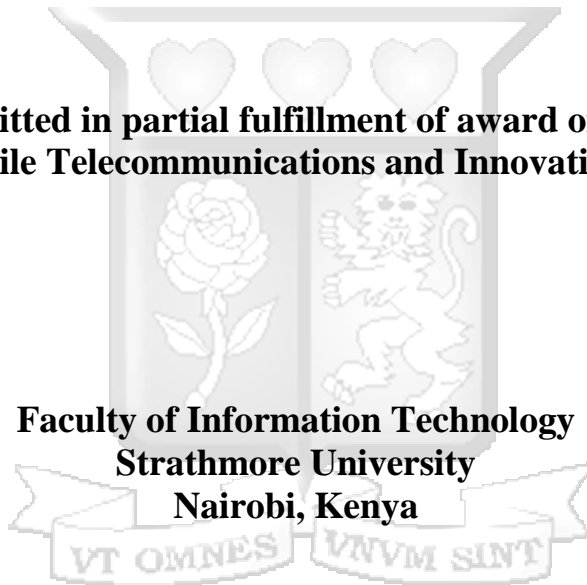2016

A Mobile Application to Assist Non-Governmental Organisations (NGOs) in Effective Monitoring and Evaluation of Projects in Kenya

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A Mobile Application to Assist Non-Governmental Organisations (NGOs) in Effective Monitoring and Evaluation of Projects in Kenya

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A Dissertation submitted in partial fulfillment of award of a Master of Science Degree in Mobile Telecommunications and Innovation (MSc. MTI)

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DECLARATION

I declare that this work has not been previously submitted and approved for the award of a degree by this or any other University. To the best of my knowledge and belief, the dissertation contains no material previously published or written by another person except where due reference is made in the dissertation itself.

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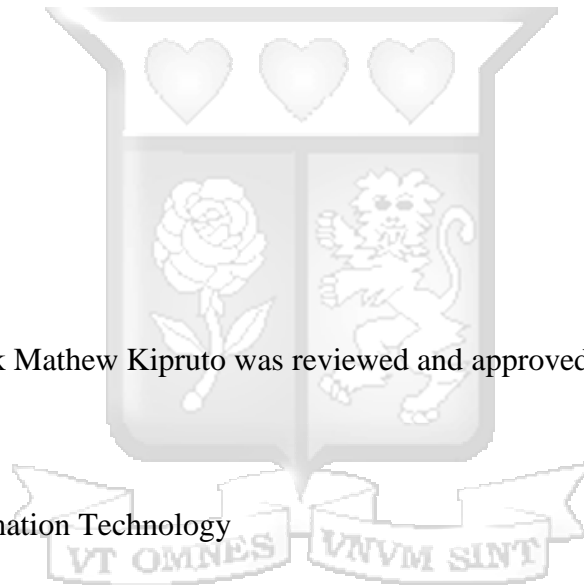
ABSTRACT

Non-Governmental Organisations (NGOs) are constantly in the process of reviewing ways in which monitoring and evaluation can achieve greater consistency and effectiveness in judging the impact of a project as well as getting recommendations on how future interventions can be improved. Developing a reporting, monitoring and evaluation system is therefore a requirement due to the growing pressure for improving performance. This is also one of the requirements by the NGOs and donors to check on the effective use of the donor funds, impact and benefits brought by the projects. This dissertation seeks to examine the challenges faced by Kenyan community based NGOs, in tracking the performance of projects. It also establishes the extent to which technology is used in reporting, monitoring and evaluation of projects by NGOs. The design, development and testing of the functionalities in the capacity building mobile application to assist NGOs in effective reporting, monitoring and evaluation of projects is presented. The target population for this dissertation was 10 NGOs in Kenya who are well established. Purposive and snowball sampling was used to select a sample of 30 respondents from the 10 NGOs selected. Data was collected using face to face and phone interviews and analysed using cross case analysis to facilitate the development of capacity building mobile application. The study adopted feature driven development methodology for system modelling and development. This model describes specific, short phases of tasks which are accomplished separately. A mobile and web application was developed to assist NGOs in reporting, monitoring an evaluation of projects. The final prototype was tested to check if the requirements were met. Testing and validation was also conducted by both the developer and potential users of the application to ensure the code developed was workable.

Keywords: Monitoring, Reporting, Non-Governmental Organisations, Evaluation, Field Officers, Donors.

DEDICATION

To my lovely Fiancée; thank you for being there when I needed encouragement.

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I would like to express my deepest appreciation to all those that made it possible for me to complete my research study. A special gratitude goes to God for his divine favour and enablement, His provision and guidance ensured that I finished the dissertation successfully. I am grateful to my family, especially my brother Christopher who continually advised on the development of the capacity building mobile application, and Gilbert for cheering me on.

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Special thanks go to my fellow classmates undertaking Masters for being an encouragement to forge on even when the times were difficult and friends who gave advise in particular Brian Karoney for advice on how to build the mobile application.

To all this people and the institution, may God reward, bless and keep you.
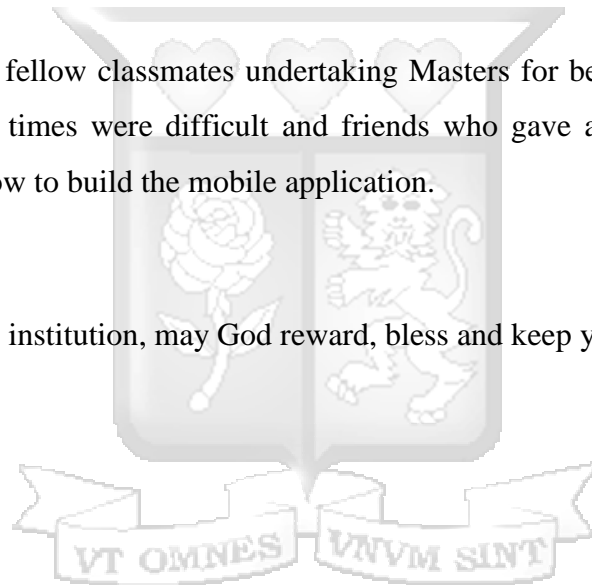
LIST OF ABBREVIATIONS/ACRONYMS

FO   –   Field officer

HME   –   Head of Monitoring and Evaluation

ICT   -   Information Communication Technology

M&E   -   Monitoring and Evaluation

NGOs   **-**   Non-Governmental Organisations

GPS   -   Global Positioning System

SMS   **-**   Short Messaging Service

DEFINITION OF TERMS

Android- This is an operating system created by Google for mobile devices; smartphones and tablets (Verizon Wireless, 2014).

Capacity building - Capacity building is any action that improves the effectiveness of individuals, organisations, networks, or systems—including organisational and financial stability, program service delivery, program quality, and growth (USAID, 2010).

Donor- Donor is person who donates something, especially money to a fund or charity.

Evaluation- Evaluation is the episodic assessment of an ongoing or completed project to determine its actual impact against the planned impact (strategic goal or objectives for which it was implemented) sustainability, efficiency and effectiveness (McCoy et al., 2005).

Monitoring- Monitoring is the routine continuous tracking of the key elements of project implementation performance i.e. inputs (resources, equipment) activities and outputs, through recordkeeping and regular reporting (McCoy et al. 2005).

NGO- Non-profit, voluntary citizens' group which is organised on a local, national or international level.

Projects- Project in the context of this research is defined as temporary endeavour to achieve an objective (PMI, 2004). The word Temporary means the project has a time frame within which it should have achieved its set objectives within a fixed budget and usually funded by a donor.

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CHAPTER 1: INTRODUCTION

1.1 Background of the Study

Non-governmental organisations (NGOs) are non-profit organisations that are neither governmental nor inter- governmental (Martin, 2002). NGOs are generally established to bring the like-minded individuals committed to achieving particular objectives. NGOs do vary considerably in the size of their constituencies and in their organisational structures and also their effectiveness. It ranges from organisations of small producers and rural people to development and environment NGOs, the traditional trade unions and to professional, industry association and academics.

According to USAID (2010), there were more than 350,000 NGOs registered between 1997–2005 in Kenya. Kenya received $537 million in official humanitarian assistance in 2011, making it the world's eighth largest recipient of aid (Global Humanitarian Assistance, 2013). NGOs received over $95 million in 2011 to be used on development projects throughout the country (Global Humanitarian Assistance, 2013). Some of the common donors who fund NGOs in Kenya include; AGRA, Ford Foundation, USAID, etc. In this East African nation, agriculture employs 75 percent of the population, and most food production is in the hands of smallholder farmers. AGRA supports improved access to credit, market information systems, strong agro-dealer networks, and relatively high use of inputs, Kenya's agricultural system is among the most developed in Africa. Agriculture accounts for 23 percent of GDP, and has been one of the country's fastest growing sectors, expanding at a rate of 7.6 percent in 2007 (Global Humanitarian Assistance, 2013).

Kenya Social Protection Sector Review (2012) shows that the monitoring and evaluation of social programmes in Kenya is weak and when it is done the information is not made public. This is further complemented by USAID (2010) that there is an urgent need for standardised indicators and evaluation of capacity building. Also, they add that there is need to make tools and approaches available and adaptable. Most NGOs do not have the ability to hire skilled monitoring and evaluation professionals and ICT staff who understand monitoring systems (Chesos, 2010). When these ICT staff are hired they develop substandard monitoring and evaluation systems that don't meet either the managerial or donor needs (Chesos, 2010).

Mobile technology is good and a nice tool for monitoring and evaluation (Thakkar, et al., (n.d).). With mobile technology NGO beneficiaries should be able to provide field-level data from their projects in real time. Having access to ongoing data, instead of one-time annual report, allows donors to understand the real impact of their support is having at the field level. Also, by requesting 'anytime and anywhere' access to project monitoring data, donors can introduce a higher degree of transparency and accountability, at each level, within a beneficiary NGO (Thakkar, et al., (n.d).).

This major challenge of capacity building not being subject to rigorous monitoring, evaluation, and reporting shall be addressed in this study, this include finding the best architecture to be used in reporting, identifying the possible and best ways of monitoring and evaluation of projects etc. By implementing technology into how capacity building operates then it will make community based capacity building organisations better and more competitive in the market.

1.2 Problem Statement

Monitoring and Evaluation (M&E) has in the recent become a necessary requirement for projects. This is evident from the many advertisements for M&E experts and request for expression of interest for M&E consultants in the local dailies. Also it is a demand from donors to assess the impacts of projects. We have seen in local dailies many NGOs being deregistered after failing to account for donor fund. This shows there is lack of transparency and accountability. Currently most NGOs do the reporting of projects manually hence too much paper work and less durability of work. The reason for this is because the NGOs have not adopted to the new technologies of monitoring and evaluation. Since there exists manual reporting there is no real time monitoring and evaluation of projects. Also, data collection becomes time consuming. Therefore, this presents an opportunity to come up with a mobile application to solve the problem.

1.3 Research Objectives

i. To examine the challenges faced by community based NGOs in Kenya in tracking the performance of projects.
ii. To establish the extent of use of technology in monitoring and evaluation of projects by NGOs.

iii.   To design and develop a capacity building mobile application that will assist NGOs in effective monitoring and evaluation and reporting of projects.

iv.   To test and validate the functionalities of the mobile application.

1.4 Research Questions

i.   What are the challenges community based NGOs in Kenya face when tracking the performance of projects?

ii.   What are the current tools used by various community based NGOs for monitoring and evaluation, reporting of projects?

iii.   How will capacity building mobile application be designed and developed?

iv.   Does the system help in reporting, monitoring and evaluation of projects for the NGOs in Kenya?

1.5 Justification of the Research

A total of 957 NGOs operating in Kenya were set to be deregistered after failing to account for more than Sh25.6 billion received from donors, among other malpractices in 2015 (Wenzala, 2015). This raises the question of accountability among the NGOs because of inadequate tools for reporting, monitoring and evaluation. Findings and recommendations that will emerge from this dissertation will serve as a spring board to generate interest for further research into the other aspects of NGO challenges. This stems from the fact that reporting, monitoring and evaluation challenge is a multifaceted phenomenon and no single research is capable of addressing it in full. The mobile application to be developed will enable organisation and donors use M&E data for real-time decision-making, better implementation and delivery of projects and services.

1.6 Scope of the Research

This dissertation focusses majorly on impact/ project assessment of community based NGOs with an aim of developing a capacity building mobile application that runs on an Android operating system. The dissertation is limited to NGOs in Kenya. At a later stage it will expand to other countries in the world and will help in reporting, monitoring and evaluation of projects.

1.7 Limitations of the Research

Developing an application to help community based NGOs in project tracking and reporting, has come with the following limitation, all the field officers responsible for reporting on various projects would need to have an android enabled smartphone in order to update what is going on when handling projects at site.

CHAPTER 2: LITERATURE REVIEW

The main purpose of literature review is to assist the researcher explain or briefly describe the work that has been reported on a topic or field. This research study aims to have an in-depth look on projects monitoring and evaluation by NGOs in Kenya.

2.1 Monitoring and Evaluation

Monitoring and evaluation are intimately linked project management functions and as a result there is a lot of confusion in trying to make them work on projects (Crawford and Bryce, 2003). PASSIA (2004) writes that Monitoring and evaluation are distinct but complementary. Casley and Kumar (1986) disproves the use the acronym M&E (monitoring and evaluation) as it suggests that we are looking at a single function without making a clear distinction between the two. Therefore, clear distinction between the two are described separately below.

2.1.1 Monitoring

McCoy et al. (2005) defines monitoring as the routine tracking of the key elements of project implementation performance, usually inputs, activities and outputs, through recordkeeping, regular reporting and surveillance. It seeks to determine if the inputs, activities and outputs (immediate deliverables) are proceeding according to plan. The Inputs to be tracked include financial resources, human resources, equipment used on the project and any other input that goes into project implementation. The financial resources are tracked with a budget and performance is analysed by comparing planned expenditure against actual expenditure. The activities or processes are tracked using a schedule which is planned schedule against actual schedule of the activities i.e. what activities have been done versus what should have been done according to the planned schedule. On the other hand, Crawford and Bryce (2003) also argues that monitoring is an ongoing process of data capture and analysis for primarily project control with an internally driven emphasis on efficiency of project. Authors define efficiency in this context as doing the right thing that is, efficient conversion of inputs to outputs within budget and schedule and wise use of human, financial and natural capital. The definition emphasizes the fact that monitoring is geared mainly to project control. This is in agreement with the operational definition that looks at project control as taking corrective action and making decisions pertaining to the project by the project manager

during implementation. Also Uitto (2004) defines monitoring briefly as a continuous function that aims primarily to provide management and stakeholders with early indicators of project performance of a project and progress (or lack thereof) in achievement of the results. Therefore, Monitoring is seen as a continuous function as highlighted in the contextual definition of this research but it does not highlight what is tracked against what so as to be able to indicate performance. It emphasizes the fact that monitoring is very important in that it provides information to the management and stakeholders about performance.

It is important as highlighted by all the authors above that there is dissemination of the monitoring information to the stakeholders.

The purpose of monitoring in summary is to:

a) Ensure that implementation is moving according to plans and if not the project manager takes corrective action, the control function of project management. The monitoring enhances project management decision making during the implementation thereby increasing the chances of good project performance (Crawford and Bryce, 2003; and Gyorkos, 2003).

b) Facilitate transparency and accountability of the resources to the stakeholders including donors, project beneficiaries and the wider community in which the project is implemented. In this case, Monitoring tracks and documents resource use throughout the implementation of the project (PASSIA, 2004; Crawford and Bryce, 2003; and Uitto, 2004).

c) Facilitate evaluation of the project. A well-designed monitoring and evaluation system, monitoring contributes greatly towards evaluation.

2.1.2 Evaluation

Evaluation is defined contextually in this research as the episodic assessment of an ongoing or completed project to determine mainly its actual impact against the planned impact (strategic goal or objectives for which it was implemented), sustainability, effectiveness and efficiency. As Uitto (2004) argues that evaluations are systematic and independent, they are an assessment of an ongoing or completed project including its design, implementation and results. Uitto (2004) further argues that evaluations asses the efficiency, relevance of implementation, impact, effectiveness and sustainability of the project.

Assessing relevance of a continuing project is important to justify continued investment of resources into the project if found that the project is no longer relevant then funding can be stopped and funds channelled elsewhere. Effectiveness is defined as the extent to which the set project objectives were achieved and efficiency as how economically resources (inputs) were converted into outputs for completed or partially completed projects.

Efficiency looks at how the project faired in terms meeting the set schedule and allocated budget. Sustainability is defined as the continuation of the project to bear benefits to the beneficiaries long after the project has ended or the donors have withdrawn funding. Efficiency looks at probability of long-term benefits of project long after the project close (Jody and Ray, 2004). In such cases, sustainability is very important in that it is not prudent to have a lot of resources invested in a project whose benefits will be short lived. The design and implementation can be altered in order to increase the chance of sustainability. Sustainability has gained a lot of currency in the recent times, because the donors want to determine whether the project benefits will continue to accrue after they cease financing the project (PASSIA, 2004). IFAD (2004) states that evaluations should be as objective as possible so that the information provided is as credible as possible and is not questionable; Objectivity could be achieved by bringing in external consultants that were not involved in the project implementation but who should work in partnership with the project implementation officials. Shapiro (2004) emphasizes the fact that evaluation compares the project impact with what was set to be achieved in the project plan and further argues that evaluation examines how the project impacts were achieved and what went wrong or right for the benefit of organisational learning. Emphasis of this approach to evaluation is on impact of the project after implementation.

2.2 The Forces Promoting Impact Assessment in Capacity Building Non-Governmental Organisations

In recent years funding constraints, media exposure and the development of a contract culture have created demands for increased accountability as to the way aid funds have been spent and their long-term impact.

This aid squeeze has led most major donors to go through a rigorous process of prioritizing aid. The decision-makers have increasingly asked projects to provide them with comparative

information and preferably linked to millennium targets, in order to choose between different aid options.

Within civil society many NGOs themselves are emphasizing the importance of learning about the effectiveness and sustainability of capacity building interventions. Example, the International Federation of the Red Cross's Capacity Building Framework (2001) acknowledges that all capacity building interventions must be measured and documented to ensure a degree of accountability and facilitate cross-organisational learning. Thus, there is a wider recognition of the need to assess the longer-term impact of any capacity building intervention, rather than merely focus on short-term outputs and outcomes.

2.3 Real-time Monitoring and Evaluation Using Information Communication Technology

For many civil society organisations, the collection of meaningful data has become essential not just to achieve positive outcomes at the level of individual projects, but also to compete effectively in an increasingly crowded aid sector (INTRAC, 2013). Monitoring and evaluation (M&E) is gaining momentum within this sector too, and programme implementers are coming under increasing pressure to generate baseline, mid-line and end-line data (INTRAC, 2013). According to INTRAC (2013), collecting meaningful and timely data is easier said than done. Historically, the collection of programmatic data has involved paper-based questionnaires and inputting data into an information management system. More recently, various actors have been looking to information and communication technology (ICT) to increase the efficiency, speed and accuracy of data collection, storage and analysis.

In *Improving Peacebuilding Evaluation*, Blum (2011) argues that despite progress in terms of tools created, manuals written, and basic information disseminated about monitoring and evaluation, there remain four outstanding structural challenges in the practice of peacebuilding evaluation.

These can be summarised as:

i. The need for better articulation of how programme level outcomes lead to peace-writ large.

ii.   The need for stronger evidence and methods that can lead to concrete conclusions of impact at all programme levels.

iii.   The lack of aggregated data across multi-layered accountability systems.

iv.   The lack of utilisation of peacebuilding data, as organisations are immersed in a competitive distribution of funds environment.

New technologies therefore will not be the sole solution, but instead can be part of the solution to some of the challenges stated above (Blum, 2011). Practitioners must do so, while implementing strong M&E practices, and improving the degree of collaboration between and amongst the different actors, including between donors and with programme participants. Without adequately and critically thinking of the purpose and process of integrating technology, it may add frustration and unnecessary complexity to what can be fragile monitoring systems (Blum, 2011).

According to Raftree (2013) some of the benefits of integrating ICT in Monitoring and evaluation includes;

i.   Real-time or near real-time feedback "up the chain" that enables quicker decision making, adaptive management, improved allocation of limited resources based on real time data, quicker communication of decisions/changes back to field-level staff, faster response to donors and better learning.

ii.   More rigorous, higher quality data collection and more complete data.

iii.   Reduction in required resources (time, human, money) to collect, aggregate and analyse data.

iv.   Reduced complexity if data systems are simplified; thus increased productivity and efficiency.

v.   Better cross-sections of information, information comparisons; better coordination and cross-comparing if standard, open formats are used.

vi.   Real-time feedback "down the ladder" that allows for direct citizen/beneficiary feedback, and complementing of formal M&E with other social monitoring approaches

vii.   Scale, greater data security and archiving, and less environmental impact.

viii.   Better user experience for staff as well as skill enhancement and job marketability and competitiveness of staff who use the system.

In Real World Evaluation, the authors make the point that one of the challenges which bedevils the field of M&E relates to data quality: "Evaluators often face constraints in the real world of practice resulting from the limited availability and accuracy of critical data" (Bamberger, Rugh, and Mabry 2012).

The specific ICT tool that has been used is Digital Data Gathering (DDG). This refers to a plethora of electronic handheld devices such as smartphones and data pens that are used to record data in the field and transfer information back to a server. Whilst ICT tools such as DDG do not necessarily provide a silver bullet for addressing all real-world M&E challenges, INTRAC (2013) believes that real-time M&E is made possible by the impact of ICTs on data collection, storage and analysis.

This is also echoed by Husch, et al. (2014) stating that mobile technology and the proliferation of smart phones, even in poorest regions, allow citizens to feed in information about the current situational data regarding everything from health, education, roads, water, disease, medical supplies, etc. Data essential for basic survival and wellbeing of the people is now available at any time. If there is a common template and standard for working with this kind of data, then citizen reporting can be harnessed also for collective action and form pivotal feedback signals to the institutions which are expected to delivery development results. Internal "memory" could also provide an avenue for investigation for trouble shooting if and when there is negative feedback coming from any specific group or place (Husch, et al., 2014).

2.4   Mobile Technology in Monitoring and Evaluation

With mobile technology NGO beneficiaries should be able to provide field-level data from their projects in real time (Thakkar, et al., (n.d).). Having access to ongoing data, instead of one-time annual report, allows donors to understand the real impact of their support is having at the field level. Also, by requesting 'anytime and anywhere' access to project monitoring data, donors can introduce a higher degree of transparency and accountability, at each level, within a beneficiary NGO (Thakkar, et al., (n.d).).

The mobile data entry forms offer numerous data validation options that can ensure that all required data is entered and that the data conforms to the correct formats and value ranges hence

reducing the effort required to clean data (USAID, 2012). Periodic data audits may still be needed, such as against new users of the mobile application and because people can still make typos and enter a response that is logically inconsistent with other responses. However, the data review effort becomes an occasional, instead of an ongoing, intensive activity (USAID, 2012).

Mobile tools enable regular feedback and early insights that can be applied immediately for greater impact, whether to correct course or address emerging issues. Using mobile technology also allows timely data mining to monitor trends to inform program design and direction. Instead of traditional M&E efforts with intensive data collection and analytical periods, such as baseline and end of project analysis, the data can now be collected iteratively and continuously throughout the project (USAID, 2012).

Moreover, the use of a mobile application for monitoring and evaluation can pay dividends beyond a single project. Survey designs, data management processes, and data definitions and standards developed on one project can potentially be leveraged on other projects, reducing the need to reinvent the wheel on each project (USAID, 2012). Some of the tools used for monitoring and evaluation include:

2.4.1 Short Messaging Service

Text messaging has allowed people to exchange information and communicate at both national and international level (Banks, n.d.). He adds that the potential to provide some of the poorest people in the world with local, relevant, useful information has not gone un-noticed and the number of NGOs using text messaging in their work continues to grow. Patients receive reminders to take their medicine, saving time and money travelling to local clinics. Farmers receive details of market prices and demand for their products before heading off to market. National parks communicate details of dangerous animals, providing an early warning system to mitigate against human/wildlife conflict. Young people living in the slums of Nairobi receive texts alerting them to job opportunities in the city. The potential uses of text messaging are endless. Figure 2.1 shows the architecture of SMS based monitoring and evaluation looks like.
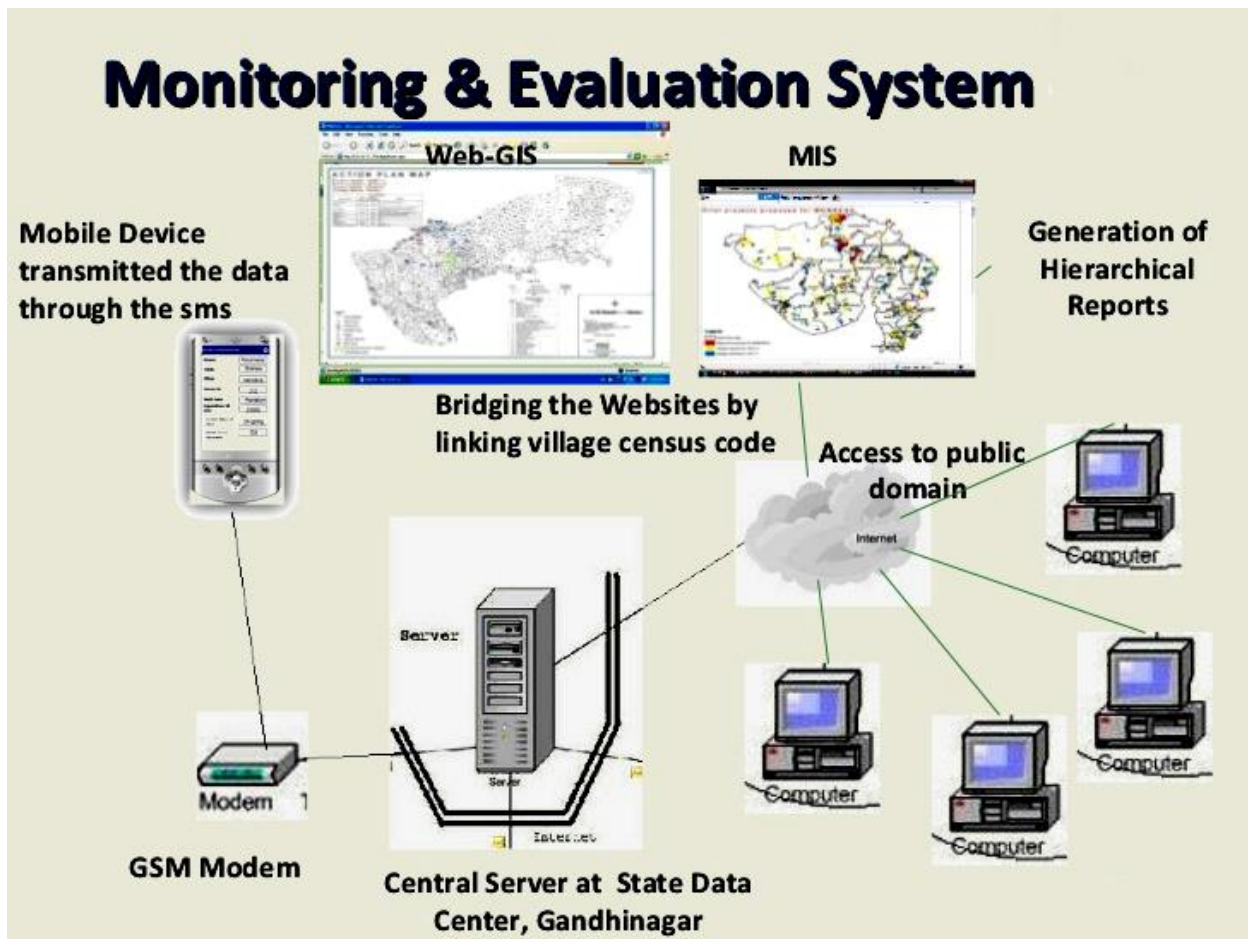
Figure 2:1: Monitoring and Evaluation System (Kumar, 2011)

2.4.2   Global Positioning System

Global Positioning System (GPS) tracking system is a new technology developed nowadays as a result of development of Global Positioning System, Internet, wireless communication and 3S technologies (Calofirescu, 2011). The monitoring system combines an electronic device installed on the asset (which interacts with the GPS receiver) with a communications component such as cellular or radio transmitters and a purpose-designed computer software at least at one operational base to enable the owner or a third party to track the asset's location, collecting data in the process from the field and deliver it to the base of operation. This can also be used by NGOs to monitor the field staff while at site. The figure 2.2 shows the architecture.
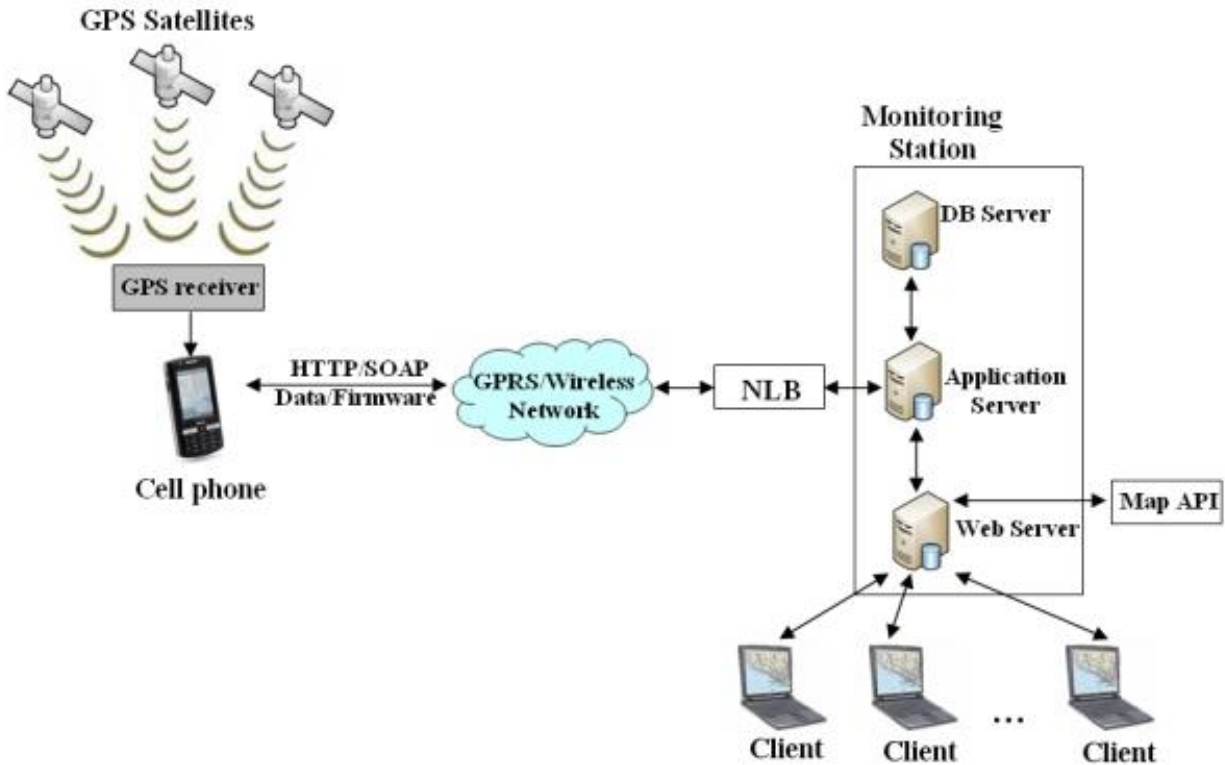
Figure 2:2: N-tier Model for Mobile Phones Based Tracking System (Calofirescu, 2011)

2.5 Mobile Data Collection in Monitoring and Evaluation

Mobile data collection requires four components according to Thakkar, et al., (n.d). This are as shown in figure 2.3.

2.5.1 Hardware Devices

This are the mobile devices used to enter data into. The devices can range from 'low-end phones' that can only be used for phone-calls and sending SMS's, to specialized devices such as point-of-sale (PoS) terminals. Add-on devices: Mobile devices such as smart phones can also be linked to add-on devices such as bio-metric sensors, bar-code readers, NFC and RFID3 chips to record data such as finger prints, inventory tags, Smart Cards, etc.

2.5.2 Data Collection Software

Data collection software is used to control how data is entered into the device based on programmed formats and rules. The software is mainly required for smart phones, tablets and notebooks, and it tends to be specific to the type of hardware device like Android phones, Windows Notebook, among others. In some cases, the software is built-in with the hardware, for e.g. PoS terminals, or is not required, like in low-end phones for sending data through SMS or IVRS. Data collection software can be: (a) custom built; (b) licensed; or (c) subscribed to as a service platform.

2.5.3 Data Transmission

Data transmission helps transmit or transfer the field-level data to a remote location or a single central computer. Mobile networks allow data collected in the field to be transmitted through SMS, voice, mobile-internet, etc. With certain devices, like PoS terminals, data is transferred physically by hot-syncing cables. Figure 2.3 show what can be used in data transmission.

Figure 2:3: Mobile Technology Options (Shukla & Sen, 2014)

2.5.4 Data Aggregation and Analysis

This is the platform used to receive, collate and analyse data. Data aggregation and analysis can be done remotely through SMS, mobile-internet gateways on webservers with online

databases, or through local hot-syncing on local computers using spread-sheet, database or statistical software. Figure 2.4 shows data aggregation.
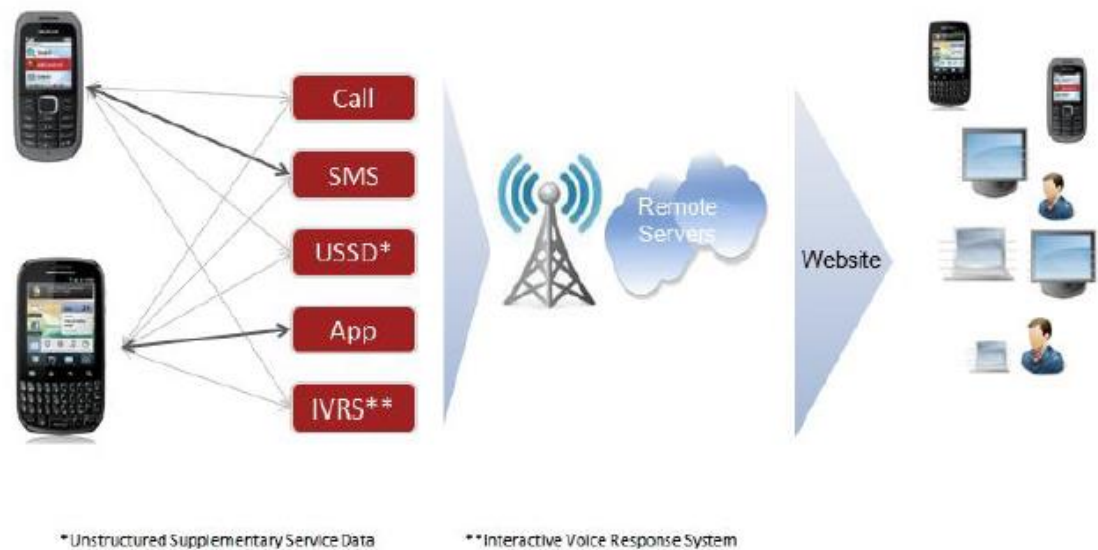
Figure 2:4: How Mobile Technology is Used (Shukla & Sen, 2014)

2.6 Use of Mobile-based Technology in Monitoring and Evaluation

According to Shukla & Sen (2014), mobile based technlogy in monitoring and evaluation can be used for;

i. Reporting- routine (real-time) reporting.
ii. Monitoring- ongoing program monitoring and also occasional (surprise) checks i.e. spot checks by supervisors to monitor attendance and performance of staff.
iii. Evaluation- survey data i.e. survey data to assess impact of <<xx>> program.

2.7   Existing Applications on Monitoring and Evaluation

2.7.1   Intelligent Mobile Health Monitoring System

The Intelligent Mobile Health Monitoring (IMHMS) System uses bio-sensors to collect patient's physiological data and aggregates it to the sensor network; the summary of the collection is then transmitted to the client's cell phone or personal computer (Shahriyar; Kundu; Ahamed; Akbar; and Bari, 2009). The devices then forward the data to the medical server in place for analysis then gives feedback to the patients on the necessary actions to be taken. The IMHMS contains three components which include; Wearable Body Sensor Network (WBSN), Patients Personal Home Server (PPHS) and Intelligent Medical Server (IMS) to do the monitoring whiles using these two approaches to evaluate it, implement a prototype of different components of IMHMS and cognitive walkthrough strategy.
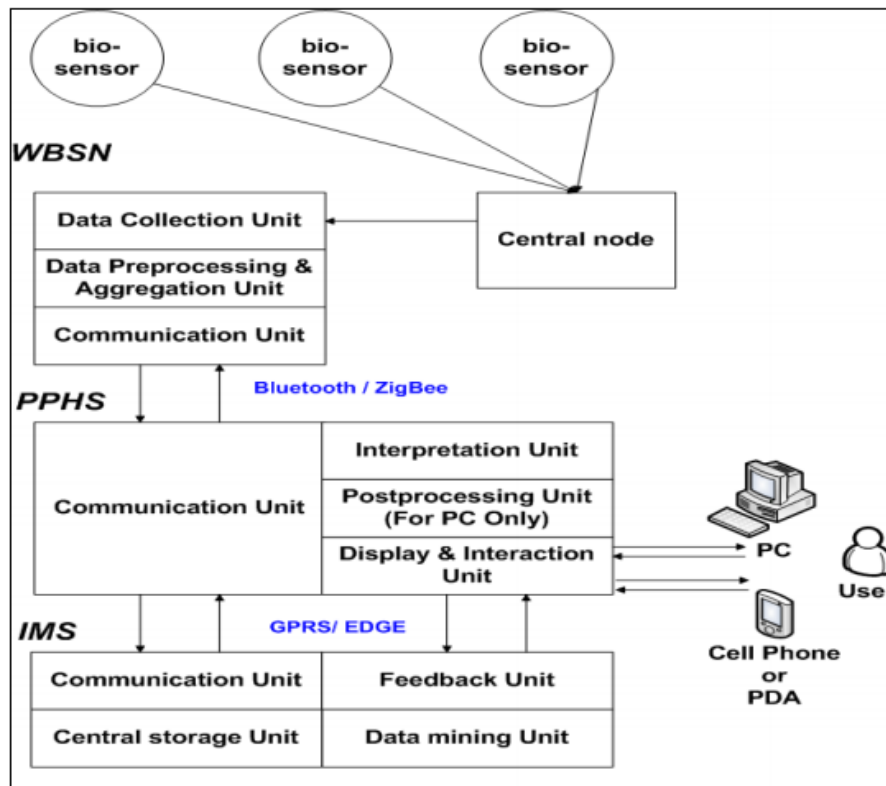
Figure 2:5: IMHMS System Architecture (Shahriyar; Kundu; Ahamed; Akbar; and Bari, 2009)

IMHMS System has good rating accordance to its objectives.
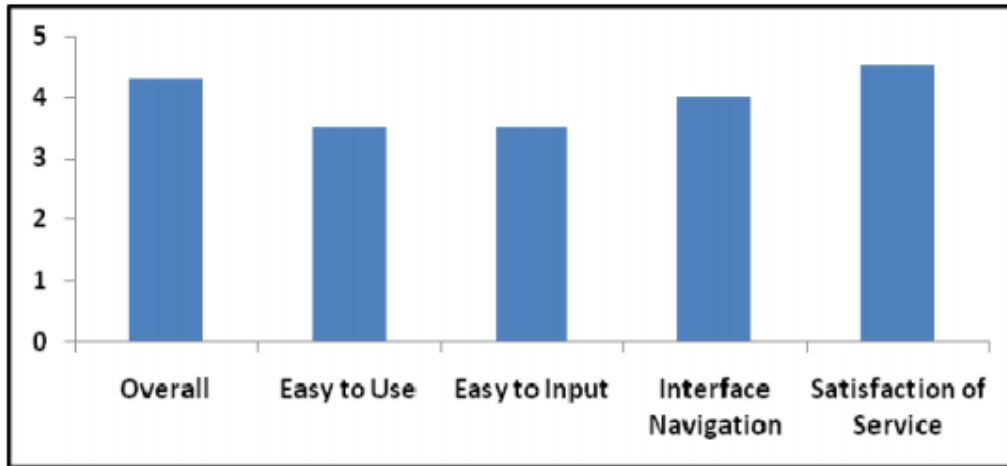
Figure 2:6: Rating of Usability Issues by Users (Shahriyar; Kundu; Ahamed; Akbar; and Bari, 2009)

According to Shahriyar, Kundu, Ahamed, Akbar, & Bari (2009), they think of a system where the patients need not to do any actions at all which IMHMS System doesn't still achieve. They are very positive that in future that will be the objective to work on.

Weakness of Intelligent Mobile Health Monitoring System

The solution is designed for hospitals only and therefore; it does not have certain features a capacity building mobile application would present.

2.7.2 Mobile-based Technology for Monitoring & Evaluation

This is a reference guide for project managers, monitoring and evaluation (M&E) specialists, researchers and donors. This is a guide into using mobile-based technology, to get real time data sharing and analysing for the benefit of monitoring and evaluation projects to enable organisations, donors and citizens to better implementation and effectiveness of undergoing projects. With mobile technology NGO beneficiaries should be able to provide field-level data from their projects in real time (Thakkar, et al. (n.d)).

Two main organisational benefits of a mobile-based managed system are:

   i.   Taking informed decisions in real-time.

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ii.   Providing feedback and exchanging information between stakeholders in real time.

There are some challenges that the researcher pin point to this type of monitoring and evaluation;

Hardware and devices issues

i.   **Set up issues:** Mobile devices differ in the way Internet connections are configured.
ii.   **Battery and charging issues:** in rural areas with limited electricity it can be a big challenge.

Software issues

i.   Upgrades and fresh installations can be a challenge.
ii.   Security: Data stored on mobile devices can be accessed if not encrypted or password protected.
iii.   Multi-media handling like photographs can delay transmission of data.

Logistics issues

i.   **Switching off mobile phones by field staff:** Tracking a field staff based on their phone numbers can become problematic.
ii.   **Theft:** Mobile devices are easy targets for theft.

2.7.3   Web-based Monitoring & Evaluation Software Tool

This is a sytem developed by United Business Solutions (UBS) Ltd who specialices in M&E Software Tools. The Framework Concept from UBS Ltd provides the Client a Stable & Ready to use Product which requires minimal customization for Deployment;thereby saving on Time & Duration of Implementation (Web-based Monitoring & Evaluation Software Tool, (n.d)). Appendix G show more images of the monitoring and evaluation software.

The web-based Monitoring & Evaluation Software;

1.   Is a web based tool for Monitoring, Evaluation, Data Capturing & Reporting.
2.   Can be used Across Offices & Across the Country.
3.   Generates Reports "ON DEMAND".
4.   Has Multiple Access Modes i.e

i.   Web or On-Line Mode (via Internet).

ii.   Offline (Desktops with limited or no internet connectivity).

iii.   Any Simple Mobile Phone using GPRS (no need of Smart or Expensive Phones).

Figure 2:7: Monitoring and Evaluation Software System (Web-based Monitoring & Evaluation Software Tool. (n.d.).)

Weakness of Web-based Monitoring & Evaluation Software Tool

As seen the system is only available for the web and there is not yet a released version which is a native mobile application.

2.8   Conclusions

According to the research done the application will help solve a few of the problems that is currently facing NGOs especially in real time monitoring and evaluation of projects. As seen, there is currently no much research which has been done relating to mobile phone and monitoring and evaluation.

CHAPTER 3: RESEARCH METHODOLOGY

The main aim of this dissertation was, to examine the challenges faced by Kenyan community based NGOs, in tracking the performance of projects. It also sought to establish the extent to which technology is used in reporting, monitoring and evaluation of projects by NGOs and later the designing, development, testing and validation of the functionalities in the capacity building mobile application. To meet this objective, it is important to define a process in which the objectives will be obtained and studied. This chapter therefore, describes the methodology that was adopted in carrying out the study. It explains in depth the Feature Driven Development (FDD) Methodology used in designing the mobile application, keeping in mind the research objectives and questions.

3.1 Feature Driven Development

The dissertation will apply Feature Driven Development (FDD) model for system development as advanced by Jeff DeLuca and Peter Coad. In this model, the solution is figured out from the start and a functional breakdown of detailed list of features is created. (Wysocki, 2010). FDD divides system development into five processes as shown in figure 3.1.
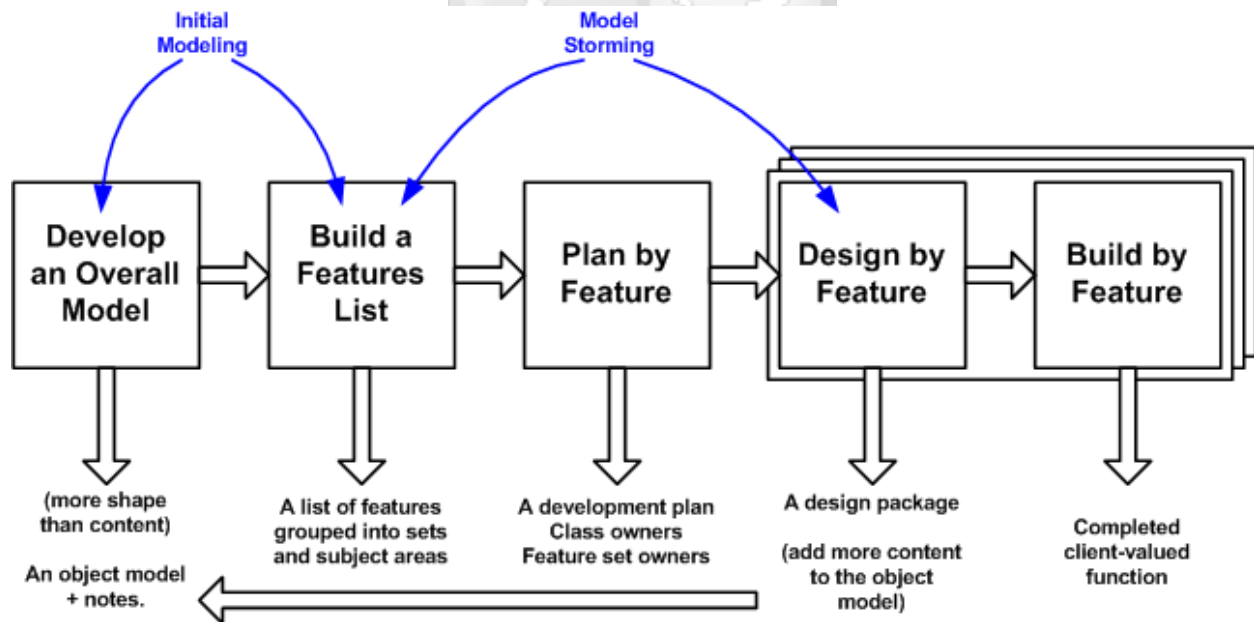
Figure 3:1: Feature Driven Development Process (Scott, 2005)

3.1.1 Develop an Overall Model

In this stage a high-level walkthrough of the scope of the system and its context (domain) is performed with domain and development members to come up with an overall model of the desired system. In this case it will involve the researcher and the key stakeholders of various NGOs in Kenya.

3.1.1.1 Research Design

The study will be carried out through a case study of various NGOs in Kenya. Yin, (2003) describes a case study as a story about something unique, special, or interesting. This story can be about individuals, organisations, processes, programs, neighbourhoods, institutions, or even events. The study focuses on the challenges facing NGOs in impact assessment with a view of developing a capacity building application for the organisation. Case study research design will be appropriate for this study as it enables the researcher to focus broadly on the phenomenon under study and carry out an in-depth study on current problems faced by NGOs in Kenya.

A qualitative approach is appropriate for this study since little research has been done on capacity building in Kenya. Creswell, (2003) notes that if a concept or phenomenon needs to be understood because little research has been done on it, then it merits a qualitative approach. Mobile application is an emerging technology in Kenya due to the continued adoption of mobile technologies in the country. The research was exploratory in nature which enabled the researcher ask questions and clarify on issues in-depth.

3.1.1.2 Study Area

The study will focus on 10 NGOs around Kenya. NGOs chosen for this study are well-established organisations accredited by Ministry of Foreign Affairs.

3.1.1.3 Study Population

Study population refers to a complete set of individuals, cases or objects with some common observable characteristics, or aggregation of elements from which the sample is actually selected (Babbie, 2010). In this study, the study population are Field officers/Capacity Builders,

Programme Managers and donors of the selected NGOs. It is from this population that the sample population will be derived from. Table 3.1 enumerates clearly the study population and the sample

3.1.1.4 Sampling Technique and Sample Size

Data will be collected from a sample of the study population that will be a purposively selected percentage of the target population. The researcher will use purposive and snowball sampling to arrive at a good sample. The respondents will be purposively selected so that respondents who are known to have key information will be selected.

In snowball sampling the researcher collects data on the few members of the target population he or she can locate, and then they ask those individuals to provide the information needed to locate other members of that population whom they happen to know (Babbie, 2010). One key informer, that is the Programme Manager of the NGO selected, will direct the researcher to other key participants of the study. Snowballing technique is appropriate as the participants will lead the researcher to other participants for instance the Programme Manager will direct the researcher to the capacity builders. The method was chosen largely because it befits exploratory studies and also the goal is more about getting core information to aid in development of the capacity building application than generalizing the collected information to a larger population.

Table 3.1: Study Population and Sample Size

Respondents	Population	Sample Size	Percentage
Programme Manager	30	10	33.3%
Donors	80	10	12%
Capacity Builders	200	10	5%
Total	**310**	**30**	**9.67%**

3.1.1.5 Description of Research Instruments

This study is a qualitative research and will employ interviews and documentary analysis as the methods of data collection. The researcher will bear in mind that some practicalities on the ground will sometimes dictate preference of a method or based the boundaries set between the researcher

and the respondent(s). Authorization from the relevant institutions to collect data will be obtained and a good ethics protocol adhered to as outlined in section 3.7 below. A brief description of the instruments to be used in data collection is given below:

3.1.1.5.1 Interviews

Formal interviews will be conducted with the selected participants of the study. So as to gather in-depth data of the phenomenon under study, the researcher will be emphatical with interviewees and try as much to gain their confidence. Semi-structured interviews places an emphasis on relatively open questions, though it may have certain closed questions will be employed in this study. According to Wengraf (2001), semi-structured interviews cover a great range of interview strategies, all counter posed to the concepts of a fully structured interview and an unstructured one.

3.1.1.5.2 Documentary Analysis

Relevant documented data from the selected NGOs will be examined to give a detailed understanding of the operations of the NGOs and other plans pertinent to the study. This will include the NGOs strategic plan and reports. Other relevant information for instance trends of usage of mobile and related technologies will be sourced from books, internet, reports and other authoritative sources. This instrument will allow the researcher gain well thought out information from the respondents since they have put a lot of attention in compiling them. It will also assist in ensuring speedy collection of data.

3.1.1.6 Quality Control

This study will be conducted within the acceptable levels of validity and reliability. This is expounded below:

3.1.1.6.1 Validity

Babbie (2010) defines validity as the extent, to which an empirical measure adequately reflects the real meaning of the concept under consideration for instance in this study, the examination of performance tracking and impact assessment of NGOs, will be focused to that and not anything else. In other words, validity means one is actually measuring what they say they are measuring. With chances of a study getting results that don't accurately reflect the concept being measured, the researcher will maintain greater objectivity; watch out for false inferences and shaky generalizations. The following types of validity will be observed:

a) **Construct validity** – Trochim (2006) refers construct validity as the degree to which inferences can legitimately be made from the operationalisations in your study to the theoretical constructs on which those operationalisations were based. In other words, it involves generalizing from ones' measures of the study to the concept of the measures. In this study this validity type will be adhered to by ensuring that the respondents are properly represented for instance giving them the right to reply during the interviews. As such they can verify that what the researcher perceived they meant, they really did mean.

b) **External validity** – here the study should be intelligible and the ideas should relate to existing knowledge so that other people, in different situations, can appropriate the ideas to themselves and interpret them in the light of their present understanding (Hayes, 2006). In other words, it is the degree to which the conclusions in one's study would hold for other persons in other places and at other times (Trochim, 2006). The sampling model proposed for use in this study, that is purposive and snowball sampling will aide in getting a sample from which the researcher will conduct the research and later generalize the results back to the population.

3.1.1.6.2   Reliability

According to Babbie (2010), reliability is a matter of where a particular technique, applied repeatedly to the same object, yields the same result each time. It is a quality of measurement that requires similar data is collected each time in repeated study of the same phenomenon. Reliability requires that the research study must be consistent, both in terms of procedures and findings (Hayes, 2006).

Like any other study, this research study is prone to random errors which may be caused by unknown and unpredictable changes in the study. Random error refers to the deviation from the true measurement due to factors that have not been addressed sufficiently by the researcher (Mugenda and Mugenda, 2003). These are issues like unclear instructions to respondents, misinterpretations, fatigue, and bias among others during the study especially at data collection.

In the study, the researcher will try as much to minimize the effects of random errors so as to increase reliability. Inaccuracies which may accrue from data collection instruments for instance the interview schedule will be checked by having a pilot interview for instant with a research assistant. The researcher will ensure that during the interview and document analysis, all issues

are articulated well and any clarification sort or given. The interview questions are also well organised to ease the process and facilitate collection of accurate data as possible.

3.1.1.7 Data Analysis and Presentation

Data collected will be analysed using the cross case data analysis technique. Cross case analysis is a technique which facilitates the comparison of multiple cases in many divergent ways not possible within a single case analysis (Abrahamsson, 2002). The comparison of the cases is done against predefined categories to deduce similarities and differences, or in another strategy, classify the data by their data sources.

Eisenhardt (1989) suggests three strategies of cross-case analysis: one is to select categories and then look for within-group similarities coupled with intergroup differences. The researcher can source the dimensions from the statement of the problem, existing literature or choose them. The second is to select pairs of cases and then list the similarities and differences between each pair. This detailed look at the similarities and differences can lead to a deeper understanding of the phenomena. The third strategy involves dividing the data by its source; for instance, deriving insights from document analysis and interviews separately. She notes that when a pattern from one data source is corroborated by the evidence from another, the finding is stronger and better grounded. The researcher looks forward to triangulate these strategies for better findings from the study.

The end result expected to be presented will be a dissertation paper detailing challenges faced by NGOs in tracking project performance and a capacity building application that will be tailored for Android smartphones and will help solve issues faced by the NGOs of reporting, monitoring and evaluation of projects.

3.1.1.8 Ethics Protocol

Permission from Foreign Affairs will be sort to conduct the research. Permission to from NGOs has already been sought and granted. During the study, the respondents will be assured that the information obtained shall be treated for research purpose and no other purpose. The researcher will maintain honesty and openness to the gain full trust of respondents. Anonymity and the

respondents 'right of reply' will be observed to avoid exposing them in any way. The results of the research study will also be published and presented objectively and with utmost faith.

3.1.2 Build a Feature List

In this process, the domain is decomposed into subject areas, the business activities within them and the steps within each business activity to form the categorised list of features. The researcher will identify the major activities that constitute reporting, monitoring and evaluation by NGOs and further break them down into individual features within each of these activities. This will give rise to the features list that will guide the next processes. The identified list of features will support the overall model discussed in process one and will be built to meet and satisfy the needs identified by the domain members.

3.1.3 Plan by Feature

Plan by Feature describes the plan of how the features will be implemented, based on feature dependencies, load across the development team and also on their complexity is written down in this step. In this process, the researcher will group the functionalities of the capacity building mobile application sequentially based on their relative importance indicating how they will be achieved in the mobile application.

3.1.4 Design by Feature

In this process the researcher will design the features of the capacity building mobile application to bring out detailed representative diagrams. The use case diagram, logical designs of the system as well as the database design will be mapped out in this process. These designs are important because they guide the next phase which is actual building or development phase. The following UML diagrams will be used in the design.

i. **Use Case Diagram**

In the prototype use case diagram, the actors are the users, head of monitoring and evaluation, field officers and donors

ii.   Dataflow Diagrams

A DFD shows the flow of data from users to the system and what functions or processes in the system they are interacting with. This will help the researcher in picturing how the actual system will look like.

iii.   Entity Relation Diagram

The entity relation diagram of the application shows various entities and their attributes and how they are related together with their cardinalities. That is, the number of instance one entity has against the other.

iv.   Sequence Diagram

The sequence diagram will be used to show interaction of the objects.

3.1.5   Build by Feature

In this last process the researcher will code the features into functional systems. usability, integration, functional testing and validation will be carried out to ensure the code developed is workable. A review of the whole functional system will be done to assist pinpoint faults and facilitate corrections. Chapter 5 describes build by feature in detail.

3.1.5.1   Prototype Development

The prototype development involves coming up with a web application and mobile application that will be both connected to the database. Wireframes of the same will also be built. Below are the approaches that were used in the applications development:

i.   Mobile Application

The platform for the mobile application implementation is Android. The source code will be written in Java, utilizing the android classes. JavaScript Object Notation (JSON) will be used to provide the interface between the Android application and the database. The reasons for choosing Android as the client application included; availability of flexible software development kit, Android Development Tools availability and support from online developer communities.

ii. Web Application

The web application will be developed using Codeigniter framework based on Hypertext Pre-processor (PHP). The website will be hosted on an online Apache HTTP server, Reasons for using PHP are; it is an Open Source platform, it is platform independent; it supports all major web servers and databases; it has multiple layers of security to prevent threats and malicious attacks.

iii. Database

The database will be developed using the MySQL database. Reasons for using MySQL is; it is an open source platform; it is fully compatible with PHP and other platforms; it is secure in that all passwords are encrypted before storage restricting unauthorized access to the database.

3.1.5.2 Prototype Testing

To test the prototype functionalities and its user acceptance, various types of test will be subjected on it, these are:

i.   **Usability Testing-** This is done to determine the usability of the application being developed. This feedback will help in validating the system i.e. if it really solves the problem of reporting, monitoring and evaluation by the NGOs. A total of 20 respondents from different NGOs that will participate in the research will be given to carry out the tests and which will then be used to refine the prototype until a satisfactory application is developed. Usability testing is discussed in Chapter 5.

ii. **Functional Testing-** This is done on the entire system, that is, the mobile application and the web application to ensure that all the functions are functioning properly.

iii. **Integration Testing-** This is a very important test conducted on the system because various features are developed as modules and it is very necessary to know whether they will work together and operate as desired. This is tested by combining all modules prototype and testing if they work together fine without any issues.

3.1.5.3 System Validation

The users are asked to test whether the implementation addresses the raised issues. This is essential as it proves whether the system attains the users' requirement as proposed earlier and shows if the research objectives were attained. To validate if the developed mobile and web application helps

in effective reporting, monitoring and evaluation of projects, a total of 20 respondents were selected from the sample population of 30 respondents who participated interviews for collecting user requirements and also participated in the usability testing of the mobile application. An Online questionnaire were designed Refer to Appendix C(vii) and sent to all the respondents to collect data from them. Users' response is discussed in Chapter 5.

3.2 Conclusions

The study sought to investigate the monitoring and evaluation practices and challenges faced by the NGOs in implementing projects in Kenya. The study findings will aid the development of a capacity building mobile application that will help these NGOs on project tracking performance. One can only but conclude that unless impact assessment system (capacity building application to be developed) are seen as an investment that can add genuine value, rather than a burdensome cost, NGOs will have little chance of measuring success or assessing the real impact of capacity building work. Therefore, the application developed will help in improving the efficient monitoring and evaluation of projects implemented by these NGOs.
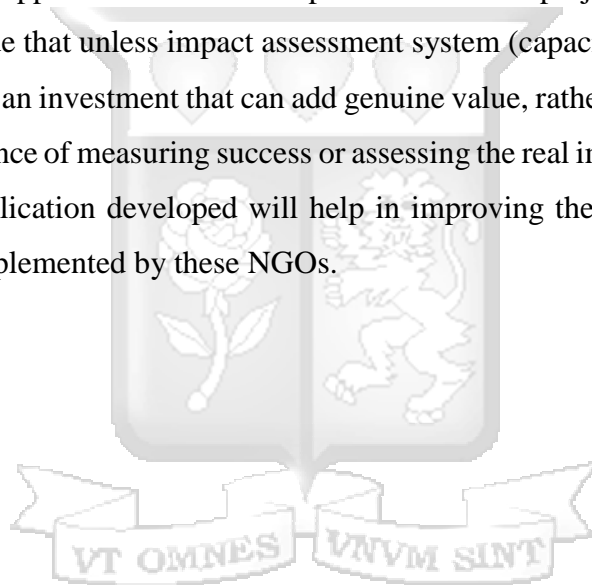
CHAPTER 4: DEVELOPING AN OVERALL MODEL, BUILDING A FEATURES LIST, PLANNING BY FEATURE AND DESIGNING BY FEATURE

This chapter details the four processes of Feature Driven Development namely; develop an overall model; build a features list, plan by feature and design by feature. The findings and interpretations are incorporated in the facets of this model in the first process. This then forms the basis of the other processes to yield a capacity building mobile application.

4.1 Developing an Overall Model

This part presents the analysis of data and discussions of the findings of the research study to aid identifying the problem domain. The findings are presented under the following themes namely: response rate and the profile of the individual respondents.

4.1.1 Response Profile

The response profile of the study is presented under two themes namely, response rate and the profile of the individual respondents. Each is described below.

4.1.1.1 Response Rate

Visits were made to this organisations and interviews administered. Other organisations preferred phone call interviews. The response rate was 85%. According to Mugenda and Mugenda (2003) a 50% response rate is adequate, and a response rate greater than 70% is very good. Hence the response rate was satisfactory. This response rate as shown in figure 4.1 can be attributed to the data collection procedures, where the researcher pre-notified the potential participants and scheduled time for the interview that the respondents were comfortable with.

Response rate of the survey

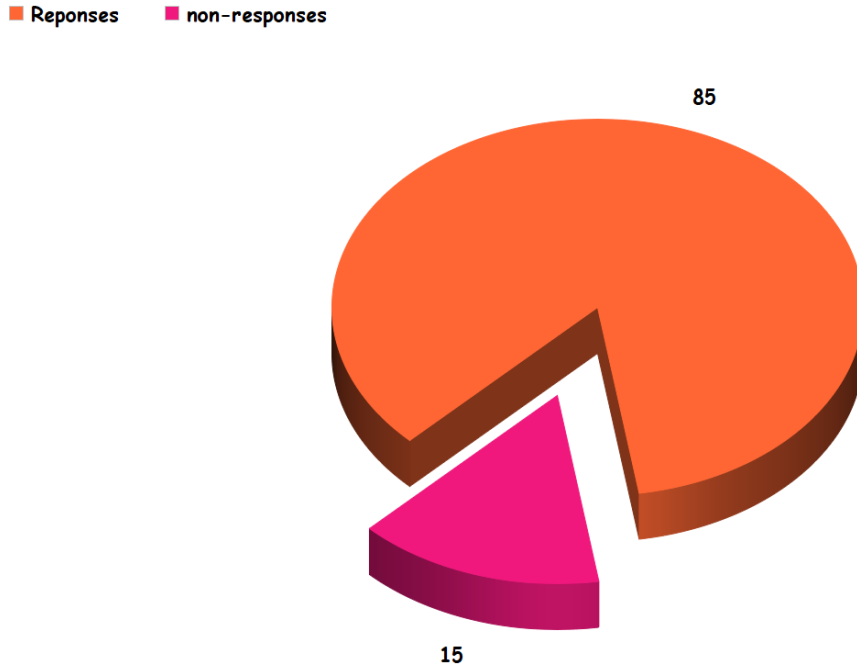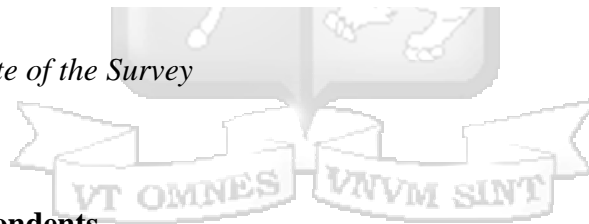Reponses   non-responses

85

15

Figure 4:1: Response Rate of the Survey

4.1.1.2   Profile of Respondents

The respondents were profiled using four different criteria that included Donors, Accountants, Program Managers and Field officers (Capacity builders). The response percentages according to the criteria are as shown in Table 4.1.

Table 4.1: Profile of Respondents

NGOs	Program Managers	Field officers	Donors
1. Fadhili Trust	100%	100%	100%
2. One Acre Fund	100%	100%	100%
3. Food for the Hungry Kenya	100%	0%	0%
4. Undugu Society of Kenya	100%	100%	0%
5. WorldView Kenya	100%	100%	100%
6. World Vision	100%	100%	100%
7. ROAD International	100%	100%	0%
8. Ogra Foundation	100%	100%	100%
9. AMPATH - Eldoret	100%	100%	100%
10. ICRAF Kenya	100%	100%	0%

After examining the profiles of the respondents, the subsequent sections highlight and discuss the findings of the research presented under the various themes of the investigative questions.

4.1.2   Users Response on Current System

In a bid to understand the current system used by the NGOs in project reporting, monitoring and evaluation, the researcher posed the following questions to the respondents customized to the specific category of respondents. The detailed questions as posed to the respondents are given in the appendices. The analysis and interpretations of their responses is discussed in the paragraphs that follow.

Research questions tackled;

1. What tools of monitoring performances of projects do you currently use?

2. What would you say are the strengths and weaknesses of the current project performance tracking system?

3. Are stakeholders e.g. donors satisfied with the current system? If no, why?

The findings are described below detailing the current system used by the interviewed respondents in the NGOs and the views of the respondents on the same.

Table 4.2: Users' Response on Current System

Respondent		Verbatim Response		Theme
#1		"Monitoring and evaluation based on Excel sheet"		Tools currently used
#2		I really don't like the system because it does not per say measure the impact		Tools currently used
#20		"Donors are able to track the projects using the system. Weakness – The system is real-time. Mostly updated on weekly, monthly."		Strengths and weaknesses of the current project performance tracking system
#3		"Not so much. It Doesn't give clear monitoring."		donor's satisfaction with the current system
#7		Not badly off. We are trying. But hope to have a better one		donor's satisfaction with the current system

4.1.3 Mobile Technology in Evaluations

Respondents were asked how a mobile technology will help in evaluation of projects. Some of the responses are gathered as below.

Table 4.3: Mobile Technology in Evaluation

Respondent		Verbatim Response		Theme
#23		"It will Improving transparency & accountability.		Need for mobile technology
#16		"It will help in better monitoring, sharing, and application of data. This data can be accesses by the donors easily hence better funding"		Need for mobile technology
#5		"Donors are able to track the projects using the system."		Need for mobile technology
#8		"Enabling organisations, donors and citizens to use monitoring and evaluation data for real-time decision-making, better implementation and delivery of projects and services		Need for mobile technology
#9		"I think it will really help in accountability"		Need for mobile technology
#17		"real time data gathering"		Need for mobile technology
#26		"I am d donor and with this technology it will really help me in tracking the impact of my contributions"		Need for mobile technology

4.1.4 Types of Phones

With the above in mind it was of essence to try and see how many of the users had smart phones which could run the application. Of the respondents that were sampled, 80 of them had smart phones, 46 had feature phone while the rest 34 had low end phones as shown in figure 4.2. This showed most of them can scale up easily to have smartphones.

Types of Phones

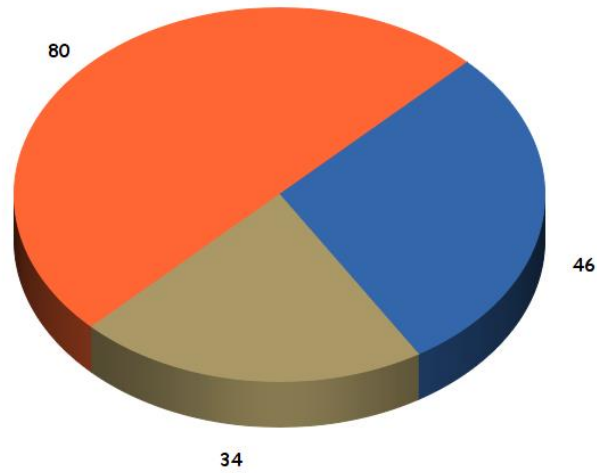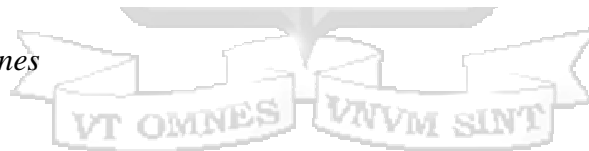■ Smart Phones ■ Feature Phones ■ Low End Phones

80

46

34

Figure 4:2: Types of Phones

4.1.5 Viability of a Mobile Application

A question was posed to the respondents if a mobile application would help in better project reporting, monitoring and evaluation. The question received a quite good response as shown below.
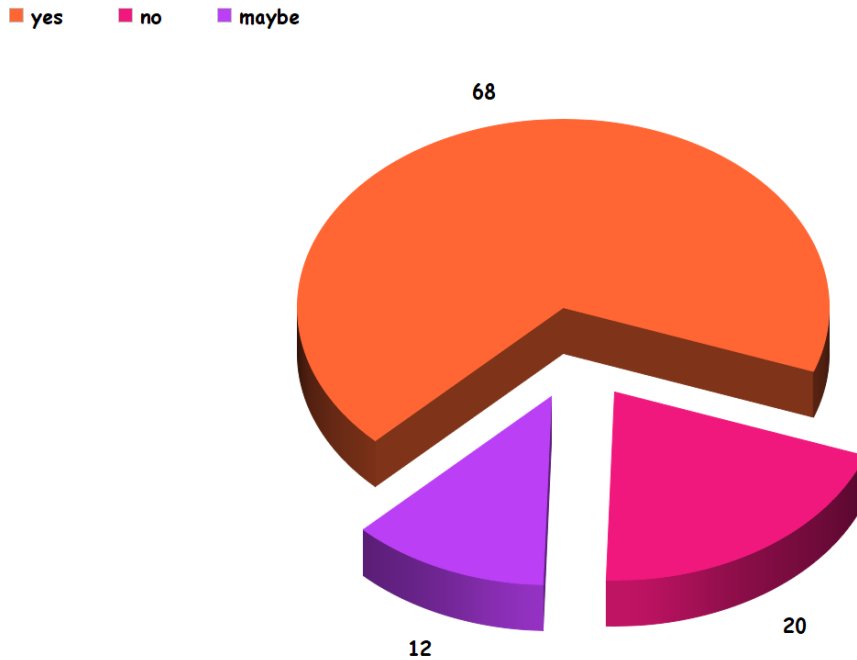
Viability of Mobile Application

■ yes ■ no ■ maybe

68

20

12

Figure 4:3: Viability of Mobile Application

4.1.6 Problem Domain

From the interviews done, it was realized that most NGOs in Kenya do the reporting, monitoring and evaluations based on Excel Sheet system. The donors therefore use this system to track and monitor the projects. The main challenges come when the field officers are updating this records in which they currently do it on a monthly, quarterly terms. There is no current system that does monitoring and evaluation on a real time basis, hence making the donors unhappy with the current system. A mobile solution was therefore sought to come in handy which will help NGOs track projects on a real time basis. This is because of mobility of phones and the advancement in technology

Generally, NGOs are good at 'doing things'. They see a problem and develop a project to solve that problem. But now there need to be an application that will be based on real-time tracking of this projects by NGOs. The application will be a mobile based solution. The designed application

will majorly focus on the field officers project tracking and reporting. When the two are captured the donors will easily track the impact of their contributions to the NGOs. The data collected will be used to address the research questions based on some of the reasons for undertaking monitoring and evaluations of projects such as:

i. Accountability (upwards to the donor).
ii. Accountability (downwards to the beneficiaries).
iii. Improvement in performance.
iv. Providing evidence for advocacy (transparency).
v. Measuring impact.

4.1.7 Development a Capacity Building Mobile Application

The researcher in collaboration with the domain members undertook to gain a good, shared understanding of the problem domain (Palmer, 2009) through the interviews he conducted. The domain in this case, represents NGOs and domain members being the stakeholders identified in this study as the donors, program manager, capacity builders and accountants of the NGOs. The problem domain was monitoring and evaluation of projects by NGOs in Kenya.

As noted in this chapter different domain problem concepts were enumerated and discussed bringing out how they relate and interact. This was majorly limited to the accountability, Improvement in performance, transparency, impact assessment at the NGOs. The object model developed at this process thus concentrates on this core services and informs the subsequent processes of the system development.

4.1.8 The Mobile Application Architecture

As extensively noted in the previous chapter, the researcher gained a good understanding of the problem domain with the help of domain members of the selected NGOs. The findings confirmed and reinforced the information noted by the researcher during the preliminary studies concerning the challenges faced by NGOs in monitoring and evaluation of projects.

The problem domain in this study was the effective reporting, monitoring and evaluation of projects by NGOs in Kenya which the researcher found out that current monitoring and evaluations

by NGOs are based on Excel Sheet system. The donors use this system to track and monitor the projects. The main challenges come when the field officers are updating this records in which they currently do it on a monthly, quarterly terms. There is also a difficulty in impact assessment by donors.

Based on these shared understating of the domain problem, the researcher and domain members agreed that the development of a capacity building mobile is welcomed to address the challenges of the current system. Below is a diagram showing the general overview of the system model of the capacity building mobile application. Detailed diagrams expounding the model are given in section 4.2.6 below detailing the use case, sequence, activity and class diagrams.
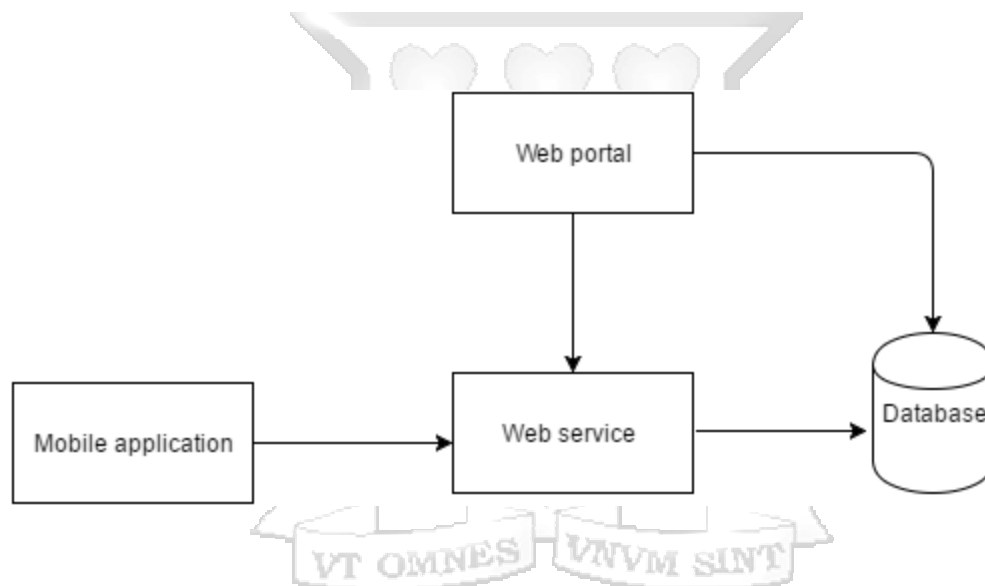

Figure 4:4: Mobile Application Architecture

4.2 Building a Features List

In this process, the researcher identified the major activities that constitute reporting, monitoring and evaluation by NGOs and further broke them down into individual features within each of those activities. This gave rise to the features list that will guide the next processes. The identified list of features supports the overall model discussed in process one and are built to meet and satisfy the needs identified by the domain members.

The features list is given in two hierarchies namely; the domain subject areas from the high-level breakdown of the problem domain and individual activities within those subject areas. The researcher tried as much to prioritize the features as advised by Coad, Lefebvre and De Luca (1999) to meet client satisfaction and aid smooth flow of the later processes.

The list is given as below

4.2.1 Functional Requirements

The researcher identified the following domain subject areas as the functional requirements for the capacity building mobile application

1. Registration of Field Officers for the particular NGO.
2. Creation of projects.
3. Creation of groups.
4. Adding members to groups.
5. Assigning projects to members.
6. Tracking projects done by members.
7. Tracking group progress.

These subject areas are the major features identified to represent the core functionalities of the capacity building mobile application. The individual activities within these subject areas are given below.

4.2.1.1 Individual Activities Within the Subject Areas

The following are the individual activities within the subject areas: -

a) Registration of Field officers

This subject area is mostly handled by the front office team at the NGO. The main activities handled here include registering new Field Officers so that they can use the mobile application. This will involve adding their emails and setting their passwords.

b) Creation of Projects

Projects differ with the NGOs. There are NGOs who deal with empowering farmers by offering trainings and giving them farm inputs while some deal with Health. Field Officers will add projects to the mobile application depending on the NGOs they are in.

c) Creation of Groups and Adding Members to the Groups

Groups are created when Field officers visit the field and enrol members to projects the NGOs are undertaking. Many NGOs require groups of between 15 to 20 members for easy training and management.

d) Assigning Projects to Members

This section involves assigning projects the NGOs are undertaking to the members in a group. Example, Bee keeping undertaken by One Acre Fund to a member. A Member can undertake more than one project e.g. bee keeping and growing maize.

e) Tracking of Projects

This involves tracking the progress of groups as well as the projects done by each member. Field officers update everything that is happening in the field e.g. trainings of groups or progress of a project done by a member. This will involve writing brief report, taking pictures and videos and posting in the mobile application

4.2.2 Non-Functional Requirements

These are requirements that specify the criteria used to judge the operation of the system. They were constructed in agreement with functional requirements that define specific behaviour and functions. They include:

  i.   Usability – the system interface should be easy to use.
 ii.   Reliability and availability – the system should be reliable and always available to perform tasks requested by the user.
iii.   Scalability – the system should be able to adopt additional functionalities. Additional data should be easy to incorporate.

iv.   Integrity – the system being data oriented it should ensure that the data analysed and stored is not altered or corrupted.

v.   Performance – the system should have an acceptable response time while performing its functions.

vi.   Security – The system should allow only authorized users to use its functionalities.

4.3   Planning by Feature

According to Gorakavi (2009), this process details a sequential list of all features listed in process 2 in the order of their priority or in terms of their relative business value (Palmer, 2009). The dependencies of the features and complexities involved in implementing them are also put into consideration. The goal of this process is to come up with a developmental plan to guide process four and five in the achievement of the system.

In the paragraphs below the researcher groups the functionalities of the capacity building mobile application sequentially based on their relative importance indicating how they will be achieved in the mobile application. Simply put, the sequence follows activities that happen when a field officer is added to the system, then they create groups, add members to groups, add projects, add members to projects, monitor the projects and send SMS to groups. The dependencies of the features are highlighted and a summary of the planned features of the system are given specifying the system objectives.

4.3.1   Publicity of the NGO

This will capture both internal and external publicity. The sequence of the features is given below:

- The NGO carries out marketing and publicity of the services they offer to members of the public in the regions being targeted. This will involve visiting the areas, gathering members and offering introductory trainings.
- Enquiry mechanism where the public can reach to the NGO.

4.3.2 Monitoring and Evaluation of Projects

The field officers register new members who want to join the NGO. They then have them form groups so that they can offer trainings and any other requirements easily. Once added to the group, progress reports are created each time a field officers visits the members or when they have a meeting with the members. The front office staff e.g. the CEO can see what is happening in the field at any given time.

4.4 Design by Feature

In this process the researcher designed the features of the capacity building mobile application to bring out detailed representative diagrams. The use case diagram, logical designs of the system as well as the database design will be mapped out in this process. The different diagrams are given in the following sections.

4.4.1 Data Flow Diagram

A DFD shows the flow of data from users to the system and what functions or processes in the system they are interacting with. Figure 4.7 below shows level 0 DFD. Figure 4.8 is a Level 1 DFD showing all the process, data stores, data flow and external entities. This is an expansion of Level 0 DFD.
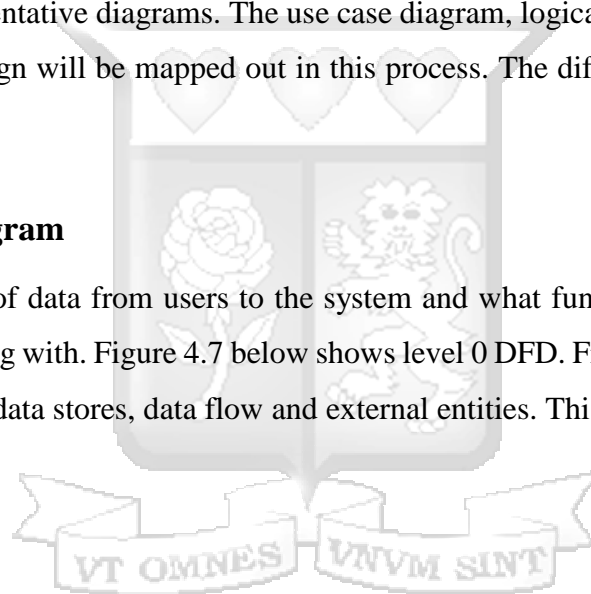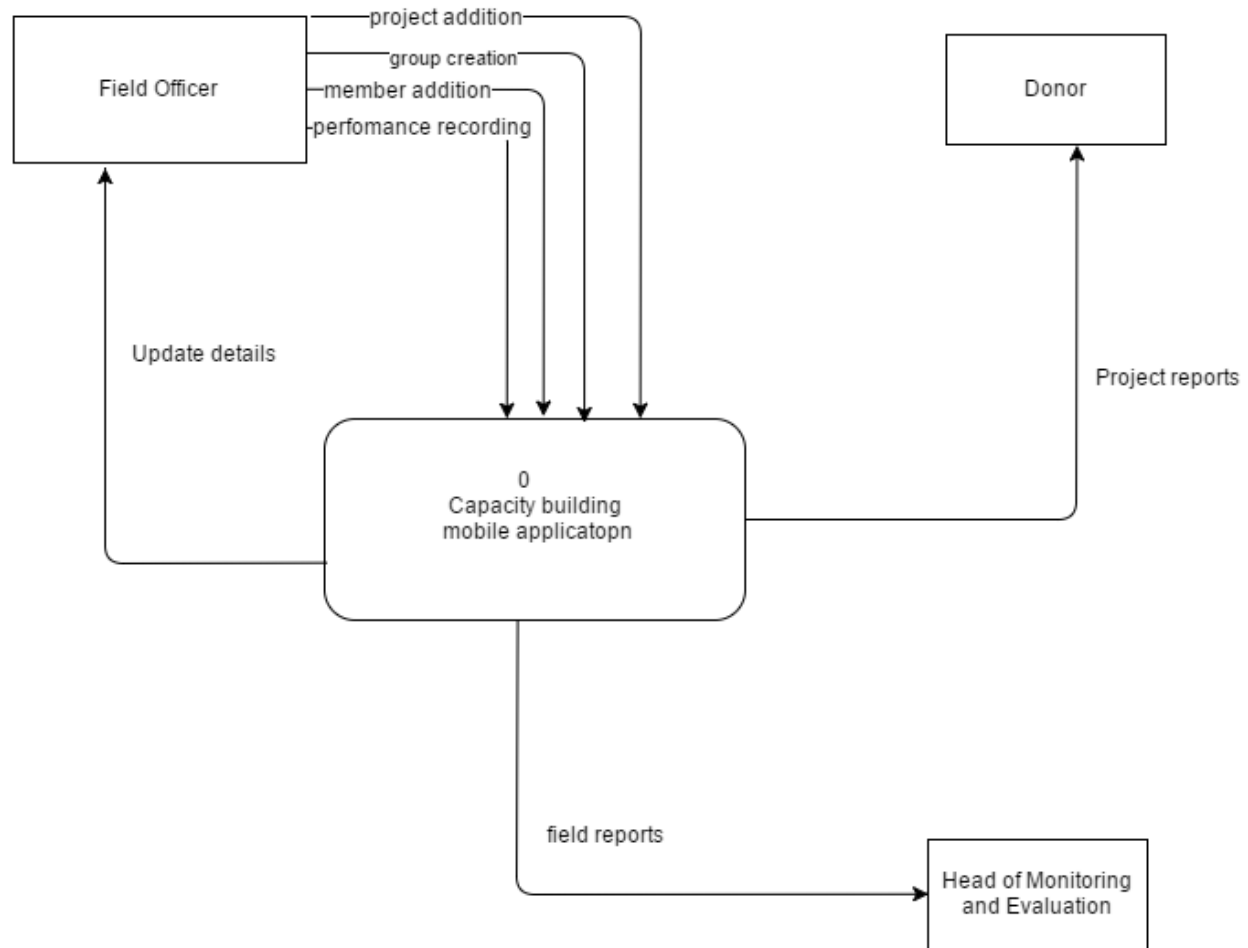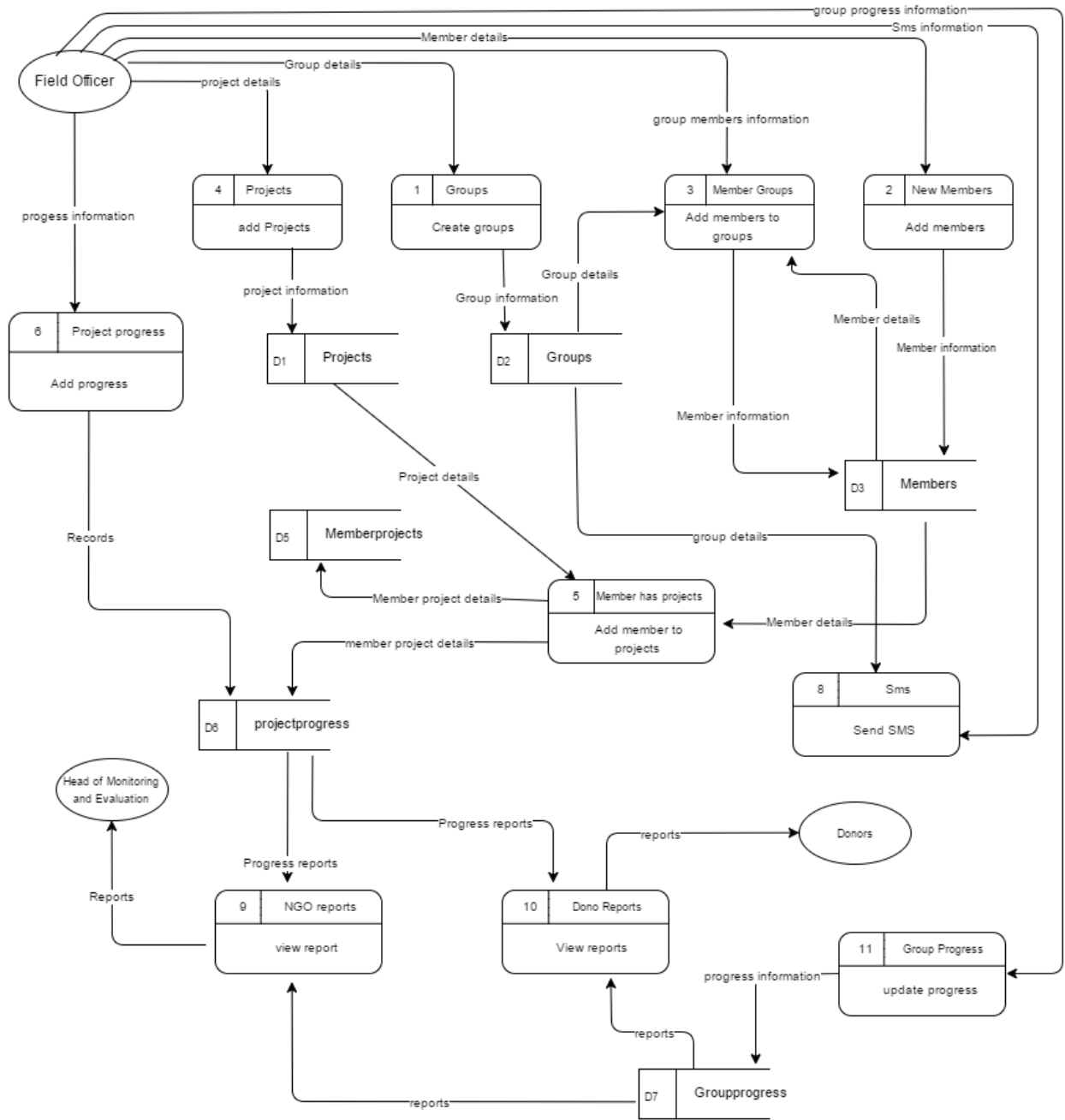
Figure 4:5: Context Diagram

Figure 4:6: DFD Level 1

4.4.2 Use Cases Modelling

Use cases are used here to describe the functional requirements in a clear and consistent manner. It allows the functional requirements to be described in an easy and synthesized manner. Use cases are considered an excellent tool to clarify the system functionality and helps in determining if the system meets the functionalities defined (Larman, 2004). The section below details the use case diagrams and use case descriptions.
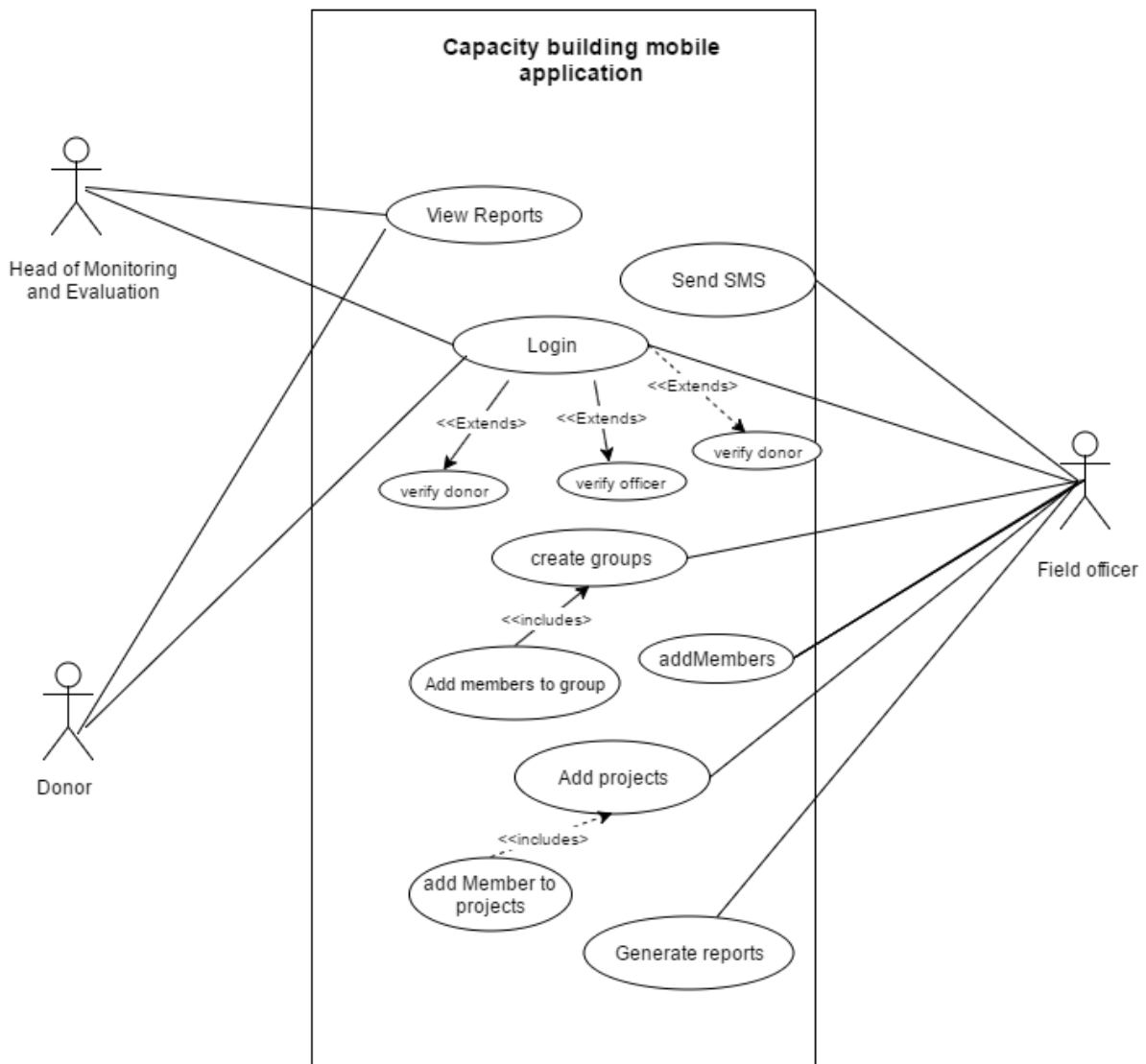
4.4.2.1 Use Case Diagram

Figure 4:7: Use Case Diagram

4.4.2.2 Use Case Descriptions

This section gives a description of the various use cases in the system, scenario, their triggers and the information that is sent by the various uses case as steps occur.

Table 4.4: Create Groups Use Case Description

Use case ID	1	
Use Case Name:	Create groups	
Scenario:	mobile-based, involving new members	
Event (Trigger):	Requirement of members to be in a groups	
Brief Description:	Field officer creates a group so as to add members	
Actors:	Field officer	
Stakeholders:	NGO	
Preconditions:	Members should exist in order to suggest the name of the group	
Post-conditions:	Members added to a group	
Flow of Events (Steps):	Actor	System
	1 Field Officer logs into the system 2 Members suggest group name and Field officer creates the group 3 Field officer adds details of the group 4 User exits the system	1.1 System presents with a login page 1.2 System presents the user with members already in the group 2.1 System presents a new group page

Table 4.5: Add Members Use Case Description

Use case ID	2	
Use Case Name:	Add members	
Scenario:	Member added to a group.	
Event (Trigger):	New member joins the NGO	
Brief Description:	Field officer creates a group then add members to the group	
Actors:	Field officer	
Stakeholders:	NGO	
Preconditions:	a group should exist for members to be added	
Post-conditions:	Members added to a group	
Flow of Events (Steps):	Actor	System
	1. Field Officer logs into the system 2. Field officer adds new members to the suggested group 3. User exits the system	1.1 System presents with a login page 1.2 System presents the user with members already in the group 2.1 System presents a new member form

Table 4.6: Add Projects Use Case Description

Use case ID	3
Use Case Name:	Add Projects
Scenario:	Existence of projects in an organisation
Event (Trigger):	User want to assign projects to members
Brief Description:	Field officer add new projects to the systems based on the projects of the organisation
Actors:	Field officer
Stakeholders:	NGO
Preconditions:	Organisation should have ongoing projects
Post-conditions:	Project created
Flow of Events (Steps):	Actor	System

	Actor	System
	1. Field Officer logs into the system	1.1 System presents with a login page
	2. Field officer add projects to the system	2.1 System presents projects added and gives option of adding new projects

Table 4.7: Send SMS Use Case Description

Use case ID	4
Use Case Name:	Send SMS
Scenario:	involving groups
Event (Trigger):	User needs to inform groups of visits or updates
Brief Description:	User drafts a message He/she wants to send to groups.
Actors:	Field officer
Stakeholders:	NGO
Preconditions:	Members should exist in a group
Post-conditions:	SMS sent

Flow of Events (Steps):	Actor	System
	1. Field Officer logs into the system	1.1 System presents with a login page
	2. Navigates to the SMS tab	2.1 System presents an SMS FORM
	3. User draft a message for a particular group and sends	3.1 System sends the SMS
	4. User exits the system	

Use case ID	5
Use Case Name:	Update progress
Scenario:	Involving members doing projects
Event (Trigger):	Existence of ongoing projects
Brief Description:	Field officer visits the field where the members are and records what's happening
Actors:	Field officer
Stakeholders:	Head of Monitoring and Evaluation, Donor
Preconditions:	Members should exist and must be undertaking a project
Post-conditions:	Data captured at field updated (Images and Videos taken at field)

Flow of Events (Steps):	Actor	System
	1. Field Officer logs into the system	1.1 System presents with a login page
	2. Members opens the progress report for the group or individual member	2.2 System presents a project progress page
	3. Field officer updates what is happening	

Table 4.9: Generate Reports Use Case Description

Use case ID	6	
Use Case Name:	Generate Reports	
Scenario:	Donors assessing impact, Head of motoring doing evaluations	
Event (Trigger):	Impact assessment, need for monitoring and evaluation	
Brief Description:	Donor or Head of monitoring and evaluation logs in to the web application and check reports at real-time of what is going on at the field.	
Actors:	Head of monitoring and evaluation, donor	
Stakeholders:	NGO	
Preconditions:	Members should exist and must be undertaking a project	
Post-conditions:	Generation of Reports	
Flow of Events (Steps):	Actor	System
	1. Head of monitoring and evaluation or donor logs in to the web application 2. Checks progress reports 3. User exits the system	1.1 System presents with a login page 2.1 System presents a project progress reports

4.4.3 Sequence Diagram

This section presents system sequence diagram. The sequence diagram is used in the study to illustrate how certain tasks are performed between users and the system. Figure 4.10 is a diagram showing the system sequence diagram.
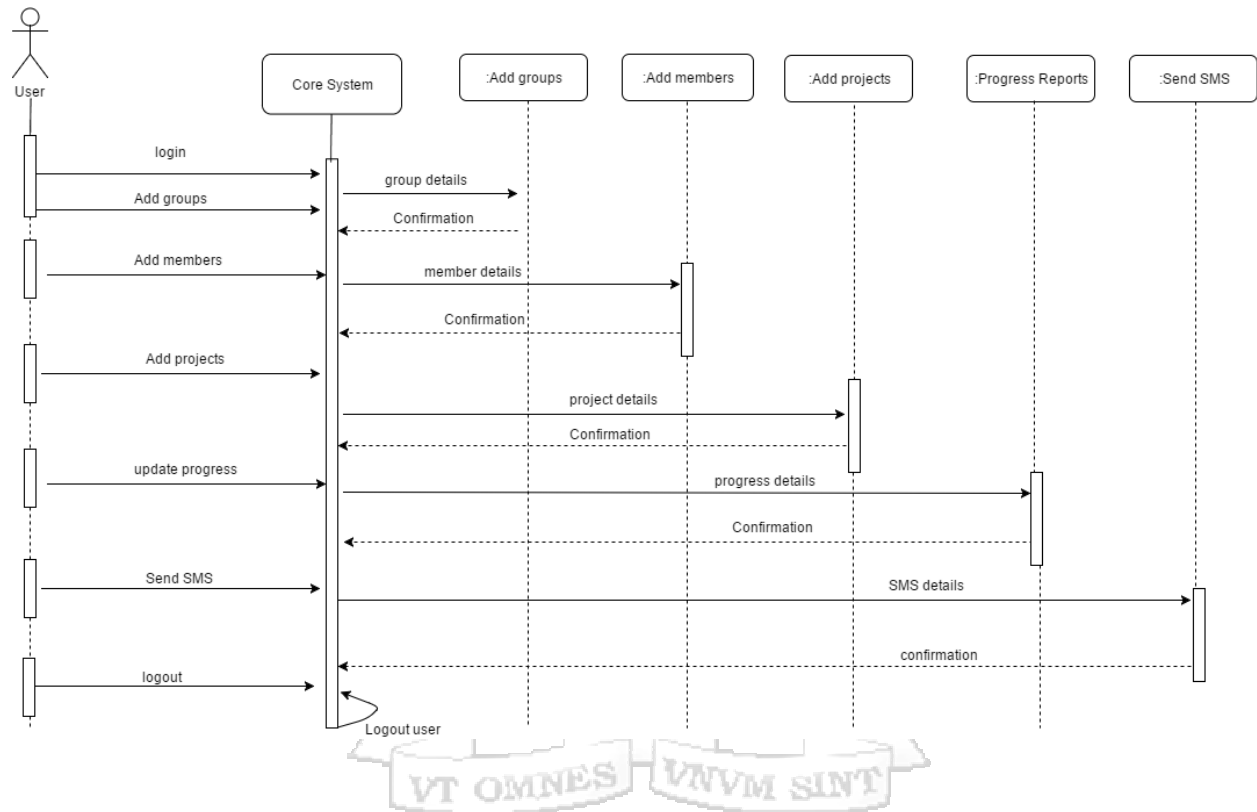

Figure 4:8: Sequence Diagram

4.4.4 Database Schema

The system in figure 4.9 implements a MySQL database with 10 tables some of which are related as shown in the Entity Relationship diagram below
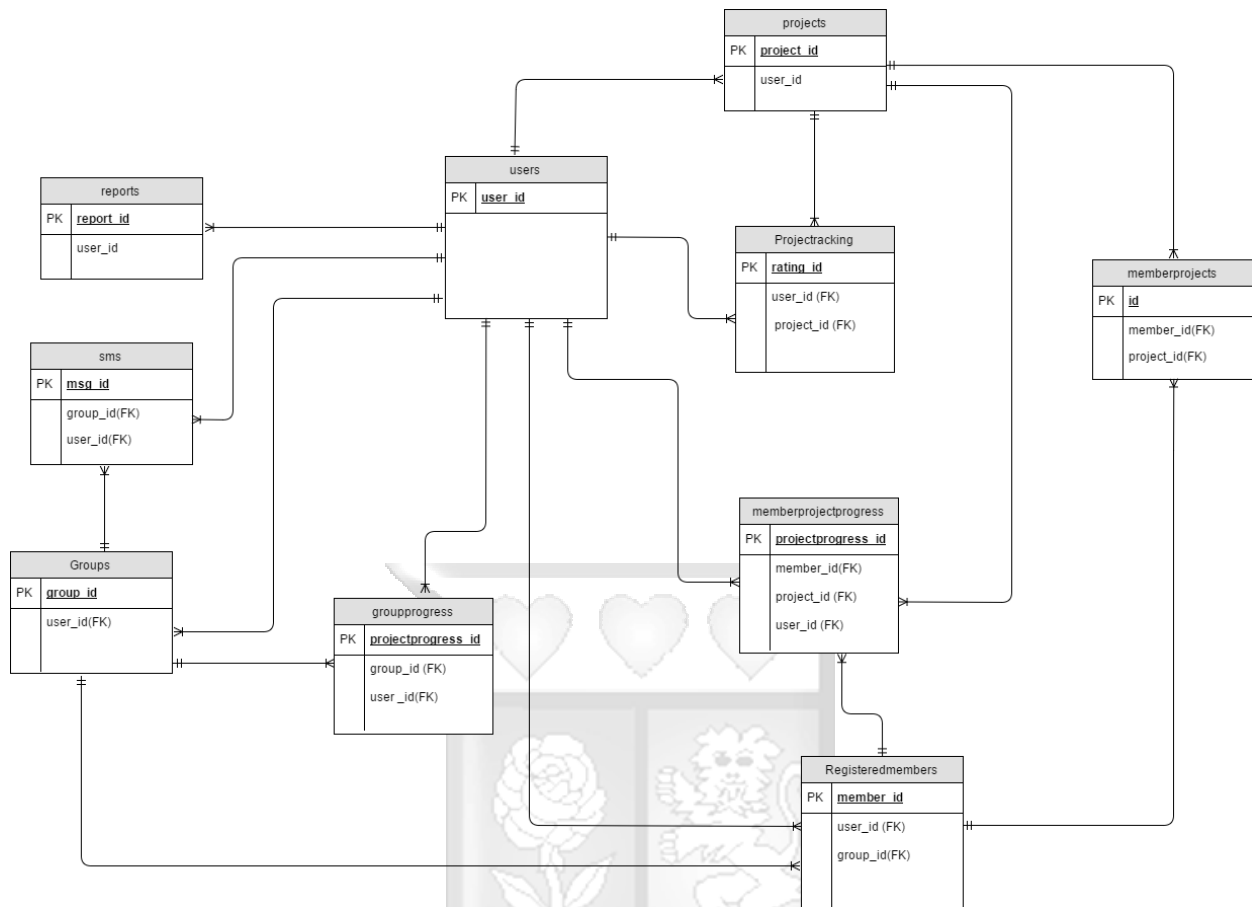
Figure 4:9: ER Diagram

a) Users Table

This table contains the attributes of a user being added to the system. The users table include three different groups of users that include: Head of Monitoring and Evaluation (HME), Field Officers (FE) and Donors. Refer Table 4.10 below for the users' attributes. Head of Monitoring and Evaluation registers projects the NGO is undertaking and also creates Field Officers and Donors based on His/her access level. The donor can view reports generated by HME. The Field officer on the other hand registers groups, rate projects, add members who will undertake the projects the organisation is offering, manage groups and the projects the members are undertaking. The access level defines these three categories where HME has access level 1, Donor has access level 2 and Field officers has access level 3.

Table 4.10: Users Table

Column Name	Data type	index
user_id	Int	Primary Key
FirstName	Varchar(255)	
LastName	Varchar(255)	
Email	Varchar(20)	
mobilenumber	Varchar(20)	
password	Varchar(255)	
accesslevel	Int	

b) Projects Table

Table 4.11 contains projects the NGOs are undertaking. HME adds projects to the system. NGO can undertake many projects at ago. Therefore, HME can add many projects.

Table 4.11: Projects Table

Column Name	Data type	index
project_id	Int	Primary Key
ProjectName	Varchar(255)	
comments	Varchar(500)	
user_id	Int	Foreign Key

c) Groups Table

Registered members are grouped together. Table 4.12 shows a groups table where members are added into. FE can create one or many groups.

Table 4.12: Groups Table

Column Name	Data type	index
group_id	Int	Primary Key
GroupName	Varchar(30)	
descriptions	Varchar(250)	
user_id	Int	Foreign Key

d) Registered Members

This are the members undertaking projects the NGO is offering. Refer to Table 4.13. FE (user access level 3) registers members. This table has attributes member_id, FullNames, PhoneNumber, user_id and group_id. A registered member belongs to a group and one group can have many members.

Table 4.13: Registered Members

Column Name	Data type	index
member_id	Int	Primary Key
FullNames	Varchar(30)	
PhoneNumber	Varchar(30)	
user_id	Int	Foreign Key
group_id	int	Foreign Key

e) Member Projects Table

This is a table generated from registered members and projects table since one project can be done by many registered members and one registered member can do many projects. Refer to Table 4.14.

Table 4.14: Member Projects Table

Column Name	Data type	index
id	Int	Primary Key
member_id	Int	Foreign Key
project_id	Int	Foreign Key

f) Projects Tracking Table

Table 4.15 highlights the progress for projects the NGO is undertaking. The project is rated users of the mobile application (Field Officers). FE can rate a project many times. Rating points are numbers 1, 2,3,4,5. This is described as:

i.   Five - highest rating, meaning the project is doing very well.

ii. Four - project performing well.

iii. Three - project performing fairly well.

iv. Two - project performing poorly.

v.   One- project performing very poor.

The rating number is an integer number 1 which will be used to get the weighted average of ratings a project got from different FEs. Other attributes in the table are rating_id, title, comments, timestamp, project_id and user_id.

Table 4.15: Projects Tracking Table

Column Name	Data type	index
rating_id	Int	Primary Key
Title	Varchar(255)	
comments	Varchar(500)	
rating_number	int	
rating_points	int	
timestamp	DATE	
user_id	Int	Foreign Key
project_id	Int	Foreign Key

g) Group Progress Table

Table 4.16 contains the progress of groups. This is how the groups created by the FE, with the registered members are faring on. A group can have many progress reports and is added by an FE.

Table 4.16: Group Progress Table

Column Name	Data type	index
groupprogress_id	Int	Primary Key
Title	Varchar(255)	
comments	Varchar(500)	
photos	Varchar(250)	
videos	Varchar(250)	
timestamp	DATE	
user_id	Int	Foreign Key
group_id	Int	Foreign Key

h) Member Projects Progress Table

Table 4.17 contains the progress for the projects each individual registered member is undertaking. There can be many progress reports for each individual member and many individual projects this member is undertaking.

Table 4.17: Member Project Progress Table

Column Name	Data type	index
projectprogress_id	Int	Primary Key
Title	Varchar(255)	
comments	Varchar(500)	
photos	Varchar(250)	
videos	Varchar(250)	
timestamp	DATE	
user_id	Int	Foreign Key
project_id	Int	Foreign Key
member_id	int	Foreign Key

i) Reports Table

Table 4.18 contains the reports of the projects generated by the user (HME). This is in form of charts of how the projects funded by the donor is performing. HME can generate one or many reports.

Table 4.18: Reports Table

Column Name	Data type	index
report_id	Int	Primary Key
user_id	int	
date_created	Date	

j) SMS Table

Table 4.19 contains a table for sending messages to groups. FE can send a message to one or many groups.

Table 4.19: Message Table

Column Name	Data type	index
msg_id	Int	Primary Key
message	Varchar(500)	
user_id	int	
group_id	int	Foreign Key

4.4.4.1 Data Security

Data is transmitted from the user's applications to the database; this data is encrypted using RSA algorithm to keep it secure. It is sent through secure protocol i.e. HTTPS. OWASP's web application testing standards will also be utilised. For instance, by following laid down software development methodologies including unit testing and data sanitisation, the attack vectors will be significantly reduced. These include SQL injection, cross-site scripting attacks as well as buffer overflows. To ensure data integrity and non-repudiation, the use of certificates with a proper chain of trust will be made use of. To ensure data integrity, only authorised users will be allowed to write to the database for instance with lowered privileges so as to protect the integrity of the stored data.

4.4.5 Mobile Application Wireframes

a) Login Page

Figure 4.10 presents a welcome page and a login page. When the field officer opens the application He/she will be presented with the login page. This is because the organisation are the ones who register its users
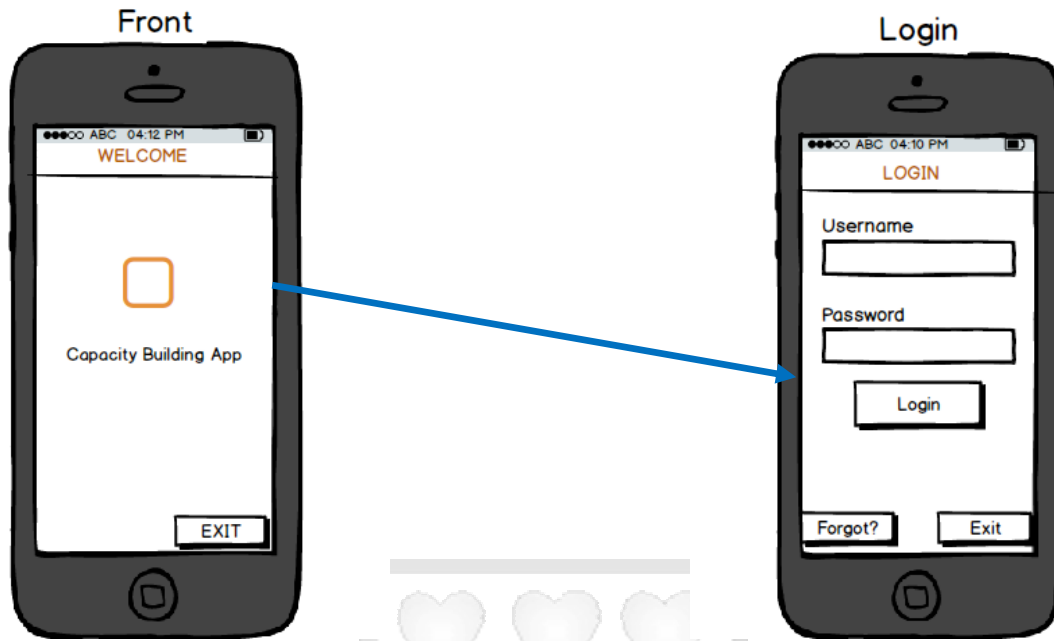
Figure 4:10: Login Page Wireframe

b) Adding New Group

The user of the mobile application can then add groups upon clicking groups on the Home screen. Figure 4.11 below shows a complete process. A list of existing groups is displayed with an option of adding new group to the system.
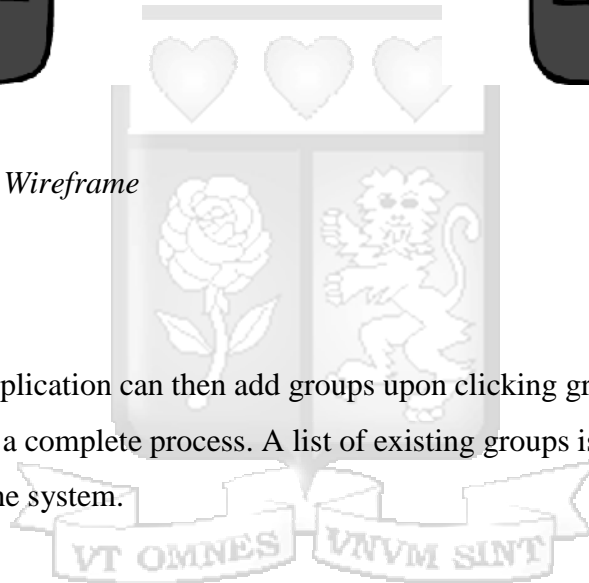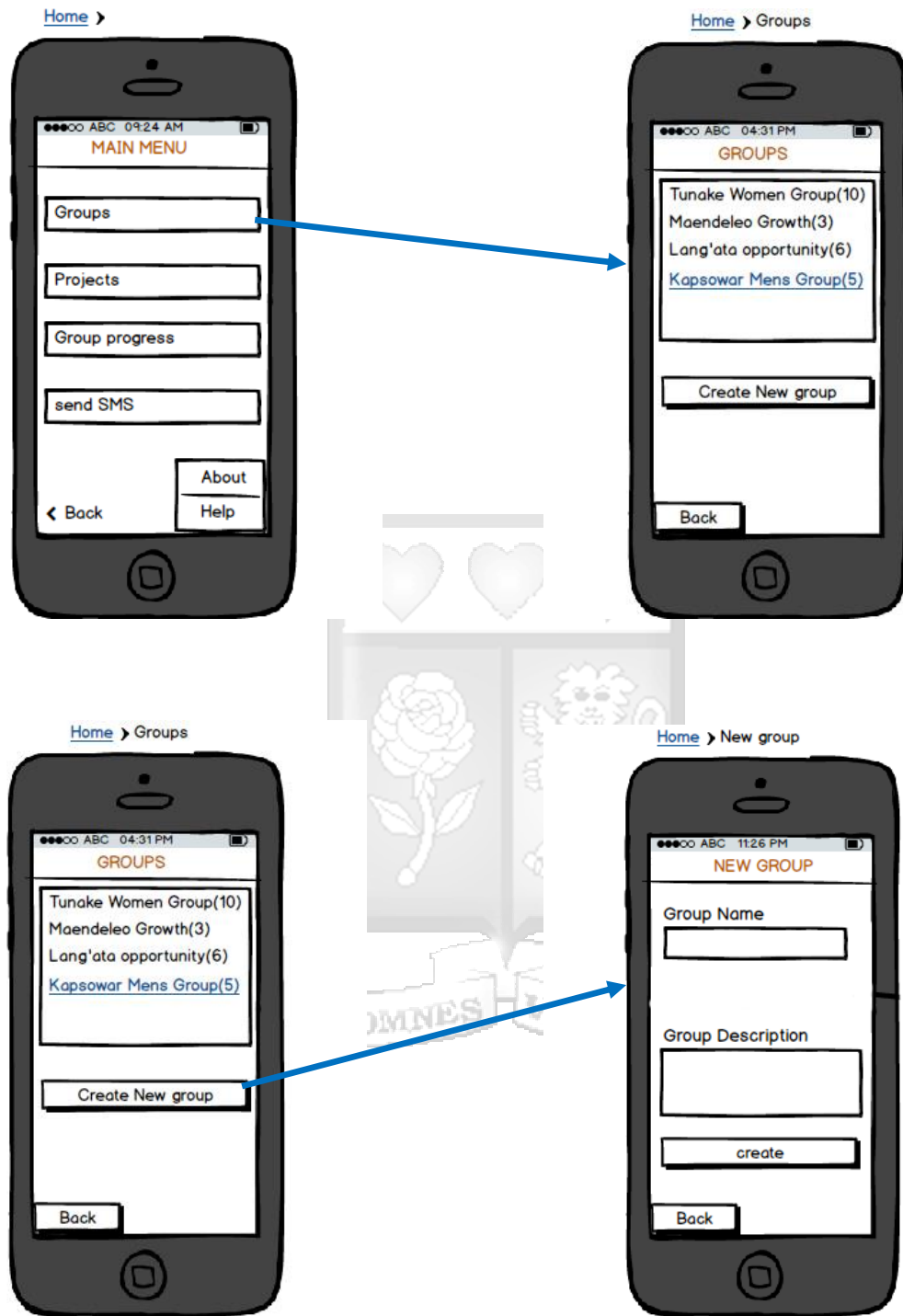
Figure 4:11: Adding New Group Wireframe

c) Adding Members to the Group

When a user opens the name of the group in the group tab, members who are in that group are displayed with an option of adding new members to the group. A user can then add new members in to the group.
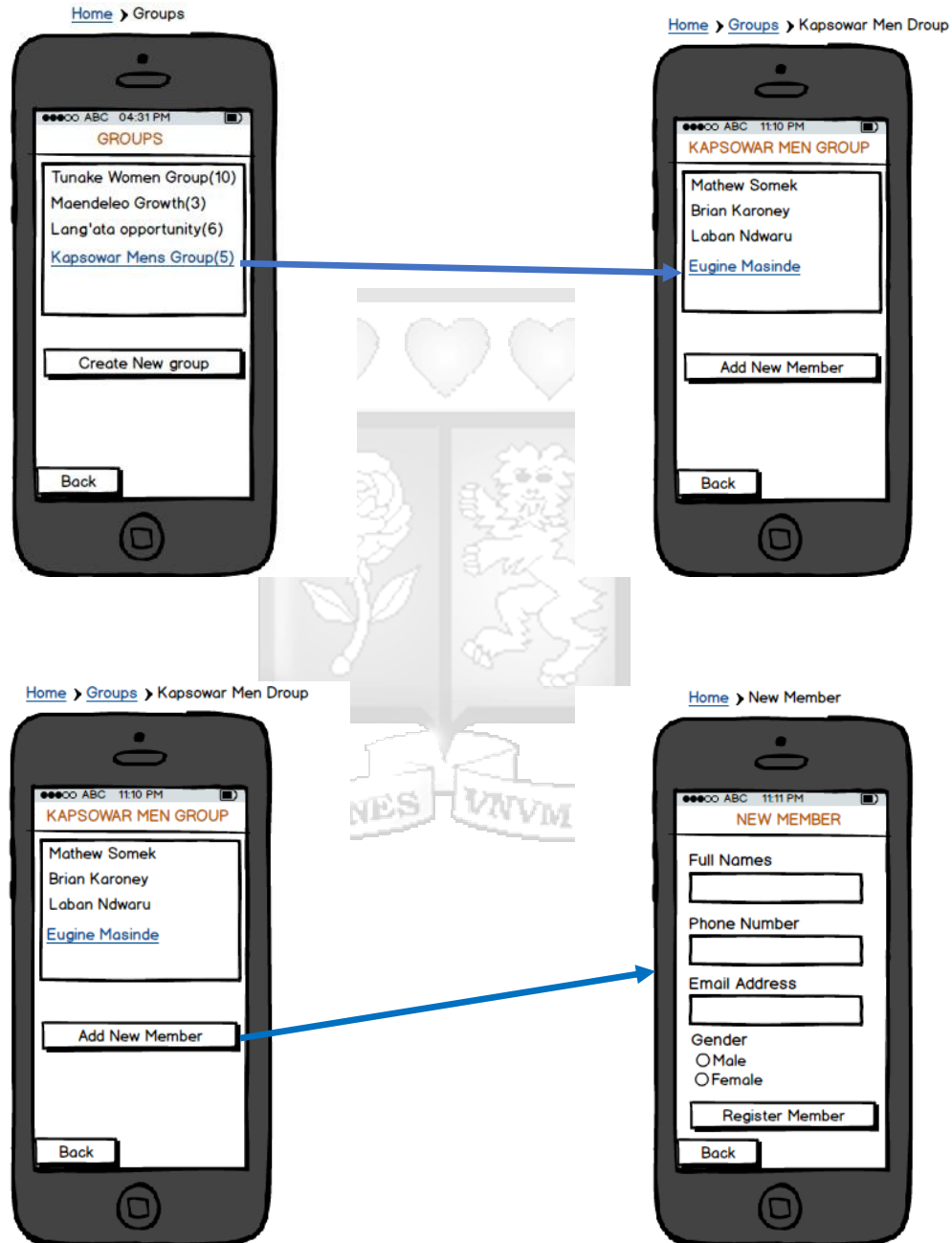
Figure 4:12: Adding Members to The Group Wireframe

d) Adding Projects

Now when a user manages to login. The Home screen appears with details such as; NGO projects, groups, project progress and send SMS. Here the user will be able to add projects i.e. ones the organisation undertakes as shown in figure 4.13 below.

Figure 4:13: Adding Projects Wireframe

e) Progress Reports for Members

A user of the system can create reports of the projects members are undertaking every time He /
She visits the members at the field. This is done when a member belongs to a group. Figure 4.16
below shows a clear detail of what is happening.
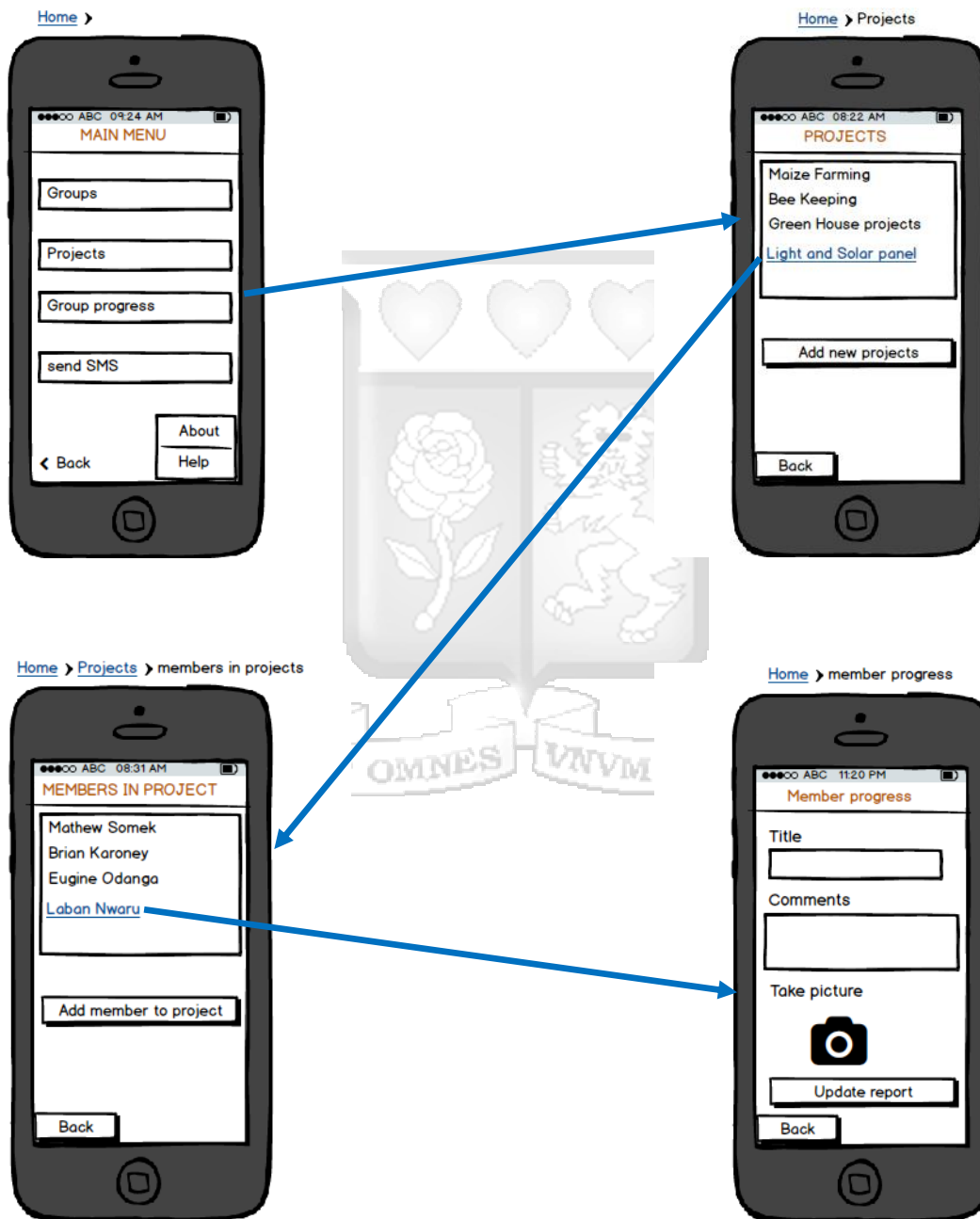
Figure 4:14: Progress Reports of Members' Wireframe

f) Progress Reports for Groups

Trainings are mostly conducted in groups i.e. 15 to 20 members per group. A user can therefore create reports of groups when He or she is at the field. This will involve taking pictures/ videos of what is happening at the field and writing comments. A detailed description is as seen in figure 4.15.

Figure 4:15: Progress Reports for Groups Wireframe

Figure 4:16: Progress Reports for Groups Wireframe

g) Send SMS

A user can send Bulk SMS to groups by using the Send SMS button on the home screen. Here a user is presented with the name of the groups which is then directed to text message composition page. A user can then write an SMS to the specific group e.g. "Tomorrow I will be visiting for a meeting".

Figure 4:17: Send SMS Wireframe

4.4.6 Web Application Wireframes

a) Dashboard

Figure 4.18 shows the main dashboard wireframe.

b) Users of the System

This will display the users of the system. Refer to Figure 4.19. The users can be deleted or their descriptions changed.

c) Registering New User

The is how a new user of the mobile or web application will be added into the system. Figure 4.20 shows registration process.

d) Projects

This wireframe contains the projects the NGO is undertaking with an option of adding new project. Refer to Figure 4.21.

e) Tracking Field Officers

This is where tracking of groups a field officer is handling. Refer to Figure 4.22.

f) Tracking Member Projects

Displays real-time monitoring of projects a member is doing. Figure 4.23 and Figure 4.24 shows tracking member projects wireframe.

g) Performance of Projects

Figure 4.25 shows how the reports for the donor is generated.
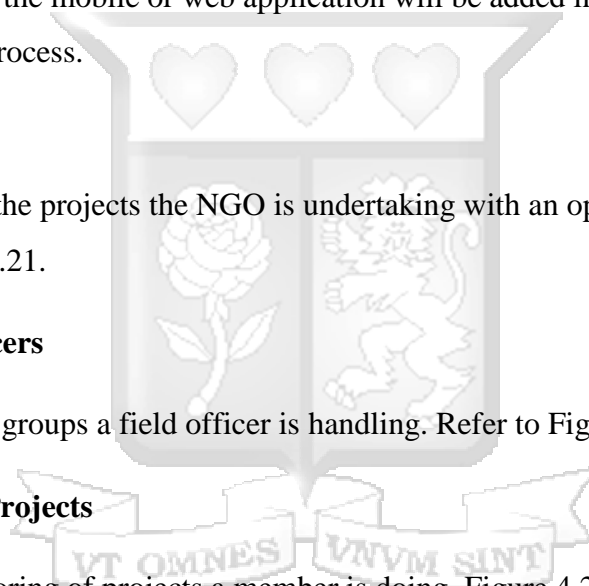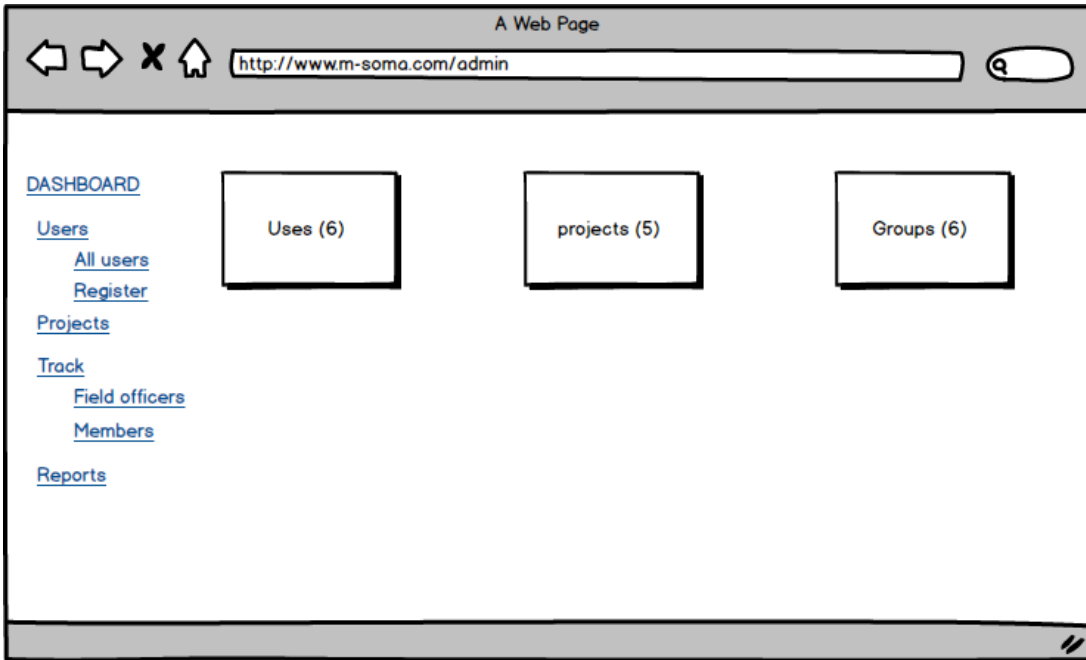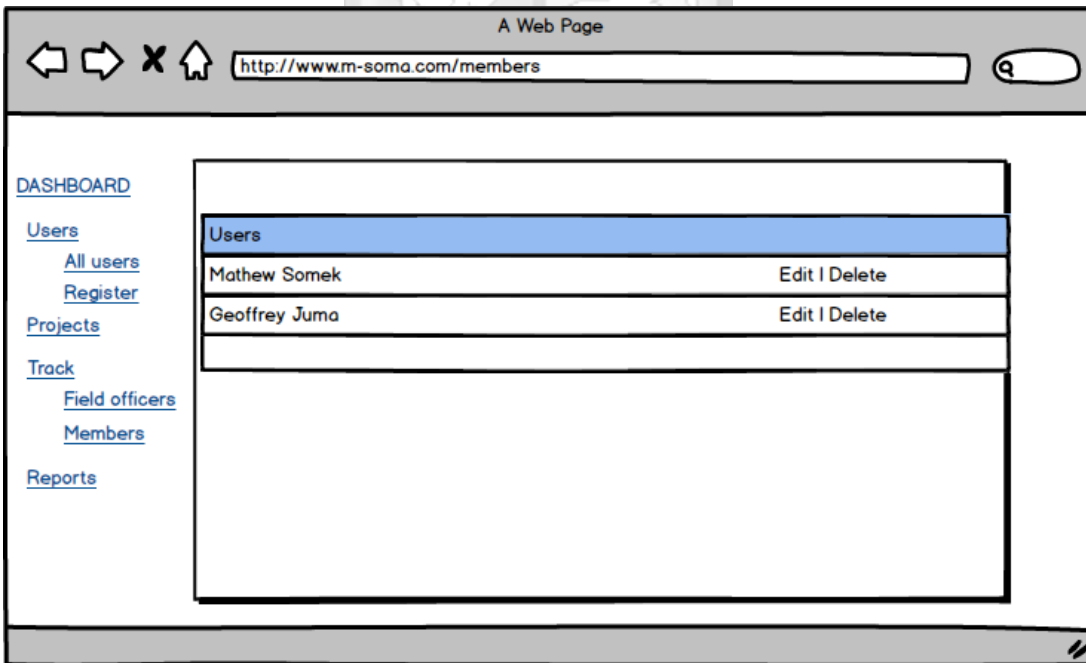
Figure 4:18: Dashboard Wireframe
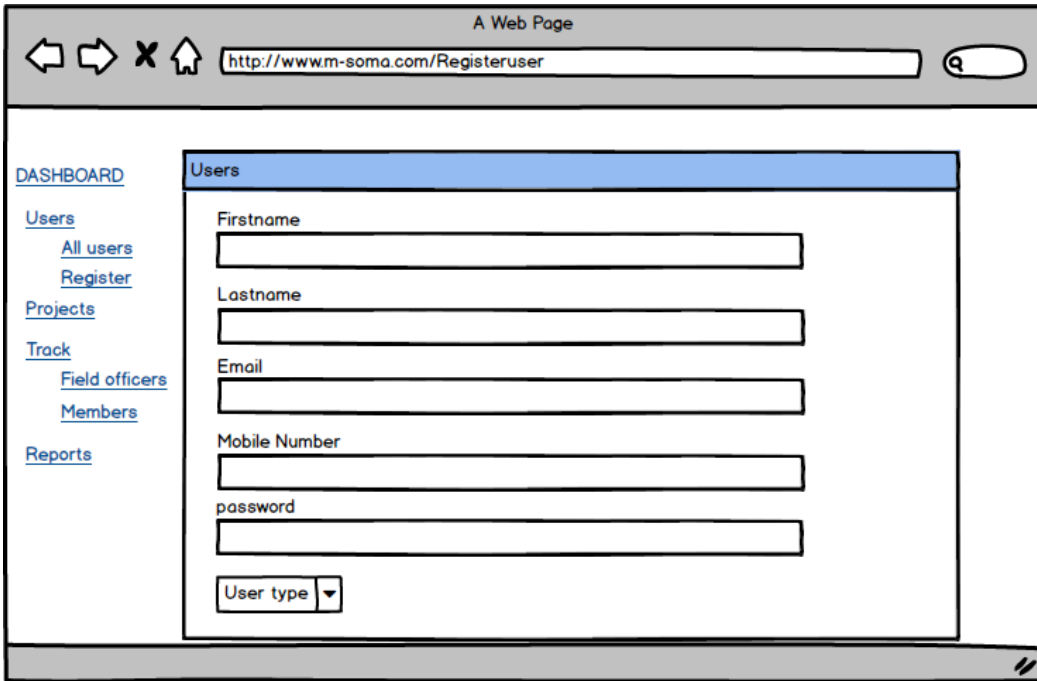

Figure 4:19: Users of the System Wireframe

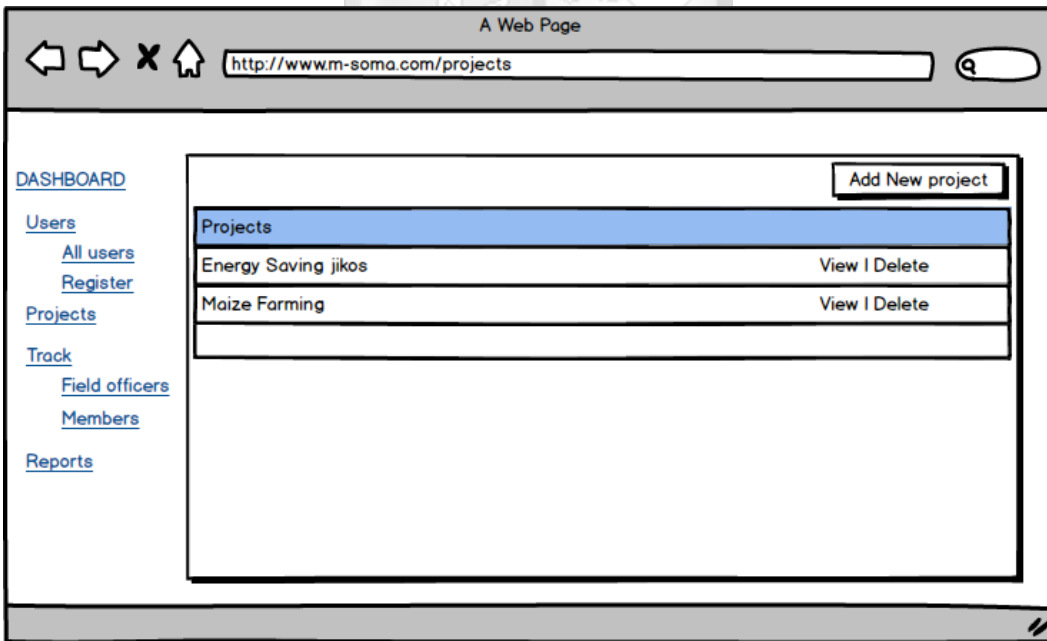*Figure 4:20: Register New User Wireframe*
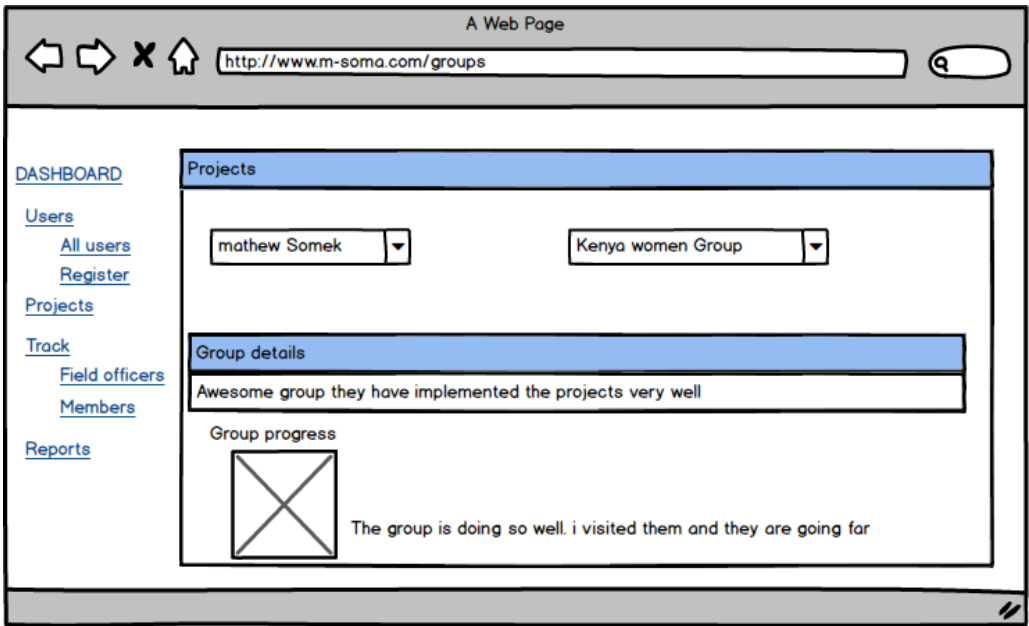

Figure 4:21: Projects Wireframe

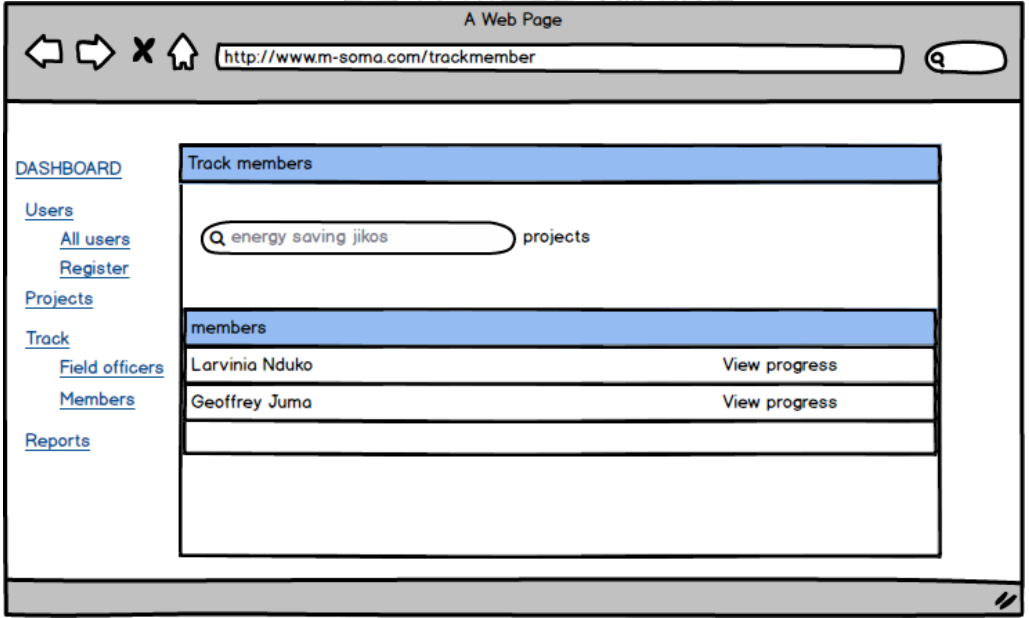*Figure 4:22: Track Field Officers Wireframe*

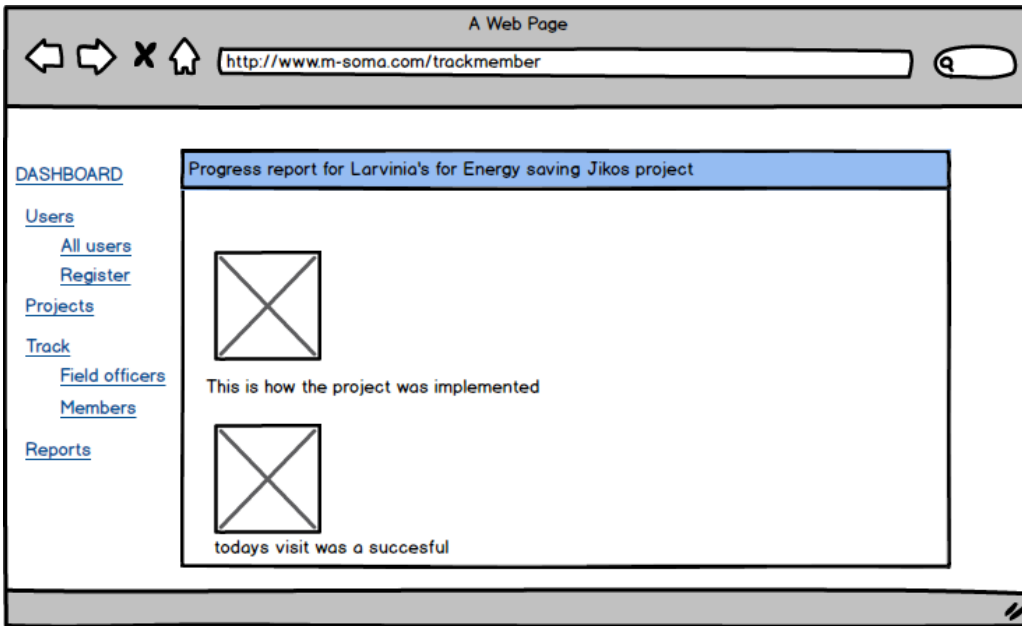*Figure 4:23: Member Projects Wireframe*
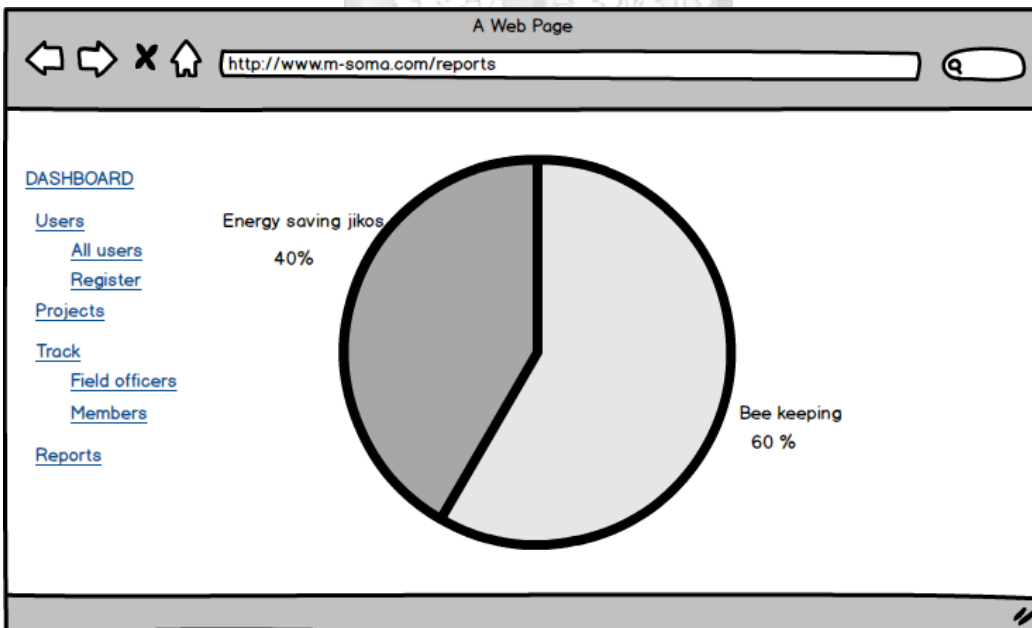
Figure 4:24: Progress Report for Member

Figure 4:25: Performance of Projects Wireframe

CHAPTER 5: BUILD BY FEATURE

This chapter describes the implementation of the proposed application. The system functional requirements that were stated in chapter 4 were incorporated in the prototype functionalities. The system design strictly adhered to the design presented in the build by feature section in chapter 4.

The implementation environment for the mobile application, web application and database will be described in this section in order to have a clear understanding of the actual implementation of the prototype. The implementation details provide descriptions of major system components and explanation of implementation procedures.

This chapter also provides the system testing procedures which include functional testing where the system functionality was tested against the functional requirements, compatibility testing where the applications were tested against different platforms and browsers and usability testing which was conducted by potential users and their feedback analysed.

5.1   Mobile Application

5.1.1   Implementation Environment

The mobile application was developed in android operating system, with the source code written in Java, utilizing android classes. The application was compiled and tested using the android Software Development Kit (SDK) emulator and an android device. The application was optimized for android version 4.4.2 compatible with android devices on minimum version 2.0 and maximum version 4.4.4. JSON was used as the web service that provides the interface between the android application and the database. JSON was used as the web service that provides the interface between the android application and the database. Reasons for choosing android is because of the popularity of the phone in Kenya.

5.1.2 Database

The database was developed using the MySQL database. Reasons for using MySQL were; it is an open source platform; it is fully compatible with PHP and other platforms; it is secure in that all passwords are encrypted before storage restricting unauthorized access to the database.

5.1.3 Mobile Application Screenshots

a) Application Home Page

When the user provides the correct information during login they are sent to the home page. From there, they are able to perform the available functions. Figure 5.1 shows the home page and the various functions.
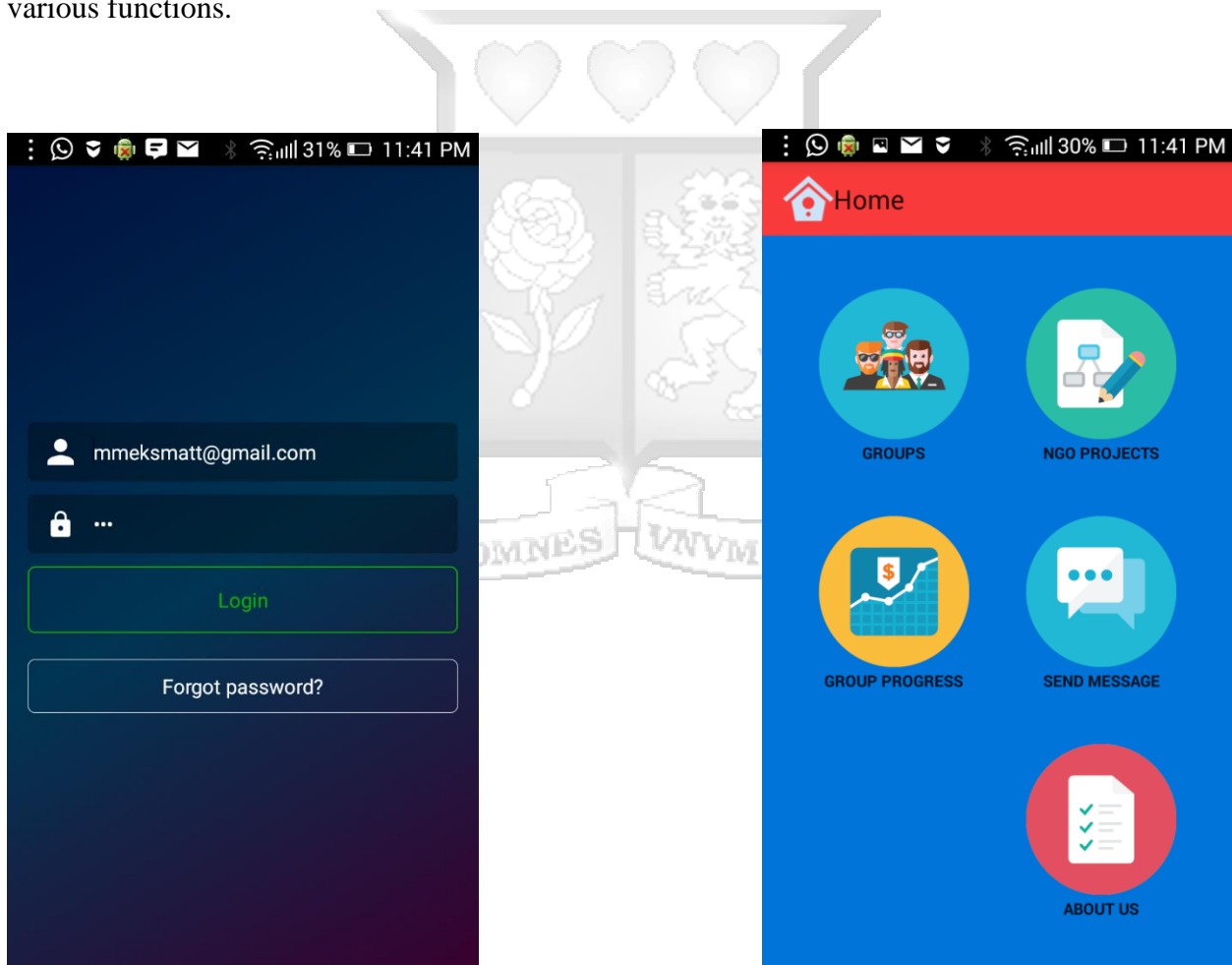

Figure 5:1: Mobile Application Home page

b) Creation of Groups

A user clicks the groups button which then directs him/her to the groups pages. This shows the available groups and also gives an option such that a user can create a new group.
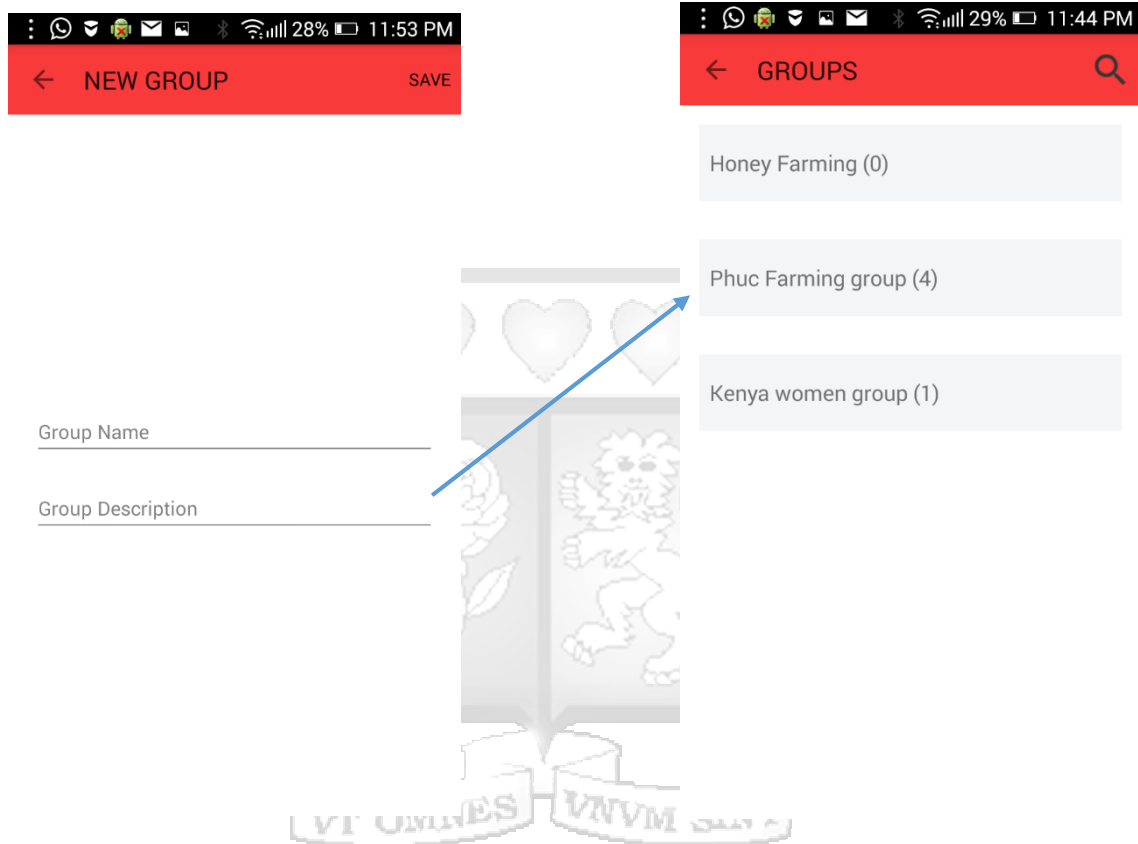

Figure 5:2: Creation of Groups in the Mobile Application

c) Adding Members to Groups

A user can view the groups and the members who are in the group. He /she can also add new members to the respective groups for easy monitoring. All required is the name and the phone number of a member.
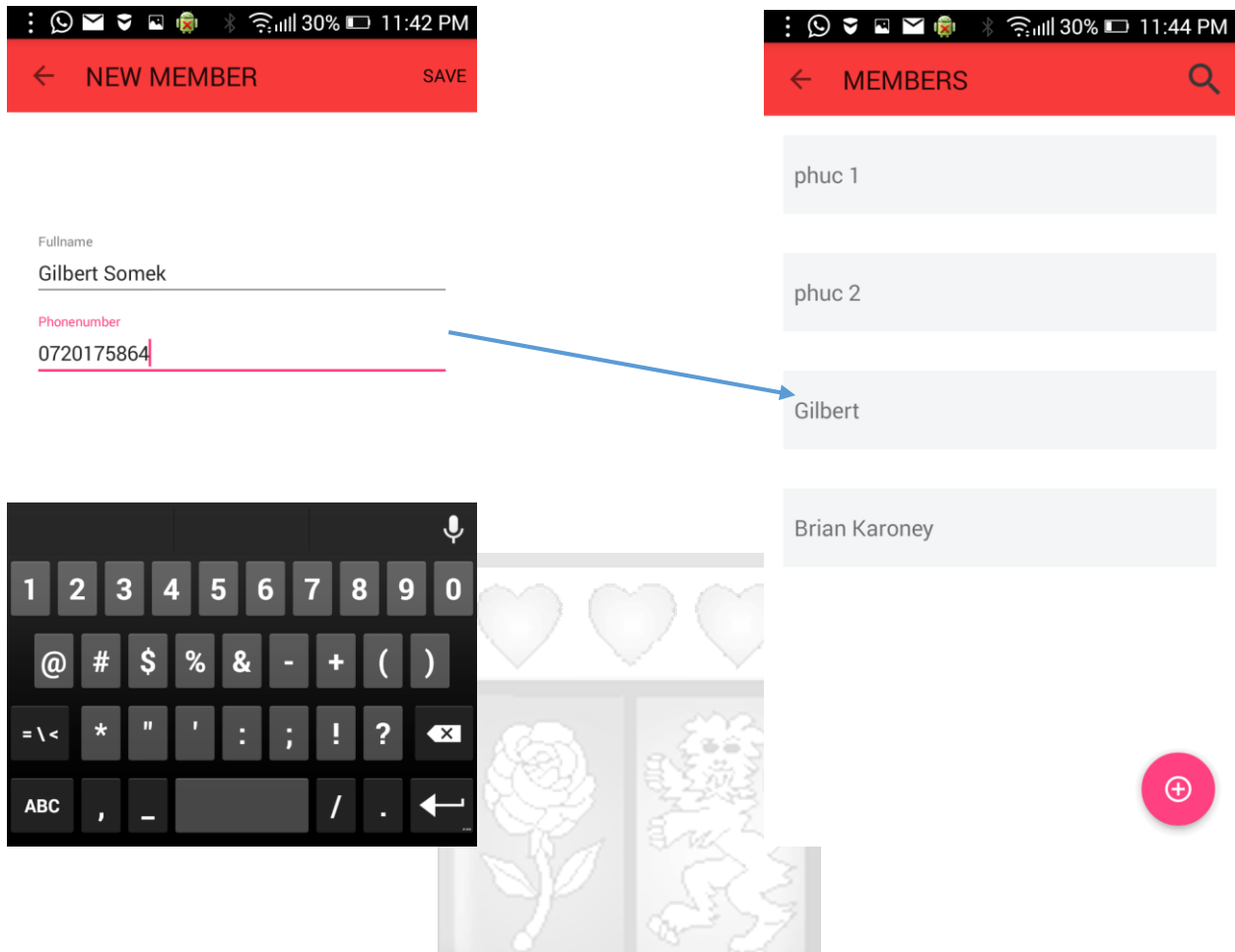
Figure 5:3: Adding Members to Groups in the Mobile Application

d) Project Progress for Members

A project progress is for individual members who are in a group and are undertaking a project. A user can update this by inputting a title then comments and can also add video clip or a picture. With this, the NGO can see the progress of projects of each individual person the field officer visits the field.
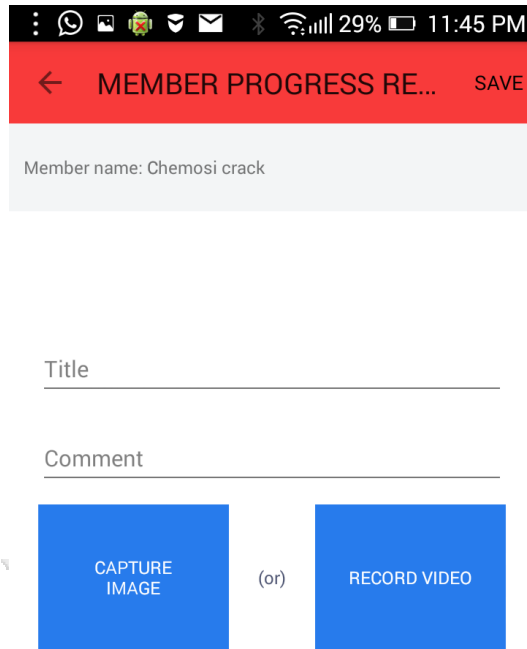
Figure 5:4: Member Project Progress

e) Group Progress

A field officer visits groups and offer trainings. This section involves tracking of individual groups. A user can update this by inputting a title then comments and can also add video clip or a picture. The NGO can then keep track of what is happening in the field.
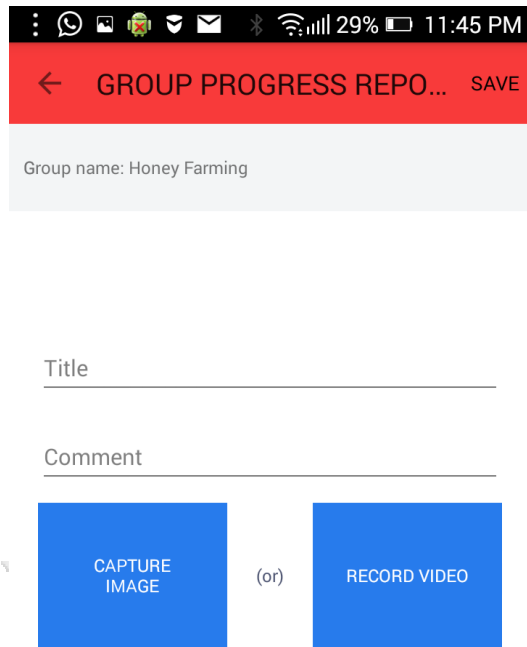
Figure 5.7: Group Progress in the Mobile Application

f) Sending bulk SMS to groups

Figure 5.8 below shows how a user of the mobile application can send SMS to groups. e.g. "we are meeting tomorrow for a training on the new solar panels installation". This is done by selecting the group and then typing the message.
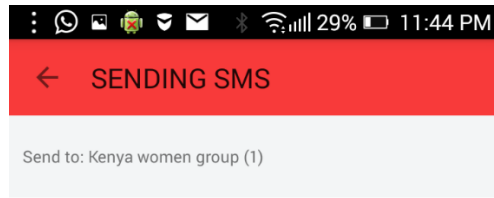
Figure 5.8: Sending Bulk SMS to Groups Using the Mobile Application

g) Project Progress

Members who register to part of an organisation can do the projects organisations are offering. I member can do more than one project. This projects can be tracked as a whole with ratings give per project per Field officer. This will help in noting which project is highest performing.
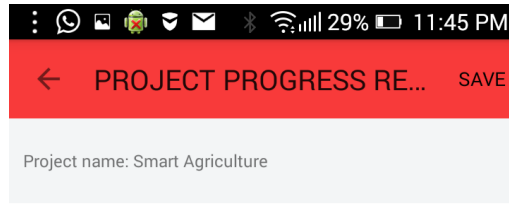
Figure 5.9: Project Progress

5.2 Web Application

The web application's main function is to retrieve reports from the developed mobile application. This application resides in the HTTP web server and is directly linked to the capacity building mobile application. This web application helps in administration of users, viewing and generation of reports. The NGO i.e. Head of Monitoring and Evaluation (HME) will use the web application to view what is happening at the field and can also generate these reports to be used for presentations. The donor who is funding the NGO also uses the web application for impact assessment.

a) Web Application Implementation Environment

The web application was developed using Codeigniter framework based on Hypertext Pre-processor (PHP). The website was hosted on an online Apache HTTP server. Reasons for using PHP were; it is an Open Source platform, it is platform independent; it supports all major web servers and databases; it has multiple layers of security to prevent threats and malicious attacks.

5.2.1 System Components

5.2.1.1 Login Page

The figure 5.1 below shows the procedure of logging in the web application. To gain access to the web application users have to login using a username and password. The username and password is authenticated and verified then access is granted or denied. This prevents against unauthorized access.
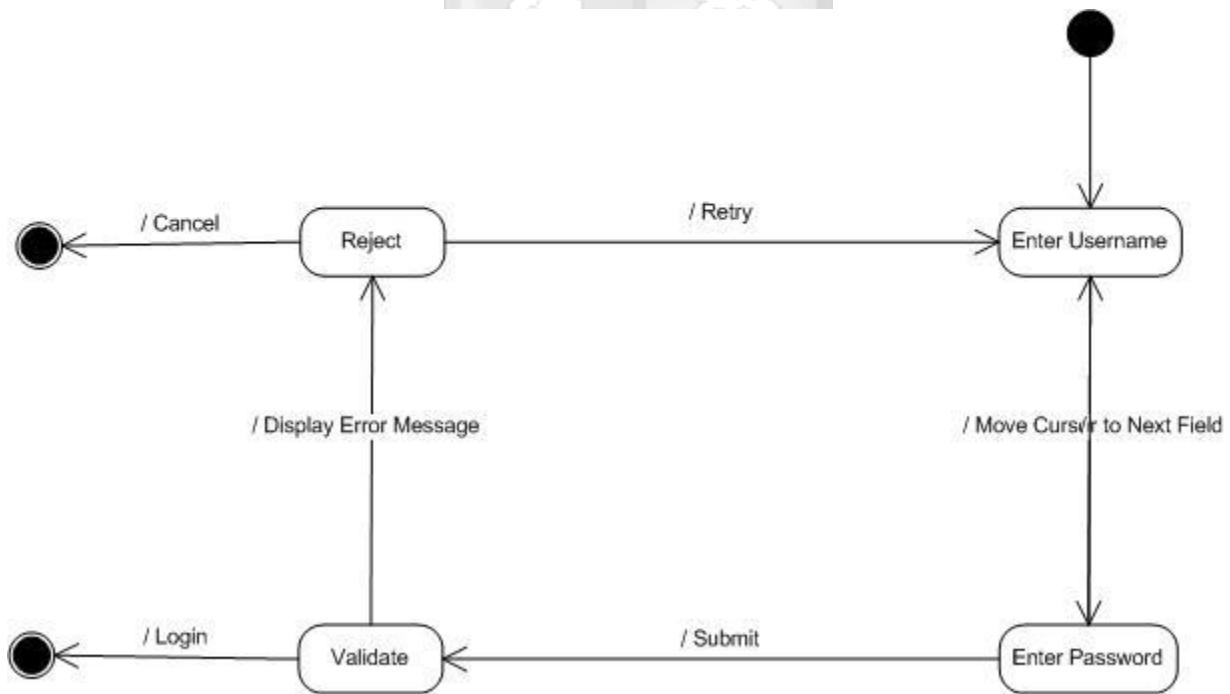
Figure 5.10: Web Application Login

A user e.g. Donor, Head of monitoring and evaluation or Field officer logs into the application based on access levels.

Figure 5.11: Web Login

a) Head of Monitoring and Evaluation (HME) Main Dashboard

This is where tracking of projects, groups, and generating of reports is done. It is the core of the web application.
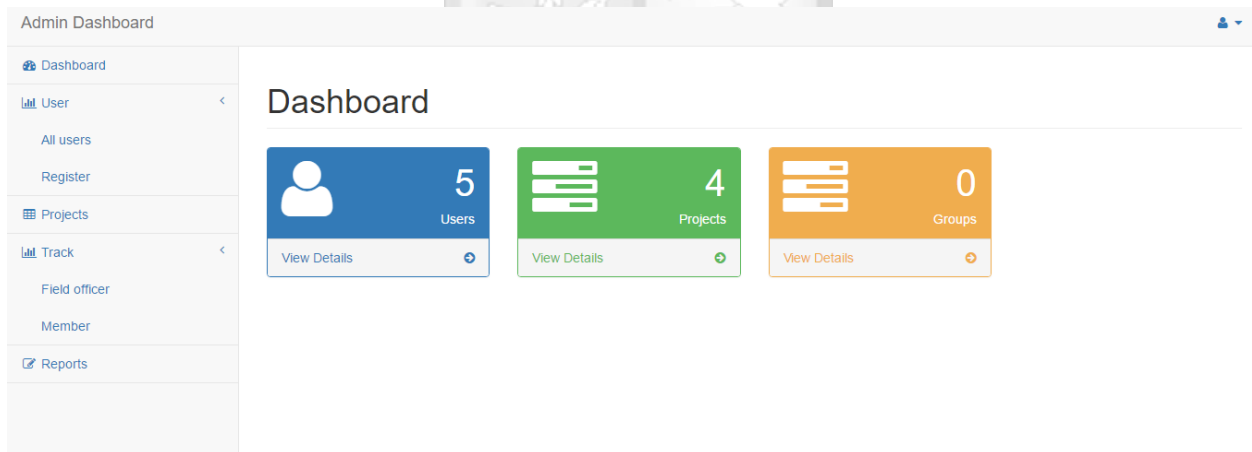
Figure 5.12: Main Dashboard

b) Managing Users

An HME can add, edit or delete a user of the particular organisation He/she is in.

Figure 5.13: Managing Users
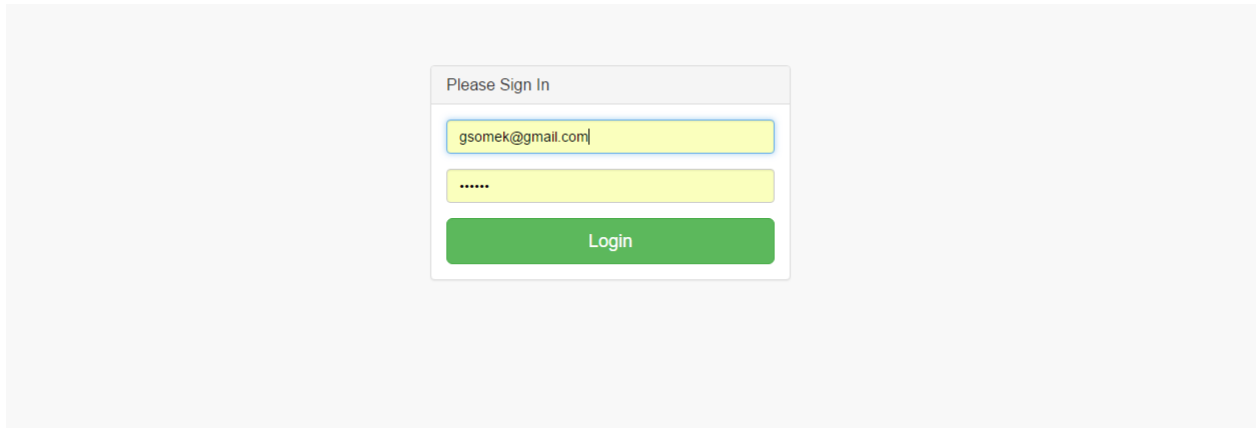
c) Adding a User

Figure 5.14: Adding a User

d) Tracking of Field officers at real time

This section represents the core of monitoring and evaluation where field officer can be track at real-time. They post information at field of what is happening at field e.g. photos, videos, comments and the HME gets this information at a go.

Figure 5.15: Tracking Field Officer

e) Tracking a member

Figure 5.16: Tracking a Member

f) Report Generation

This is where reports are generated for the donor. It includes the projects the donor is funding and how the projects are performing.
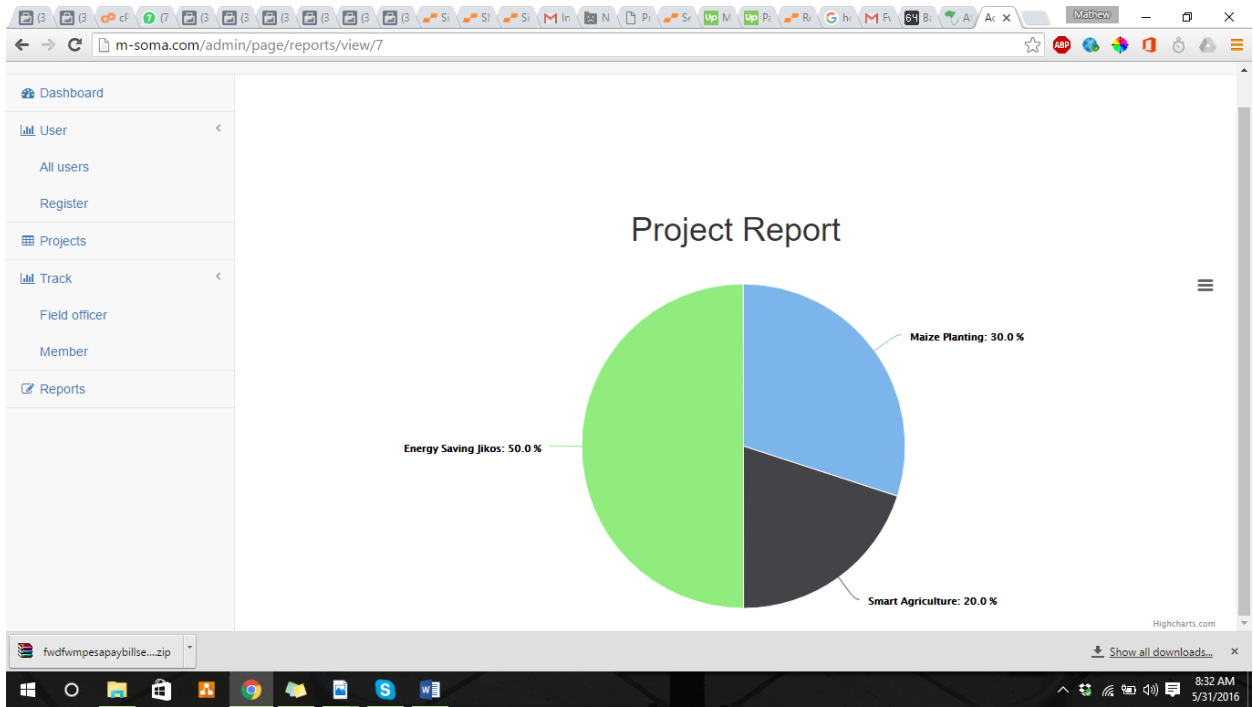
Figure 5.17: Report Generation

6.3.1.1 User Management

The web application has mainly for users namely; The super user, a field officer (FO), donor, Head of Monitoring and Evaluation (HME) who can log in and use the system. These users perform different functions as described below;

a) **Super User - (Access level 0)**

    i.   Creates an organisation.

    ii.   Creates Head of monitoring and evaluation(HME).

    iii.   Add HMEs to an organisation.

    iv.   Deletes or view or edits all users or edit all users.

    v.   Manage billing of the organisations.

b) **Head of Monitoring and Evaluation- (Access level 1)**

    i.   Registers Field officers.

    ii.   Register Donors.

    iii.   Deletes, views or edits all users that belong to the particular organisation.

iv. Create projects an organisation is undertaking.

v. Track field officers and the groups they are managing.

vi. Track members who signed up with the organisation and are undertaking projects.

vii. Share projects with donors of the particular organisation- i.e. so that a donor can see the projects he/she is funding.

viii. Generate reports for the organisation and the donor e.g. visualizations of how projects are performing.

c) **Donor - (Access level 2)**

i. Required to change password on login.

ii. Can manage his accounts e.g. change passwords.

iii. Can see ongoing projects – generated by HME.

iv. See generated reports.

d) **Field Officer- (Access level 3)**

i. On login the FO can manage his accounts e.g. change passwords.

ii. Perform edits e.g. editing reports of what he/she did at the field.

5.3 System Testing

5.3.1 Introduction

The researcher in this process tested the validity of the smallest units of system to help uncover errors within the boundary of the module. A good example is the discussion forum facility in the system or the login system which are units of the bigger system. This helped in the debugging of any issues in the individual modules.

Having written the codes for each module, the modules were integrated (combined) and then the resultant main modules were tested for conformity and completeness. This helped uncover errors associated with interfacing the modules and ensured the overall system felt within the structure that was dictated by the design of the system.

5.3.2 Functional Testing

Functional tests were done based on use cases to determine success or failure of the system implementation and design. For each use case testing measures were set with results being considered successful or unsuccessful. Below are tables showing some of the major use cases and their test results.

Table 5.1: Creating of Groups Test Case

Identifier	1
Test Case	Creating groups
Description	Field officer create groups for members
Utilized Use Case	Create Group
Results	Successful creation of groups was done and listing the created groups already
Pass/Fail	Pass

Table 5.2: Add Member to Groups Test Case

Identifier	2
Test Case	Adding members to groups
Description	A member is added to the groups created while at field.
Utilized Use Case	Add Member Groups
Results	Adding of new members to the created groups was successful
Pass/Fail	Pass

Table 5.3: Addition of Projects Test Case

Identifier	3
Test Case	Field officer adding projects
Description	A field officer adds projects the NGOs are doing
Utilized Use Case	Add Project
Results	Project addiction successful and listing of the added projects
Pass/Fail	Pass

Table 5.4: Add Member to Groups Test Case

Identifier	4
Test Case	Progress of Individual Member projects
Description	Involves user submitting individual project report while at the field
Utilized Use Case	Individual Project Progress
Results	Reports were submitted with pictures and Videos and it was successful
Pass/Fail	Pass

Table 5.5: Progress of Groups Test Case

Identifier	5
Test Case	Progress of groups
Description	Updating of groups projects showing progress
Utilized Use Case	Group Project Progress
Results	Group project progress testing was conducted and it was successful
Pass/Fail	Pass

Table 5.6: Send SMS Test Case

Identifier	6
Test Case	Sending SMS alerts to groups
Description	A field officer is able to send SMS alerts to groups informing them of trainings, meetings, progress reports etc.
Utilized Use Case	Send SMS
Results	SMS sending successful
Pass/Fail	Pass

Table 5.7: Donor Reports Test Case

Identifier	7
Test Case	Donor reports
Description	Donor query reports and the reports displayed to them
Utilized Use Case	Donor Reports
Results	Donor reports successfully displayed to the user
Pass/Fail	Pass

Table 5.8: NGO Reports Test Case

Identifier	8
Test Case	NGO reports
Description	NGO query reports and the reports displayed to them
Utilized Use Case	NGO Reports
Results	NGO reports successfully displayed to the user
Pass/Fail	Pass

5.3.3 Compatibility Testing

Compatibility test was done to ensure that the mobile and web applications are compatible with the available platforms. The mobile application was tested against the available Android versions while the web application was tested against the available web browsers that are commonly used.

Android Platform Compatibility Testing

Compatibility test conducted for each of the available Android platforms is shown in Table 5.9 below.

Table 5.9: Android Platform Compatibility Test

Android Platform	Compatible
Android 10 (2.3.3)	Yes
Android 11 (3.0)	Yes
Android 12 (3.1)	Yes
Android 13 (3.2)	Yes
Android 14 (3.3)	Yes
Android 15 (4.0.3)	Yes
Android 16 (4.1.2)	Yes
Android 17 (4.2)	Yes
Android 19 (4.4)	Yes

Web Browser Testing

Table 5.10: Web Browser Test

Browser types	Compatibility
INTERNET Explorer (versions 4 and above)	Yes
Firefox (version 8.0 and above)	Yes
Chrome (All versions)	Yes

5.3.4 Usability Testing

The mobile application was taken to the NGO and given to the field officers, Programme managers to test the mobile application. A total of 20 respondents from different NGOs was given to carry out the tests and which was then used to refine the prototype until a satisfactory application was developed. 20 respondents participated in the user testing so as to have at least 1 user from each NGO. User testing was done to achieve the following objectives: User friendliness, functionality; look and feel, attractiveness and acceptance among others. Evaluation matrix was used to represent user responses as shown in table 5.11. This is further explained in Appendix F.

5.3.5 System Validation

This was done in order to ascertain whether the capacity building mobile application met the expectations of the NGOs and if it solved the problem of reporting, monitoring and evaluation of projects by these NGOs. A total of 20 respondents from different NGOs were requested to validated the system. 20 respondents participated in system validation so as to have at least 1 user from each NGO. Figure 5.11 below shows what the users thought of the implementation and if the system solves the problem.

Table 5.11: System Validation

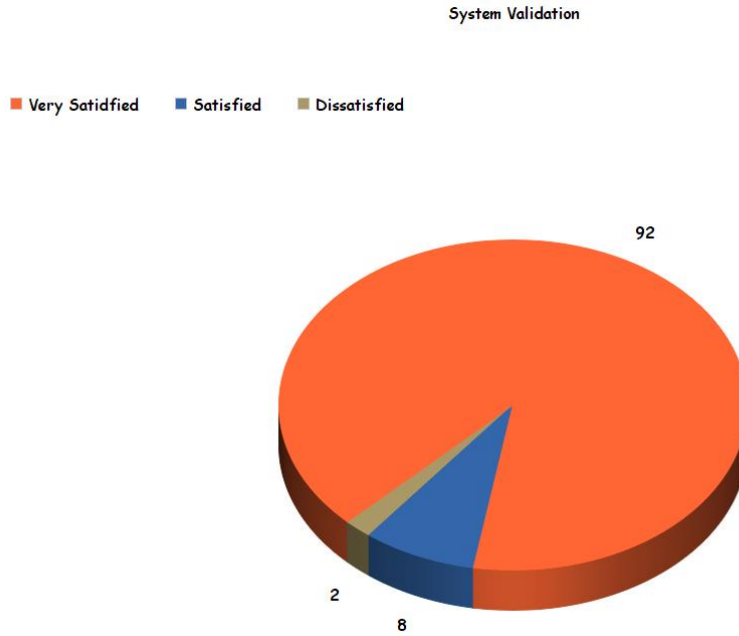| Very Satisfied	92%
Satisfied	8%
Dissatisfied	2%

Figure 5.18: System Validation

Figure 5.18 shows that majority of the users of the system were satisfied with the system. Users who were not satisfied with the system highlighted that more feature could be incorporated into the system such as Global Positioning System(GPS) tracking of field officers. The suggested that this can be done at later stages during system versioning. Ogra Foundation Kenya really liked the system and suggested the would implement it on large scale.

5.3.6 Summary

The system requirements formulated in the requirements gathering and analysis stage provided fundamental information that was used in system implementation. The system design provided details of how the system was implemented. The research objectives and questions were also put into consideration to ensure that the system was implemented to achieve user requirements provided by potential users.

The overall development and implementation was done in adherence to the proposed objectives, which majority of them were fulfilled by the development of the mobile and web application. The

mobile application was developed on the Android platform. It comprises reporting features, creation and management of groups. The mobile application improves data quality, speed, transparency, accessibility and flexibility. The web application was implemented for user management, data manipulation, report generation and representation, and graphical representation of data.

System testing was conducted by testing system functionality to ensure that all user requirements were met. compatibility testing was carried out to test for Android platform compatibility and web browsers compatibilities. User testing was also carried out to test user interface intuitiveness simplicity, attractiveness, application functionality etc.

Table 5.12: Evaluation Matrix results

	Items	5	4	3	2	1	References
Intuitiveness	Familiarity to use	√					
Simplicity	Simplicity	√					
Attractiveness	Stylistic expectation		√				
	Variation in the visual factors			√			
Navigation	Clear, concise and consistent labels for navigation		√				
Contents	Appropriate organisation	√					
Functionalities	Understandable and complete content		√				
Consistency	Consistency of content	√					
Responsiveness	Application responsive		√				
Final Score (Out of 45)	32						

CHAPTER 6: DISCUSSION OF RESULTS

This chapter presents the summary of major findings, achievements accrued from the research study and a synopsis of the challenges the researcher encountered.

6.1 Findings

The study sought to investigate the challenges faced by NGO in report, monitoring and evaluation of projects with a view of developing a mobile application. This was successfully conducted and findings detailed in chapter four of this study. The mobile application for reporting, monitoring and evaluation was developed as described in chapter six of this document. As such, the research objectives set out at the beginning of the study were adequately met.

The researcher found out that most NGOs in Kenya do the reporting, monitoring and evaluations based on Excel Sheet system a product of Microsoft. Though using this system, it is still not satisfactory in terms of reporting, monitoring and evaluation. Field officers do update records currently on a monthly, quarterly terms. There is a lot of paper work involved, Errors in entry (needing additional scrutiny), information flow is one way and not actionable, questions about transparency and accountability. The researcher also found out that there is no current mobile application targeted for NGOs in Kenya that has been developed to help in reporting, monitoring and evaluation. This gave him a chance to clearly clarify the meaning of a mobile application for effective reporting, monitoring and evaluation of projects by NGOs.

6.2 Achievements

One of the objectives of the study was to develop a mobile application for effective reporting, monitoring and evaluation of projects by NGOs. This was done after the researcher in liaison with the stakeholders of the various NGOs, concluded that did not have such a system and they would greatly adopt it since it was very helpful. The researcher was able to identify the services that could be delivered through the mobile application. This together with the features the stakeholders of the various NGOs expected from the system was incorporated into the development of the system. The researcher was able to design the mobile application successfully bringing out all the system objectives. The system had a front end for field officers and a backend accessible by field officers,

the donors and head of monitoring and evaluation at an NGO. The backend access was implemented based on the level of access given to the different stakeholders. The advantages of the developed mobile application as compared to the current one used by NGOs include:

i. Projects are tracked in real time, changes easy on the field.

ii. Limited errors due to built in logic flows and validation, Single entry.

iii. Real time tracking, time/date features improve monitoring.

iv. Single device for videos, pictures. Easy to integrate, can be used for verification.

CHAPTER 7: CONCLUSIONS, RECOMMENDATIONS AND FUTURE WORK

7.1 Conclusions

The researcher conducted this study with an open mind assuming that the stakeholders at various NGOs were generally unaware about a mobile application for reporting, monitoring and evaluation and therefore couldn't exploit the benefits of such a system.

He also assumed that NGOs are majorly using traditional methods such as paper work in monitoring and evaluation because they lack the knowledge and knowhow of developing mobile applications. From the findings of the study this assumption was confirmed as explained in section 6.1 above.

From the findings of the study, it is also clear that NGOs have done their best to embrace technology and the willingness to continue in this path remains very positive. Most use excel sheet system a product of Microsoft for monitoring and evaluation. They are also willing to adapt new technologies. When the researcher gave them the idea of a mobile application to complement the reporting, monitoring and evaluation, the stakeholders were happy about the idea saying it will assist overcome some of the challenges they currently face. Some of the benefits they mentioned include; transparency, accountability, less paper work involved, high durability of the records, less time in collecting data and analyses, real time reporting at field by field officers. This research therefore was timely and assisted the NGOs to see opportunities that the current technologies can be employed to complement the existing systems and increase efficiency in reporting, monitoring and evaluation.

7.2 Recommendations

The researcher has the following recommendation

7.2.1 Adoption of the System

The findings from the research study revealed that most NGOs in Kenya do the manual reporting, monitoring and evaluations based on excel sheet system. Though using this system, it is still not satisfactory in terms of reporting, monitoring and evaluation. Field officers do update records

currently on a monthly, quarterly terms. This brings a lot of paper work involved, Errors in entry (needing additional scrutiny), information flow is one way and not actionable, questions about transparency and accountability.

Based on these findings, the researcher recommends to the management of NGOs to adopt the developed mobile application as a way of overcoming the challenges faced in reporting, monitoring of projects. The system can further and continuously be improved and customized to meet the dynamic needs of each NGO and technological advancements.

7.3 Further Areas of Study

The research study was limited to finding the challenges faced by NGOs in reporting, monitoring and evaluation of projects with an aim of developing a mobile application to assist these NGOs in reporting, monitoring and evaluation of projects.

Further research should try focussing on:

i. Developing the application for other platforms, iPhone and Windows so as to capture the whole market.
ii. Project design and planning practices of the NGOs since monitoring, evaluating and controlling projects should be integrated with project planning and design.
iii. GPS tracking of field officers while at the field.
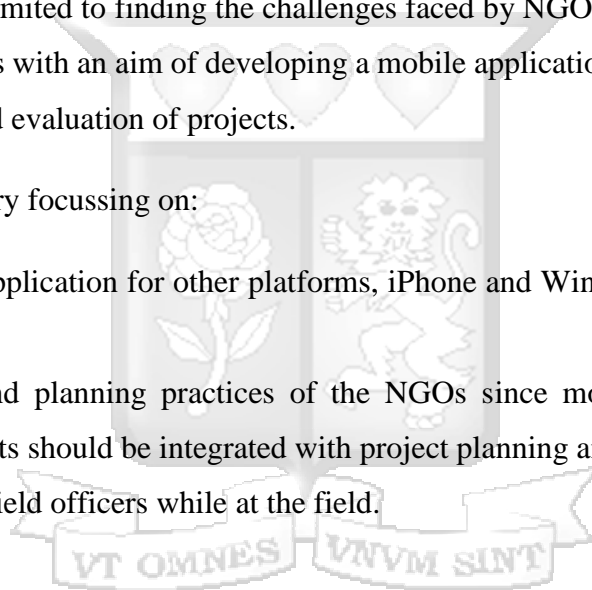
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APPENDICES

APPENDIX A: Letter of Introduction

> Mathew Somek
> PO Box 9953 – 00200 Nairobi
> Cell: 0721489544

Chief Executive Officer
[NGO NAME].
Kisumu

Dear Sir,

RE: A MOBILE APPLICATION TO ASSIST NON-GOVERNMENTAL ORGANISATIONS IN EFFECTIVE REPORTING, MONITORING AND EVALUATION OF PROJECTS IN KENYA

I am a student at Strathmore university- Safaricom academy pursuing a master's degree in mobile telecommunication and innovation. I am undertaking a research study based on the topic above in partial fulfilment of the requirement for the master of mobile telecommunication and innovation.

I kindly request for your permission to conduct the research in your organisation among selected members; 1 program manager, 1 donor and 1 field officer. The study aims to examine the challenges faced by NGOs in reporting, monitoring and evaluation of projects with a view of developing a mobile application to assist in effective reporting, monitoring and evaluation of projects.

In order to maintain confidentiality and anonymity for all the participants, no names will be required. Kindly note that the information provided will be treated with utmost confidentiality and will only be used for the purpose of the research study. Upon completion, a copy of the final research document will be brought to the organisation and a demonstration of the system done.

Attached, kindly find other supportive documents including how the institution will benefit from the study. Your assistance and participation in this study is greatly appreciated.

Yours sincerely,

Mathew Somek
REG NO: 084995

APPENDIX B: Interview Guide Questions

1. What tools of monitoring performances of projects do you currently use?

2. Are stakeholders e.g. donors satisfied with the current system? If no, why?

3. What would you say are the strengths and weaknesses of the current project performance tracking system?

4. To what extent are current technologies e.g. mobile application support you in carrying out day in day out about the projects

5. To what extent has the capacity builders adopted the current system

6. Would a mobile application play a role in overcoming the challenges of the current of project tracking performance?

7. One of the objectives of this study is to develop a capacity building application that will assist in monitoring and Evaluation. What is your opinion on this?

8. What would you say about the future trends in mobile technologies?

9. Do you think the application to be developed will solve the problem?

10. What are the Challenges you might face if the application was introduced?

APPENDIX C: User Testing

a) User testing evaluation Matrix

Users were asked to evaluate the mobile application on their first use. They evaluated the mobile application in a scale of 1-5 based on the following rating criterions.

Table 8.1: User Testing Evaluation Matrix

	Items	5	4	3	2	1	References
Intuitiveness	Familiarity to use						
Simplicity	Simplicity						
Attractiveness	Stylistic expectation						
	Variation in the visual factors						
Navigation	Clear, concise and consistent labels for navigation						
Contents	Appropriate organisation						
Functionalities	Understandable and complete content						
Consistency	Consistency of content						
Responsiveness	Application responsive						
Final Score (Out of 45)							

i.   Simplicity

Table 8.2: Simplicity User Testing

Score	Criteria
5	1. Text is very concise, paragraphs are short and there are no needless words. 2. The use of white space makes users very comfortable and allows users to read the content very easily.
4	1. Text is concise, paragraphs are short and there are no needless words. 2. The use of white space makes users comfortable and allows users to read the content easily.
3	1. Text is concise; paragraphs are short but there are some needless words. 2. The use of white space makes users somewhat comfortable and allows users to read the content somewhat easily.
2	1. Text is not concise, paragraphs are long and there are many needless words. 2. The use of white space makes users uncomfortable and does not allow users to read the content easily.
1	1. Text is too expansive, paragraphs are very long and there are too many needless words. 2. The use of white space makes users very uncomfortable and does not allow users to read the content without frustration.

ii.   Intuitiveness

Table 8.3: Intuitiveness

Score	Criteria
5	The application is very easy to learn and use because the application uses a very familiar paradigm based on previous experiences.
4	The application is fairly easy to learn and use because the application uses a fairly familiar paradigm based on previous experiences.
3	The application can be learnable and is usable because the application is in a familiar paradigm based on previous experiences.
2	The application is difficult to use because the application does not use a familiar paradigm based on previous experiences.
1	The application makes users frustrated to use it because it has an overblown design, it is complicated to use, and it is not based on previous experiences.

iii. Attractiveness

Table 8.4: The Rating Criteria for the Attractiveness of the Mobile Application

Score	Criteria
5	1. The visual look of the application meets the stylistic expectation of the target audience very well. 2. There is enough variation in the visual factors to establish a sense of visual interest in the application.
4	1. The visual look of the application meets the stylistic expectation of the target audience well. 2. There is some variation in the visual factors to establish a sense of visual interest in the application.
3	1. The visual look of the application somewhat meets the stylistic expectation of the target audience. 2. There is a variation in the visual factors to establish a sense of visual interest in the application.
2	1. The visual look of the application does not meet the stylistic expectation of the target audience. 2. There is little variation in the visual factors to establish a sense of visual interest in the application.
1	1. The visual look of the application never meets the stylistic expectation of the target audience. 2. There is no variation in the visual factors to establish a sense of visual interest in the application.

iv.   Navigation

Table 8.5: The Rating Criteria for the Navigation of the Mobile Application

Score	Criteria
5	1. There are very clear, concise and consistent labels for navigation throughout the application.
4	There are fairly clear, concise and consistent labels for navigation throughout the application.
3	There are consistent but less clear and concise labels for navigation throughout the application.
2	There are less clear, concise and inconsistent labels for navigation throughout the application.
1	The labels for navigation are unclear, complicated and inconsistent throughout the application.

v.   Consistency

Table 8.6: The Rating Criteria for the Consistency of the Mobile Application

Score	Criteria
5	Visual factors of same groups are used very consistently on every page.
4	Visual factors of same groups are used consistently on every page.
3	Visual factors of same groups are used somewhat consistently on every page.
2	Visual factors of same groups are not used consistently on every page.
1	There is no consistency at all regarding the use of visual factors of the same groups.

vi. Responsiveness

Table 8.7: The Rating Criteria for the Responsiveness of the Mobile Application

Score	Criteria
5	The mobile application is very responsive
4	The mobile application is somehow responsive
3	The mobile application is fairly responsive
2	The mobile application is almost responsive
1	The mobile application is not responsive at all

vii. User Verification Questionnaire

1. Did you take part in the user testing of the mobile or web application for reporting, monitoring and evaluation of projects for NGOs?

 o Yes

 o No

2. If Yes, Does the functionalities provided by the application solve the problems posed by the current systems for reporting, monitoring and evaluation of projects?

 o Yes

 o No

3. What are some of the key functionalities of the mobile/web application that provides solution to the current problems in reporting, monitoring and evaluation of projects?

 1. ……………….

 2. ……………….

 3. ……………….

4. Are you satisfied with the solutions provided by the mobile/web application as far as reporting, monitoring and evaluation of projects is concerned?

 o Yes

 o No

5. Would you recommend that the application to be adopted by all NGOs in Kenya as a solution to the current challenges faced by the NGOs of reporting, monitoring and evaluation of projects?

 o Yes

 o No

APPENDIX D: Web-based Monitoring & Evaluation Software Tool

Donor Management

Figure 8:1: Donor Management Portal (Web-based Monitoring & Evaluation Software Tool. (n.d.).)

Program Management

Figure 8:2: Project Management Portal (Web-based Monitoring & Evaluation Software Tool. (n.d.).)

APPENDIX E: Turnitin Report

Figure 8:3: Turnitin Report