

Auxiliary plant integration system

BY

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Information Systems

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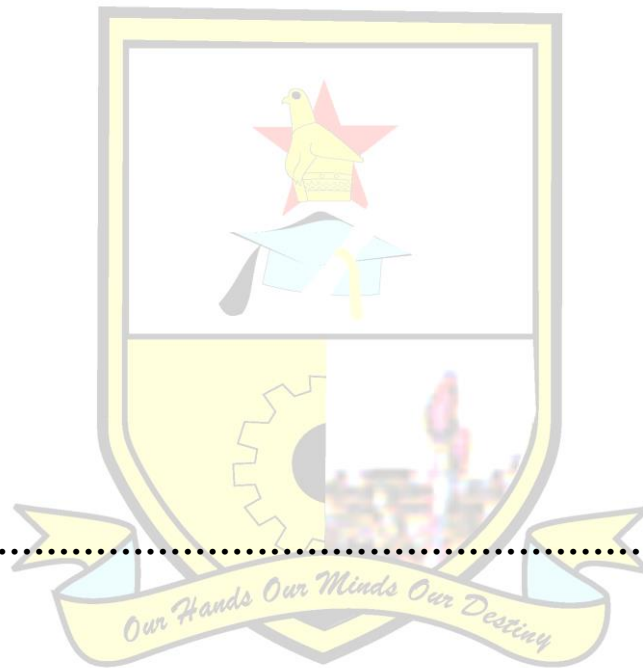
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Our Hands Our Minds Our Destiny

June 2015

DECLARATION

I, TARISAI MUNDONDO declare that I am the author of this dissertation and I authorize the Midlands state University to lend this document to other institutions and students for supporting scholarly research



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APPROVAL

The dissertation “Auxiliary plant integration system” done by TARISAI MUNDONDO meets the regulations governing the award of the Bsc HONOURS DEGREE IN INFORMATION SYSTEMS and approval is made because of its contribution to knowledge and literal presentation.



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CHAPTER ONE

1.1 Introduction

Preeti Gupta(2005) A system is an association of components to perform a specific function .In this case the Auxiliary Plants integration system is a system that will allow ZPC to fully manage its auxiliary plants allowing the management to know the status of the water treatment plant and coal plant. The system will integrate the coal plant and water treatment plant, whereby operators will enter the readings of the plant in the system and the operator details will be known and the foreman will confirm the figures. In this study the researcher is proposing a system that will allow the management, foremen and section head make decision in the daily operations of the auxiliary plants.

1.2 Company Background

ZESA Holdings (Zimbabwe Electricity Supply Authority) is the main provider of electricity in the country and is owned by the government of Zimbabwe. It was formerly known as Electricity Supply Commission (ESC), before its incorporation in 1996. Following the passing of two acts by the Parliament of Zimbabwe, the Electricity Act (Chapter 13:19) and the Rural Electrification Fund (Chapter 13:20) comprehensive reforms have since been experienced in the electricity industry. The Rural Electrification Fund led to the formation of the Rural Electrification Agency (REA) whereas the Electricity Act led to the formation of four successor companies namely Zimbabwe Power Company(ZPC), Zimbabwe Electricity Transmission and Distribution Company(ZETDC), ZESA Enterprises(ZENT) and Powertel Communications. Exhibit 1.0 below illustrates the commercialization of ZESA as enacted by the electricity act.

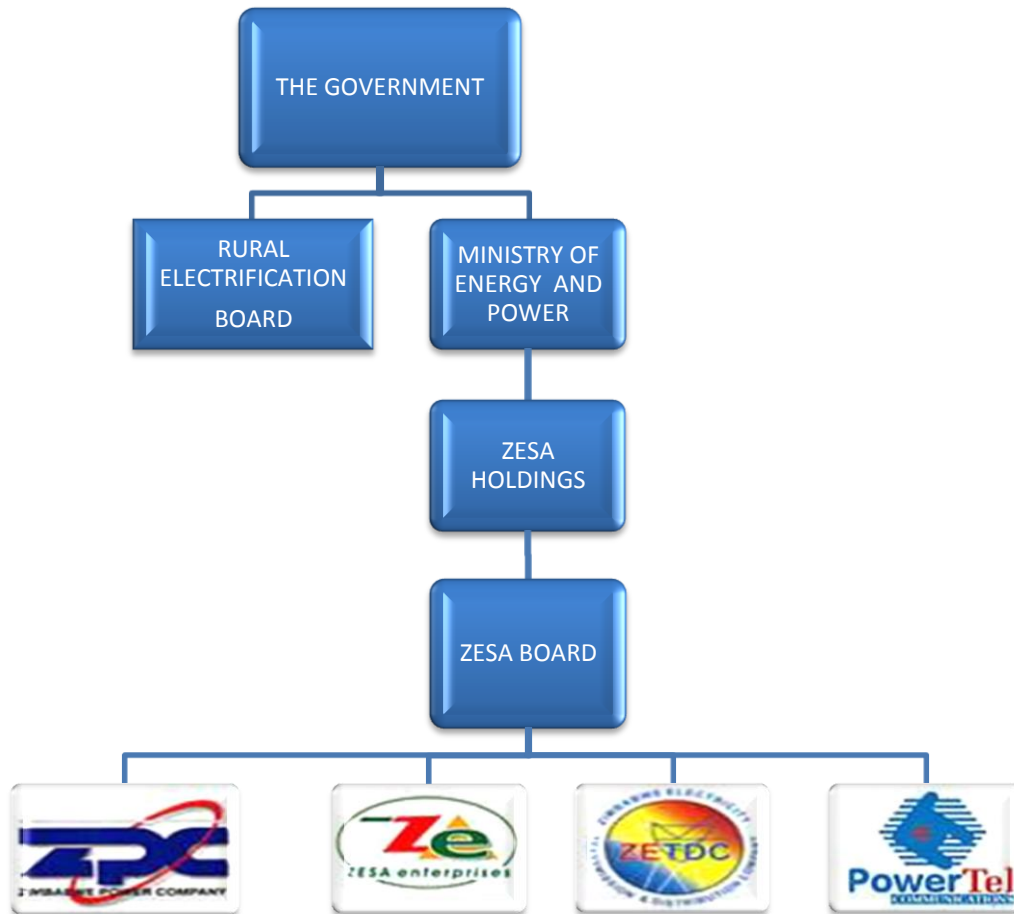


Figure1.1: Organogram showing organizational structure

Business units under Zesa Holdings

Zimbabwe Power Company (ZPC).

All power generation assets and operations are under the Zimbabwe Power Company (ZPC). The Zimbabwe Power Company incorporates all generation plants of Hwange, Kariba, Munyati, Bulawayo and Harare Power Stations. The company’s mandate is to generate electricity for the domestic market.

Zimbabwe Electricity Transmission and Distribution Company (ZETDC)

It is responsible for planning, managing, handling and operating all grid assets. It also manages the supply and retailing of electricity to customers and is also responsible for distribution assets.

Zesa Enterprises (ZENT)

This is a flexible investment arm for ZESA holdings that has diversified business portfolio. It spearheads the drive into new dimensions such as land development, irrigation works and installations, manufacturing electricity end use equipment, development of new IT products

and regional markets. It comprises of four business units namely ZESA Technology Centre, Production and Services, Transport Logistics and Projects.

Powertel Communications

Powertel Communications is a public data network operator fully licensed by the Postal and Telecommunications Regulatory Authority of Zimbabwe (POTRAZ) to provide data communication services.

1.2.1 Background

The Zimbabwe Power Company (ZPC) is responsible for the **generation of electricity** and other related services.

The company's mandate is to generate electricity for the domestic market. The small thermal power stations are operating as embedded generators (power stations that are directly connected to the distribution network) but will be dispatched only to meet supply shortfalls as follows;

- For strategic system security
- To cover constraints on the national grid
- To provide an alternative to imports to reduce demand on foreign currency
- To sell electricity to the domestic market through power purchase agreement (**PPA**) with **ZETDC**.

The Zimbabwe Power Company is the custodian of five electricity generating assets of Hwange, Kariba, Bulawayo, Munyati and Harare power stations.

1.2.2 Organisational Structure



Figure1.2: Organogram showing ZPC structure

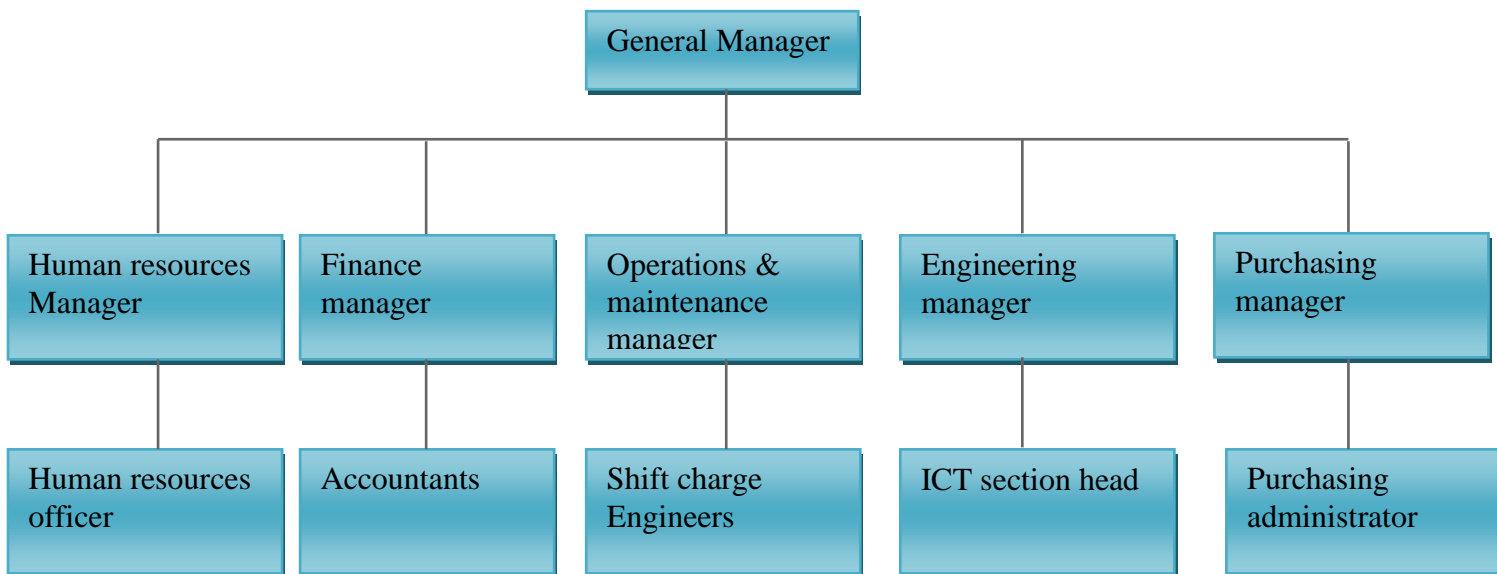


Figure1.3: Organogram showing Hwange Power Station structure

Hwange Power Station (920 MW)



Figure 1.4: Hwange Power Station Map

Of all the power stations, Hwange Power Station has the largest installed generating capacity. Hwange Power Station is located in Matabeleland North Province, 335km from the City of Bulawayo. It has an installed generating capacity of 920 megawatts (MW) .Broken down as 4x120 MW (stage1) and 2 x 220 MW (stage 2)

1.2.3 Mission Statement of Zimbabwe Power Company

The company's mission statement is, we are committed to generating reliable electrical energy to meet customer needs and guarantee returns for our shareholders through

- use of environmental friendly technologies
- development and retention of highly skilled effective and motivated staff

1.2.4 Vision

To be a leading regional player in the generation and supply of power and energy related services in the region.

For ZPC to be the leading player in power generations its auxiliary plants are the backbone of the main plant, they support the main plant which produces electricity hence there is a need for an efficient system that integrate these plants.

1.3 Problem Definition

Rajib Mall (2003) Is the immediate motive to build a new system. Hwange Power Station owns one among the best ICT services compared to other power stations and they seek to provide quality services.

- Their challenge is to integrate information about the plant status and services for effective decision making.
- They have sections that support the plant which are the auxiliary plants that are dispersed around the station.
- The section head of Operations sections move around the station regularly to gather information directly from their foremen who again move to the Operators to confirm information.
- It is difficult to know the status of the plant at a given time and the main control takes time to know the plant condition.
- There is no system at all that integrates the water treatment plant and the coal plant.
- There is no database that contains all the necessary information about the Auxiliary Plants.

1.4 Aim of the Research Study

Turner (1993:108) It identify the highest level of hope in achieving the project what is intended to be achieved. This project is aimed on designing and implementing an Auxiliary Plant Integration System which can be accessed by Operations department on the Hwange Power station Local Area Network. The intention is to have the system that coordinates and integrates the auxiliary plant functionalities to determine their status at any time as well as retrieving data at any given time.

1.5 Objectives

Turner (1993:108), Objectives recognize detailed quantifiable achievements' that gather decisive goal of the project, quantitative and qualitative measures by which project results will be judged upon .Weiss and Wysocki (1992:13), They are vital elements of the system that gives direction of work activities. They highlight what we want to achieve and they are as follows:

- To implement a system that capture coal suppliers.
- To implement a system that calculate weigher variance for weigher comparison
- To implement a database with information for both plants
- The system should allow operators on duty to enter plant figures

- The system should store operator details
- The system should generate reports that displays summary of information for auxiliary plants

1.6 Hypothesis

John C.Munson, PHD. (2005) Decisions faced in system engineering are binary with distinct courses of actions possible, purposes of statistics is to give information that lead to a decision. A combination of two simple hypotheses will give a composite hypothesis that will be true if some of the simple hypothesis is true. The developer proposes to create an Auxiliary Plants Integration System. Summary of details is as follows:

TITLE	: Auxiliary Plants Integration System
Client	: Zimbabwe Power Company {Hwange Power Station}
Environment	: HTML, Cascading Style Sheets, PHP, Win XP
Role	: Coding, Design and setting up Server environment
Team size	: 2

CSS- cascading style sheets allows you to separate your website content (HTML) from its style (presentations). It is worldwide web consortium (W3C) which means all web browser manufacturers have agreed to support CSS in their products

Mysql Database Server- a scalable and robust relational database system, it works well with web applications

PHP- is a scripting language which allows web developers to write dynamically generated pages.

HTML- the presentation language for web applications.

ADOBE Photoshop- is a graphics editor that is one of the most popular programs for image manipulation. It is widely used by graphics professionals for all sorts of tasks including website design

APACHE- The Apache HTTP Server Project is a collaborative software development effort aimed at creating a robust, commercial- grade implementation of an HTTP web server

1.7 Justification and Rationale of the study

The development of the proposed Auxiliary Plants Integration System will help to reduce problems faced by Operators ,Section ,Heads ,Foreman ,Main Control ,Management and Stakeholders emanating from the use of old fashioned ways Log Book System.

- The system can keep logs of operator's personal history for future reference so that trends and trouble areas can be quickly identified and addressed or recommend maintenance if necessary
- There will be an improvement in the nature of meetings since all the plant status information and updates will be available
- The system will increase the employee's productivity by checking readings on required time
- The Section Head and foremen can log in the system to see the status of their respective departments.
- On the user's side there will be great reduction in time spent figuring out the sequence of the plant and decision making.
- Leverage use of the LAN reduces movement.
- Generate a positive Return on Investment in the plant as a whole.

1.8 Conclusion

In this modern world Information and Communication Technology is critical in determining how business processes are being completed and handled. Completion of this project will see ZPC aligning with ISO standards and principles which govern better service management to staff and the industry

CHAPTER TWO: PLANNING

2.1 Introduction

The planning phase is a stage that gives the outline and assessment of the project by testing the feasibility by looking at the technical and economic aspects. It takes into account the project constraints and looks at the best possible way of carrying out the project. Basically this stage looks at the benefits that the organization derives in engaging into this project, the rationale of the system. Dennis, Wixom, Roth (2012:13) It is analyzing the rationale of building the system and how best to build it The following aspects are looked at in detail:

2.2 Why build the system

- The need to integrate the auxiliary plants for easy access to information when it is needed.
- To identify auxiliary plant as single unit for easy management.
- To improve the nature of meetings since all the figures are available and the units are known.
- Increase flexibility to foremen and managers for them to work from the comfort of their own offices which will lead to an increase in production.
- It increases the operator efficiency due to its flexibility, when readings are easily entered in the system.
- Information about the operator on duty is known hence the management knows who is accountable.
- The database that contain information about the auxiliary plants enable the management to measure effectiveness and efficiency of the plant

2.3 Business Values

Robert L Brady JD (2005:170) It is all forms of value that influence the survival and well being of a business in the long run .Business value is the absolute advantage that the organization derives as a result of using the system, it looks at the benefits that enable the organization to meet its strategic objectives. Listed below are the business values the Auxiliary Plants Integration system will yield:

- Efficient and effective communication between the organization management, foreman and operators through a central system.
- Reliable and operational database.
- A report of coal and water plant.

2.4 Feasibility Study

Dennis, Wixom, Roth (2012:23) It analyses the major aspects' of the new system.

- The technical feasibility- Can we build it?
- The economic feasibility- Will it provide business value?
- The organizational feasibility -If we build it, will it be used?

The system feasibility is shown to the approval committee which is the steering committee which has the overall say as to whether the project should be undertaken or not.

2.4.1 Technical Feasibility

Dennis et al (2012:24) It is to assess the technical feasibility of a project looking at the extend to which a system can be build successfully and be used on hardware. This study seeks to evaluate ZPC's resourcefulness pertaining to hardware, software, I.T expertise and other I.T infrastructure that is required to implement the proposed system.

Table 2.1: Database Server

ITEM	MINIMUM	RECOMMENDED	AVAILAB ILITY	COMMENT
Processor	2GHz	2.5GHz	no	Requisition approved, provided when needed.
Memory	4GB	8GB	no	Requisition approved, provided when needed.
Hard Disk Drive	800GB	1TB	no	Requisition approved, provided when needed.
Network Card 3com	10/100	10/100	yes	Network is readily available
CD ROM Drive	52x	52x	yes	Requisition approved, provided when needed.
Tape drive	20/40	20/40	no	Requisition approved, provided when needed.
UPS		UPS 300va	yes	The organization has plenty UPSs and requisition approved.
Printer	Laserjet	Laser	yes	Printers requisition approved to be collected from main stores.

Table 2.2: Network Specifications

ITEM	MINIMUM	RECOMMENDED	AVAILABILITY	COMMENT
HUB	32 Port	32 Port	yes	Readily available
Patch Panel	32 Port	32 port	yes	Readily available
Cables for connections	UTP CAT 35 Fly leads patch codes	UTP CAT 35 Fly leads patch codes	yes	Readily available
Power UPS	3u	3u	yes	Readily available
Cabinet	Power Backup 220va	Power Backup 300va	yes	Readily available

Table 2.3: Software Specification

ITEM	MINIMUM	RECOMMENDED	AVAILABILITY	COMMENT
Microsoft Windows	Windows7	Windows 8	yes	Readily available
MS Office	2007	2013	yes	Readily available PCs
Antivirus	Avast 2014	Avast 2014	yes	Already installed on PCs
PHP			yes	Readily available, its open source
Dream weaver	8	CS Version	yes	Readily available
MySQL	2.1.1	2.1.1	yes	free-source and readily available

2.4.2 Economic Feasibility

Dennis et al (2012:25) The economic feasibility justifies the economic benefits of building the system, it strives to answer whether to build the system or not. The following important tools are used to justify whether it's feasible or not:

- Cost-benefit analysis
- Return On Investment (R.O.I) and
- Payback period

The results that are produced from these calculations will lead to a conclusion whether the study is worth undertaking or not.

Cost Benefit Analysis

Thomas Aronsson and Karl Gustaf Lofgran (2010:164) It is a tool that is used to rate the desirability of a project.

Costs

The development costs of a system not actual figures but estimates that will be revised once the stage passes and they are only incurred at the start of the project. Development costs are as follows:

Table 2.4 Development costs

Training and installation	\$1299
Stationary	\$145
Computer Hardware and software	\$6496
Network Card	\$13
Total	\$7953

Benefits

Tangible benefits.

- Improve data availability to foremen, section head and management.
- Security is assured with the use of secure password policy.
- Enable reading entry.

Intangible benefits

These benefits cannot be easily measured in monetary terms

- The system will improve and enhance work performance in all business operations
- The system will ensure personal efficiency since movement is limited
- Develop the organization's corporate image through ISO certification

Cost- Benefit Analysis

Table 2.5 Benefits

Reduced stationary use	\$420
Reduced fuel cost	\$800
Improved security	\$150
Reduce labour	\$370
Increased productivity	\$18 000
Total Benefits	\$19 740
Benefits Less Costs	\$11 787

All prices are in US Dollar

2.4.3 Return on Investment Analysis (ROI)

ACCA (2007:136) Is estimating the accounting rate of return a project should yield. It is used to evaluate the efficiency of the project, profit in relation to capital invested. It measures per period rate of return on invested capital, High Return means investment gains compared to invested capital.

Threshold: ZPC considers a Return on Investment figure that is above 100% to approve the project.

$$\text{R.O.I} = \frac{(\text{Total Benefits} - \text{Total Costs})}{\text{Total Costs}} * 100$$

$$\begin{aligned} \text{R.O.I} &= \frac{(19740-7953)*100}{7953} \\ &= \underline{148\%} \end{aligned}$$

During the first year there are a lot of expenses hence there are little benefits, much benefits are realized once training has been carried out. Annual return on investment will rise by 148% which it earns in the second year of the investment

2.4.4 Payback period

C.Paramasivan et al (2009:122) It is time that will be required to return initial investment. It measures how long the investment will take to return the initial investment outlay. A project with the shortest Pay Back period is the most favorable.

Threshold: ZPC accept the project that has a payback period of less than 2 years.

Table 2.6: Payback period

Year (year ending December)	Cashflow(in/out) (USD\$)	Cashflow(in/out) (USD\$)	Net Cash inflow/outflow
2014	(17 000-8 500)	(8 500)	(8 500)
2015	(60 000-31 200)	28 800	20 300
2016	180 000-31 200	148 800	169 100

The project assumes the earnings are the same the whole year.

The project gives a sensible payback period of 1 year 2 months.

2.4.5 Social feasibility

A.A Puntambeka (2007) It is looking at whether the public will accept the system or not.

Social feasibility is much concerned with benefits that ordinary people in the society or on the street derive from the use of the system; this excludes the organisation and its stakeholders. It looks at the effects of the system in the external world of the organisation.

These include:

- Employment creation
- General improvement in the welfare of citizens.
- The project will create awareness on the company to the fans and the general public.
- Clean environment due to reduced paper-work

2.4.6 Operational Feasibility

B.B Agarwal, S.P Tayal, M Gupta (2010:31) It is looking at whether the employees, management and suppliers are willing and prepared to accept the functions of new system.

The study looks at the user perceived usefulness of the system and perceived user friendly.

Once the system is implemented and in full use ZPC has some employees who are computer literate hence training is vital to orient the system to employees. It also focuses on the ability to improve employee productivity and risk of employees being replaced by the system.

Operational feasibility should have benefits to the group below.

Staff:

- Performance of the proposed system – Emphasis was placed on the throughput and response time of the system to address user's queries.

- Service – The system's ability to provide desirable and reliable services to the users was also examined and the proposed system was recommended.
- Security– as is it among of the objectives to be achieved it is catered for by this system that incorporate security at different levels.

Management:

- Improved decision making because of the reports the system produces.
- Effectiveness and efficiency in making strategic.

2.5 Work plan

Dennis et al (2012), Systems Development Life Cycle is a strong and comprehensive software project management tool and will be used to model the tasks to be undertaken in developing the ZPC Auxiliary Plants Integration system. The choice is mainly because this tool is arguably the best tool in this fraternity and is excellent in modeling of tasks beforehand. This linear tool typically involves exhaustive documenting of activities which are of distinct phases of project development and their completion approximate time. This characteristic provides a platform for assessing the project’s progress phase by phase. The project time allocation for each individual phase is shown below in the work plan table and then followed by the Gantt chart.

Timing

Table 2.7:Timing

Task	Start date	Completion	Duration
Project proposal	10-02-2014	17-02-2014	1 week
Planning phase	17-02-2014	24-02-2013	1 week
Analysis	24-02-2014	03-03-2014	1 weeks
Design	03-03-2014	10-03-2014	1 week
Coding	10-03-2014	24-03-2014	2 weeks
Testing	24-03-2014	07-04-2014	2 week
Implementation	07-04-2014	14-04-2014	1 week
Maintenance	14-04-2014	28-04-2014	Ongoing process
Documentation	14-04-2014	28-04-2014	10 week

Table 2.8: Project time allocation for each individual phase.

Gantt chart

Sharon Yull and Tracey Stump (2003:210) Gantt chart provide an overview of the sequence and timing of events shows the start and end of activities. This shows a series of activities and their duration.

<u>Week / stage</u>	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>10</u>
Documentation	■	■	■	■	■	■	■	■	■	■
Project proposal	■									
Planning		■								
Analysis			■							
Design				■						
Coding					■	■				
Testing							■	■		
Implementation									■	
Maintenance										■

Figure 2.1: Gantt chart

Time/weeks

2.6 Conclusion

The project feasibility study shows that the project is feasible as well as the time frame given. After the economic feasibility has indicated that the project is feasible. Approval of the project gives the development team go ahead to carry on with the project. The project work plan indicate that activities and their sequences can be carried out on the desired times. The system development will now move to the next phase which is the analysis phase.

CHAPTER THREE: ANALYSIS PHASE

3.1 Introduction

J.B Dixit Raj Kumar (2007:23) The core purpose of this stage is gathering and analysing data. The analysis phase highlights the operations of the current system and strives to address the problems of the system in place with the proposed system. This phase analyses how a series of activities are linked in the current system, it also give an insight of how the activities will be coordinated in the proposed system. There are tools used to come up with information of the current system and the gathered data is then used to analyse the strength and weaknesses of the system in place figuring out possible alternative solution to weaknesses of the current system

3.2 Information Gathering Methodologies

ISD Group (2007:148) It is more difficult to develop a system when requirements are not known, information gathering is important for requirements elicitation. This process of information gathering has clearly defined procedures which bring about what people value the most rather than just asking people. In the fact finding process of uncovering strength and weaknesses of the current system the analyst used the following methodologies:

- Questionnaires
- Interviews
- Observation and Document Review

3.2.1 Questionnaires

Briony J Qates (2006) .Questionnaires are pre-defined bunch of questions arranged in a pre-determined order and are answered in the absence of the researcher. These are set of questions that are prepared by the researcher and are answered by the respondents and can be answered in two ways:

- Filling in questioners in the absence of the researcher
- Completing questions in the presence of researcher with structured questions

It is a very important tool in data gathering which can be used for analytical and statistical purposes, the set of questions are usually prepared for a targeted group in an organization for information gathering .Questions were prepare for coal plant and water treatment and were handed on 25/11/2013 for completing and were returned on 29/11/2013.The analyst found some advantages and disadvantages of this method.

Advantages

- It gave the employees or respondents the time to think and to give precise answers.
- Easy to conduct since less monitoring is needed.
- It is time saving since questions were distributed to a lot of respondents in the water treatment plant and the coal plant
- Employees were free to express their thoughts without intimidation so chances are high that genuine information is gathered.
- Compilation of data is easy since it is in standardised form.

This technique has its own advantages but the analyst also uncovered the shortcomings of this data gathering technique.

Disadvantages

- It is very hard to know if the respondents have understood the questions or not
- Many questioners were issued but only a few were returned so the return rate was poor.
- Time consuming as compared to interviews
- It is hard to come up with conclusions in some areas since other questions are left unanswered.

3.2.2 Interviews

Harry J, Rosenblatt, Gary Shelly (2010) It is a two way formal form of discussion where information is exchanged with two parties, information is gathered during this discussion which may also be with many parties.

Findings from the Interviews:

Interviews were carried out in the Water Treatment plant which included the plant operators, foremen and section head. Coal Plant interviews were conducted with operator, foremen and section head. The interviews evaluated staff responsiveness, attitudes and perceptions

Advantages

- There is much clarity of questions since the analyst is present unlike questioners.
- It is a fast technique since answers are directly from the respondents.
- Direct questioning enabled for probing to certain answers.
- The respondent's body language and facial expressions can give further ideas to the analyst.

- It allows the analyst to customize questions to suit Water treatment plant and Coal plant
- The interviewer has ability to get more information by making the interviewee feel free
- There is direct interaction of the system analyst and the actual people whose jobs revolve around the system who operate the plant uncovering current problems and the potential to improve the system

Disadvantages

- There is high risk of gathering wrong information as the interviewee might want to please the interviewer.
- It is costly in terms of time and money if there is a large group to be interviewed.
- The interview may decide the results with the way the interview is conducted hence it is hard to rely on the results.

3.2.3 Observation

Dennis et al (2012) It is a fact noticing tool of perceiving or watching attentively the behavior of the users. With observations the analyst is able to recognize missed tasks or tasks the need to be re-aligned. The data relating to the physical environment of the task that is physical layout was also obtained.

Advantages:

- It allows the observer to find information of his/her own without consulting anybody.
- It does not disturb the working employees or require attention from employees.

Disadvantages:

- Not all actions were noticeable
- The change of normal way of doing things that result from people who know that they are being observed may lead to misleading results.

3.3 Analysis of existing system

After data is obtained from the three information gathering techniques the analyst came up with the processes of the current system ,when Plant operator for water treatment plant comes to his/her shift logs in the log book takes plant readings at the required intervals. The foreman of that department compiles the plant figures and then approves the figures and submits the

figure to the section head when they are required. The plant operator writes his/her details before entering the plant values in the log book. The plant operator indicates figures that are not within the desired parameters in the log book. In coal plant the plant operator again writes his/her details when his/her shift starts, the operator then start to enter the coal weights in the log book and when he/she completes a shift the foreman then calculate the weigher variance for ZPC weighers and the supplier weighers .The foreman then submit the recordings as hard copy and the workings for weigher variance .The section head will now have decisions whether to calibrate the weighers or not.

3.4 Process analysis

3.4.1 Activity Diagram of current system

Satzinger, Jackson, Burd (2012:57) Describes the system workflow ,it shows the individual who carries out the activity and the sequence of activities. An activity diagram is used to envision the activities and process flows within the Auxiliary plants of the organization. It shows the stepwise activities and actions with support for choice, iteration and concurrency. The following diagram helps illustrate the processes that take place when operator enters a shift.

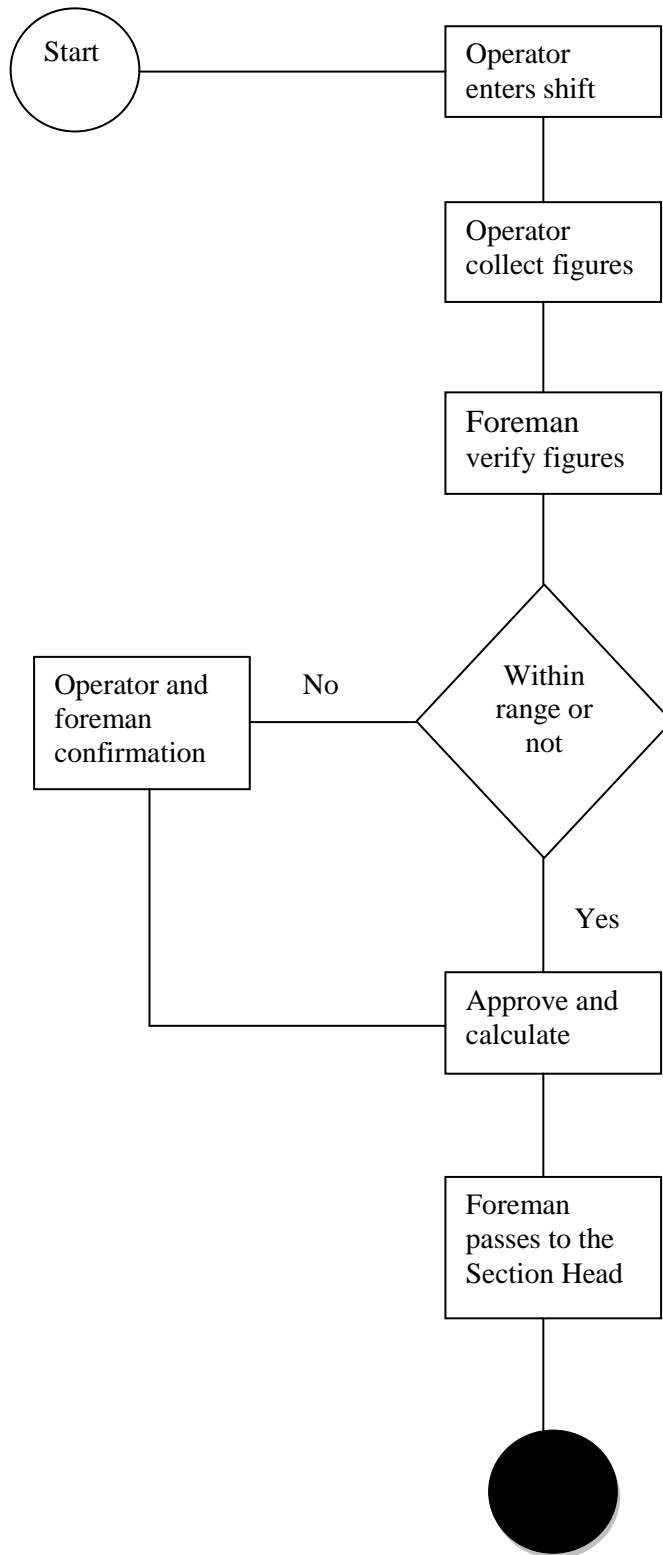

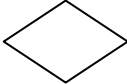





Figure3.1: Process diagram of existing system

Symbol	Description
	Initial State
	Decision
	Activity/Process
	Control of data
	Final State

Inputs

These are the plant figures that are entered into the system although the current system is a manual log book system and is characterized by bureaucracy, inefficiency and errors

- Plant figures are kept in the log book and put in record files.
- Plant figures are compiled and calculated by the plant foreman.
- The plant foreman for coal plant will calculate the weigher variance of each supplier and compile then submit to the section head.
- Reports are compiled manually and the details of plant operator on duty will be in the log book for accountability purposes.

Processes

The data entered will be used to calculate the weigher variance in the coal plant and in the water treatment the data is used to make routine decision by the section head.

Outputs

After the aforesaid processes the results will be as follows:

- Weigher variances.
- Reserve feed water tank levels.
- Reserve feed water tank conductivity.

- Water produced or consumed
- Pressure vessels.
- Water flow rate.

3.5 Data Analysis

Context Diagram

S.A.Kelkar (2004:99) It shows the whole system as a one process. For further clarity of how the current system works the analyst used the context diagram to clearly shows the relationship between the system under investigation and the external entities with which it communicates with

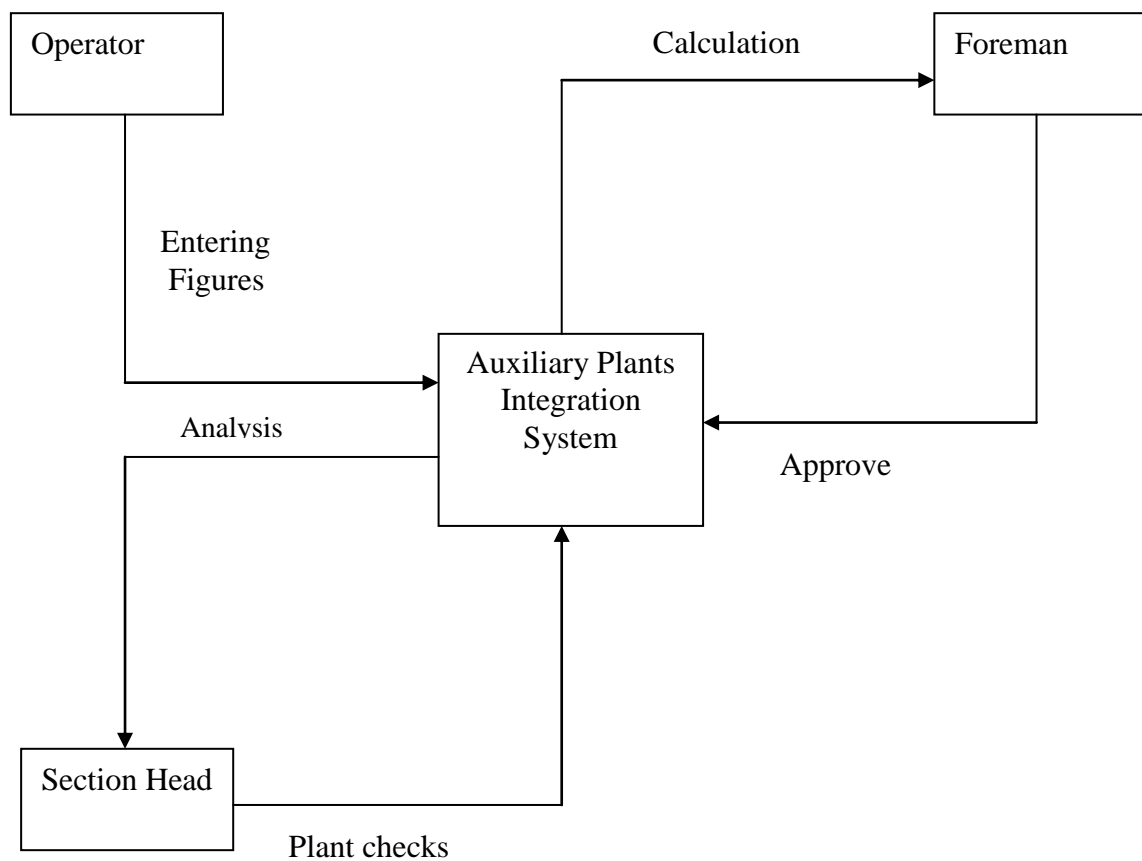


Figure3.2: Context diagram of existing system

Data Flow Diagram

V Rajaraman (2000:77) Data flow diagrams resemble the movement of data in a system, are data modeling tools provide a clear representation of any business function. It helps to visualize the movement of data where it comes from and where data goes as well as its storage place. The data flow diagram of the current system is shown Fig 3.2 below.

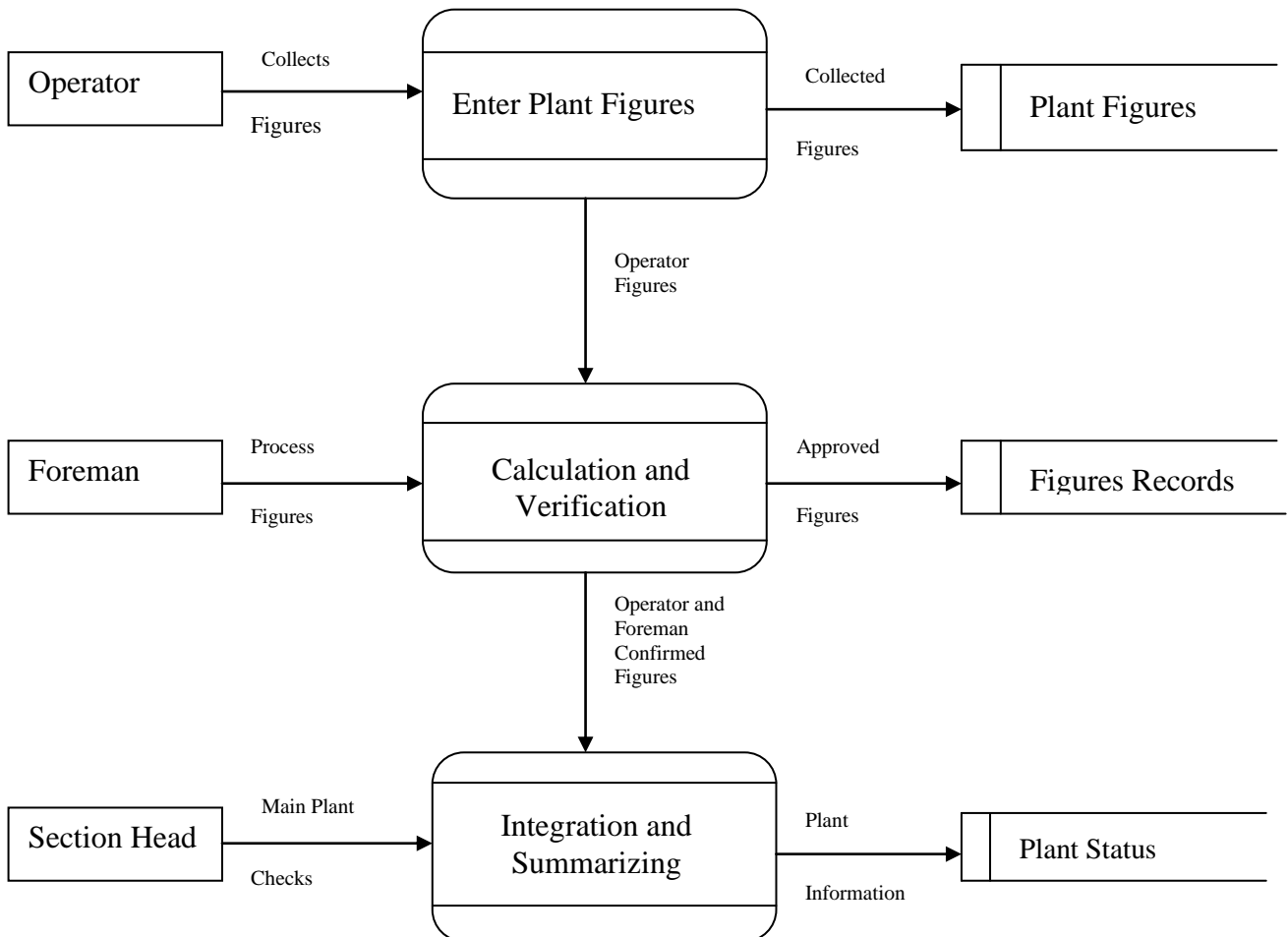


Figure 3.3: Data Flow Diagram of existing system

3.6 Weaknesses of current system

It is the cause of building a new system; it looks at the inefficiencies of the current system which we sort to resolve with the new system that is proposed. The more weaknesses we have on the existing system, the more the need of a system that solves the limitations of the current system. Below are the weaknesses of the current system.

- Unavailability of information at the time it is needed.
- Slow decision making due to slow movement of information from operators to the section head.

- Poor security of information which lead to alteration.
- Suppliers need the summary of weigher variences so that they calibrate their weighers.
- System is not cost effective since a lot of stationary is used and this includes the cost of paper, manual files and pens.
- A lot of errors which may result from eligible handwritings.
- Work is quite stressful especially for the records department employees who have to deal with numerous volumes of data manually and move around files on a daily basis.
- No proper feedback mechanism.

3.7 Evaluation of Alternatives

Having clearly identified the activities in the current system the analyst identifies the the flow of data in the current system. The analyst considers options of acquiring the system and the possible solutions are weighed below to find the best.

3.7.1 Outsourcing software

Kenneth J Sousa, Efy Oz (2011:422) It is contracting an individual or organization to do a job that can be done by employees in your organization. This can be hiring the software developing companies to develop the system that is custom made or buying readymade shelf software.

Advantages

- It is much quicker in addressing the problem since the software can be readily available.
- Limited number of technical staff is required.
- No development costs are incurred.

Disadvantages

- The software packages are very expensive.
- May have high maintenance costs especially when the software is ready made and may be inefficient when the vendor does not support the software.
- The costs of training users may be very high since it is conducted with the vendor.
- The software may be fixed and rigid which can not fit some user requirements.

3.7.2 Improving the Current System

- Improving the file system with each plant operator log books arranged with dates.
- To increase the number of employees who move around the plant.

Advantages

- Developing a new system may have high development and training costs, so the organisation may save its financial resources.
- Policies and procedures keep on working in a normal way common to everyone.

Disadvantages

- It is quite evident that some of the problems in the current system cannot be solved hence there is need to restructure.
- Recruiting more employees to move around the plant may bring about more costs in paying salaries and training.
- The incorporation of technology may be difficult in the manual system.
- The system will continue to function unreliably and inefficiently

3.7.3: In house development (Developing a new system)

Gary Shelly ,Harry J ,Rosenblatt (2010:422) This is developing the system that is tailor made to meet the specified needs of the organization; it is more flexible since it is made with conformity of the users. The development team is within the organization.

Advantages

- High control on system development.
- There is a possibility of optimum configuration.
- There is reduction in manual work involved.
- data redundancy is reduced
- Improves data consistency and integrity
- High stationary costs in the current system are curbed.
- Solves unique user requirements and can be tailor made to function in a way all users can understand.
- Users get sufficient training.

Disadvantages

- Resistance from users may affect the use of the system.
- It is time consuming as compares to the other alternatives.

- Expenses are too high for in-house development though it is beneficial in the long run.

3.8 Requirements Analysis

V.Rajaraman (2000) Having analyzed the flow of data and processes in the current system the following step is establishment of requirements for the current system. Requirements are divided into functional and non-functional requirements. Functional requirements are tasks the system must support, whilst non- functional requirements are constraints on various attributes of these tasks.

3.8.1 Functional Requirements

The functional requirements consists of various inputs, processes and outputs that are expected of the new system. The system's functional requirements should include:

- Managing user accounts with security, user should have username and password and able to change their passwords whenever necessary.
- Creating, Editing and Deleting user accounts.
- Centralized database to enable data storage and retrieval when needed and also reduce data redundancy.
- Mechanism to facilitate integrity checks to allow for data verification for the data that has been captured in the system.
- Enable calculation of weigher variance.
- Validation and verification

The system requirements can be clarified by the use of Use Case Diagrams below:

Use Case

Gary Shelly et al (2010) It is a visual representation of interaction of user and system. It has a description of sequences of actions, who does what actions to produce results. Use cases specify the expected behavior and not the exact method of making it happen. Use cases are created based on identified functional requirements but are not mapped one-to-one to requirements.

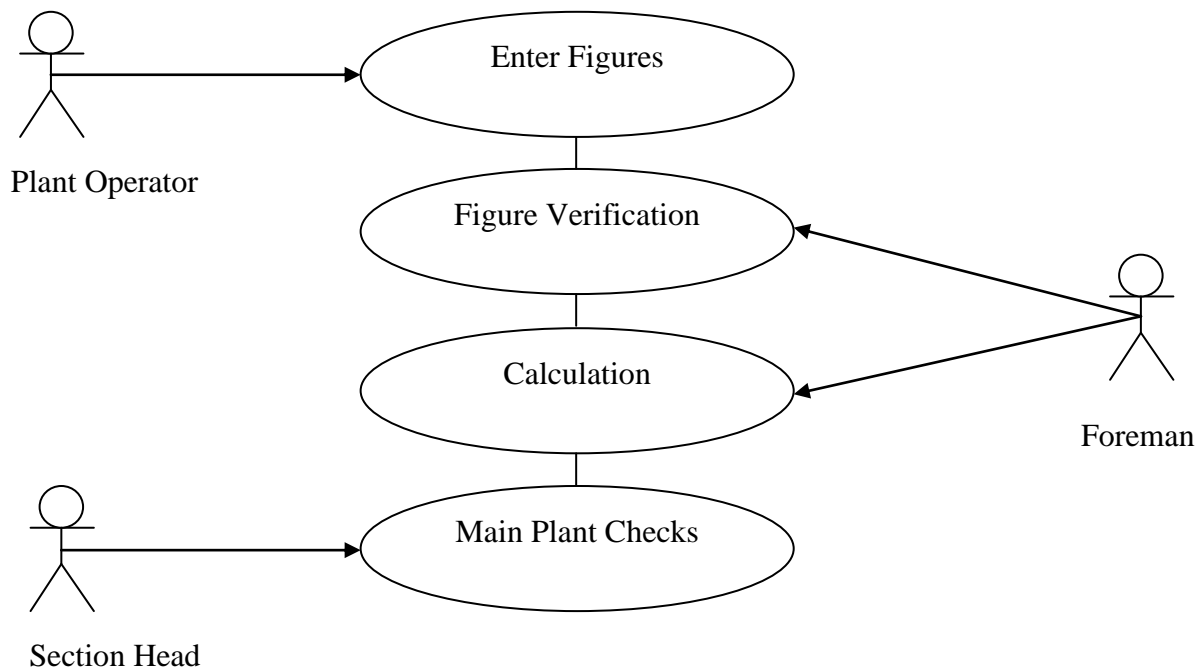
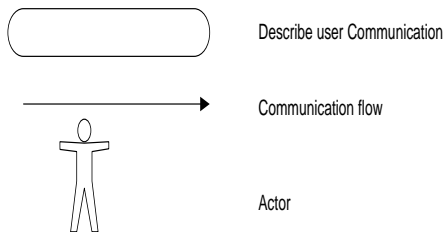


Figure 3.4: Case Diagram
Key



3.8.2 Non-functional requirements

It is looking at constraints that are faced as the system is being developed. The functional requirements of the proposed system range from the needs of general users to the needs of the organizations senior management.

User Interface and Human Factors

Basically by user interface and human interface we look at how the system will present itself to the users. In other words how the users perceive the system. Users may quickly adopt the

system or may have an attitude towards the system. Below are factors to consider so that the system is accepted with users

- The system should be simple and easy to learn.
- The user interface should be almost self-explanatory.
- The system should allow for error recovery.
- The system must be user friendly.

Error Handling

The system should have error handling for

- Data capture.
- Data and or user details analysis.

Security Issues

The proposed system must be more secure through;

- Using access rights, secure authentication and passwords.
- Variation in access level for different uses for securing information.
- Capturing the details of the user currently logging on to the system.

System efficiency and throughput

The proposed system is supposed to;

- Allow users to quickly retrieve data at the time needed as well data should be available
- Improve faulty logging process.
- Eliminate job assignment duplication
- Improvement of the services provided in terms of response time, efficiency and reliability.
- Reduction of operational costs due to minimization on overtimes.

Technical constraints

In the development of the system the following maybe encountered during the different stages of development

- More technical staff will be needed to help develop the modules of the system.
- The system may become a bit complex and may need experts for support in the future.

3.9 Conclusion

The weaknesses of the current system have been noted and it was agreed to develop this system using in-house development having pointed out the benefits of in-house development. Data gathering techniques used were evident enough to prove that the current system is inefficient. Therefore the next step is to proceed to the actual design of the proposed system.

CHAPTER FOUR: DESIGN PHASE

4.1 Introduction

Dennis et al (2012:14) The design phase gives an outline of how the system is going to work regarding network, hardware and software resources, as to how are they going to be arranged .Resources such as database ,forms ,files and programs’ that are going to be used to build the system. It is a phase that looks at the development of the new system having briefly looked at the current system and outlined the weaknesses of the current system. In this design phase we use the stepwise or top down approach which is breaking the system into small subsystems to visualise and gain control on each subsystem. It outlines the following:

- system design
- physical design
- architectural design
- interface design
- database design

Firstly in design phase is to look at the need in the current system and how the system is going to work including input and output forms as well as interfaces, in designing the system there are core guidelines and are as follows:

- User acceptance - the users must perceive the usefulness of the system as problem solving to their current problems.
- Reliability – the system should always be available to the exposure of the users whenever the users need it.
- Maintainability – the system should allow error to be dealt with in a short period of time as well as fixing time when the system goes down should be minimal.
- Effective – the system should be in a position to solve the user problems.

4.2 System Design

Dennis et al (2012:14), This describes the structure of software and hardware and should be drawn in accordance to the following characteristics:

- Secure – the system should allow those who are authorised only to use the system, it should be confidential.

- Reliable – whenever information is needed the system should be in a position to retrieve the information.
- User friendly – system should be understood and be used with minimal consultation and effort.
- Efficient – system should execute queries and carry out processes in a short period of time

4.2.1 Context Diagram

P.T Joseph ,S.J Sunjay Mohapatra (2009:103) It describe the highest level flow of data that has only one process for the whole system.

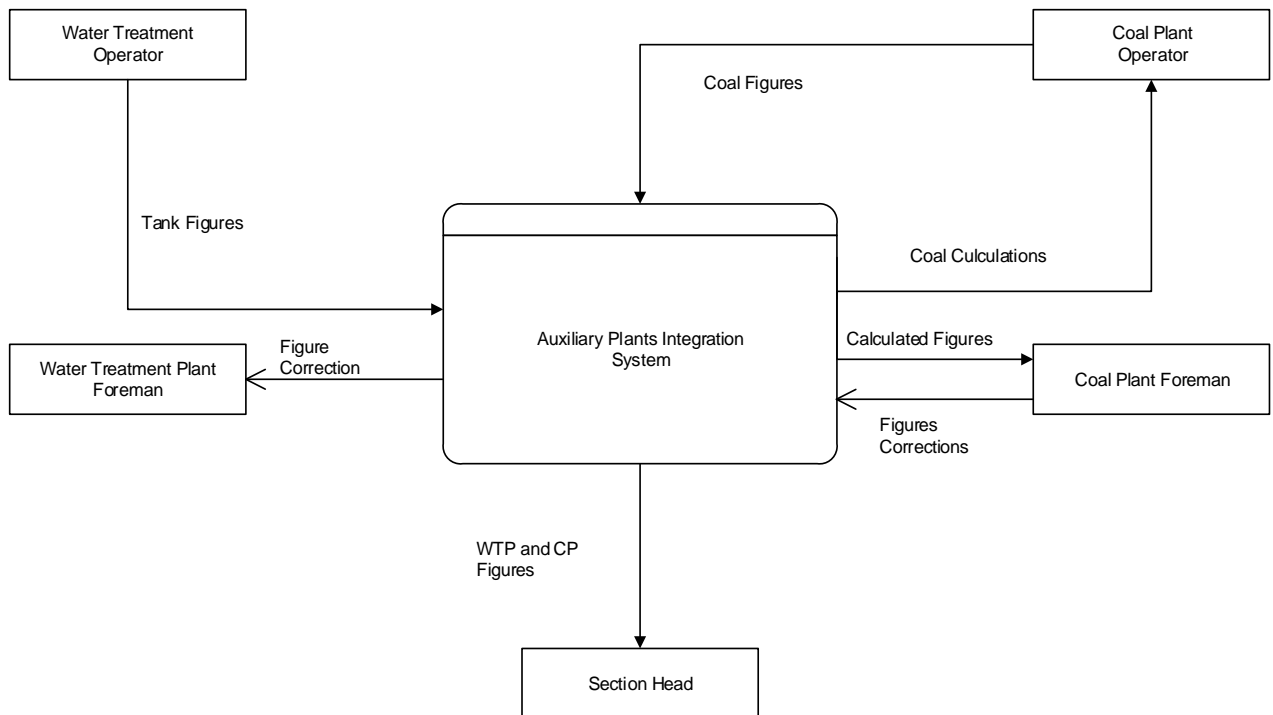
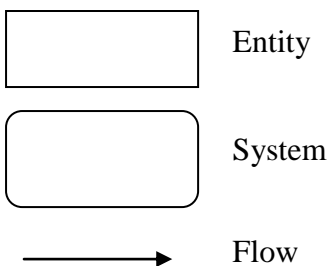


Figure4.1: Context Diagram

Key



4.2.2 DFD of the proposed System

V.Rajaraman (200:77), It uses extended entities to model a system. Data enters a process and the process transforms data into output and that data can either be stored or passed to another process. Data in storage can be input for another process. It is representing processes graphically in a system of how the information flows, showing data storage and links.

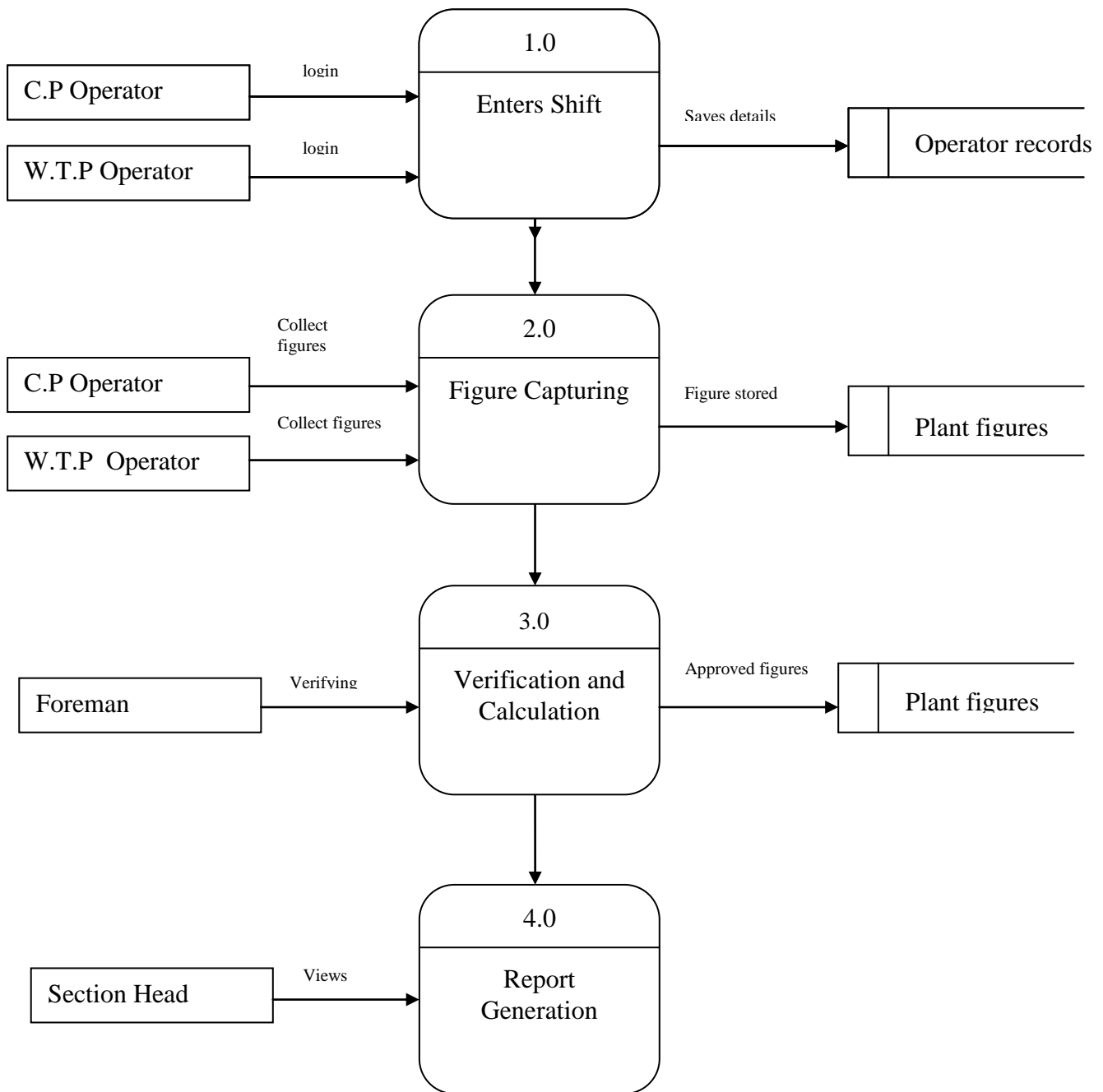
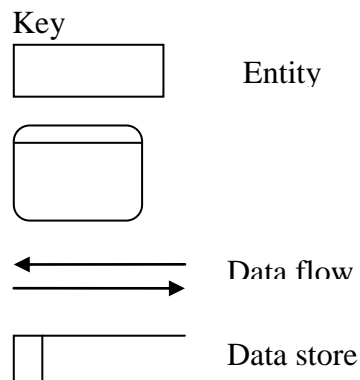


Figure 4.2: Data flow diagram



4.3 Architectural design

Bharat Bhushan Argarwal ,Sumit Prakash Tayal (2007:101), It shows the structure of components and data that are needed to construct a system. It is how the component in a system are related and arranged, it also focuses on the structure of data in a system.

4.4 Physical design

Rosenblatt (2010:297),It is a set of actual components that are used to build a system .A physical design describes the real processes' of data entry ,data verification, and data storage; the physical arrangement of data files' and procedures for sorting, report formats, and so on .It describes the physical layout of the system components, a model of the actual system.

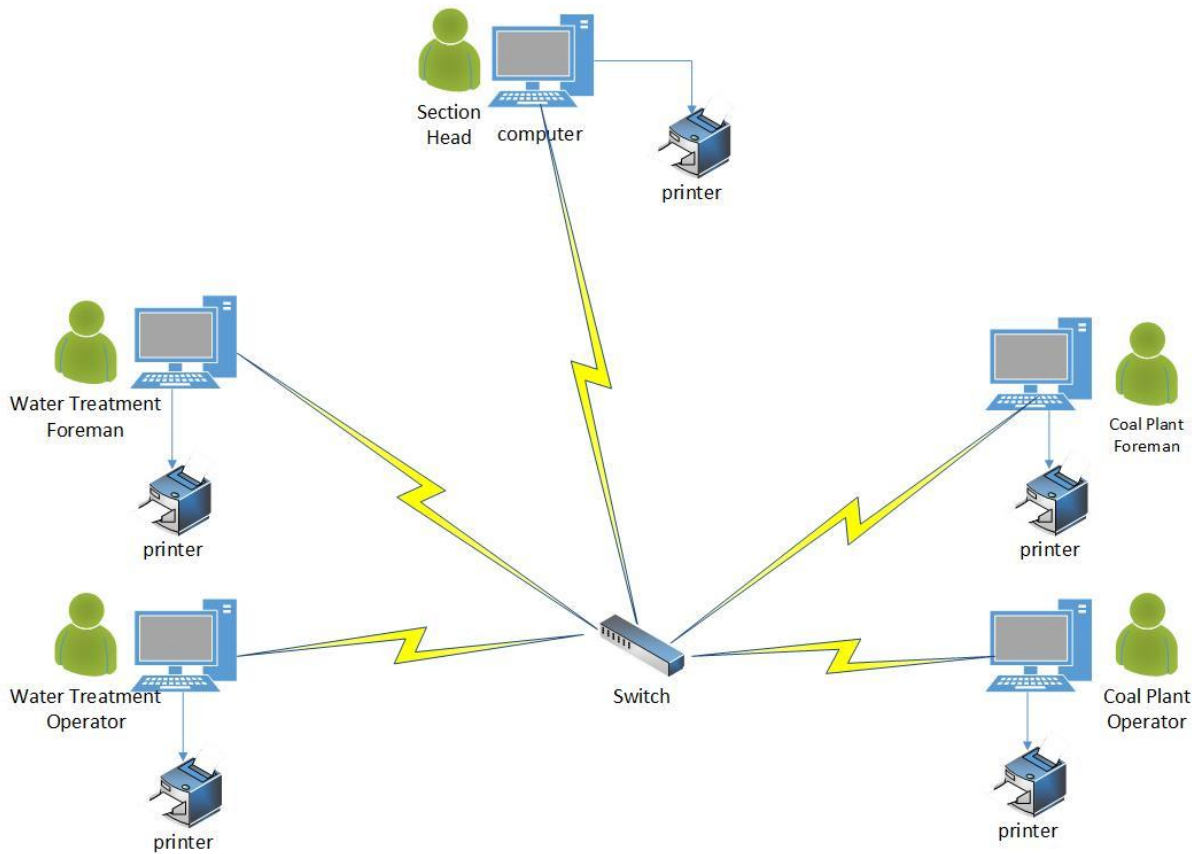


Figure4.3: Physical Design.

4.5 Database design

Shouhong Wang, Hai Wang (2012:121) It is defining how data should be stored and be accessed. It includes logical and physical design based on data models obtained in the system analysis phase. It describes the data structures in a database, how the data is stored and related. It also contains security features that hide the actual physical storage of data from user. The database architecture diagram is as follows:

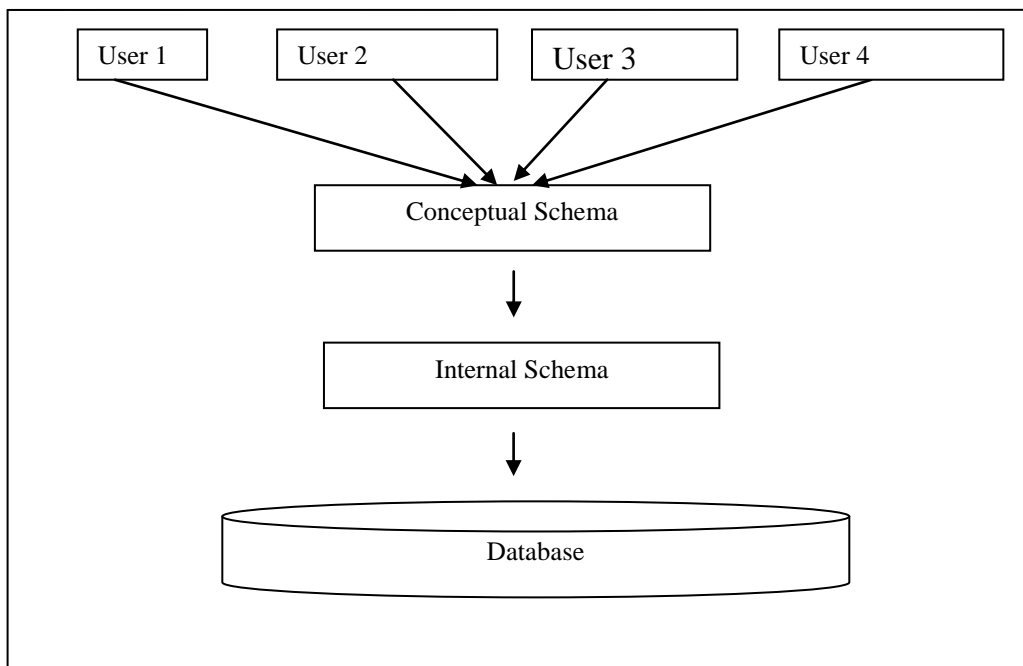


Figure 4.4: Database architecture

External level – At this level each user has a customized view for example Operators have their own way of viewing the database and security is maintained at this level so that the operator can only enter plant figures.

Conceptual level – This level describes the relationship among data in the database and is the community view.

Internal Level – It represents the actual location data on a computer including information like data compression placement of data and actual space. It is coordinated the computer operating.

4.5.1 Physical Level

Shio Kumar Singh (2006:62), It is the lowest level of abstraction showing the actual database on the computer. Describes how data should be stored in the database, structure of files and ways to access data. Describes how the operating system and database management system perceives data.

4.5.2 Conceptual Level/ Schema

Shio Kumar Singh (2006:62), It defines the relationships in the database. It is the community view of the database which describes data storage and relationships which exists within data entries.

4.5.3 View Level

The external level is the users' view of the database. This level is at the highest level of the data abstraction where only those portions of the database of concern to a user or application program are included.

Reasons for using Relational Databases

- They are simple to modify data and to delete data.
- Allow storage of multiple data types
- All data in tables is linked so that it easy to change data
- More secure because data is split into tables.

4.5.4 Logical Design

Dennis *et al* (2008), It shows the logical representation of data in the database, and table below shows the logical structure in the database.

4.5.6.4 Staff table

NAME	DATA TYPE
Staff ID	Int
First Name	Varchar
Surname	Varchar
Gender	Varchar
ID no	Varchar
Phone no	Varchar
Email	Varchar
Address	Varchar
Department	Varchar
Position	Varchar
Password	Varchar

Table 4.1: Staff table

4.5.6.5 Supplier Table

NAME	DATA TYPE
Name	Varchar
Company registration no	Varchar
VAT no	Varchar
Phone no	Int

Email	Varchar
Address	Varchar
Comments	Varchar

Table 4.2: Supplier Table

4.6 Enhanced Entity relationship diagram

Shio Kumar Singh (2006:275) It is the extension of entity relationship used in database construction.

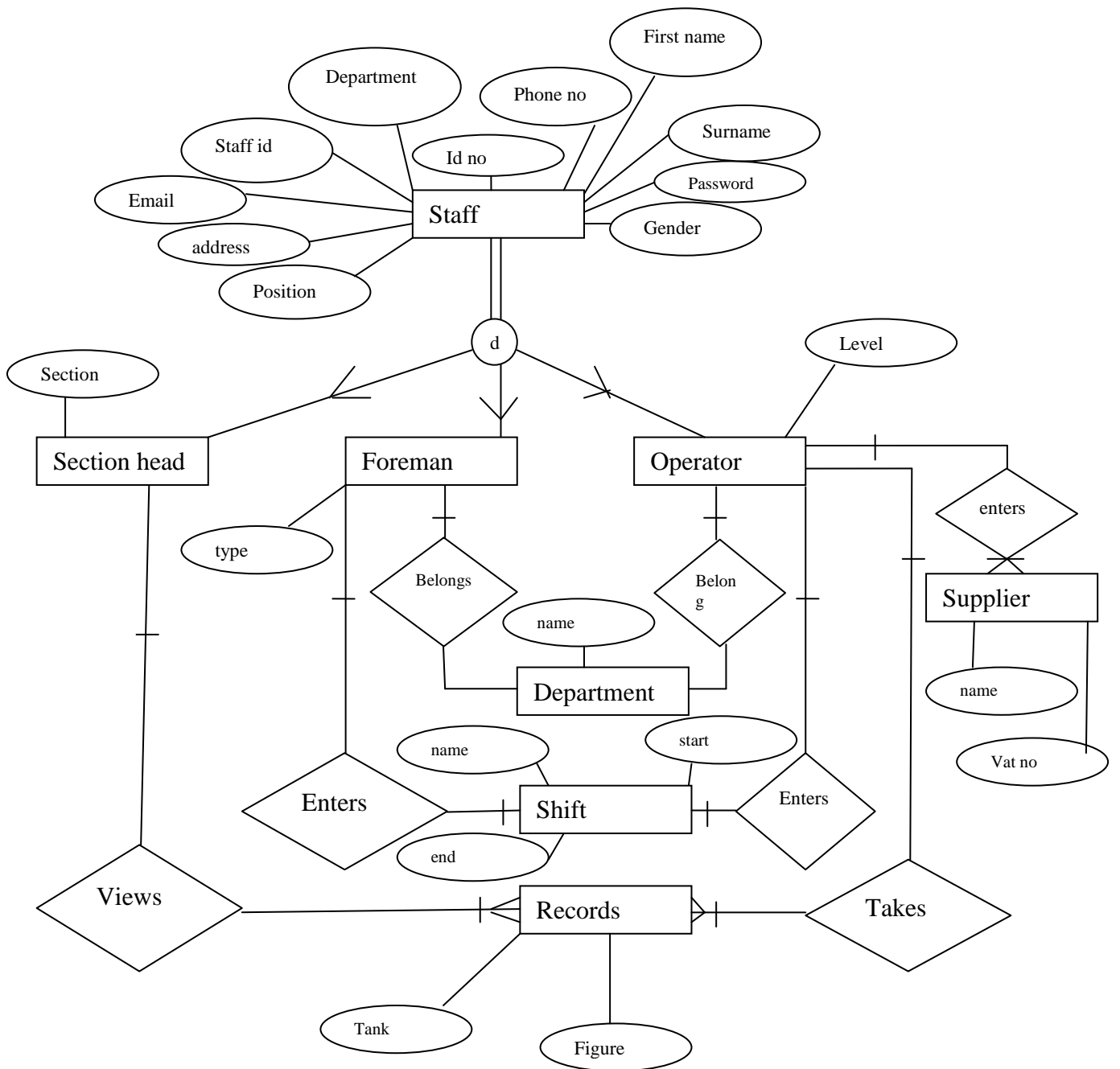
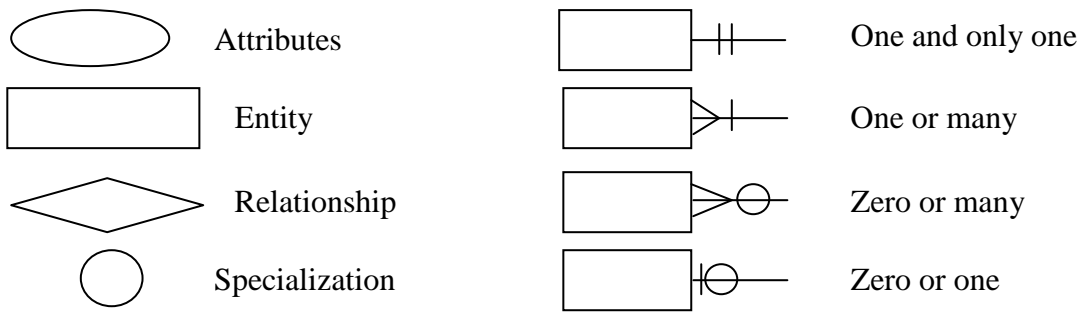


Figure 4.5: Enhanced Entity Relation Diagram



4.6.1 Package diagram

Ian Sommerville' (2011), A package diagram shows the breakdown of unit modules and their coordination, the package diagram reduces the complexity of the system thereby making it easy for the system to be understood. Developers will have a clear insight of the system units.

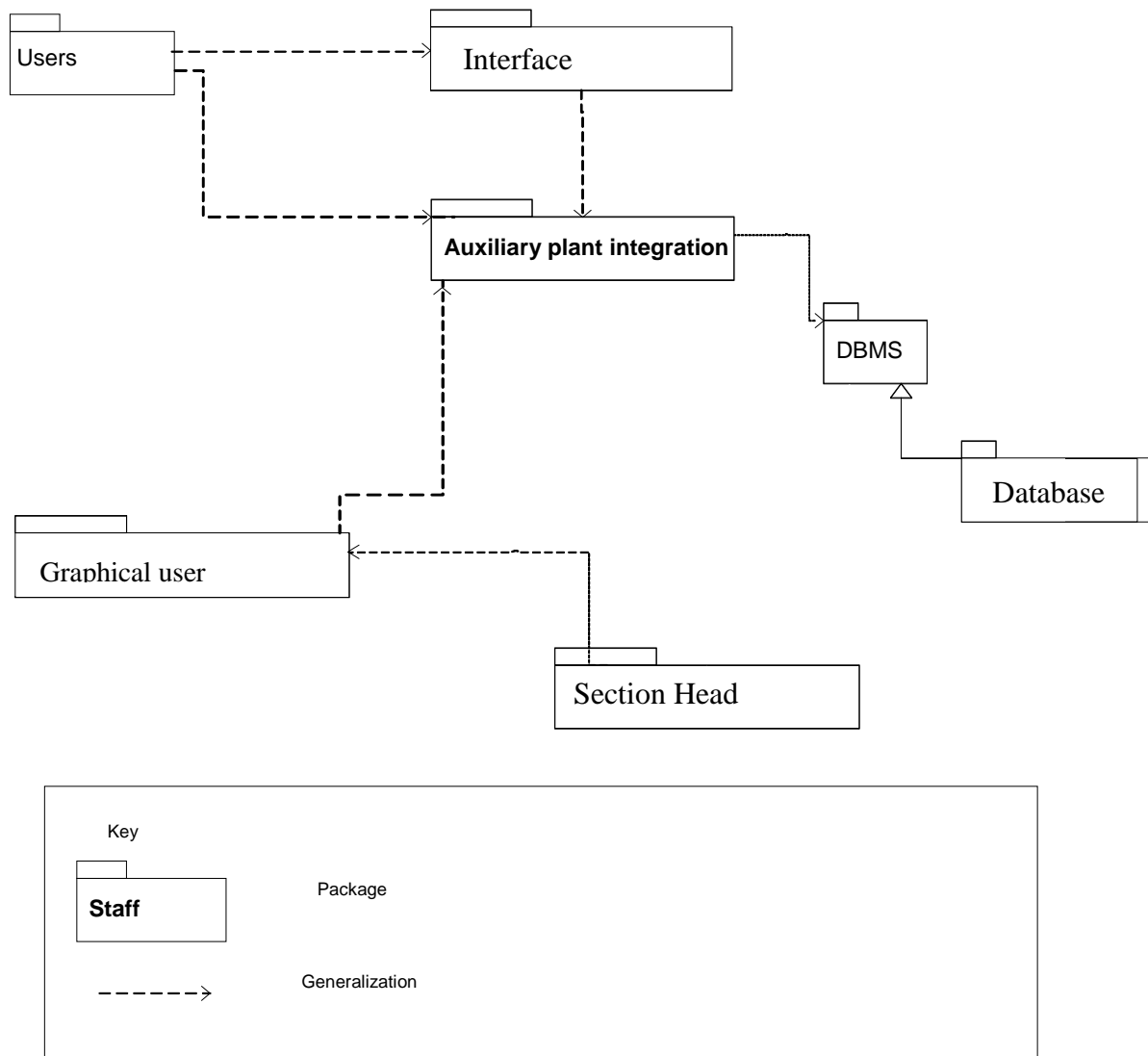


Figure4.6: Package Diagram.

4.6.2 Class Diagram

Dennis et al (2012:522) It is a static model that gives an overtime static view as the system evolve. It shows the relations among classes in a system that remains static overtime. A class diagram transforms from logical model to a complete and working information system. The Class Diagram below illustrates how the expected classes of the proposed system.

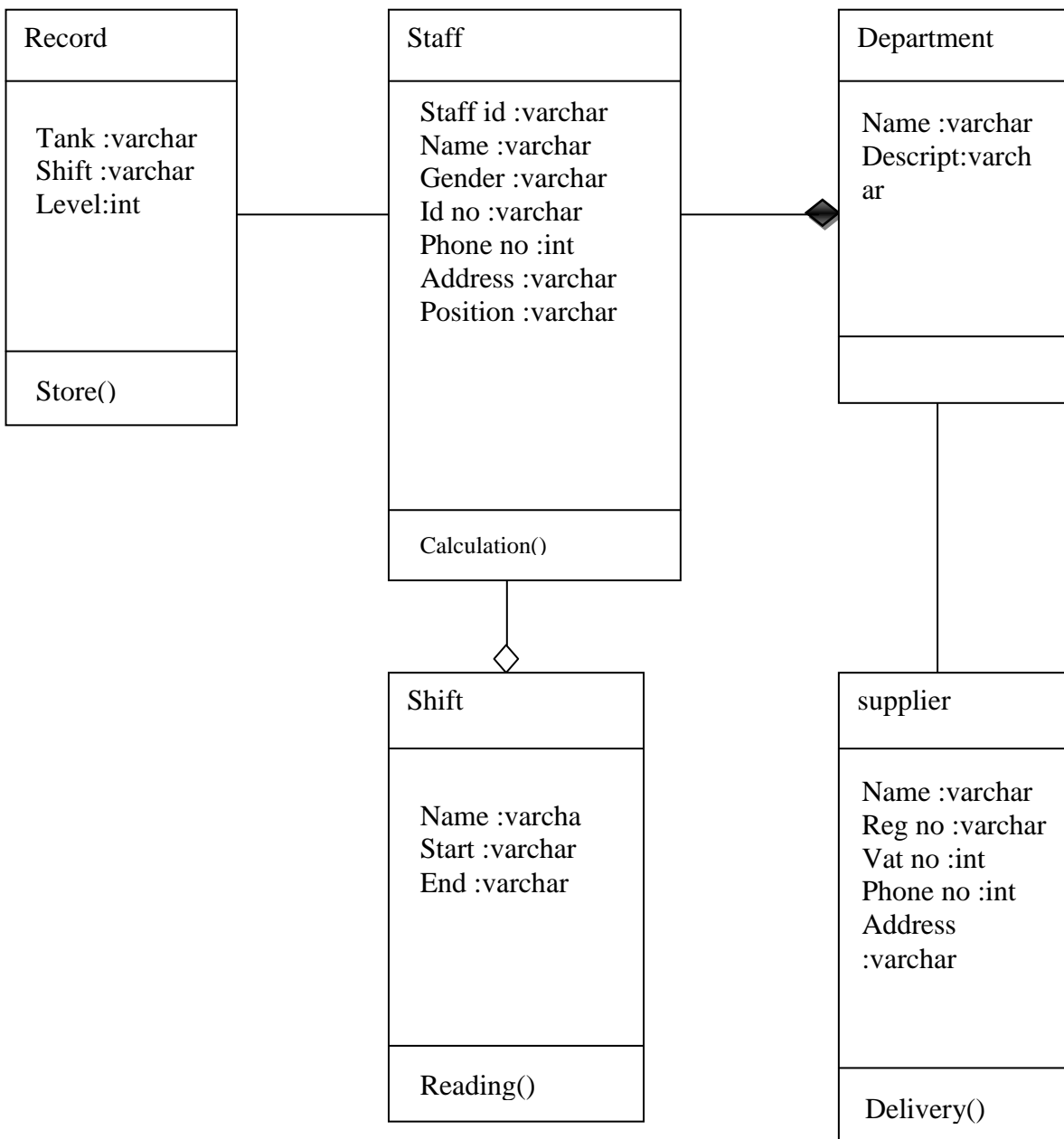


Figure 4.7: Class Diagram.

4.6.3 Sequence Diagrams

Dennis et al (2012), It forms the object that take part in the use case and facilitate the messages that pass between the use case over time .Sequence diagram shows the objects and the sequence time.

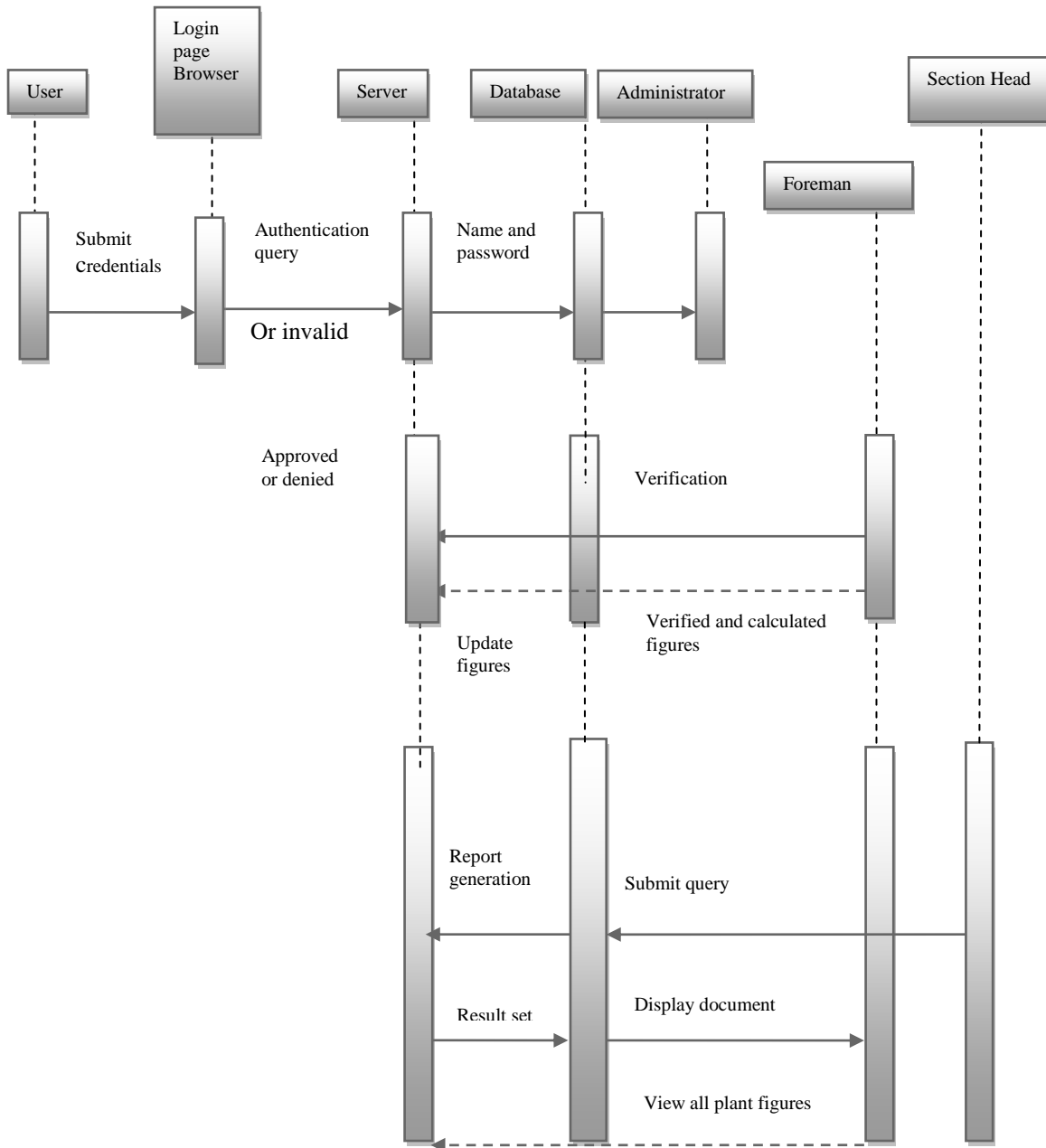


Figure 4.8: Sequence Diagram

4.7 Interface design

Dennis et al (2012), For a user to interact with the system he/she needs screen, controls, input screen, output screen and report screen. The graphical controls that the user uses to communicate with the system are referred to as interface. The aim is to build the system with interfaces that are easy to understand and involve use of mouse point and click interface. The

Graphical User Interface is used to make the system more easy to use and popup menus that accept data inputting.

4.7.1 Functional structure design

All type of users have different access levels or privileges' but initially all users are faced with one entry level which is the main form that enable every user to log in using his/her credentials'. When the user logs in the respective form will show up but the forms are differentiated with the type of user, Water treatment plant Operator is faced with an interface which enables him/her to start work in the rightful department, as well as coal plant.

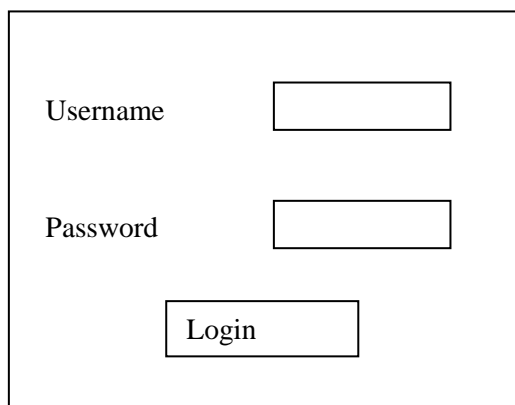
4.7.2 Input Design

It is an interface that allows for communication of users and the system, the user inputs data to the system using the input devices on the interface screen. The interface allows users to enter data to the system without much complexity so that users will enter data on the right form.

4.7.3 Log on control

At this page there is authentication to allow and disallow users with regard to their access rights. The system provides three access level which allows operator, foreman and section head to log in the system. The system will provide different forms for the three users Operator gets the form to enter plant figures, foreman calculates and verify the plant figures using his differentiated form and also the section head has a unique form. The home page shows the start up. Figure 4.10 shows log in design.

Staff login interface.



The image shows a rectangular box representing a staff login interface. Inside the box, there are three elements: a label 'Username' followed by a rectangular input field, a label 'Password' followed by another rectangular input field, and a rectangular button labeled 'Login' positioned below the password field.

Figure4.9: Staff login

4.7.4 Main Home page


System Menu	
Departments	
Work Shifts	
Staff	
Suppliers	
Water Treatment Plant	
Coal Plant Records	
System Backup	
Help	
Reports	

Figure4.10: Main Menu

4.7.5 Reserve Feed Water Tank

Reserve Feed Water Tank	
Tank Name	<input type="text"/>
Hourly Time	<input type="text"/>
Percentage Level	<input type="text"/>
<input type="button" value="Submit"/>	<input type="button" value="Reset"/>

Figure4.11: Reserve Feed Water Tank.

4.7.6 Reserve Conductivity Records.

Reserve Conductivity Record	
Tank Name	<input type="text"/>
Level	<input type="text"/>
<input type="button" value="Submit"/>	<input type="button" value="Reset"/>

Figure4.12 Reserve Conductivity Records

4.7.7 Add New Supplier

Name	<input type="text"/>
Company Reg Number	<input type="text"/>
Vat Number	<input type="text"/>
Phone Number	<input type="text"/>
Email	<input type="text"/>
Address	<input type="text"/>
Comment	<input type="text"/>
<input type="button" value="Submit"/>	<input type="button" value="Reset"/>

Figure4.13: Add New Supplier

4.7.8 Add Shift

Shift Name	<input type="text"/>
Start Time	<input type="text"/>
End Time	<input type="text"/>
<input type="button" value="Submit"/>	<input type="button" value="Reset"/>

Figure4.14 Add Shift

4.7.9 Output Design

Output from the processes will now be shown on the output design, the output forms show different results based on the user request.

4.7.10 Reports Design

This shows the structure of reports to the Section Head, the Section Head need reports for plant figure limits and the calculations for the plant figures that will be used in the day to day decision making in the Coal plant and Water treatment plant.

. The figure 4.16 shows raised orders report

Weigh Comparison sheet				
Date	Supplier	ZPC	Variance	V%

Figure4.15: Reports interface

4.8 Conclusion

Having looked at different forms of data the input and output methods and having noted the hardware and software requirements this paves a way for the implementation and testing phase. The design phase was significant in identifying and organizing the project object as

well as creating the interfaces and data storage structures. This marked the end of the design phase and implementation and testing will begin.

CHAPTER: IMPLEMENTATION

5.1 Introduction

Gary Shelly et al (2012:507). In this phase the main focus is to look at the implementation of the Auxiliary Plants Integration system, this phase encompasses the functionalities' of the system, snippets of code, snapshots as well as the implementation plans'. In this phase much attention is on system modules. It is a stage a deliverable is realised, a system is made up of units that are integrated to bring about a fully functional system. All units are tested as a separate entity and combined for a test of a single unit system. The system will be tested for user requirements if it meets the specified needs then the system functions.

5.2 Coding (Pseudo Code)

Gary Shelly et al(2012:513), A pseudo code outlines the steps of a program without strict syntax representations', it is a summary of what a system must do ,it is a general representation of the actual code without sticking to programming rules in other words it is informal. Pseudo code is not a programming language but a way to represent the logic of the program.

5.2.1 Program Pseudo code

In the program pseudo it shows how the information flow from the login page, figure capturing and supplier weigher variances'. It is a vital way to express the system functionalities.

Code for Login

Start

Select system

Enter username and password

If (username and password) valid

Log in

Else

Wrong credentials, Try again.

End.

Add User Form.

Start

If (check user) is administrator

If (add user)

Enter user details and add user

Figure entering.

Enter Tank, Hr time and reading.

Check input

If(incorrect) the prompt the user

Else

Save readings

Verification process

Check readings

Then approve readings

Section Head views.

5.3 Testing

Preeti Gupta (2005:98) ,It is a process of evaluating the system components as to whether they meet the specified needs of the users. It is accessing the system ability to deliver what it is intended to produce; system is measured with its objectives. During system development a system is tested as a unit or a system in order to uncover errors. Unity testing basically is intended in uncovering the errors of a module rather than the whole system. The diagram below shows ‘steps that are followed in testing.

5.3.1 Testing processes

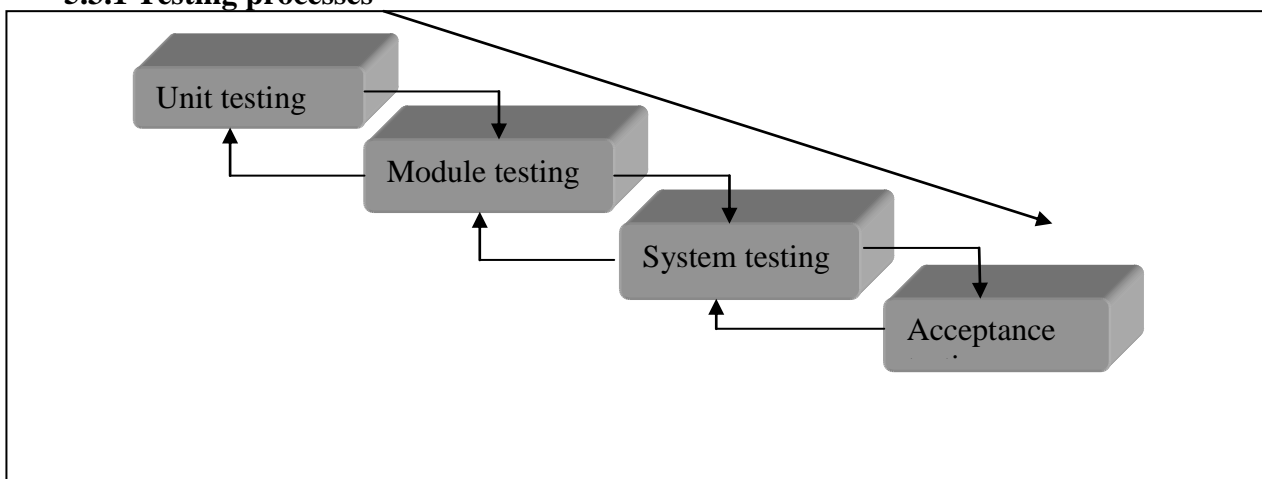


Figure5.1: The testing flow process’.

5.3.1.1 Unit testing

Garry Shelly et al (2010:515), It is when individual component of a system is tested to uncover errors that might not have been recognised during desk checking, all possible

situations should be tested for and the unit should contain correct data. For example the administrator module can be tested to see whether it performs the required functionalities like creation of user accounts as well as assigning the user level of an individual in an Auxiliary Plants Integration system. There are two categories used 'white box or logical testing' and 'black box or functional testing'. Example is that the system should verify the user logging if it's the actual individual.

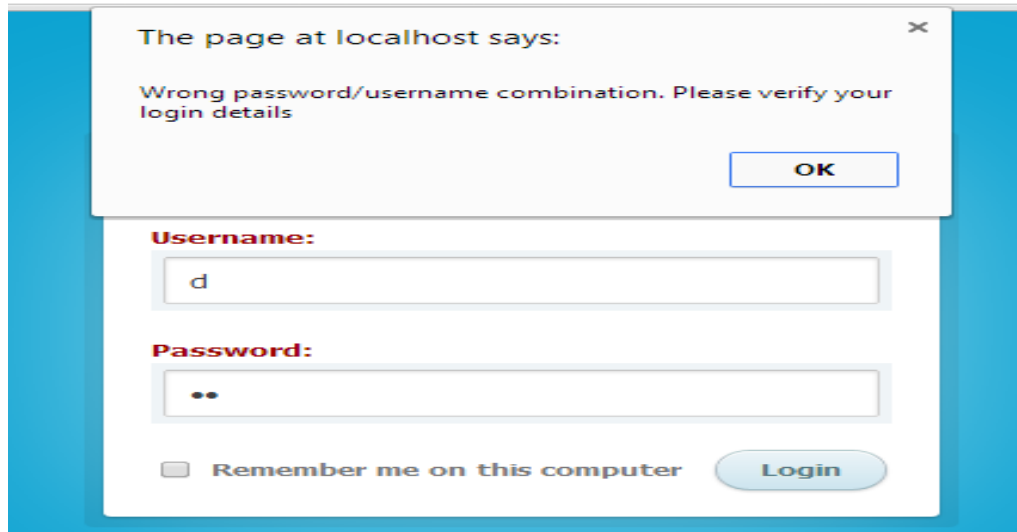


Figure 5.2: Screenshot for validation of user passwords.

5.3.1.2 Logical testing (white box testing)

Kassem A.Saleh (2009:224) It is a test of the code to verify if it works the intended task, it looks at the internal components or mechanisms' of the program. This test is carried out by an individual who has explicit knowledge about the code and tests to examine the output of the code. It tests internal parts of the system which may be testing a unit or the integrated system, if the code is declared clear it means the output produced will meet the specified needs of the system.

Advantages

- Errors will be uncovered early
- Code that has a defect will be removed

Disadvantages

- High expertise which brings about high costs
- It is impossible to look into every bit of code

5.3.1.3 Functional testing (Black box testing)

It is not concerned with the source code, the test focuses' on the functional aspects of the system without looking into the internal structure of the system .Kassem A.Saleh (2009:224) The people who test does not have access and control of the code, it uncovers error such as errors found in data structures, missing functions as well as error in interfaces.

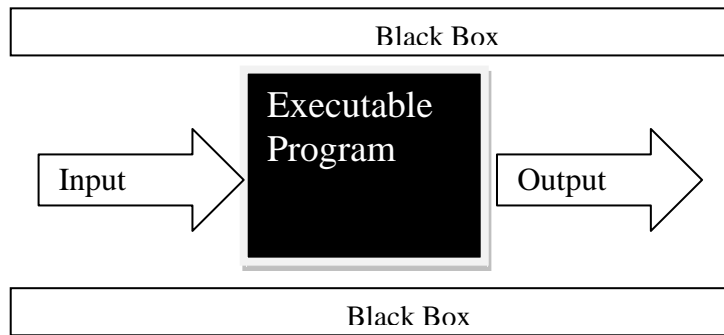


Figure5.3: Black Box Testing

Advantages

- The environment that the system is running can be tested
- The tests are carried out on the users' point of view
- It is very efficient on big projects
- Non technical person can do testing

Disadvantages

- Not all aspects of the software can be tested
- Chances are very high that tests that are carried out by programmer are repeated
- The very reason for the failure is not known

5.3.1.4 Module testing

Vinod Kumar Garg ,S.Srinivasan(2000) It is the testing of dependent component of the system, testing can be done on a single component without other components ,testing is done according to the desired outcome of the module. It is a very important test as it tests the interfacing of the modules.

5.3.1.5 System testing

Roger S .Pressman (2001) It focuses on the whole system ability to meet the specified functions, it involve the coordination and the interaction of all the elements of the system .The integrated components will now be tested for errors as a single unit. Major functionalities are security and ability to produce desired output. Also the compatibility of the

software on the available hardware will be tested, and possible threats are looked at with software ability to adapt to threats.

5.3.1.6 Objectives vs System solution

Objective 1: To make an Auxiliary Plants Integration System that will allow shifts to be managed.

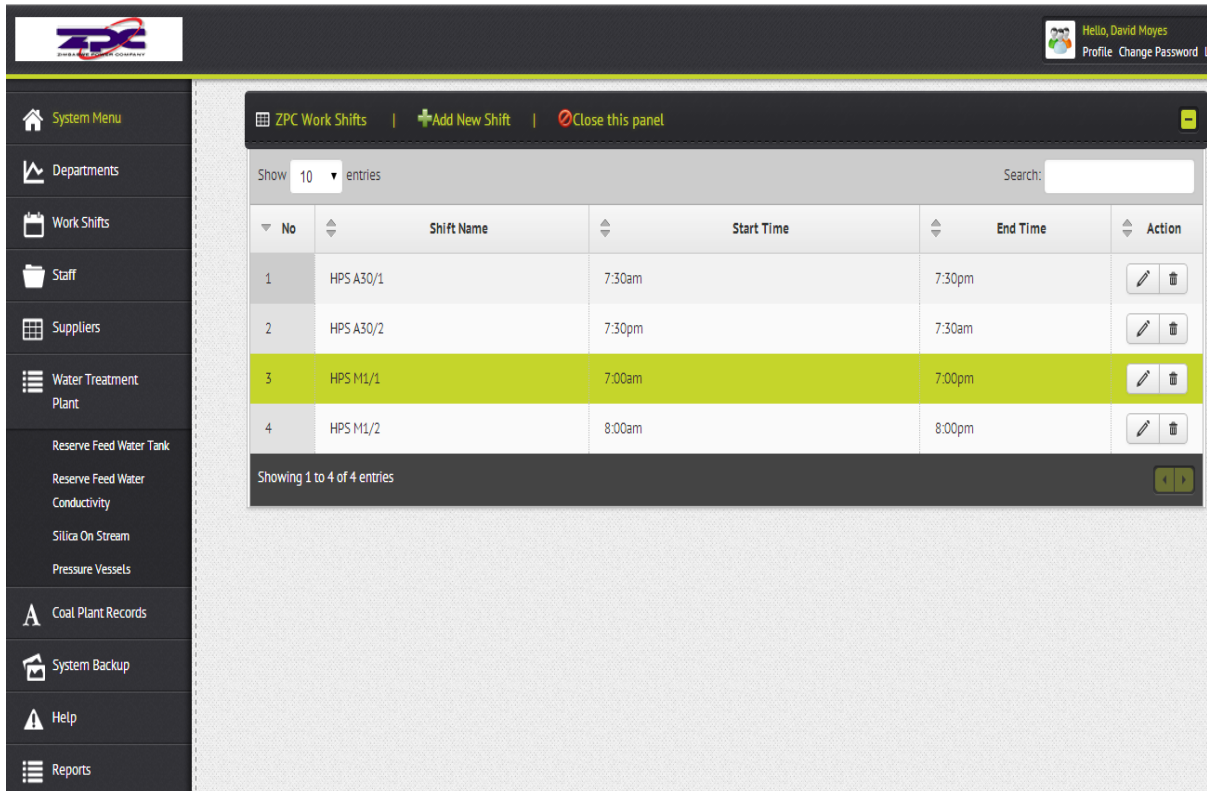


Figure 5.4: Solution for objective 1

Objective 2: To calculate the weigher variances for ZPC weighers and the supplier weighers.

The screenshot shows a web application interface for adding a new coal record. The interface is divided into a sidebar menu on the left and a main content area on the right. The sidebar menu includes the following items: System Menu, Departments, Work Shifts, Staff, Suppliers, Water Treatment Plant, Reserve Feed Water Tank, Reserve Feed Water, Conductivity, Silica On Stream, Pressure Vessels, and Coal Plant Records. The main content area has a header with a plus sign, "Add New Coal Record", a link "Click Here to Coal Plant Records", and a "Close this panel" button. Below the header is a form with the following fields: Supplier (Hwange Colliery Mine), ZPC Quantity (23000 Tonnes), Supplier Quantity (19500 Tonnes), Variance (3500 Tonnes), and Variance Percentage (17.94871794871795 %). At the bottom of the form are "Submit" and "Reset" buttons.

Field	Value	Unit
Supplier	Hwange Colliery Mine	
ZPC Quantity	23000	Tonnes
Supplier Quantity	19500	Tonnes
Variance	3500	Tonnes
Variance Percentage	17.94871794871795	%

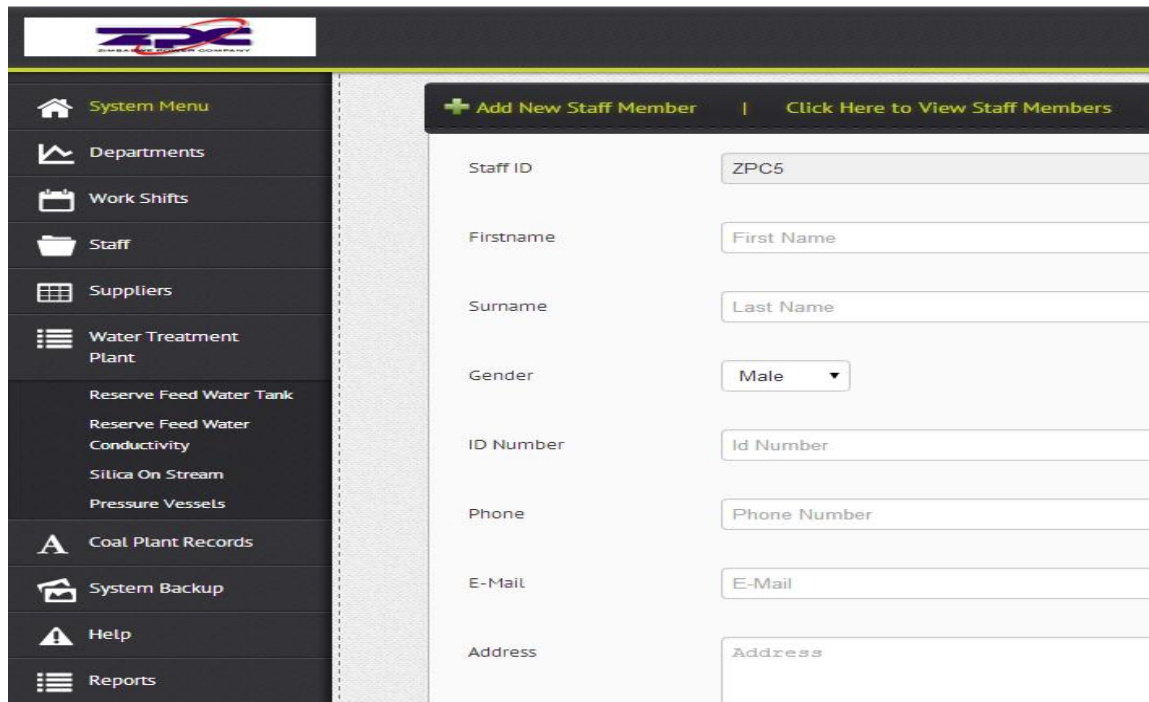
Figure 5.5: Solution for objective 2

Objective 3: To enable Operators who have entered a shift to enter plant figures for Water treatment plant and Coal plant.

The screenshot shows a web application interface for adding a new pressure vessel record. The interface is divided into a sidebar menu on the left and a main content area on the right. The sidebar menu includes the following items: System Menu, Departments, Work Shifts, Staff, Suppliers, Water Treatment Plant, and Reserve Feed Water Tank. The main content area has a header with three links: '+ Add New Pressure Vessel Record', 'Click Here to View Pressure Vessels', and 'Close this panel'. Below the header are three input fields: 'Tank Name' with a dropdown menu showing 'Tank A', 'Shift' with a dropdown menu showing 'hghghghg', and 'Pressure Level' with a text input field containing '%age' and a unit 'kpa'. At the bottom of the form are two buttons: 'Submit' and 'Reset'.

Figure 5.6 Solution for objective 3

Objective 4: To allow entering of details of Operators



The screenshot displays a web application interface for managing staff members. On the left is a dark sidebar menu with icons and text for various system functions. The main content area features a header with two links: '+ Add New Staff Member' and 'Click Here to View Staff Members'. Below the header is a form for adding a new staff member, with the following fields and values:

Field Label	Value
Staff ID	ZPC5
Firstname	First Name
Surname	Last Name
Gender	Male
ID Number	Id Number
Phone	Phone Number
E-Mail	E-Mail
Address	Address

Figure5.7: Solution for objective 4

Objective 5: To create a system which display reports for information of Water treatment plant and Coal Plant.

No	Supplier	ZPC Qty	Supplier Qty	Variance	Variance %	Record Date
1	South Park Mine	11 Tonnes	13 Tonnes	-2 Tonnes	-15 %	2014-04-28
2	Makomo	1299 Tonnes	1222 Tonnes	77 Tonnes	7 %	2014-04-28
3	Hwange Colliery Mine	120 Tonnes	113 Tonnes	7 Tonnes	7 %	2014-04-28
4	Hwange Colliery Mine	1887 Tonnes	1788 Tonnes	99 Tonnes	6 %	2014-04-28
5	South Park Mine	177 Tonnes	155 Tonnes	22 Tonnes	15 %	2014-04-28
6	Makomo	1888 Tonnes	227 Tonnes	1661 Tonnes	732 %	2014-04-28
7	Makomo	29000 Tonnes	10000 Tonnes	19000 Tonnes	190 %	2014-04-29
8	Makomo	22000 Tonnes	23000 Tonnes	-1000 Tonnes	-4 %	2014-05-03

Figure 5.8: Objective 5

5.3.1.7 Acceptance testing.

Vinod Kumar Garg et al (2000) It is when the actual is delivered to the actual users of the system who test it on the hardware that it is suppose to run on and the actual data that will be dealt with during the entire life of the software. It is the last stage of testing and once it is successful in this stage it will be ready to be deployed for full operational use. The system will be tested with data that will be entered by the operators rather than test data to make sure that the system is working as required by the specifications. The actual users will review errors and difficulties in the system; alpha beta test was used for acceptance testing. Example: Login form tested to find out if it's communicating with the database.

No	Tank Name	Hour Recorded	Level	Staff	Record Date
1	Tank A	0100	40 ppm		2014-04-15
2	Tank A	0000	34 ppm		2014-04-15
3	Tank A	0000	44 ppm		2014-04-15
4	Tank A	0000	22 ppm		2014-04-15
5	Tank A	0000	22 ppm		2014-04-15
6	Tank A	0800	22 ppm		2014-04-15
7	Tank A	0900	12 ppm		2014-04-15
8	Tank A	1500	23 ppm		2014-04-16
9	Tank A	0300	45 ppm		2014-05-03
10	Tank A	0200	34 ppm		2014-05-03

Figure5.9: Screenshot to ensure link to database.

Figure5.10: Ensuring connection to the database through password log in.

5.3.2 Validation

P Bryant, D Howard, G Lock, Z Philander (2009), the main objective of validation is to check if we are developing the right system which solves the intended problem; it is tested through the data that is entered and the output. It is for ensuring the correct and desired data is the only entered in order to produce desired output.

Validation basically checks the entered data in the text box to see if it is rightful to the specified field type. This form was tested to make sure it has the connection to the database.

The screenshot shows a web-based form for adding a new staff member. The form is contained within a dark header bar that includes three navigation options: '+ Add New Staff Member', '| Click Here to View Staff Members', and '| Close this panel'. The form fields are as follows:

- Staff ID:** ZP008
- User Name:** ngalaz
- Password:** Masked with four asterisks (****). A red error message is displayed to the right: "Minimum number of characters not met".
- Confirm Password:** Masked with four asterisks (****).
- First Name:** Estipmog
- Last Name:** mangala
- Gender:** Male (with a dropdown arrow)
- ID Number:** 66-099999A64

Figure 5.11: Screenshot for new staff validation.

5.3.3 Verification

John W. Satzinger, Robert B. Jackson and Stephen D. Burd (2007:8) It is reviewing, inspecting and testing for establishment and documenting the product. It is ensuring that the system meets technical and regulatory standards or whether the system was built conforming to required standards. It strives to answer the question as to whether the system is meeting its functional requirements. In conclusion to verification it reveals that the system was validated correctly and meets specific objectives.

5.4 Installation

It is concerned with converting data that was previously entered into the old system to the new system. All users, water treatment plant figures, coal plant weight variances', departments and shifts will now be entered into the new system, ensuring that data is accurately entered. Cleaning of data is done to do away with unwanted data. Generation of reports is carried out to show all data that is converted into the new system, this is to avoid omission. Visual checks are also important to the data by the data capturing personnel.

5.4.1 Hardware installation

It involve the set up of necessary hardware that have been presented in the earlier stages of this project, It is the complete set up of the entire system hardware components including network components for example switch ,server ,network cables ,printers and computers.

5.4.2 System installation

It involve running of the system on the server and the application on the client computers .Installation of MySql ,Apache server to allow the application to run from our environment.ZPC will run the setup of the application which will reside on the server.

5.4.3 User training.

Garry Shelly et al (2011:558), User training is initial training which is carried out when new software is introduced. Staff and new employees should be trained to use the company's system.

Employee training can have positive advantages to the organisation as a whole due to an improvement in the performance of workers, which lead to an improvement in productivity hence high profits are realised. Prospective users taught how to use the system in workshops held at Hwange Power Station. They are taught how to create shifts, departments, how figures in the water treatment plant should be entered, how the suppliers of coal in the coal plant should be registered and the calculation of coal weights. The security aspects of the system are also taught, and how reports will be generated.

5.4.4 Operation environment

The following we deemed functional before file conversion was carried out:

- Software
- Hardware
- Utilities'
- Operating system programs'
- Network components'

5.4.5 File conversion

Having carried out user verification files were transferred to the new system. Specific programs were designed to convert the files into the new system ,since the files will be in full use during the week the conversion was done on a weekend .It was carried out after user training has been completed and the operational environment made ready. Two weeks were set aside for data conversion.

5.4.6 System changeover

Gary Shelly et al (2010) it is a shifting process from an old system to new system, which can be slow or rapid depending on the changeover strategy used. Following are approaches used in system changeover:

Direct change over

It is the immediate movement from the old system to the new system once the new system becomes fully operational. It is more risky but less expensive since the IT personnel will only focus one system.

Pilot operations

It is when the system is implemented on part of the plant for example it may be made fully operational in one department only which might be Water Treatment Plant before the whole system is changed. The first group to use the system is referred to as pilot. The old system remains functional up until the new system is proven to be capable of replacing the old system.

Phased changeover

The new system will be implemented in stages ,the implementation of module can be done with any of the changeover strategies

Parallel running

It is when both systems run at the same time in parallel. Users can refer to the old system. It is less risky since there is back up in both systems.

Recommendation

I recommend phased conversion, where the current manual system is transposed with the new system, in a process by process manner. User training and testing will be carried out on each module that will be implemented. Risk of the system failure will be reduced since the conversion will take a long time. The users will understand the implementation of all the elements of the system.

5.5 Maintenance

Due to the ever changing dynamic world of business the system need to be reviewed and updated to ensure that the system continues to cope up with changes .Maintenance is carried out after the system is delivered periodically usually monthly to make sure that the changes in demand are met by the system. Firstly the system is made with is objectives and implemented ,after implementation enhancement is necessary to ensure that the user changes are accommodated .Maintenance process' is triggered by request changes form Operators ,Foremans' and Section Head. The following are four types of maintenance:

- Corrective maintenance
- Perfective maintenance
- Adaptive maintenance

5.5.1 Corrective maintenance

J. B. Dixit et al (2007:412) it is the replacing of components that cause the system to fail whilst leaving the system specifications unchanged. It looks at the errors that were done during the design of the system and is done unpredictably because there is no knowledge when the system is going to fail. The idea is to return the system operations in a short period of time; it is carried out in three steps:

- Diagnosing the problem.
- Repairs and replacements of faulty component.
- Verification of the repair action.

5.5.2 Adaptive maintenance

Garry Shelly (2012:576) it is done for enhancement of the system making the system user friendly. It is the changes to the system in order to accommodate changes' in the size of the database. Mostly changes in hardware and operating system results in adaptive maintenance.

5.5.3 Perfective maintenance

Gary Shelly (2012) it involves improving performance in processing of the system hence adding the desire to use the system. It is more like development of a new thing because some features will not be necessarily needed. It is concerned with add-ons to the system to add extra value and efficiency giving room for improvements.

Recommendations

The need for constant maintenance of hardware for efficiency of the system ,and network upgrade that must accommodate many users and high data traffic during client and server communication. System maintenance is of great importance to meet diverse and changing user requirements as well as technological changes.

5.6 Conclusion

Auxiliary Plants Integration System has passed the testing phase. System implementation was successful, with user training successfully carried out. All necessary procedures' being recognised the system proves to be a success.

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Appendices

Appendix A: User Manual.

1. All the staff logs into the system using their credentials' as follows:

ZPC AUXILIARY PLANTS INTERGRATION SYSTEM

Secure Login

Username:
Username

Password:
Password

Remember me on this computer

Login

Enter username

Enter password

Click to login

Tick to remember password

2. This is the main screen after user logs in. All staff can sign out by clicking sign out, change password by clicking on change password as shown below:

ZPC AUXILIARY PLANTS

localhost/zpc%20apis/dashboard.php

Hello, Tarisai Mundondo
Profile Change Password Logout

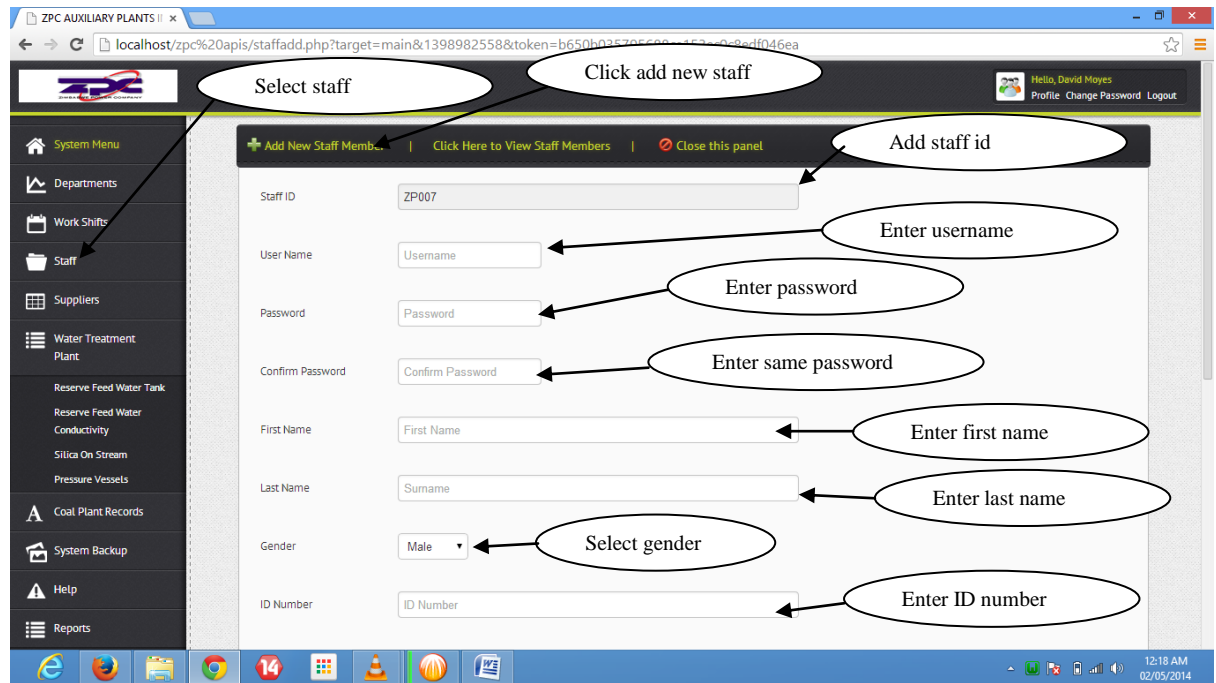
Departments	Shifts	Staff	WTP Plant	Coal Plant
324	74% ↓	14	22% ↑	77

Auxiliary Plants Intergration System

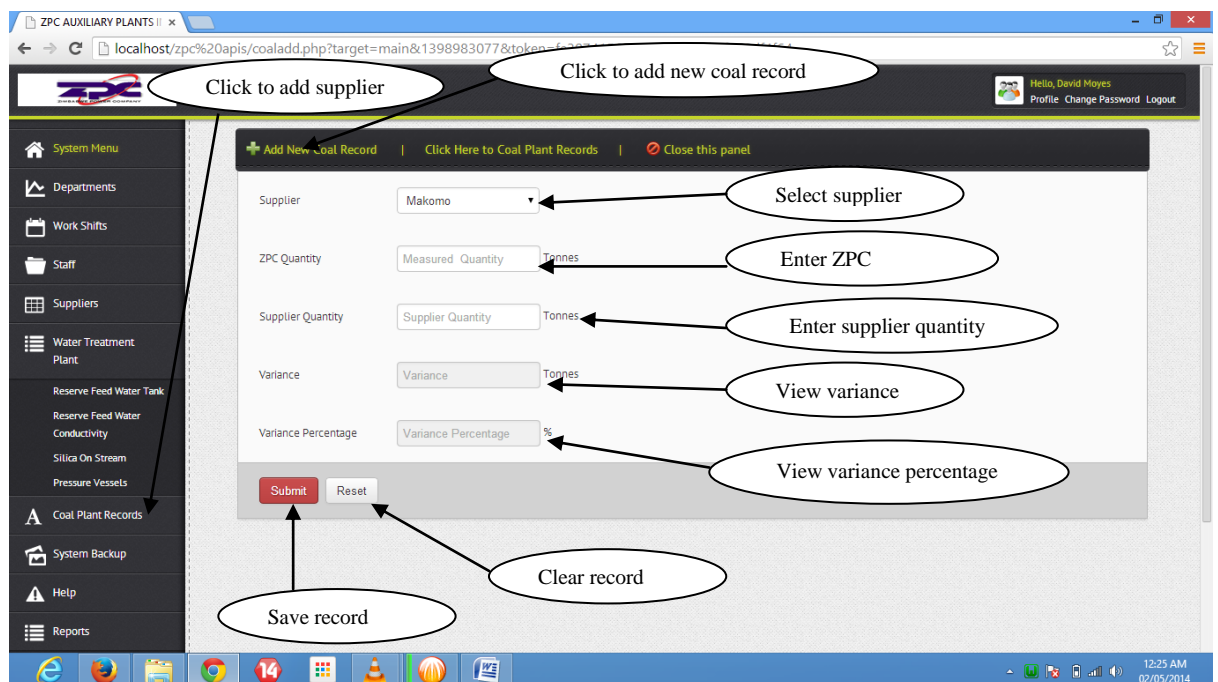
Copyright 2014. ZPC APIS . Developed by Tarisai Mundondo. All Rights Reserved.

1:12 AM
02/05/2014

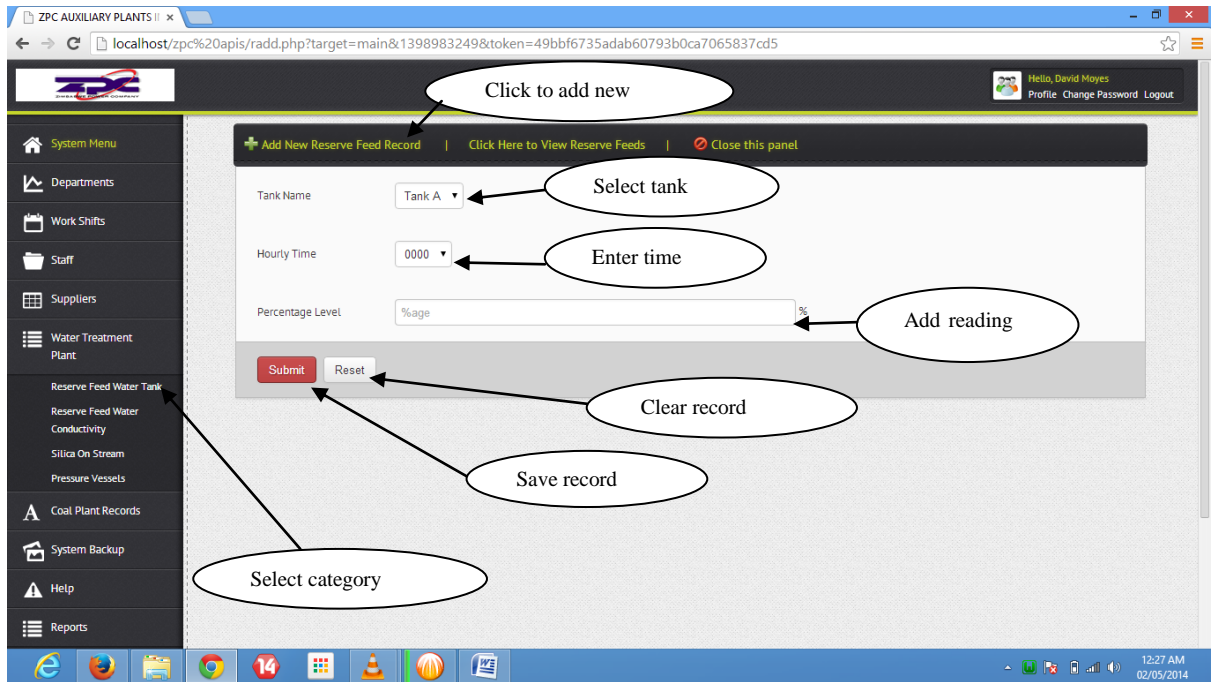
- The administrator is responsible for adding Operators and Foramen's, and creation of profiles. Profiles are created according to levels from lowest being the operator followed by the foreman. Interface is shown below:



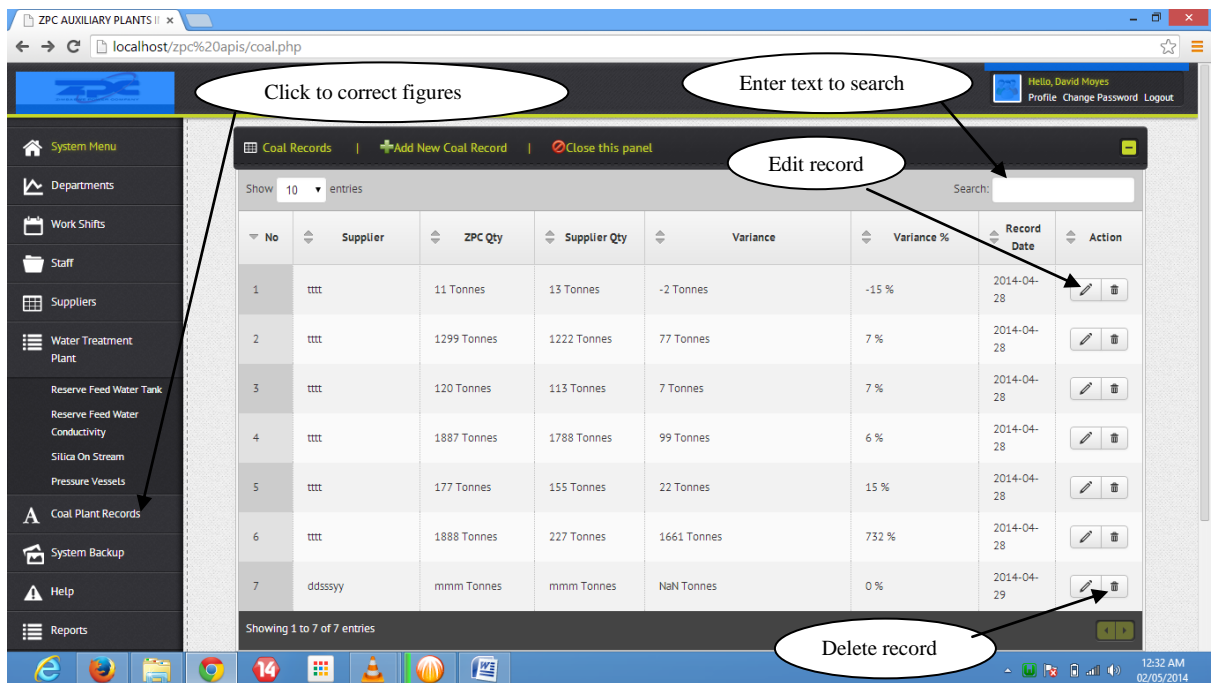
- The Operator who is the lowest level logs in the system with username and password and enters reading depending on the department. Shown below is Coal Plant screen:



Shown below is Water Treatment screen:

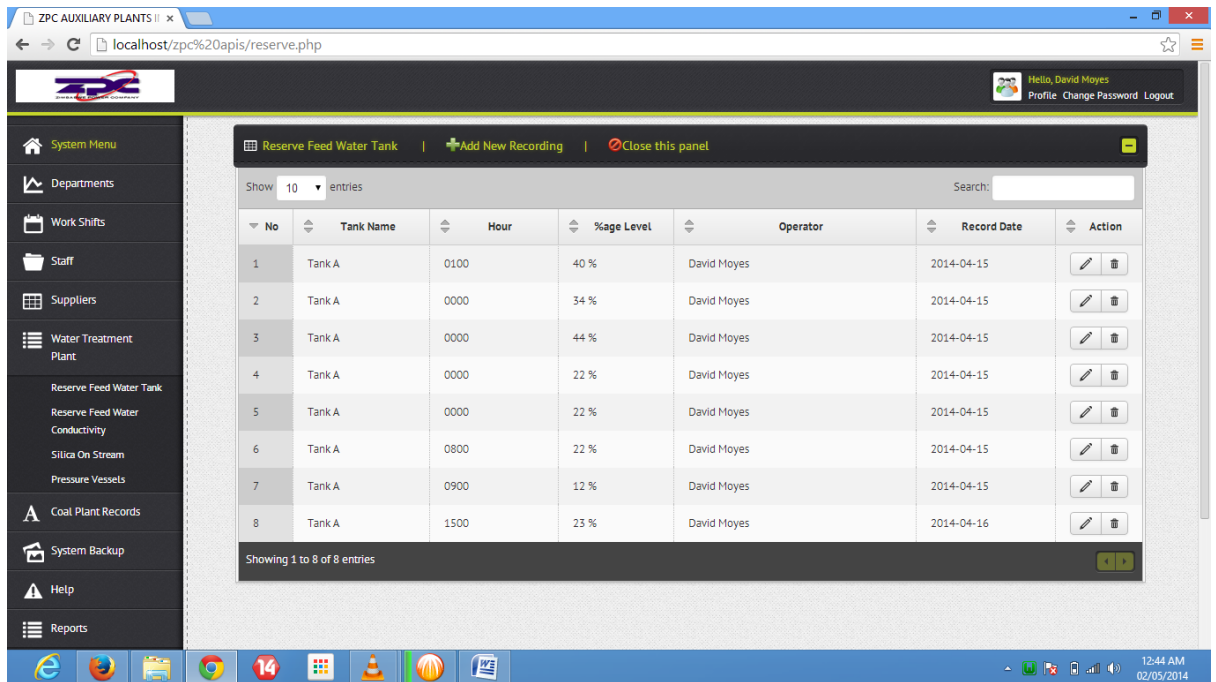


5. The Foreman logs in the system to verify and approve the data that was entered by the Plant Operators.

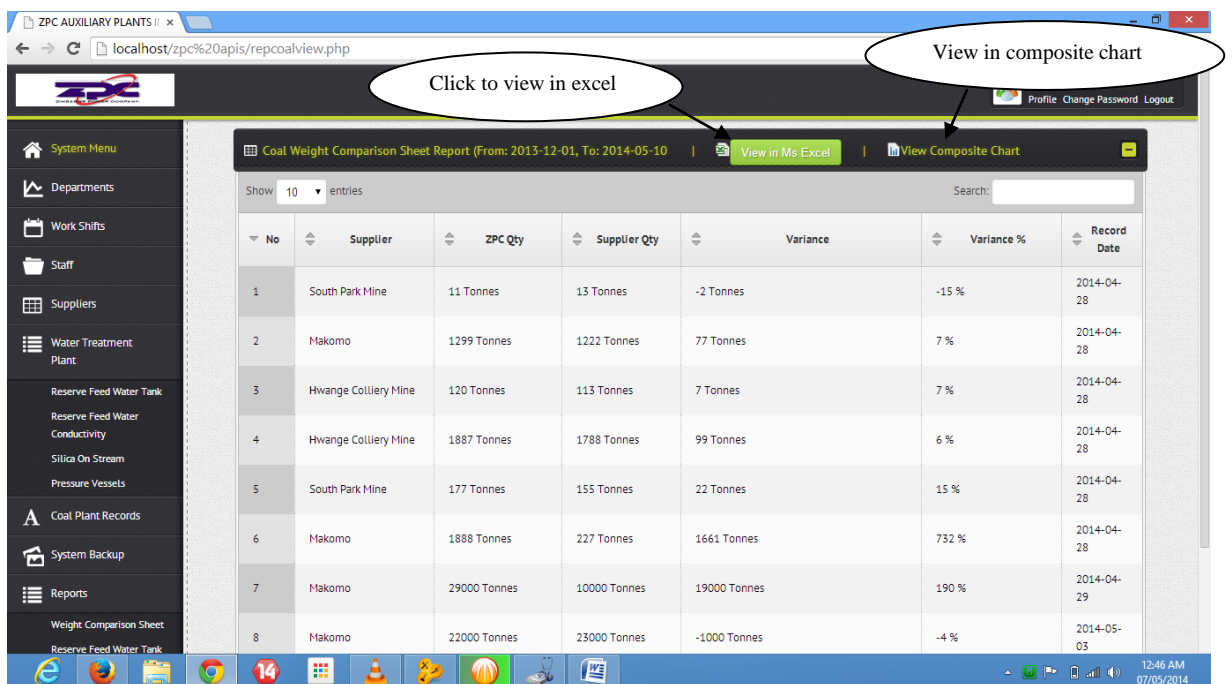


It is the same with both Water Treatment plant and Coal plant Foremans'.

- After the foreman has approved the plant figures the Foreman can edit or delete a record, and can approve the figures. This is shown by the screen below:



- The Section Head can produce reports from Water Treatment Plant and Coal Plant depending on the nature of the figures; can view in excel or composite chart. Screen below shows nature of reports:



Above is the wegher variance comparison sheet report.

below is the staff report :

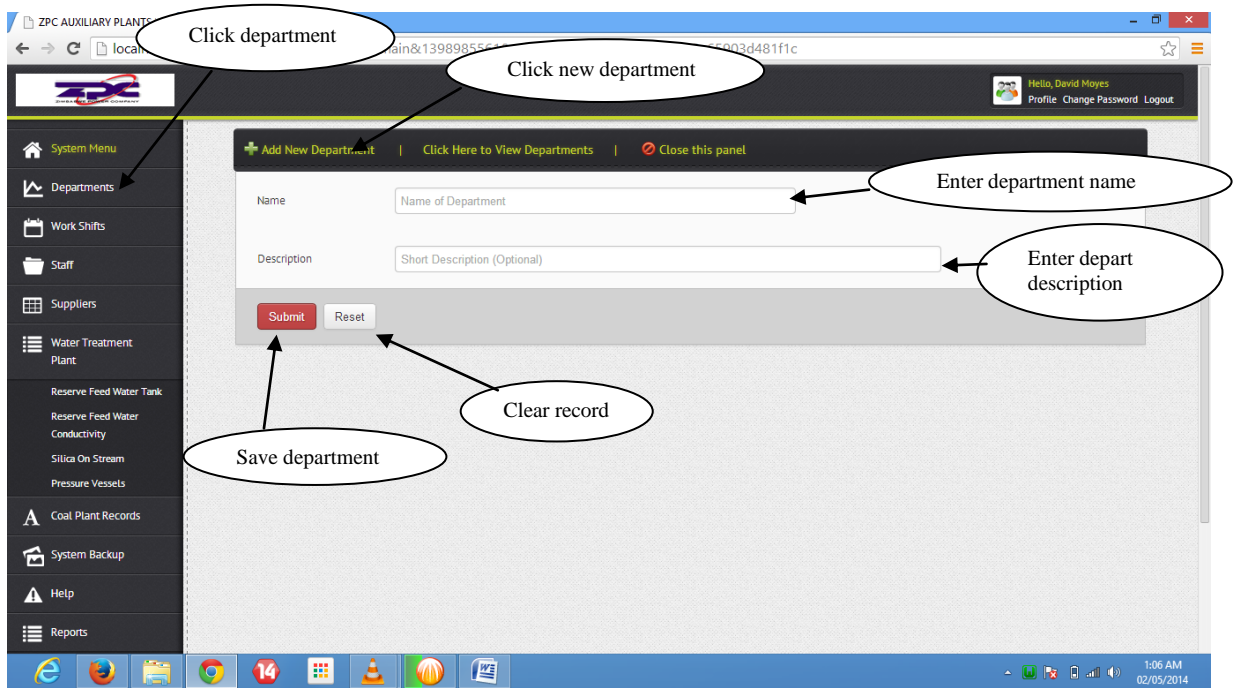
No	Action	Time	Server Address	Staff	Record Date
1	Deleted Shift named Record was added on 2014-04-15	2014-04-15 14:20:30	:::1		2014-04-15
2	Deleted Staff named fff ffff. Record was added on 2014-04-15	2014-04-15 15:27:16	:::1		2014-04-15
3	Deleted Reserve feed record for Tank A. Record was added on 2014-04-15	2014-04-15 23:25:45	:::1		2014-04-15
4	Deleted Silica record for Tank A. Record was added on 2014-04-15	2014-04-15 23:44:47	:::1		2014-04-15
5	Deleted Reserve feed water conductivity record for Tank A. Record was added on 2014-04-16	2014-04-16 10:30:26	:::1		2014-04-16
	Deleted Pressure vessel record for Tank A. Record				

Below is a screen showing how shifts can be created with the Administrator:

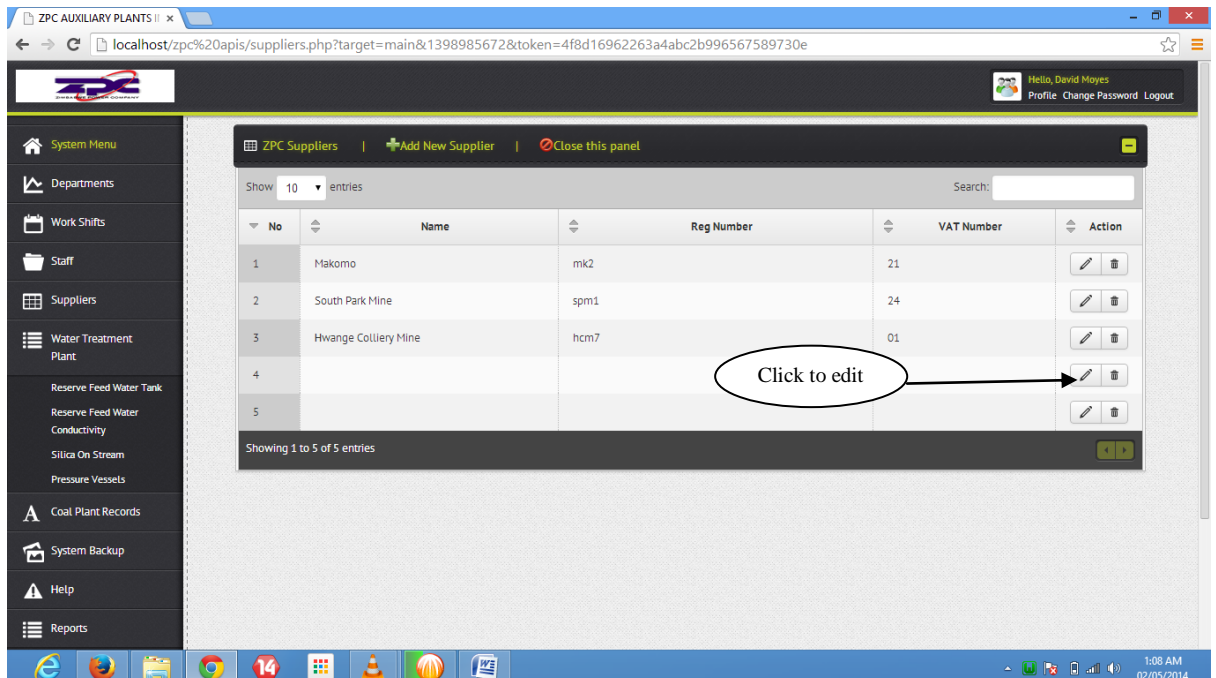
Annotations for the 'Add New Shift' form:

- Select work shift (points to 'Work Shifts' in the sidebar)
- Click add shift (points to '+ Add New Shift' button)
- Enter shift name (points to 'Shift Name' input field)
- Enter start time (points to 'Start Time' input field)
- Enter end time (points to 'End Time' input field)
- Click to clear (points to 'Reset' button)
- Click to save shift (points to 'Submit' button)

8. The administrator can also create departments as shown below:



9. The administrator can also view or edit suppliers into the system as demonstrated below:



10. Unlike Foreman and Section head the operator can only enter data and can not delete or edit data once it has been entered into the system.Operators can not see reports for any plant .

Appendix B: Interview

Auxiliary Plants Integration System

Interview Questions

Interviewer Name

Name of Company.....

Interviewee's department and position.....

What is the procedure taken in recording plant figures and how the shifts operate?

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

How does data move from the source plant to the Foreman and Section Head?

Calling Movement E mail

How the section head get reports in the current system?

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

Does the information move in the right time from the Operators, to Forepersons' and then to the Section Head?

Yes No

In every system the reporting structure is so important and should be efficient in a way adhoc.

How does your system work in terms of reporting?

Is the system efficient and effective?

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

Does the current system need to be replaced with a new system? Justify

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

Stamp

Appendix C: Questionnaire

Organization's questionnaire

Please note: Name is not required on this questionnaire. Only tick where it is applicable. This information gathered will stay undisclosed and secret and will be used for academic purposes' only.

Briefly describe the current system?

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

How does the current system functions? (Procedures) .

Complex Easy

How do you rate your current system according to the time taken to process data?

Worst Better Good Very good

Does your system secure all plant figures?

Yes No

In every system the reporting structure is so important and should be efficient in a way. How do you rate your system in terms of reporting?

Average Good Excellent

Does your system track shifts and staff?

Yes No

Does the system need to be replaced with a new system? Justify

Yes No

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

Stamp

Appendix D: Observation

Observation Sheet For Auxiliary Plants Integration System

Observation guide schedule.


Date..... Observer.....

Time.....

Department.....

Observation
.....
.....
.....
.....
.....
.....
.....

Conclusion
.....
.....
.....
.....

Stamp 

Appendix E: Snippet Of Code

```
<!DOCTYPE html>
<!--[if lt IE 7]> <html class="lt-ie9 lt-ie8 lt-ie7" lang="en"> <![endif]-->
<!--[if IE 7]> <html class="lt-ie9 lt-ie8" lang="en"> <![endif]-->
<!--[if IE 8]> <html class="lt-ie9" lang="en"> <![endif]-->
<!--[if gt IE 8]><!--><html lang="en"><!--<![endif]-->
<head>
<meta charset="utf-8">
<!-- Viewport Metatag -->
<meta name="viewport" content="width=device-width,initial-scale=1.0">
<!-- Plugin Stylesheets first to ease overrides -->
<link rel="stylesheet" type="text/css" href="plugins/colorpicker/colorpicker.css"
media="screen">
<link rel="stylesheet" type="text/css" href="custom-plugins/wizard/wizard.css"
media="screen">
<!-- Required Stylesheets -->
<link rel="stylesheet" type="text/css" href="bootstrap/css/bootstrap.min.css"
media="screen">
<link rel="stylesheet" type="text/css" href="css/fonts/ptsans/stylesheet.css" media="screen">
<link rel="stylesheet" type="text/css" href="css/fonts/icomoon/style.css" media="screen">
<link rel="stylesheet" type="text/css" href="css/mws-style.css" media="screen">
<link rel="stylesheet" type="text/css" href="css/icons/icol16.css" media="screen">
<link rel="stylesheet" type="text/css" href="css/icons/icol32.css" media="screen">
<!-- Demo Stylesheet -->
<link rel="stylesheet" type="text/css" href="css/demo.css" media="screen">
<!-- jQuery-UI Stylesheet -->
<link rel="stylesheet" type="text/css" href="jui/css/jquery.ui.all.css" media="screen">
<link rel="stylesheet" type="text/css" href="jui/jquery-ui.custom.css" media="screen">
<!-- Theme Stylesheet -->
<link rel="stylesheet" type="text/css" href="css/mws-theme.css" media="screen">
<link rel="stylesheet" type="text/css" href="css/themer.css" media="screen">
<link rel="stylesheet" href="css/responsive-tables.css">
```

```
<title>ZPC AUXILIARY PLANTS INTERGRATION SYSTEM - Admin -  
Dashboard</title>
```

```
</head>
```

```
<body>
```

```
<!-- Themer (Remove if not needed) -->
```

```
<script LANGUAGE="JavaScript">
```

```
<!--
```

```
// Nannette Thacker http://www.shiningstar.net
```

```
function confirmSubmit()
```

```
{
```

```
var agree=confirm("Are you sure you want to delete this record?. NB: After record has been  
deleted it will never be recovered.");
```

```
if (agree)
```

```
return true ;
```

```
else
```

```
return false ;
```

```
}
```

```
</script>
```

```
<!-- Themer End -->
```

```
<!-- Header -->
```

```
<?php
```

```
include('header.php');
```

```
$user_query = mysql_query("select * from `auth` where id='$session_id'") or  
die(mysql_error());
```

```
$user_row = mysql_fetch_array($user_query);
```

```
$token = md5(uniqid(rand(), true));
```

```
?>
```

```

<tr>

<?php
    error_reporting(E_ALL ^ E_NOTICE);
    if ($_GET[x]==1){
        ?>
        <script type="text/javascript">function hideMessage(){
            document.getElementById("popup").style.visibility="hidden";}
            document.getElementById("popup").style.visibility="visible";
            window.setTimeout("hideMessage()",3000);
        </script>
        <th colspan="2" bgcolor="#FF0000" scope="col"><div id="popup"><h4
class="widgettitle title-success">Records successfully updated. Thank you</h4></div>
        <?php
            }
        ?> </th>
</tr>

<!-- Main Container Start -->
<div id="mws-container" class="clearfix">

    <!-- Inner Container Start -->
    <div class="container">

        <!-- Statistics Button Container -->
        <div class="mws-panel grid_8 mws-collapsible">
            <div class="mws-panel-header">
                <span><i class="icon-table"></i> Pressure Vessels &nbsp; &nbsp; &nbsp;
|&nbsp; &nbsp; &nbsp; &nbsp; <i class="icol-add"></i><a href="padd.php?target=main&<?php
echo time(); ?>&token=<?php echo $token; ?>">Add New Recording</a>&nbsp; &nbsp;
&nbsp; &nbsp; &nbsp; &nbsp; &nbsp; <i class="icol-delete"></i><a

```



```

href="dashboard.php?target=main&<?php echo time(); ?>&token=<?php echo $token;
?>">Close this panel</a> </span>
</div>
<div class="mws-panel-body no-padding">
<div class="mws-panel-body no-padding">
<table class="mws-table mws-datatable">
<thead>
<tr>
<th width="5%">No</th>
<th width="17%">Tank Name</th>
<th width="16%">Shift Name</th>
<th width="14%">Pressure Level</th>
<th width="31%">Operator</th>
<th width="31%">Record Date</th>

<th width="17%">Action</th>
</tr>
</thead>
<tbody>
<?php
                $n=0;
                $semp_query=mysql_query("select * from `pressure` ");
while($row=mysql_fetch_array($semp_query)){
                    $id=$row['id'];
                    $uid=$row['userid'];
                    $key = "secret";
$v_query=mysql_query("select * from `auth` where id='$uid'")or die(mysql_error());
$v_row=mysql_fetch_array($v_query);

                    $n++;
                ?>
</tr>
<td><?php echo $n; ?></td>

```

```

        <td><?php echo $row['tankname'];?></td>
        <td><?php echo $row['shiftname'];?></td>
        <td><?php echo $row['level']." ". "kpa";?></td>
        <td><?php echo $v_row['firstname']." ".$v_row['surname'];?></td>
        <td><?php echo $row['dateadded'];?></td>
        <td>
            <div align="center"><span class="btn-group">

                <a href="pedit.php<?php echo 'id='.encode($row['id']); ?>"
class="btn btn-small"><i class="icon-pencil"></i></a>

                <a onclick="return confirmSubmit()" href="pdelete.php<?php echo
'id='.$row['id']; ?>" class="btn btn-small"><i class="icon-trash"></i></a>

            </span></div></td>
        </tr>
        <?php }?>
    </tbody>
</table>
</div>

<!-- Panels Start -->
<!-- Panels End -->
</div>

<!-- Inner Container End -->

<!-- Footer -->

</div>
<!-- Main Container End -->

</div>
<?php include('footer.php'); ?>
<!-- JavaScript Plugins -->

```

```

<script src="js/libs/jquery-1.8.3.min.js"></script>
<script src="js/libs/jquery.mousewheel.min.js"></script>
<script src="js/libs/jquery.placeholder.min.js"></script>
<script src="custom-plugins/fileinput.js"></script>

<!-- jQuery-UI Dependent Scripts -->
<script src="jui/js/jquery-ui-1.9.2.min.js"></script>
<script src="jui/jquery-ui.custom.min.js"></script>
<script src="jui/js/jquery.ui.touch-punch.js"></script>

<!-- Plugin Scripts -->
<script src="plugins/datatables/jquery.dataTables.min.js"></script>
<!--[if lt IE 9]>
<script src="js/libs/excanvas.min.js"></script>
<![endif]-->
<script src="plugins/flot/jquery.flot.min.js"></script>
<script src="plugins/flot/plugins/jquery.flot.tooltip.min.js"></script>
<script src="plugins/flot/plugins/jquery.flot.pie.min.js"></script>
<script src="plugins/flot/plugins/jquery.flot.stack.min.js"></script>
<script src="plugins/flot/plugins/jquery.flot.resize.min.js"></script>
<script src="plugins/colorpicker/colorpicker-min.js"></script>
<script src="plugins/validate/jquery.validate-min.js"></script>
<script src="custom-plugins/wizard/wizard.min.js"></script>

<!-- Core Script -->
<script src="bootstrap/js/bootstrap.min.js"></script>
<script src="js/core/mws.js"></script>

<!-- Themer Script (Remove if not needed) -->
<script src="js/core/themer.js"></script>
<script src="js/demo/demo.table.js"></script>

<!-- Demo Scripts (remove if not needed) -->
<script src="js/demo/demo.dashboard.js"></script>

```

```
</body>  
</html>
```