncalves, M., Magalhaes, L., Bessa, M., Peres, E., & Varajao, J. (2011). *Foundations for a Mobile Context-Aware Advertising System.* Paper presented at the COMMUNICATIONS IN COMPUTER AND INFORMATION SCIENCE, Vilamoura, Portugal.

Alter, S. (2002). *Information Systems: The foundation of e-Business* (4th Edition ed.): Darling Kindersley (India) Pvt Ltd.

American Marketing Association. (2014). Dictionary. Retrieved 30th May, 2014, from https://www.ama.org/resources/Pages/Dictionary.aspx

Apoyo Consortia. (2012). Study on ICT Access Gaps in Kenya (pp. 243). Nairobi, Kenya.: Communications Commission of Kenya.

Apple Inc. (2011). Apple - iAd - Brands. Retrieved 22 Feb, 2013, from http://advertising.apple.com/brands/

Becker, C., & Durr, F. (2005). On location models for ubiquitous computing. *Personal and Ubiquitous Computing, 9*(1), 11. doi: 10.1007/s00779-004-0270-2

Belanche, D., Casaló, L. V., & Guinalíu, M. (2011). Website usability, consumer satisfaction and the intention to use a website: The moderating effect of perceived risk. *Journal of Retailing and Consumer Services, 19*(1), 8. doi: 10.1016/j.jretconser.2011.11.001

Belkhamza, Z., & Wafa, S. A. (2009). The effect of perceived risk on the intention to use E-commerce: The case of Algeria. *Journal of Internet Banking and Commerce., 14*(1).

Bodic, G. e. L. (2003). Short Message Service *Mobile Messaging Technologies & Services* (pp. 83): Hoboken, NJ : John Wiley & Sons, Inc. / Engineering, 2003.

Bollen, K. A. (1989). *Structural Equation with Latent Variables*. New York: Wiley and Sons.

Bowen, M., Morara, M., & Mureithi, S. (2009). Management of Business Challenges among Small and Micro Enterprises in Nairobi, Kenya. *KCA Journal of Business Management, 2*(9), 16.

Brown, I. T. J. (2002). Individual and Technological Factors Affecting Perceived Ease of Use of Web-based Learning Technologies in a Developing Country. *The Electronic Journal on Information Systems in Developing Countries, 9*(5), 15.

Brown, J., Shipman, B., & Vetter, R. (2007). SMS: The Short Message Service. *Computer, 40*(12), 4. doi: 10.1109/MC.2007.440

Bulander, R., Decker, M., Schiefer, G., & Kölmel, B. (2007). Advertising Via Mobile Terminals – Delivering Context Sensitive and Personalized Advertising While Guaranteeing Privacy. *Communciations in Computer and Information Science, 3*, 10. doi: 10.1007/978-3-540-75993-5_2

Byun, S., & Feinberg, R. A. (2007). Understanding Consumer Acceptance of Mobile Technology for Financial Service Delivery. *AMA Winter Educators' Conference Proceedings, 18*, 24.

Cazier, J. A., Jensen, A. S., & Dave, D. S. (2008). The Impact of Consumer Perceptions of Information Privacy and Security Risks on the Adoption of Residual RFID Technologies. *Communications of AIS. 2008, 23*, 22.

Chandra, S., Srivastava, S. C., & Theng, Y.-L. (2010). Evaluating the Role of Trust in Consumer Adoption of Mobile Payment Systems: An Empirical Analysis. *Communications of AIS, 27*, 28.

Child, D. (2006). *The Essentials of Factor Anlsysis*: Continuum International Publishing Group.

Clarkson, A., McCallum, S., Solhjoo, N., & Velentzas, S. (2004). *Hybridised Geo-location Algorithms in Location Based Services.* Paper presented at the 1st Workshop on Geo-location, Navigation and Communication (WPNC'04).

Cronbach, L. J. (1951). Coefficient Alpha and the Internal Structure of Tests. *Psychometrika, 16*(3), 38.

Cronholm, S., & Goldkuhl, G. (2003). *Six Generic Types of Information Systems Evaluation.* Paper presented at the The 10th European Conference on Information Technology Evaluation (ECITE-2003), Madrid.

Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. *MIS Quarterly, 13*(3), 23.

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User Acceptance of Computer Technology: A Comparison of Two Theoretical Models. *Management Science, 35*(8), 22.

Dawood, R., Jackson, S. J., & Yew, J. (2010). *Supporting the information needs of mobile microentrepreneurs in the developing world: the case of Indonesian food cart vendors.* Paper presented at the Proceedings of the 4th ACM/IEEE International Conference on Information and Communication Technologies and Development.

Demo, G., Neiva, E. R., Nunes, I., & Rozzett, K. (2012). Human Resources Management Policies and Practices Scale (HRMPPS): Exploratory and Confirmatory Factor Analysis. *Brazilian Administration Review (BAR), 9*(4), 26.

Dhar, S., & Varshney, U. (2011). Challenges and Business Models for Mobile Location-based Services and Advertising. *Communications of the ACM, 54*(5), 121. doi: 10.1145/1941487.1941515

Dialogic Corporation. (2009). Claro Deploys SMS-Based Location-Based Service in Central America – Case Study (pp. 5). Canada: Dialogic Corporation.

Dickinger, A., Haghirian, P., Murphy, J., & Scharl, A. (2004). *An investigation and conceptual model of SMS marketing.* Paper presented at the System Sciences, 2004. Proceedings of the 37th Annual Hawaii International Conference on.

European Union (EU) (2003). Commission Recommendation of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises. *Official Journal of the European Union, 46*, 6.

Everitt, B. S., & Dunn, G. (2001). *Applied Multivariate Data Analysis* (2nd Edition): John Wiley & Sons.

Faqih, K. M. S. (2013). Exploring the Influence of Perceived Risk and Internet Self-efficacy on Consumer Online Shopping Intentions: Perspective of Technology Acceptance Model. *International Management Review. Jun2013, 9*(1), 11.

Farmani, M., Kimiaee, A., & Fatollahzadeh, F. (2012). Investigation of Relationship between Ease of Use, Innovation Tendency, Perceived Usefulness and Intention to Use Technology: An Empirical study. *Indian Journal of Science & Technology. Nov2012, 5*(11), 5.

Foeken, D. W. J., & Owuor, S. O. (2000). Urban Farmers in Nakuru Kenya (pp. 117). Leiden, The Netherlands.: African Studies Center & Center for Urban Research.

Fonchamnyo, D. C. (2013). Customers' Perception of E-banking Adoption in Cameroon: An Empirical Assessment of an Extended TAM. *International Journal of Economics & Finance, 5*(1), 11. doi: 10.5539/ijef.v5n1p166

Forsythe, S., Liu, C., Shannon, D., & Gardner, L. C. (2006). Development of a Scale to Measure the Perceived Benefits and Risks of Online Shopping. *Journal of Interactive Marketing, 20*(2), 21.

Frewer, L. J., Howard, C., & Shepherd, R. (1998). Understanding public attitudes to technology. *Journal of Risk Research, 1*(3), 15. doi: 10.1080/136698798377141

GDRC. (2008). What is a Microenterprise? Retrieved 30 January, 2013, from http://www.gdrc.org/icm/micro/what-is.html

Gefen, D., & Straub, D. (2000). The Relative Importance of Perceived Ease of Use in IS Adoption: A Study of E-Commerce Adoption. *Journal of the Association of Information Systems, 1*(1), 30.

Gefen, D., & Straub, D. W. (1997). Gender Differences in the Perception and Use of E-Mail: An Extension to the Technology Acceptance Model. *MIS Quarterly, 21*(4), 12.

Gikenye, W. (2011). The Diffusion of Mobile Phones for Business and Information Management in Kenya. *Proceedings of the European Conference on Information Management & Evaluation*, 511.

Gilmore, W. J. (2010). *Beginning PHP and MySQL : from novice to professional*. Berkeley, CA: Springer.

Gonzales, F., Bon, F., Cimetiere, J. C., André, N., Farges, N., & Mougin, P. (1999). Java Application Servers Report (pp. 221). Burlington, MA.: TechMetrix Research.

Google Inc. (2013). AdMob -- monetize and promote your mobile apps with ads – Google Ads. Retrieved 22 Feb, 2013, from http://www.google.com/ads/admob/

Gupta, P. (2010). End to End USSD Implementation. India: TATA Tele Service Ltd.

Haddadi, H., Hui, P., & Brown, I. (2010). *MobiAd: private and scalable mobile advertising*. Paper presented at the Proceedings of the fifth ACM international workshop on Mobility in the evolving internet architecture.

Hansen, M. T., & Birkinshaw, J. (2007). The Innovation Value Chain. *Harvard Business Review, 85*(6), 10.

Harris, I., Hillebrand, F., Holley, K., & Trosby, F. (2010). *Short message service (SMS) the creation of personal text messaging*. Chichester, West Sussex, U.K.: Wiley.

Hevner, A. R., & Chatterjee, S. (2010). *Design research in information systems : theory and practice*: New York ; Springer, c2010.

Hightower, J., & Borrielo, G. (2011). Location systems for ubiquitous computing. *IEEE Computer, 34*(8), 29. doi: 10.1109/2.940014

Hornby, A. S. (1998). *Oxford Advanced Learners Dictionary*. New York: Oxford University Press.

Huang, X., & Brown, A. W. S. (1999). An analysis and classification of problems in small business. *In: International Small Business Journal. (International Small Business Journal, 18*(1), 12. doi: 10.1177/0266242699181004

IBM. (2013). IBM SPSS software. Retrieved 01 April 2013, from http://www-01.ibm.com/software/analytics/spss/

ISO 27001. (2005). Information Security Management – Specification with Guidance for Use. London: ISO.

ITU. (2010). The World in 2010: ICT Facts and Figures: International Telecommunications Union.

Jakic, V. (2011). Empirical research into use of marketing by small businesses. *TTEM- Technics Technologies Education Management, 6*(4), 1204.

Jongepier, J. (2011). *Young adopters of Smartphones: Examining determinants of the adoption decision.* (Master of Arts), Erasmus University Rotterdam,, The Netherlands.

Katankar, V. K., & Thakare, V. M. (2010). Short Message Service using SMS Gateway. *International Journal on Computer Science and Engineering, 2*(4), 4.

Kelly, T. (2007). *The Art of Innovation: Lessons in Creativity from IDEO, America's Leading Design FirmThe Art of Innovation*: Crown Business.

Kenya National Bureau of Statistics. (1999). Analytical Report on Migration and Urbanization *Kenya 1999 Population and Housing Census* (Vol. 6, pp. 98). Nairobi, Kenya.: Kenya National Bureau of Statistics.

Kenya National Bureau of Statistics. (2013). Economic Survey 2013 (pp. 330). Nairobi, Kenya.: Kenya National Bureau of Statistics.

Kock, N., Gray, P., Hoving, R., Klein, H., Myers, M. D., & Rockart, J. (2002). IS Research Relevance Revisited: Subtle Accomplishment, Unfulfilled Promise, or Serial Hypocrisy? *Communications of the Association for Information Systems, 8*(1).

Kurkovsky, S., & Harihar, K. (2006). Using ubiquitous computing in interactive mobile marketing. *Personal and Ubiquitous Computing, 10*(4), 13. doi: 10.1007/s00779-005-0044-5

Labiod, H., Afifi, H., & Santis, C. d. (2007a). Bluetooth™: Architecture and Functions. In H. Labiod, H. Afifi & C. d. Santis (Eds.), *WI-FI™, Bluetooth™, Zigbee™ and Wimax™* (pp. 75-108). Netherlands: Springer Netherlands.

Labiod, H., Afifi, H., & Santis, C. d. (2007b). Wi-Fi™: Architecture and Functions. In H. A. Labiod, Hossam. Santis, Costantino de (Ed.), *WI-FI™, Bluetooth™, Zigbee™ and Wimax™* (pp. 5-74): Springer Netherlands.

Laudon, K., Laudon, J., & Dass, R. (2010). *Management Information System: Managing the Digital Firm* (11 ed.). India: Dorling Kindersley.

Lee, J. H., & Song, C.-H. (2013). Effects of Trust and Perceived Risk on User Acceptance of a New Technology Service. *Social Behavior & Personality, 41*(4), 12.

Lee, M. C. (2008). Factors influencing the adoption of internet banking: An integration of TAM and TPB with perceived risk and perceived benefit. *Electronic Commerce Research and Applications, 8*(3), 11. doi: 10.1016/j.elerap.2008.11.006

Leppanen, A. (2010). *Technology Trust Antecedents: Building the Platform for Technology-Enabled Performance.* (Masters in Information Systems Science), Aalto University, Helsinki School of Economics.

Macmillan Education. (Ed.) (2002) Macmillan English Dictionary for Advanced Learners (1st Edition ed.). Oxford: Macmillan Publishers Limited.

Malik, Y. (2011). Can Pakistan Build a Mobile Marketing Ecosystem? *International Journal of Mobile Marketing, 6*(2), 10.

Mann, D. (2004). *Hands-On Systematic Innovation for Business and Management*. Malaysia: Creax.

March, S. T., & Smith, G. F. (1995). Design and natural science in Information Technology (IT). *Decision Support Systems, 15*, 15.

McCloskey, D. (2004). Evaluating Electronic Commerce Acceptance with the Technology Acceptance Model. *Journal of Computer Information Systems, 44*(2), 9.

Medani, A., Gani, A., Zakaria, O., Zaidan, A. A., & Zaidan, B. B. (2011). Review of mobile short message service security issues and techniques towards the solution. *Scientific Research and Essays, 6*(6), 19. doi: 10.5897/SRE11.107

Mobile Marketing Association. (2011). Mobile Advertising Guidelines: Mobile Marketing Association.

Mobile Marketing Association. (2013). Mobile Advertising | Mobile Marketing Association. 2013, from http://www.mmaglobal.com/wiki/mobile-advertising

Moehrle, M. G. (2005). What is TRIZ? From Conceptual Basics to a Framework for Research. *Creativity & Innovation Management, 14*(1), 11. doi: 10.1111/j.1476-8691.2005.00320.x

Morris, l. (2011). How to Innovate: The Innovation Process *The Innovation Master Plan: The CEO's Guide to Innovation* (Special Edition ed., pp. 39).

NASA. (2004). *NASA Software Safety Guidebook*: National Aeronautics and Space Administration.

NESC. (2007). *Kenya Vision 2030 : The Popular Version.* Kenya: Government of the Republic of Kenya Retrieved from http://www.vision2030.go.ke/cms/vds/Popular_Version.pdf.

Oddity Software LLC. (2014). GIS Geocode Data - Sample Kenya Geocode Database. Retrieved 26 June 2014, 2014, from http://www.odditysoftware.com/gis/geocode/kenya-geocode-database_32.html#DOWNLOAD_SAMPLE

Orlikowski, W., & Iacono, C. (2001). Research commentary: desperately seeking the "IT" in IT research—a call to theorizing about the IT artifact. *Information Systems Research, 12*(2), 13.

Patnaik, S., Brunskill, E., & Thies, W. (2009). *Evaluating the accuracy of data collection on mobile phones: A study of forms, SMS, and voice.* Paper presented at the ICTD'09 Proceedings of the 3rd international conference on Information and communication technologies and development, Doha.

Patton, M. Q. (1990). *Qualitative Evaluation and Research Methods,* (Second ed.). London: Sage Pub-lications.

Pharr, J. M., & Weinrauch, J. D. (2007). Differentiators of Successful Small Business Advertising Strategy: Advice from Agencies Handling both Large and Small Business Clients. *Society for Marketing Advances Proceedings*, 4.

Placecast. (2013). Placecast :: How it works. Retrieved 22 Feb, 2013, from http://placecast.net/platform/impl.html

Popovici, S. (2010). Bluetooth Networks and Wireless Sensors. *Petroleum - Gas University of Ploiesti Bulletin, Technical Series, 62*(4), 6.

Portman, E. A., Gailey, M. L., Holmes, C. S., Burgiss, M. J., Smith, A. K., Pitts III, A. F., . . . Che, V. W.-y. (2005). United States Patent No. US6944447B2

Rahimian, V., & Habibi, J. (2008). *Performance evaluation of mobile software systems: challenges for a software engineer.* Paper presented at the 5th International Conference on Electrical Engineering, Computing Science and Automatic Control, Mexico City, MX.

Ramayah, T., & Ignatius, J. (2005). Impact of Perceived usefulness, Perceived ease of use and Perceived Enjoyment on Intention to shop online. *ICFAI Journal of Management, 3*(3), 15.

Rashid, O., Coulton, P., & Edwards, R. (2008). Providing location based information/advertising for existing mobile phone users. *Personal & Ubiquitous Computing, 12*(1), 8. doi: 10.1007/s00779-006-0121-4

Ratsameethammawong, P., & Kasemsan, M. L. K. (2010). Mobile Phone Location Tracking by the Combination of GPS, Wi-Fi and Cell Location Technology. *Communications of the IBIMA*, 7. doi: 10.5171/2010.566928

Ratsimor, O., Finin, T., Joshi, A., & Yesha, Y. (2003, 09/30/2003). *eNcentive: a framework for intelligent marketing in mobile peer-to-peer environments.* Paper presented at the Proceedings of the 5th international conference on Electronic commerce.

Roberts, M., & Wood, M. (2002). The strategic use of computerised information systems by a micro enterprise. *Logistics Information Management, 15*(2), 10.

Rogers, E. M. (1962). *Diffusion of Innovations* (1st Edition ed.). New York: Free Press.

Rogers, E. M. (1983). *Diffusion of Innovations* (3rd Edition ed.). New York: Free Press.

Rogers, E. M. (1995). *Diffusion of Innovations* (4th Edition ed.). New York: Free Press.

Rose, J., & Fogarty, G. (2006). *Determinants of Perceived Usefulness and Perceived Ease of Use in the Technology Acceptance Model: Senior Consumers' Adoption of Self-Service Banking Technologies.* Paper presented at the Academy of World Business, Marketing & Management Development.

Rosenberg, N., & Kline, S. J. (2010). An Overview of Innovation. In N. Rosenberg (Ed.), *Studies on science and the innovation process [electronic book] selected works / by Nathan Rosenberg.* (pp. 32). Singapore: World Scientific.

Rutledge, P. A., Wong, J. K., Smith, R. A., & Reinink, K. (1998). United States Patent No.

Saadeghvaziri, F., & Seyedjavadain, S. (2011). Attitude toward Advertising: Mobile Advertising Vs Advertising-in-General. *European Journal of Economics, Finance & Administrative Sciences*(28), 11.

Safaricom Ltd. (2014). Value Added Services. Retrieved 30th May, 2014, from http://www.safaricom.co.ke/personal/value-added-services

Sammut, M., Montebello, M., & Camilleri, V. (2010). Location Based Mobile Advertising. *Proceedings of the IADIS International Conference on WWW/Internet*, 4.

Sanganagouda, J. (2011). USSD - A Potential Communication Technology that can Ouster SMS Dependency. *International Journal of Research & Reviews in Computer Science, 2*(2), 10.

Scharl, A., Dickinger, A., & Murphy, J. (2005). Diffusion and success factors of mobile marketing. *Electronic Commerce Research and Applications, 4*(2), 159-173. doi: 10.1016/j.elerap.2004.10.006

Sheu, D. D., & Lee, H. K. (2011). A proposed process for systematic innovation. *International Journal of Production Research, 49*(3), 22. doi: 10.1080/00207540903280549

Shulist, J. (2012). Safaricom Kenya Feasibility Study *GSMA Community Power from Mobile* (pp. 11). London: GSMA Alliance.

Slovic, P., & Alhakami, A. S. (1994). A Psychological Study of the Inverse Relationship Between Perceived Risk and Perceived Benefit. *Risk Analysis: An International Journal. Dec94, 14*(6), 12.

Smit, L., Stander, A., & Ophoff, J. (2012). An Analysis of Base Station Location Accuracy within Mobile-Cellular Networks. *International Journal of Cyber-Security and Digital Forensics (IJCSDF), 1*(4), 8.

Solanki, P., & Hu, H. (2005). Techniques used for Location-based Services: A survey. United Kingdom: University of Essex.

Soper, D. (2012). Is Human Mobility Tracking a Good Idea? *Communications of the ACM. Apr2012, 55*(4), 3. doi: 10.1145/2133806.2133819

Steiniger, S., Neun, M., & Edwardes, A. (2006). Foundations of Location Based Services (Geogrpaphy, Trans.) *Lecture Note on LBS* (1.0 ed., pp. 28). Zurich: University of Zurich.

Stone, M. A., & Desmond, J. (2006). *Fundamentals of Marketing* (pp. 505). Retrieved from University of Liverpool Catalogue database

Su, S.-p., Tsai, C.-h., & Hsu, W.-l. (2013). Extending the TAM Model to Explore the Factors Affecting Intention to Use Telecare Systems. *Journal of Computers, 8*(2), 8. doi: 10.4304/jcp.8.2.525-532

Suki, N. M., & Suki, N. M. (2011). Relationship between Perceived Usefulness, Ease of Use, Enjoyment, Attitude and Subscribers' Intention Towards Using 3G Mobile Services. *Journal of Information Technology Management Volume, 22*(1), 7.

Svennerberg, G. (2010). Location, Location, Location. *Beginning Google Maps Api 3* (pp. 329): Apress.

Thakur, R., & Srivastava, M. (2013). Customer usage intention of mobile commerce in India: an empirical study. *Journal of Indian Business Research, 5*(1), 12.

Thaw, Y. Y., Mahmood, A. K., & Dominic, P. D. D. (2009). A Study on the Factors That Influence the Consumers Trust on Ecommerce Adoption. *International Journal of Computer Science and Information Security, 4*(1), 23.

Trevisani, E., & Vitaletti, A. (2004). *Cell-ID location technique, limits and benefits: an experimental study.* Paper presented at the Mobile Computing Systems and Applications, 2004. WMCSA 2004. Sixth IEEE Workshop on, Windermere, Cumbria, UK.

Venkatesh, V. (2000). Determinants of Perceived Ease of Use: Integrating Control, Intrinsic Motivation, and Emotion into the Technology Acceptance Model. *Information Systems Research, 11*(4), 23. doi: 10.1287/isre.11.4.342.11872

Wadhe, A., & Sable, N. A. (2013). Mobile SMS Banking Security Using Elliptic Curve Cryptosystem In Binary Field. *International Journal of Engineering Research and Applications (IJERA), 3*(3), 8.

Wamuyu, P. K., & Maharaj, M. (2011). Factors influencing successful use of mobile technologies to facilitate E-commerce in small enterprises: The case of Kenya. *African Journal of Information Systems, 3*(2), 25.

Wendel, S., Dellaert, B. G., Ronteltap, A., & van Trijp, H. C. (2013). Consumers' intention to use health recommendation systems to receive personalized nutrition advice. *BMC Health Services Research [BMC Health Serv Res] 2013 Apr 04, 13*(126), 13. doi: 10.1186/1472-6963-13-126

Wu, G., & Gao, X. (2004). Algorithms and Infrastructures for Location-Based Services. In S. Dixit & T. Wu (Eds.), *Content Networking in the Mobile Internet* (pp. 34). Hoboken, NJ, USA: Wiley.

Wu, S.-y., & Wu, K.-T. (2006). Effective location based services with dynamic data management in mobile environments. *Wireless Networks, 12*(3), 13.

Xu, J., & Quaddus, M. (2013). *Managing Information Systems*: Atlantis Press.

Yezersky, G. (2007). General Theory of Innovation. *Trends in Computer Aided Innovation*, 11.

APPENDIX A

MICROENTERPRISES QUESTIONNAIRE

Factors influencing awareness, utilization and potential for use of location-based mobile advertising

1. Age _____
2. Gender
   - o Male
   - o Female
3. Highest educational Level
   - □ Class 8
   - □ Form 4
   - □ Diploma
   - □ Degree
   - □ Masters Degree
   - □ PhD
4. What type of phone do you use?
   a. Basic Phone (Call & SMS features only)
   b. Feature Phone (Basic features + Internet)
   c. Smart Phone (Internet Video & install applications)
5. What type of business / service / product do you offer? _____
6. How do you advertise your services?
   - □ Word of mouth
   - □ Customer referrals
   - □ Posters and flyers
   - □ Signposts
   - □ Newspapers
   - □ Magazines
   - □ Radio
   - □ TV
   - □ Notice boards
   - □ Telephone directory
   - □ Internet / Website
   - □ SMS
   - □ Other _____
   - □ I do not advertise

7. What is your opinion on the following statements?

	No	Not Sure	Yes
□ I would be comfortable using a new mobile service if there is help.			
□ I would be comfortable using a new mobile service if I have enough time to complete a transaction.			
□ I am able to learn how to use new phones on my own.			
□ I am able to learn how to use new mobile services on my own.			
□ I find using mobile phones for functions other than SMS and calling easy.			
□ I prefer to use simple mobile phones.			
□ I am interested in learning about new technology applications			
□ I only use technologies that I am familiar with.			
□ I only use technologies that are reliable.			
□ I do not use technologies that have failed before.			

8. Have you ever heard of the term 'location based mobile advertising'?

   o Yes o No

9. Consider the following description:

   "A system that can store your name, mobile phone number, location and service or product that you offer. This information will be accessed by potential clients to access it using an SMS shortcode service. Once your mobile number is sent to the potential client you will also receive their mobile number".

	No	Not Sure	Yes
1. I would like to use such an application.			
2. You can contact me to test the application.			

3. I would like to know more about the application.			
4. I will only try using the application if it does not look complicated			
5. I would prefer to use the application if it is based on a simple technology like SMS			
6. I would prefer to use the system if I do not need to learn about new technologies			
7. I would use the application if I do not have to change mobile providers			
8. I would use the application if it takes a short while to learn.			
9. I would use the application if it works on the technologies I am already familiar with.			
10. The application can help me increase my profits			
11. The application can make it easier to get clients.			
12. Giving out my personal details to unknown clients is risky.			
13. Getting calls from new clients might interfere with my performance with the existing ones.			
14. Being listed on such a service might associate me with illegal activities or crime if it is misused.			
15. I would prefer to get paid a deposit before going out to meet a client.			
16. I fear that some clients might call and not give me business.			
17. Getting calls from clients at odd hours might interfere with my privacy.			
18. I would use it if it was a Java or Android based mobile applications			
19. I would use it if it required internet access			
20. I would use it if it was SMS based			
21. I would use it if it was USSD based.			

APPENDIX B

OBJECTIVE ONE RESULTS

Table 13: Inter-item correlations

	v1	v2	v3	v4	v5	v6	v7	v8	v9	v10	v11	v12	v13	v14	v15	v16	v17	v18
v1	1.00	0.63	0.19	0.08	-0.10	0.47	-0.03	-0.19	0.07	0.04	0.20	0.08	0.05	0.15	-0.05	-0.45	0.08	-0.25
v2	0.63	1.00	0.25	0.24	-0.10	0.41	-0.12	-0.21	0.08	0.15	0.08	0.08	0.12	0.22	0.03	-0.33	0.00	-0.17
v3	0.19	0.25	1.00	0.66	-0.15	0.30	-0.33	-0.18	0.14	0.43	0.07	0.15	0.30	0.37	0.19	0.06	-0.05	0.22
v4	0.08	0.24	0.66	1.00	-0.10	0.31	-0.23	-0.21	0.14	0.40	0.09	0.18	0.34	0.37	0.23	0.02	-0.15	0.21
v5	-0.10	-0.10	-0.15	-0.10	1.00	-0.01	0.27	0.23	-0.10	-0.36	-0.07	-0.17	-0.18	-0.19	-0.06	0.04	0.08	-0.06
v6	0.47	0.41	0.30	0.31	-0.01	1.00	-0.07	-0.25	0.21	0.16	0.04	0.02	0.04	0.18	0.12	-0.29	0.01	-0.10
v7	-0.03	-0.12	-0.33	-0.23	0.27	-0.07	1.00	0.27	-0.12	-0.44	-0.07	-0.26	-0.33	-0.31	-0.10	-0.04	0.14	-0.12
v8	-0.19	-0.21	-0.18	-0.21	0.23	-0.25	0.27	1.00	-0.20	-0.12	-0.21	0.02	-0.04	-0.47	-0.18	-0.06	0.03	-0.14
v9	0.07	0.08	0.14	0.14	-0.10	0.21	-0.12	-0.20	1.00	0.30	-0.13	-0.06	0.04	0.27	0.33	0.10	-0.08	0.18
v10	0.04	0.15	0.43	0.40	-0.36	0.16	-0.44	-0.12	0.30	1.00	0.06	0.24	0.43	0.43	0.32	0.10	-0.04	0.35
v11	0.20	0.08	0.07	0.09	-0.07	0.04	-0.07	-0.21	-0.13	0.06	1.00	0.30	0.15	0.20	-0.16	-0.01	0.12	0.03
v12	0.08	0.08	0.15	0.18	-0.17	0.02	-0.26	0.02	-0.06	0.24	0.30	1.00	0.55	0.19	-0.08	-0.01	-0.02	-0.10
v13	0.05	0.12	0.30	0.34	-0.18	0.04	-0.33	-0.04	0.04	0.43	0.15	0.55	1.00	0.35	0.09	0.06	-0.11	0.12
v14	0.15	0.22	0.37	0.37	-0.19	0.18	-0.31	-0.47	0.27	0.43	0.20	0.19	0.35	1.00	0.26	0.15	-0.12	0.20
v15	-0.05	0.03	0.19	0.23	-0.06	0.12	-0.10	-0.18	0.33	0.32	-0.16	-0.08	0.09	0.26	1.00	0.38	-0.03	0.53
v16	-0.45	-0.33	0.06	0.02	0.04	-0.29	-0.04	-0.06	0.10	0.10	-0.01	-0.01	0.06	0.15	0.38	1.00	-0.05	0.50
v17	0.08	0.00	-0.05	-0.15	0.08	0.01	0.14	0.03	-0.08	-0.04	0.12	-0.02	-0.11	-0.12	-0.03	-0.05	1.00	-0.06
v18	-0.25	-0.17	0.22	0.21	-0.06	-0.10	-0.12	-0.14	0.18	0.35	0.03	-0.10	0.12	0.20	0.53	0.50	-0.06	1.00

Key:

	Item
v1	I will only try using the application if it does not look complicated
v2	I would prefer to use the application if it is based on a simple technology like SMS
v3	I would prefer to use the system if I do not need to learn about new technologies
v4	I would use the application if I do not have to change mobile providers
v5	I would use the application if it takes a short while to learn.
v6	I would use the application if it works on the technologies I am already familiar with.
v7	The application can help me increase my profits
v8	The application can make it easier to get clients.
v9	Giving out my personal details to unknown clients is risky.
v10	Getting calls from new clients might interfere with my performance with the existing ones.
v11	Being listed on such a service might associate me with illegal activities or crime if it is misused.
v12	I would prefer to get paid a deposit before going out to meet a client.
v13	I fear that some clients might call and not give me business.
v14	Getting calls from clients at odd hours might interfere with my privacy.
v15	I would use it if it was a Java or Android based mobile applications
v16	I would use it if it required internet access
v17	I would use it if it was SMS based
v18	I would use it if it was USSD based.

Table 14: Initial KMO and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.740
Bartlett's Test of Sphericity	Approx. Chi-Square	1639.578
	df	136
	Sig.	.000

Table 15: Initial anti-image matrices

	v1	v2	v3	v4	v5	v6	v7	v8	v9	v10	v11	v12	v13	v14	v15	v16	v17
v1	.670[a]	-.491	-.162	.206	.053	-.238	-.077	.029	-.054	.066	-.221	-.009	-.026	-.040	-.086	.274	.068
v2	-.491	.775[a]	-.013	-.112	-.010	-.059	.034	.053	.050	-.055	.072	.018	-.020	-.057	-.053	.073	.081
v3	-.162	-.013	.758[a]	-.543	.024	-.106	.172	-.082	.037	-.099	.064	.030	.000	-.089	.096	-.128	-.100
v4	.206	-.112	-.543	.742[a]	-.056	-.143	-.089	.084	.021	-.065	-.051	-.035	-.135	-.060	-.093	.114	-.031
v5	.053	-.010	.024	-.056	.715[a]	-.123	-.060	-.215	-.004	.289	-.029	.088	-.012	-.052	-.007	-.060	-.029
v6	-.238	-.059	-.106	-.143	-.123	.803[a]	-.048	.158	-.121	-.077	.023	-.014	.066	.050	-.113	.154	.091
v7	-.077	.034	.172	-.089	-.060	-.048	.804[a]	-.246	-.012	.253	-.052	.119	.091	-.007	-.031	-.032	-.025
v8	.029	.053	-.082	.084	-.215	.158	-.246	.632[a]	.072	-.231	.184	-.122	-.089	.383	.051	.042	.071
v9	-.054	.050	.037	.021	-.004	-.121	-.012	.072	.789[a]	-.189	.150	.039	.054	-.129	-.154	-.035	.016
v10	.066	-.055	-.099	-.065	.289	-.077	.253	-.231	-.189	.787[a]	-.036	-.029	-.172	-.200	-.094	.084	-.225
v11	-.221	.072	.064	-.051	-.029	.023	-.052	.184	.150	-.036	.528[a]	-.259	.038	-.095	.233	-.066	-.160
v12	-.009	.018	.030	-.035	.088	-.014	.119	-.122	.039	-.029	-.259	.652[a]	-.447	-.012	.001	-.079	.192
v13	-.026	-.020	.000	-.135	-.012	.066	.091	-.089	.054	-.172	.038	-.447	.772[a]	-.164	.013	.004	-.052
v14	-.040	-.057	-.089	-.060	-.052	.050	-.007	.383	-.129	-.200	-.095	-.012	-.164	.822[a]	-.051	-.122	.068
v15	-.086	-.053	.096	-.093	-.007	-.113	-.031	.051	-.154	-.094	.233	.001	.013	-.051	.731[a]	-.242	-.373
v16	.274	.073	-.128	.114	-.060	.154	-.032	.042	-.035	.084	-.066	-.079	.004	-.122	-.242	.737[a]	-.267
v17	.068	.081	-.100	-.031	-.029	.091	-.025	.071	.016	-.225	-.160	.192	-.052	.068	-.373	-.267	.728[a]

Key:

	Item
v1	I will only try using the application if it does not look complicated
v2	I would prefer to use the application if it is based on a simple technology like SMS
v3	I would prefer to use the system if I do not need to learn about new technologies
v4	I would use the application if I do not have to change mobile providers
v5	I would use the application if it takes a short while to learn.
v6	I would use the application if it works on the technologies I am already familiar with.
v7	The application can help me increase my profits
v8	The application can make it easier to get clients.
v9	Giving out my personal details to unknown clients is risky.
v10	Getting calls from new clients might interfere with my performance with the existing ones.
v11	Being listed on such a service might associate me with illegal activities or crime if it is misused.
v12	I would prefer to get paid a deposit before going out to meet a client.
v13	I fear that some clients might call and not give me business.
v14	Getting calls from clients at odd hours might interfere with my privacy.
v15	I would use it if it was a Java or Android based mobile applications
v16	I would use it if it required internet access
v17	I would use it if it was USSD based.

Table 16: Initial communalities

	Initial	Extraction
I will only try using the application if it does not look complicated	1	0.696
I would prefer to use the application if it is based on a simple technology like SMS	1	0.608
I would prefer to use the system if I do not need to learn about new technologies	1	0.662
I would use the application if I do not have to change mobile providers	1	0.691
I would use the application if it takes a short while to learn.	1	0.595
I would use the application if it works on the technologies I am already familiar with.	1	0.601
The application can help me increase my profits	1	0.482
The application can make it easier to get clients.	1	0.722
Giving out my personal details to unknown clients is risky.	1	0.487
Getting calls from new clients might interfere with my performance with the existing ones.	1	0.678
Being listed on such a service might associate me with illegal activities or crime if it is misused.	1	0.721
I would prefer to get paid a deposit before going out to meet a client.	1	0.637
I fear that some clients might call and not give me business.	1	0.651
Getting calls from clients at odd hours might interfere with my privacy.	1	0.588
I would use it if it was a Java or Android based mobile applications	1	0.605
I would use it if it required internet access	1	0.684
I would use it if it was USSD based.	1	0.654

Extraction Method: Principal Component Analysis.

Table 17: Initial factor loadings based on a principal components analysis for 17 items of the intention to use location-based mobile advertising scale (n=304)

		Component				
		1	2	3	4	5
V1	I will only try using the application if it does not look complicated	.300	-.743	.217	-.083	.028
V2	I would prefer to use the application if it is based on a simple technology like SMS	.410	-.621	.229	.040	.008
V3	I would prefer to use the system if I do not need to learn about new technologies	.695	-.019	.044	.350	.234
V4	I would use the application if I do not have to change mobile providers	.675	.000	.032	.363	.320
V5	I would use the application if it takes a short while to learn.	-.387	.017	.187	.275	.578
V6	I would use the application if it works on the technologies I am already familiar with.	.408	-.485	.410	.139	.106
V7	The application can help me increase my profits	-.555	-.060	.251	.086	.316
V8	The application can make it easier to get clients.	-.478	.066	-.248	.649	-.079
V9	Giving out my personal details to unknown clients is risky.	.370	.163	.448	-.023	-.349
V10	Getting calls from new clients might interfere with my performance with the existing ones.	.723	.205	-.107	.159	-.277
V11	Being listed on such a service might associate me with illegal activities or crime if it is misused.	.221	-.204	-.389	-.505	.473
V12	I would prefer to get paid a deposit before going out to meet a client.	.358	-.123	-.699	.066	.014
V13	I fear that some clients might call and not give me business.	.561	.038	-.536	.218	-.011
V14	Getting calls from clients at odd hours might interfere with my privacy.	.698	.064	.025	-.292	.099
V15	I would use it if it was a Java or Android based mobile applications	.416	.487	.439	.048	.001
V16	I would use it if it required internet access	.091	.777	-.007	-.143	.225
V17	I would use it if it was USSD based.	.344	.682	.184	-.045	.185
	Extraction Method: Principal Component Analysis.					

Table 18: Final KMO and Bartlett's Test

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.767
Bartlett's Test of Sphericity	Approx. Chi-Square	1361.505
	df	91
	Sig.	.000

Table 19: Final anti-image Matrices

	v1	v2	v3	v4	v5	v6	v7	v8	v9	v10	v11	v12	v13	v14
v1	.675[a]	-0.494	-0.147	0.198	-0.249	-0.068	-0.025	0.064	-0.069	-0.009	-0.104	-0.037	0.268	0.027
v2	-0.494	.762[a]	-0.014	-0.114	-0.068	0.049	0.038	-0.046	0.042	-0.019	-0.073	-0.072	0.077	0.091
v3	-0.147	-0.014	.764[a]	-0.538	-0.094	0.160	0.032	-0.128	0.041	-0.011	-0.049	0.085	-0.119	-0.081
v4	0.198	-0.114	-0.538	.739[a]	-0.164	-0.077	0.025	-0.038	-0.041	-0.127	-0.114	-0.084	0.104	-0.050
v5	-0.249	-0.068	-0.094	-0.164	.820[a]	-0.021	-0.134	-0.020	0.010	0.079	-0.010	-0.125	0.145	0.080
v6	-0.068	0.049	0.160	-0.077	-0.021	.842[a]	0.009	0.247	0.103	0.068	0.103	-0.018	-0.030	-0.011
v7	-0.025	0.038	0.032	0.025	-0.134	0.009	.765[a]	-0.189	0.085	0.054	-0.149	-0.197	-0.028	0.037
v8	0.064	-0.046	-0.128	-0.038	-0.020	0.247	-0.189	.839[a]	-0.079	-0.198	-0.139	-0.092	0.114	-0.221
v9	-0.069	0.042	0.041	-0.041	0.010	0.103	0.085	-0.079	.651[a]	-0.463	-0.009	0.066	-0.092	0.169
v10	-0.009	-0.019	-0.011	-0.127	0.079	0.068	0.054	-0.198	-0.463	.762[a]	-0.132	0.006	0.010	-0.038
v11	-0.104	-0.073	-0.049	-0.114	-0.010	0.103	-0.149	-0.139	-0.009	-0.132	.886[a]	-0.036	-0.165	0.012
v12	-0.037	-0.072	0.085	-0.084	-0.125	-0.018	-0.197	-0.092	0.066	0.006	-0.036	.757[a]	-0.235	-0.352
v13	0.268	0.077	-0.119	0.104	0.145	-0.030	-0.028	0.114	-0.092	0.010	-0.165	-0.235	.729[a]	-0.290
v14	0.027	0.091	-0.081	-0.050	0.080	-0.011	0.037	-0.221	0.169	-0.038	0.012	-0.352	-0.290	.754[a]

Key:

v1	I will only try using the application if it does not look complicated
v2	I would prefer to use the application if it is based on a simple technology like SMS
v3	I would prefer to use the system if I do not need to learn about new technologies
v4	I would use the application if I do not have to change mobile providers
v5	I would use the application if it works on the technologies I am already familiar with.
v6	The application can help me increase my profits
v7	Giving out my personal details to unknown clients is risky.
v8	Getting calls from new clients might interfere with my performance with the existing ones.
v9	I would prefer to get paid a deposit before going out to meet a client.
v10	I fear that some clients might call and not give me business.
v11	Getting calls from clients at odd hours might interfere with my privacy.
v12	I would use it if it was a Java or Android based mobile applications
v13	I would use it if it required internet access
v14	I would use it if it was USSD based.

Table 20: Final Communalities

	Initial	Extraction
I will only try using the application if it does not look complicated	1.000	.688
I would prefer to use the application if it is based on a simple technology like SMS	1.000	.618
I would prefer to use the system if I do not need to learn about new technologies	1.000	.532
I would use the application if I do not have to change mobile providers	1.000	.500
I would use the application if it works on the technologies I am already familiar with.	1.000	.581
The application can help me increase my profits	1.000	.384
Giving out my personal details to unknown clients is risky.	1.000	.361
Getting calls from new clients might interfere with my performance with the existing ones.	1.000	.587
I would prefer to get paid a deposit before going out to meet a client.	1.000	.635
I fear that some clients might call and not give me business.	1.000	.665
Getting calls from clients at odd hours might interfere with my privacy.	1.000	.451
I would use it if it was a Java or Android based mobile applications	1.000	.616
I would use it if it required internet access	1.000	.630
I would use it if it was USSD based.	1.000	.653

Extraction Method: Principal Component Analysis.

Table 21: Correlations between risk, convenience and perceived benefits

		Risk	**Benefits**	**Convenience**
Risk	Correlation	1	.186**	.349**
	P value		.001	.000
Benefits	Correlation	.186**	1	.325**
	P value	.001		.000
Convenience	Correlation	.349**	.325**	1
	P value	.000	.000	

***. Correlation is significant at the 0.01 level (2-tailed).*

APPENDIX C

SYSTEM CORE SOURCE CODE

```
<?php
@session_name('lbs');
@session_start();
header('Content-type: text/plain');

// Web interface for registration ... USSD and SMS for searching only.

require_once('../includes/config.php');
require_once('../classes/functions.php');

//SMS Gateway API
require_once('../classes/AfricasTalkingGateway.php');

// SMS login credentials
$username   = "secret";
$apiKey     = "secret";

// Reads the variables sent via POST from our gateway
$sessionId   = $_POST["sessionId"];
$serviceCode = $_POST["serviceCode"];
$phoneNumber = $_POST["phoneNumber"];
```

```
$text       = $_POST["text"];

// Get the registered user ID from the phone number
$UserID = getUserID_Mobile($CON,$phoneNumber);

// Ensure that the message comprises of characters between A – Z and 0 - 9
if (preg_replace('/[^A-Za-z0-9\-]/', '', $text)!='') {
        // If the session has been started then query it to get the current state and determine the next menu level to display
        if (isset($sessionId)) {
        $SQL_GET_STATE = " SELECT * FROM lbs_state WHERE SessionID = ".$sessionId." ORDER BY TransactionTime DESC LIMIT
1";
        $RESULT_GET_STATE = mysqli_query($CON,$SQL_GET_STATE) or die(mysqli_error($CON).$SQL_GET_STATE);
        $RESULT_SET_ARRAY_GET_STATE = mysqli_fetch_assoc($RESULT_GET_STATE);
        $RESULT_SET_NUM_ROWS_GET_STATE = mysqli_num_rows($RESULT_GET_STATE);

                if ($RESULT_SET_NUM_ROWS_GET_STATE>0) {
                        if ($RESULT_SET_ARRAY_GET_STATE['Level']==0) {
                                $text = preg_replace('/[^1-9\-]/', '', $text);
                                        if ($text!='') {
                                                        $path = $text;
                                                        $NextLevel = $RESULT_SET_ARRAY_GET_STATE['Level']+ 1;
                                                } else {
                                                        $path = 0;
                                                        $NextLevel = 0;
                                                }
                                } else {
                                        $path = $RESULT_SET_ARRAY_GET_STATE['Path'] ;
                                        $NextLevel = $RESULT_SET_ARRAY_GET_STATE['Level']+ 1;
```

```
                        }

                } else {
                        $path = $text;
                        $NextLevel = 1;
                }
        }
} else {
        $NextLevel = 0;
        $path = 0 ;
}

// Clear the $SQL and response variables
$SQL = "";
$response = "";

// if the text is 0 then this is the first step in the process
if ($text=='0') {
        $NextLevel = 0;
        $path = 0 ;
}

//Select the path / menu option based on the value of the path variable
switch ($path) {
        case 0:
        //The first step … display the main menu
                echo getMainMenu();
                $NextLevel = 0;
```

```
        $path = 0 ;
break;

case 1:
//Information search process
        if (!getUserID_Mobile($CON,$phoneNumber)) {
                        // The user has not been registered
                        $response = "CON You must be registered as a user first\n";
                        echo getMainMenu();
                        $NextLevel = 0;
                        $path = 0 ;
                } else {
                        $text = str_replace('*','',strrchr($text,'*'));
                        switch ($NextLevel) {
                                case 1:
                                        // Build the county list query
                                        $SQL = "SELECT * FROM lbs_county";
                                        $response = "CON Information Search - Please select a county\n ";
                                break;

                                case 2:
                                        //Save the County ID first
                                         $CountyID = getCountyID($CON, $text);
                                         $UserID = getUserID_Mobile($CON,$phoneNumber);
                                        $SQL_INSERT = "INSERT INTO lbs_search (EntryDate,UserID,SessionID,CountyID)
                                        VALUES ('".date('Y-m-d H:i:s')."',".$UserID.",".$sessionId.",".$CountyID.") ";
                                        $RESULT_SET_INSERT = mysqli_query($CON,$SQL_INSERT) or
                                        die(mysqli_error($CON).$SQL_INSERT);
```

```
            // Build the location query
            $SQL = "SELECT * FROM lbs_location WHERE CountyID = ".$text." ";
            $response = "CON Information Search - Please select a location\n ";
break;

case 3:
            //Save the Location ID first
            $LocationID = getLocationID($CON, $text);
            $SQL_UPDATE = "UPDATE lbs_search SET LocationID  = ".$LocationID." WHERE
            SessionID = ".$sessionId." ";
            $RESULT_SET_UPDATE = mysqli_query($CON,$SQL_UPDATE) or
            die(mysqli_error($CON).$SQL_UPDATE);
            // Query the product category
            $SQL = "SELECT * FROM lbs_category";
            $response = "CON Information Search - Please select a product / service category\n ";
break;

case 4:
            //Save the Category ID first
            $CategoryID = getCategoryID($CON, $text);
            $SQL_UPDATE = "UPDATE lbs_search SET CategoryID  = ".$CategoryID." WHERE
            SessionID = ".$sessionId." ";
            $RESULT_SET_UPDATE = mysqli_query($CON,$SQL_UPDATE) or
            die(mysqli_error($CON).$SQL_UPDATE);

            // Query the product category
            $SQL = "SELECT * FROM lbs_product WHERE CategoryID = ".$text."";
```

```
        $response = "CON Information Search - Please select a product / service\n ";
break;

case 5:
        //Save the Product ID first
        $ProductID = getProductID($CON, $text);

        $SQL_UPDATE = "UPDATE lbs_search SET ProductID  = ".$ProductID." WHERE
        SessionID = ".$sessionId." ";
        $RESULT_SET_UPDATE = mysqli_query($CON,$SQL_UPDATE) or
        die(mysqli_error($CON).$SQL_UPDATE." ProdID ".$ProductID." Text ".$text);

        // Query the product category
        $SQL_SEARCH = "SELECT * FROM lbs_search WHERE SessionID = ".$sessionId."";
        $RESULT_SET_SEARCH = mysqli_query($CON,$SQL_SEARCH) or
        die(mysqli_error($CON).$SQL_SEARCH);
        $RESULT_SET_ARRAY_SEARCH = mysqli_fetch_assoc($RESULT_SET_SEARCH);
        $RESULT_SET_NUM_ROWS_SEARCH =
        mysqli_num_rows($RESULT_SET_SEARCH);

        $SearchID = $RESULT_SET_ARRAY_SEARCH['ID'];

        $SQL_FINAL = "SELECT * FROM lbs_providers WHERE ProductID =
        ".$RESULT_SET_ARRAY_SEARCH['ProductID']." AND LocationID =
        ".$RESULT_SET_ARRAY_SEARCH['LocationID']." ORDER BY TransactionTime ASC
        LIMIT 0,3";
        $RESULT_SET_FINAL = mysqli_query($CON,$SQL_FINAL) or
        die(mysqli_error($CON).$SQL_FINAL);
```

```
$RESULT_SET_ARRAY_FINAL  = mysqli_fetch_assoc($RESULT_SET_FINAL);
$RESULT_SET_NUM_ROWS_FINAL  = mysqli_num_rows($RESULT_SET_FINAL);

$ProductName =
getProductName($CON,$RESULT_SET_ARRAY_SEARCH['ProductID']);
$LocationName =
getLocationName($CON,$RESULT_SET_ARRAY_SEARCH['LocationID']);

 if ($RESULT_SET_NUM_ROWS_FINAL>0) {
        // Prepare message to the person making the inquiry
        $response = "END Providers for ".$ProductName." in ".$LocationName." found.
        You will receive the contacts on SMS";
        $UserMessage = "Providers for ".$ProductName." in ".$LocationName." " ;

        // get the confirmation code
        $ConfirmationCode = getCode($CON);
        do {
                $Mobile =
                getUserMobile($CON,$RESULT_SET_ARRAY_FINAL['UserID']);
                $Name =
                getUserName($CON,$RESULT_SET_ARRAY_FINAL['UserID']);
                $Mobile_Formatted = "0".substr($Mobile,3,9);
                $UserMessage .= $Name." ".$Mobile_Formatted.", ";

        } while ( $RESULT_SET_ARRAY_FINAL  =
        mysqli_fetch_assoc($RESULT_SET_FINAL) ) ;

        $UserMessage .= "Confirmation Code ".$ConfirmationCode;
```

```
                                        $UserID = getUserID_Mobile($CON,$phoneNumber);

                                        $SQL_INSERT = "INSERT INTO lbs_confirmation
                                        (SearchID,UserID,ConfirmationCode,EntryDate) VALUES
                                        (".$SearchID.",".$UserID.",'".$ConfirmationCode."','".date('Y-m-d H:i:s')."') ";
                                        $RESULT_SET_INSERT = mysqli_query($CON,$SQL_INSERT) or
                                        die(mysqli_error($CON).$SQL_INSERT);

                                        // Add the advert
                                        $UserMessage .= getAdvert ($CON,$UserID,$sessionId,1);

                                        } else {
                                                $response = "END No Providers found for ".$ProductName." in
                                                ".$LocationName."\n ";
                                        }
                                break;

                        default:
                                display_menu();
                                $NextLevel = 0;
                                $path = 0 ;

                                break;
                }
        }
break;
```

```
case 2:
// Registration Process
        if (getUserID_Mobile_Reg($CON,$phoneNumber)==='') {
                // The user has not been registered
                $response = "CON ".str_replace('+','',$phoneNumber)." Sorry, we have not received your registration
                information!\n";
                        $NextLevel = 0;
                        $path = 0 ;
                } else {
                        $UserID = getUserID_Mobile_Reg($CON,$phoneNumber);
                        $SQL_UPDATE = "UPDATE lbs_user SET Confirmed = 'Y', ConfirmationDate = '".date('Y-m-d H:i:s')."'
                        WHERE ID = ".$UserID."";
                        $RESULT_SET_UPDATE = mysqli_query($CON,$SQL_UPDATE) or
                        die(mysqli_error($CON).$SQL_UPDATE);
                        $response = "END ".getMainMenu()." ";
                        $Username = getUserName ($CON,$UserID);

                        if($RESULT_SET_UPDATE) {
                                $response = "END ".$Username.", your registration was successful.\n".getMainMenu()." " ;
                                $NextLevel = 0;
                                $path = 0 ;
                        } else {
                                $response = "END ".$Username.", your registration was not successful. Please try
                                again.\n".getMainMenu()." " ;
                                $NextLevel = 0;
                                $path = 0 ;
                        }
                }
```

```
break;

case 3:
//Register as a provider
        $text = str_replace('*','',strrchr($text,'*'));
        //Check if user is already registered
        if (getUserID_Mobile($CON,$phoneNumber)=='') {
                        // The user has not been registered
                        $response = "CON ".str_replace('+','',$phoneNumber)." You must be registered as a user first
                        ".getMainMenu()." ";
                        $NextLevel = 0;
                        $path = 0 ;
                } else {

                switch ($NextLevel) {
                                case 1:
                                        // Build the county list query
                                        $SQL = "SELECT * FROM lbs_county";
                                        $response = "CON Provider Registration - Please select a county\n";
                                break;

                                case 2:
                                         //Save the County ID first
                                         $CountyID = getCountyID($CON, $text);
                                         $UserID = getUserID_Mobile($CON,$phoneNumber);
                                        $SQL_INSERT = "INSERT INTO lbs_register (SessionID,UserID,CountyID) VALUES
                                        (".$sessionId.",".$UserID.",".$CountyID.") ";
```

```
        $RESULT_SET_INSERT = mysqli_query($CON,$SQL_INSERT) or
        die(mysqli_error($CON).$SQL_INSERT);
         // Build the location query
         $SQL = "SELECT * FROM lbs_location WHERE CountyID = ".$text." ";
         $response = "CON Provider Registration - Please select a location\n";
break;

case 3:
         //Save the Location ID first
         $LocationID = getLocationID($CON, $text);
        $SQL_UPDATE = "UPDATE lbs_register SET LocationID  = ".$LocationID." WHERE
        SessionID = ".$sessionId." ";
        $RESULT_SET_UPDATE = mysqli_query($CON,$SQL_UPDATE) or
        die(mysqli_error($CON).$SQL_UPDATE);
         // Query the product category
         $SQL = "SELECT * FROM lbs_category";
         $response = "CON Provider Registration - Please select a product category\n";
break;

case 4:
         //Save the Category ID first
         $CategoryID = getCategoryID($CON, $text);
        $SQL_UPDATE = "UPDATE lbs_register SET CategoryID  = ".$CategoryID." WHERE
        SessionID = ".$sessionId." ";
        $RESULT_SET_UPDATE = mysqli_query($CON,$SQL_UPDATE) or
        die(mysqli_error($CON).$SQL_UPDATE);
         // Query the product category
         $SQL = "SELECT * FROM lbs_product WHERE CategoryID = ".$text."";
```

```
            $response = "CON Provider Registration - Please select a product / service\n";
break;

case 5:
            //Save the Product ID first
            $ProductID = getProductID($CON, $text);

           $SQL_UPDATE = "UPDATE lbs_register SET ProductID  = ".$ProductID." WHERE
           SessionID = ".$sessionId." ";
           $RESULT_SET_UPDATE = mysqli_query($CON,$SQL_UPDATE) or
           die(mysqli_error($CON).$SQL_UPDATE);
            // Query the product category
           $SQL_SEARCH = "SELECT * FROM lbs_register WHERE SessionID = ".$sessionId."";
           $RESULT_SET_SEARCH = mysqli_query($CON,$SQL_SEARCH) or
           die(mysqli_error($CON).$SQL_SEARCH);
           $RESULT_SET_ARRAY_SEARCH = mysqli_fetch_assoc($RESULT_SET_SEARCH);
           $RESULT_SET_NUM_ROWS_SEARCH =
           mysqli_num_rows($RESULT_SET_SEARCH);

            $UserID = getUserID_Mobile($CON,$phoneNumber);

           $SQL_FINAL = "SELECT * FROM lbs_providers WHERE UserID = ".$UserID." AND
           ProductID = ".$RESULT_SET_ARRAY_SEARCH['ProductID']." AND LocationID =
           ".$RESULT_SET_ARRAY_SEARCH['LocationID']." LIMIT 1,5";
           $RESULT_SET_FINAL = mysqli_query($CON,$SQL_FINAL) or
           die(mysqli_error($CON).$SQL_FINAL);
           $RESULT_SET_NUM_ROWS_FINAL  = mysqli_num_rows($RESULT_SET_FINAL);
```

```
                $ProductName =
                getProductName($CON,$RESULT_SET_ARRAY_SEARCH['ProductID']);
                $LocationName =
                getLocationName($CON,$RESULT_SET_ARRAY_SEARCH['LocationID']);

                 $response = "END";
                 if ( $RESULT_SET_NUM_ROWS_FINAL>0) {
                                $response = "END You are already registered as a provider for
                                ".$ProductName." in ".$LocationName;
                                $NextLevel = 0;
                                $path = 0 ;
                        } else {
                                // create the new provider
                                $SQL_INSERT = "INSERT INTO lbs_providers
                                (UserID,ProductID,LocationID,RegistrationDate) VALUES
                                (".$UserID.",".$RESULT_SET_ARRAY_SEARCH['ProductID'].",".$RESU
                                LT_SET_ARRAY_SEARCH['LocationID'].",'".date('Y-m-d H:i:s')."') ";
                                $RESULT_SET_INSERT = mysqli_query($CON,$SQL_INSERT) or
                                die(mysqli_error($CON).$SQL_INSERT);
                                $response = "END You have been successfuly registered as a provider for
                                ".$ProductName." in ".$LocationName;
                 }
        break;

default:
        echo getMainMenu();
        $NextLevel = 0;
        $path = 0 ;
```

```
                        break;
                }
        }
break;

case 4:
// Place advertisement
        if (getUserID_Mobile($CON,$phoneNumber)==='') {
                // The user is not registered
                $response = "CON ".str_replace('+','',$phoneNumber)." You must be registered as a user first ".getMainMenu()." ";
                $NextLevel = 0;
                $path = 0 ;
        } else {
                $text = str_replace('*','',strrchr($text,'*'));
                // Select a location
                switch ($NextLevel) {
                        case 1:
                                // Build the county list query
                                $SQL = "SELECT * FROM lbs_county";
                                $response = "CON Place Advertisement - Please select a county \nA. All\n";
                        break;

                        case 2:
                                // Select product category
                                 //Save the County ID first
                                if (is_numeric($text)) { $CountyID = getCountyID($CON, $text); } else { $CountyID =
                                "A"; }
                                 $UserID = getUserID_Mobile($CON,$phoneNumber);
```

```
        $SQL_INSERT = "INSERT INTO lbs_advert (SessionID,UserID,CountyID) VALUES
        (".$sessionId.",".$UserID.",'".$CountyID."') ";
        $RESULT_SET_INSERT = mysqli_query($CON,$SQL_INSERT) or
        die(mysqli_error($CON).$SQL_INSERT);

         // Query the product category
         $SQL = "SELECT * FROM lbs_category";
        $response = "CON Place Advertisement - Please select a product category \nA. All\n";
break;

case 3:
        // Select target user profile
        //Save the Category ID first
        if (is_numeric($text)) { $CategoryID = getCategoryID($CON, $text); } else { $CategoryID
        = "A"; }

        $SQL_UPDATE = "UPDATE lbs_advert SET CategoryID  = '".$CategoryID."' WHERE
        SessionID = ".$sessionId." ";
        $RESULT_SET_UPDATE = mysqli_query($CON,$SQL_UPDATE) or
        die(mysqli_error($CON).$SQL_UPDATE);
         // Query the age brackets
        $SQL = "SELECT ID, Number, CONCAT(LowerLimit,' - ',UpperLimit) as Name FROM
        lbs_agebracket";
        $response = "CON Place Advertisement - Please select an age bracket \nA. All\n";
break;

case 4:
        // Age
```

```
        //Save the Age bracket ID first
        if (is_numeric($text)) { $AgeBracketID = getAgeBracketID($CON, $text); } else {
        $AgeBracketID = "A"; }

        $SQL_UPDATE = "UPDATE lbs_advert SET AgeBracketID  = '".$AgeBracketID."'
        WHERE SessionID = ".$sessionId." ";
        $RESULT_SET_UPDATE = mysqli_query($CON,$SQL_UPDATE) or
        die(mysqli_error($CON).$SQL_UPDATE);
         // Query the gender
         $SQL = "SELECT * FROM lbs_gender";
        $response = "CON Place Advertisement - Please select the target gender \nA. All\n";
break;

case 5:
        // Gender
        //Save the gender ID first
        if (is_numeric($text)) { $GenderID = getGenderID($CON, $text); } else { $GenderID =
        "A"; }
        $SQL_UPDATE = "UPDATE lbs_advert SET GenderID  = '".$GenderID."' WHERE
        SessionID = ".$sessionId." ";
        $RESULT_SET_UPDATE = mysqli_query($CON,$SQL_UPDATE) or
        die(mysqli_error($CON).$SQL_UPDATE);
        $SQL = "SELECT * FROM lbs_target";
        $response = "CON Place Advertisement - Please specify your target\n";
break;

case 6:
        //  Save the target group
```

```
                $SQL_UPDATE = "UPDATE lbs_advert SET TargetID  = '".$text."' WHERE SessionID =
                ".$sessionId." ";
                $RESULT_SET_UPDATE = mysqli_query($CON,$SQL_UPDATE) or
                die(mysqli_error($CON).$SQL_UPDATE);
                $response = "CON Place Advertisement - Please Key in your adverstisment MAX 50
                Characters\n";
            break;

            case 7:
                // Save the advert
                $SQL_UPDATE = "UPDATE lbs_advert SET Advert  = '".$text."' WHERE SessionID =
                ".$sessionId." ";
                $RESULT_SET_UPDATE = mysqli_query($CON,$SQL_UPDATE) or
                die(mysqli_error($CON).$SQL_UPDATE);
                $response = "CON Place Advertisement - How many times do you want the advertisement
                sent? \n";
            break;

            case 8:
                // Save the number of times to send the advert
                $SQL_UPDATE = "UPDATE lbs_advert SET Number  = '".$text."', EntryDate = '".date('Y-
                m-d H:i:s')."' WHERE SessionID = ".$sessionId." ";
                $RESULT_SET_UPDATE = mysqli_query($CON,$SQL_UPDATE) or
                die(mysqli_error($CON).$SQL_UPDATE);
                $response = "END Place Advertisement - Your advert has been received successfully \n";
            break;
        }
}
```

```
break;

case 5:
// user De-registration
        if (getUserID_Mobile($CON,$phoneNumber)==='') {
                // The user is not registered
                $response = "CON ".str_replace('+','',$phoneNumber)." You must be registered as a user first ".getMainMenu()." ";
                        $NextLevel = 0;
                        $path = 0 ;
        } else {
                $UserID = getUserID_Mobile($CON,$phoneNumber);

                $SQL_INSERT = "INSERT INTO lbs_user_deregistered
                (ID,FName,MName,SName,National_IdentityNo,YearOfBirth,GenderID,Mobile,RegistrationDate,Confirmed,Con
                firmationDate) SELECT
                ID,FName,MName,SName,National_IdentityNo,YearOfBirth,GenderID,Mobile,RegistrationDate,Confirmed,Conf
                irmationDate FROM lbs_user WHERE ID = ".$UserID." ";
                $RESULT_SET_INSERT = mysqli_query($CON,$SQL_INSERT) or die(mysqli_error($CON).$SQL_INSERT);

                $user_delete = FALSE;

                if ($RESULT_SET_INSERT) {
                        $SQL_DELETE = "DELETE FROM lbs_user WHERE ID = ".$UserID."";
                        $RESULT_SET_DELETE = mysqli_query($CON,$SQL_DELETE) or
                        die(mysqli_error($CON).$SQL_DELETE);
                        $user_delete = TRUE;
                }
```

```
                $SQL_INSERT = "INSERT INTO lbs_providers_deregistered
                (UserID,ProductID,LocationID,TransactionTime,RegistrationDate,Confirmed,ConfirmationDate) SELECT
                UserID,ProductID,LocationID,TransactionTime,RegistrationDate,Confirmed,ConfirmationDate FROM
                lbs_providers WHERE UserID = ".$UserID." ";
                $RESULT_SET_INSERT = mysqli_query($CON,$SQL_INSERT) or die(mysqli_error($CON).$SQL_INSERT);

                $provider_delete = FALSE;
                if ($RESULT_SET_INSERT) {
                        $SQL_DELETE = "DELETE FROM lbs_providers WHERE UserID = ".$UserID."";
                        $RESULT_SET_DELETE = mysqli_query($CON,$SQL_DELETE) or
                        die(mysqli_error($CON).$SQL_DELETE);
                        $provider_delete = TRUE;
                }

                if ($user_delete && $provider_delete) {
                        $response = "END You have been de-registered from the service";
                } else {
                        $response = "END The de-registration process was not successful. Please try again!";
                }
        }
break;

default:
//No option selected
        echo getMainMenu();
        $NextLevel = 0;
        $path = 0 ;
        break;
```

```
}

$SQL_UPDATE = "INSERT INTO lbs_state (Message,Phone,SessionID,Level,Path) VALUES ('".str_replace(',','
',$text)."','".$phoneNumber."','".$sessionId."','".$NextLevel."','".$path."') ";
$RESULT_SET_UPDATE = mysqli_query($CON,$SQL_UPDATE) or die(mysqli_error($CON).$SQL_UPDATE);

if ($SQL!='') {
        $RESULT_SET = mysqli_query($CON,$SQL) or die(mysqli_error($CON).$SQL);
        $RESULT_SET_ARRAY = mysqli_fetch_assoc($RESULT_SET);
        $RESULT_SET_NUM_ROWS = mysqli_num_rows($RESULT_SET);

        if ($RESULT_SET_NUM_ROWS>0 ) {
                do {
                        $response .= $RESULT_SET_ARRAY['Number']." ". $RESULT_SET_ARRAY['Name']."\n";
                } while ($RESULT_SET_ARRAY = mysqli_fetch_assoc($RESULT_SET)) ;
         }
 }

// Print the response onto the page so that the USSD gateway can read it

if ($response!='') {

        // Create a new instance of the SMS gateway class
        $gateway  = new AfricaStalkingGateway($username, $apiKey);

        // Send the message to the recipient
        $results  = $gateway->sendMessage($phoneNumber, $UserMessage);
```

```
if ($RESULT_SET_FINAL) {
        mysqli_data_seek($RESULT_SET_FINAL,0);
        // Send the message to the providers
        $UserID = getUserID_Mobile($CON,$phoneNumber);
        $UserName = getUserName($CON,$UserID);

        while ($RESULT_SET_ARRAY_FINAL = mysqli_fetch_assoc($RESULT_SET_FINAL)) {

                $Mobile = getUserMobile($CON,$RESULT_SET_ARRAY_FINAL['UserID']);
                $Name = getUserName($CON,$RESULT_SET_ARRAY_FINAL['UserID']);

                $Mobile_Formatted = "0".substr($Mobile,3,9);

                $UserMessage .= $Name." ".$Mobile_Formatted.", ";

                $SMSRecipients = $Mobile;

                updateProviderTransTime($CON, $RESULT_SET_ARRAY_FINAL['ID']);

                // Keep a record of the inquiry, the user making the inquiry and the user ID's of the providers
                identified.

                // Provider Confirmation Code
                $ProviderConfirmationCode = getCode($CON);

                $SQL_INSERT = "INSERT INTO lbs_confirmation (SearchID,UserID,ConfirmationCode,EntryDate)
                VALUES
```

```
                                        (".$SearchID.",".$RESULT_SET_ARRAY_FINAL['UserID'].",'".$ProviderConfirmationCode."','".date('Y-
                                        m-d H:i:s')."') ";
                                        $RESULT_SET_INSERT = mysqli_query($CON,$SQL_INSERT) or
                                        die(mysqli_error($CON).$SQL_INSERT);

                                        // Prepare a message to the providers found
                                        $SMSMessage = "Hi, ".$UserName." ".$phoneNumber." is looking for ".$ProductName." in
                                        ".$LocationName.", we have sent them your number. ConfirmationCode = ".$ProviderConfirmationCode."
                                        ";

                                        // Add the advert
                                        $SMSMessage .= getAdvert ($CON,$RESULT_SET_ARRAY_FINAL['UserID'],$sessionId,2);

                                        if ($SMSRecipients !='' && $SMSMessage!='') {
                                                $results  = $gateway->sendMessage($SMSRecipients, $SMSMessage);
                                        }
                                }
                        }
                        echo $response;
        }
// DONE!!!
?>
```

APPENDIX D

PILOT STUDY MATERIALS

Interview Guide

System Description

The system is a location based service for finding products and services based on a location. Users register by providing their name, age and gender. Service and product providers then register and indicate their locations. Potential clients then proceed to search for services and products using the USSD menu. The names and mobile number of the providers found on the system are sent to the user by SMS. The providers also get the name and mobile number of the potential client.

System Demonstration

- User registration
- Provider registration
- Information search
- De-register

Boda Boda Operator's & Clients Pre-usage Interview

1. Name _____
2. Mobile No _____
3. Would you like to use the service? **No** **Yes**
4. What would you fear most about using this service?
    a) Criminals could pretend to be clients / providers **No** **Yes**
    b) Clients / providers who do not materialize **No** **Yes**
    c) The cost of the service **No** **Yes**
    d) Any other … *please explain*

    _____

    _____
5. Would you pay to use this service? **No** **Yes**

6. How much would you pay per transaction? (*Every time you receive contacts*) _____

Boda Boda Operator's Post Usage Interview

1. Mobile Number _____
2. Were you glad to receive calls from potential clients? **No** **Yes**
3. Were you comfortable with the fact that your number was sent out to potential clients? **No** **Yes**
4. Did you like the fact that you received the contacts of potential clients? **No** **Yes**
5. Did you call any of the potential clients upon receiving their contacts? **No** **Yes**
6. What did you like most about the service?

   _____

   _____
7. What did you not like about the service?

   _____

   _____
8. How did you find the system? Easy to use or complicated?

   _____

   _____
9. Would you like to continue using this service? **No** **Yes**
10. Would you pay to use this service? **No** **Yes**
11. How much would you pay per transaction? (*Every time you receive contacts*) _____

Client Post Utilization Interview

1. Mobile Number _____
2. Were you glad to receive calls from providers? **No** **Yes**
3. Were you comfortable with the fact that your number was sent out to service providers? **No** **Yes**
4. Did you like the fact that you received the contacts of providers? **No** **Yes**
5. Did you call any of the providers upon receiving their contacts? **No** **Yes**
6. Did you receive calls from any of the providers? **No** **Yes**
7. What did you like most about the service?

_____

_____

8. What did you not like about the service?

_____

_____

9. How did you find the system? Easy to use or complicated?

_____

_____

10. Would you like to continue using this service? **No** **Yes**
11. Would you pay to use this service? **No** **Yes**
12. How much would you pay per transaction? (*Every time you receive contacts*)

_____

SYSTEM Usage Procedure

1. Registration

a. Register with an agent
b. You receive an SMS asking you confirm your registration
c. Dial "*384#9870#" on your phone
d. You get a menu with four options;
    i. 1 - Information search
    ii. 2 - Confirm user registration
    iii. 3 - Confirm provider registration
    iv. 4 - De-register.
e. Respond with 2 to confirm your registration as a user on the service.
f. Respond with 3 to confirm your registration as a provider on the service

2. Information Search

a. Dial "*384#9870#" on your phone.
b. You get a menu with four options;
    i. 1 - Information search
    ii. 2 - Confirm user registration
    iii. 3 - Confirm provider registration
    iv. 4 - De-register.
c. Respond with 1 to search for information.
d. Select a county, a location, a product/service category and a product or service.

e. If there are providers registered for the location and product / service requested for then 3 names and mobile numbers will be sent to you by SMS.
f. The providers too will be notified by SMS indicating your name and mobile number.

3. De-registration

a. Dial "*384#9870#" on your phone.
b. You get a menu with four options;
    i. 1 - Information search
    ii. 2 - Confirm user registration
    iii. 3 - Confirm provider registration
    iv. 4 - De-register.
c. Respond with "4" in order to De-register from the service.

PILOT STUDY

REGISTRATION FORM

FIRST NAME: _____

MIDDLE NAME: _____

SURNAME: _____

MOBILE NUMBER _____

NATIONAL ID NUMBER: _____

YEAR OF BIRTH: _____

For Providers Only

SERVICE / PRODUCT: _____

LOCATION: _____

Terms and conditions: This is a mobile based service that brings together service and product providers by sending their mobile contacts on request. All users will be registered but it does not guarantee the authenticity of the clients or providers likely to use the service. Upon receiving the contacts providers are advised to satisfy themselves on the ability of the clients to engage them as well as to pay for the services mutually agreed upon by the two parties. Users are similarly advised to satisfy themselves on the ability of the identified providers to deliver the service or product desired.

I agree that I have read, understood and accepted, the terms and conditions for use of the NIPATE service.

SIGN: _____

DATE: _____

APPENDIX E

AUTHOR PROFILE

Moses M. Thiga holds a B.Sc. in Computer Science and an M.Sc. in Statistics from Egerton University as well as an M.Sc. in Information Systems Management from Liverpool University. He is currently a PhD candidate in Information Systems at Kabarak University. His research is in the area of SMS and USSD location based mobile applications for use by microenterprises. thigamoses@gmail.com, mthiga@kabarak.ac.ke

LIST OF PUBLICATIONS

Thiga, M. M., Siror, J. K., & Githeko, J. (2013). An SMS and USSD Model for Location-based Mobile Advertising. *International Journal of Computer Science & Engineering Technology, 4*(7), 14.

Thiga, M.M. (2013). Addressing Public Service Vehicle Security Challenges using an SMS and USSD Identity Confirmation System. *International Journal of Computer Engineering and Applications, 3(3),* 229.

Mwangi, R., Ngure, P., Thiga, M., & Ngure, J. (2014). Factors Influencing the Utilization of Voluntary Counseling and Testing Services among University Students in Kenya. *Global Journal of Health Science. 6(4).*

Mutiga, M.W., Ndogo, S. N., & Thiga, M.M. (2014). How Apps Impact Farming Communities. *ICT Update*, Issue 77, pp 18 – 19. http://ictupdate.cta.int/Feature-Articles/How-apps-impact-farming-communities/(77)/1400182160

APPENDIX F

RESEARCH PERMIT

CONDITIONS

1. You must report to the District Commissioner and the District Education Officer of the area before embarking on your research. Failure to do that may lead to the cancellation of your permit
2. Government Officers will not be interviewed with-out prior appointment.
3. No questionnaire will be used unless it has been approved.
4. Excavation, filming and collection of biological specimens are subject to further permission from the relevant Government Ministries.
5. You are required to submit at least two(2)/four(4) bound copies of your final report for Kenyans and non-Kenyans respectively.
6. The Government of Kenya reserves the right to modify the conditions of this permit including its cancellation without notice

GPK6055t3mt10/2011

REPUBLIC OF KENYA

RESEARCH CLEARANCE PERMIT

(CONDITIONS—see back page)

PAGE 2

THIS IS TO CERTIFY THAT:
Prof./Dr./Mr./Mrs./Miss/Institution
Moses Mwangi Thiga
of (Address) Kabarak University
P.O Box Private Bag, Kabarak.
has been permitted to conduct research in

Nakuru — Location
Rift Valley — Province

on the topic: A location-based SMS and USSD model for pull mobile advertising micro-enterprises.

for a period ending: 31st December, 2013.

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Research Permit No. *NCST/RCD/13/013/63*
Date of issue *11th June, 2013*
Fee received *KSH. 2000*

Applicant's Signature

For Secretary
National Council for Science &Technology

LETTER OF INTRODUCTION

REPUBLIC OF KENYA

NATIONAL COUNCIL FOR SCIENCE AND TECHNOLOGY

Telephone: 254-020-2213471, 2241349, 254-020-2673550
Mobile: 0713 788 787 , 0735 404 245
Fax: 254-020-2213215
When replying please quote
secretary@ncst.go.ke

P.O. Box 30623-00100
NAIROBI-KENYA
Website: www.ncst.go.ke

Our Ref: **NCST/RCD/13/013/63**

Date: **11th June 2013**

Moses Mwangi Thiga
Kabarak University
P.O Box Private Bag
Kabarak.

RE: RESEARCH AUTHORIZATION

Following your application dated **3rd June, 2013** for authority to carry out research on ***"A location-based SMS and USSD model for pull mobile advertising microenterprises."*** I am pleased to inform you that you have been authorized to undertake research in **Nakuru District** for a period ending **31st December, 2013.**

You are advised to report to **the District Commissioner and District Education Officer, Nakuru District** before embarking on the research project.

On completion of the research, you are expected to submit **two hard copies and one soft copy in pdf** of the research report/thesis to our office.

DR. M. K. RUGUTT, PhD, HSC.
DEPUTY COUNCIL SECRETARY

Copy to:
The District Commissioner
The District Education Officer
Nakuru District.

"The National Council for Science and Technology is Committed to the Promotion of Science and Technology for National Development".