

A Geographical Information System for ZETDC



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By

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ABSTRACT

The main motive behind the research was to derive an answer to the discovered problems of the current system of the Zimbabwe Electricity Transmission and Distribution (ZETDC) with regards to the way the fault reports were being carried out and the quality of services offered. The conduction of research through research methodologies such as questionnaires, observations as well as interviews led to problems identification such as being more manual since it does not allow the ZETDC electrical engineers locate the fault easily thus the engineers would manually search for the transformer without any given co-ordinates of the transformer location hence the process is timeous leading to long response time to customer problems. Furthermore, the system doesn't help management in calculating overtime and the effectiveness of employees since there is no time recorded in attending to faults, the engineers will sometimes claim more than their overtime leading to incompetence within the organization. However, the main aim of this project is to help the ZETDC electrical engineers to easily locate the transformers for instant response to reported electricity faults. The researcher saw it as key to develop a geographical information system for the ZETDC electrical engineers. The core emphasis on geographical information systems (GIS) is on remote sensing which is an essential tool for the data capturing to subsequently to be incorporated into a GIS and for real time monitoring of environmental conditions for operational management of electricity. The tools that were used in system development includes, PhP, Java script, Xampp, and Micro-media Dreamweaver. In addition the system's major aim was to automate the manual system of ZETDC into a more reliable and less tedious system.

DECLARATION

I, Kwanisai Onismo, hereby announce that I am the original writer of this scholarly dissertation therefore I would like to permit Midlands State University to handover the writing to other academic institutes or individuals for academic purposes.

Signature.....

Date.....

APPROVAL

This scholarly dissertation entitled Geographical Information Systems for ZETDC (GIS) developed by Kwanisai Onismo and is the sole author of this dissertation. I approve the Midlands State University to lend this to other institutions or individuals for the purpose of scholarly research.

Supervisor.....

Date.....

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Firstly I would like to give thanks to the Almighty God for giving me a chance to be part of the information system class of August 2014. In addition, I appreciate the computer science and the information system board for every sweat beads you they dropped on helping me achieve my goals and would also like to express my sincere gratitude to them for granting me the opportunity to pursue my desired project which has been a big milestone in my career development. Furthermore, I would also want to give utmost respect and gratitude to my family and my friends for their financial support and as well their encouragement on my researches and all the work hard until the accomplishment of this project. Above all, after creating so many memories that are very challenging, inspiring, and innovative, I would like to salute my supervisor, Mr P Mupfiga for his never ending support, efforts, his understanding and his professional mentorship throughout the project.

DEDICATION

This scholarly document is therefore dedicated to the late Onias Kwanisai and Jane Maziriri who are the reason why I made it this far. All this is because of your mentorship.

CHAPTER 1: INTRODUCTION

1.1 INTRODUCTION

The main aim of this project is to help the ZETDC electrical engineers to easily locate the transformers for instant response to reported electricity faults. I saw it as key to develop a geographical information system for the ZETDC electrical engineers. The core emphasis on geographical information systems (GIS) is on remote sensing which is an essential tool for the data capturing to subsequently to be incorporated into a GIS and for real time monitoring of environmental conditions for operational management of electricity facilities. Furthermore, the system reports transformer faults and alarms instantly if there is an attempt in transformer vandalism since this has been the major problem to the company since intruders would drain transformer oil thereby lowering maintenance cost of the transformers.

1.2 BACKGROUND OF THE STUDY

After thorough investigations at ZETDC during the researcher's work related learning at ZETDC he noted some problems which were currently being faced by ZETDC as an organization thus there have been a very high response time to customer complains on electricity faults since faults were leading to a decline in total revenue of the company. In addition to that, the customers would go to the nearest ZETDC depot to report the identified faults hence it would take the engineers a lot of time to locate the fault since the transformer co-ordinates were not given. Furthermore, ZETDC doesn't have a facility on which customers would report faults from wherever they are. The researcher would do periodic checks on how the customers were served. In addition the researcher saw that ZETDC did not have their transformer locations on the map.

1.2.1 BACKGROUND OF ZETDC

Following the passing of two Acts by the Parliament of Zimbabwe, the Electricity Act (Chapter 13:19) and the Rural Electrification Fund Act (Chapter 13:20) comprehensive reforms have since been experienced in the electricity industry. The Electricity Act also ushered in the formation of four successor companies, the Zimbabwe Power Company (ZPC), Zimbabwe Electricity

Transmission and Distribution Company (ZETDC), ZESA Enterprises and Powertel Communications. In line with the approved structure, ZETDC is the distribution and retail of electricity to the final end user and meeting the challenges of balancing supply and demand, transmission of electricity from existing and new domestic generation plants and electricity trading (imports/exports)

1.2.2 ORGANISATIONAL STRUCTURE

Organisational structure is a structure which depicts the lines of authority, accountability and who can directly delegate to who as well as the chain of communication (Baligh, 2006). Furthermore, Robbins, Judge and Millet (2010) added that organisational structure strongly influence on how things get done within the organisation thus the behaviour and attitude of the organisation.

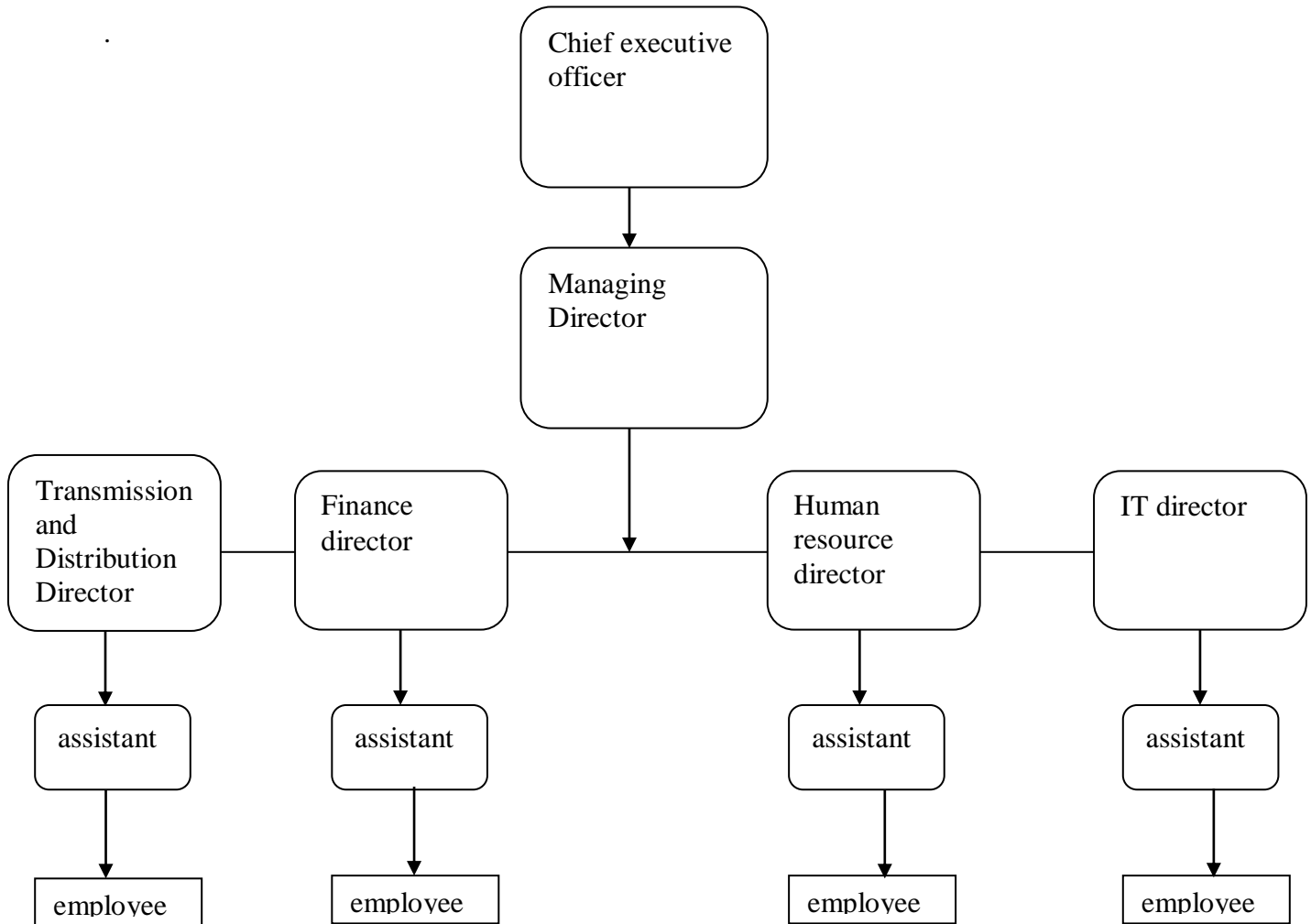


Figure 1.1

1.2.3 Vision

Vision is an ambitious representation that shows what an organisation wishes to accomplish (Blai, S, 2011). It aids as a crystal clear guide to decide on future and current alternative courses of actions. Vision for ZETDC is to reference point of incredibleness in the procurement of financial administrations and assistance of exchange and travel.

1.2.4 Mission statement

It is a statement that defines the scope of an organisation and purpose, includes customer needs, profit orientation and also community responsibilities (Shim, Siegel and Levine, 1998). The mission statement for ZETDC is to advance financial improvement through effective income era and exchange help. This is accomplished by developing skillful and propelled staff, using ecologically feasible procedures, and engaging with the worldwide group in a socially dependable manner.

1.3 PROBLEM DEFINITION

This is the first phase of the system design and development, it comprises of the documentation of the challenges and approaches put in place for the enhancement of the system (Davis and Yen 1994). However, the geographical information system is a professional system to be established for ZETDC. The current system tend to be more manual since it doesn't allow the ZETDC electrical engineers locate the fault easily thus the engineers would manually search for the transformer without any given co-ordinates of the transformer location hence the process is timeous leading to long response time to customer problems. The system doesn't help management in calculating overtime and the effectiveness of employees since there is no time recorded in attending to faults, the engineers will sometimes claim more than their overtime leading to incompetence within the organization. Furthermore the system does not locate ZETDC transformers making it very difficult to resolve faults in time.

1.4 AIM

An aim is a goal which is intended to be achieved and the goal or aim should be attainable. The main aim of this project is to help the ZETDC electrical engineers easily locate the transformers for instant response to reported electricity faults

1.5 OBJECTIVES

System objectives are realistic goals or aims which a specific organisation wishes to attain within a given period (Wasson, 2005). In this regard the research objectives should allow development of the geographical information systems that would.

- Report transformer faults and stores records for future references
- Gives geographical co-ordinates of the transformer
- Record time taken to attend to faults helping in coming up with over payments
- Provide a chat platform for customers to report faults.

1.6 INSTRUMENT AND METHODS

Instruments are programming devices which are utilized for the advancement of the framework and the compelling utilization of the accompanying apparatuses will bring about the accomplishment of the proposed framework objectives.

- Java script
- Dreamweaver
- PHP
- Xampp

Interviews are formal meetings mostly individually, particularly one masterminded the evaluation of the capabilities of a candidate (Kothari, 2009). Meetings can be attempted with assortment of information sources (administrator to clients), and through option media, for example, by phone or in person.

A questionnaire is an examination instrument comprising of open or closed questions to which the responded should answer to achieve the end goal of social occasion (Fielding, 2006). These are generally used to cover questions on a large number of people.

Observations often require the observer to go to the field to carry out a research based on the actions of the one being observed without notifying him or her (Fielding, 2006). Observations are often more effective when several observations are carried per a given research and if the one to be observed is not aware that he or she is under investigation.

1.7 JUSTIFICATION AND RATIONALE

The development of the geographical information system for ZETDC will be of great essence since it addresses the problems that ZETDC is currently facing, thus, for

example, long response time to electricity faults. Moreso, the geographical information system comes with remote sensing which is viewed as an essential tool for the capture of data subsequently to be incorporated into a GIS and for real time monitoring of environmental conditions for operational management of electricity facilities. The system will help management in calculating overtime and the effectiveness of employees since there is time recorded in attending to faults since the engineers will sometimes claim more than their overtime leading to incompetence within the organization

1.8 CONCLUSION

To sum up, the introduction phase enlightens the problems that are currently faced by the organisation and as well as the objectives to overcome these problems. This phase is the initial stage which acts as the foundation of the system development and its successful completion allows proceeding to the planning phase.

CHAPTER TWO: PLANNING PHASE

2.1 INTRODUCTION

As alluded in the preceding chapter, the planning phase is critical in the success of the ZETDC GIS and it basically consists of the feasibility study of the project which will help the management to assess the viability of the project to be undertaken thus whether the project is feasible or not. Therefore the feasibility study helps in coming up with a decision focusing on the economic, operational and technical feasibility. This phase is concerned about the risk involved and their countermeasures in the proposed project and the business value of the proposed system which will be briefly described earlier in this chapter. A scheduled work plan is presented on the Gantt chart where the time will be presented against the activities.

2.2 REASONS FOR BUILDING THE SYSTEM

ZETDC is a nationwide business therefore the need for quick response to faults is needed so as to ensure business effectiveness. The GIS system will enable the electrical engineers to:

- Report transformer faults and stores records for future references
- Locate the transformers by their geographical co-ordinates.
- Record time taken to attend to faults helping in coming up with over payments
- Help in increasing organisation competitiveness.
- Reduce customer complains therefore increasing customer trust in the business.

2.3 BUSINESS VALUE

Business value includes the consolidation of a range of values that selects the interests and successfulness of the organisation in the long run through the use of information systems as supported by (Sward, 2006). This chapter gives an overview of the business value of the proposed system and the main motive behind the development of the GIS for ZETDC. The proposed system is designed to address all the identified problems in the preceding chapter which includes failure of the current system to locate faults to mention but a few. Business value does not only cover the economic value thus it can be expanded to client value, managerial value, societal value as well as the security value. Business value is usually not in monetary value thus there is no price attached to the benefit. The GIS will be of paramount importance to ZETDC since it brings the following business values to the organisation.

Client value – this shows the value or benefit to the clients of ZETDC. Client value is attained since the proposed system is more effective thus it speeds up the response time to the electrical faults by giving the coordinates of the transformer faults.

Societal value – the system is of paramount importance to the society since it reduces theft cases of transformer oil, leading to minimal load shedding to the community resulting in a lower cost per unit of electricity to the society thereby enhancing the relations with society hence good will.

Managerial value – managerial value is realised in the proposed system when managers can easily come up with overtime payments for the employees as their actual working time on the site of faults is captured in the system therefore helping managers to come up with accurate payments.

Table 2.1: Project business value table

Project Name: GIS
Business Value:
1. The system Improves business productivity and brings better moral amongst the employees since the system is more effective, user-friendly, accurate and more reliable.
2. Reduction in total unit cost per unit.
3. Speeds up decision making and resolving of electricity faults.
4. Can be easily modified to suit the ever changing needs of the organisation.
5. Captured data can be backed up for future references.
6. Helps in coming up with factual forms of payments.
7. Provide security through the use of protected database system that will prevent unauthorized access to business critical information.

2.4 FEASIBILITY STUDY

Feasibility study is a yardstick measure used for examination of the proficiency of accomplishing the project successfully, bearing in mind a rational monetary budget and diverse variables as supported by (Michele 2008). Furthermore, feasibility study allows project managers to assess the possible outcomes thus positives and negatives before pouring enormous amount of cash and resources to the project. Feasibility study answers the question: Is the proposed system viable given the apparent time and resource constraint? However, for the project to be viable enough

the projected benefits should outweigh both the development and initial setup costs. The proposed GIS system will replace the current manual system which makes electrical engineer's work terrible hence the economic, technical and operational factors should be analysed to come up with a decision on whether to partake or not on the development of the proposed system.

2.3.1 TECHNICAL FEASIBILITY

Technical feasibility is the assessment of the compatibility of the proposed system with the currently existing technologies (Dawn 2002). This assessment heavily relies on the system requirements summary, to foresee if the organization is proficient enough to undertake the project to the end. A feasibility study is an essential tool for problem solving, future planning as well as decision making. Technical feasibility should answer the following questions?

- Is the proposed idea feasible within the limitations of the technology at hand?
- Is there adequate hardware and software infrastructure?
- Is the technical expertise available?
- Does the system address the current problem?

After the above questions have been favourably addressed it has been acknowledged that the development of the proposed system should be continued without interfering with the existing system since the technical benefits outweighs the drawbacks. An overview of the technical feasibility is depicted in the tables below. Table 2.1 indicates the hardware prerequisite for the system to function as expected.

Table 2.1 Hardware resources

Necessary	Amount	Resource	Resource status	Comment
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Resource	required	description		
computers	2	AMD E2-1800 APU with Radeon(tm) HD Graphics 1.70GH, 2G RAM, 400gb hard drive	1 available	One more laptop is needed
Printers	1	HP desk jet printer 1516	Not available	Printer is also required for the completion of the project
HP server	2	4GHz, 1 terabyte hard drive, 8G RAM	Available	The company will provide
External hard drive	1	samsung I terabyte	Available	Very useful for data backup
Network cards	5/50 LAN	Relink RT3090 802.11/b/g/n Wi-Fi adapter	Not available	Useful for researches

Furthermore, the required software for the system development is shown in the table 2.2 below. The table contains three columns showing the software name, status and version and whether the software needs to be purchased or its for free.

Table 2.2 Software resources

Name of the software	Software version	Software status
Operating system	Windows 7, 8 or 10	Windows 8 available
Micromedia Dreamweaver	8.0	Available but needs a product key
XAMPP	V3.2.1	Not available but open source
AVG Antivirus	2016	Not available need to be purchased
Microsoft Word	2013	Available

Technical expertise

This helps on assessing whether the available workforce is able to tackle the challenge of the proposed GIS system or not. However, the decision is made based on the assessment thus whether the existing personal will be trained to do the proposed project or the company should hire new employees to carry out the task on behalf of the organisation. ZETDC has a well-grounded IT infrastructure which comprises of programmers, systems analysts, database administrators as well as technicians. In conclusion, ZETDC is willing to commit the resources to the project and has the required workforce and experience to tackle the challenge of developing the proposed system.

2.3.2 ECONOMIC FEASIBILITY

This is a technique used for evaluating the effectiveness of the proposed project through an assessment of economic benefits to costs. This economic analysis incorporates the economic benefits and costs so as to determine on decision whether the project continues or it will be terminated thus the project will only continue when the economic benefits outweighs the costs. (Brown, 2008) supported the view that if the general advantages exceeds the costs then the economic feasibility will be considered to be positive. To carry out a successful economic feasibility, there are several decision making techniques that can be used such as the payback period, return on investment and the interest rate of return to mention but a few.

Costs

In systems development, costs can be classified into development, operational as well as set up costs. These costs can be regarded as monetary valuation of action, time, forgone alternatives, materials and assets for the development of the proposed GIS system for ZETDC. However, the ZETDC finance department considered the project to be of paramount importance to the organisation, so it decided to pour some funds for the project when required from the commencement of the project.

Development cost

These are cost associated with system development and are usually incurred during development phase and these include team remuneration and training costs, additional material costs to mention but a few (Brown, 2008).

Table 2.3 development costs

Item	Quantity	Estimated cost (USD)
Computers	2	700
Software license	n/a	100
Main server	1	100
Labour	5 people	1000
Training costs	4 people	500
Router	1	80
Total		2480

Set up costs

These are costs that are incurred before full operation of the system and these costs include software set-up, hardware preparations and remodel cost for sustainable functioning of the system (Matson, 2000).

Table 2.4 Set up costs

Description	Estimated cost (USD)
Hardware required	180
End user orientation to the system	120
Opportunity costs	150
Total	450

Operational cost

These are the costs associated with the day to day operation of the system and they are expected as long as the system is in effect (Matson, 2000). However, the operational cost incorporates the hardware and software maintenance, operational labour costs as well as other computer consumables.

Table 2.5 operational cost

Description	Estimated cost for 2015	Estimated cost for 2016
Software maintenance	600	550
Hardware maintenance	550	500
Other computer consumables	-	1000
Total	1150	2050

Benefits

These are the proceeds brought about from the utilization of the system that should help the organisation in achieving its goals (Kotler, 2012) and the proposed system benefits can be classified in tangible and intangible benefits.

Intangible benefits

These are benefits that are elusive thus one cannot touch or feel and they cannot be easily assigned a monetary value (Cohan, 2005). Non tangible benefits include love, companionship, establishment and goodwill. Non tangible benefits include:

- Increased organisation good will.
- Enrichment of customer satisfaction.
- Increased employee morale and job security.
- Data security and integrity.
- Time saving.

Tangible benefits

These are benefits that accrue to the organization after utilising the proposed system and a monetary value can be easily assigned to the benefits (Cohan , 2005), for example increased yield or reduced cost.

Table 2.6 Tangible benefits

YEAR	2017	2018	2019
ITEM	Cost USD\$		
Estimated Stationary costs	\$5000	\$3500	\$2000
Estimated Labour costs	\$2500	\$1500	\$500
Estimated Operational costs	\$2000	\$1200	\$800
<u>TOTAL</u>	\$9500	\$6200	\$3300

Cost benefit analysis

Cost benefit analysis is a financial analysis tool that is mainly used by project managers that helps them to come up with projects that have a great benefit as compared to costs. Cost and benefit analysis serves as a comparative tool for the organisation by assessing the proposed system expected costs to benefits (Bently ,2007).

Table 2.7 cost benefit analysis

	2017	2018
Benefits	USD \$	USD \$
Tangible benefits	2000	2900
Intangible benefits	1000	1500
Total Benefits	3000	4400
Costs		
Development cost	2500	n/a
Set up cost	500	n/a
Operational cost	100	2000
Total Cost	4000	2400
benefit/(loss)	(1000)	2000

The cost and benefit analysis done by project managers for ZETDC GIS system depicts that the proposed system was of paramount importance to ZETDC since the company was incurring a loss of \$1000 hence the introduction of GIS lead to a profit of \$2000 in 2018.

Return on Investment (R.O.I)

R.O.I is a performance measure that is used to give an assessment of the proposed system or project and is usually determined by the difference between the total costs and proceeds of the project (Kalvar, 2003).

R.O.I is calculated as follows:

$$(Average\ annual\ profits / Total\ investment) * 100$$

However, R.O.I was used by ZETDC project managers and the results were as follows

$$Average\ annual\ profits = \$2800 + \$3700 + \$4500 = \$12000$$

$$\$12000 / 3 = \$4000$$

$$Total\ investments = \$1000 + \$2000 + \$1200 = \$4200$$

$$R.O.I = (\$4000 / \$4200) * 100 = 95.2\%$$

Decision:

The project is favourable since the return on investment (R.O.I) is greater than 50% hence the system is of value addition to ZETDC.

Payback Period

Payback period is an investment appraisal technique which takes into account the amount of time taken by a project to cover its initial capital (Schwalbe, 2006). The technique is based on the assumption that projects with a shorter payback period should be considered first given that it does not exceed its payback hurdle period. This technique is very useful when the financial resources are limited.

Table 2.8 payback period

Year	Cashflow	Balance
0	(6000)	(6000)
1	3500	(2500)
2	4500	-

The payback period for the ZETDC GIS system is calculated as follows:

$$1\text{year} + (2500/4500) * 12 = 6.6\text{ months}$$

Payback period = **1year 7 months**

The GIS project is considered to be financially viable since it has a shorter payback of 1 year 7 months.

2.3.3 SOCIAL FEASIBILITY

This phase concentrates on the well-being of the proposed system to its society where it will be presented to the users (Brown, 2008). However, the proposed system should be of social benefit for it to be accepted by the stakeholders. Stakeholders include everyone that is directly affected or have an interest in the business activities and these include the shareholders, government, employees, customers and the community at large. Taking social feasibility into account the ZETDC development team made use of prototypes where the users were involved at each stage of production aiming to meet the stakeholder requirements hence reducing chances of product failure. The development of the proposed GIS system for ZETDC has been considered as socially feasible since it reduced response time to electricity faults and reducing chances of electricity oil theft thereby benefiting both the customers and the employees. However, the introduction of the system would pose a challenge to other employees since it weakens their job security.

2.3.4 OPERATION FEASIBILITY

This phase indicates how the proposed system fulfils the stated requirements in the requirement analysis phase and measures how the proposed system addresses any given challenge (Fracheti, 2011). Operational feasibility is keen to see how the proposed system blends with the current environment of the business with an aim to improve the current business systems. It focuses on the questions such as are the employees viewing the change as inevitable, are the top management fascinated with the proposed system, are the customers satisfied with the system. However, ZETDC's top management showed their commitment to the project by the provision of the required enormous sum of \$6000 for the project to commence. The system has been easily accepted since it made work ease and was able to tackle the given challenges.

2.4 RISK ANALYSIS

Risk analysis is a technique used to highlight potential threats that may arise due to the use of the proposed system Kotler (2012). Risk analysis is a technique that requires a lot of time to identify the factors that may jeopardize the on-going of the project. It also identifies the level of risk involved and the possible measures to be taken to counter the identified challenges. Generally

there are two types of risk analysis that are qualitative and quantitative and a table below shows a quantitative risk analysis.

Table 2.9 Risk Analysis

Risks	Probability of occurrence	Risk effect	Prevention/Avoidance
Chances of resource delays and resource shortages	Lower	Extend the project duration	Implement the just-in-time delivery and commence the project when resources are available.
Availability of manpower	Minimal	development of an ineffective system	On the job training as well as part time employment for other difficult tasks to tackle.
Poor communication which may result in misunderstanding.	High	Unclear objectives leading to wrong tasks being done	Objectives must be clearly defined and understood before the system development.
May lack proper time management	Minimal	Upsurge organizational cost	Effective planning and time scheduling
Lack of coordination among the project leader and subordinates.	Lower	Misunderstanding	Introduce team works
Lower employee morale.	Minimal	Incomplete tasks	Involve employees at all stages

2.4.1 TECHNICAL RISK

Technical risk is associated with the users, and these can be viewed as technical challenges faced by the users in trying to use the system hence ZETDC overcame these challenges by training its

system users thus the employees on how the GIS works. Furthermore, user manuals have been created and distributed all over the organisation.

2.4.2 TIME RISK

The time risk is the risk that is associated with the failure of meeting the deadlines of the project. The time risk however helped the project managers in identifying critical activities thus activities that must not be delayed such as system development. However a work plan have been drafted for the whole project which states what is supposed to be done at a given time. A Gant chart was also developed showing the amount of time taken by each activity.

2.4.3 ECONOMIC RISK

This is a risk that is beyond the organisation's control such as inflation, balance of payment (BOP) and the exchange rate. With all these in consideration, it has been viewed that the project would be successful given the current economic state of Zimbabwe. Inflation rates seemed to be stable as well as the exchange rates hence purchasing of software and hardware resources within or outside would not be a challenge. Cash shortages in the economy has been viewed as the major destruction to the ease going of the project, however, alternatives such as RTGs or swipe cold be used to overcome the challenge.

2.5 STAKEHOLDER ANALYSIS

Stakeholder is someone that is directly affected or someone that is interested in the activities of the business for instance the GIS project (Bently, 2007). Generally there different types of stakeholders which include: employees, government, community customers, shareholders to mention but a few.

Customers

Customers are considered to be the key stakeholders in the organisation since their responses will ensure continuity of the business. The newly developed GIS system has been of paramount importance to customers since it ensures quick response to electricity faults and it comes with a chat platform where they can communicate their queries unlike the old suggestion boxes which was not effective.

Employees

Employees viewed the system as of great importance since its emphasis was to ease the work for employees by easily locating faults hence reducing disputes with the management as well as with the customers. The system will also facilitate accurate overtime payments for the employees since they will logon start and end time.

Shareholders

These are people who have invested stake in the business and in the case of ZETDC there are no direct shareholders since it's a state owned company therefore the shareholders are the board members and the top executives. The shareholders were pleased with the new system since it reduces loss of revenue due to high incompetence of the organisation.

2.6 PROJECT PLAN

A project plan highlights a sequence of activities showing the stages that will be encountered to the accomplishment of the project as supported by the project management board of knowledge (PMBK). A good project plan should have well defined stages that should be met one after the other. On the GIS system project the project team decided to use the waterfall model which is also known as the traditional model. The waterfall model has well defined stages and is easy to understand and the system requirements are stated before venturing into the project.

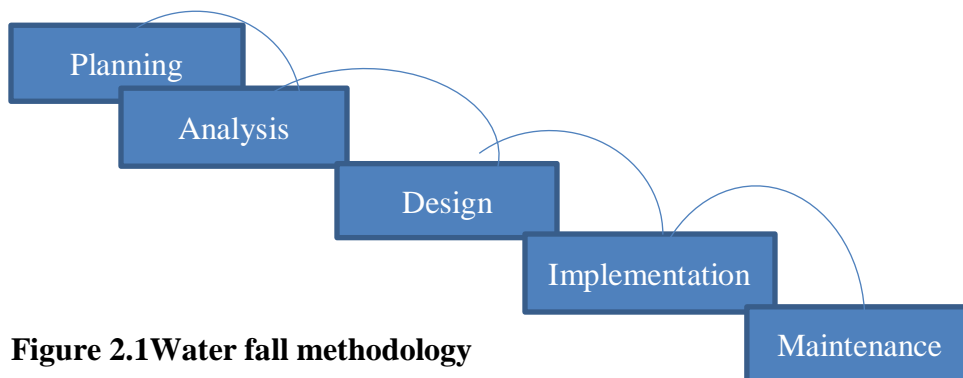


Figure 2.1 Water fall methodology

The table below highlights a project plan showing the activities, their description, their duration as well as their estimated start and end dates.

Table 2.91 Project Plan

Activity	description	Duration in weeks	Estimated start and end dates	Anticipated deliverables
Project proposal	Recognizable proof of issue definition and destinations	1	23/02/16-01/03/16	Documentation which will be requesting the system
Planning	Embrace attainability study, hazard examination furthermore distinguish business values	2	02/03/16-16/03/16	Feasibility and risk analysis report and also work plan schedule
Analysis	Investigation of data social event strategies	2	17/03/16-31/03/16	Analysis report

Design	Planning framework engineering, interfaces and databases	2	01/04//16-15/04/16	Proposed system structure
Implementation	Development, establishment and client preparing	2	16/04/16-30/04/16	Delivery of the system
Maintenance and evaluation	Keep up and assess how the framework is functioning	1	01/05/16-08/05/16	System review

2.6 Gantt Chart

A Gantt chart is a sort of bar graph that shows an undertaking plan. Gantt diagrams outline the start and complete dates of the terminal components and outline components of an undertaking.

Phase	Time(weeks)									
	1	2	3	4	5	6	7	8	9	10
Documentation										
Proposal										
Planning										
Analysis										
Design										

Implementation										
Maintenance and evaluation										

2.7 Conclusion

Conclusively, since all the stages under the planning phase are gone through and the project appears to be feasible enough to be put in practice so the researcher will have to proceed to the next phase which is the (analysis phase) in chapter 3.

Chapter 3: Analysis Phase

3.1 Introduction

This phase is of great essence to the success of the project since it gives a greater highlighting and an overall description of the entire current system that is being utilized by the organization. The prime goal of this phase is not on the newly proposed system but to provide a deeper analysis and understanding of the current system. In addition to that, for a detailed analysis to be done different gathering techniques have been used to come up with effective information about the current system, in order to pave way for a successful completion of the project. An evaluation of the current system will be made based on the benefits and limitations of the current system. Furthermore, a dataflow diagram, a context diagram and a process modeling are drafted in this chapter giving an insight of how the current system operates.

3.2 Information Gathering Methodologies

Information gathering methodologies are fact finding techniques where the decision will be based on the collective opinions and reactions of the users (Yeates, 2014). To come up with a sound decision, different data gathering techniques have been used which include: interviews, questionnaires, observation to mention but a few. The researcher managed to gather information in Harare at the ZETDC head office using different data gathering techniques as follows:

3.2.1 Questionnaires

A questionnaire is a rule book that has governed questions to be attended to by the user by either filling in the blank spaces or by ticking the required boxes (Bently, 2007). However, the researcher managed to generate and set questions to be presented to both the employees and the clients. The questions were designed such that there will be open-ended questions that prompts the user to give answers based on their point of view and usually provide blank spaces to fill in, for instance, how does the current system operate? However, the researcher also made use of closed-ended questionnaires that sticks to the “yes or no” answer and are usually filled in by a tick in a blank box. Both the closed-ended and open-ended questions have been drafted by the researcher and distributed on a clean white sheet at a ZESA press conference targeting the top executives, employees, system developers as well as the customers. Furthermore, for the researcher questionnaires appeared to be advantageous than other methods such as interviews and observations as it saves time and is very cost effective since there are less inputs required.

Moreso, questionnaires also appeared to be one method that can only be used to address a large multitude of people at once such as at an AGM without interference. Alternatively, using questionnaires have been a great challenge since the rate of reaction as occupied and busy individuals may be very poor to the given questionnaires. Furthermore, closed-ended questions do not permit individuals to fully answer the given questions.

3.2.2 Interviews

These are fact finding techniques where formal meetings are conducted individually and the communication is verbal two and way between the interviewee and the interviewer (Willson, 2013). The researcher conducted interviews in several ways which include the use of technologies such as video conferencing, cellphones or in person. The researcher in this case the interviewer arranged the interview date and time with the interviewee in this case the employee, customer. The researcher, however, for proximity he conducted the interviews in person so that he can pick the non-verbal cues and emotions of the interviewee. ZETDC is a very big organization, so that interviewing everyone at the organization would be very tiresome and almost impossible so interviews were done at random targeting the employees that are directly affected with the current system that are the electricity engineers. However, other employees have also been interviewed including the customer in order to get diverse views of the system from different point of view. With the use of interviews the researcher would give the interviewer room to change to meet the requirements of the interviewee. Furthermore, the researcher would pick raised emotions and use of non-verbal cues added very important information that cannot be raised by the interviewees. Unlike other research methods such as observation and questionnaires interviews helped in building relations between the interviewer and the interviewee. The researcher also experienced some misconceptions that rose and as a result it was quickly resolved with the use of interviews. However, interviews overall planning and conduction have been very tedious and time consuming for the researcher. Furthermore, the researcher discovered that the outcome of the interviews heavily depends on the effectiveness of the interviewer thus if the interview is not well structured the results may be misleading. In addition, the researcher figured out that interviews have been a more costly method in contrast to other methodologies.

3.2.3 Observations

Observation requires the researcher in this case the observer to monitor the reactions of the users towards the current system that is being used. The researcher observed at different ZETDC depots not making it so clear for the observed to suspect in any way suspect that they are being observed. However, the researcher managed to carry out his observation of some engineers deployed from the head office in Harare to search for a fault in Mabvuku and other several cases. The researcher managed to carry out the observation without the employees suspecting that they were being observed. Thus the researcher saw that the employees have been reluctant since they were aiming to maximize on their overtime payments. Observation helps the researcher to draw the actual picture than to base on the speculations done on other methodologies. The researcher managed to carry out several observation so as to get a bigger picture thus the researcher also observed the fault that he reported to ZETDC himself. Furthermore the ZETDC fault recovery wasn't good enough, however, in contrast to other methodologies the researcher viewed observation as less costly. On the other hand, without full knowledge of whether the employees were aware that they were being observed or not the researcher saw observation as misleading in some way. Furthermore, the researcher faced some challenges while trying to observe the engineers try to rectify a problem since some of the reported faults may take days working on the fault. In addition to that the researcher realized that he can forgo some quality features such as instructions given by the management as well as full knowledge of electricity and the measures to be taken to recover the fault.

3.3 Analysis of the Current System

According to Bently (2007) it is an examination of the existing system that mainly focuses on the negatives of the system so as to conceal the highlighted weaknesses when developing the new system. However, the assessment of the current system should be based on the information that has been collected from the different data gathering techniques. Furthermore, the problem definition highlighted earlier on that the existing system at ZETDC tends to be tedious since it is more manual.

3.3.1 Current System Description

The current system operates as follows:

The customers will have to visit any ZETDC depot to report the fault. After fault reports have been made, the engineers will have to manually search for the fault in the specified location. Customers in this scenario will only work on faith as there is no feedback given to them until the fault is recovered. This however will lead to constant checks and reports being made by several customers concerning the fault.

Inputs

For fault reports to be made it is mandate that the necessary inputs are highlighted for the customers to know what they are required to provide. Inputs can be described as unprocessed information that is positioned in a system with an aim that it can get a yield.

ZETDC clients should provide the following inputs when reporting a fault.

- ❖ Name and Surname
- ❖ National ID number
- ❖ Physical address/ location
- ❖ Date of fault occurrence

Processes

A process is an illustration that highlights actions to be carried out in a system. To be more precisely, a process is an element that varies and requires proper planning of entities in which processors are selected (Matha, 2000). The process of the current system is highlighted below.

- ❖ The complainant or client visits any ZETDC depot.
- ❖ The client joins the queue.
- ❖ The client issues the required inputs.
- ❖ The client reports the fault.
- ❖ The client waits for fault confirmation.

Output

Output provides answers to the conveyed inputs. The inputs and the processes result in the highlighted outputs (Sommerville, 2004).

- ❖ Fault report have been produced.

❖ A fault has been recovered.

3.4 Process Analysis

This phase can be described as a sequence of activities or actions heading to reach a specified target. This phase can be further classified as short description for the user that highlights the procedures of fault reporting by the customers.

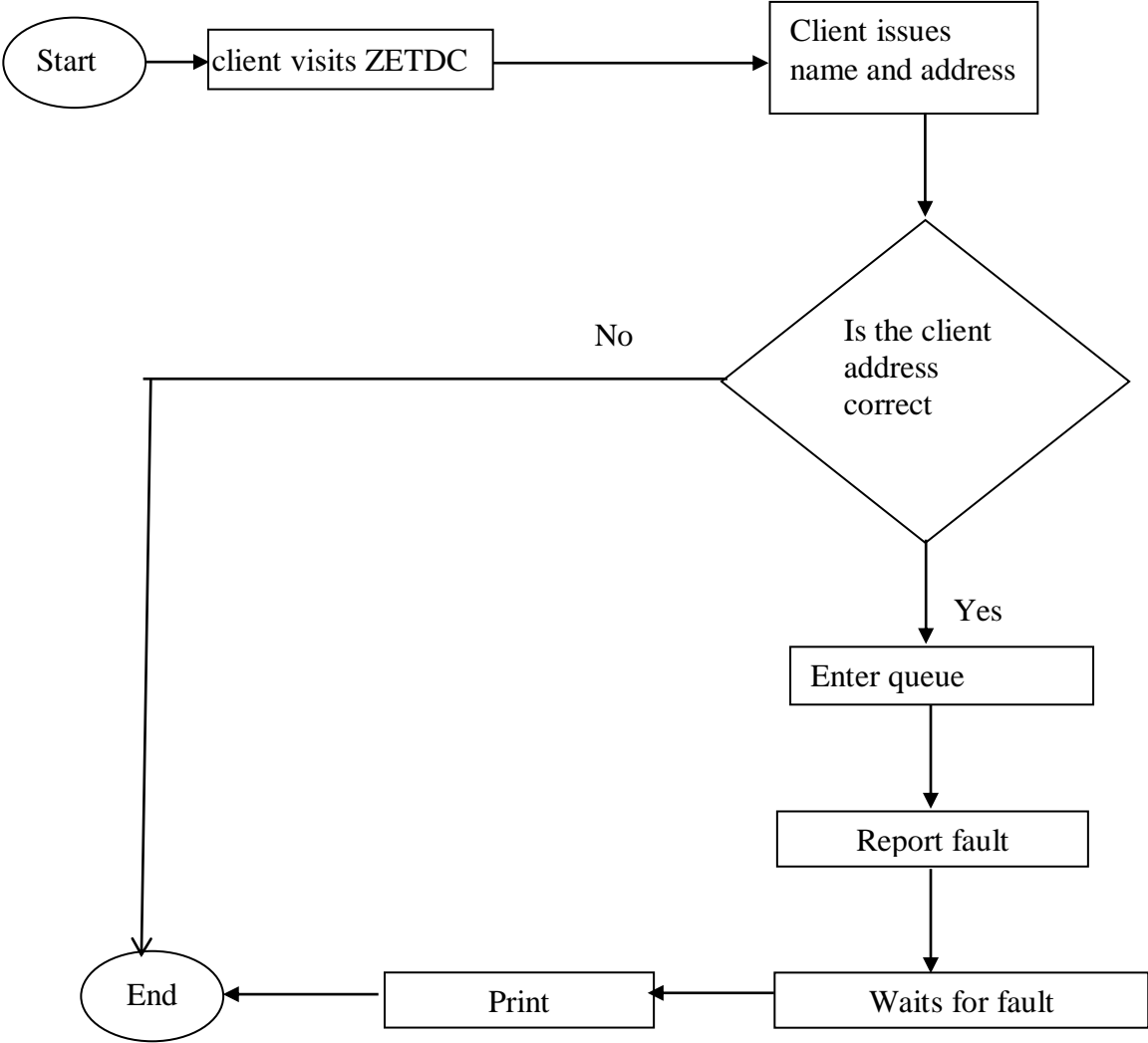


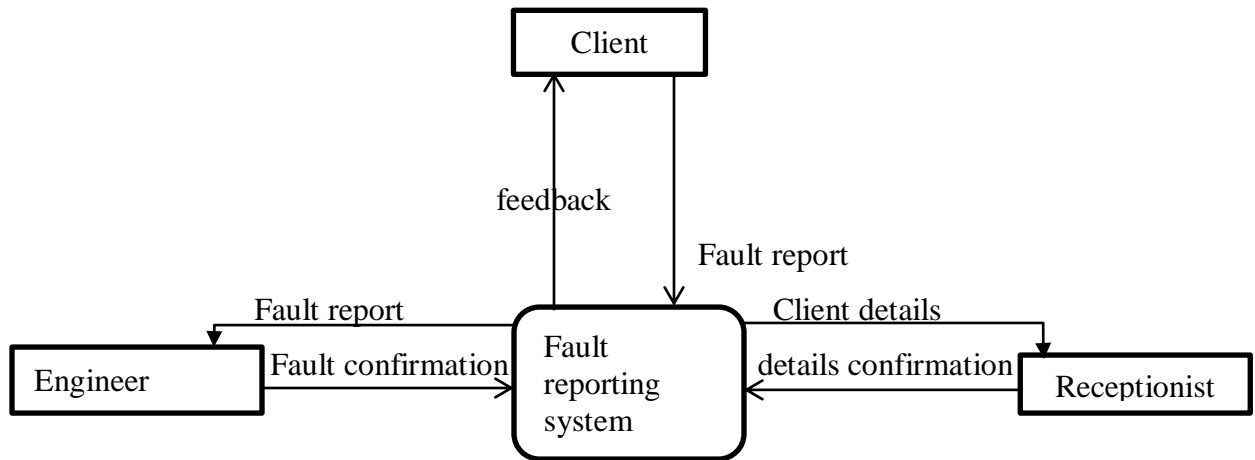
Fig 3.1 Process Analysis

3.5 Data Analysis.

Data analysis is a procedural assessment of data using systematic examination of data in order to investigate given information (Twisk, 2013). To give a clear glance of data analysis the research team used the context and dataflow diagram.

Context Diagram

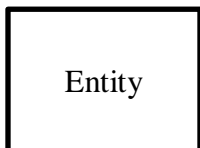
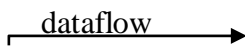
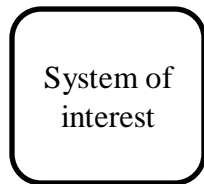
A context diagram is a pictorial representation that highlights the relationships of the entities and their processes and merging each and every process to the entire system (Gomma, 2016). The context diagram is meant to provide a high-level view of the ZETDC current system.



Electricity Fault Report

Figure 3.2 Context diagram

KEY



Dataflow Diagram

Dataflow diagram (DFD) is a chart that shows how information flows through the procedure of data outline (Rosenblatt, 2013). The current system dataflow diagram is represented below.

Dataflow Diagram for Existing fault recovery system

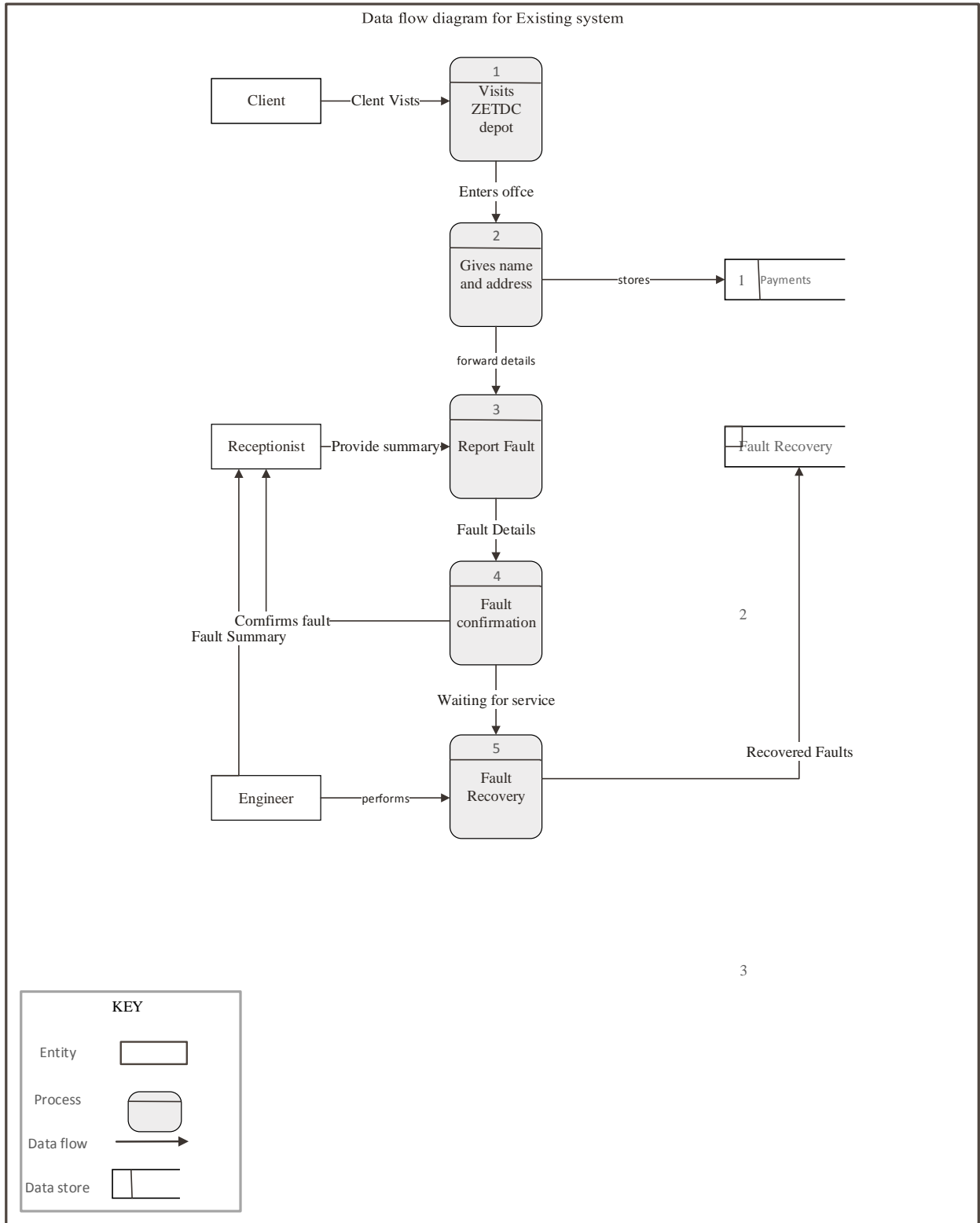


Figure 3.2

3.6 Strengths and Weaknesses of the Current System

Like any other system the current ZETDC fault recovery system has its own strength and weaknesses to be shown below.

Strength of the Current System

- The current system allows use of emotions since there is direct contact of the client and their service providers hence resulting in quick attendance to the fault.
- Constant contact of the client and the service providers may lead to increased relations between them.

Weaknesses of the Current System

- The current system is very costly to clients since they will have to commute to reach a ZETDC depot.
- The current system is time consuming for both the clients and electrical engineers since it does not help them in fault recovery.
- Data capturing is done manually so there are high chances of data loss.

3.7 Evaluation of Alternatives

Before proceeding with the project, the project team had to consider other available alternatives to develop the newly proposed system which are outsourcing, in-house development and lastly perfecting the existing system. To be more precisely, it is of great essence for the project managers to select the best alternative making use of the cost and benefit analysis.

3.7.1 Outsourcing

Outsourcing occurs when a company has no intentions to develop the system in-house but it would get the system from a reputable development company for a fee (Biggs 2000) et al. When an organisation chooses outsourcing it will be of great importance for it to train its employees on the system to be implemented, so that they will familiarize and get to know the new system requirements. However, outsourcing has its pros and cons that are discussed below.

Advantages of Outsourcing

- ❖ It saves time and therefore outsourcing can accord more time for the company to focus on its core system rather than on the system itself.
- ❖ Outsourcing reduces risk of system exploitation since it is developed by more skilled and equipped labor and therefore reduced bugs.

- ❖ Apart from that, outsourcing is cost effective since there are no administration, operation and recruitment cost associated with the need for an IT infrastructure for an in-house development of the system.

Disadvantages of Outsourcing

- ❖ There is a very high risk that the system developers may leave backdoors so that they can have unlawful access of the company's confidential information.
- ❖ Outsourcing is also associated with recurring cost such as system licenses yearly which may end up being costly than building the system in-house.
- ❖ The trained individual may fail to grasp some concept of the system hence may lead to additional cost

3.7.2 In-house System Development

This way of system development requires a set-up of an IT infrastructure and the recruitment of skilled labor since the system development occurs within the organisation usually for own use, using the accessible resources (Kenneth and Kendell, 2011). The pros and cons of in-house development are highlighted below.

Merits of In-house System Development

- ❖ The method creates a bond between the system users and the system developers through constant interactions.
- ❖ In-house development comes with more convenience since everything is done in total control by the organisation, helping in coming up with flexible schedules.
- ❖ It will be more confidential since there will be no third part having access to the developed system.

Demerits of In-house System Development

- ❖ Setting up an IT infrastructure will be costly adding overhead costs.
- ❖ The developed system might not have a resale price since the system may be designed to suit only the specific organizational needs.
- ❖ In-house development might not be the suitable method when the system is required in short period of time since it requires a short time.

3.7.3 Improvement of the Current System

Improvement of the system is done internally without outside help to cater for system worrying issues particularly affecting system functionality (Kiddiq, 2014). This method requires alterations to be done on the existing system so as to make it more proficient and practical for instance the manual ZETDC fault reporting system. This system development method has its own costs and benefit to be shown below:-

Benefits of Improvement of the Current System

- ❖ Improvement of the current system does not disturb the normal operation of the business since time can be devoted for system improvement.
- ❖ It is less costly as compared to other methods since little resources and additional training is required.

Costs of Improvement of the Current System

- ❖ A change from manual to complete automation of the current system may be very timeous
- ❖ If the project to be improved is too big it may disrupt other business activities
- ❖ Some of the problems can only be identified but will be very challenging to address and therefore no alterations will be done.

In coming up with the best alternative method the project team had to make use of the cost and benefit analysis for evaluation. With the aid of the of the cost and benefit analysis and other evaluation techniques the project team opted for the in-house development as it had a higher initial cost but they were once of costs and not recurring costs and no special training required as compared to other methods and the project will come with higher levels of privacy since some organizational information may be very sensitive.

3.8 Requirements Analysis

This phase simplifies and highlights the requirements of the system underway. Thus the phase has two categories that are subdivided into the functional and non-functional requirements that are to be explained below:-

3.8.1 Functional Requirements

This phase focuses mainly on clients therefore aiming on enhancing clarity on the client needs and how those needs will be addressed and it stretches up to the expected standard of the system

performance (paradkar, 2017). To be more precisely, the functional requirement phase focuses on the feasibility of the proposed system and concentrating on the usefulness thus whether the system will be in line with the business objectives or not (Stephanidis, 2003). However the is supposed to help both the clients and the engineers in electricity fault recovery thus the customer will log a query inform of a chat from wherever they are and the system will however help the engineers with giving the location co-ordinates of the fault. The functionality of the system is highlighted below:-

- ❖ The proposed system should consist of a group chat platform that enables the users to report the faults online by providing their contact details thus their name, surname, physical address and location.
- ❖ The customer should get the ZETDC fault recovery application online so that they can overcome distance barriers.
- ❖ Clients should get the feedback on their requests concerning the date the recovery is supposed to be done and be updated when the fault has been recovered.
- ❖ Furthermore, the engineers should be updated by the system about the fault.
- ❖ The system should give the location co-ordinates of the transformer fault.

3.8.2 Non Functional Requirements

These are the principles that are used on the analysis of the system (Nikkola, 2011). During system development there will be expectations to experience challenges and these are the non-practical conditions of the proposed system. There is an inverse relationship between the non-functional requirements of the current system and the functional requirements of the proposed system (Sommerville, 2004). The non-functional requirements are highlighted below:-

- ❖ The proposed system should have data integrity and security thereby avoiding data loss.
- ❖ The system should have data security thus enabling data backups.
- ❖ It should be available when needed to all the clients
- ❖ The system should make work more easier and be time saving
- ❖ It should have a good graphical user interface and be user friendly
- ❖ It should also enhance security so that those people without direct access to the system cannot manipulate or change anything on it.

3.9 Conclusion

The researcher in this chapter used different data gathering techniques in which the evaluations were made of the best method. Furthermore, overall analysis of the current system was done on analysis phase showing the pros and cons of the existing system. However, the limitations of the existing system overweigh the benefits leading to the proposal of a new system by the project developers. After this phase the developers will proceed to the design phase.

CHAPTER 4: DESIGN PHASE

4.1 Introduction

The design phase concentrates on the generation, configuration and delivery or deployment of the proposed system (Rana, 2013). This chapter clearly explains how the system to be developed will look like. The functionality of the proposed system will also be well outlined in this chapter, so generally the design phase emphasizes on the architectural design, physical design, interface design, database and file specification and the program design.

4.2 System Design

The design illustrates how the proposed system operates, in terms of hardware, software, interfaces, network infrastructure, forms, database and files; this is fashioned through the use of set of guidelines and techniques (Stasinopoulos, 2013). Validity of the proposed system is considered a good design when the following objectives are met:

- **Flexibility** – the design should allow incorporation of future requirements without too much toil or strain.
- **Maintainability** – a good design should be easy to maintain.
- **Portability** – a good design should have the capability of being transferred from one machine environment to another, with the least amount of converting effort.
- **Easy to use** – a good design should be user friendly, that is easy to learn and understand, and also straightforward to operate.
- **Reliability** – a good design should secure against human error, that is production of correct results and being trustworthy, and should also be available when needed by the user
- **Security** – a good design should also secure the confidentiality of data.

4.2.1 Context Diagram

Context diagram defines the margin between the system and the systems environment, highlighting the main actors (entities) that interact with the system (Kenneth and Kendell, 2011). Context diagram is made of the system of interest at the middle, enclosed by the entities who interact with the system. The context diagram of the new system is as:

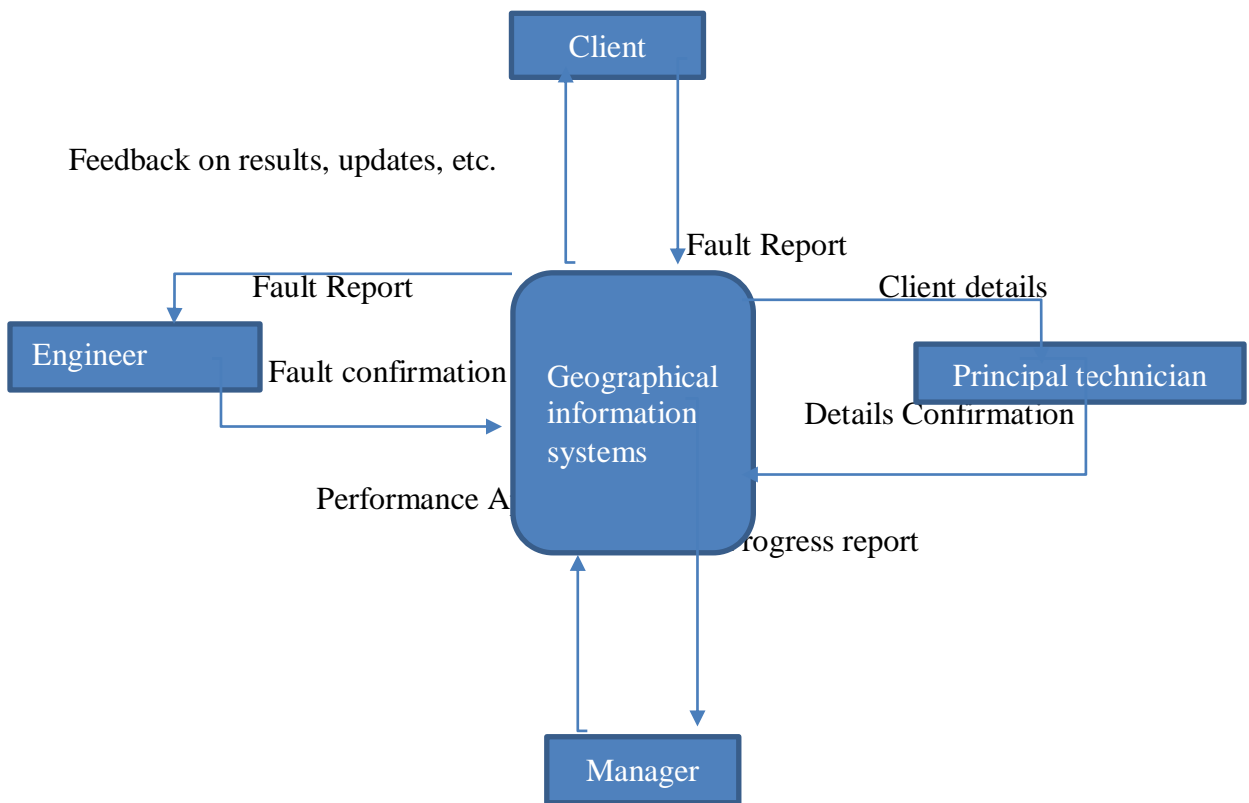
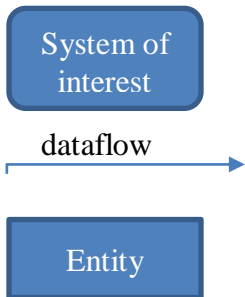


Figure 4.1 Context diagram

Key



4.2.2 Dataflow Diagram (DFD)

Dataflow diagram is a more advanced context diagram that clarify the relationship between and among several components in the system. Dataflow diagram is a vital method which is used in modelling of the system (Butt, 1994). Construction of a DFD for the new system was done to ensure that all the essential modules were defined. The DFD illustrates the movement of data thereby making it easier to comprehend the movement of data. The following fig indicates the framework's DFD:

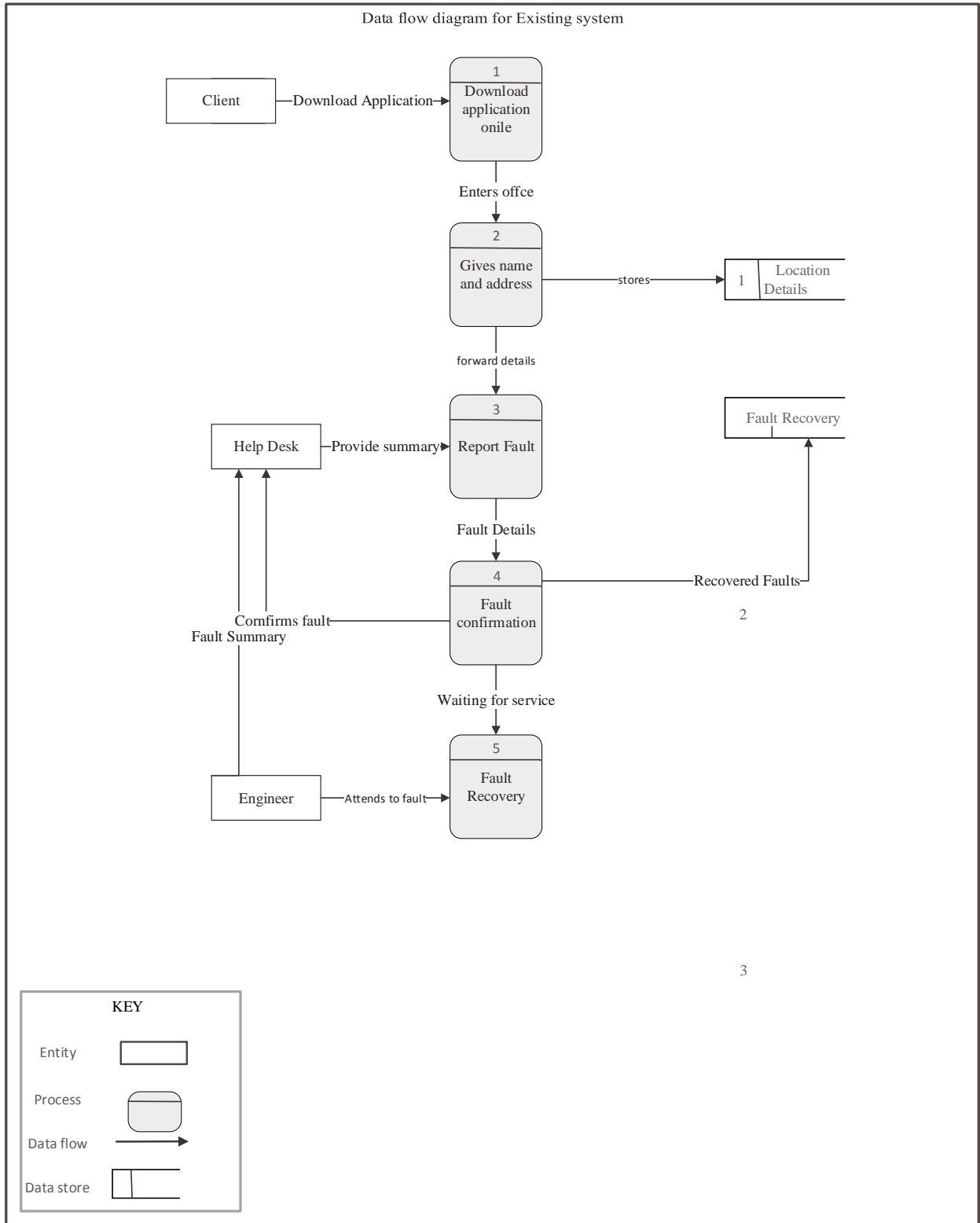


Figure 4.1 Context diagram

4.3 Architecture Design

The architecture design is the formal background in which the system components interact thus the software, hardware as well as network setup of the system to be developed (Fisher, 2008). The architecture design also consists of a brief description of how the system will behave, the system dataflows and their communication or relationships. This phase gives a highlight of the proposed system features into a logical and functioning system in line with the stated system objectives. The diagram below depicts architecture design of the GIS for ZETDC.

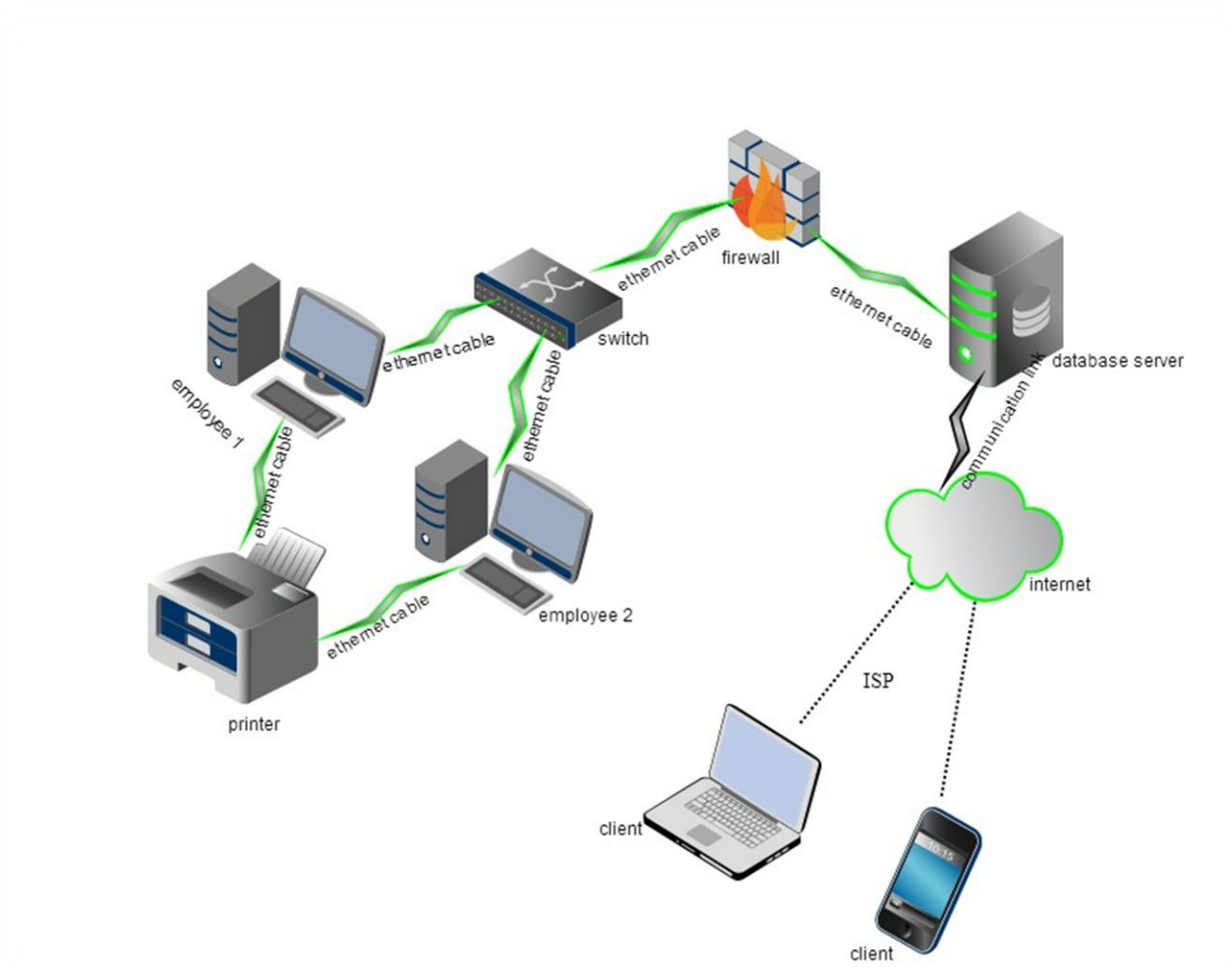


Figure 4.3 Architectural Design.

4.3.1 The Client Server Approach

The approach comprises of an application that allows the combination of the clients and the server on the computer system and is done through the process whereby clients request resources from the sever (Kenneth and Kendell, 2011). The client server model best works when both the server and the client have different tasks that they regularly perform, for example, on the geographical information systems for ZETDC the sever side saves the system from failure and notifies the user that a certain tasks cannot be performed while the client side will only ensure that fault details entered by the client is valid thus it saves time for the server by handling invalid data. The structure of the proposed geographical information system is a web-enabled system which also makes use of web-servers. This approach has been chosen since it comes up with the user friendly interface for the clients and as well making the source code invisible for its clients.

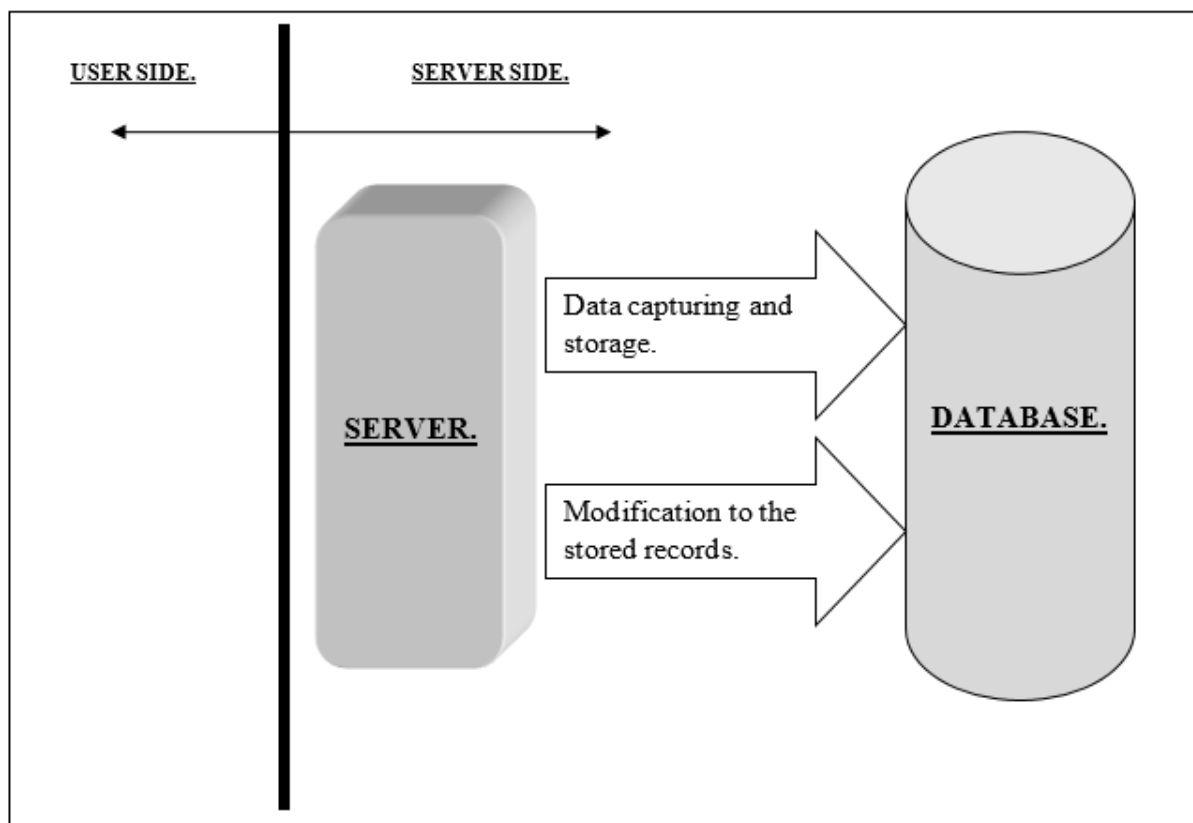


Figure 4.4 client server approach

4.4 Physical Design

The physical design is a way of altering the given model into a real tangible system that shows the way of components arrangement thus the system users, hardware as well as software to be developed (Wasson, 2015). The physical design depicts the system components integration thus how the components communicate within the new system.

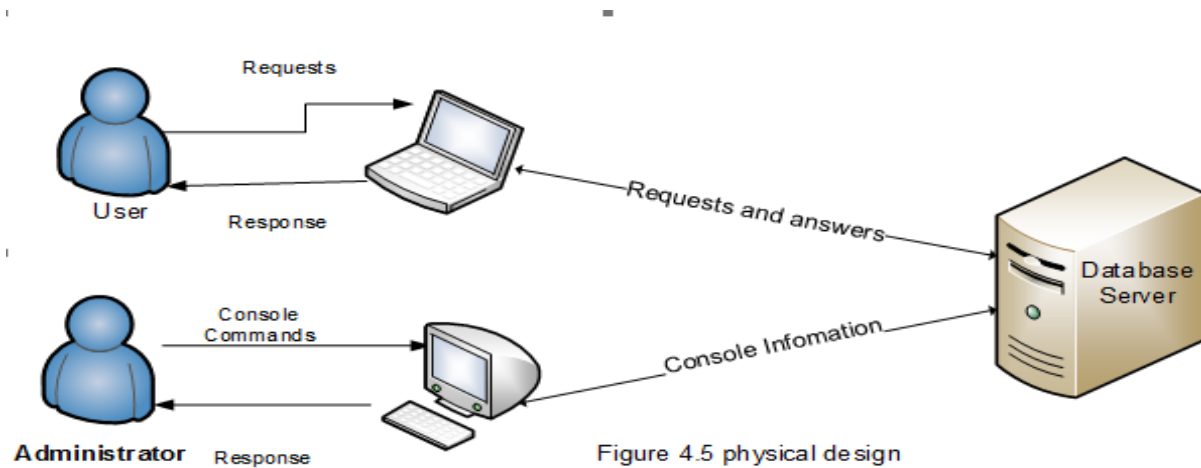


Figure 4.5 physical design

Figure 4.5 Physical Design

4.5 Database Design

This is a method of producing a clearer and meaningful data model (Dennis and Roberta, 2012). Generally there are six major steps in database design which include requirement analysis, conceptual database design, logical database design, schema refinement, physical database design and application and security design. Database design comprises of information arrangement which is entirely explained in the database schemas. However, the development team took into account the six steps previously stated.

- **Requirement analysis** – this involves consultation of the system potential users to get the required information such as data to be stored and the desired operations and requirements.
- **Conceptual database design** – it involves the construct of a best explanation of data and constraints.
- **Logical database design** – this is the conversion of the conceptual model to the relational model.

- **Schema refinement** – involves the processes of problem identification and trying to address the identified problems.

4.5.1 Database Design Architecture

It is an exercise that outlines the governing procedures, steps and conditions relating to storing and inserting the data in database and it also determines the people who can have access to the given database between the various users (Meyer, 2007). The research team made use of the ANSI-SPARC model which will be highlighted below with its three levels.

The Three Level Architecture: ANSI-SPARC

The architecture consists of three levels which include the external level, conceptual level as well as the internal level. The major aim of the model is to hide the physical storage details from the system users (Coronel, 2008).

External level

This level represents the user's view of the database and may present the same data differently for example clients may view the date as (day/month/year) while employees may view it in other format (year/month/day) and it describes a portion of database that has a significance to the targeted user (Sommerville, 2004). The external level is of great importance since it includes derived or calculated data for the system users who include the clients, employees and managers.

Conceptual level

This level is also known as the community's view of the database and it defines the data stored in the database as well as the relation among the given data. Thus the conceptual level signifies all the entities, the given attributes as well as their relationships, it also shows the data constraints and provides the data integrity and data security information (Sommerville, 2004).

Internal level

The internal level defines how data is to be stored in the database by the file organization and data structures. This level is more concerned about storage space allocation and tables, defining the format the records will use after being stored, data location, as well as the techniques of data

compression and encryption. After the internal level is the physical level controlled by the operating system (Sommerville, 2004).

The three ANSI/SPARC levels of abstraction

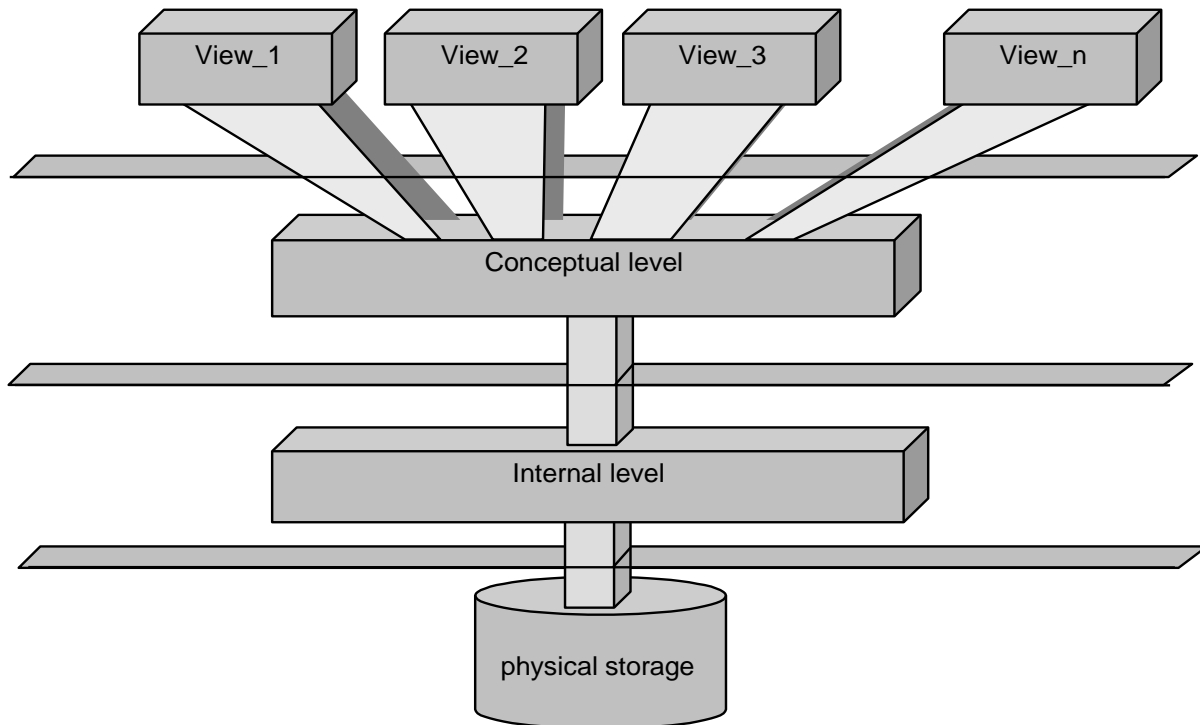


Figure 4.6 ANSI-SPARC models

4.5.2 Table Design and their Attributes

This is the designing of the relational tables for data storing and easy retrieval of the data stored in the database. Several relational tables are designed to meet different user requirements at all levels. The designed tables include:

Admin table shows an overview and admin super powers in monitoring the GIS system

Name	Type	collation	Attributes	Null
Id	int (11)			No
Fullname	Varchar (200)	Latin_swedish_ci		No
Username	Varchar (200)	Latin_swedish_ci		No
Password	Varchar (200)	Latin_swedish_ci		No

Table 4.1 Admin

The table Job consist of how the job will be performed within the GIS system for ZETDC

Name	Type	collation	Attributes	Null
Id	int (11)			No
date	Datetime			No
Start_date	Datetime			No
End_date	Datetime			No
Transformer_id	Int (11)			No
Description	Varchar (200)	Latin_swedish_ci		No
Is_complete	Int (11)			No
leader	Int (11)			No

Table 4.2 Job

The table below consists of the transformer details and location

Name	Type	collation	Attributes	Null
Id	int (11)			No
Transformer_number	Varchar (200)	Latin_swedish_ci		No
X_cood	float			No
Y_cood	float			No
Model	Varchar (200)	Latin_swedish_ci		No
Description	Varchar (200)	Latin_swedish_ci		No

Table 4.3 Transformer

The table below consists of the web chat details

Name	Type	collation	Attributes	Null
Id	int (10)			No
Author	Varchar (16)	utf8_general_ci		No
gravatar	Varchar (12)	utf8_general_ci		No
text	Varchar (255)	utf8_general_ci		No
ts	timestamp			No

Table 4.4 Web Chat

The table below consists of the transformer Job details

Name	Type	collation	Attributes	Null
Id	int (11)			No
Worker_id	int (11)			No
Job_id	int (11)			No

Table 4.5 Transformer Job

The table below consist of worker details

Name	Type	Collation	Attributes	Null
Id	int (11)			No
Fullname	Varchar (200)	Latin_swedish_ci		No
email	Varchar (200)	Latin_swedish_ci		No
Surname	Varchar (200)	Latin_swedish_ci		No
Password	Varchar (200)	Latin_swedish_ci		No
Role	Int (11)			No
Is_assigned	Int (11)			

Table 4.6 Table worker

4.6 Logical Design

Logical design mainly focuses on objects relationships (Gupta, 2005). Entity relationship diagrams (ER) are used to show objects relationships.

4.6.1 Enhanced Entity Relationship Diagram (ER)

This is the graphical representation of all the given entities and their attributes showing the relationships among these entities (Malik, 2011). The research team discovered the major entities in the GIS system as well as the relationships among the entities shown on the ER diagram below:

Enhanced Entity Relationship Diagram

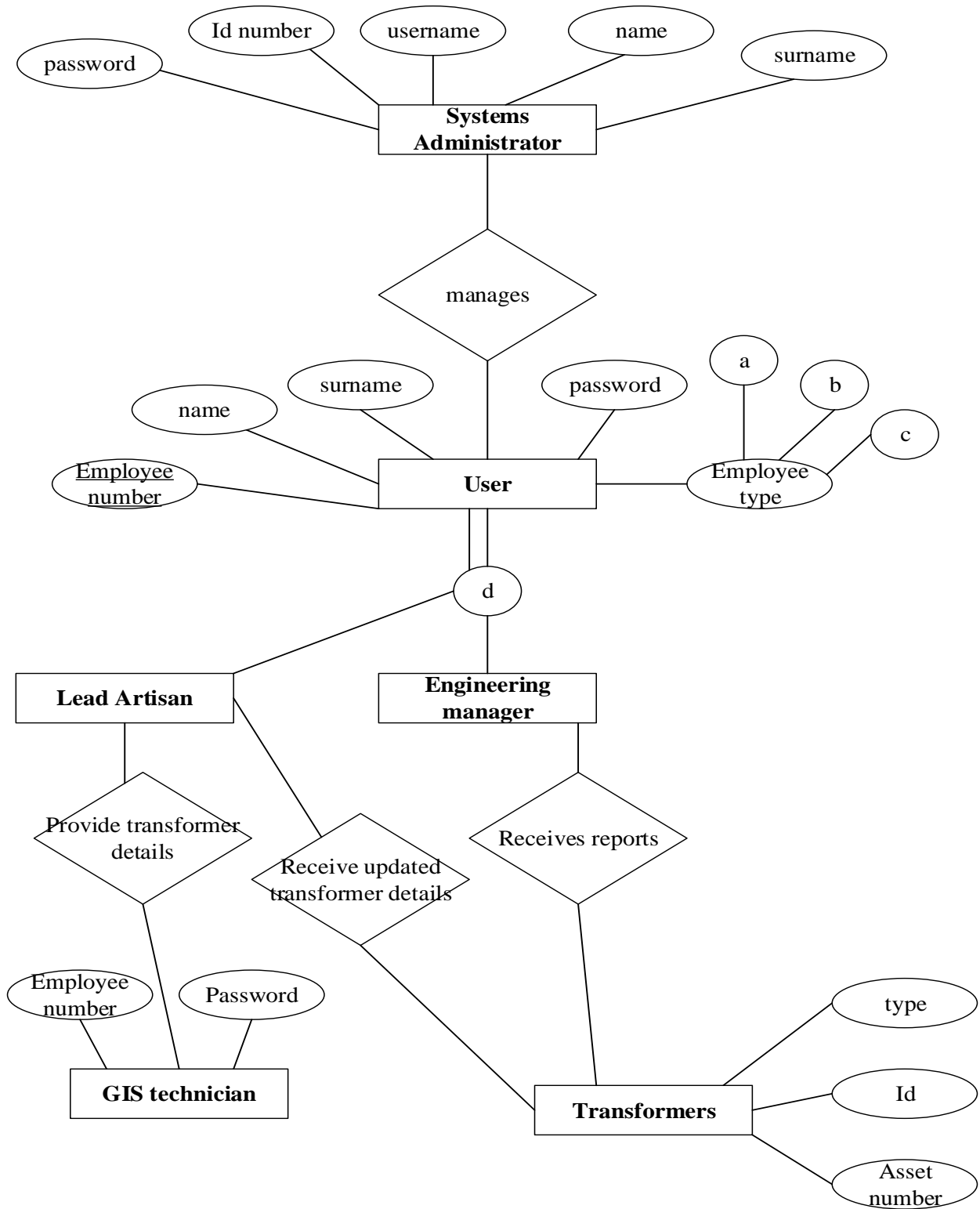


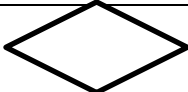


Fig 4.5 Entity Relationship Diagram

Table 4.7 EER Key

Symbol	Meaning
	Entity
	Entity Attribute
	Relationship

As shown in figure 4.7 the client send a fault report to the helpdesk where the update will be given to the engineers.

4.7 Program design

It is a technique used for system designing and creation by developing from a condition of the vital program to give a program summary. The analysis of program requirements is done at this stage by stating how the program will perform and the decision on how the program will meet the targeted requirements is made. The program design process is done from end to end with the Unified Modelling Language which comprises of the class and sequence diagrams as well as the package diagrams (UML) (McConnell, 2004).

4.7.1 Package diagram

This is a Unified Modelling Language (UML) organized diagram which highlights the system components gathered into packages and needs concerning these packages to fulfill the system requirements (Rouse, 2005). The graphical representation below depicts a GIS system package design for ZETDC to be developed and the interaction of modules with the new system.

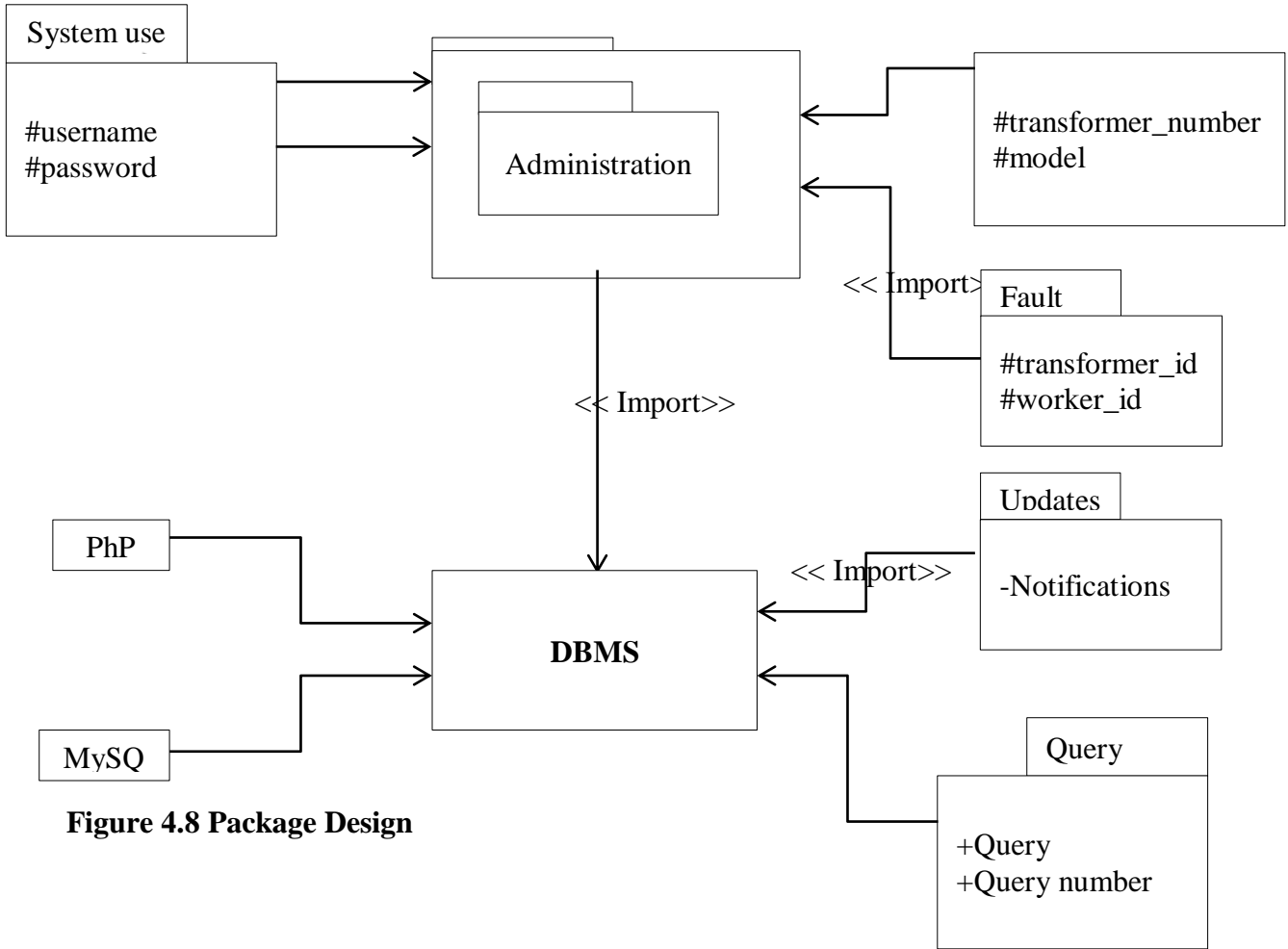
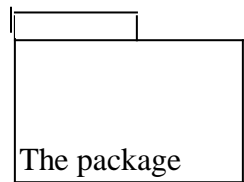


Figure 4.8 Package Design

Key

Protected attribute



<< Import >> dependency

- a private attribute

+ a public attribute

4.7.2 Class Diagram

In Unified modeling language (UML) a class diagram is more of fixed structure diagram of the new system that defines the system structure by highlighting the classes of the system, attributes, methods and their relationships (Pitman, 2005). The diagram below shows the class diagram of the new system

Class Diagram for new system

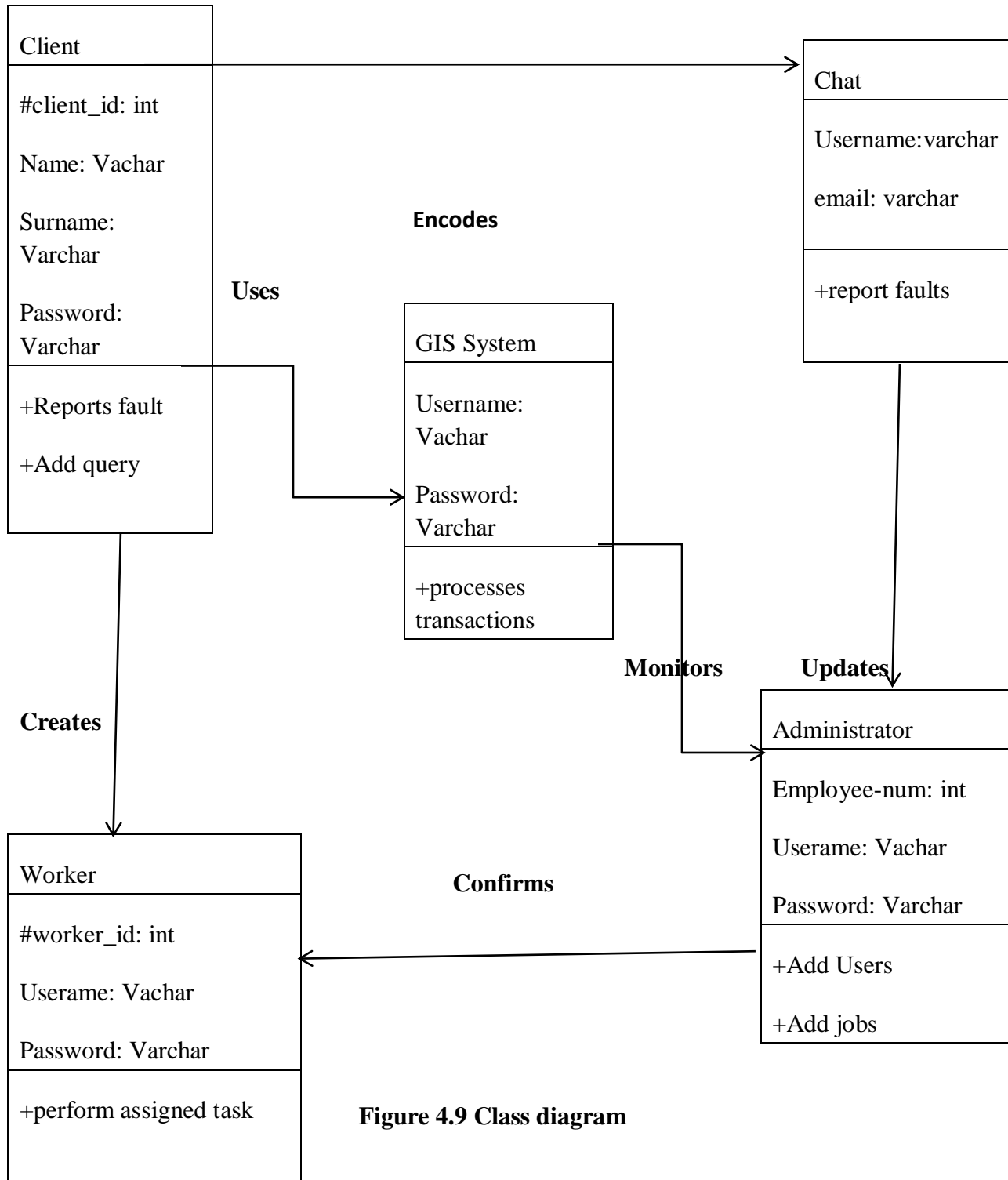


Figure 4.9 Class diagram

Key

Class
Attribute
Operation

4.7.3 Sequence Diagram

This is an interaction diagram that highlights how the processes functions with one another in their order of operation (Thompson, 2003). Moreover, sequential diagrams are often a hypothesis of a communication series chart and indicate interaction of objects ordered in time series. They pass messages that share numerous objects to reach the final class

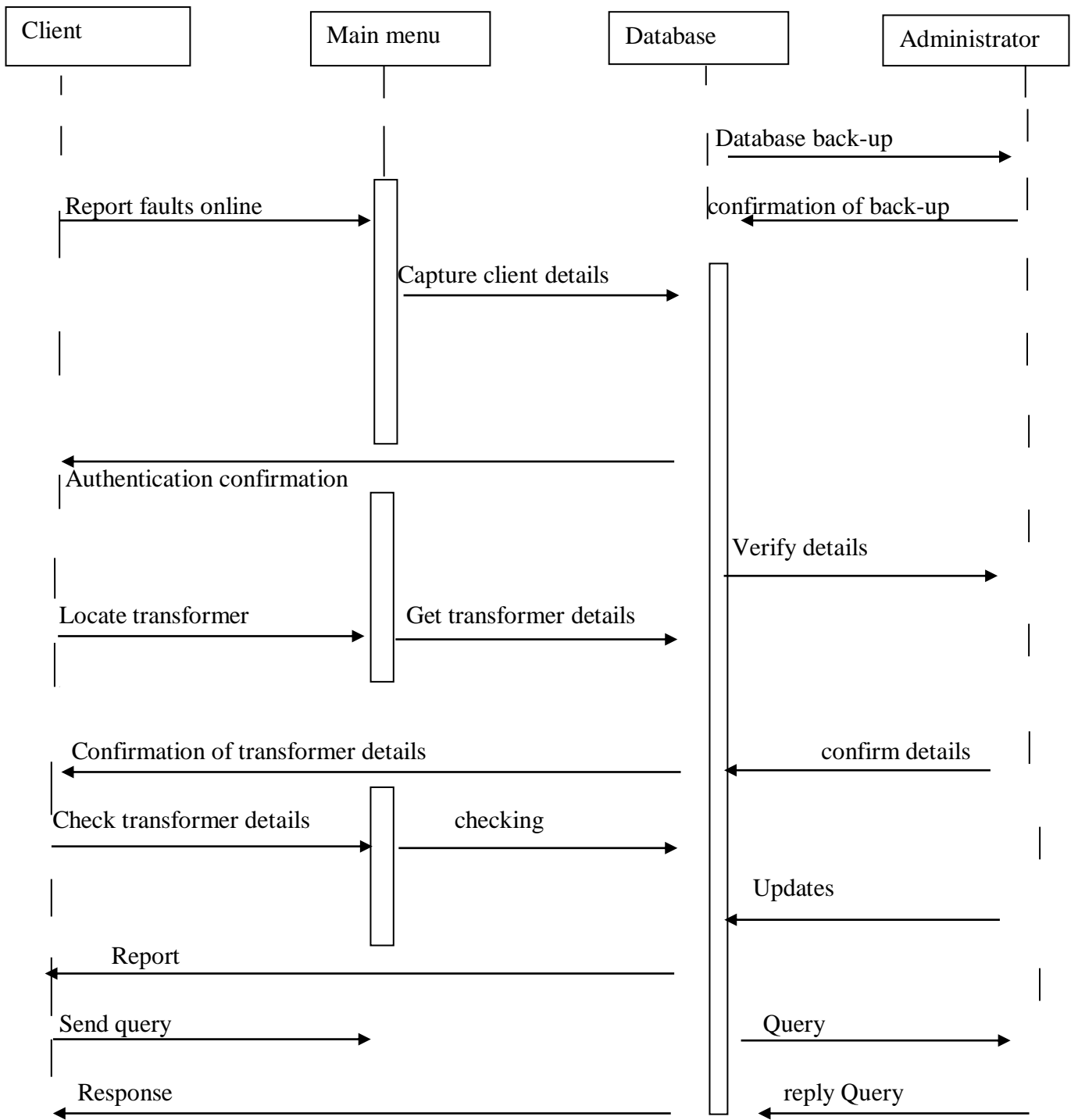


Figure 4.10 Sequence diagram.

4.7.4 Pseudo-code design

A pseudo-code design is an algorithm which is shown in human expressions using own language that creates the model of actual code to enable non-programmers to interpret without hustle (Rouse and Smith, 2005).

The Pseudo Code for:

Login

First

Type the link or URL on web browser

Input login details

 If the inserted details matches

then

 Successful login

 User can access the system

Else

 Log in unsuccessful

 Show an error message

then

 User is directed to the login page

New Client Sign Up

Fill in the required fields

Verify and validate the inserted details

If details have errors for example (email does not contain an @ sign)

then

Show an error message

Else

. Access the database

Save the entered details

Direct the user to confirmation window

Then after successful confirmation

User is notified that an account has been successfully created

Data Capturing and Updating

Class conn

Set connection properties;

Connect to database;

If it is true then

Proceed;

Else

Notify and discontinue connecting

Validate forms

If there is an empty field

Notify the client

Else if the passwords doesn't match

Notify the user and deny access

Else if password length < 8
Notify the user and deny access
Else if given field requires numbers only
Discard character and make the user aware
Else
Link the user to home page

4.8 Interface Design

An interface design is a two way communication concerning the system users and the computer system (Pressmen, 2001). The interface design allows effective communication and presents the relationships on web between the system users and the computer thus for the user to determine whether the system is user friendly or not.

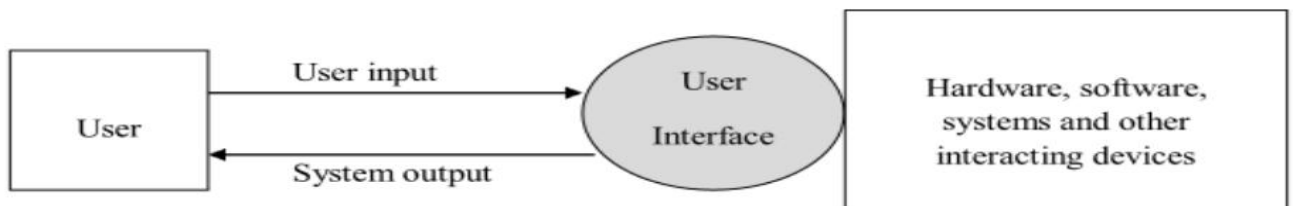


Figure 4.11 Interface Design

4.8.1 Menu Design

Menu design is a designing of platform with alternative option accessible by the user to run a program task or gather essential data. The essential processes are presented on menu platform where the system users should provide the required login details on the login page for them to be redirected to other pages to perform various functions.

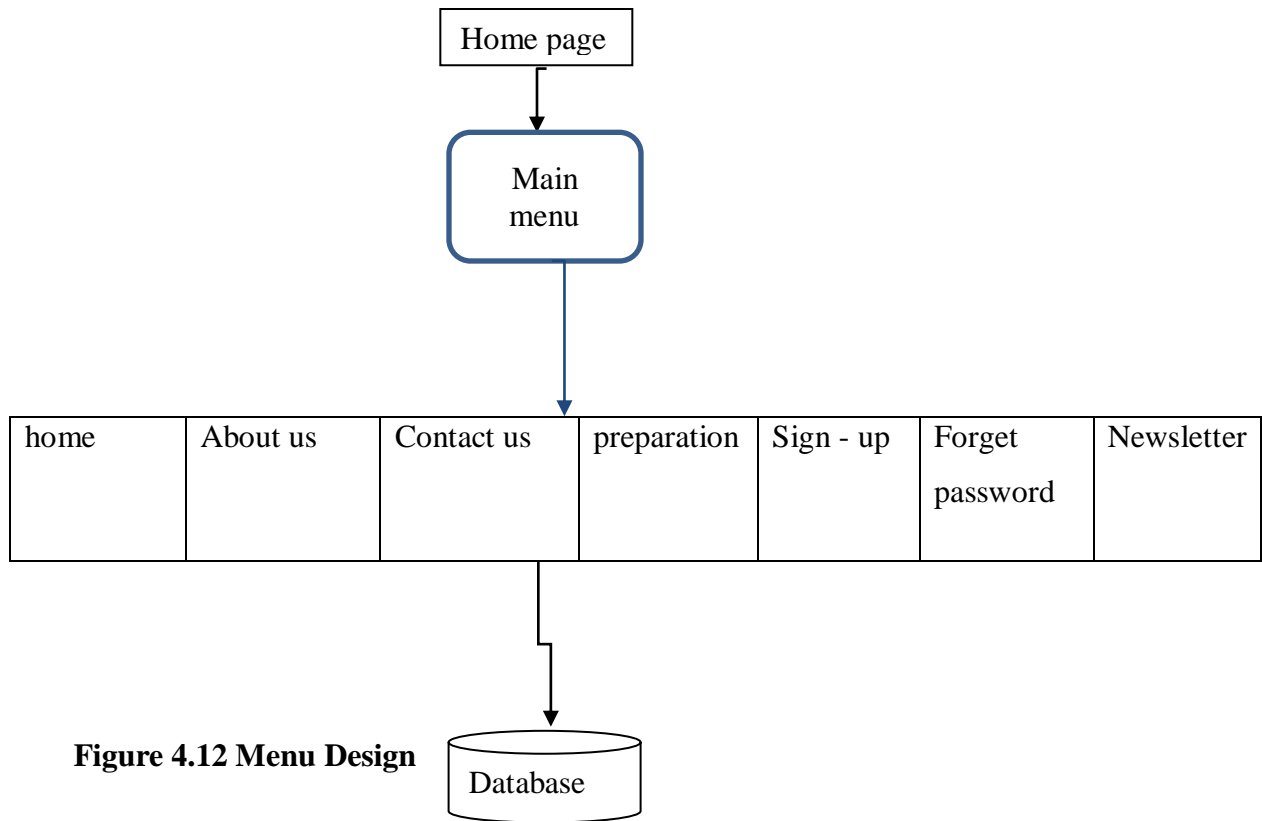


Figure 4.12 Menu Design

4.8.2 Input Design

Input design is a platform that allows the system users to enter the required information or data. However, system design should be less complex hence friendly to its users by the guaranteed trustworthiness thus data integrity (Brown, 2008). The designed interfaces below should direct the system users to their required fields simply by completing the login requirements on the login platform.

GEOGRAPHICAL INFORMATION

Username

Password

Fig 4.12

Transformer registration form

Transformer type	<input style="width: 90%; height: 20px;" type="text"/>
Asset number	<input style="width: 90%; height: 20px;" type="text"/>
Location	<input style="width: 90%; height: 20px;" type="text"/>
Voltage	<input style="width: 90%; height: 20px;" type="text"/>
Status	<input style="width: 90%; height: 20px;" type="text"/>

Fig 4.13 Transformer Registration Form

When the clients are registered they will be directed to their profile page. Profile page design is shown below:

Change password

This design is available to every user as one should be able to change their password at any given time because of security reasons to avoid unauthorized individuals to make use of one's password.

The image shows a 'Change Password Platform' form. It consists of four input fields on the right, each corresponding to a label on the left. The labels are 'Username', 'Old Password', 'New Password', and 'Confirm password'. Below these fields are two buttons: 'OK' and 'Cancel'. The form has a light gray background and a subtle gradient.

Fig 4.14 Change Password Platform

Transformer reports

This is a form that will be designed using a data grid view to get the output that would have been requested after a command has been executed.

Transformer ID	<input type="text"/>	Search

Table 4.8 Transformer Reports

4.8.3 Output Design

This design produces results for the users of the system and these results are shown as reports, so when a new client joins the service the following maternity joining report should be produced and this report is only visible to relevant users.

Electrical Faults Report

Client	Fault date	Date Reported
Kwanisai Onismo	11/ 04/18	12/04/18
Dumisani Mavunga	20/ 04/18	20/04/18

Table 4.9 Electrical Faults Reports

It is advised that the clients should notify the engineers about the faults as soon as they identify one. The clients should notify the engineers through the GIS system on a chat system.

Progress Report

Engineer	Date Reported	Engineer Grade	Employee id	Examination Date
Adonis Ruwaya	11/04/2018	D2	E1234	12/04/2018
Ease Chikata	20/04/2018	D4	E1234	20/04/2018

Table 4.10 Progress Report

The progress report is given to the managers so as to view the general performance of their employees thereby enabling them to come up with performance appraisals.

4.9 Security Design

Security design is an approach to software and hardware development that that intends to build systems as free of vulnerabilities and impervious to attack as possible through such measures as continuous testing, authentication safeguards and adherence to best programming practices (Gouin, 2007). The system must be secure from outside clients as this reduces the danger of alteration of data by unauthorized clients. Data can be secured by use of programming controls. In the system the database administrator has actualized programming controls and this integrates the use of passwords whereby level of authorizations and parts are set characterizing whether the user is as super user with super rights. The security feature given by this system has two levels. The principle level is section into the system itself that is, having admittance to where the system

is. The segmentation router and hub will cater for this. Access records are arranged on this router to deny access from terminals.

The other level of security is having authentication on the system itself. An unauthorized user may have figured out how to bypass the primary level by changing their IP address to match any of the ones permitted access. The second level is there to facilitate that it is secure just in case one will have been able to pass the first level. The system gives a log-in feature where secret key entered is checked.

4.9.1 Physical security

Physical security is the safeguarding of personnel, hardware, networks, programs and information from physical circumstances and events that could cause serious damage or losses to an enterprise, institution or agency (Layton, 2016). This involves protection from natural disasters, fire, theft, burglary terrorism and vandalism. Physical security is often overlooked in favor of more dramatic and technical issues such as hacking, Trojans, viruses and spyware. Therefore, physical security breaches can be undertaken with little or no technical knowledge on the end of an attacker. In addition, natural disasters and accidents are part of everyday life and they are inevitable in the long term.

Physical security has three main components. Firstly, complications can be placed in the way of potential attackers and sites can be protected against accidents and environmental disasters. Such actions can include multiple locks, walls, fencing, fireproof safes and water sprinklers. Secondly, surveillance and notification systems can be used, such as heat sensors, smoke detectors, intrusion detectors, cameras and alarms. Thirdly, processes can be implemented to capture attackers and to recover quickly from accidents, fires or natural disasters.

4.9.2 Network Security

Network security is the process of taking software and physical precautionary measures to protect the underlying networking infrastructure from unauthorized access, misuse, malfunction, destruction, modification or improper disclosure, thereby creating a secure platform for computers, users and programs to perform their intended critical functions within a secure environment (Poole, 2007). The auditing process of network security requires checking back on implementation measures to determine how well they have aligned with the security policy. Auditing urges continuous improvement by requiring organizations to reflect on the

implementation of their policy on a consistent basis. Organizations are given the opportunity to adjust their policy and enforcement strategy in areas of evolving need.

4.9.3 Operational Security

Operation security refers to a risk management process which enables managers to protect sensitive information to get to unauthorized users (Voelz, 2011). A process of identifying critical information and subsequently analyzing friendly actions attendant to the transformer geographic information system tracking operations and other activities to:

- a) Identify those actions that can be observed by adversary intelligence systems.
- b) Determine indicators that hostile intelligence systems might obtain that could be interpreted or pieced together to derive critical information in time to be useful to adversaries.

Select and execute measures that eliminate or reduce to an acceptable level the vulnerabilities of friendly actions to adversary exploitation

4.10 Conclusion

In a nutshell, the design phase gives an insight of the overall look and performance of the proposed system hence the GIS system appeared to be user friendly to the system users since it makes the system readily available to all users when required and easy to use. Furthermore, this phase also give emphasis on how data is stored in the database and also gives clarity about the type of information to be stored. Thus for a successful accomplishment of this venture the researchers will have to consider the next phase which is last phase of implementation and maintenance of the proposed system.

CHAPTER 5: IMPLEMENTATION PHASE

5.1 Introduction

Implementation phase concentrate on system coding, testing, installation and maintenance of the developed system(Moreira, 2004). Testing is undertaken with the intention of confirming if the new system is performing as expected (objectives are met and problems solved), through the process of validation and verification. The changeover strategies on installation are well described in this chapter as well as different maintenance activities, and lastly the recommendations are outlined and evaluation of objectives to review the success of the new system is undertaken.

5.2 Coding

Pseudo code phase involves the procedures enveloping the changing over of the proposed system rationale into particular directions executable by the PC (Petrie, 2014). Pseudo coding is otherwise called a programming stage, when the software engineer changes over the determinations of a system into PC justifiable language (Gupta, 2008). The programmer in this scenario will use PHP and HTML for the coding phase. Moreso, pseudo code shows how the proposed system was customized, which includes the each stage's project stream, builds for circling and the structures utilized by the software engineer as a part of system regulatory.

5.3 Testing

This stage involves the process of identifying the new system failures or faults and takes the possible procedure or measures to come up with a better system before system distribution (Kenneth and Kendell, 2007). Testing works in line with the verification process thus confirming if the new system is operating as anticipated. This process is carried out to expose the unidentified system errors in preceding chapters. However, as for this project the research team used various testing techniques which includes verification and validation, integration, unit testing, black and white box testing and lastly system and acceptance testing. The diagram below will help to give a further explanation about the testing processes.

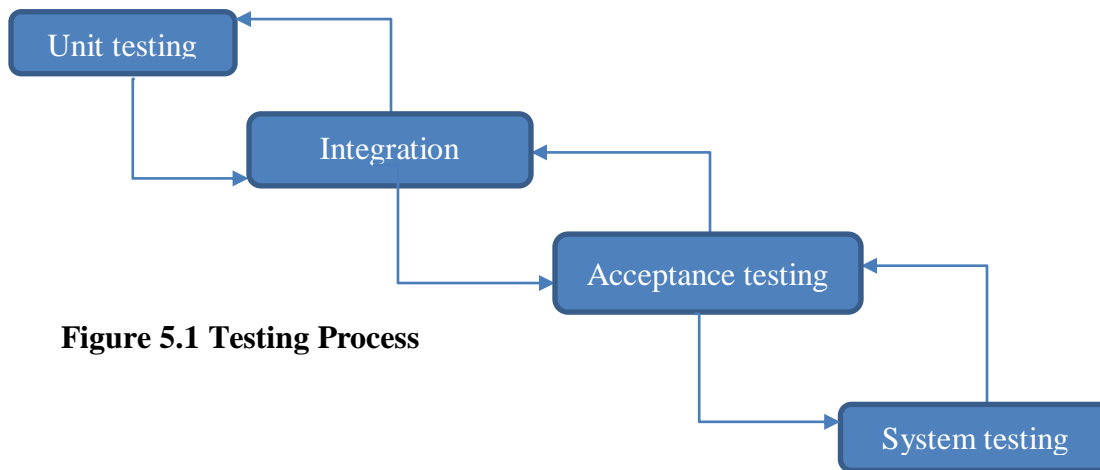


Figure 5.1 Testing Process

5.3.1 Unit Testing

Unit testing phase is a technique that focuses on giving more attention or focus to an element and the main objective being confirming whether the individual elements are operating as intended (Stephanidis, 2003). Unit testing comes up with its own main advantage which is making it easier to identify each element error as compared to identifying the whole system errors at once. Thus the system elements were tested individually, for example, the registration and the login element. Furthermore, the research team made use of the verification and validation process. The research team also used the registration element for their unit test which would successfully create a user account if the user enters correct registration credentials for them to login to the system, however, the registration unit test continues by rejecting user access to the system if the registration element is unsuccessful thus they won't be able to login to the system.

5.3.2 Verification and Validation

The validation process aims on building the right system and is attained by the process of calibration which compares whether the developed system is a correct representation of the proposed system whereas, verification process aims on developing the right system concentrating on questions such as is the system developed as intended? And is the system implemented correctly in the computer? (Sommerville, 2004). The diagram below shows the calibration process and validation of system models.

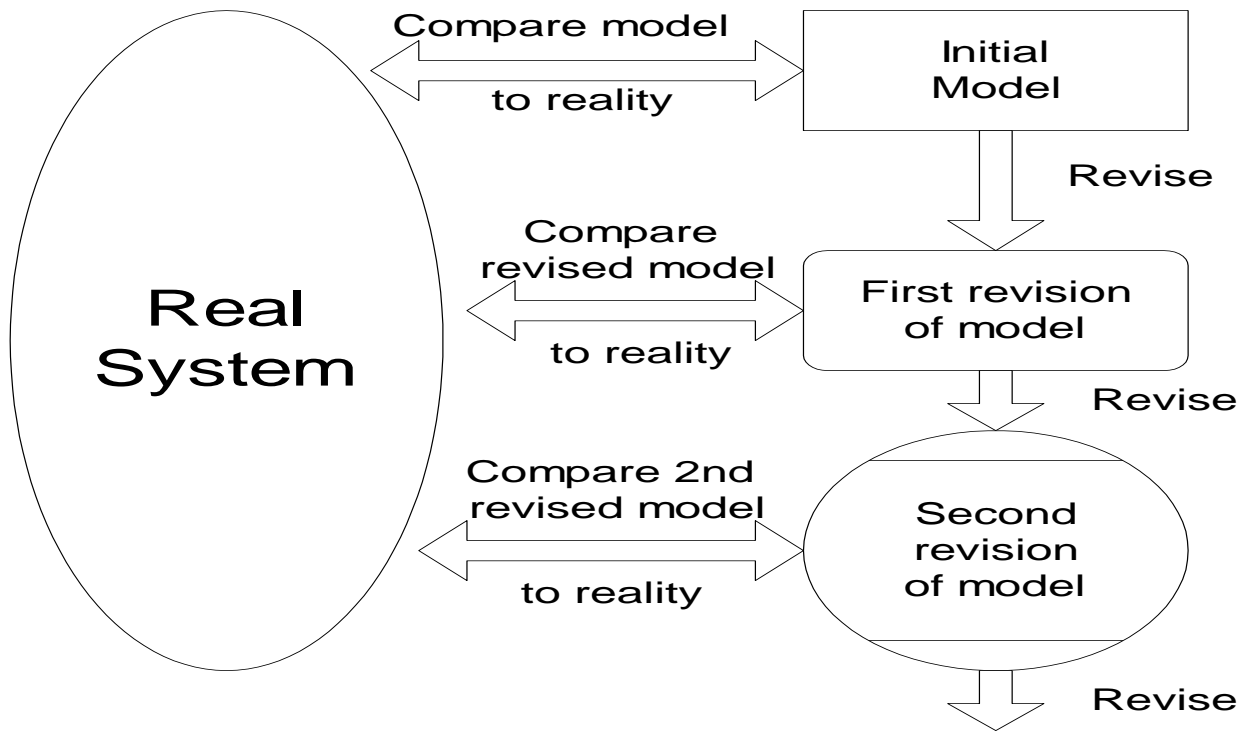


Figure 5.2 Calibration Process

The graphical representation below shows verification and validation relationships

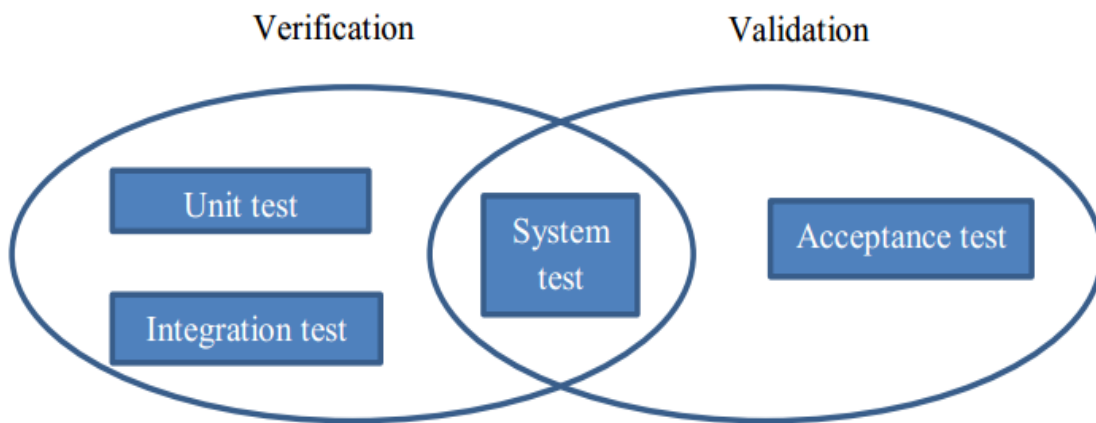
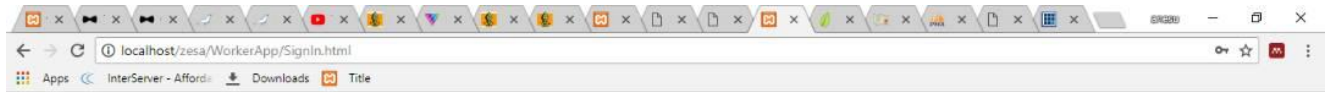


Figure 5.3 Verification and Validation

5.3.3 Login Testing

The ZETDC GIS system has been tested to see if it validates properly thus if the user uses a wrong email address and password. Thus if authenticated very well it should deny the user access to the system.



Worker SignIn

anesucain

Invalid Credentials

SIGN IN



Fig 5.3 Wrong credentials message

If a user tries to login with different or wrong credentials access to the system will be denied and an error message will appear.

Figure 5.4 Client registration verification form

Furthermore, if the user does not fill all the required fields for example on the registration platform, the system will then notify the user to fill in the required fields. Thus the system user will only proceed if all the fields are filled thereby ensuring data integrity. If, for instance, the user enters an invalid email the system should let the user know that the email address entered is invalid.

Fig 5.5 Client Validation form

Thus when the user enters data into the system, the system should validate the data by notifying the user if the data inserted is invalid and will not perform the user request unless the user makes required correction thereby guaranteeing data security, for instance, when login details are incorrect, the system will not permit the user access to the account and an error message will be shown for instance “password do not match”.

5.3.3 White Box Test

(Sommerville, 2004) the white box test outlines the actual system organization as well as the source code procedures. Thus this method is mainly concerned about the inner features of the new system. The research team used the step by step technique when monitoring the system performance in white box testing and the results were obtained at each phase and every single code segment was validated. This phase gives an in-depth analysis of the interior features of the system thus the system source code.

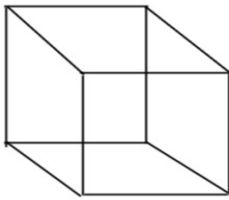


Fig 5.6 White Box

5.3.4 Black Box Test

Unlike the white box the black box method is mainly anxious about the way the system operates as well as its functions without concern to the inner features of the system (Godfrey, 1999). The researchers obtained this by testing if the system is operating as they intend and indeed the system met the stated objectives. This, however, guaranteed the research team of data consistence of the system as the system met its requirements.



Fig 5.7 Black Box

5.3.5 Integration Test

This test is an arranged method of building up the structure of a project whilst steering tests that audit defaults which are associated with interface (Gupta, 2008). The tried modules are combined into systems segments that make it simpler to mark or distinguish blunders. Integration testing target was to guarantee that no mistakes happen when the integrating the modules. This method is repeated to a point where the errors a clear in the code and when modules incorporate superbly.

5.3.5 System Test

The system test began keeping in mind the end goal to confirm if the complete scheme was working as expected and if these modules can chip in. As indicated by Dubois, Jolibort and Muhlbacher (2007) a complete testing of the whole system is done at system testing. Furthermore, system testing is done after the unification of the subsystem to end up one significant system. System testing goes for distinguishing mistakes linked with the subsystems collaboration process which are well on the way to contrarily influence the smooth running of the framework (Bookshear, 2012).

5.3.5.2 Beta testing

Beta testing advises clients in instances where the inputs are not valid. Beta testing makes utilization of the information conveyed by the clients thus beta testing is viewed as an outside client acknowledgment testing and is done after the alpha testing Hughes et al, (2002). Moreso, information acceptance by the system is displayed in beta testing.

5.3.6 Acceptance Test

The usefulness of the system is tried in acknowledgment testing by the clients of the system McWatters, Zimmerman and Morse (2010). Acceptance testing is normally done final in testing and the final users will subsequently complete the test being more worried about the system functionality (Gupta, 2008), so the system was given to the end clients to assess the system usefulness. This testing phase comprises of beta and alpha testing in reliance with the examinations of information. It is revealed that acceptance test gives vital answers to the already obscured mistakes, which were not really perceived in the before tests (Hoffer, 2003).

5.4 Installation

A movement from the present system to the proposed system is included in this establishment stage (Kendall and Kendall, 2011). Installation is a procedure in which the finished programming will be executed in nature it was worked to work in (Sommerville, 2004). Installation is vital to guarantee that an exact record of client data is kept in the proposed system database. However, the new system has successfully met the stated objectives hence various activities on framework changeover were talked about underneath.

5.4.1 System Changeover

System Changeover is a process of moving from the older system to the new system (Gupta, 2008). This change over method is an unpredictable one since it likewise holds the achievement

and disappointment of the undertaking subsequent to the changeover methodologies affect how the end clients will acknowledge the new system. ZETDC stakeholders were curious about this phase as it accords time for the sharing of ideas on system changeovers and these includes phase changeover, direct, pilot and parallel.

5.4.1.1 Direct changeover

System changeover is the procedure of ending the whole current system at the same time and in a flash actualizing the new system Morgan (2012). On system changeover a date is generally set where the present system will end and the date, when the new system is presented thus the dates are normally set on convenient days where there very few disturbances of organizational operations, for example, on holidays. This strategy comes up with the following advantages and disadvantages

Advantages of Direct Changeover

- Reduced execution time prompting quick conveyance of the system.
- It is likewise connected with low transformation and working expenses
- A solitary system will be running at a specified time, therefore there will be low linked expenses.
- A short timeframe range for a complete system changeover is needed.

Disadvantages of Direct Changeover

- High levels of risk and very expensive model if the framework comes up short.
- Denial of the new system by end clients.
- Disruption of work on changeover process.

5.4.1.2 Parallel conversion

Parallel change includes a simultaneous utilization of both the old and new system with the goal of seeing if the new system executes as expected (Schwalbe, 2008). Both systems will be preparing and executing the same occupation or assignment. At the point when the usage of the new systems is regarded a win, then the old framework is deserted and the new framework assumes control over the employment completely. This strategy comes up with the following merits and demerits

Merits of parallel conversion

- The penalties of the new system are confirmed.
- The old system reinforcement part makes it secure to utilize.

- This conversion can be utilized as a stage for assessment and criticism

Demerits of parallel conversion

- It is unreasonable to run two frameworks simultaneously.
- Takes a more time range before a complete change is made.
- There is likelihood of puzzlement to clients when utilizing the two systems in the meantime.
- There will be an increase in workload

5.4.1.3 Phased conversion

Phased change is the release of another system in stages Hughes et al (2005). On the off chance that one stage is effective then the execution of the following stage starts, this in the end leads to the last stages when the old system will be completely substituted with the new system. These are some of points of interest and detriments of this technique.

Advantages of phased conversion

- The danger is stuck just on a solitary module thus if there should be an occurrence of any issues, just a single range will be influenced. Associated with less expenses in relationship with the immediate transformation.

Disadvantages of phased conversion

- Longer time range is required before a complete transformation is made hence time consuming.
- Associating the new system module with the present system might be unrealistic.

5.4.1.4 Pilot conversion

This phase includes initiating the new system with just a set number of clients, more often than not a solitary division whilst different offices are as yet making utilization of the present system (Pressman 2011). The new system is submitted to a fraction of ZETDC which is also identified as pilot location, this location will give input on the usefulness or execution of the new system to the undertaking group and this give the venture group the chance to adjust any faults that might be uncovered. However, the pilot site has been a success leading to the implementation of the system to ZETDC. The strength and loopholes of this approach are:

Advantages of pilot conversion

- On account of the system disappointment, the entire association won't be influenced.
- The association will accustom with the system since the change is progressive.

- Associated with a lesser hazard than the immediate conversion strategy.
- Less expensive when evaluated with parallel conversion.

Disadvantages of pilot conversion

- There is the likelihood that the system can execute magnificently on the pilot then comes with failures in organization.
- It is time consuming.

Changeover Decision

The development team preferred to use the phased conversion since it has proved to be less costly than other strategies thereby it is in line with the overall organizational goal which is cost minimization so ZETDC executive agrees over the use of the phased conversion in system implementation(GIS).

5.4.2 User Training

User training is of great importance to ZETDC since it enables familiarization of all the system entities to the new system on the system functionality thus on how the system works and how they will work with the system to avoid dilemmas brought about by the use of new system. Training of users also grant the system users knowledge about the system and security to their job since they will be recognized as part of the organization because of user involvement in the system which will reduce the chances of resistance to the developed system. User training was conducted very well at ZETDC for the new system since the users felt part and parcel of the organization.

5.5 Maintenance

Maintenance is a continuous procedure which is performed on regular basis with the intention to satisfy that the new system executed is working legitimately is as yet fulfilling the necessities details it was worked for (Sommerville, 2004). Formerly the system has been executed; certain redesigns are done on the system programming with the goal of enhancing its execution and making it to conform to the steadily evolving environment. Since client necessities are always showing signs of change, conservation is a continuous procedure. The types of maintenance comprise of adaptive, preventative and corrective.

5.5.1 Corrective Maintenance

This phase is about giving answers for the system mistakes brought about when the system is underutilization which is typically the smashing of the system program Valacich (2002). Standard examination should be carried out to continue recognizing bugs and making remedial move to correct them.

5.5.2 Preventive Maintenance

Preventative maintenance is a measure to curb system failures when executing the suggested tasks. This sort of support does not sit tight for blunders to happen but rather it expects mistakes that may happen before they truly happen and a precaution move is made to keep these blunders from happening (Stephanidis, 2003). Commonly, the preventative maintenance is about making upgrades on the system directive and the formats of the interfaces of the system.

5.5.3 Adaptive Maintenance

This technique helps the developed system to comply with the changes in the operating environment (Sommerville, 2004). Adaptive maintenance occurs when the system can adapt to changed system hardware and software, for example, if the system can operate on a hp 64 bit 8 gig ram with a windows software and can as well perform the same functions on a dell 32 bit 2 gig ram using Linux software. In case of the developed system for ZETDC it adapts to the changes in the operating environment.

5.5.4 System Backup

System backup is of paramount importance since in cases of system tragedy which may cause the loss of the entire system it will recover the loss of the system (Gupta, 2008). ZETDC considers the possible data losses and made use of the external hard drives as well as online drives such as Google drive to secure their source code. The system database also requires backup which was done on a weekly basis. The geographical information system for ZETDC was backed up in such a way that the secured data should be readily available and therefore retrieved quickly. However, system backup was a duty to be performed only by the administrator.

5.6 Recommendations and future work

- For smooth operation of the system, they were recommendations which were identified to be beneficial and they include the following.

- For the smooth functioning of the geographical information system for ZETDC the organization should consider training of both the users of the system as this will help them to use the system as required thereby making the system user-friendly and developers as well to make possible upgrades and amendments of the system.
- The system should also be designed in such a way that all the possible upgrades to be done will not affect user operations.
- In addition the system should provide a manual guide facility for its users thus aiding them on the general uses of the system.
- The system developers should regularly maintain the system to allow the smooth functioning of the system.

5.7 Objective Evaluation

The objective evaluation is of paramount importance since it allows the research team to compare the developed system to the proposed system objectives through the process of calibration and validation of the developed system. Therefore, it has been an incredible delight since all the objectives have been met as expected thus the first objective was to report transformer faults and stores records for future references. Furthermore, the other objective is to give geographical coordinates of the transformer thus locating the transformer on the map view. In addition, the system also records time taken to attend to faults helping in coming up with over payments. To be more precisely, the system also provides a chat platform for customers to report faults.

Objective 1: Stores fault records for future references

The figure below shows the job that should be attended by the assigned worker to carry out the task. Furthermore it also highlights the transformer number and the location of the transformer to enable the users to attend faults quickly.

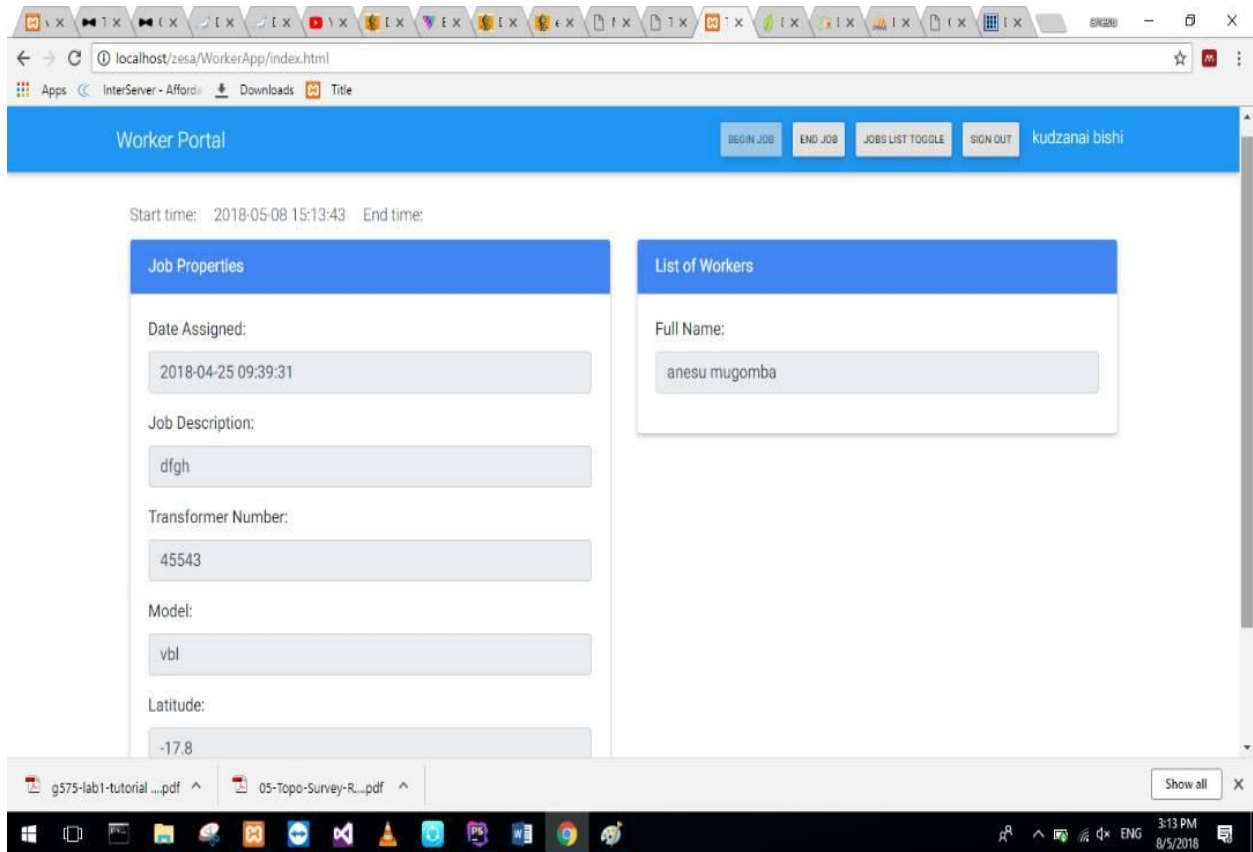


Fig 5.3 Job properties

Objective 2: Gives geographical co-ordinates of the transformer

The GIS system for ZETDC comes with the map view which enables the electrical engineers to see the location of the faults.

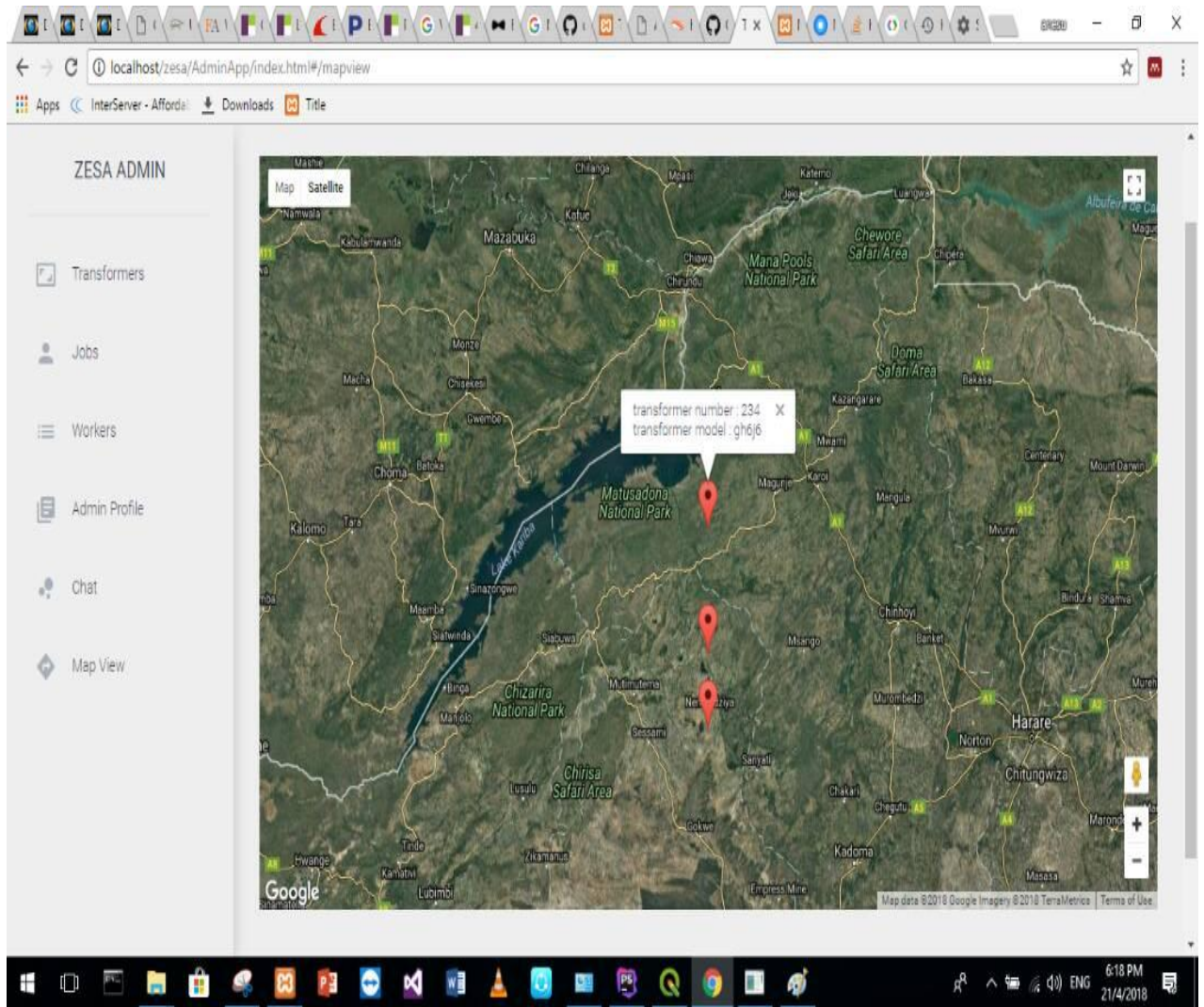


Fig 5.4 Map view of the GIS system

Objective 3: Record time taken to attend to faults

It records time taken by the employees in resolving a fault which will then help management in coming up with in coming up with overpayments.

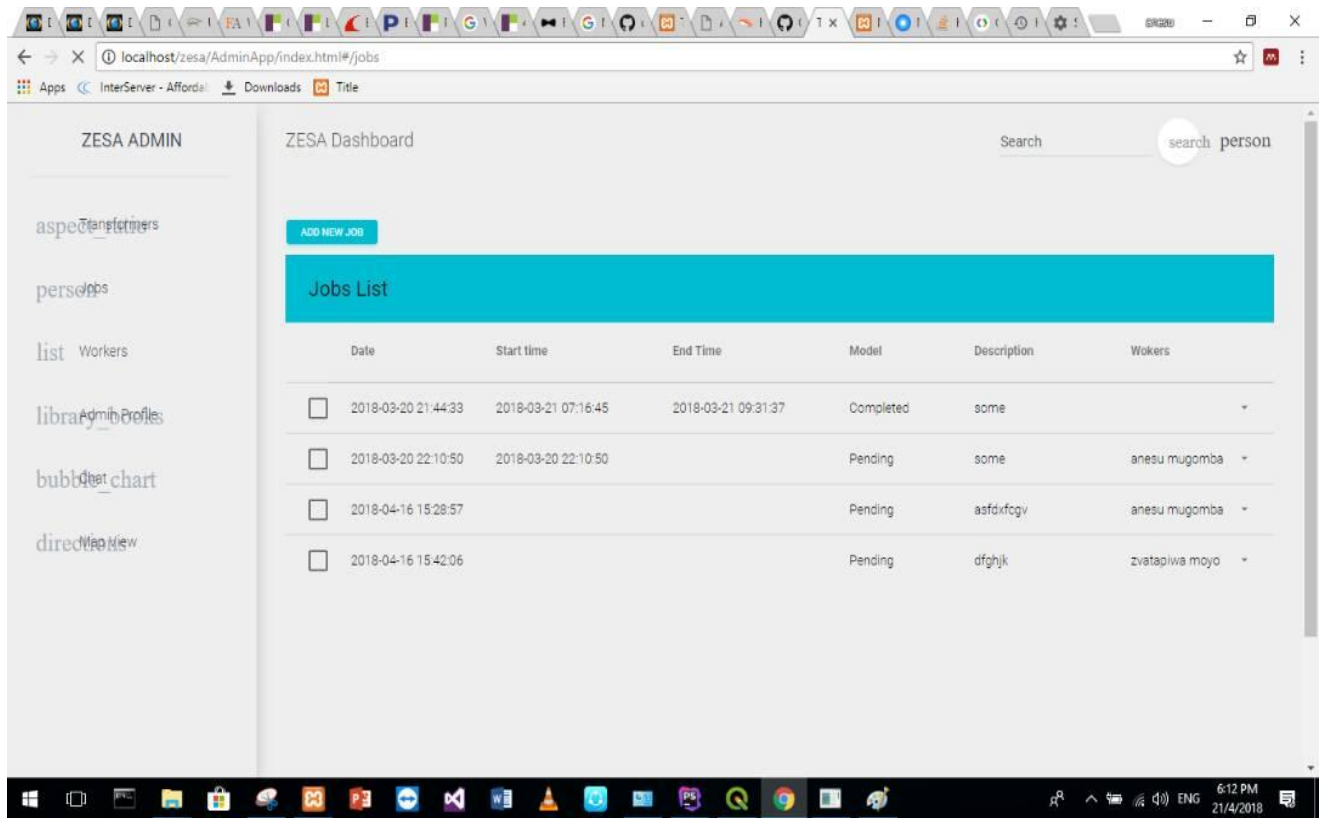


Fig 5.5 time recorded

Objective 4: Provide a chat platform for customers to report faults

It provide a forum where everyone can sign in by using their nickname and email address whereby the clients can log their queries and comments to ZETDC workers.

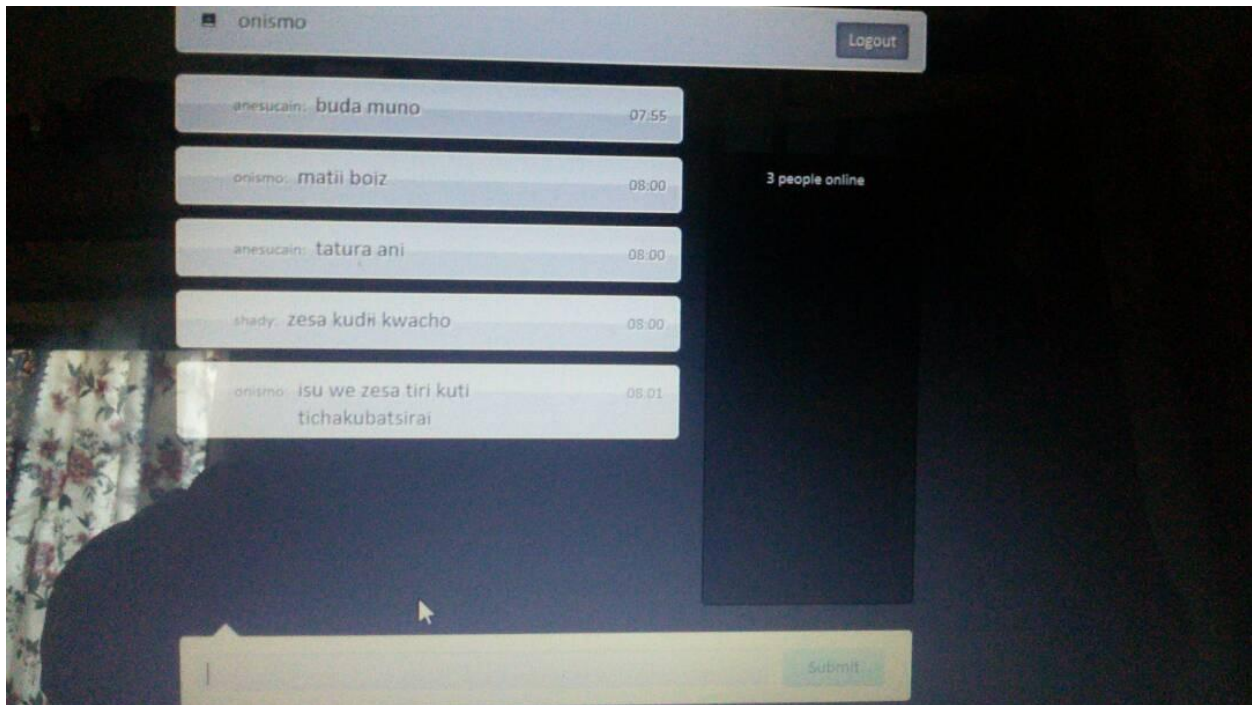


Fig 5.6 Chat forum for the clients and employees

5.8 Conclusion

To sum up, the proposed system brings light to ZETDC as this ties the organization's relations with its clients since it made it easier for both employees and clients to cooperate through the facility of fault reporting which brought better understanding to all system users thereby lowering the levels of faults. The system was significantly treasured by the organization since it tackled all the obstacles which were currently being faced by ZETDC.

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APPENDICES

APPENDIX A

USER MANUAL

The Geographical information system (GIS) is a professional that comes up with remote sensing which is viewed as an essential tool for data capturing and real time monitoring. The system permits users to send their fault reports and complains from wherever they are. Furthermore, the system helps management in calculating overtime since it record the begin time and end time of given task.

TECHNOLOGY

The GIS system was developed using following technology:

Micro-media Dreamweaver for interface design

Xampp sever for database management system.

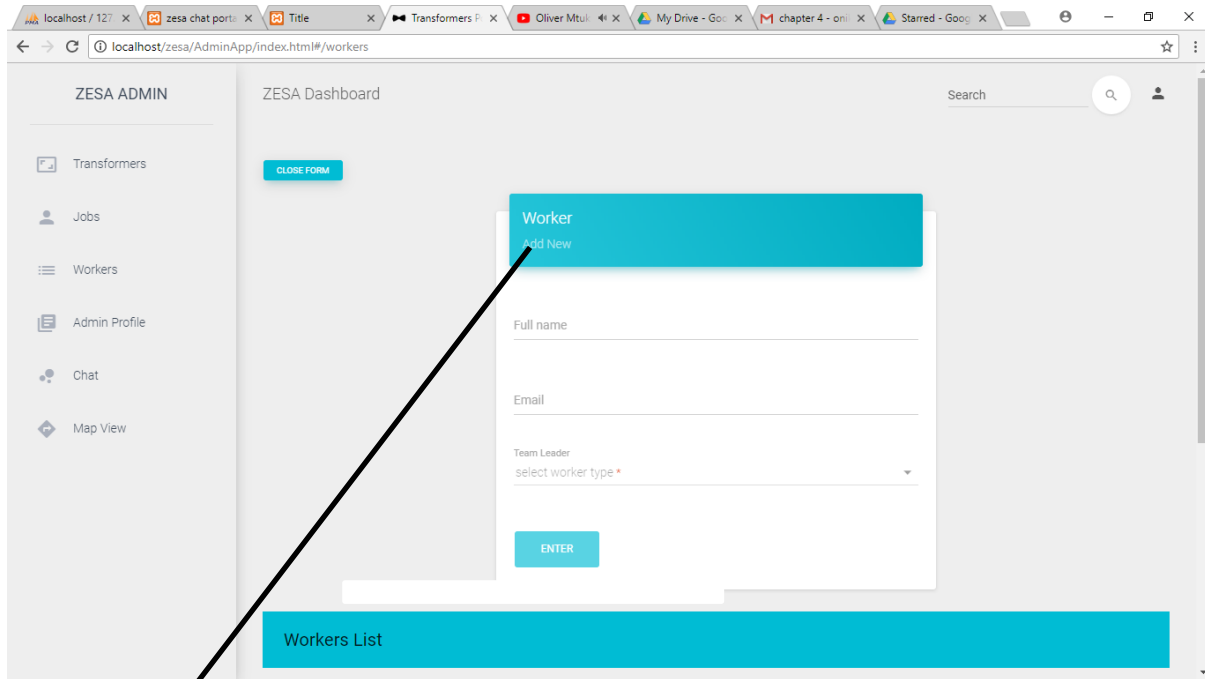
GETTING STARTED

When the user enters the organisation link on the url he will be directed to the home page as highlighted

FIG A1 ADMIN HOME PAGE



FIG A2: ADD USER



ADD USER

Thus the system permits the system admin to add the users to the system thus giving them their roles thus whether it is a Leader or a General hand.

FIG A3: DELETE USER

The system administrator can as well delete user from the workers

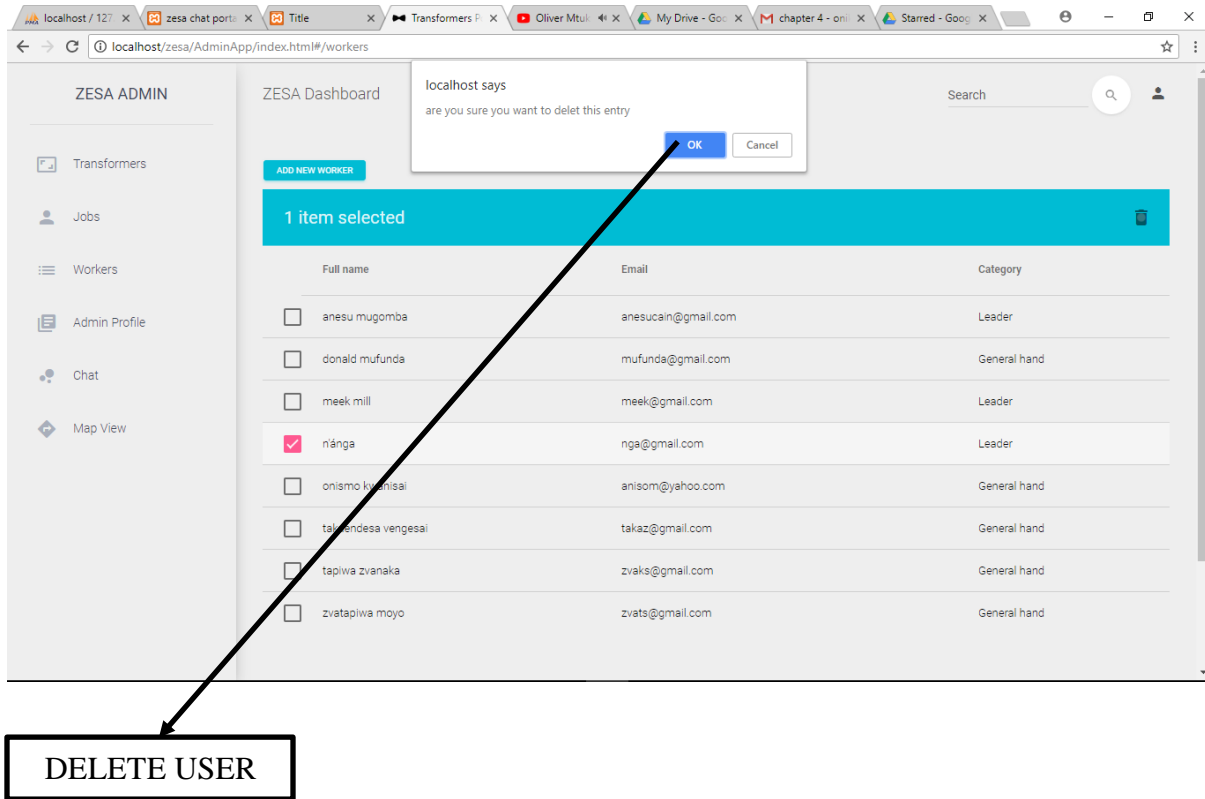


FIG A4: ADD TRANSFORMER

The administrator can also add a new transformer and giving it the actual coordinates so that it will be located on the map.

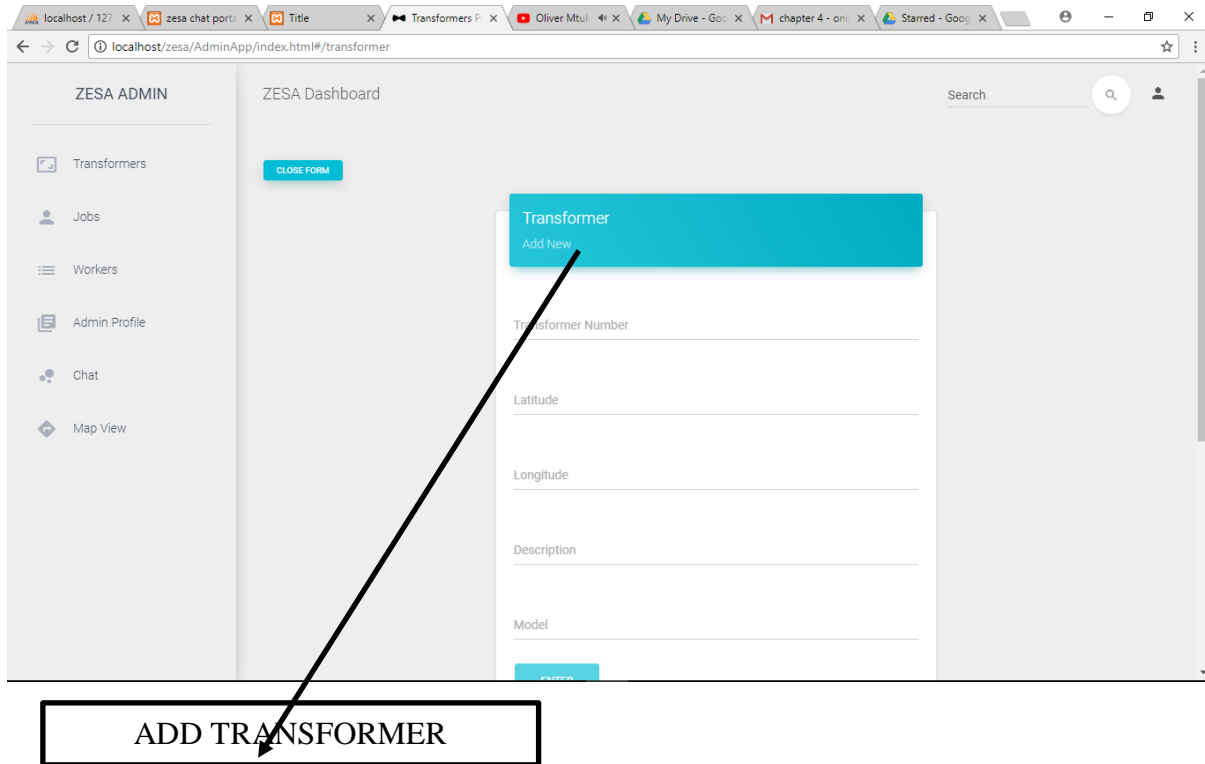


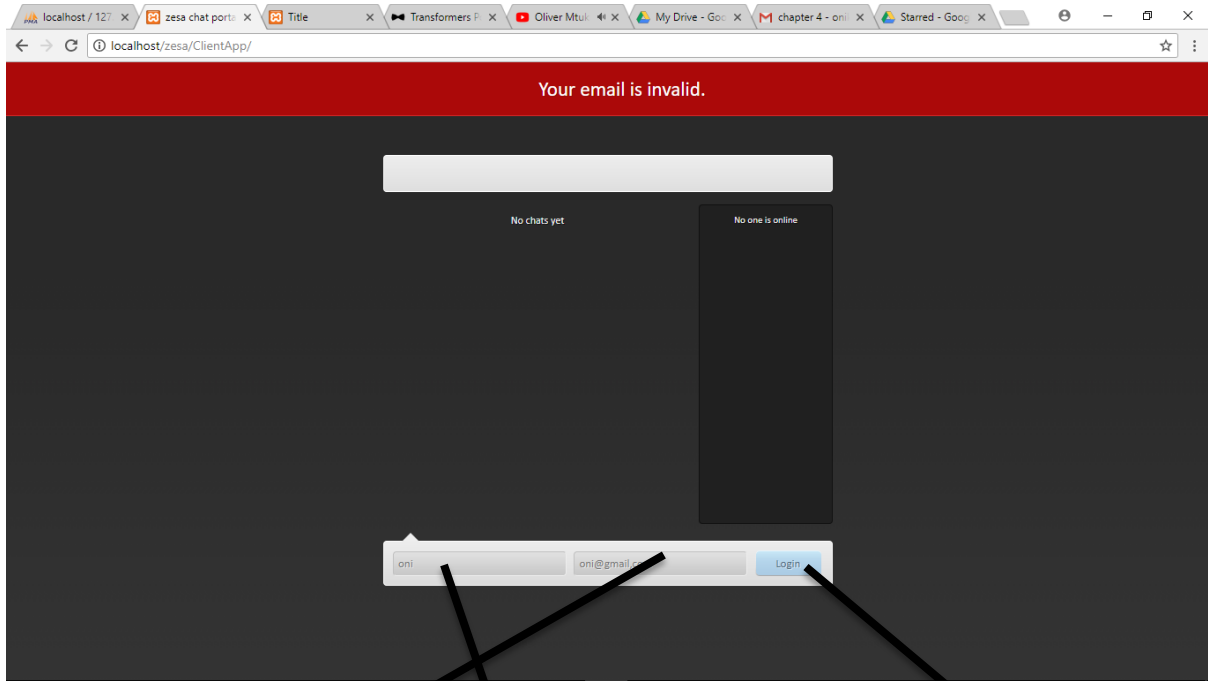
FIG A5: ADD TRANSFORMER DETAILS

1. Transformer number – Enter transformer number.
2. Latitude – Enter the latitude coordinates.
3. Longitude – Enter the longitude coordinates
4. Description – Give your transformer a suitable name.
5. Model – Enter transformer model number.

HOW TO REPORT AN ELECTRIC FAULT

The users that have experienced a fault and are willing to inform the ZETDC staff to attend should follow the given steps

FOLLOW THE GIVEN STEPS BELOW



ENTER A VALID EMAIL

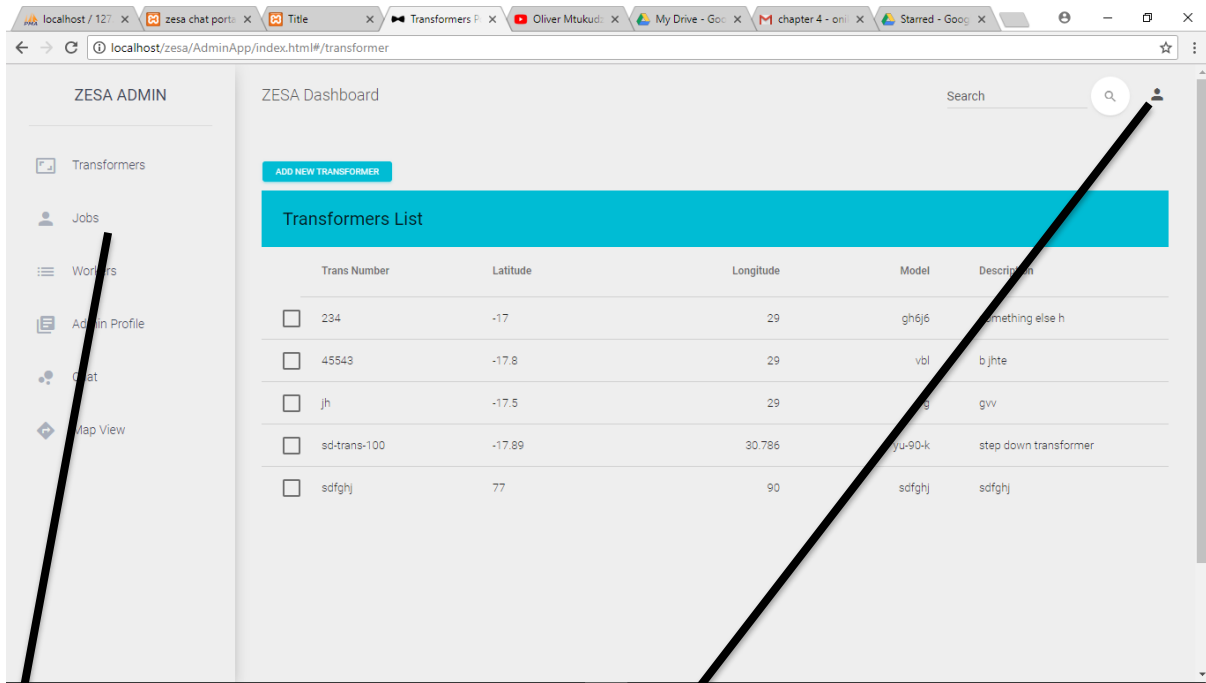
ENTER SUGGESTED NICKNAME

LOGIN

The customers should search the ZETDC chart portal on a browser and enter a nickname and a valid email so as to allow the

FIG A6 ADMINISTRATOR'S HOMEPAGE

After successful login of the administrator he/she will be directed to the administrator's home page.

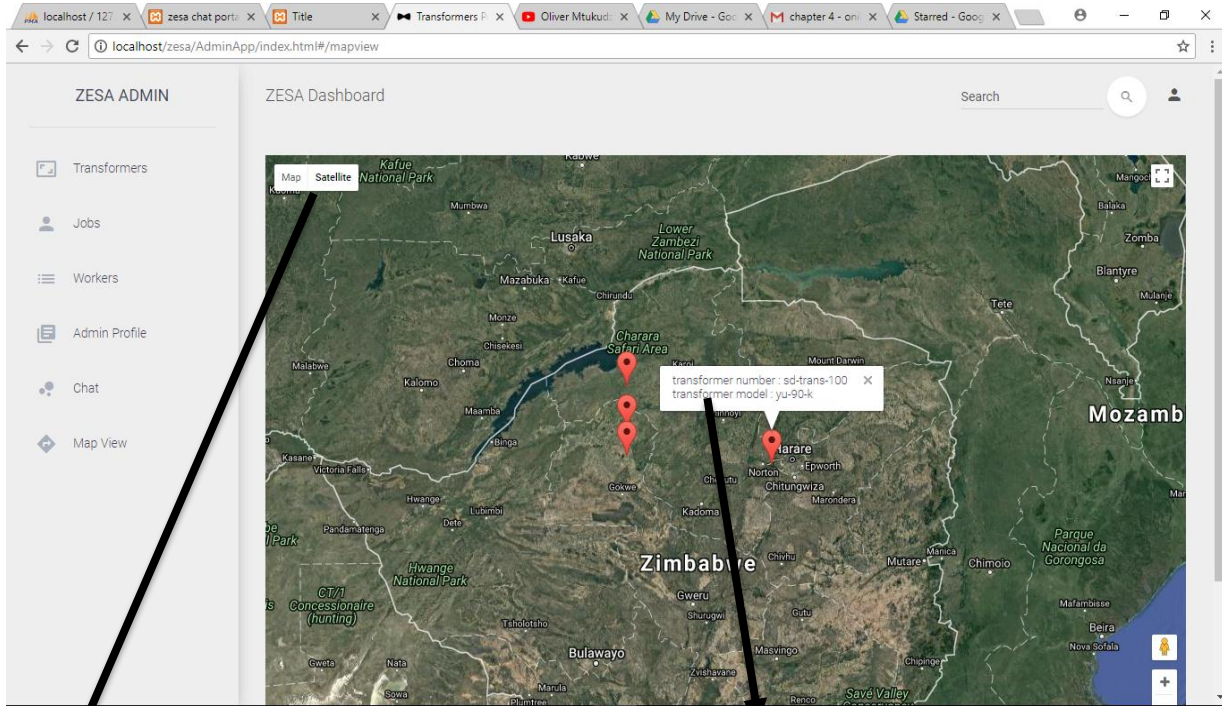


ADMIN ROLES

CLICK TO

FIG A7: MAP OVERVIEW

The map overview



Change from map view to satellite

Transformer location

3. What are your areas of concern on the current system?
4. What do you think needs to be improved on the current system?
5. What do you expect from the proposed system?
6. How is the new system going to be of support to you as an employee?
7. Are you in support of the introduction of the proposed system?
8. What Problems are likely to arise after the implementation of the new system?

THANK YOU FOR YOUR CO-OPERATION

APPENDIX C

INTERVIEW TRANSCRIPT

The following is an extract of the questions that were asked during the interviews conducted during data gathering activity.

1. Manager

Q1. Do you think the current system is efficient and does it support your business goals?

Q2. Have you ever experienced any inconveniencing problems with the current system?

Q3. Do you have any suggestions on how we can solve the problems being experienced?

2. Employee (User)

Q1. Do you enjoy working with the current system and if so what are its strengths?

Q2. Do you have busy days or work over time when you have a large number of clients?

Q3. How do you take the idea of a production modelling system as a way of migrating from the current problems?

Q4. Have you ever talked with your management about problems that are being brought by the current system?

APPENDIX D

Code Section

Worker's code

```
(function () {
  var app = angular.module("AdminApp");

  app.controller("workerCtrl",function ($scope,svcAdmin,$route,$mdEditDialog,$document) {
    $scope.options = {
      rowSelection: true,
      /* multiSelect: true,*/
      autoSelect: true,
      decapitate: false,
      largeEditDialog: false,
      boundaryLinks: false,
      limitSelect: true,
      pageSelect: true
    };

    $scope.selected = [];

    $scope.worker = {};
    $scope.addNewWorker = false;
    $scope.text = "Add New Worker";

    $scope.toggleAddNewWorker = function () {
      if($scope.addNewWorker === true){
        $scope.addNewWorker = false;
        $scope.text = "Add New Worker";
      }else {
        $scope.addNewWorker = true;
        $scope.text = "Close Form";
      }
    };

    $scope.query = {
      order: 'name',
      limit: 100,
      page: 1
    };

    $scope.addWorkerType = function (i) {

      switch (i){
```

```

    case 0:
        $scope.isLeaderOrNot = false;
        break;

    case 1:
        $scope.isLeaderOrNot = true;
        break;
    }
    $scope.workerType = i;
}

svcAdmin.getAllWorkers("").then(function (d) {
    console.log(d);
    $scope.workers = d;
});

$scope.submitForm = function (isValid) {
    if(isValid){

        switch ($scope.workerType){
            case 0:

                svcAdmin.addWorker($scope.worker.fullname,$scope.worker.email,$scope.workerType).then(f
                unction (d) {
                    $route.reload();
                });
                break;
            case 1:

                svcAdmin.addLeader($scope.worker.fullname,$scope.worker.email,$scope.worker.username,$sc
                ope.worker.password,$scope.workerType).then(function (d) {
                    $route.reload();
                });
                break;
        }
    }
};

$scope.delete = function () {

    var r = confirm("are you sure you want to delet this entry");

    if(r){
        svcAdmin.deleteWorker(parseInt($scope.selected[0].id)).then(function (d) {

```

```

        $route.reload();
    })
    }else {}

};

$document.ready(function () {
    var lastValue = "";
    $("#searchbox").on('change keyup paste mouseup', function() {
        if ($(this).val() != lastValue) {
            lastValue = $(this).val();

            console.log($(this).val());

            svcAdmin.getAllWorkers($(this).val().trim()).then(function (d) {
                console.log(d);
                $scope.workers = d;
            });
        }
    });
});

$scope.editName = function (event, dessert) {
    event.stopPropagation();

    var dialog = {
        // messages: {
        //   test: 'I don\'t like tests!'
        // },
        modelValue: dessert.fullname,
        placeholder: 'Add a description',
        save: function (input) {

            dessert.fullname = input.$modelValue;

            if(dessert.fullname.trim() === ""){
                alert("name cannot be empty");
                $route.reload();
            }else{
                svcAdmin.editWorker(dessert.fullname,dessert.email,dessert.id).then(function (d)
            {
                $route.reload();
            }

```

```

    });
  }

  /**/

  },
  targetEvent: event,
  title: 'Add a comment',
  validators: {
    'md-maxlength': 500
  }
};

var promise = $scope.options.largeEditDialog ? $mdEditDialog.large(dialog) :
$mdEditDialog.small(dialog);

promise.then(function (ctrl) {
  var input = ctrl.getInput();

  input.$viewChangeListeners.push(function () {
    input.$setValidity('test', input.$modelValue !== 'test');
  });
});

$scope.editEmail = function (event, dessert) {
  event.stopPropagation();

  var dialog = {
    // messages: {
    //   test: 'I don\'t like tests!'
    // },
    modelValue: dessert.email,
    placeholder: 'Add a description',
    save: function (input) {

      dessert.email = input.$modelValue;

      if(dessert.email.trim() === ""){
        alert("email cannot be empty");
        $route.reload();
      }else{
        svcAdmin.editWorker(dessert.fullname,dessert.email,dessert.id).then(function (d)
{
          $route.reload();

```

```

        })
    }

    },
    targetEvent: event,
    title: 'Add a comment',
    validators: {
        'md-maxlength': 500
    }
};

var promise = $scope.options.largeEditDialog ? $mdEditDialog.large(dialog) :
$mdEditDialog.small(dialog);

promise.then(function (ctrl) {
    var input = ctrl.getInput();

    input.$viewChangeListeners.push(function () {
        input.$setValidity('test', input.$modelValue !== 'test');
    });
});
});
}());

```

Map code

```

(function () {

    var app = angular.module("AdminApp");

    app.controller('mapCtrl',function ($scope,uiGmapGoogleMapApi,svcAdmin) {

        $scope.map = {
            center: {
                latitude: -17,
                longitude: 29
            },
            zoom: 6
        },markersEvents: {
            click: function(marker, eventName, model) {

```

```

        $scope.map.window.model = model;
        $scope.map.window.show = true;
    }
},
window: {
    marker: {},
    show: false,
    closeClick: function() {
        this.show = false;
    },
    options: {}
}
};

$scope.onClick = function(marker, eventName, model) {
    console.log(model);
    model.show = !model.show;
    //model.options.labelContent = "Dragged lat: " + model.latitude + " lon: " +
model.longitude;
};

$scope.options = {
    scrollwheel: true
};

uiGmapGoogleMapApi.then(function (maps) {
    // offset to fit the custom icon
    $scope.map.window.options.pixelOffset = new google.maps.Size(0, -35, 'px', 'px');
});

var markers = [];

svcAdmin.getAllTransformers().then(function (data) {
    console.log(data);
    for(var j = 0; j < Object.keys(data).length; j++){
        markers.push( { id:data[j].id,
            latitude:data[j].x_coord,
            longitude:data[j].y_coord,
            transformer_number:data[j].transformer_number,
            model:data[j].model
        });
    }
})
/* markers.push({ "id":1,latitude:40,longitude:-99});

```

```

        markers.push({"id":2,latitude:41,longitude:-98});*/

    $scope.randomMarkers = markers;
});

app.controller('templateController',function(){});
}());

```

Admin sign-in code

```

(function () {
    var app = angular.module("AdminApp");

    app.controller("signInCtrl",function ($scope,svcAdmin,$rootScope) {

        $scope.user = {};
        $scope.errorMessage = "";

        $scope.submitForm = function(isValid){

            if(isValid){

                svcAdmin.adminSignIn($scope.user.username,$scope.user.password).then(function(d){
                    if(d != "null"){
                        $rootScope.isLoggedIn = true;
                        window.location.href = "index.html";
                    }else{
                        $scope.errorMessage = "Invalid Credentials";
                    }
                });
            }
        }

    }
}

```

```

$scope.signOut = function () {
    svcAdmin.signOut().then(function (d) {
        window.location = "signIn.html";
    });
}
})();

```

Chat code

```

$(document).ready(function(){

    // Run the init method on document ready:
    chat.init();

});

var chat = {

    // data holds variables for use in the class:

    data : {
        lastID      : 0,
        noActivity  : 0
    },

    // Init binds event listeners and sets up timers:

    init : function(){

        // Using the defaultText jQuery plugin, included at the bottom:
        $('#name').defaultText('Nickname');
        $('#email').defaultText('Email (Gravatars are Enabled)');
    }
};

```



```
// Converting the #chatLineHolder div into a jScrollPane,  
// and saving the plugin's API in chat.data:
```

```
chat.data.jspAPI = $('#chatLineHolder').jScrollPane({  
    verticalDragMinHeight: 12,  
    verticalDragMaxHeight: 12  
}).data('jsp');
```

```
// We use the working variable to prevent  
// multiple form submissions:
```

```
var working = false;
```

```
// Logging a person in the chat:
```

```
$('#loginForm').submit(function(){  
  
    if(working) return false;  
    working = true;  
  
    // Using our tzPOST wrapper function  
    // (defined in the bottom):  
  
    $.tzPOST('login',$($.this).serialize(),function(r){  
        working = false;  
  
        if(r.error){  
            chat.displayError(r.error);  
        }  
        else chat.login(r.name,r.gravatar);  
    });  
});
```

```

    });

    return false;
});

// Submitting a new chat entry:

$('#submitForm').submit(function(){

    var text = $('#chatText').val();

    if(text.length == 0){
        return false;
    }

    if(working) return false;
    working = true;

    // Assigning a temporary ID to the chat:
    var tempID = 't'+Math.round(Math.random()*1000000),
        params = {
            id            : tempID,
            author        : chat.data.name,
            gravatar      : chat.data.gravatar,
            text          :
text.replace(/</g,'&lt;').replace(/>/g,'&gt;')
        };

    // Using our addChatLine method to add the chat
    // to the screen immediately, without waiting for
    // the AJAX request to complete:

```

```

chat.addChatLine($.extend({},params));

// Using our tzPOST wrapper method to send the chat
// via a POST AJAX request:

$.tzPOST('submitChat',$($.this).serialize(),function(r){
    working = false;

    $('#chatText').val("");
    $('#div.chat-'+tempID).remove();

    params['id'] = r.insertID;
    chat.addChatLine($.extend({},params));
});

return false;
});

// Logging the user out:

$('a.logoutButton').live('click',function(){

    $('#chatTopBar > span').fadeOut(function(){
        $(this).remove();
    });

    $('#submitForm').fadeOut(function(){
        $('#loginForm').fadeIn();
    });
});

```

```

        $.tzPOST('logout');

        return false;
    });

    // Checking whether the user is already logged (browser refresh)

    $.tzGET('checkLogged',function(r){
        if(r.logged){
            chat.login(r.loggedAs.name,r.loggedAs.gravatar);
        }
    });

    // Self executing timeout functions

    (function getChatsTimeoutFunction(){
        chat.getChats(getChatsTimeoutFunction);
    })();

    (function getUsersTimeoutFunction(){
        chat.getUsers(getUsersTimeoutFunction);
    })();

    },

    // The login method hides displays the
    // user's login data and shows the submit form

    login : function(name,gravatar){

        chat.data.name = name;

```

```

chat.data.gravatar = gravatar;
$('#chatTopBar').html(chat.render('loginTopBar',chat.data));

$('#loginForm').fadeOut(function(){
    $('#submitForm').fadeIn();
    $('#chatText').focus();
});

},

// The render method generates the HTML markup
// that is needed by the other methods:

render : function(template,params){

    var arr = [];
    switch(template){
        case 'loginTopBar':
            arr = [
                '<span>',
                '<span class="name">',params.name,
                '</span><a href="" class="logoutButton
rounded">Logout</a></span>'];
            break;

        case 'chatLine':
            arr = [
                '<div class="chat chat-',params.id,' rounded"><span
class="gravatar">','</span><span
class="author">',params.author,
                                ';</span><span
class="text">',params.text,'</span><span class="time">',params.time,'</span></div>'];
                                break;

                                case 'user':
                                        arr = [
                                                '<div class="user" title="',params.name,'"><img
src="",
                                                params.gravatar,'" width="30" height="30"
onload="this.style.visibility=\`visible\` /></div>'
                                        ];
                                break;
                                }

                                // A single array join is faster than
                                // multiple concatenations

                                return arr.join("");

                                },

                                // The addChatLine method ads a chat entry to the page

                                addChatLine : function(params){

                                        // All times are displayed in the user's timezone

                                        var d = new Date();

```

```

if(params.time) {

    // PHP returns the time in UTC (GMT). We use it to feed the date
    // object and later output it in the user's timezone. JavaScript
    // internally converts it for us.

    d.setUTCHours(params.time.hours,params.time.minutes);
}

params.time = (d.getHours() < 10 ? '0' : " ") + d.getHours()+':' +
              (d.getMinutes() < 10 ? '0':" ") + d.getMinutes();

var markup = chat.render('chatLine',params),
    exists = $('#chatLineHolder .chat-'+params.id);

if(exists.length){
    exists.remove();
}

if(!chat.data.lastID){
    // If this is the first chat, remove the
    // paragraph saying there aren't any:

    $('#chatLineHolder p').remove();
}

// If this isn't a temporary chat:
if(params.id.toString().charAt(0) != 't'){
    var previous = $('#chatLineHolder .chat-'+(+params.id - 1));
    if(previous.length){
        previous.after(markup);
    }
}

```

```

        }
        else chat.data.jspAPI.getContentPane().append(markup);
    }
    else chat.data.jspAPI.getContentPane().append(markup);

    // As we added new content, we need to
    // reinitialise the jScrollPane plugin:

    chat.data.jspAPI.reinitialise();
    chat.data.jspAPI.scrollToBottom(true);

},

// This method requests the latest chats
// (since lastID), and adds them to the page.

getChats : function(callback){
    $.tzGET('getChats',{lastID: chat.data.lastID},function(r){

        for(var i=0;i<r.chats.length;i++){
            chat.addChatLine(r.chats[i]);
        }

        if(r.chats.length){
            chat.data.noActivity = 0;
            chat.data.lastID = r.chats[i-1].id;
        }
        else{
            // If no chats were received, increment
            // the noActivity counter.

```



```

        chat.data.noActivity++;
    }

    if(!chat.data.lastID){
        chat.data.jspAPI.getContentPane().html('<p
class="noChats">No chats yet</p>');
    }

    // Setting a timeout for the next request,
    // depending on the chat activity:

    var nextRequest = 1000;

    // 2 seconds
    if(chat.data.noActivity > 3){
        nextRequest = 2000;
    }

    if(chat.data.noActivity > 10){
        nextRequest = 5000;
    }

    // 15 seconds
    if(chat.data.noActivity > 20){
        nextRequest = 15000;
    }

    setTimeout(callback,nextRequest);
});
},

```

```

// Requesting a list with all the users.

getUsers : function(callback){
    $.tzGET('getUsers',function(r){

        var users = [];

        for(var i=0; i< r.users.length;i++){
            if(r.users[i]){
                users.push(chat.render('user',r.users[i]));
            }
        }

        var message = "";

        if(r.total<1){
            message = 'No one is online';
        }
        else {
            message = r.total+' '(r.total == 1 ? 'person':'people')+'
online';
        }

        users.push('<p class="count">'+message+'</p>');

        $('#chatUsers').html(users.join(""));

        setTimeout(callback,15000);
    });
},

```

// This method displays an error message on the top of the page:

```
displayError : function(msg){
    var elem = $('<div>',{
        id      : 'chatErrorMessage',
        html   : msg
    });

    elem.click(function(){
        $(this).fadeOut(function(){
            $(this).remove();
        });
    });

    setTimeout(function(){
        elem.click();
    },5000);

    elem.hide().appendTo('body').slideDown();
}
};

// Custom GET & POST wrappers:

$.tzPOST = function(action,data,callback){
    $.post('php/ajax.php?action='+action,data,callback,'json');
}

$.tzGET = function(action,data,callback){
    $.get('php/ajax.php?action='+action,data,callback,'json');
}
```

```
}
```

```
// A custom jQuery method for placeholder text:
```

```
$.fn.defaultText = function(value){  
  
    var element = this.eq(0);  
    element.data('defaultText', value);  
  
    element.focus(function(){  
        if(element.val() == value){  
            element.val('').removeClass('defaultText');  
        }  
    }).blur(function(){  
        if(element.val() == "" || element.val() == value){  
            element.addClass('defaultText').val(value);  
        }  
    });  
  
    return element.blur();  
}
```