

ZETDC INSPECT TO CONNECT MOBILE APPLICATION



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By

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ABSTRACT

The need to develop an Inspect to Connect Mobile Application (ZETDC ITC) was necessitated by the lack of a facility that was convenient in the operations of electrical inspection to the connection procedures. Clients had to incur expenses of travelling from one point to another for them to get inspection and connection services, despite having to travel long distances to ZETDC offices they also had to wait for hours in queues waiting to be attended to. Employees also ended up having burnout syndrome and fatigue due to working extra hours as well as writing some monotonous weekly and monthly reports. The development of the new system using android and PHP (for back end application) helped to curb the challenges faced by customers as well as the employees since most of the client electrical inspection and connection procedures are now done at the comfort of their homes and employees reports are now auto generated by the system. Data was gathered using interviews, observations and questionnaire as the data gathering methodologies with the intention of understanding the operations of the old system and identify problems that were being faced as well as determining the requirements and functionality that was being expected in the new system. Feasibility study was undertaken and the results permitted the project team to go to the next development procedure. Alternatives were evaluated on which way to develop the new system and in-house development was recommended since it was the best alternative among others. The system was installed using parallel changeover as the changeover strategy since this was considered safe enough to countermeasure the risks of data loss in case of a system failure. The project team decided to implement all the maintenance strategies since they considered them to serve different purposes. The new system should accommodate the use of USSD code for non-android users, as well as for the clients with internet access problems, for client fault reporting and purchase of ZETDC electricity tokens

DECLARATION

I, **Tsitsidzashe Makuni**, hereby declare that I am the sole author of this dissertation. I authorize the **Midlands State University** to lend this dissertation to other institutions or individuals for the purpose of scholarly research.

Signature: Date:

APPROVAL

This dissertation entitled **ZETDC Inspect to connect mobile application** by **Tsitsidzashe Makuni** meets the regulations governing the award of the Honours degree in Information Systems of the Midlands State University, and is approved for its contribution to knowledge and literal presentation.

Supervisor.....

Date.....

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DEDICATION

The research project is dedicated to my mom for her tireless support, motivation and affection throughout all my education.

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LIST OF ACRONYMS

ZETDC	Zimbabwe Electricity Transmission and Distribution Company
ITC	Inspect to Connect Mobile Application
CBA	Cost Benefit Analysis
I.T	Information Technology
DFD	Data Flow Diagram
EER	Enhanced Entity Relationship Diagram
MSU	Midlands State University
PHP	Hypertext Pre-processor
ROI	Return on Investment
USSD	Unstructured Supplementary Service Data

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CHAPTER 1: INTRODUCTION

1.1 Introduction

Zimbabwe Electricity Transmission and Distribution Company Inspect to Connect (ZETDC ITC) is a system that was new to take care of the issues that were being faced by ZETDC. These issues included high telephone bills and transport costs incurred by both the clients and company when inquiring about inspection, and connection procedures as well as informing clients on the readiness of their quotations respectively. ZETDC artisans/electricians are not allowed to do wiring for installation (tubing). Clients hire private electricians/artisans for the tubing exercise. Some private electricians did incorrect tubing, which led to inspection failures because they were ignorant of ZETDC requirements but the new system provides the client with the guidelines that they must show the private electrician they hire for the tubing exercise. Clients were travelling long distances to apply and pay for inspection and connection fees because there was no facility that enabled them to apply from where they were (remotely). The new system aims at improving the efficiency and convenience of ZETDC inspection and connection operations by providing a facility that enables clients to apply for electricity inspection and connection facility remotely. The new system also allows clients to receive their quotations and inspection results from wherever they are (remotely), make payments and upload payment proof on the mobile application for processing and is done by sending the cash using Ecocash, Telecash, Netone or RTGS then upload the payment proof using the mobile application. The client is now able to make inquiries and receive notifications or guidelines using the Inspect to Connect Mobile application thereby counter measuring the mentioned difficulties that were faced. The chapter comprises of the foundation of study, which shows the inspiration, and need of the research, gives an outline of the organisation's background, organisation structure, mission statement and vision, problem definition and objectives formulation. Software tools and information gathering techniques that were used in the development of ZETDC ITC are also defined in this chapter.

1.2 Background of study

The research focused on inspection and connection processes of electricity under the ZETDC. The researcher noted that due to high costs on telephone and transport some clients are resorting to other sources of energy resulting in the organisation losing potential customers that might lead to ZETDC having difficulties in meeting the set target of connecting 800 000 new clients by 2018.

The discovery inspired the researcher to request for a system that brings convenience to both the customer and the company thereby improving customer-company relationship, which is essential for a business to succeed.

1.2.1 Background of the organisation

ZETDC was incorporated under the companies Act of Zimbabwe in 1998 as a limited company, which is entirely owned by the Zimbabwe government. The main business is electricity transmission and distribution through the interconnected and off grid power supply systems as well as retailing services nationwide. The company handles large portfolio of electricity and civil works, projects of development, maintenance nature to meet electricity demand. According to www.zetdc.co.zw, the main activities of ZETDC include “maintenance of electricity networks, provision of safe power (electricity) to customers, plant maintenance, network development, meter reading, billing, attending faults, inspecting and new connections, transmission and grid asset management, bulk purchasing and bulk divisions of power from internal and external generation source”.

1.2.2 Vision

Gandlin (2014) states that a vision shows important primary goals of a company, it communicates these goals to employees and management in single sentence or short paragraph. ZETDC vision defines the purpose of ZETDC. It communicates the purpose and values as well as ZETDC's future (the position the company aspires to attain in the market). The vision of ZETDC reads:

"To be among the leading and most dynamic electricity and energy services providers".

1.2.3 Mission

It defines the primary objective of the company and justifies its existence (Gandlin, 2014). The main function is internal with the leadership team and stakeholders as its primary audience. Thus the mission statement can be referred to as the ultimate guide for ZETDC, source of motivation to organisational members and a source of identity for the company. ZETDC's mission statement reads:

"To bring convenience to our valued customers through provision of adequate, safe, reliable electricity and related services at competitive prices."

1.2.4 Organisational structure

An organisational structure is the route in which a firm has masterminded its lines of authority, communication, commitments and it likewise administrate how power and responsibility are conveyed and composed, and furthermore how information streams between different administrations levels (Borrington, 2013). The following organisational structure demonstrates how authority is passed and exercises are facilitated in order to accomplish organisation's objectives.

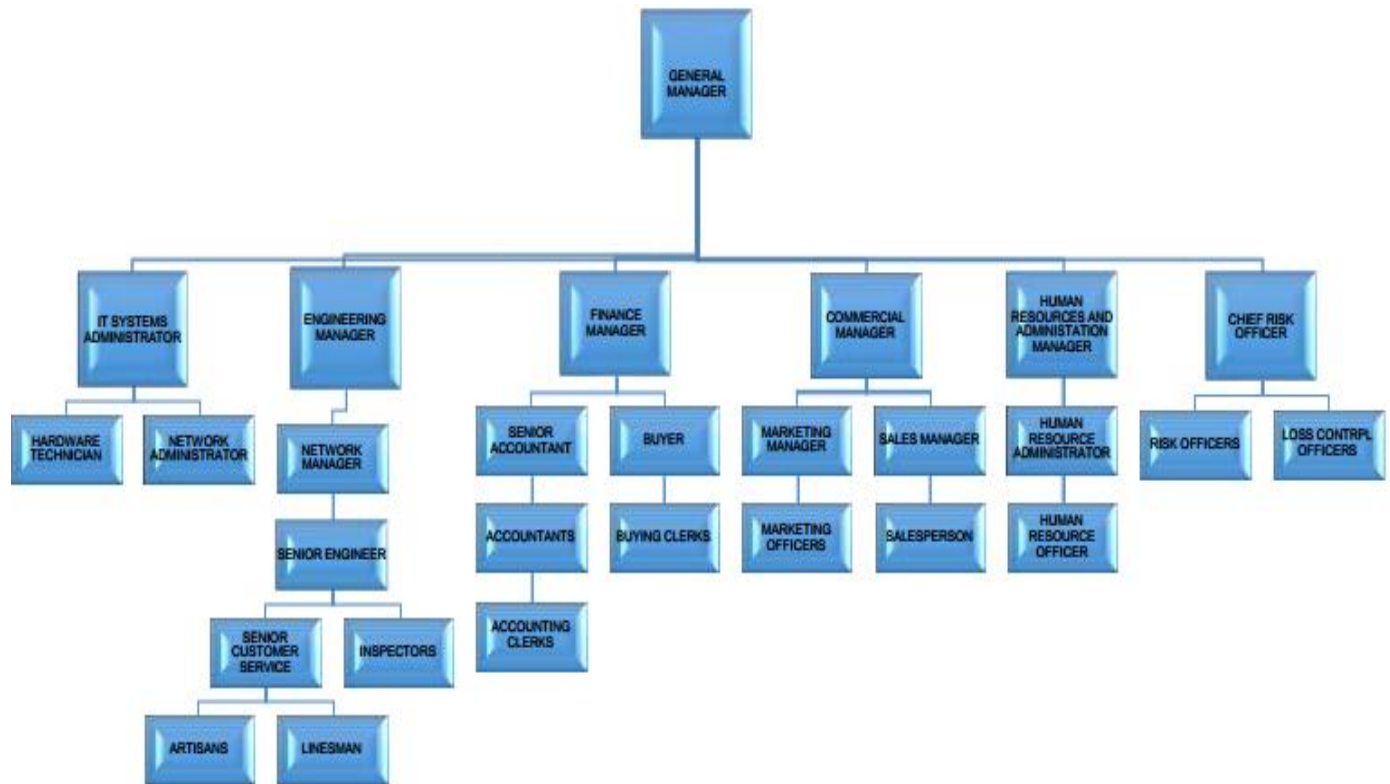


Figure 1.1 Organisational structure

1.3 Problems identified

These were the hitches encountered in the operations of the old system. During the organisation analysis, focusing on the house inspection after tubing (wiring for installation) for electricity connection, the researcher noted that:

Clients were complaining of high telephone charges they incur when inquiring about inspection requirements, how to apply. Remote clients complained of high transport

charges they also incur when they visited for inspection application, collection of quotation forms and many other procedures.

After the inspection exercise, the customer either fails or passes, so if he or she fails s/he revisited the district office for re-inspection application. If he passes, he also revisited the district office to collect connection quotation as well as paying the quoted amount, since there were no facilities that enabled the client to receive the quotation forms and make payments from where they are, so clients considered this process inconvenient.

At times ZETDC goes out of stock of connection materials, which include prepaid meters, meter box and a lot more. Therefore, after the client pays the connection fee the next step is to be connected, and if there are no materials in the stock the customers must wait until the materials are available, so they are listed in the waiting list for connections. When materials are available, ZETDC found it difficult to notify all the clients, so the artisans just took addresses and gate crushed, which resulted in some clients being left out because they were not home (absent) when connection team visited. The customer were then forced to follow or call the offices and explain that they were left out for connection, which was costly on the customer side and some of the customers just gave up especially on inspection phase and resort to other source of energy that resulted in ZETDC losing potential customers.

Due to telephone costs that were incurred by customers when they enquired about inspection and connection details, transport costs and lack of communication why connections were being delayed resulted in other customers opting for other sources of energy, which led to the loss of valuable customers by ZETDC.

Many customers seemed to fail the tubing inspection because they were ignorant of what was expected during wiring for connection process since there was no platform that helped them with instructions and or guidelines.

1.4 Aim

Aim outlines the purpose or intention of the new system. (Gandlin, 2014) defined aim as an intention to reach a specific goal. Aim of the project was to develop a mobile system that allows

ZETDC customers to apply for electrical inspection in the comfort of their homes using smartphones.

1.5 Objectives of research

An objective is what the system seeks to achieve (Gandlin, 2014). These were set goals that the new system aimed to achieve at the end of its development. The objectives were to develop a system that:

Allows clients to apply for electrical inspection and connection services via a mobile application

Enables ZETDC to send quoted connection fee to its clients

Allows customers to pay for their quoted connection fee using mobile wallets as well as uploading payment proof to prove payment.

Notifies the customer regarding connection material availability and when they should expect a visit for either inspection or connection.

Provides clients with education content regarding electrical inspection and connection procedure.

Provides a communication forum, where clients will send their queries, make inquiries on matters that concern electrical inspection and connections thereby eliminating high telephone costs.

1.6 Instruments and methods

According to (Kumar, 2014) instruments are the tools which are used to accomplish a certain task and methods are the techniques used to collect relevant information from a specific group of stakeholders needed for understanding the operations of a certain activity as well as their expectations from that activity.

1.6.1 Methods

These are data gathering methods, which are used for gathering the required information needed for a successful development of a system or any other software (Kumar, 2014). The instruments used during the problem identification exercise and collection of user requirements at ZETDC regional office in Mutare included interviews, observations and questionnaires. The pilot research

study that came up with the mentioned problems and objectives were conducted by the writer during her attachment period that is from 13 February to 23 December. The data gathering techniques that were also used in the main data gathering process also included interviews, observations and questionnaires, where the researchers mainly focused on the analysis of the old system, and processes that were to be associated with the new system.

1.6.2 Instruments

Instruments are software tools that are used to develop a software, an application or a system (Kumar, 2014).the instruments used in this research include:

Android Studio, which is the official integrated development environment (IDE) for the android platform. It provides the fastest tools for building apps on every type of android device (Burton and Felker, 2012). The new system was developed using the android studio, since the project team considered this instrument as the one that develop applications that are compatible with the android software in many smartphones.

PHP (HyperText Pre-processor), Welling and Thomson (2016) states that it is a "server side scripting written in a HTML context", which is characterised by great performance, fast application development tools that comprise interfaces to various database systems. This language was used for the development of a backend application, which is used by the ZETDC employees for processing the requests submitted by the clients using the mobile application thereby achieving two-way communication between the ZETDC clients and employees.

Time frame is the time required for project to be completed and the project commenced on 4 August 2017 and it ended on 12 October 2017.

1.7 Justification

Justification is defined as an activity of clarifying why the development of the new system is of utmost importance (Kumar, 2014). Generally, justification seeks to uncover the potential value of caring a study; in this case, it defended the essentiality of developing the new system. The new system was justified as follows:

Improved convenience since application will be done on a mobile app meaning a client will be able to apply for inspection anytime, anywhere, thereby eliminating transport cost that are incurred by the user when travelling to the districts for applications and payments

of connection fee as well as enabling the organisation to move along with the latest technology.

The developed system will enable the user to receive quotation on his or her mobile phone thereby saving the clients from the trouble of physical collection that the current system is offering, which also lead to eliminated transport costs.

The developed system will have payment platform, so the customers can make required payments in the comfort of his or her home thereby saving time that was supposed to be used for travelling for other important things.

Effective communication is vital in every business if it is to keep good relationship with its clients. The new system aims to improve the communication channel by delivering a product that allows notifications on materials, inspection and connection dates so that customers will be prepared for a visit thereby eliminating the gate crushing method, which is currently used by the current system. The provision of a communication forum will also help ZETDC to be informed on matters that affect its clients on inspection and connection so that they will be addressed.

Provision of guidelines on tubing will also reduce the high inspection failure rate currently being faced.

1.8 Conclusion

In this chapter, problem definition and objectives of the new system were stated as well as the justification, which explains why the system should be developed. Techniques, which were used to come up with the identified problems, the objectives of the new system as well as to have an overview of the old system, were also outlined. The organisational structure, vision and mission were also clearly explained in this chapter. The next chapter focuses on feasibility study of the research

CHAPTER 2: PLANNING PHASE

2.1 Introduction

The planning phase focused on feasibility study, which enabled the project team to determine the technical, economic, social and operational feasibility, as well as understanding the business value brought about by the new system. Elements of business value are shareholder, customer, employee, management, societal value as well as suppliers' value. Risk analysis, shareholder analysis and work plan are also crucial parts in this chapter and they were clearly outlined to help the decision makers on whether to continue with the development of the new system or abort.

2.2 Business Value

According to (Borrington, 2013), business value includes all forms of value to define the fitness and well-being of the business in the long run. Business value expands the idea of value of the enterprise beyond economic profit or benefit, to comprise additional/extra forms of value such as employee value, customer value, supplier value, managerial value, societal value and to mention but a few. Many of these forms of value are not directly measured in monetary terms, but it embraces other intangible values such as employee motivation, improved relationships within the company, with customers and suppliers etc. Business value seeks to answer if the developed system adds value to its stakeholders.

The ZETDC ITC mobile application brought customer value, which is the value received by end customers by the introduction of the new system, and these include:

The inspection and connection application and payment process is done using a mobile application, thereby allowing customers to conveniently undertake the process in the comfort of their homes.

Elimination of clients long queues, waiting to be serviced in district office, thereby saving time for other activities.

Less costly since the travelling cost to the district offices or depots for application, payments and quotation collection is eliminated. Thereby enabling customers to use the money for other purposes, which might include topping up the quotation fee.

Customers are provided with the guidelines facility that helps them undertake the tubing process without errors, thereby reducing the number of tubing failures.

Removal of traditional barriers since the new system enables the customer to apply anytime and anywhere, thereby eliminating the possibility of customers abroad to be crooked by their relatives and friend who they used to send during the old application process. The service will be available 24/7; 365 days per year, so time, distance and other barriers are also eliminated.

The new system also provided an extra ordinary value to the employees of ZETDC in such a way that their morale and self-esteem might be improved

Due to clients long ques that were experienced on the current system, employees performance were measured based on those queues and it was demotivational, which resulted in some employees feeling under pressure and ended up having burn out syndrome in the bid to eliminate the long queues and serve all customers. However, the introduction of the mobile application resulted in the elimination of the long queues and the performance measure criteria is no longer based on queues but on other new factors introduced by the new system, which include the number of processed applications and to mention but a few.

Workload reduction since weekly, monthly or even yearly reports production are automatically done by the new system, thereby improving their job performance. Most workers considered the previous report production process monotonous.

Help desk inquiries that is either calls or visits were reduced since the new system comprises of the help desk section at which most frequently asked questions are answered and tubing guidelines are uploaded, as well as unique individual questions are addressed through the use of tutorials and queries section respectively.

Management also benefited from the introduction of the system in an adorable way.

The managers are able to view employees work progress at any given time, thereby determining employee performance as well noticing areas that need improvements at an earlier stage so as to improve the workers performance and productivity, rather than having to wait for a weekly report which is summarised (not detailed) and sometimes window dressed to meet the managerial satisfaction and expectations. However, the new system permits managers to effectively monitor the work and determine the progress of each employee.

Generally, ZETDC is involved in the social responsibility where it offers apprenticeship to the society, so that they will study and be better persons tomorrow, but due to financial constraints that are currently being faced by the company the number of apprentices is limited. However, the introduction of the new system will result in an increased customer base meaning more money and profits to the company. This also means the number of apprentices enrolled may increase thereby imparting society with knowledge, skills and capabilities to fend for themselves. The empowerment of the society result in crime rate reduction as well as prostitution reduction (meaning HIV transmission rate might be reduced) leading to the achievement of the sustainable development goal 1 and 3 (whole world objectives that aims at reduction of poverty to 0% and achievement of good and wellbeing in the society). This will add societal value in many ways, which include societal empowerment through education, healthy society due to reduced prostitution rate thereby reducing transmission of sexual transmitted infections, reduced crime rate resulting in a peaceful society and to mention but a few.

2.3 Feasibility Study

Feasibility study is an exercise of determining how fruitful a project can be accomplished, accounting for aspects that affect it such as economical, technical, social and operational feasibility (Havard, 2013). The research was undertook to determine possible positive and negative results of the ITC project before spending a substantial or significant amount of time and cash into it. The study enabled the project team to also determine and organise all essential details needed to make decisions on whether to undertake the ITC project or not since the feasibility study aim was to accurately and rationally reveal the strengths and weaknesses of the new system. Threats, opportunities, resource required, tangible and non-tangible benefits, and a lot more was uncovered in this study. The next subtopic exploits technical feasibility.

2.3.1 Technical Feasibility

Technical feasibility focuses on understanding the contemporary/present technical resources of the enterprise and their applicability to the anticipated requirements of the ITC system. It is an assessment of the available hardware, human resource and software and how it satisfies the needs of the new system (Havard, 2013). Technical feasibility should answer questions, which include

Is the required technology available?

Is the new system feasible within the limitations of the technology at hand?

Is there any additional requirements needed to be added to available technology?

Do the developers perceive the technology as appropriate?

Does the developers need training to be able to use the available technology?

The questions above are just a glimpse or glance of the questions normally asked during technical feasibility, and a lot more questions, which were not mentioned above were answered during this study.

The following table summarises the hardware resources, needed for the development of the new system. Attributes of the table include the resources required, quantity, specifications, status and remarks.

Table 2.1 Hardware resources

Resources	Quantity	Resource Specifications	Status of the resource	Remarks
Computers	2	-At least 500GB hard drive -At least core i2 processors -At least 4GB RAM. -HP, Lenovo and any other brand with the above specifications	Available	No need to purchase because the computers are already available and all employees have computers.
Server	1		Available	No cash outflow because the compatible server is already available.
External hard drive	2	At least 500GB	Not available	The company should purchase external hard drives for backing up purposes and

				should be ready to supplement the drives when needed.
Network devices that is routers, switches, access points	at least 1		available	A company already established a robust network with all the resources mentioned, so no money is involved for the purchase of these resources.
Network Service provider	2	Provide at least 5000mb/ms bandwidth	available	ZETDC is currently supplied high quality network services with the most competitive companies that is Telone and Powertel.

Besides hardware components, there were software resources that were needed for the development, testing, system operation and other functionalities of the new system. The software components are described on the following table and the attributes of the table include the software name, specifications and the status.

Table 2.2 Software resources

Software Name	Specifications	Status
Operating system	Windows 7, 8 or 10.32 or 64 bytes	All operating system are available
Macromedia Dreamweaver	C6 or 8 version	Available
Antivirus	System endpoint, avast or eset	Available but need to be updated from time to time.
Android Studio	Latest version	Available
Eclipse or NetBeans	Latest version	Available

Human resource was classified under technical expertise, which was the analysis of determining if there was enough personnel with the required abilities to construct and operate the new system efficiently. Technical expertise mainly answers questions such as

Is there enough human resource needed for the development and operation of the new system?

Does the human resource possess the required expertise for the development and operation of the system?

Is there any training needed to enhance the performance of the human resource?

Various questions were answered during this exercise and the above stated questions are just a snapshot of the technical expertise exercise. There was also an issue of customers, which focused on training the whole world on how to use and notify them on the availability of the new system through advertisement. Table 2.3 shows a summarised human resource analysis as it was drafted during research and it consist of the type of human resource (stakeholders), status, company's perspective and the comments.

Table 2.3 Technical Expertise Analysis

Stakeholder	Current Status	Company's Perspective	Comments
Operation Employees	All ZETDC employees and the stakeholders of the new system have a computer usage background	The company is ready and willing to incur cost on additional computer training that is needed for the effective and efficient use of the new system	Training is required to familiarise the employees with the new technologies that comes with the use of the system as well as the training on how to use the system itself.
Developers	Developers have experience in PHP, C++, JAVA, and a	The company is also ready to support the programmers with	Developers needs more training on android

	little knowhow on Android	the required resources needed for studying the android language as well as enhancing their knowledge on other programming language	programming language, and they have impressive experience on the other mentioned languages.
Customers	They only know and use the current system and they are also not trusting the new system with their money	The company is willing to incur marketing costs so as to make the new system acceptable to the public	Intensive advertisement (though the use of television stations, radios, newspapers, road shows etc.) is needed so as to educate the customers on how to use the new system and its advantages as well as imparting them with knowledge on how to secure their information from cyber crimes

The questions that needed attention on technical feasibility were efficiently tackled, analysis was done and evaluated, so after the evaluation it was found that the project is technically feasible. However, the development of the new system could not commerce if other feasibilities like operational, social and to mention but a few were not analysed and considered appropriate. The next subtopic focuses on the analysis of economic feasibility.

2.3.2 Economic Feasibility

The study seeks to determine the monetary benefits and budgets, which are to be expected, if the company is to go ahead with the development of the new system (Cohn, 2014). During the economic feasibility exercise, there was comparison between the identified benefits and costs. If the total benefits outweigh all the costs, then the new system is considered to be economically feasible (Ness, 2016). There was need to compute return on investment (ROI) and payback period based on the cost benefit analysis to determine economic feasibility of the system.

Costs

These are expenditures, which were incurred during the development and operation of the new system. The operation and development costs were essential for the financial department to understand and know how much was needed to be set aside for the development, launching and operation of the new system, as well as determining if they were able to finance the budget.

Development cost

These costs were incurred during the development of ZETDC ITC mobile application. All the expenditure, which include procurement of additional assets for development purpose, training of the development team, payment of the development team and to mention but a few, are classified under development cost.

Table 2.4 Development Costs

Item	Quantity	Estimated costs \$/ unit	Total estimated cost \$
External hard drive	2	50	100
Labor (the project team was given a certain amount to share among themselves as a token of appreciation for agreeing to undertake the research, design	10	1 640	16 400

and development of the new system)			
Training costs for the project team for android certification.	10	250	2500
Total cost			19 000

Operational costs

These are unescapable cost incurred by the business during the operation of the system, and they are incurred on a daily basis (Pettinger, 2014). The following table summarises the estimated operational costs for 2017 and 2018.

Table 2.5 Operational Costs

Description	2017 Cost	2018 Cost
Hardware maintenance	600	500
Software maintenance	700	600
Other computer consumables		700
Total	1300	1800

Benefits

These are reimbursements of introducing the new system (Ness, 2016) and they are categorised into tangible and non-tangible benefits.

Tangible benefits

Tangible benefits are type of remunerations that can be quantified in monetary term (Ness, 2016) and they include reduction in stationary costs, labor costs and other related costs, which were incurred by the old system. The table below shows estimated tangible benefits brought by the introduction of ITC mobile application for 2017 and 2018.

Table 2.6 Tangible Benefits

Description	2017 Benefits	2018 Benefits
Reduction in stationery cost	1200	1 400
Reduction in labor cost	500	700
Estimated decrease in other expenses	800	1 300
Estimated increase in profit	20 000	22000
Total	22 500	25 400

Non-Tangible Benefits

These reimbursements cannot be easily quantified into monetary terms, but have a significant bearing on the productivity, relationships and profit of the company (Pettinger, 2014). The non-tangible benefits brought by the adaption of the new system include

Improved customer satisfaction leading to improved customer loyalty, resulting in good and robust relationship between ZETDC and its clients.

Improved employee's job satisfaction resulting in motivated employees with high morale, thereby increasing the company's productivity.

Time saving for both the customer and employees through the elimination of some time consuming processes, which were associated with the use of the old system thereby making use of the saved time for other productive and profitable activities.

Improved organisation reputation that is goodwill

Improved data integrity and data security

Cost Benefit Analysis

Cost benefit analysis is a process of summing up all the monetary benefits, and all the costs incurred, and then weigh or compare the total benefits against the total costs (Ness, 2016). The outcome of cost benefit analysis exercise is usually expressed in terms of payback period, return

on investment, net present value and to mention but a few. The following table contains the estimated benefits and costs.

Table 2.7 Cost Benefit Analysis

Description	2017	2018
	\$	\$
Estimated Benefits		
Tangible benefits	22 500	25 400
Total	22 500	25 400
Estimated Costs		
Development	19 000	-
Operational	1300	1800
Total	(20 300)	(1800)
Profit or (Loss)	2 200	23600

According to the table 2.7, ZETDC got a low margin of \$2 200 in the first year, but the profit will increase to \$23 600 in 2018, using the results from table 2.7 it was proved that the project was economically feasible, and the finance department agreed to provide the required funds. However, it was not enough to go ahead with the development of the system without undertaking ROI and payback period.

Return on Investment (ROI)

It is also known as the accounting rate of return, and was defined by Ness (2016) as a “way of comparing the net profitability to the investment required” it makes use of the following formula for its calculation

$$\text{ROI} = (\text{average annual profit}/\text{total investment}) * 100$$

$$\text{Average annual profit} = \text{net profit}/\text{number of years}$$

$$= (2\,200 + 23\,600)/2$$

$$= 12\,900$$

$$\text{ROI} = (12\,900/19\,000) \times 100$$

$$= 67.9\%$$

The return on investment is 67.9% and it was considered favorable by the project team.

Payback Period

Payback period is the time taken to breakeven or payback the initial investment (Havard, 2013). The main focus of calculating payback period was to determine when the initial investment of \$19 000 will be paid back.

$$\text{Payback} = (\$19\,000/\$22\,500) \times 12$$

$$= 10 \text{ months}$$

The calculated payback period indicated that the company need 10 months to cover the initial cost of ITC mobile application investment, which was concluded as favorable.

Economic feasibility was considered feasible, so economically the development of the system was good to proceed, however it was not enough without the outcome of social feasibility.

2.3.3 Social Feasibility

Social feasibility study seeks to determine the response of the stakeholders to the new system, these responses also determine if the system will be used or not after its development and implementation (Horine, 2012). The stakeholders of ITC mobile application include management, commercial clerks or officers, inspectors, artisans and customers.

The new system relieved the ZETDC clients from monotonous visits to district offices or depots for application, collection of quotations as well as payments, through the introduction of a new facility that enables them to do all activities required for inspection of electricity tubing application to connection in the comfort of their homes. The new system is saving a significant amount of money and time, which they can use for other activities.

Customers considered the new system convenient, they are happy, and they were also eagerly waiting for the official launch of the mobile application to the public.

The new system also have a significant bearing on employee motivation, since they no longer have to deal with large and tiresome piles of files containing application forms, quotation forms and etc., thereby making it easy for the employees to manipulate and retrieve information at a faster rate compared to the existing manual facility. Generation of automated reports is also saving employees from writing tedious weekly and monthly reports.

Employees are also very excited about the new system and were impatiently waiting for the system to be officially launched.

Real time management facility is also another operation that seemed fascinating to management since they are able to see the progress of their subordinates anytime and anywhere, thereby enabling remote monitoring. Management will also be able to see the weekly, monthly reports thereby eliminating the element of report window dressing, which was associated with the old system, resulting in decision-making based on true information.

Employees, management and customers accepted the system; however, there were some doubts from some of the stakeholders, which included employees, who were wondering if the new system is going to result in reduction of salaries and/ or retrenchment. The customers were also afraid that the system might result in loss of their essential information, money (through hacking). All these stakeholders' insecurities were addressed and they were all assured that the system is not going to result in any negative impacts i.e salary reduction and retrenchment for employees then hacking for customers (there are security features that guarantees confidentiality of customer information such as personal details, passwords and a lot more).

It was concluded that the social feasibility exercise was viable for the system development to continue, however operational feasibility also needed to be done for the feasibility study to be considered appropriate.

2.3.4 Operational Feasibility

(Borrington, 2013) defined operational feasibility as “the study that determines how well the new system solved problems, takes advantage of the opportunities identified in the requirements analysis phase of the system”. The operational feasibility assessment focuses on the degree to which the new system affects the existing business environment and objectives with regard to

development schedule, delivery date, cooperate culture and existing business processes. In general, operational feasibility seeks to answer the following questions

How well the new system will solve the problems at hand?

How the new system satisfies the requirements recognized in the requirements analysis?

Will the system operate after development?

When operational feasibility was undertaken, all the stakeholders were made aware of the slight changes that might take place in the way they work when the system is deployed, they all understood and accepted the changes brought about the use of the new system. All the stakeholders also requested for continuous orientation on the system operations until perceived ease of use is achieved. ZETDC gave full support on the development of the system meaning management is committed to the success of the new system, employees are also ready to use the system, so there was high rate of acceptance and the system was anticipated to be operational after development. It was concluded that the new system was operational feasible, since all the stakeholders accepted it. The environment and the organisation culture are conducive for the development and operation of the new system, since they both embrace information technology as an enabler and integral part for long-term success.

All the feasibilities, which include economic, social, operational and technical, were considered favorable to continue with the development of the ITC system, however it was not enough to only look at the feasibility study and be satisfied with the development of the new system, so there was need to put into consideration all the risks associated. Risk identification and analysis also assisted in deciding on whether to continue with the system development or abort, outsource the new system as well as purchasing a ready-made system (off-the-shelf system), depending with the intensity of the risk involved.

2.4 Risk Analysis

It is defined by (Cohn, 2014) as a “process that broadly include risk assessment, risk characterisation, risk communication and risk management” generally risk analysis is the process which include risk identification, evaluation and solving (which include the total elimination of

the risk, or lessening the probability of the risk occurrence, or even the impact of the risk when it occurs). Risk analysis seeks to answer questions such as

What is likely to happen (that is what might go wrong)?

How likely is it to happen?

What are the consequences of the risk?

What can be done to avoid it from happening or to reduce its impact as well as its probability of occurring?

The following table summarises the risk analysis of ITC mobile application and it consist of identified potential risks, probability of occurrence, impact of the risk as well as the risk counter measures as table attributes

Table 2.8 Risk Analysis

Potential Risks	Probability of Occurrence	Risk Impact	Counter Measures
Resource deficiency that is shortage of resource during the development process	Minimum	Failure to meet the deadline	Development must commence when all resources are available and a budget must also be put aside for unforeseen or unexpected additional expenses that might arise during the development
Break down of specifications (During development the project team might identify that objectives	Low	Failure to meet deadline or delivery of an incorrect system	Objectives or specifications must meet the SMART criteria. User involvement must also be encouraged so that they will explain in more detail on the specification if it seem to be unclear. Moreover, make use of

are not clear or incomplete)			prototype system to confirm with the user if the system is operating in the way they expect.
End-user resistance	Minimum	Resist change	Encourage stakeholder involvement throughout the development process. In addition, make use of reward systems for the use of the new system, for example if a customer applies on mobile applications he or she will be awarded certain points or will be given \$3 free electricity token.
Lack of team spirit, that is absence of coordination and cooperation among team members	Average	Late delivery of the system. Delivery of the wrong system or even the inability to deliver the system at all.	Encourage team building and team work culture in the organisation
Failure to meet the deadline	low	Deliverance of an obsolete product. Incurrence of additional and unbudgeted costs to complete the product	Effective and interactive planning as well as realistic time scheduling
Unavailability of experts	Very low	Development of incorrect system and	Necessary training must be done before development of the system starts, so that the

		also inability to meet the deadlines	developers will acquire the required knowledge. Outsourcing is another route that can be taken where the project will be contracted to external reputable experts.
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All the potential risks were identified on table 2.8 as well as the countermeasures, the conclusion was that the risk associated with the new system does not qualify for the development abortion. Preparation of the unforeseen risks was done, meaning the project partakers were ready to face and solve any risk that comes during development thereby resulting in the success of the system.

2.5 Stakeholder Analysis

Stakeholder analysis exercise focuses on the identification of stakeholders or groups that are likely to be affected by the new system. This analysis answers questions, which include:

Who are the new system stakeholders?

What does these stakeholders expect from the new system?

(Cohn, 2014) states that a stakeholder analysis does not preclude the interests of the other stakeholders overriding the interest of other affected stakeholders but it ensures that all affected will be considered. It also assessed the attitudes of the stakeholders regarding potential changes. Benefits of stakeholder analysis include the identification of stakeholder interests, key personnel to be kept informed about the project progress during the development, implementation and execution. Also helps in the identification of the negative stakeholders and their adverse or negative effects to the overall success of the project, as well as the mechanism to influence other stakeholders and to mention but a few. The following stakeholder’s analysis table attributes include type of stakeholders, their interests, the risks associated with the inability to meet their expectations or interests as well as how to address the identified interests and their reaction to the new idea of the new system.

Table 2.9 Stakeholder Analysis

Stakeholders	Interests	Risks	Address interests	Reaction
Customers	More convenient way of doing business, which is less time consuming and also less expensive that is the ability to apply remotely , pay and receive their quotations through the use of a mobile application	Losing more customers	Development of an application that cater for the specified user interest	The statistics indicated that 99.6% of the clients are impatiently waiting for the launch of the new system and they are happy with the new idea or way of doing business since they considered it more convenient.
Employees	Improved job performance by elimination of tiresome paper work, manipulation, retrieval as well as report preparation. <ul style="list-style-type: none"> - Automated report generation facility - Easy manipulation and retrieval of information - Achieve paperless office 	Demotivated employees, more errors in the employee's work.	System will have features that will meet all the mentioned employee interests. Continuous involvement in the development to ensure that the correct features are built as expected.	Employees feel as if their prayers have been answered with the introduction of the new system since they claim that it makes their duties easy to carry, so they are happy and waiting for the new system implementation.
management	Real time management facility, that is the ability to monitor employees	Resistance to the use of the new system	Development of the system that meets	Management is excited with the development of the new system

	work anytime, from anywhere as well as timeless viewing of reports		management expectations.	since they claim that it enables them to achieve real time employee monitoring thereby eliminating the issue of report window dressing associated with the current system
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2.6 Work Plan

Work plan was established after schedule feasibility was done and (Horine, 2012) defines it as the “measure of how reasonable the time project is, given technical expertise and all other resources. Are the project deadlines reasonable or practical?” After the project time was considered viable then the work plan was drafted using Gantt chart. A work plan specifies when an activity is going to be executed and how long will it take.

Table 2.10 Time Schedule

Activity	description	Duration in weeks	Anticipated deliverables
Project proposal	Problem identification and objective formulation	1	Proposal draft, which explains the problem, identified, formulated objectives and justification of the new system.
Planning	Embark on feasibility study, risk analysis as well as the identification of business values	2	Feasibility and hazard analysis report as well as time schedule
Analysis	Analysis of the current system, provision of a detailed information	2	Analysis report

	gathering techniques and identification of functional and non-functional requirements		
Design	Designing new system's architecture, process, interfaces and database	2	New system design
Implementation	Construction and installation of the new system as well as user training	2	System delivery
Maintenance and evaluation	System maintenance and evaluation	continuous	Review report

Gantt chart

Phases	Time(weeks)									
	1	2	3	4	5	6	7	8	9	10
Proposal	■									
Planning		■	■							
Analysis				■	■					
Design						■	■			
Implementation								■	■	
Maintenance and evaluation										■
Documentation	■									

Maintenance, evaluation and documentation of the system will continue for the lifetime of the system.

2.7 Conclusion

After feasibility study, risk analysis, business value, stakeholder analysis, and work plan were undertaken, the project team concluded that it was viable to continue with the development since all the analysis was done and considered favorable. The next chapter focuses on the phase.

CHAPTER 3: ANALYSIS PHASE

3.1 Introduction

Analysis phase is the process of examining the old system that is how the old system worked using activity diagram, context diagram as well as the data flow diagram. It also consist of information gathering methodologies, weaknesses of the old system, evaluation of alternatives and requirement analysis.

3.2 Information Gathering Methodologies

Information gathering methodologies are methods used to gather the required information. The methodologies that were used are interviews, questionnaires and observation (Kumar, 2014). The data gathering methods produced a comprehensive report on the shortcomings of the old system as well as understanding the mind of stakeholders (what they are expecting, their experiences with the old system as well as their view on the system that was being new).

3.2.1 Interviews

An interview is a discussion where the interviewer queries questions of concern and the interviewee responses (Manual, 2012). It is a two-way communication with one or more persons being interviewer/s and the other/s being interviewee/s. The interviews were undertaken at ZETDC regional office in Mutare with the main aim of obtaining information from the stakeholder's oral response to oral inquiries. Artisans, commercial officers, inspectors, customers, management and I.T personnel were all interviewed with the purpose of comprehending their view on the old system as well as the system that was being new. The interviews dates and time were set by the human resource office where each group was interviewed independently for example the artisan group. Then few representatives from each group gathered in the final interview and were asked their views and expectations as well as outlining how their processes were supposed to cooperate. Advantages and disadvantages, which were associated with the interview session included

Advantages

Face to face conversation, which enabled the project team interviewers to interpret non-verbal languages of the interviewees leading to the correct conclusion of how the various stakeholders view both the old system and the one that was being new since non-verbal language give emphasis of the spoken information.

Project members who were interviewing stakeholders were able to adjust to the language, which was easily comprehended and comfortable with the interviewee and it resulted in the interviewees being able to express themselves leading to collection of a lot essential information.

Some of the questions were not clear to the interviewees and the project team interviewers were able to explain further on the unclear questions.

Instant feedback associated with interviews resulted in quick decision making by the project team

Disadvantages

Disturbances on certain operations of the organisation occurred when the interview was undertaken and among other disturbances were preparation of quotation, inspections and connections since the stakeholders responsible for the mentioned operations were being interviewed.

Some stakeholders said the questions were asked in a biased manner to satisfy the expectations and needs of the interviewers.

Some stakeholders did not come to the interview due to some supervening impossibilities, which occurred on the interview date, so the project team might have missed important information from those who were absent.

The results collected from the interviews showed that majority of the stakeholders wanted the new system since they considered the old system as monotonous, tiresome and outdated, so they were proposing that the new system should move hand in hand with the current technology. All the interview questions are attached on the appendices of this document.

3.2.2 Questionnaires

Questionnaire is a research instrument entailing of a series of queries and other prompts for gathering information (Manual, 2012). Open ended questions (the respondents formulated his or her own answers) and closed ended questions (the responded picked an answer from a given number of options) were both used. The questionnaires were distributed to all appropriate stakeholders that is artisans, commercial officers, and inspectors and to mention but a few, analysis

showed that 98% of the distributed questionnaires got attention whilst 2% was ignored. Merits and demerits of using questionnaires as an information-gathering tool at ZETDC included:

Merits

98% of the distributed questionnaires were answered, which was considered as a good response rate by the project team.

Operations of the current system were not disturbed since the respondents answered during their free time

The process was less expensive as compared to the interviews where breakfast and lunch was bought for both the interviewers and interviewees.

Demerits

2% of the distributed questionnaires were not answered, since some of the respondents did not take the exercise seriously and decided to ignore

Some of the questions were left unanswered, which resulted in obtaining incomplete data.

The exercise deprived the project team to read and understand some forms of information that comes with non-verbal communication i.e changes in emotions, behavior, paralanguage and to mention but a few.

Conclusively the information gathered using questionnaires as a technique showed that most of the stakeholder were not pleased with how the old system operated and they were all supporting the idea of the new system since they think it will improve their job performance, productivity and their morale, as well as empowering them with the current and updated technology skills. The questionnaire sample is attached on the appendices of this documentation.

3.2.3 Observations

Observation is a process of watching the various stakeholders as they are doing their daily activities. (Kumar, 2014) defined observations as the “process of watching someone doing his/her assigned duties or activities to actively attain information from the primary source”. Generally, observation involves noticing, perceiving, and witnessing how the stakeholders perform their daily activities as well as understanding how the current system itself operate which results in a

personalised view on the operations of the system itself and also the interaction between the stakeholders and the existing system. Unknown team members were tasked to observe workers as they do their daily activities.

Advantages

The project team observers collected first-hand information without being window dressed.

No disturbances or interferences with the operations of the current system.

The observers were very different from the interviewers and the members who distributed questionnaires so the majority of the stakeholders never suspected that they were being watched.

Disadvantages

Not all activities were observable

The few stakeholders who suspected that they were being observed altered their behavior.

Observations showed that many employees were having fatigues and burn out syndromes due to the pressure that came with the use of the old system. The customers were also surrendering and going back home without being served altering for other alternatives that include solar energy, which resulted in ZETDC losing its potential customers.

3.3 Analysis of the old system

The client visited ZETDC district office or various depots to collect tubing guidelines and application forms, when done with tubing the client then filled in the inspection application form and submitted it to district office or nearest depot. The inspectors visited the applied client for inspection without notice, which resulted in some clients being left out since they were not expecting any visits from the inspection team. After inspection a client was given his or her inspection results, if it was a fail, then the client will have to make amendments and reapply for inspection. If it was a pass then the commercial officer prepares a quotation for connection, which is sent to the client or collected by the client. When the client paid the quoted amount she or he then waited for connection in the waiting list. When it is the client turn to be connected, the artisans visited the client's site for connection and the client is connected.

Inputs

An input is raw data entered into the system for processing, to produce processed data known as output (Tomsho, 2016). Inputs required for ZETDC clients to be connected included

Application form with clients details which included full name, address, contact details etc.

Cash for payment of quotations

Materials needed for connection, which include meter box, meters etc.

Processes

These are activities responsible for converting the input into output (Rosenblatt and Tilley, 2016) and these processes include

Application for inspection

Inspection for connection and quotation

Preparation of quotation

Payment of quotation

Await connection

Connection of the client

Output

These are the results of processed input (Rosenblatt, 2014) and they comprise

Inspection results that is either a pass or a fail

Quotation details

Connection results

3.4 Process analysis

The exercise of process analysis explains systematically how something is done or how to do something (Dennis, Wixom and Roth, 2015); in this case the process analysis was focusing on how the old system worked using an activity diagram.

Activity Diagram of current system

Activity UML describe the dynamic aspects of the system. Activity diagram is a flow chat that that represent the flow from one activity to another (Dennis, Wixom and Roth, 2015), and these activities are described as operations of the system.

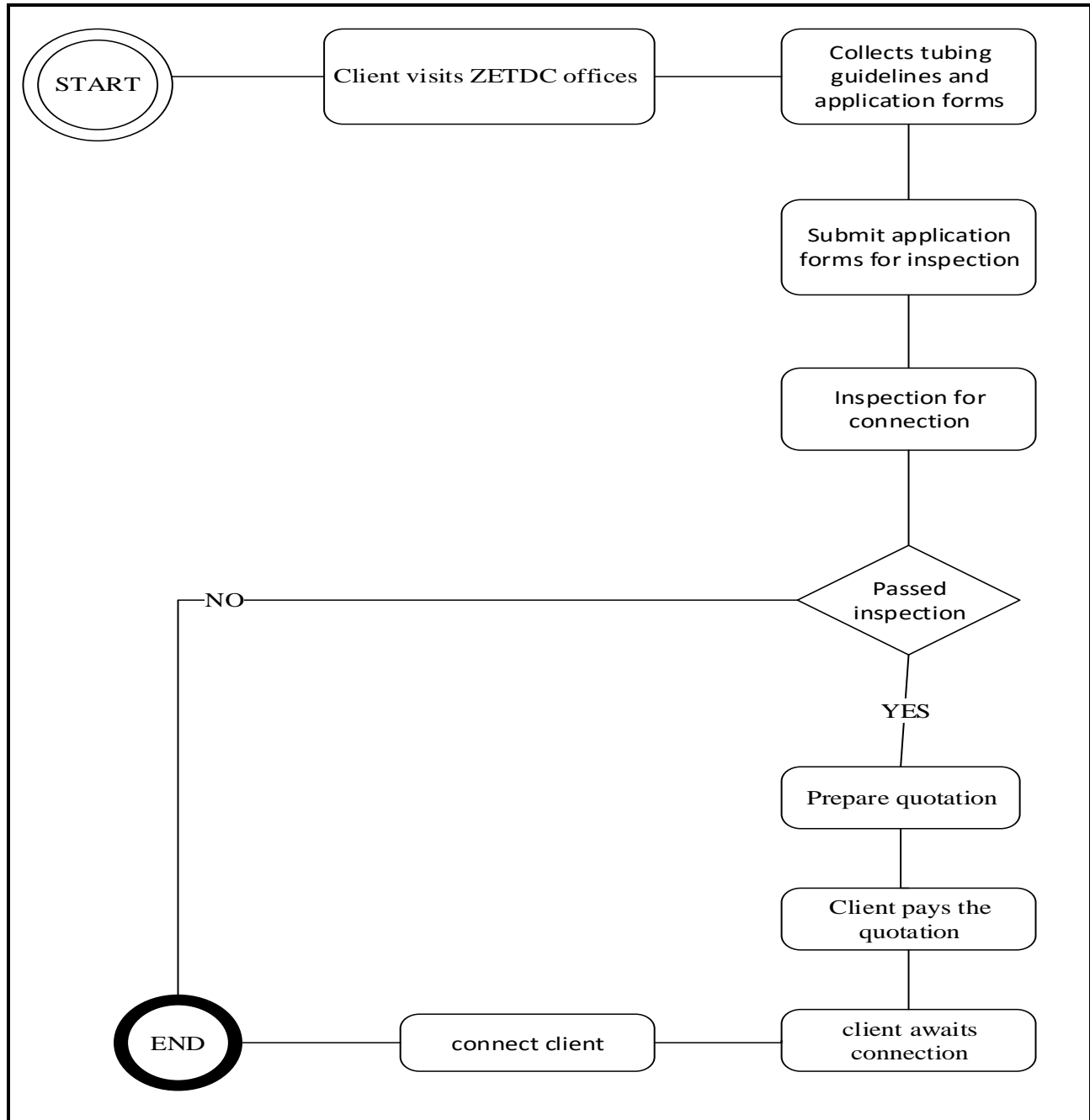


Figure 3.1 Activity Diagram

3.5 Data Analysis

The practice of data evaluation using analytical and logical reasoning to observe each component of provided data (Rosenblatt, 2014). Data from numerous sources were collected, revised and analysed to come up with a comprehensive conclusion of how the old system operated. Context diagram and data flow diagram of the old system were used for the data analysis exercise.

Context Diagram

Context diagram describes the boundary between the system and the environment of the system, showing the main entities, which work together with the current system (Kendall and Kendall, 2014). Context diagram structure comprise the system of interest at the central without knowledge of the system's internal functions, enclosed by the entities that work with the system.

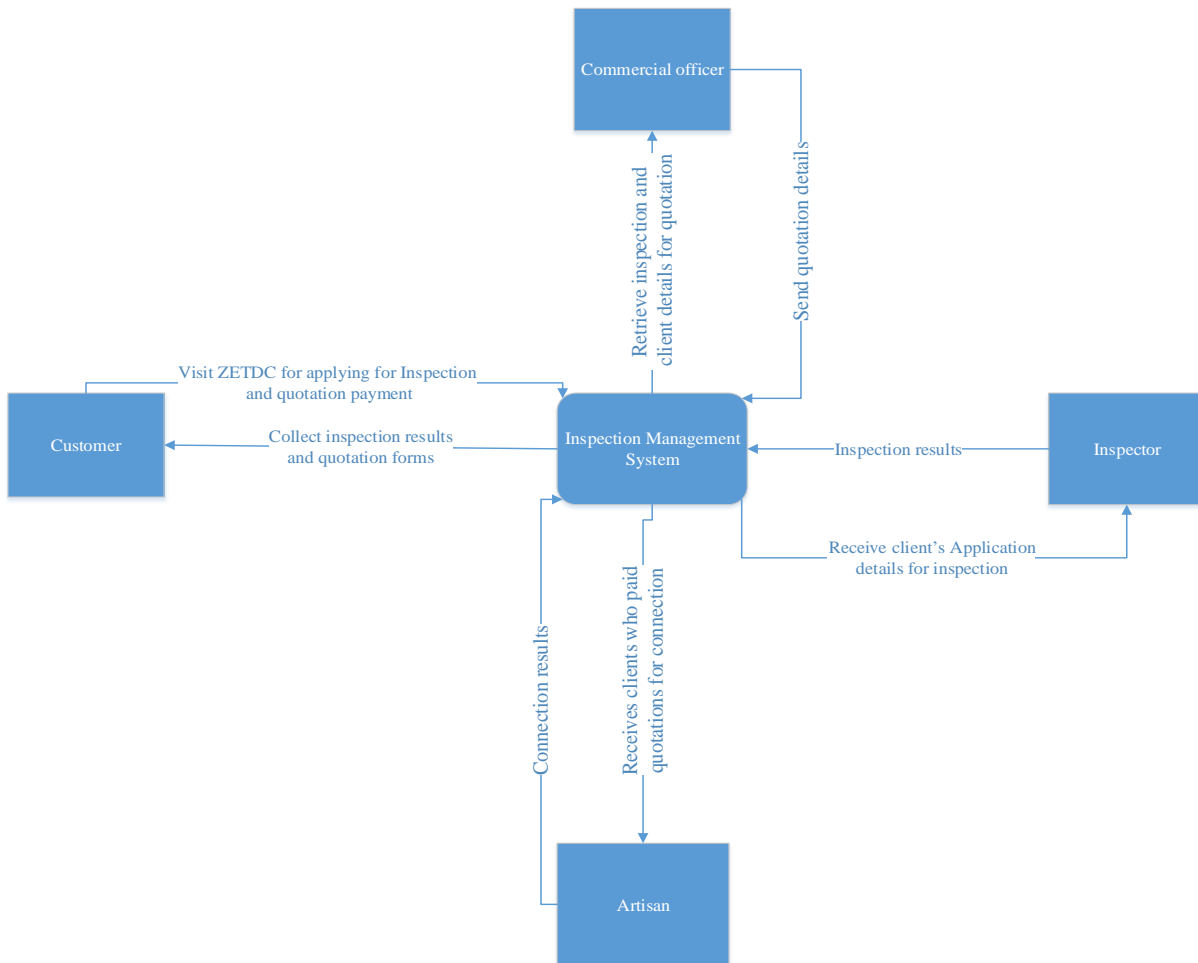


Figure 3.2 Context Diagram

Key



Data Flow Diagram

Dataflow diagram demonstrates and explores the association among several components in the system. DFD is a significant technique used in system modelling (Rosenblatt and Tilley, 2016). After examining the old system, the project team was able to come up with the dataflow diagram below for ZETDC.

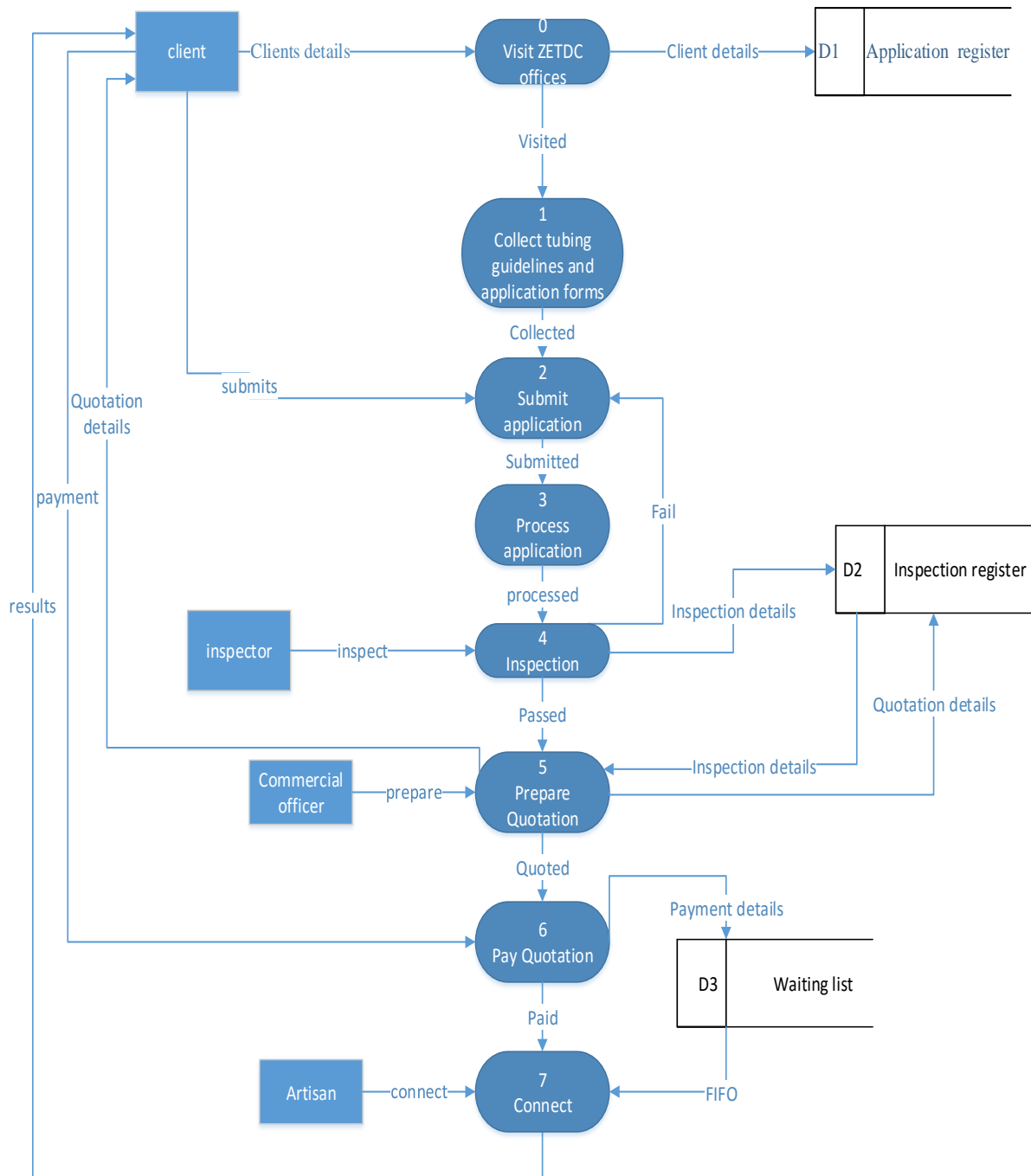


Figure 3.3 Data Flow Diagram

Key



3.6 Weaknesses of the old system

These were shortcomings associated with the use of the old system (Tomsho, 2016). After all necessary researches were done using the above-mentioned data gathering techniques; the project team was able to compile the following weaknesses:

Data entry, manipulation and retrieval is manually done, which was highly subjected to human error

A lot needed to be printed that is quotations, which was an expense to the organisation, since it had to purchase a bulk of the required stationery.

Lacked quality security measures since the only security provided was door locking which subjected customer's information to unauthorized access

Lacked effective communication between the client and the company leading to some being left out when connection were done since they were not expecting any visits.

The old system was associated with traditional barriers such as distance and time since the client had to travel to get a service from the old system and s/he was supposed to arrive within business hours else s/he had to wait for tomorrow or go back without being attended.

Long queues, which resulted in some clients opting for other source of energy and preserve the time they would spend waiting in ques to be serviced for other productive activities, which led to ZETDC losing its potential customers.

3.7 Evaluation of Alternatives

The evaluation of alternatives phase focuses on how the new system was to be delivered, which include outsourcing (where the company contracts an external development organisation for the development and implementation of the new system), then the other alternative is the actual development and implementation of the system by the internal I.T department, which is known as total insourcing. The last alternative is the improvement of the current system to meet the new specifications, which is also known as defacto sourcing (Dennis, Wixom and Roth, 2015). Before the alternative was chosen, it was considered essential to first understand the advantages and disadvantages of each alternative as well as the justification of either choosing it or not.

3.7.1 Outsourcing

Outsourcing is when an organisation contract an external reputable company for the development and implementation of the new system (Baltzan and Phillips, 2015). Research showed that Maximus solutions limited company found at 1347 Mukute road, Houghton Park, Waterfalls,

Harare; Integral Edge System Design located at 42 Fifth Avenue, Harare; and Exclusive solutions in Johannesburg, South Africa, were the most reputable and recommended companies that could do the development and implementation of the new system. Project team outlined the advantages and disadvantages associated with outsourcing the new system.

Advantages

Delivery of high quality system since the mentioned external companies have adequate expertise required for the development of the new system

External companies develop the required system using their own resources so the company will not have to purchase the assets needed for the internal development of the new system thereby eliminating the cost of purchasing development assets, which might be used for other activities.

Time of system deliverance will be shortened since the training of the development team on android programming language will no longer be necessary, which was resulting in the delay of system delivery.

Disadvantages

The contracting out of the new system costs \$35 000, which is expensive as compared to the internal development cost, which is \$19 000. The variance of \$16 000 can be used to cover operational cost if the system is internally developed.

The approached external organisation needed half of the fee payment before the development commences, and the financial sector said the amount was exhaustive since they were supporting other projects, which were under development such as OMS (Outage Management System), EIS (Executive Information System) and GIS (Geometric Information System). The finance department was unable to pay the required amount since their coffers were running out.

The copyright of the system remains with the developing company.

Not all workers from the external company are trustworthy, so they may leave a loophole, which they may later use to commit cyber-crime during the system operation phase

To ensure maximum security, experienced system analysts need to be hired to examine the outsourced system, which means additional cost to ZETDC.

Outsourcing was expensive and also accompanied with many treats of being attacked at a later stage through the use of backdoor hacking tactic. The copyright of the new system remains with the developing company meaning the source code won't be given to ZETDC and in case the system need to be upgraded the contracted company have to do the job and be paid for it, in case of a system failure ZETDC will have to contact the contracted company. The alternative was found not convenient enough and it was denied.

3.7.2 Improvement

The exercise involves modifying the current system with the aim to make it meet new user requirements (Koumpis, 2012) that were outlined in the first chapter of this documentation. Improvement of the current system is impossible if the company is to meet the new specifications because the old system was not associated with the current technology, it was more of a manual system and they only used excel for recording the client inspection, and connection details. All application forms and quotations were filed in large files. The system that was being proposed could only be achieved by computerising all operations and for the customers to be able to apply and process their transactions remotely, there was need to develop a mobile application that support such activities. Advantages and disadvantages of improving the old system as an alternative were not outlined since the alternative was considered not suitable for the success of the new system. Keeping the old system and try to work with it to achieve the new idea was going to leave the identified problems unsolved, and the only way to solve all the identified problems and meet new user requirements was to go the current technology way.

3.7.3 Development

Gandlin (2014) outlined that this is the internal development of the of the new system by ZETDC I.T department using the resources that the company already have and some additional resources needed for the successful development of the new system, which are listed on the technical feasibility in the previous chapter. When an analysis on in-house development was undertaken, the following advantages and disadvantages were noted.

Advantages

Total ownership of the system, which result in the I.T department of ZETDC having the exclusive right to modify and upgrade the system at any time.

The cost of development was less expensive (\$19 000) as compared with the total cost of contracting an external developing company (\$35 000), so it was considered cheap to internally develop the system since the variance of \$16 000 is good enough to support another profitable project.

Development of the new system enhanced the skills of ZETDC internal programmers, thereby equipping them with lifetime expertise, which is an asset to the organisation and the employee as well.

The ZETDC developers felt trusted and motivated when they were entrusted with such a great responsibility, thereby aspiring to deliver high quality product.

Disadvantages

Development of a system from scratch takes a lot of time and expertise, due to lack of some skills in android development language by the internal development team, made the project team manager to anticipate that there might be a little delay in the delivery of the new system.

The company still had to incur cost of hiring external system analysts and ethical hackers for both white box and black box testing to ensure high quality security, since the internal developers and analysts might ignore some loopholes that might be of great threat to data security and integrity.

The evaluation process concluded that in-house development was the way to go since it out weight the other two alternatives. The cost of development was \$19 000 which was less expensive as compared to the cost of outsourcing. It was agreed that development of the system was to be done using internal resources that is internal I.T department, assets and to mention but a few.

3.8 Requirements Analysis

Requirements analysis is an exercise of determining or finding the functional and non-functional requirements that addresses the weaknesses, which were associated with the old system, as well as classifying the identified user requirements into functional and non-functional requirements.

3.8.1 Functional Requirements

According to (Kendall and Kendall, 2014) “functional requirements specifies the behavior or function for instance add customer or print invoice”. Generally, a functional requirement delineate how a system is supposed to work. The functional requirements include

Ability of the client to apply for inspection

Authentication of users on login

Concurrency access of the system

Receive quotations and other inspection and connection results on mobile phone

Payment of quotations via mobile application.

Communication between clients and help desk should be facilitated

Case diagram

Msdn.microsoft.com states, “In software and systems engineering, a use case is a list of actions or event steps, typically defining the interactions between a role (known in the UML as an actor) and a system, to achieve a goal. The actor can be a human or other external system.” This is just a graphical illustration of the relationships among various elements of a system. A use case is a methodology that identifies, clarifies, and organises system requirements.

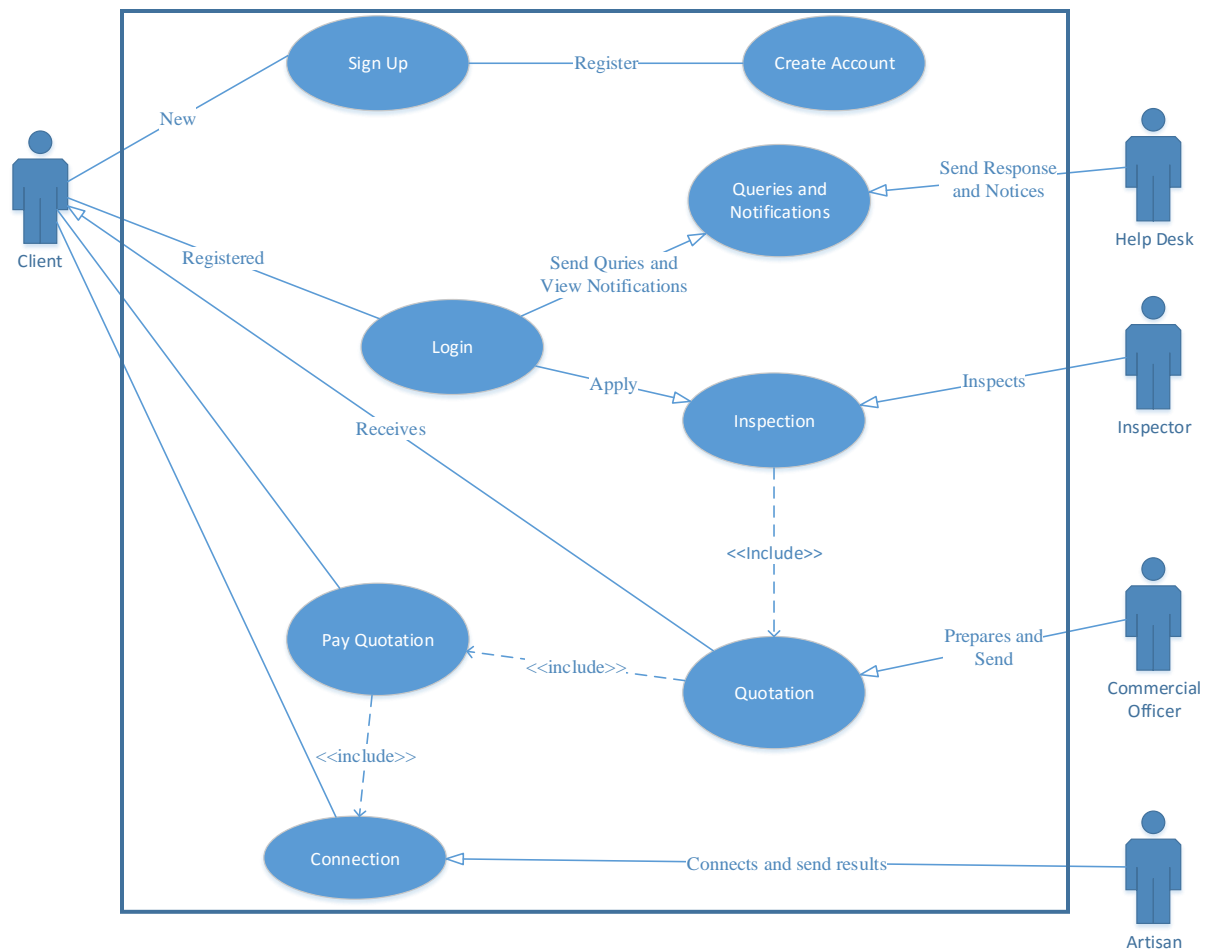


Figure 3.4 Use Case Diagram

Key



3.8.2 Non-functional requirements

Specifies criteria that can be used to judge the operation of a system rather than the system specific behavior (Rosenblatt, 2014), so generally non-functional requirements show quality attributes of the system or attributes that support the functionality of the system and these include

Compatibility, the system must be compatible with various operating systems such as Microsoft windows, Linux, Mac and a many more.

Maintainable, the system must be easy to install and maintain

Easy to use and understand, the system must be user friendly

The system must be secure, provision of maximum security so as to keep company and client data private and confidential

Modifiable, the system must also be easy to extend

Provision of effective and efficient response time

The new system must also be reliable, available and robust

On availability, there are some clients who are located in remote area and does not have access to internet which makes the system unavailable to them and also those who does not have android devices that accommodates the new application will also have difficulties to access the system. Those clients located in areas with poor internet signals might experience poor response rate from the system.

3.9 Conclusion

The analysis phase showed a synopsis of how the old system operated. Data gathering techniques used to acquire information of the old system operations, and its imperfections. Evaluation of alternatives was tackled with the aim of coming up with a decision on what alternative to use for cost effective and quality delivery of the new system. The next chapter will be focusing on the designing of the new system.

CHAPTER 4: DESIGN PHASE

4.1 Introduction

Design phase establishes the architecture where it maps the requirements identified in the requirements phase into architecture (Dennis, Wixom and Roth, 2015). The architecture outlines the system components, behaviors as well as its interfaces. Design phase illustrates how the functional and non-functional requirements were implemented in the new system so generally this phase mostly focus on the “how” part. Details on system design, architectural design, physical design (how software and hardware will interact), database design (tables and EER diagram), Program design (package and class, collaboration or sequence diagram), interface design, menu design, pseudo code as well as the security design are encompassed and well explained in this chapter.

4.2 System Design

Kendall and Kendall (2014) defines system design as “the process of defining the components, modules, interfaces, and data for a system to satisfy specified requirements”. The focus of the system design is to diagrammatically illustrate how the data or information flow within the new system as well as the entities that are involved with Inspect to connect system; this was achieved using Context diagram and Data Flow Diagram. A good system design must be maintainable, flexible, portable, reliable, secure as well as usable.

Description of the new system

The client uses a mobile application (new system) known as ITC mobile application to apply for electrical inspection. The inspectors schedule and sent inspection date to the client and they visit the client on the scheduled date for inspection, they fill in all the inspection details and results as well the required material for connection on E22 form (manual form), which will be submitted to the commercial officer for quotation. The commercial officer then sends the results on the E22 and quotation details (if the client passed). The client have to pay the quoted amount using Ecocash, Telecash etc and then upload the payment proof for processing. If the client’s approval code and amount sent matches with the received amount and code then the payment is approved and the connection team is given the list of those who paid for connection. The connection team schedules and send the connection date to the client then visit the client for connection on the scheduled date. The client is connected and the inspection to connection process ends.

4.2.1 Context Diagram

Kendall and Kendall (2014) states that the diagram expresses the new system as the single top-level process, and it also illustrates the association that the new system have with its internal and exterior entities, which includes other systems, organisational groups, external data stores, stakeholders and to mention but a few. Context diagram illustrates how the system interact with its entities, so it is made up of the system (Inspect to Connect) at the center and then encapsulated with the system entities (stakeholders who directly interact with the system). The following illustration is a context diagram of the ITC mobile application.

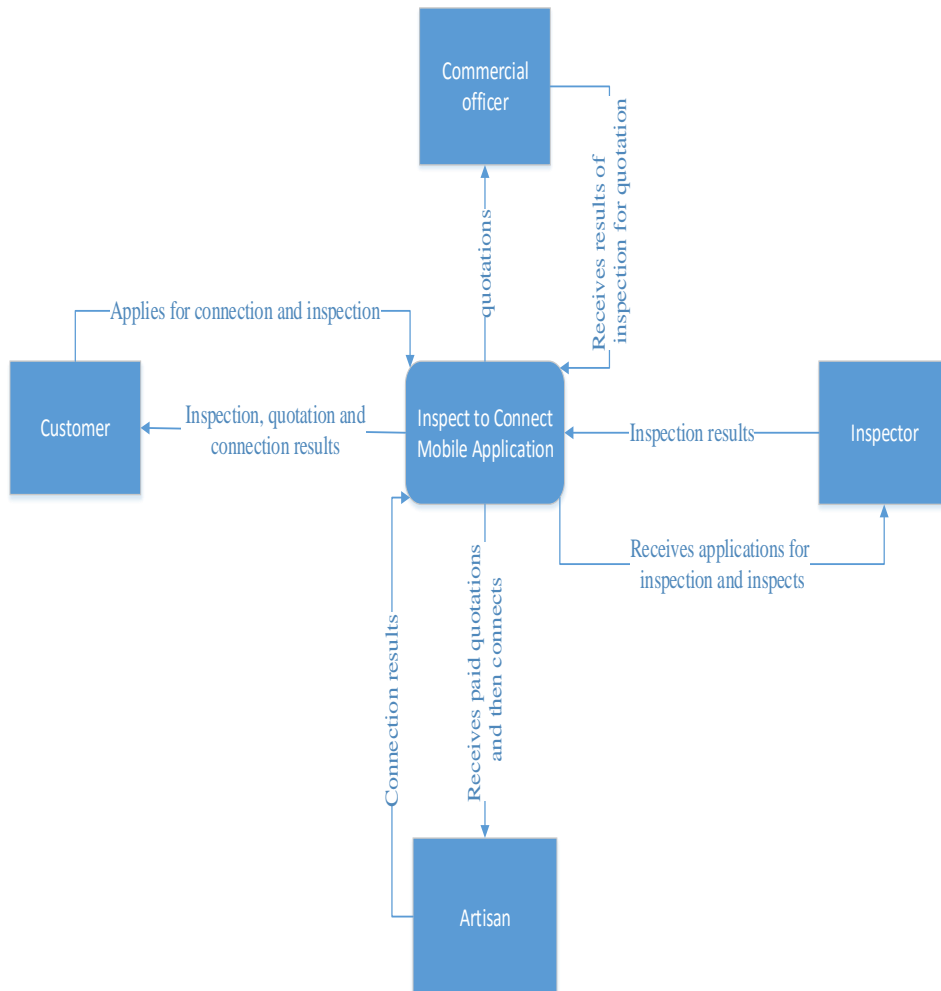


Figure 4.1 Context diagram

Key



4.2.2 Data Flow Diagram

This is a graphical representation of data flow or movement throughout the system. “A DFD is process centric and depicts 4 main components which include processes, entities, data stores, and data flows, and it illustrates the movement of data thereby making it easier to comprehend the information flow within a specific system,” stated (Kendall and Kendall, 2014). Each Data flow diagram contains a number of various processes and data stores with data flowing or moving into and out of each process as well as data stores and being represented to the appropriate stakeholders when requested. The following is the DFD for ZETDC Inspect to Connect system, which was designed to ensure that all-important modules were defined as well as helping management and other stakeholders to comprehend how data in the new system will be flowing.

Key



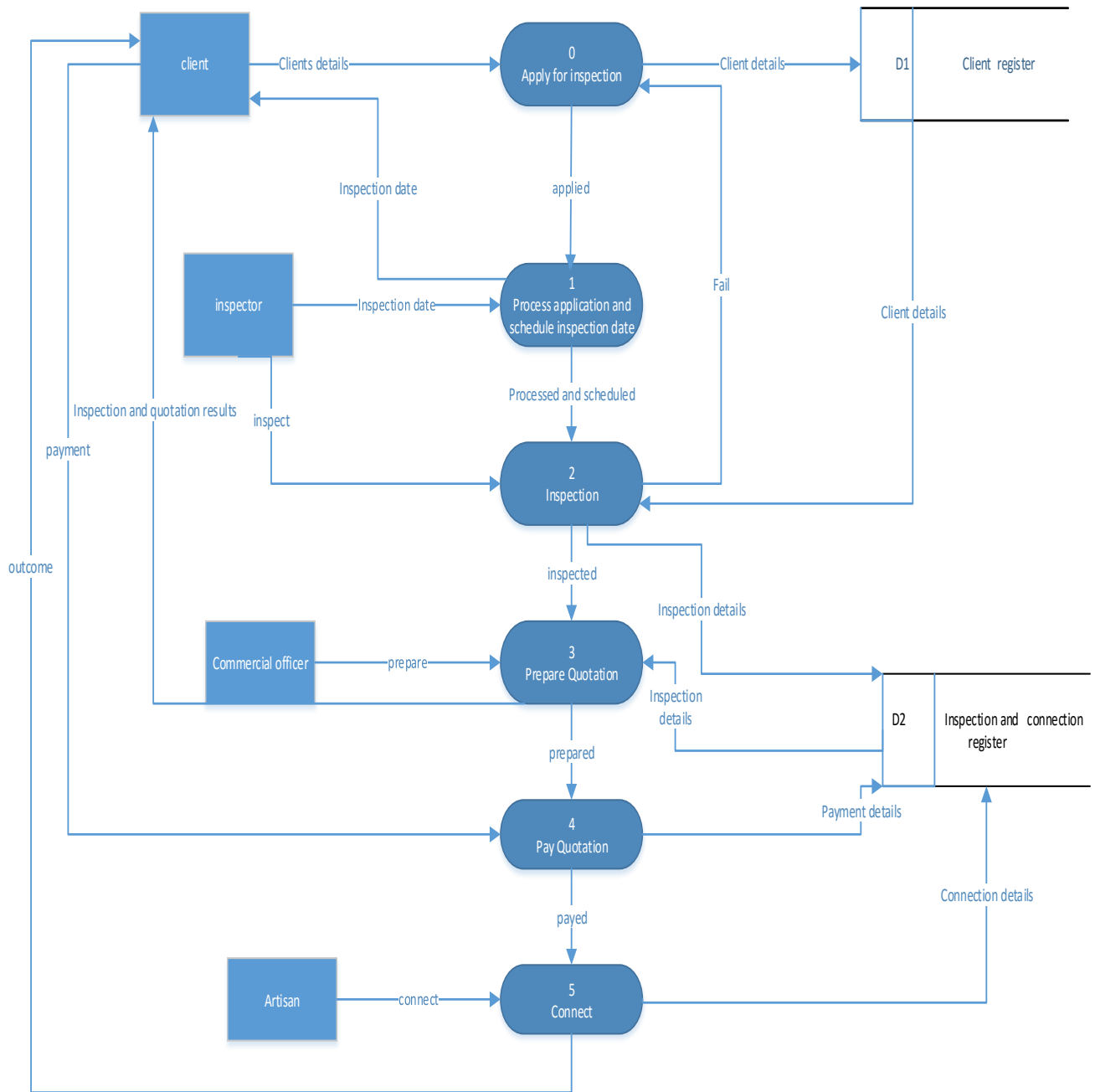


Figure 4.2 Data Flow Diagram

Context and DFD diagram does not require any technical knowledge to understand the flow of information so it enabled all ZETDC stakeholders to comprehend the new system scope.

4.3 Architectural Design

It is responsible for demonstrating how hardware, network and other infrastructure is laid out in an operation environment (Date, 2012), so during this design main components of the new system

were identified and how these components will communicate or relate. The diagram on figure 4.3 illustrates the architectural design of ZETDC ITC system.

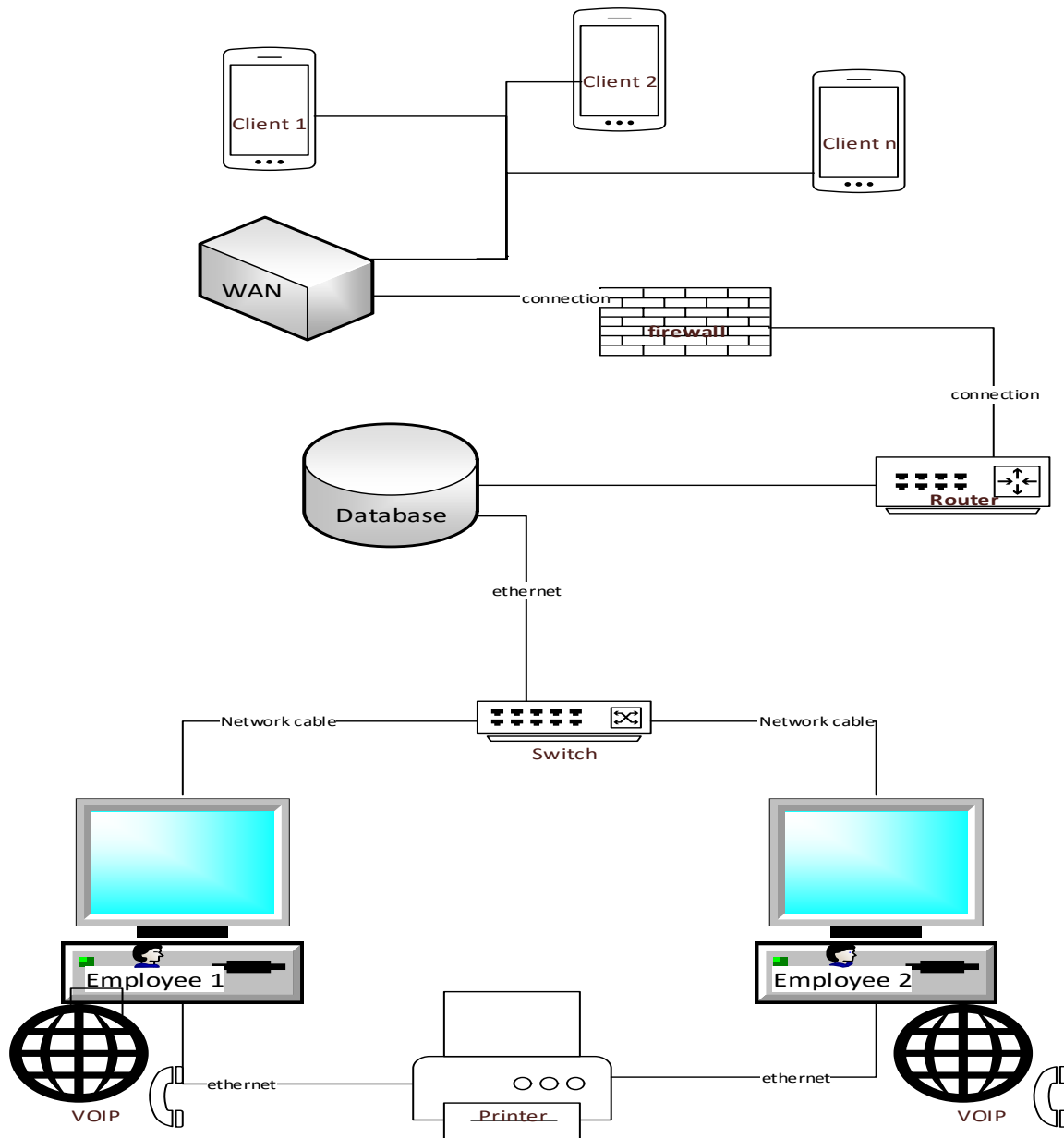


Figure 4.3 Architecture design

4.3.1 The Client Server Approach

A client server network is the one used on the architectural design and it is designed for end users known as clients (in this case these involve ZETDC customers, employees and management) to access resources such as files, guidelines and other services from the central computer known as the server. The client, which can be a laptop, desktop or any mobile device makes a request from

the server and the client uses network as a means of connection and communication with the server. Using the new system the client that is either the customer or employee uses the network to send and receive information about its request, the server takes in the request and ensure that it is a valid request, and if everything checks out fine, then the server will fetch the request and serve the client. The server can make a request from the client as well for instance a customer might have a query and send the question to the server, if the server does not have a response then it directs the question to the help desk (which is another client) if it gets a respond then it get back to the customer. The project team chose the use of this approach since it centralises data and it makes it easy for administrators to manage the server, and it is also cost effective as compared to other approaches and since all businesses focus on reducing costs and maximizing profits, ZETDC does the same as an enterprise.

4.4 Physical Design

It is a technique of changing a logical model into physical/actual technical model, which displays the layout of components i.e. software, hardware and users in the new system (Rosenblatt, 2014). This design also gives a general view of how the components relate and communicate within the new system.

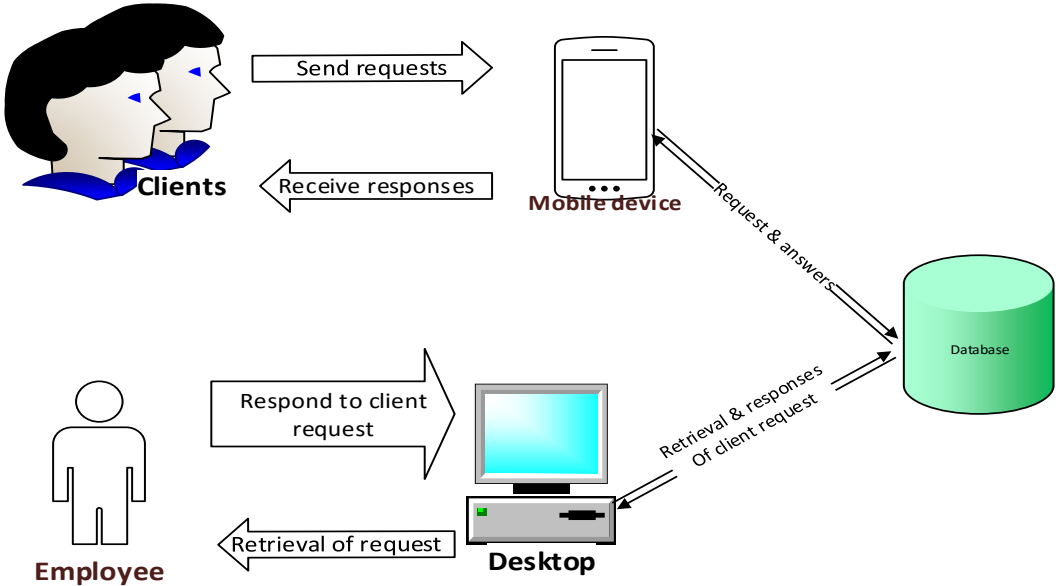


Figure 4.4 Physical Design

4.5 Database Design

This is a process of creating a comprehensive data model of database. The data model comprises all the required logical and physical design choices and physical storage parameters necessary to create an appropriate design in a data definition language, which will be used to generate a database (Date, 2012)

4.5.1 Database Tables

Table 4.1 Employee

Details	Datatype	Description
id	Varchar(10), Auto increment, Not Null	Unique identifier
F-name	Varchar(255)	First name of the employee
L-name	Varchar(255)	Employee surname
Dept	Varchar(255), Not Null	The department that an employee belong to
password	Varchar(255), Not Null	Employee's password
email	Varchar(255), Not Null	Employee's email
Created_at	Timestamp	Date employee created
Updated_at	Timestamp	The date employee details are updated

Table 4.2 Client

Details	Datatype	Description
id	Int(10), auto increment, Not Null	Primary key
Email	Varchar(255), Not Null	Primary key
f-name	Varchar(255)	Client first name
l-name	Varchar(255)	Client surname
Password	Varchar(255), Not Null	Customer's private access code
Address	Varchar(255)	Residential address
City	Varchar(255)	Residential town of the client
nat_id	Varchar(15,20)	Client's national id
Created_at	timestamp	Date of application
Updated_at	timestamp	Modification date

Table 4.3 Application

Details	Datatype	Description
Email	Varchar(255), Not Null	Client email address
Id	Int(10), Not Null, Auto increment	Primary key
Address	Varchar(255), Not Null	Client address

city	Varchar(255), Not Null	Client city
status	Varchar(255), Not Null	Status of the application
Type	Varchar(255), Not Null	Type of application
Created_at	timestamp	Date created
Updated_at	timestamp	Updated date

Table 4.4 Payments

Details	Datatype	Description
Email	Varchar(255),Not Null	Client email address
id	Varchar(255),Not Null, auto increment	Unique identifier
amount	Varchar(255),Not Null	Amount paid
method	Varchar(255),Not Null	Method of payment
code	Varchar(255),Not Null	Payment approval code
status	Varchar(255),Not Null	Payment status
Created_at	timestamp	Date created
Updated_at	timestamp	Updated date

Table 4.5 Admin

Details	Datatype	Description
Name	Varchar(255)	Administrator name
id	Int(10) , auto increment, Not null	Primary key
password	Varchar(255)	Administrator password
email	Varchar(255)	Administrator email
Created_at	Timestamp	Date created
Updated_at	Timestamp	Date modified

Table 4.6 Quotation

Details	Datatype	Description
Created_at	timestamp	Date created
Updated_at	timestamp	Date modified
id	int(10), Not Null, auto increment	Unique identifier
Email	Varchar(255), Not Null	Client email
description	Text, Not Null	Inspection results and Quotation details

Table 4.7 Query

Details	Datatype	Description
id	Int(10), Not Null, auto increment	Primary key
Query	text (Not NULL)	Client's query
action	Varchar(255)	Query action
Status	Varchar(255)	Query status that is either replied or not
Email	Varchar(255)	Client email
Reply	text	Reply to the query

Table 4.8 Tutorials

Details	Datatype	Description
title	Varchar(255), Not Null	Tutorial title
Created_at	timestamp	Date created
id	Int(10), Not Null, Auto increment	Primary key
path	Varchar(255), Not Null	File path
Updated_at	timestamp	Date updated

4.5.2 Enhanced Entity Relationship Diagram

EER is an advanced data model, which includes more features to the normal entity relationship model. It is a diagrammatic technique for displaying the completeness constraints, disjointness constraint, subtype discriminator as well as super type and subtype relationship (www.tutorialride.com).

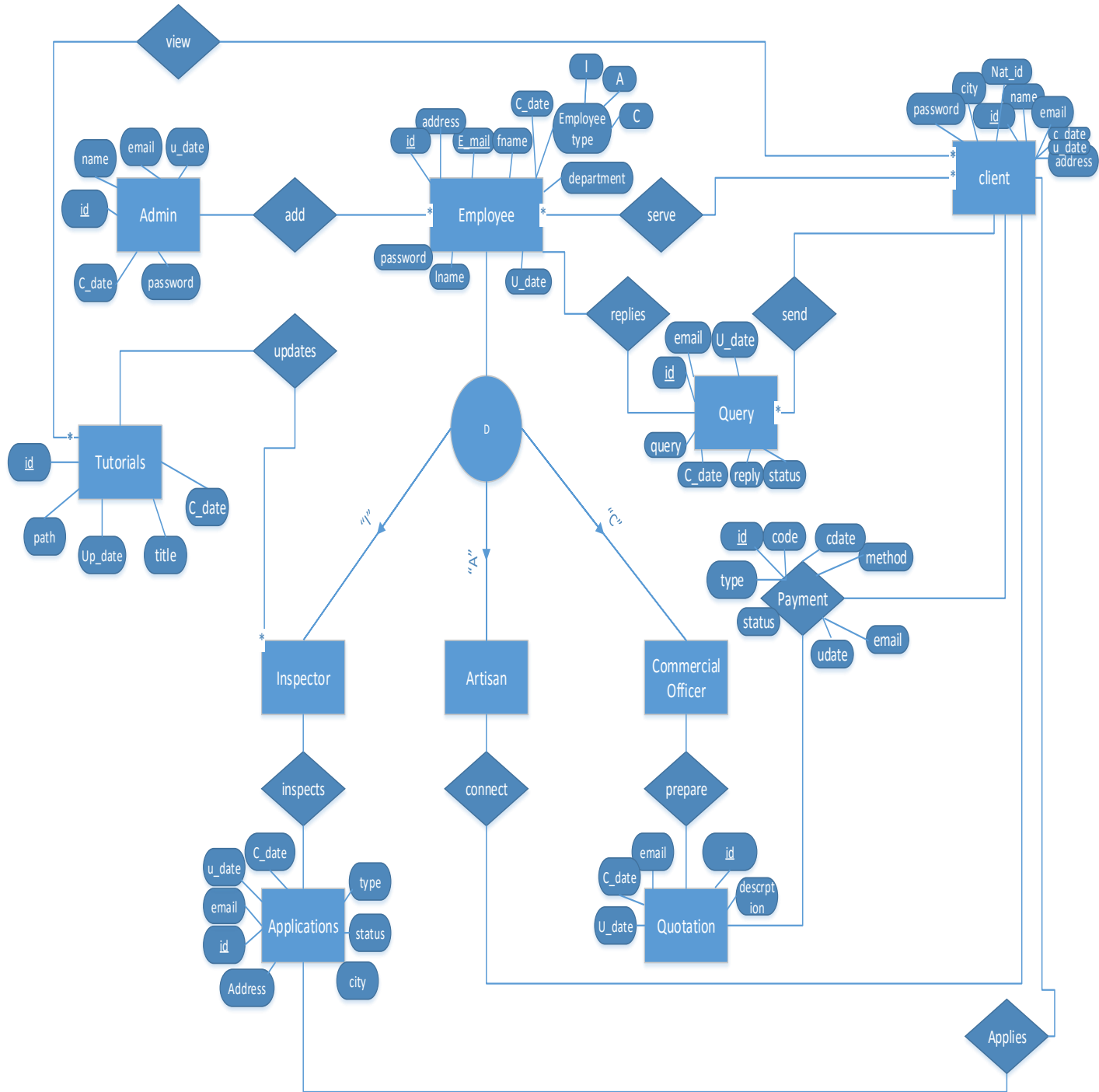


Figure 4.5 EER

4.6 Program Design

This is a technique of designing and constructing modules of the new system as well as describing the interaction among the various modules. Program design is achieved through the modelling of package diagram, class and sequence diagrams. Unified Modelling Language (UML) support the creation of the above-mentioned diagrams (Dennis, Wixom and Roth, 2015).

4.6.1 Class Diagram

This is within the UML, and it gives a summation of modules in the new system, and how these modules associate with each other as well as the cardinality between these modules (Date, 2012), the Inspect to connect mobile application class diagram is modelled as illustrated overleaf.

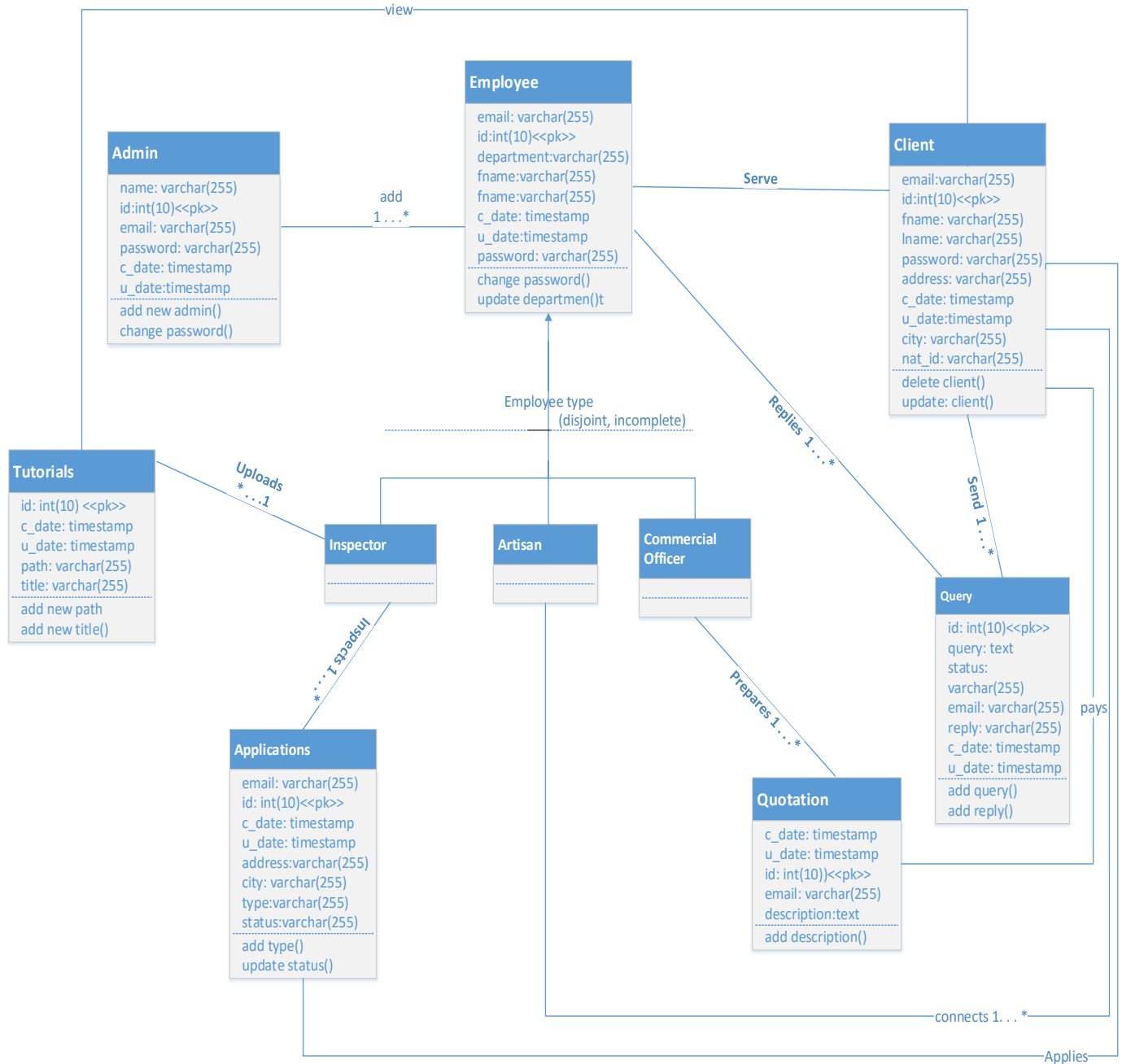


Figure 4.6 Class Diagram

4.6.2 Package diagram

Package diagram shows modules of the new system, which are collected into packages that collaborate to satisfy the system requirements (Dennis, Wixom and Roth, 2015). The following

diagram demonstrates the package design of the new system and the key modules that interacts with the system being developed.

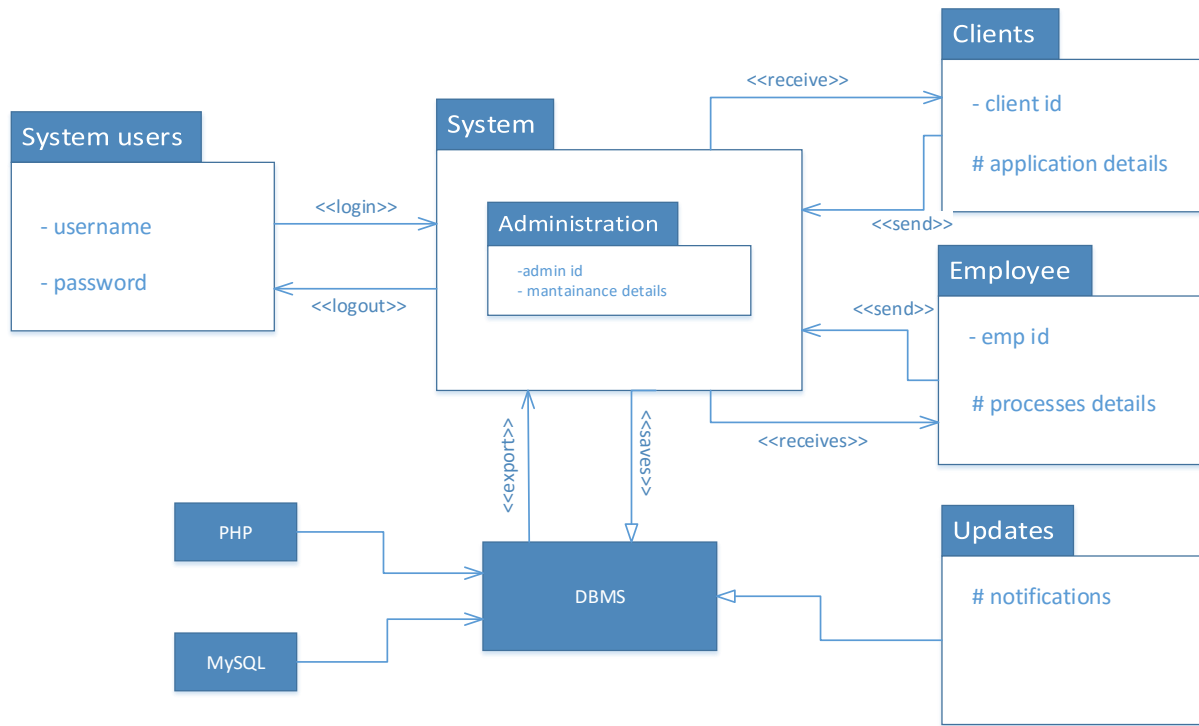
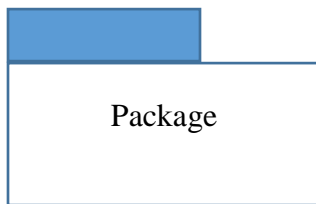


Figure 4.7 Package Diagram

Key

Protected attribute



+ Public attribute

- Private attribute

<< Send >> Dependency

4.6.3 Sequence Diagram

The diagram demonstrates the sequential order of how the new system interact (msdn.microsoft.com). It also specify the system’s object activity and the message passed from one object to another. The message passes several objects until it gets to its final class.

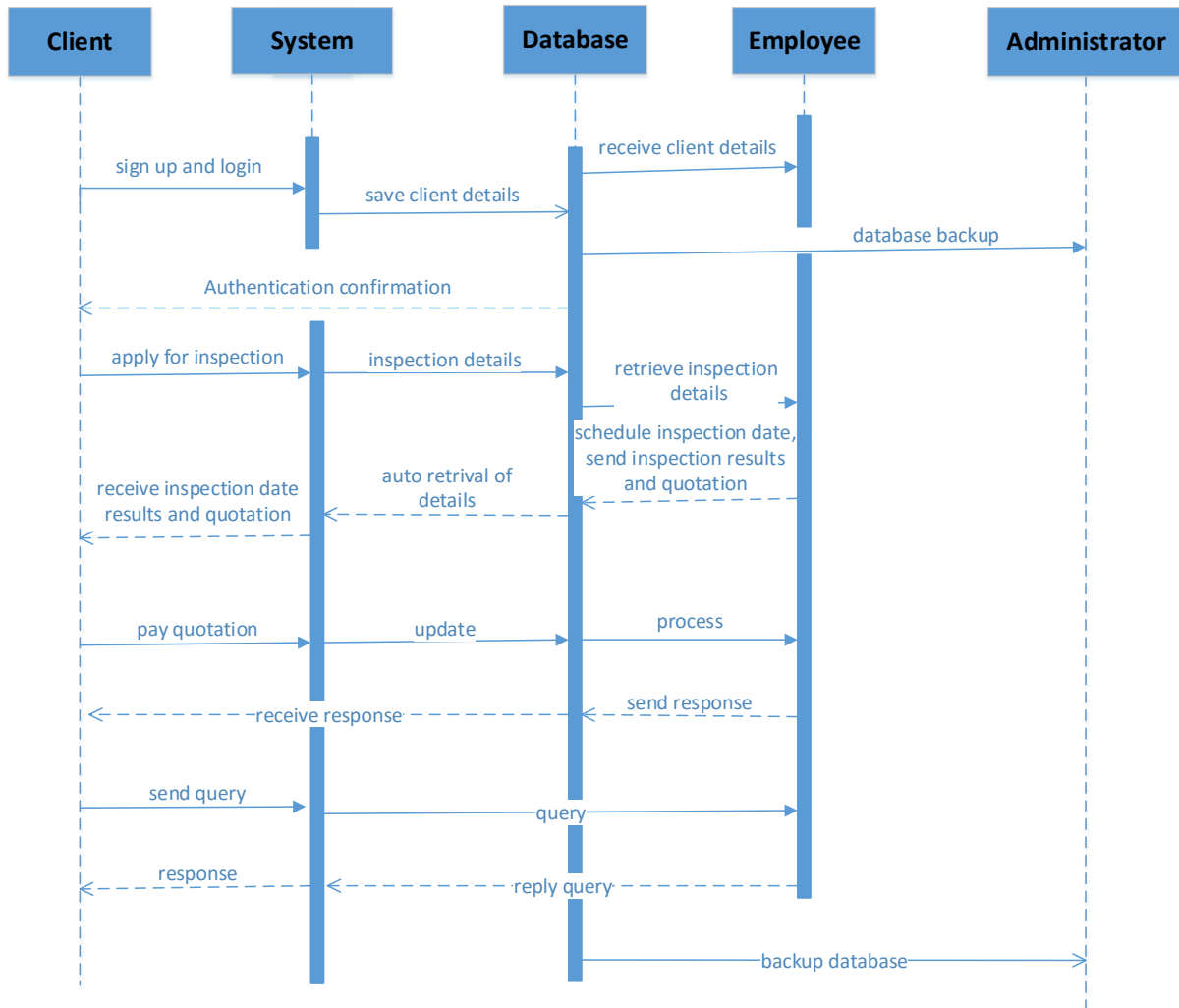


Figure 4.8 Sequence Diagram

4.7 Interface Design

(Rosenblatt and Tilley, 2016), defined user interface design as “the design of websites, computers, appliances, machines, mobile communication devices, and software applications with the focus on the user’s experience and interaction. The goal of user interface design is to make the user’s interaction as simple and efficient as possible, in terms of accomplishing user goals, which is often

called user-centered design.” This is a front-end application that users interact with when using the new system, since it enables users to manipulate and control the system thereby providing fundamental platform for human system interaction. A good user interface must be attractive (beautiful), easy to use, responsive (respond in short time), easy to understand as well as facilitating two way communication (should offer informative feedback).

4.7.1 Menu Design

Main menu is an array of standard and universal commands grouped together and placed at a visible place inside the application window, the main menu usually appears when the user opens the application, and it may be programmed to appear or hide on mouse clicks or hovering (Kendall and Kendall, 2014). The following Figure illustrates how the user gets to main menu.



4.7.2 Input Design

Input is raw data that is processed to produce output; system input quality determines the quality of system output. A well-defined input design must be able to use validation check and develop effective input control (Dennis, Wixom and Roth, 2015), the input interface must be easy to understand (self-explanatory) and easy to use.

SIGN UP			
Name	<input type="text"/>	Surname	<input type="text"/>
National id	<input type="text"/>	Address	<input type="text"/>
Email	<input type="text"/>	City	<input type="text"/>
Password	<input type="text"/>		
<input type="button" value="Create Account"/>			

LOGIN
<input type="text" value="Email"/>
<input type="text" value="Password"/>
<input type="button" value="Login"/>
<input type="button" value="Create Account"/>

A client to create an account uses sign up form, and then s/he will be automatically assigned a client id. The login in form enables both employee and the client to access the ZETDC ITC system.

The client to apply for electricity inspection and connection fill in the required details and then click apply on the following application form.

Inspection Application	
<input type="text" value="Address"/>	
<input type="text" value="City"/>	
Type	<input type="text" value="Residential"/> <input type="text" value="Domestic"/>
<input type="button" value="Apply"/>	

Submit Payment	
Amount	\$
Method	Ecocash Telecash OneWallet RTGS
Payment Proof code	A09983
Send	

A client enter the amount she or he paid, select the method s/he used for payment, enter the payment proof code and then submit the form for processing.

Send your query
Enter your query message here
Submit

A client submits all his or her questions, not addressed on the tutorial platform using the query form.

Employee forms

Inspector	
Queries	
Email	tsitsi@gmai
Query	
Reply	
Submit	
Tutorials	
Title	Upload
Submit	

Commercial Officer	
Email	tsitsi@gmail.
Quotation	Meterbox\$50 5mcable \$30 Total \$80
Quote	

Artisan	
Email	tsitsi@gma
Date	06-06-2017
Inspection	Pass
Amount	\$19500
Connection	connected
Remarks	
Submit	

The client details comes by default, so is the requirements on commercial officer form, inspection, amount on Artisan form.

When the employee logs in s/he will be directed to his or her appropriate platform.

4.7.3 Output Design

The developers recognise the type of output needed, and then considers the necessary output controls and prototype report layouts. A good output design must serve its intended purpose and eliminate the production of unwanted output, meet the user requirements, deliver appropriate output quantity, output forms must be in appropriate format and directed to the right person as well as make output available on time for decision-making process (Dennis, Wixom and Roth, 2015).

Table 4.9 Client Report

Email	Name	Surname	National id	Address	City	Type
tsitsimakuni@gmail.com	Tsitsi	Makuni	38-12401S83	1107 Chikanga	Mutare	Residential
devenm@gmail.com	Deven	Makuke	38-12301S83	2011 Chikanga	Mutare	Commercial

Shows the applied clients

Table 4.10 Employee Report

Email	Name	Surname	Department
tsile@gmail.com	Tsitsi	Makuni	Engineering
conny@gmail.com	Constance	Mabaso	Inspection
nai@gmail.com	Naison	Guzha	Commercial

Table 4.10 shows the employee report of those who work with the new system

Table 4.11 Application Report

Id	Email	Name	Surname	address	city	status	Type
1	tsitsimakuni@gmail.com	tsitsi	makuni	1107 chiks	Karoi	Send quote	commercial
2	devenm@gmail.com	deven	makuku	234 rprak	Chinhoyi	reject	domestic

Table 4.12 Payment report

Id	Email	Payment code	Payment method	Amount	Status	Action
1	tsitsimakuni@gmail.com	A1245	Ecocash	200	Approved	
2	devenm@gmail.com	T345tg	Telecash	50		Approve

Table 4.11 and 4.12 shows all the clients who applied and their payments respectively

Reports Overview

Table 4.13 Weekly Statistical Report

Clients Applied	Clients Inspected	Clients Connected
100	80	50

Shows a number of clients who applied, inspected and connected on weekly intervals the same applies on the following monthly statistical report.

Table 4.14 Monthly Statistical Report

Clients Applied	Clients Inspected	Clients Connected
1000	800	600

4.8 Pseudo Code

Pseudocode is a "text-based" detail (algorithmic) design tool (Braharu, 2017). It makes use of the structural conventions of the common programming language; it is intended for human reading and understanding, not machines or computers. Pseudocode usually ignores details that are important for machine comprehension of the algorithm, which include declaration of variables, system-specific code and to mention but a few.

Pseudo Code:

Login

Begin

Open mobile application

Input login authorizations

 If authorizations are, correct

Then

 Successful login

 Commence operator session

Else

 The login is unsuccessful

 Print out an error note

 Remain on the login platform

New User Sign Up

Enter the sign up details

 Check if the entered particulars are correct

If particulars are incorrect

Print out an error note

Else

. Enable database connection

Save the details in database

Send confirmation message

Saving Data to the Database

Set connection parameters;

Connect to the DB

If captured data is accurate then

Save in the database and pass a notification message e.g. saved

Else

Notify and discontinue connecting

Validate login forms

If field is blank

Notify the user

Else if Password is incorrect

Notify the user and deny access

Else if password length is less than eight characters

Notify the user and deny access

Else, if field does not require special characters and the typed characters are special

Reject character and make it known to the user

Else

Stay on the login page

Data Capturing and Updating

If field is empty

Notify user for amendments

Else if

Typed data does not meet set length specifications

Make it know to the user for correction

Else if

Typed data does not meet set character specifications

Alert the user for correction

Else

Accept data and save to the database

Redirect to the next procedure/ appropriate page (if available)

4.9 Security design

These are measures taken against all kinds of traits, which might damage data integrity, security or confidentiality as well as data consistency (McClure, Scambray and Kurtz, 2012). The measures are categorized into three, which include physical security, network security, and operational security. Discussion for more details on the mentioned measures are explained below

4.9.1 Physical security

These are physical protection measures on Information technology or computer infrastructure, which include hardware, software, network and data. The infrastructure is secured from physical activities and actions that could cause severe damage or impairment to an organisation, agency or institutions (Forouzan, 2012). The physical measures include protection from fire, terrorism, theft, vandalism, flood and burglary, so the security should provide locks, rational artificial intelligent agents like fire detectors, smoke and fire sensors that either alerts the responsible personnel or sprinkle anti-fire liquids or gases and at the same time alerts the responsible person. Surveillance cameras all over the business infrastructure is also another physical security measure, as well as the use of softbot robots like javex on the entire building or server room.

Physical security layout

Security guard on the main entrance

Assets like physical database, routers, and servers and to mention but a few are locked in the server room, which is not accessible to the unauthorized personnel.

Temperatures in the server room are monitored and maintained to avoid damages caused by weather on the computer assets since servers must operate at a specified range of temperature else they will crash and data will be lost.

Smoke and fire detection agents are installed in the server room to alert administration if fire or smoke is detected as well as activating sprinklers if the fire rate is above 15%

4.9.2 Network security

According to www.cisco.com, “network security is any activity designed to protect the usability and integrity of network and data, it includes both hardware and software technologies. An effective network security controls access to the network and it targets a variety of threats and stops them from entering and spreading on the network. Network security combines the multi layers of defense, each network security layer implements policies and controls”. Authorized users have access to network resources and malicious actors are denied access of carrying out exploits. ZETDC secured its network though the use of network access control (where only the authorized users will have access to the network), antivirus and antimalware software, and behavioral analysis (where network administrators understand what normal network behavior looks like and detects abnormal network behavior). Network intrusion detection systems like packet sniffing , firewall (puts a barrier between ZETDC trusted interior network (LAN), and untrusted exterior network like internet) are also other measures taken by the company to secure its network.

4.9.3 Operational security

This analytical process categorizes information assets and ascertains the controls required to safeguard the unauthorized access of the new system (McClure, Scambray and Kurtz, 2012). ZETDC operational security measures for both employees and clients are as follows:

Employees

Machines are accessed using domain accounts on active directory, which requires passwords and employee id for access and the passwords are set to change after every two weeks, so that it becomes difficult for a hacker to guess the password.

On ITC employee backend application, employees are requested to first input their login credentials for them to have access to the operational part of the system.

Use of strong passwords with special character and numbers, which makes them difficult to guess, is encouraged.

Clients

Clients are encouraged to put patterns, password or any other form of security measures on their mobile devices (optional).

There is use of passwords and client id (login credentials) to enable the client to have access to the ITC mobile application.

4.10 Conclusion

The design phase explained how the new system looks like. All the designs that encompass architectural, program, physical, interface and database were outlined and explained in this chapter. The phase also explained how and what data must be retained in the database as well as, how system components interact on various designs mentioned above. The next chapter focuses on the implementation and maintenance phase.

CHAPTER 5: IMPLEMENTATION PHASE

5.1 Introduction

Implementation phase is the execution and practice of plan or a design (Sommerville, 2015). This involves putting the project's blueprint into action, where the project team actually did the project work to come up with the new system. In I.T context software and hardware, implementation encompasses development of the system (coding), testing, installation, configuration, integrations, user training, maintenance and recommendations.

5.2 Coding

Coding is also known as computer programming, where the developer design, writes, debugs and maintain the source code of the new system. According to Dickins, Stowell, and Melmoth (2015) the programmer converts the specifications or user requirements in chapter 1 into computer comprehensible language. Android studio was the software used to develop the Inspect to Connect (ITC) mobile application for ZETDC. The programmers, system analysts, researchers, and the appropriate users participated in the coding exercise

5.3 Testing

Software testing is an exercise of debugging a system or software with the intention of discovering the faults within the developed software that might affect its performance or security. It can also be stated as an exercise of validating and verifying the new system, application or product. The main objective of undertaking software testing is to find out if the software meets the user requirements (both functional and non-functional requirements). Mahapatra (2016) also defines it as “a process of evaluating a software item to detect differences between input and expected output”. The testing process also evaluates the quality attributes of the software. Verification and validation is part of the software testing exercise where verification guarantees that the system meets the conditions imposed at the beginning of the system development, so the product must behave as expected in the specification phase. Validation then ensures that the system satisfies the specified user requirements at the completion of the development phase, so the system must be fabricated as per user requirements. Testing is mainly conducted using either black-box testing technique, white-box testing technique or both. The following subtopic focuses on black box and white box testing technique respectively.

Black box testing

Black box technique pays no attention to the internal mechanism of the system but concentrate on the output produced or generated against any input (Suryan, 2014). This technique is also known as the functional testing and is mainly used for validation purposes.

White box testing

White box testing technique takes into consideration the internal mechanism of the system (Suryan, 2014). It is also known as the structural, or glass box testing. The personnel that use this technique are required to have knowledge on the programming field. The technique is mainly used for verification process.

There are various stages associated with the testing exercise using the mentioned two testing technique (white and black box) and they encompass unit, integration and acceptance, which are explained in detail on the next subtopics.

5.3.1 Unit testing

Unit testing is the process of examining an individual unit where a single module is given attention with the aim of verifying if the module is performing as per user requirements (msdn.microsoft.com). Unit testing encompasses functional testing, which ensures that all the specified or stated functionality or user requirements in the system specifications are working as expected. All the modules were independently tested as demonstrated by the following screenshots and black box and white box testing were the techniques used in this stage. On black box testing technique the appropriate end users without programming knowledge were given the various units to ensure if they were working as expected and fulfilling their purpose. Systems analyst, and programmers who tested the independent units from within the units or modules source code to the physical functionality of each module conducted white box testing technique.

The image shows a mobile application interface for creating an account. At the top, there is a blue header with a back arrow and the word "Apply". Below the header, the form consists of several input fields: "Email", "First Name" (with a red underline), "Surname", "Address", "City", "National ID Number", and "Password" (with an eye icon for visibility). At the bottom of the form is a grey button labeled "Create Account". The status bar at the top of the phone shows various icons and the time 19:34 with 41% battery.

Figure 5.1 Create Account

This module was tested to verify if it works as expected, by submitting the required details to the company database and creating an account for the user that he or she will use to undertake all the processes of electrical inspection and connection. The project team concluded that the module is functioning well.

Objective 1: Remote inspection application using mobile phone

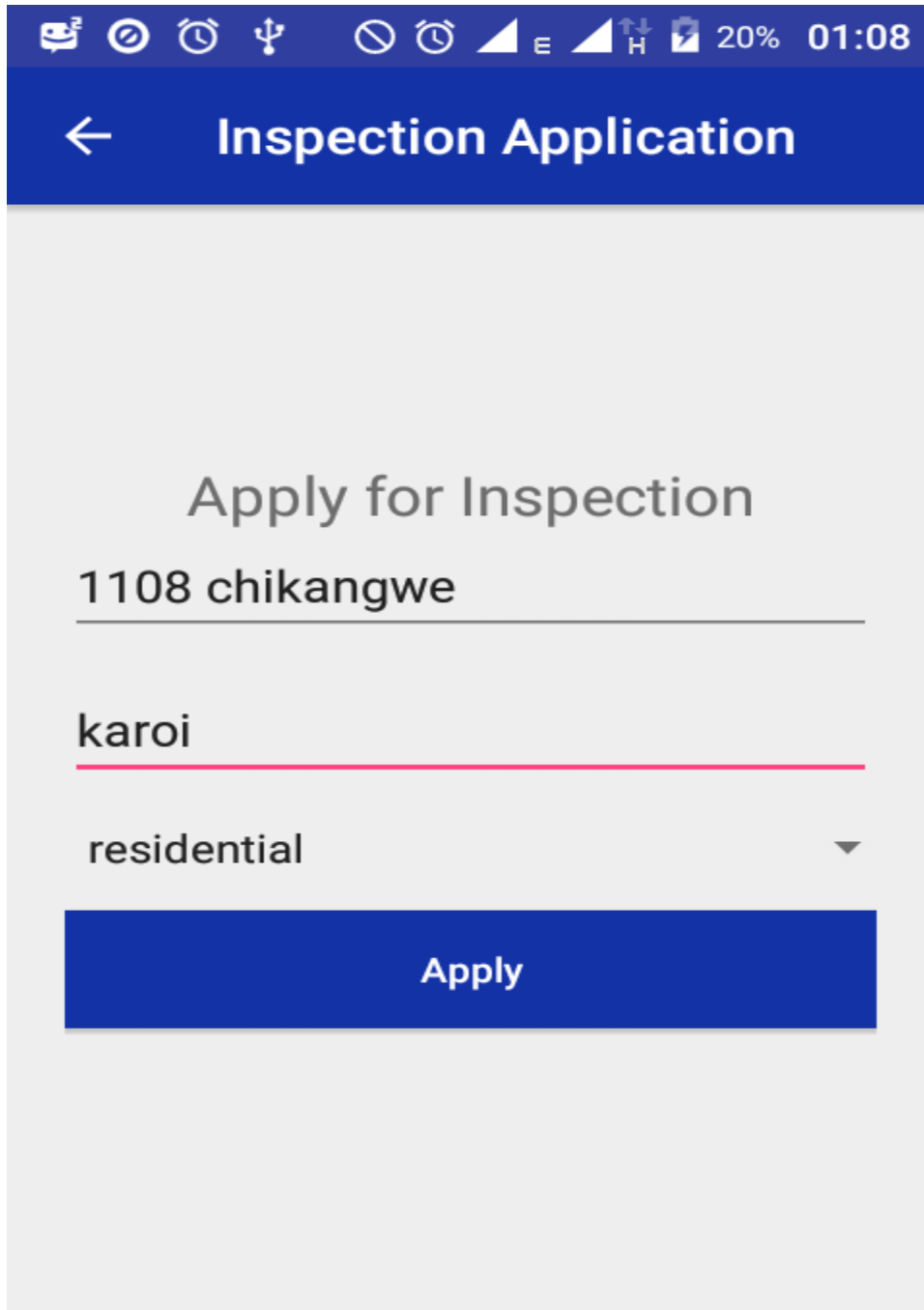


Figure 5.2 Inspection Application

This module focuses on the application for inspection, so it was tested to see if it functions as required and the testing team said it was designed well and it functions as expected. The problem which were associated with the inability to apply remotely was solved using figure 5.2

Objective 2: Remote Payment Proof Submission

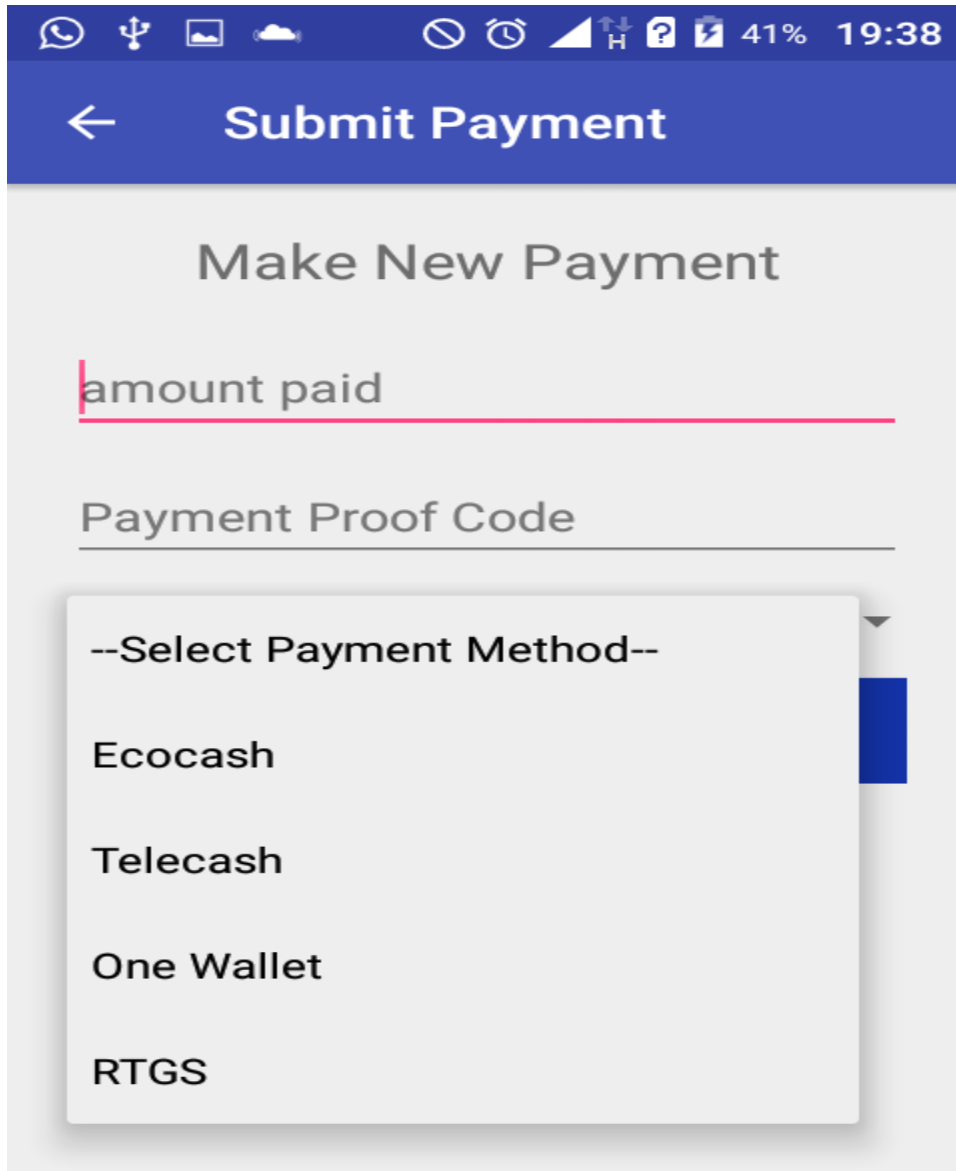


Figure 5.3 Payment Module

The module was tested to verify if the clients are able to make payment using their mobile wallets by sending the quoted amount to ZETDC number and then upload their payment proof using the mobile application. If the payment proof reflects to the responsible employee, he or she then checks if s/he received the money on the payment proof and the code uploaded thereby meeting another system objective in chapter 1 on topic 1.5. The source code of this modules was checked to verify if it is bug free. The module functions perfectly well.

Objective 3: Sending Queries

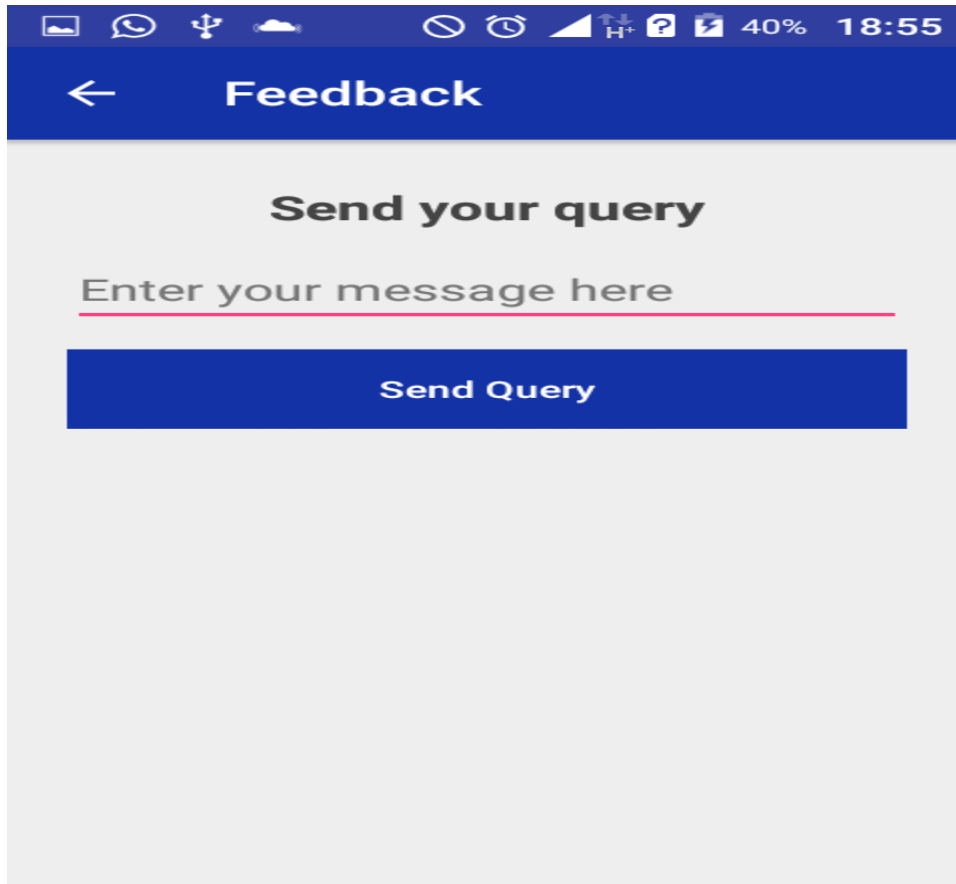


Figure 5.4 Queries Module

The query module was tested to see if the ZETDC clients are able to send queries to the company, and the testing team verified that the module is working as expected and it is free from bugs thereby achieving the third objective of providing a communication forum where clients will send the inquiries and queries using the mobile application.

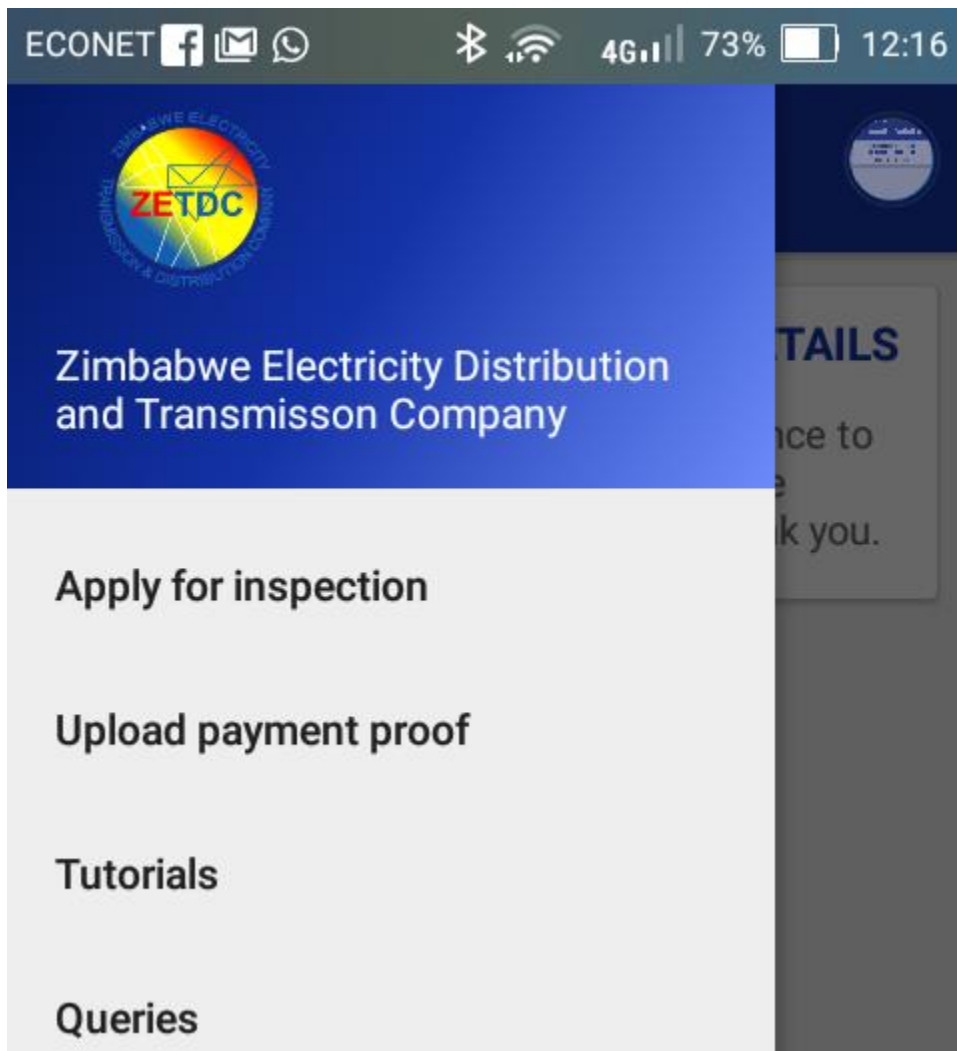


Figure 5.5 Main menu module

The main menu module was tested to see if the submenus will be redirected to the correct page or module upon selection for example apply for inspection must redirect the user to the module on Figure 5.2.

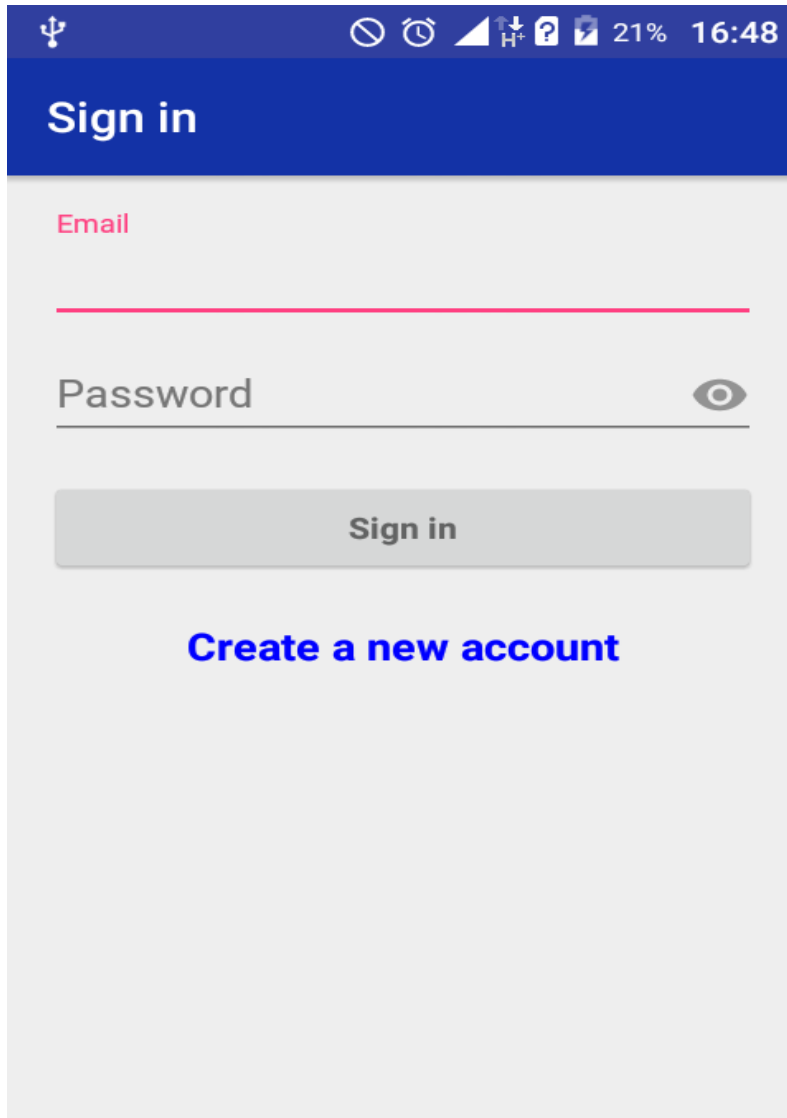


Figure 5.6 Sign in

This module (Figure 5.6) provides security to the clients that is for a client to have access to the functionalities of the mobile application must have correct credentials failure to provide the accurate credentials means the customer cannot have access to the mobile application as illustrated by the following Figure

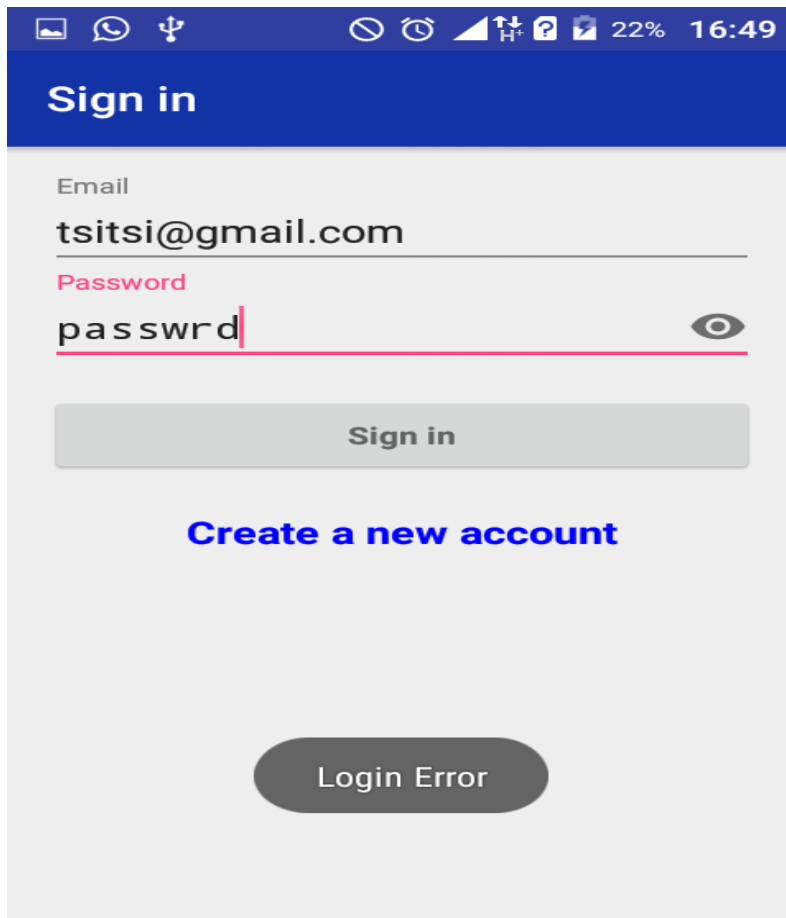


Figure 5.7 Validation and Security Illustration

Figure 5.7 shows that if the password or email address is incorrect the user will be denied access and password is encouraged to be typed when activating the “eye” so that as you type password will be displayed in special character not a plain text on the Figure, thereby improving security of client password confidentiality.

The testing team agreed that the security feature was well designed and no one can access the application unless they do have correct details required.

Objective 4: Ability to quote and send quotation details to the client on the mobile application

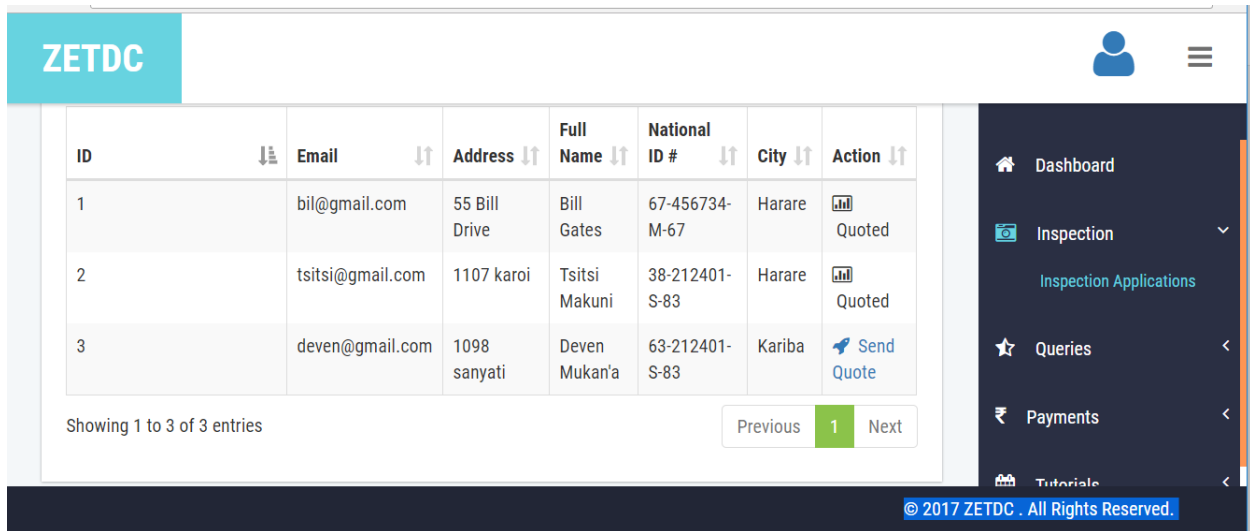


Figure 5.8 Quote

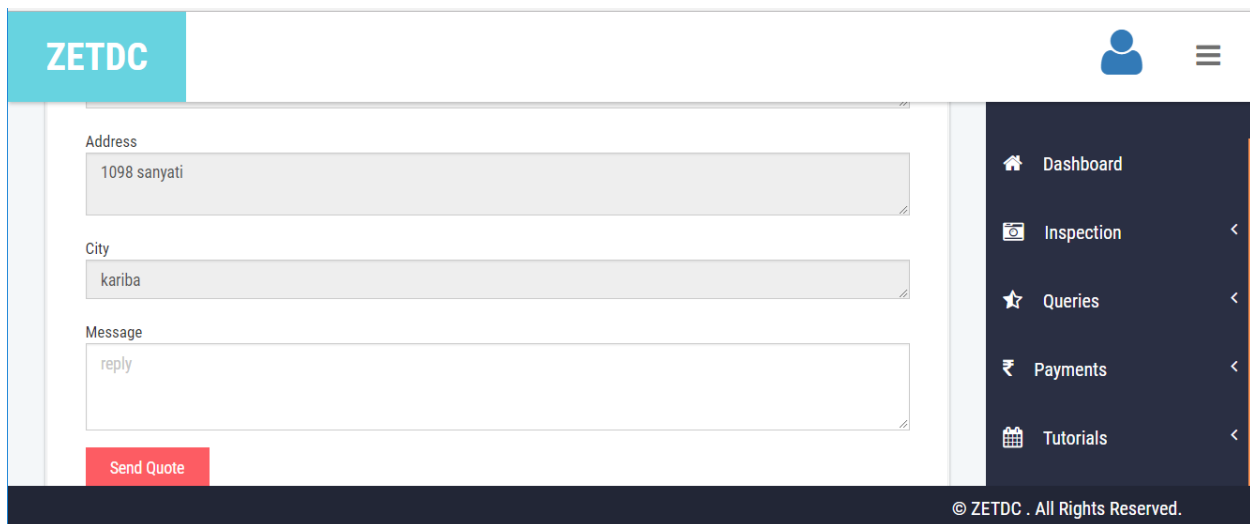


Figure 5.9 Send quote

Figure 5.8 and 5.9 enables the responsible employee to make a quotation from the results submitted by the inspector and send it to the clients thereby achieving the fourth objective of allowing ZETDC to send inspection results and quoted connection fee to the clients. Functionality of the module was tested and deemed successful.

Objective 5: Uploading education content regarding inspection and connection procedures

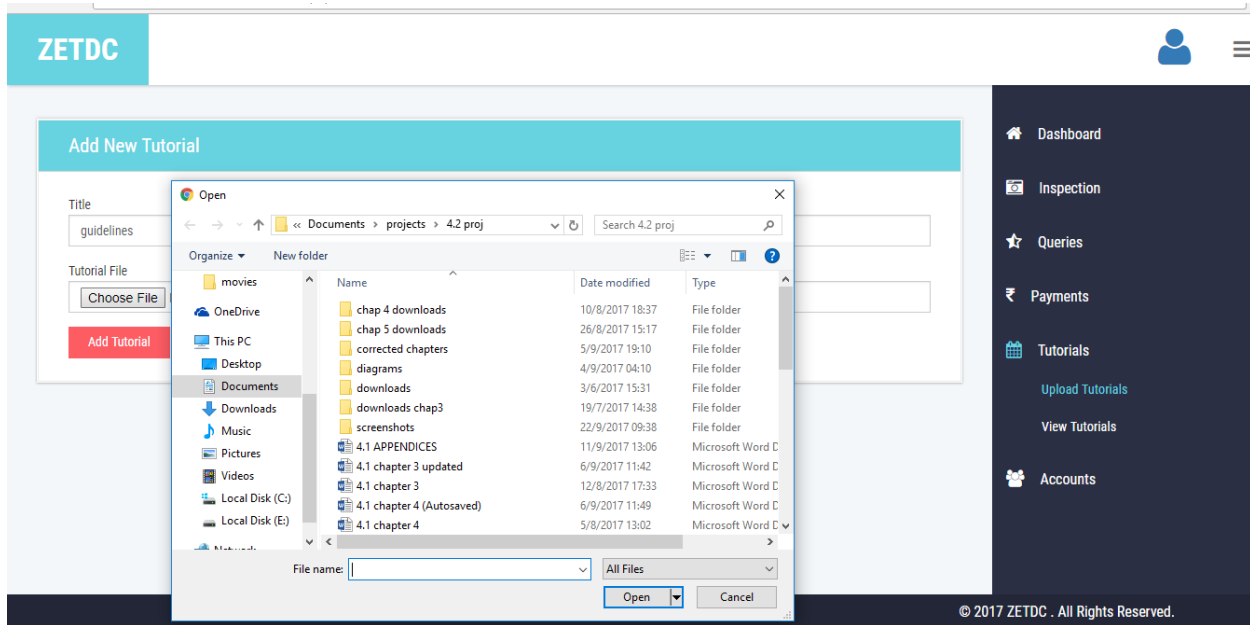


Figure 5.10 Upload tutorials

Figure 5.10 enables the responsible official to upload pdf documents with inspection and connection educational content, which includes electrical inspection guidelines thereby achieving the fifth objective of providing clients with content regarding electrical and inspection procedure. The functionality was tested and validated and it was judged good.

5.3.2 Integration Testing

The single units on 5.3.1 are combined into subsystem that should work together which makes it easier to spot or identify errors associated with module compatibility. The aim of undertaking the test was to make sure that errors would not surface during the integration process as well as checking if the modules are compatible with each other and they interact as expected, thereby producing accurate results (msdn.microsoft.com). This exercise is repeated until there are no more bugs on the integrations and when modules interact and communicate effectively with each other. Integration testing also encompasses software and hardware interaction testing that is ensuring if hardware and software components have any association. Black box testing partakers focused on checking if the modules are interacting and communicating as expected whilst the white box partakers drilled a little dipper to check if there are no bugs associated with the integration of various modules or surfacing during integration process.

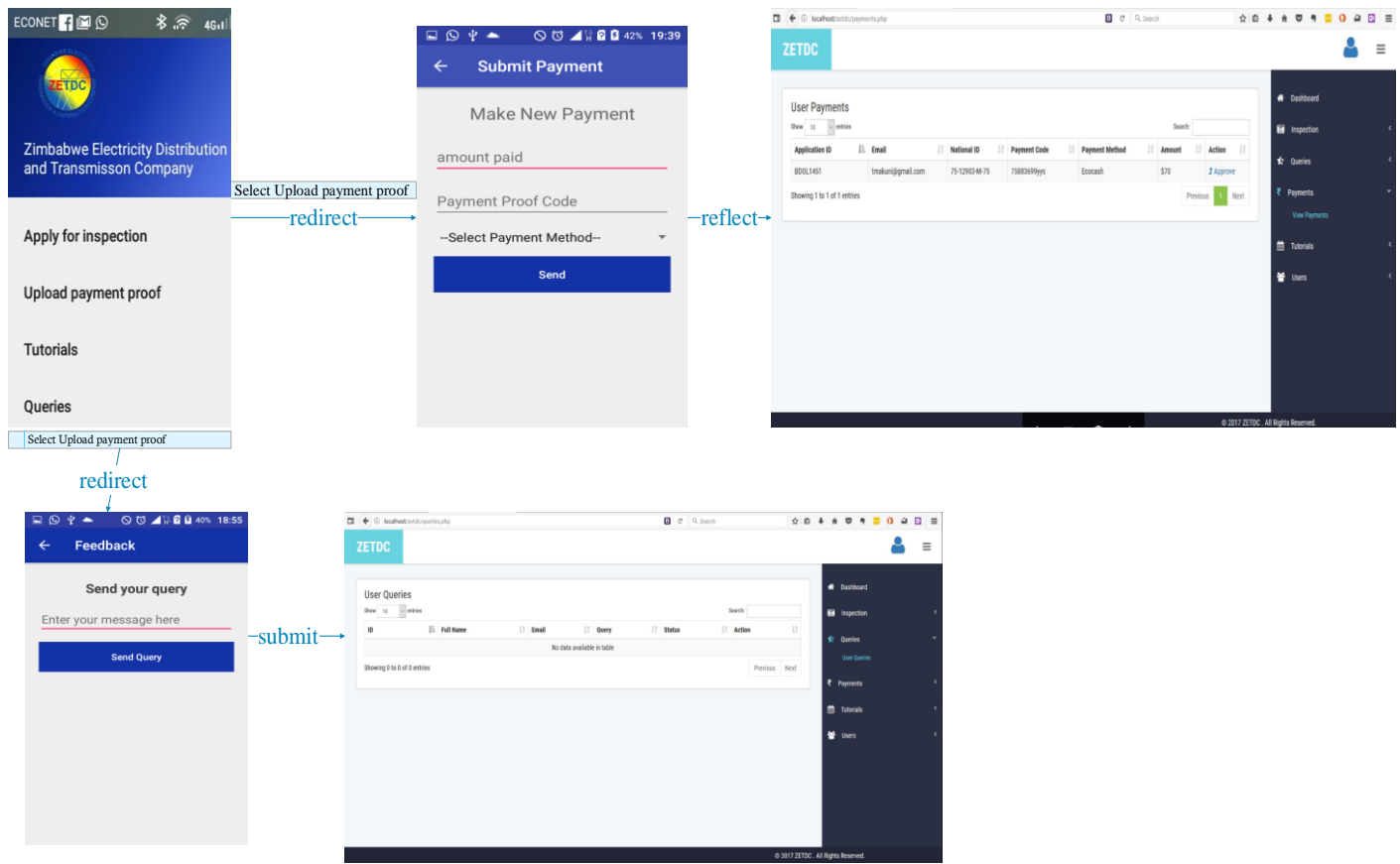


Figure 5.11 Integration Illustration

Figure 5.11 illustrates the interoperability among various modules, which were tested on the unit testing. The integration illustration diagram says if the client select “upload payment proof”, she or he must be redirected to the payment module and if the payment module is submitted, it must reflect to the ZETDC user payments, so that the responsible official will work on it that is either approving it or asking for clarification. The same occurs when the client select queries on the menu, she or he will be redirected to “send us your queries page” and once he submit the query it must appear in the ZETDC users queries page so that the responsible employ will work on it. If the modules fail to cooperate it means integration testing have failed. After undertaking the integration test the testing team concluded that, the sub modules cooperated well so they moved on to system testing.

5.3.3 System Testing

Modules were interrelated or connected during integration test, which resulted in the creation of a full system. The full system/ software was then put in different environments that is different

operating systems, hardware components with different specifications to test if it still works or operate as expected. The objective of system testing was to verify if the full system was still functioning as per requirements as well as examining how the entire system perform, withstand stress and its usability through performance testing, stress testing and usability testing (Tsui, Karam and Bernal, 2014). On performance testing, there was assessment on the system speed and effectiveness as well as ensuring if it is producing outcomes within a stated time as in non-functional requirements. On stress testing the partakers were focusing on evaluating how the system performs or behaves under unfavorable conditions for example, how the system behaves when pressurized by many users, does it slow down, freeze or even crush. Then on usability testing, the focus was on the client perspective evaluating how the system graphical user interface is user-friendly? How effortlessly can the customer learn (perceived ease of use)? In addition, after attaining knowledge on how to use the new system, then how competently can the customer perform? Is the design attractiveness or pleasing to use? System testing falls under black box testing where the partakers checked if the entire system still meets the specified objectives, as well as checking if the modules still cooperate well. The partakers of black box testing also checked if the appropriate outcome was produced by the system. After system-testing exercise was deemed successful, the project team needed to ensure that the new system would be accepted and used, so they undertook an acceptance testing exercise.

5.3.4 Acceptance Testing

The project team and stakeholder representatives needed to ensure or guarantee that the end users will use the new system after installation, so they conducted an acceptance testing exercise. Acceptance testing shows if the system will be accepted and used by the end users when it is finally implemented (Suryan, 2014). Usability tests done on system testing showed that the clients found the system user-friendly, easy to learn and use, and were eagerly waiting for the official launch of the system.

After all the testing stages or procedures were done and considered successful, it was considered good enough to move to the installation phase, where the new system was officially launched in the organisation.

5.4 Installation

Installation is an exercise of making the new system ready for operation. Sommerville (2015) states, “Installation typically involves code being copied/generated from the installation files to new files on the local computer for easier access by the operating system”. Installation of a whole information system comprise of user training, data migration and system changeover strategies and recommendation on the best change over strategy.

Client installation procedures

Download ZETDC APK file from play store or any other recommended sites.

Run the application on your android device.

After successfully installing open the application and you can start using it.

Employee installation procedures

Install a browser application that is Chrome (recommended), Firefox, Opera etc.

Write <http://35.166.225.33/zetdc> on URL.

Bookmark for easy access (optional).

5.4.1 System Changeover strategies

This is the procedure of shifting from the ancient system to new system. Sommerville (2015) defined the system changeover as “the process of putting the new system online and retiring the old system”. There are three strategies used, which include parallel running, direct changeover and pilot conversion.

Parallel running

The old system and the new system operate simultaneously for a specified period, both utilizing live data, so that the efficiency and reliability of the new system can be measured and compared with the old system and once the outcomes of the new system are satisfactory then the old system is taken offline and the new system becomes wholly active and used throughout the enterprise (Sommerville, 2015). The old system and new system operate concurrently for a specific period of time and the results produced by these two systems are then compared, if the results of a new system are more satisfactory then the old system is stopped and the new system takes over. Advantages and disadvantages associated with this technique include:

Advantages

Users have the chance to acquaint or familiarise with the newly implemented system while the old system is operational

In the case, something goes wrong with the new system e.g. system failure, it is easy to revert to the old system.

Old system might be used for reference purpose

Provides an evaluation and feedback platform.

Disadvantages

The cost of operating two systems simultaneously is high.

Users consider this strategy tiresome since there is replication of work

Direct changeover

Direct changeover is also known as the immediate replacement where the old system is stopped and replaced with the new system (Tsui, Karam and Bernal, 2014). There is a fixed point where the old system is stopped abruptly then the new system go live. The strategy is considered as a cheap, quick and easy changeover technique, but at the same time it is also associated with high risks of data loss in case of a system failure, the entire firm suffers. The technique is mainly recommended when system disaster is not serious enough to result in a tragedy for the business.

Pilot conversion

Pilot conversion involves implementation of the new system to a defined cluster of users for the purpose of testing, evaluation and feedback. Mahapatra (2016) defined this technique as a process where the new developed system is tried out at the pilot site before officially launched companywide. The partakers on the pilot or beta site provide feedback on the quality, performance, reliability, efficiency and effectiveness of the new system. If the feedback is satisfactory then the system will then be rolled out to the entire organisation. The use of the pilot conversion technique enables the business to implement the newly developed system next to the existing old system but on a smaller scale.

Advantages

Users have the chance to evaluate the new system before it is launched companywide thereby determining the performance, quality and reliability of the new system rather than implementing disaster.

The company can make use of the pilot site for training purposes

If the system fails or encounter any challenges the entire organisation will not be affected.

Disadvantage

The system might perform well at the pilot site but then fail when implemented companywide.

Recommendations

The changeover strategies available were discussed and it was agreed to use the parallel running as the changeover strategy. The two systems will operate simultaneously for some time (until further notice), and then the new system takes over if it proves to be satisfactory and until all clients are accommodated as well as when all operations are automated (that is accommodation of digital signatures and digital certificates to avoid information repudiations). The finance department did their calculations on the expenses of operating the two systems and they concluded that the cost of operating the two systems is less than the cost of operating the old system alone and it was concluded that the introduction of the new system adds fascinating value to the organisation. Direct change over and pilot conversion were not considered convenient enough for smooth operation. The parallel change over strategy is also associated with less risks of data loss in case of the system failure and that is why it was also recommended.

5.4.2 Data Migration

Data migration is a process of transmitting data between data stores or computer systems. (Mahapatra, 2016) states that “A data migration project is done for numerous reasons, which include replacing or upgrading servers or storage equipment, moving data to third-party cloud providers, website consolidation, infrastructure maintenance, application or database migration, software upgrades, company mergers or data center relocation and implementation of the new system”.

Factors to take into consideration during a data migration exercise include how long the migration will take; the amount of downtime required; and the risk to the business due to technical compatibility issues, data corruption, application performance issues, and missed data or data loss.

The project team concluded that for data migration to take place the old system must have been using databases and servers to store the information. However, research showed that the old system used hard copy files to store the electrical inspection to connection information from the previous years to date, so if the data before the implementation of the system is to be stored in the new system, data captures must be contracted to transfer the hard-copied information to the new system. ZETDC management decided that the data on the hard copies must be left as it is for now and the new system should only capture information from the day it became operational.

5.4.3 User Training

User training is the process of educating the end users on how the new system operate, as well as training the I.T department how to install the software on new machines and the configurations procedures (Sommerville, 2015). Educating the users is an essential part for system implementation to succeed, so weekly workshops were conducted, where the end users were equipped with the new system operational knowledge. The users help when testing exercise was conducted prepared them for the new system when it goes live. Users are excellent on judging the performance of the system and are the one who can make the implementation successful or not, so lack of training may result in user resistance because of the fear of the unknown. Once the users resist to use the system it means implementation phase failed (system failure), and the organisation will encounter a big loss of \$19 000 (investment amount). The training was undertaken at Mutare ZETDC training center, where each group of stakeholders (artisans, commercial officers, inspectors and the I.T department) were trained for a week and the training period was allocated and budgeted for a month (04 September 2017 to 29 September 2017). Each training session had some few customers and I.T personnel, and then advertisements of the new system were done during the period of training with the intention of informing the entire country about the new application, how it works and its benefits. The training schedule is as follows

Table 5.1 Training Schedule

Date	Department	Time	Venue	Purpose
04 – 08 September	I.T	11am – 4pm	Regional office Boardroom	Administration and overall functionality of the system
11 – 15 September	Inspection	11am – 4pm	Manicaland District office boardroom	On uploading tutorials, scheduling inspection dates, as well as responding to queries
18 – 22 September	Commercial	11am – 4pm	Mutare District office boardroom	Quotation preparation and sending, as well as payment approval process.
25 – 29 September	Engineering	11am – 4pm	Mutare urban depot	Scheduling connection dates and uploading connection results.

5.5 Maintenance

Beichelt and Tittmann (2012) defined maintenance as the amendments done on the final system after it have been delivered with the intention of either correcting emerging defects, performance improvement and many other attributes like adding new user requirements and to mention but a few. Therefore, any effort done with the aim of altering the software or system when it have been operational is considered as maintenance. Preserving the worth of system over time is the main purpose of maintenance exercise and this is achieved through expanding the client base, meeting supplementary user requirements, adapting new technology, detecting system defects and amending them, improving the usability and efficiency of the new system. There are several types of maintenance and they include, adaptive, perfective, corrective and preventative.

5.5.1 Adaptive Maintenance

Adaptive maintenance involves the modification of a system to adapt to the environmental changes such as operating system, database management system and hardware components. Beichelt and Tittmann (2012) stated, “The term environment in this context refers to the conditions and the

influences which act on the system. For example, business rules, work patterns, and government policies have a significant impact on the software system". Generally, this type of maintenance enables the system to remain operational in an ever-changing environment since it keeps the system updated about the activities taking place in its operational environment.

Adaptive maintenance plan

The project team and the stakeholder representatives agreed that adaptive maintenance will be carried out in 6 months intervals, so if there are changes in the operational environment, they will be adapted after every 6 months, but if the conditions in the environment changes more frequently then revision on this plan will be considered.

5.5.2 Perfective Maintenance

Perfective maintenance exercise implements supplementary or additional user requirements, which is concerned with the system functionality enhancement. Perfective type of maintenance involves the improvement of system performance through making functional improvements or enrichments to the system in addition to the current activities. Beichelt and Tittmann (2012) defined perfective maintenance as the process of modifying and updating the software with the aim of making it usable over lengthy period of time. It takes into account the novel user requirements, new features for refinement of the system as well as the system's reliability and performance improvement.

Perfective maintenance plan

It was agreed that perfective maintenance will be carried on monthly basis, so that new user requirements will be taken into account as soon as they are identified as well as perfecting the operations of the new system.

5.5.3 Corrective Maintenance

Corrective maintenance mainly focuses on day-to-day repairing of errors/bugs to correct or fix problems, which are either identified by the end users or concluded by user weekly and monthly error reports (Sommerville, 2015). The bug or fault complains from the end users usually initiate corrective maintenance. The residual errors that avoid or preclude the new system from being compliant with the agreed specifications might be caused by design inaccuracies, logical faults and coding blunders so they must be corrected for a system to perform well. If a system failure

occurs because of an error, actions are then taken to reinstate the original operation state of the system.

Corrective Maintenance Plan

It was also agreed that corrective maintenance will be done on a daily basis for the first 3 months and the plan will be revised when the bug complains rate reduces.

5.5.4 Preventive Maintenance

Preventive maintenance focuses on modifying and updating the system to avoid future glitches or problems, which might not be considered significant now but might cause serious issues in the near future (Sommerville, 2015). Preventative maintenance takes into consideration documentation updating, code optimization as well as code restructuring. On documentation updating there is modification of the documentation by updating the areas that were affected by changes so that they match with the recent state of the system. Code restructuring, which gives attention to the program structure transformation for decreasing the complications in the source code and making it easy to comprehend thereby reducing the software complexity and improving the program comprehensiveness as well as increasing the system maintainability. Code optimization also focuses on the programs modifications for enhanced (quicker) execution and efficient utilization of storage space thereby preventing the issues of the system performing at an extremely low speed.

Preventive Maintenance Plan

The exercise that concentrates on precluding the occurrence of faults in the system was scheduled to be conducted in yearly intervals.

The project team and stakeholder representatives concluded that all the maintenance strategies must be implemented since it was identified that they serve different purposes because, when the environmental conditions changes the appropriate strategy to use is the adaptive not preventative, corrective nor perfective so they came up with plans for each type of maintenance.

5.6 Recommendations for future/further development

Recommendation for further development is an activity of suggesting what should be expected of the system in the near future, and the expectations include:

The new system should accommodate the use of USSD code (for non-android users and those who have difficulties with accessing the internet) since USSD code uses the mobile network.

The application should cover fault reporting as well as the ability of tracing the progress of resolving the reported fault.

The facility should enable ZETDC clients to purchase ZETDC tokens using the ZETDC mobile applications.

More recommendations except the mentioned are welcome, to make the new system activities broad and efficient as well as making ZETDC working environment more conducive and user-friendly.

5.7 Conclusion

The development of the new system was a success, ZETDC as a whole is proud of its internal I.T developers for coming up with such a brilliant system. ZETDC Company is also thankful to all the stakeholders who participated in the development and implementation of the system for their cooperation and guidance. The implementation phase and all the other previous phases succeeded, which resulted in the success of the new system meaning the research was successful and worth all the effort exerted on it. However, the success of the implementation phase does not mean it is the end of development, new ideas on improvement and additional functionality are welcome.

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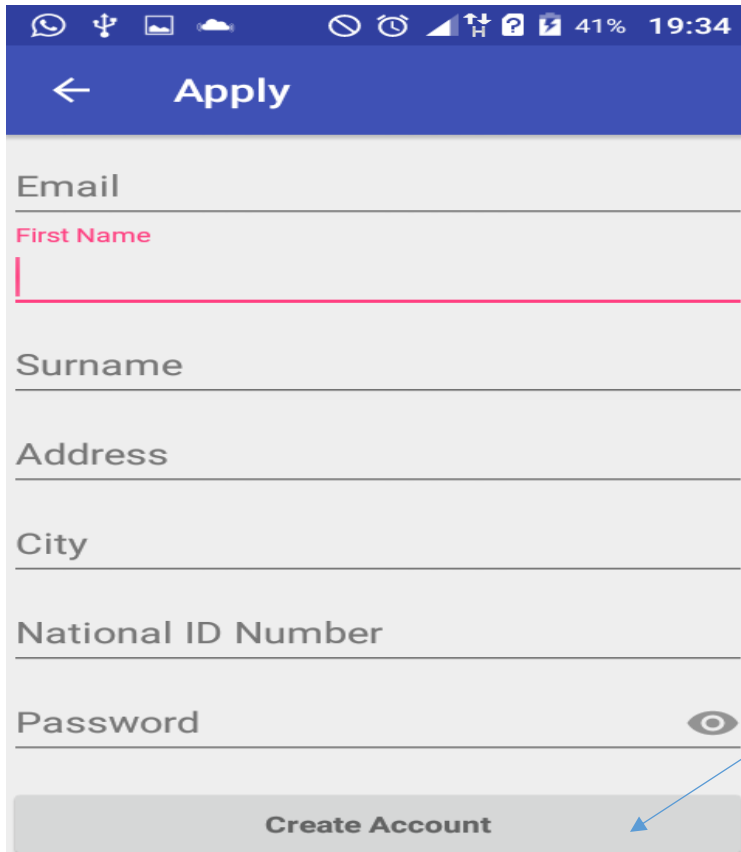
APPENDICES

Appendix A: User Manual

This significant article guides the end users of the system on how to operate or use the system by informing them on what certain features are for and how to manipulate them.

Customer Manual

Sign up page



The screenshot shows a mobile application interface for a sign-up page. At the top, there is a blue header with a back arrow and the word "Apply". Below the header, there are several input fields: "Email", "First Name" (with a red underline), "Surname", "Address", "City", "National ID Number", and "Password" (with an eye icon for visibility). At the bottom, there is a grey button labeled "Create Account". A blue arrow points from the text "Click here to create an account after filling in all the required details from email to password" to the "Create Account" button.

Click here to create an account after filling in all the required details from email to password

Fill in all the required details and then click create account to create an account.

Login page

The screenshot shows a mobile application interface for logging in. At the top, there is a blue header with the text "Sign in". Below the header, there are two input fields: "Email" and "Password". The "Email" field has a red underline, and the "Password" field has a grey underline and a toggle icon (an eye) on the right. Below the input fields is a grey button labeled "Sign in". Below the button is a blue link labeled "Create a new account". Two blue arrows point from the text instructions on the right to the "Sign in" button and the "Create a new account" link.

1) If you have an account enter, your email address and password then click on sign in

2) If you do not have an account click on create a new account

Enter your credentials to login into your account that is the email and password you entered when your account was created. If you do not have an account click on create new account and you will be redirected to the sign up page.

Home page



To apply for inspection click on “Apply for inspection” and you will be redirected to the application page, after paying your service using mobile wallets you have to upload payment proof so click on “Upload payment proof”. Click on “Tutorials” to view the uploaded documents. If you have any questions that need clarification or that are not addressed in the tutorials, click on “Queries” to send your questions.

Application page

1) Enter Inspection site address and city

2) Type of inspection application

3) Click apply to submit

Enter the address and city of the inspection site, not your residential address. Then choose the type of connection from the drop box. Click on “Apply” to submit your application. The city you enter must be a city or town in Zimbabwe, else your application will be denied and your account deleted.

Payment page

The screenshot shows a mobile app interface for submitting a payment. At the top, there is a blue header with a back arrow and the text 'Submit Payment'. Below the header, the main content area is titled 'Make New Payment'. It contains a text input field with the number '50', another text input field with the alphanumeric string 'a1233', and a dropdown menu with the text '--Select Payment Method--'. At the bottom of the form is a large blue button labeled 'Send'. Four blue arrows point from numbered instructions to specific elements: 1) points to the '50' input field, 2) points to the 'a1233' input field, 3) points to the dropdown menu, and 4) points to the 'Send' button.

- 1) Enter amount
- 2) Enter payment proof code here
- 3) Click the dropdown to view and select the payment method
- 4) Click here to submit

Enter amount of money you paid (NB pay the exact quoted amount else you risk losing money), payment proof code and select the payment method you used to pay for your quotation. Click send to submit

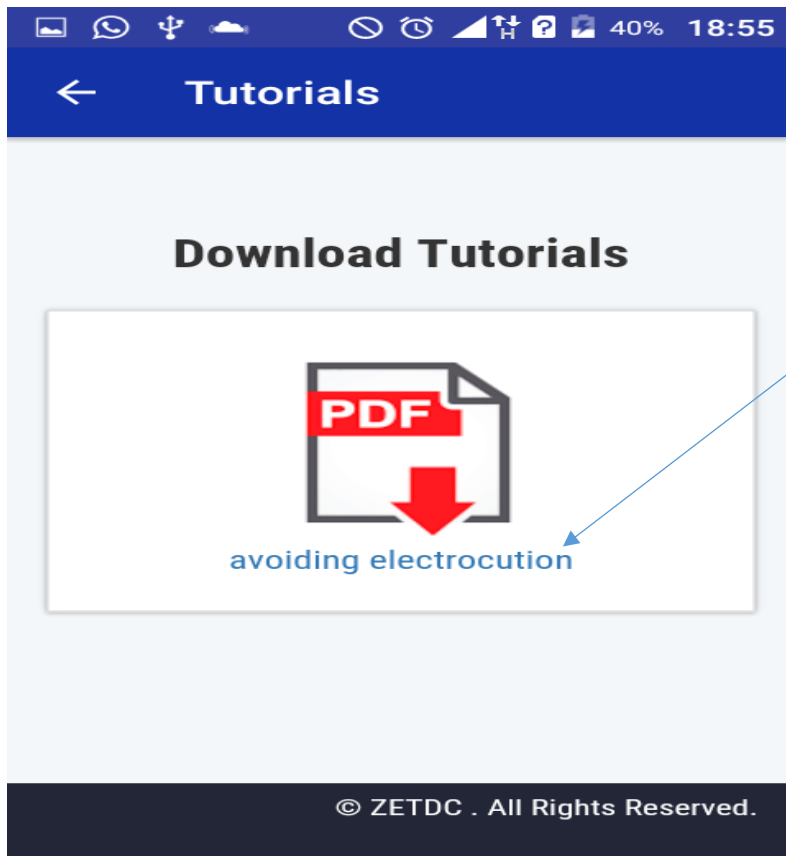
Query page

The screenshot shows a mobile app interface for sending a query. At the top, there is a blue header with a back arrow and the text 'Feedback'. Below the header, the main content area is titled 'Send your query'. It contains a text input field with the placeholder text 'Enter your message here' and a large blue button labeled 'Send Query'. Two blue arrows point from numbered instructions to the form: 1) points to the text input field, and 2) points to the 'Send Query' button.

- 1) Enter your questions here
- 2) Click here to submit

Use query page to send unaddressed questions or for making inquiries.

Tutorial page



Click here
to
download

Download the tutorials for you to be able to view them.

Feedback page

Message from +263 77 784 0461 @ COOK

ZETDC

Reply to your application greetings

please note the following details

meter	\$40
cable	\$20
total	\$80

Reply to your query
click on upload file

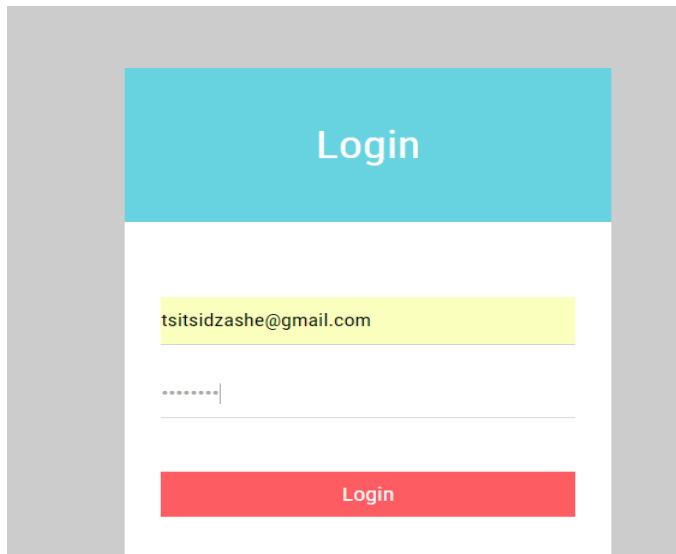
Payment approved
Your payment of 50 using Ecocash has been approved

Payment approved
Your payment of 50 using Ecocash has been approved

View all your replies on the feedback page.

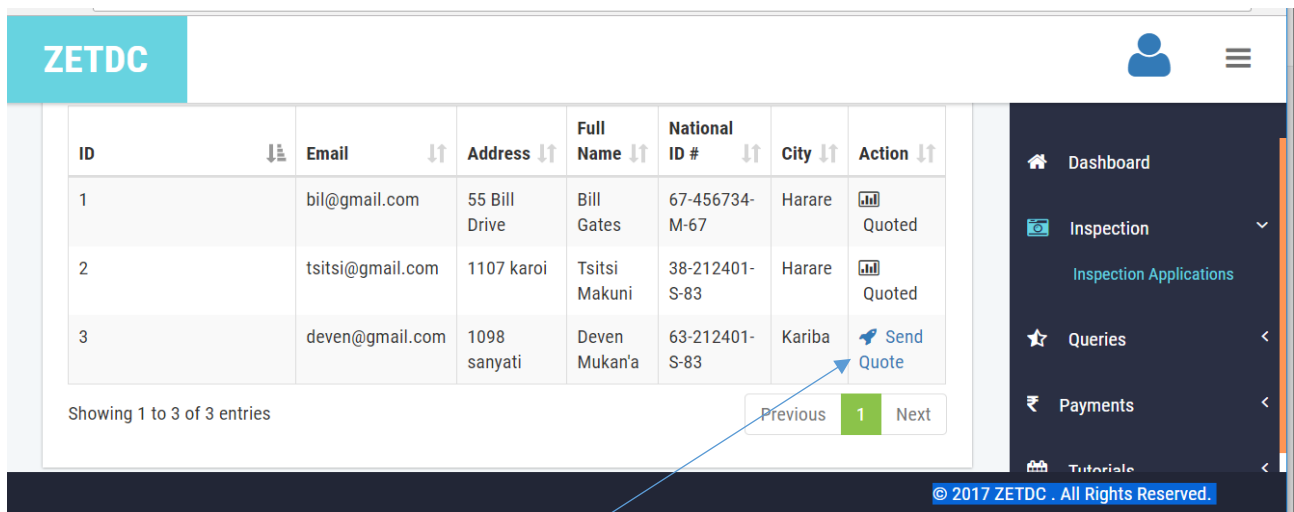
Employee Manual

Login Page



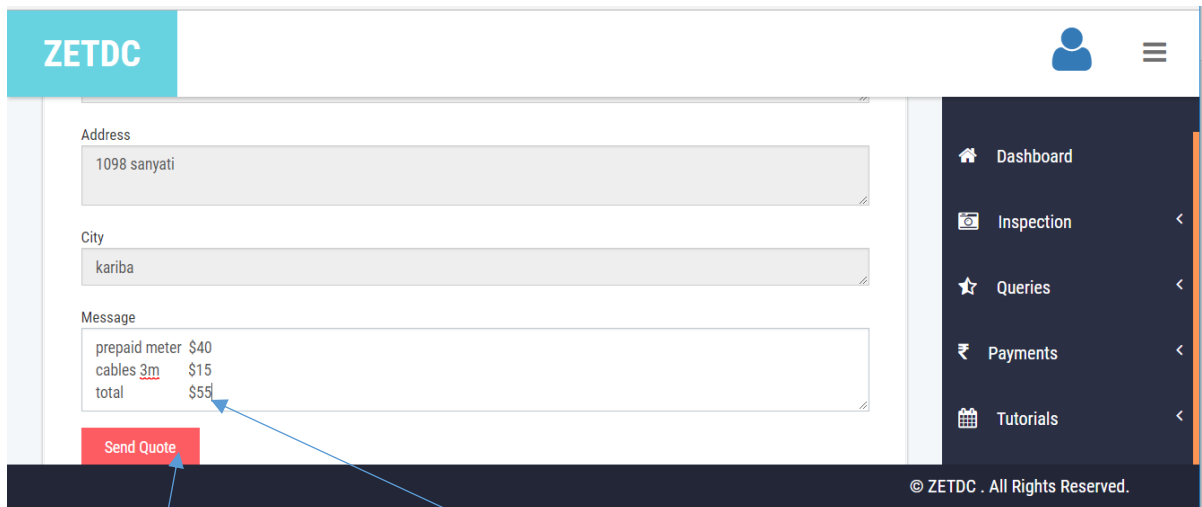
Enter your correct email address and password and click login to access the system.

Sending Quotation



ID	Email	Address	Full Name	National ID #	City	Action
1	bil@gmail.com	55 Bill Drive	Bill Gates	67-456734-M-67	Harare	Quoted
2	tsitsi@gmail.com	1107 karoi	Tsitsi Makuni	38-212401-S-83	Harare	Quoted
3	deven@gmail.com	1098 sanyati	Deven Mukan'a	63-212401-S-83	Kariba	Send Quote

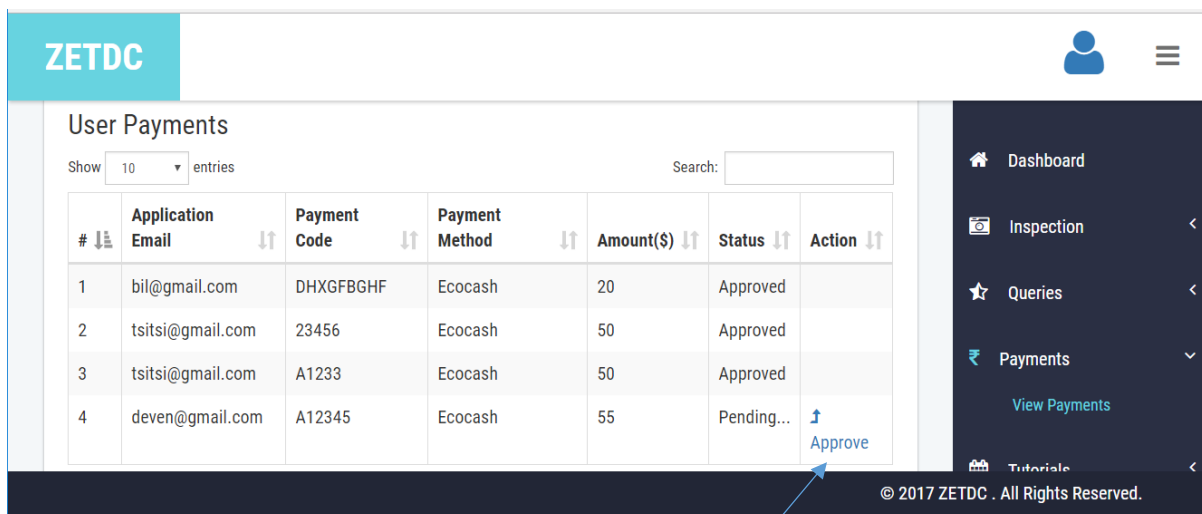
Click Send Quote to send a quotation to a client



2) Click send quote to send the quotation details

1) Write quotation details on Message platform

Proving Payment



Click approve for payment approval after the payment have reflected in the

Uploading Tutorials

The screenshot shows the ZETDC dashboard with the 'Add New Tutorial' form. The 'Title' field contains 'guidelines'. The 'Tutorial File' field has a 'Choose File' button and an 'Add Tutorial' button. A file explorer window is open, showing a folder named '4.2 proj' with several subfolders and files. A red arrow points to the 'Add Tutorial' button, and another points to the 'Open' button in the file explorer.

1) Enter the name of the tutorial

3) Click add tutorial to upload

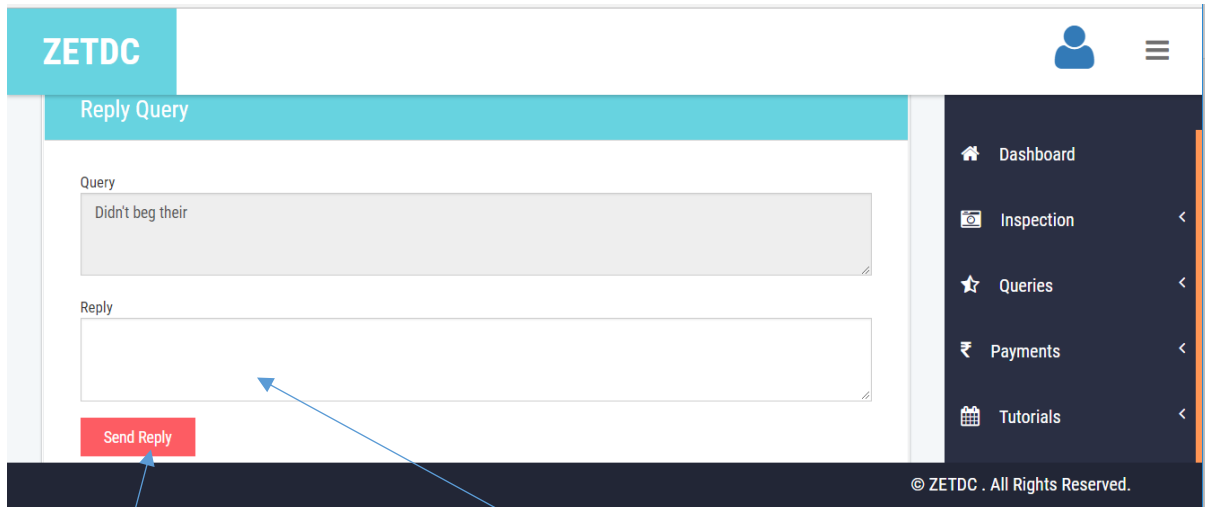
2) Choose the tutorial PDF from your computer

Reply Queries

The screenshot shows the ZETDC dashboard with the 'User Queries' table. The table has columns for '#', 'Email', 'Query', 'Replied?', 'Reply', and 'Action'. A 'Reply' button is visible in the 'Action' column for the second query.

#	Email	Query	Replied?	Reply	Action
1	bil@gmail.com	Egg FCC hunch tv brb ghv	Yes	okay thanks bill	Already replied
2	bil@gmail.com	Didn't beg their	No		Reply
3	tsitsi@gmail.com	how do I upload cash	Yes	click on upload file	Already replied

Click reply to reply a query



2) Click send reply to send a query reply to the client

1) Write the reply on the reply platform

Appendix B: Interview Checklist

The sample questions that were asked and answered during the interview sessions.

Interviewer name.....

Interviewee position.....

Interviewee department.....

Questions

Q1. We understand a need for a system to be developed has risen, what are the contributing factors?

.....
.....
.....
.....

Q2. How does the current system work?

.....
.....
.....

Q3. What are the main challenges associated with the current system?

.....
.....
.....
.....

Q4. What do you think can be done to curb all these challenges?

.....
.....
.....
.....

Q5. Do you think the introduction of the mobile application will improve the way you operate?

.....
.....
.....

Q6. If a new system is to be introduced what are the main features or functions do you require the system to perform?

.....
.....
.....

THANK YOU FOR YOUR COOPERATION

Appendix C: Questionnaire Checklist

Please answer all questions

1. Are you satisfied with the current system?

Yes No

If not, what are your concerns and what do you think should be done? Are customers satisfied with the services offered?

Yes No

If not, what suggestions and recommendations are they proposing?

.....
.....

3. Does the existing system store data efficiently and are the records easy to manipulate?

.....
.....

4. How long does it take you to respond to a customer's needs?

Less than 10 Minutes 10-20 Minutes More than 20 Minutes

.....

5. How do you rate your communication with the clients?

Excellent Average Bad

If not excellent, what are the difficulties you encounter in your communication channel and what are your suggestions?

.....
.....

6) Do you think the new system will be of benefit to your department and organisation as a whole and what's your reasons?

.....
.....

DATE.....

THANK YOU FOR YOUR COOPERATION

Appendix D: Observation score sheet

Date
Time
Department under observation
Conclusion

Appendix E: Code Snippets

Payment approval code

```
public class Payments extends AppCompatActivity {
    Intent intent;
    private ProgressDialog progressDialog;
    private String callbackMessage;
    private Button mBtnPay;
    private EditText mEtAmount;
    private EditText mEtAppId;
    private EditText mEtCode;
    private Spinner mSpMethod;

    private SharedPreferences settings;
    public static final String MyPREFERENCES = "Prefs" ;
    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_payments);

        android.support.v7.app.ActionBar actionBar = getSupportActionBar();
        actionBar.setBackgroundDrawable(new
ColorDrawable(Color.parseColor("#3F51B5")));
        actionBar.setHomeButtonEnabled(true);
        actionBar.setTitle("Submit Payment");
        actionBar.setDisplayUseLogoEnabled(true);
        actionBar.setDisplayHomeAsUpEnabled(true);

        settings = getSharedPreferences(MyPREFERENCES, MODE_PRIVATE);
        mBtnPay = (Button) findViewById(R.id.pay_btn);
        mEtAmount = (EditText) findViewById(R.id.pay_amount);
        mEtCode = (EditText) findViewById(R.id.pay_code);
        mSpMethod = (Spinner) findViewById(R.id.pay_spinner);
        //mEtAppId = (EditText) findViewById(R.id.pay_app_id);

        progressDialog = new ProgressDialog(this);
        progressDialog.setMessage("Processing...");
        progressDialog.setProgressStyle(ProgressDialog.STYLE_SPINNER);
        progressDialog.setIndeterminate(true);

        mBtnPay.setOnClickListener(new View.OnClickListener() {
            @Override
            public void onClick(View view) {
                ConnectivityManager cm = (ConnectivityManager)getApplicationContext()
                    .getSystemService(Context.CONNECTIVITY_SERVICE);
                NetworkInfo activeNetwork = cm.getActiveNetworkInfo();

                if(activeNetwork != null){
                    String amount = mEtAmount.getText().toString();
                    String code = mEtCode.getText().toString();
                    String appId = "12345";
                    String paymentMethod = mSpMethod.getSelectedItem().toString();
                    //validate input here
                    if(Double.parseDouble(amount) < 0 || amount.equals("")){

                        Snackbar.make(view, "Enter the amount paid",
Snackbar.LENGTH_LONG)
                            .setAction("Action", null).show();

                    }else if(code.equals("")){
```



```

        System.out.println("End of content");
    }
    return null;
}

@Override
protected void onPostExecute(Void aVoid) {
    progressDialog.dismiss();
    if(callbackMessage.equals("success")) {
        Snackbar.make(view, "Payment details sent successfully",
Snackbar.LENGTH_LONG)
            .setAction("Action", null).show();

    }else if(callbackMessage.equals("error")){

        Snackbar.make(view, "An application error has occurred, please try
again later", Snackbar.LENGTH_LONG)
            .setAction("Action", null).show();

    }else if(callbackMessage.equals("payment exists")){

        Snackbar.make(view, "You have already submitted this payment, wait
for approval", Snackbar.LENGTH_LONG)
            .setAction("Action", null).show();

    }
}
};

```

Application code

```

progressDialog = new ProgressDialog(this);
progressDialog.setMessage("Sending Application...");
progressDialog.setProgressStyle(ProgressDialog.STYLE_SPINNER);
progressDialog.setIndeterminate(true);

mBtnApply.setOnClickListener(new View.OnClickListener() {
    @Override
    public void onClick(View view) {
        ConnectivityManager cm = (ConnectivityManager)getApplicationContext()
            .getSystemService(Context.CONNECTIVITY_SERVICE);
        NetworkInfo activeNetwork = cm.getActiveNetworkInfo();

        if(activeNetwork!= null){
            //instantiate vars and validate
            String type = mSpType.getSelectedItem().toString();
            String address = mEtAddress.getText().toString();
            String city = mEtCity.getText().toString();

            if(type.equals("--Select Application Type--")){
                Snackbar.make(view, "Please select type",
Snackbar.LENGTH_LONG)
                    .setAction("Action", null).show();
            }else if(address.length()<3){
                Snackbar.make(view, "Please enter a valid address",
Snackbar.LENGTH_LONG)
                    .setAction("Action", null).show();
            }else if(city.length()<3){
                Snackbar.make(view, "Please enter a valid city",
Snackbar.LENGTH_LONG)

```

```

        .setAction("Action", null).show();
    }else{
        //call login method here
        progressDialog.show();

        apply(settings.getString("email","Not
found"),type,address,city,getApplicationContext(),view);
    }

    }else{
        Snackbar.make(view, "No internet connection",
Snackbar.LENGTH_LONG)
            .setAction("Action", null).show();
    }
    });
}

private void apply(final String email, final String type, final String address,
final String city, final Context context, final View view){
    AsyncTask<Integer,Void,Void> task = new AsyncTask<Integer, Void, Void>(){

        @Override
        protected Void doInBackground(Integer... integers) {
            OkHttpClient client = new OkHttpClient();
            Request request = new Request.Builder()

.url(API.HOST+"api/apply.php?email="+email+"&type="+type+"&address="+address+"&city="+
city)

            .build();

            try{
                Response response = client.newCall(request).execute();

                Log.d("network","Response has come "+response.toString());

                JSONObject jsonObject = new JSONObject(response.body().string());
                callbackMessage = jsonObject.getString("message");

            }catch (IOException e){

                e.printStackTrace();
            }catch (JSONException e){

                System.out.println("End of content");
            }
            return null;
        }

        @Override
        protected void onPostExecute(Void aVoid){
            progressDialog.dismiss();
            if(callbackMessage.equals("success")){
                Snackbar.make(view, "Application successful",
Snackbar.LENGTH_LONG)
                    .setAction("Action", null).show();

            }else if(callbackMessage.equals("no account")){

```

```

        Snackbar.make(view, "Account not found, please create account
first", Snackbar.LENGTH_LONG)
            .setAction("Action", null).show();

        }else if(callbackMessage.equals("already applied")){

            Snackbar.make(view, "You have already applied",
Snackbar.LENGTH_LONG)
                .setAction("Action", null).show();
        }else if(callbackMessage.equals("error")){

            Snackbar.make(view, "An application error occurred, please try
again later!!!", Snackbar.LENGTH_LONG)
                .setAction("Action", null).show();
        }
    }
};

task.execute();
}

@Override
public boolean onCreateOptionsMenu(Menu menu) {
    // Inflate the menu; this adds items to the action bar if it is present.
    getMenuInflater().inflate(R.menu.main, menu);
    return true;
}

@Override
public boolean onOptionsItemSelected(MenuItem item) {
    int id = item.getItemId();

    if (id == android.R.id.home) {
        intent = new Intent(Inspection.this, MainActivity.class);
        startActivity(intent);
        return true;
    }

    return super.onOptionsItemSelected(item);
}
}
}

```

Query code

```

@Override
protected void doInBackground(Integer... integers) {
    OkHttpClient client = new OkHttpClient();
    Request request = new Request.Builder()
        .url(API.HOST+"api/queries.php?email="+email+"&description="+description)
        .build();

    try{
        Response response = client.newCall(request).execute();

        Log.d("network", "Response has come "+response.toString());

        JSONObject jsonObject = new JSONObject(response.body().string());
        callbackMessage = jsonObject.getString("message");
    }
}

```



```

    }catch (IOException e){

        e.printStackTrace();
    }catch (JSONException e){

        System.out.println("End of content");
    }
    return null;
}

@Override
protected void onPostExecute(Void aVoid){
    progressDialog.dismiss();
    if(callbackMessage.equals("success")){
        Snackbar.make(view, "Message sent, Thank you", Snackbar.LENGTH_LONG)
            .setAction("Action", null).show();

    }else if(callbackMessage.equals("error")){

        Snackbar.make(view, "An error has occurred, please try again later",
Snackbar.LENGTH_LONG)
            .setAction("Action", null).show();

    }else if(callbackMessage.equals("invalid email")){

        Snackbar.make(view, "Account not found, logout of app and login again",
Snackbar.LENGTH_LONG)
            .setAction("Action", null).show();
    }
}

```