SHEQ PLANNING, MONITORING AND EVALUATION SYSTEM

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By

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ABSTRACT

SHEQ Planning, Monitoring and Evaluation System is a software application that was developed for Lobel's Bread organization specifically for the SHEQ department. The software was developed to allow employees to be able to carry out activities such as electronic money allocation and analysis, event scheduling and tracking, instant communication through gaining access to the notifications platform giving feedback of activities and tests, publishing of the activities, report generation and analysis that will have taken place or are to take place. Information gathering methodologies such as interviews, questionnaires, observations and document review were used to identify the problems that arose due to the use of the current system. These problems included the amount of time and unnecessary effort needed to carry out PQI tests because of the distance between offices. After the research the new SHEQ system was proposed which overcomes the problems that were associated with the current manual system such as too much bottlenecks. Instruments such as PHP, MySQL and the Internet were used to develop the proposed system. Feasibility analysis was carried out in terms of social, economic, operational and technical aspects to see whether developing the system is a viable decision and it proved to be viable. In-house development was chosen as the best alternative to introduce this system in the organisation. Diagrams which include the context diagram, data flow diagram, class diagram and Use case diagram were used to illustrate the flow of data in both the previous and developed system. Implementation strategy used in implementing the system is the parallel changeover. This is because the previous SHEQ system is mostly manual and therefore running both systems parallel to each other allows measuring of other modules that may need amending before the system is fully implemented. Adaptive maintenance was chosen because it allows the system to adapt to environmental changes of the software and hardware. For future recommendations, the system should be able to operate on android or iPhone or any other devices and not only as web-based. The SHEQ system may be utilized for promoting Lobel's Bread as a whole.

DECLARATION

I, **Rutendo Shanganya,** 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 "**SHEQ Planning, Monitoring and Evaluation System**" by **Rutendo Shanganya** meets the regulations governing the award of the degree of **BSc Honours Information Systems** of the **Midlands State University,** and is approved for its contribution to knowledge and literary presentation.

Supervisor' Signature: …….

Date: …….

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DEDICATION

I dedicate this dissertation to my parents, Mr. F and Mrs. F.C Shanganya, who continuously contributed notably to my welfare and resources and whose inspiration was my source of motivation. Thank you for your overwhelming support and may the Lord continue to bless them.

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LIST OF ACRONYMS

CEO- Chief Executive Officer

DFD- Data Flow Diagram

EERD- Enhanced Entity Relationship Diagram

EMA- Environmental Management Agency

HRM- Human Resource Management

ISP- Internet Service Provider

I.T- Information Technology

NPV- Net Present Value

NSSA- National Social Security Authority

PQI- Product Quality Index

RAM- Random Access Memory

ROI- Return on Investment

SHEQ- Safety Health Environment Quality

WAN- Wide Area Network

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CHAPTER 1: INTRODUCTION

1.1 Introduction

SHEQ Planning, Monitoring and Evaluation System is an organizational centralized system that will be used by the targeted end-users that is the employees at Lobel's Bread on the low level, middle level and top level for Safety, Health, Environment and Quality (SHEQ) department related work. The aim is for the employees to be able to carry out activities such as electronic money allocation and analysis, event scheduling and tracking, internal instant communication through gaining access to the notifications platform giving feedback of activities and tests, publishing of the activities, report generation and analysis that will have taken place or are to take place. Therefore, it is in this chapter where the background of study, background of the organisation, organizational structure, the problem definition and instruments and methods are analysed and explained. It is also in this chapter where the aim and objectives of proposing a new and improved system are investigated and justified.

1.2 Background of the study

Alleyne (2015) perceives the background of the study as a process of carrying out a mere review of some part of the organisation under study or being looked into in terms of existing adequate information which is around the problem trying to be solved. It is the authorized employees of an organization who usually provide with the essential information necessary to know the background of an organization. The authorized employees assisted in giving the much-needed information because they agreed to the motivation and necessity behind the development of the proposed system. The motivation and necessity of developing an improved system was mainly based on too much workload offloading for the SHEQ employees and cutting down on costs and expenses for the SHEQ department at Lobel's Bread.

1.2.1 Background of the organization

Lobel's Bread is arguably one of the oldest bakeries still in existence in Zimbabwe. It was established in 1957 by the Lobel's family and owned the first travelling oven in Zimbabwe. Before the economic changes in Zimbabwe and the organizational restructuring, the organization used to produce different types of bread, tea loaves and confectioneries including queen cakes, sugar buns and hot dog rolls. However, currently the organization specializes only in the production of four types of bread that is the Prime White, Hi-Fiber, Whole Wheat and Whole meal. This therefore reduced the number of original employees

from around 500 to 350 in both day and night shifts depending on other prevailing external factors. Each shift goes on for approximately 12 hours every day with the Production and SHEQ departments overseeing the greater part of the production process.

In its present form, Lobel's Bread has the main branch in Harare and another branch in Bulawayo which was established in October 2004. The Bulawayo branch was established following the purchase of the bread section of the business by a consortium of indigenous businesspeople. Over the years the Lobel's Bread retail shops changed the complexion of the central business districts of the towns and cities they were situated. These shops were characterized by state-of-the-art equipment such as chillers, warmers, cake holders, fridges and freezers, chip fryers and many others; point of sale, sharp ambience inside the shops and visible branding outside. However, again due to economic changes in Zimbabwe and organizational restructuring all the retail shops were forced to be closed.

For a company to be more connected to the society it doesn't only take marketing or merchandising or making bread with the best quality but also it takes being physically involved in the society. Lobel's Bread is physically involved in the Harare and Bulawayo communities through making donations, participating in cancer walks and so on. Lobel's Bread has been donating to schools and associations like the diabetes association, to churches and so on. Annually the organization participates in a cancer walk which is hosted by SPAR supermarket and sponsored by various companies to raise funds for cancer treatments and other cancer related issues. Besides raising funds, this event is for visibility that is it puts Lobel's Bread on the map whilst the society appreciates the organisation even more.

1.2.2 Organizational Structure

Gruba and Zobel (2017) are of the view that the organizational structure's function is to provide the context for one's work and explain their position in relation to the field. Lobel's Bread is a formal organization or a strategic business unit, run like any business corporation with complete management structure. According to Brunsson and Olsen (2018) departments or whole organizations are frequently merged or split and organizational charts are rewritten. Changes are often introduced in the systems for delegating authority, disseminating information or distributing responsibility. To be precise, a well-established organizational structure should be flexible and for Lobel's Bread, it has been evolving since 1957. The organization has on top the Chief Executive Officer the followed by the General manager and Directors. After the Directors and General Manager, we have the department executives

followed by the managers that is the Finance manager, Production manager, SHEQ manager, Human Resources manager, Engineering manager and Marketing manager. These are referred to as Business Drivers. Below the managers are the department employees from the ancillary and non-ancillary workers. The organizational structure is illustrated in the figure that follows;

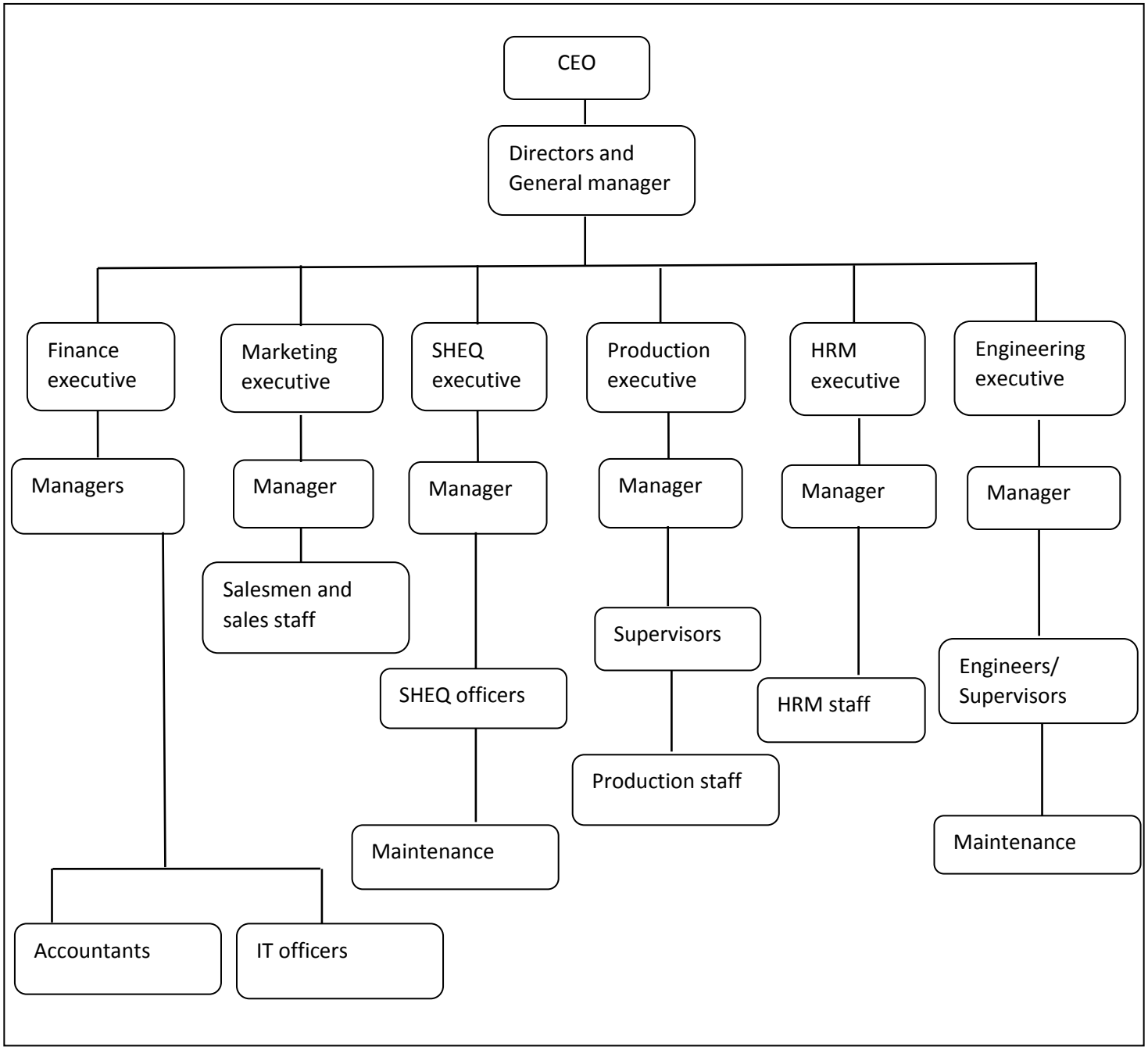


Figure 1.1: Organizational Structure

1.2.3 Vision

To be the most preferred and trusted provider of uncompromised quality and healthy food products in Zimbabwe and Africa.

1.2.4 Mission Statement

We aim to be the best, most innovative, customer oriented public, listed producing company, manufacturing, distributing and retailing uncompromised quality and value for money and food products in Zimbabwe. We believe our operation will ensure high return in investment for our shareholders at the same time empowering and creating wealth for all employees and to be of maximum benefit to all stakeholders while realizing social responsibilities.

1.3 Problem definition

Roozenburg and Eekels (2015) believe that a problem always has to do with dissatisfaction about a certain situation. In this phase, the problems are to be defined and briefly described. There is a great distance between the SHEQ office and the rest of the employees' offices and there are surveys and tests which need to be done daily. Therefore, when the SHEQ employee conducted surveys and tests for example the Product Quality Index in all different offices, it became time consuming and tiresome which led to some of the surveys not done daily as expected. At the end of the day, when the SHEQ department is done with its workshops, it doesn't know to what extent the workshop was helpful up until the taught employees implement the ideas they learnt. The department is therefore left with unclear objectives as to whether it should conduct a more intense workshop, or it should conduct a different workshop altogether and how much to budget for their workshops. The use of white boards, notice boards and papers for notices and schedules has led to wastage of resources in the organisation because it might take long for someone to see the notices and schedules and it also takes time for the SHEQ employee to type and print and publish the notices. There has been an increase in the number of work sheets and other important information paper sheets such as the written and reported accidents that employees are involved in that have gone missing at the organisation which has resulted in some of the SHEQ work being untraceable.

1.4 Aim

To create a centralised system that can be accessed by employees, with the management inclusive, which shows the various plans, monitoring and analysis of activities that the employees will be engaged in.

1.5 Objectives

- To enhance sustainable use of financial resources by allocating and making them available for all SHEQ events and projects through electronic budgets, event scheduling and tracking.
- To mitigate risks through pro-actively identifying, assessing and if possible, eradicate hazards in the plant through the use of the instant communication platform.
- To measure and monitor performance and quality of bread or the working environment using feedback from the various surveys and tests undertaken by the employees which is calculated and output as graphs, charts and so on.
- To come up with a centralised system that displays all the activities and awareness campaigns as notifications that are going to take place and prior to the actual dates.
- To create a system that records and stores general employee's health information and output as reports for month end analysis and evaluation.
- To develop a system that allows communication with the external parties such as the Laboratory Technicians or the yeast providing company.

1.6 Instruments and methods

1.6.1 Instruments

At the end of the day, for the development team to have a successful SHEQ system, there are tools that must be utilized which are JavaScript, PHP, MySQL and the internet.

PHP

Created by Hypertext Pre-processor, PHP is a programming tool essential for the development of web-based systems and their maintenance and or improvement. PHP is an open source software which can be publicly accessed therefore making it less costly to use and easier to get help for the development team.

MySQL

It is an open source and user-friendly language which is used to develop databases. MySQL is compatible with most operating systems including Windows 8.1. Even though it is easy to understand, it also offers security through the encryption of passwords.

Internet

The open and global network provides with ideas which will bring about a more secure and better proposed system. It also gives access to online journals and academic research are also essential as they provide the development team updated information necessary in the development of the proposed system.

JavaScript

It is a dynamic language which supports object-oriented programming in both web-based and those that are not web-based environments. The JavaScript language is used when a webpage is to be made dynamic adding special effects for example rolling over or roll out or other types of graphics.

1.6.2 Methods

A few research methods were considered and applied during the proposed system development and these include interviews, observations, questionnaires and documents review.

Interviews – both the structured and unstructured interviews were used because the structured interviews were short giving direct answers and the unstructured interviews were open-ended giving room for further clarifications to the interviewee.

Observations – these provided with first-hand information on how the SHEQ department operates on a day to day basis and it is observed that people perform differently under observation either in a positive or negative manner.

Questionnaires – both the open and closed questionnaires were used because the closed questionnaires limited the respondents to provide with the only necessary information required whilst the open questionnaires gave room for respondents to give more detailed information.

Document review – the SHEQ department employee records, company policies, SHEQ accounts documents and other SHEQ related documents were analysed and studied.

1.7 Justification and rationale

This proposed system will be ideal for the organisation as it will reduce the paperwork that currently is in use where SHEQ department is concerned since the SHEQ related records will be captured on the system. The use of this system is also helpful because every employee will see the notices and awareness without having to walk to the noticeboard. In addition, the monitoring and evaluation system will, at any given time, print out or output the analysed data in pictorial form for example in the graph format. Working on the budgets and planning of SHEQ related workshops becomes clearer and faster using the proposed system because there will be instant feedback from employees after the workshops. SHEQ tests done can be

done daily online without the SHEQ employees having to walk around the whole factory collecting feedback from the rest of the employees.

1.8 Conclusion

This chapter has highlighted and given a clearer insight to the development team and the rest of the proposed system stakeholders as to why there is genuine need to create a new and better system which is the SHEQ Planning, Monitoring and Evaluation System. The next chapter therefore strives to emphasize the planning phase. The planning phase focuses on different categories of the feasibility study of the proposed system, analyses the extent of potential risk posed by the proposed system, work plan, stakeholder analysis and so on.

CHAPTER 2: PLANNING PHASE

2.1 Introduction

Webb (2017) views planning as an activity carried out to minimize forecasted risks that is lessening the unknown and maximizing the known. This planning phase is a phase which will provide the system developers and management team with a well-researched proposed procedure or guidelines on the activities to be carried out throughout the project mitigating future risks. It works on the limitations most likely to be met in the project completion and finding solutions and a way forward. The planning phase therefore minimizes the risks of the system development project failing since there will be the planned management of time, risks, money through budgets and so on. Therefore, this phase analysis the business value, the feasibility study, the risks most likely to be encountered, the stakeholders and the work plan.

2.2 Business Value

According to Schwartz (2016), the business value of the organization is the standard measure that provides numerous practices concerning values that briefly define the health and wellbeing of the corporate over a long trend. A business value should be efficient and effective enough to aid in incrementing the goodwill value of the business. The SHEQ Planning, Monitoring and Evaluation System will provide the company with tangible and intangible benefits.

2.2.1 Shareholder Value

Schwartz (2016) defines the shareholder value as the value being brought in by the proposed SHEQ system that must be appreciated by the investors of the Lobel's Bread organization. The proposed system aims at helping the management team uphold the stakeholder's interests while carrying out day to day operations in the SHEQ department. This is done through cutting down on the SHEQ department expenses and being transparent about them whilst maximizing on ways to make more profit through quicker communication channels on the communication platform.

2.2.2 Employee Knowledge

According Chari (2015) to employees contribute the "human capital" that is employees' contribution is company specific just like owner's capital. This means that for workers to be have maximum contribution there is need for maximum motivation. Worker motivation is an essential asset to any organization and the proposed system will aid in encouraging it since it will cut short the distance that has to be walked by the SHEQ employee daily to do all duties.

At the end of the day, therefore, the employee goes back home less tired and ready to work again the next day. The proposed system will help reduce the expenses incurred on printing of notices or buying and manually updating the employee health records. Decentralising of personal employee SHEQ related information by the proposed system will provide the employees with quicker access to the urgent and needed information.

2.2.3 Managerial Value

Schwartz (2016) is of the view that managers contribute greatly to the quality of services by the employees. The proposed SHEQ system in development will see to it that there is room for innovation in years to come as the technology is changing with time allowing the management to provide better services for the employees with time. It is the duty of the management to aid in controlling the accessibility of different users to the system therefore maintaining a tighter security and minimizing the risk of leakage of sensitive information to competitors.

2.3 Feasibility Analysis

According to McCrone et al., (2017) it is the assessment and evaluation of the practicality of a proposed plan or method. After a problem is identified, an alternative solution is recommended, and the study aims at investigating if the solution is worth the development effort, time and expenses. In other words, feasibility study determines whether the proposed SHEQ Planning, Monitoring and Evaluation system is worth developing or not. The feasibility study will be conducted in four subparts which are technical feasibility, economic feasibility, social feasibility and operational feasibility.

2.3.1 Technical Feasibility

Basheikh and Miski (2014) concluded that technical feasibility measures the depth of the project, technical expertise and experience possessed by the project team and if it is technologically possible to implement the project based on the existing technological infrastructure. Technical feasibility investigates the adequacy and accessibility of the technologies that is already there and that is required both in hardware and software during and after the development of the proposed SHEQ system. The study also points out and identifies the relevant technical expertise essential for the proposed SHEQ system to be successfully developed and maintained.

2.3.1.1 Technical expertise

To see to the development completion of the proposed system and its proper maintenance, the developing team, the IT team at Lobel's Bread and the authorized IT consultancy company must have excellent skills and knowledge in PHP and MySQL. It was proven that all parties are experts and are familiar with the required tools.

2.3.1.2 Hardware requirements

Below is a table which clearly shows the hardware tools essential for the development and maintenance of the proposed SHEQ system;

Item	Quantity	Availability
500GB hard disk space	1	No
2GB RAM	1	Yes
Computer - P3 or better	4	No
Surge Protectors	2	Yes
LaserJet printer	1	No
UPS	1	Yes
Routers	2	Yes
Switches	2	Yes

Table 2.1: Hardware requirements

2.3.1.3 Software requirements

Below is a table which clearly shows the software tools essential for the development and maintenance of the proposed SHEQ system;

Item	Quantity	Availability
Windows 8.1	1	No
XAMPP	1	Yes
MySQL	1	Yes
Notepad++	1	No
Mozilla Firefox	1	Yes
Microsoft Office	1	Yes
Antivirus Software	1	Yes

Table 2.2: Software requirements

2.3.2 Economic Feasibility

Basheikh and Miski (2014) define economic feasibility as the evaluation of the monetary expenditures against the benefits to decide whether or not to proceed with the development and implementation of a project. In this evaluation study, the current monetary value is used to assess the financial fitness of the development of the proposed system through investigating the costs against the benefits and giving a final decision in the end.

2.3.2.1 Costs

These are categorized into two parts which are the development and maintenance costs, and operational costs.

Development and maintenance costs

According to Hullet (2016), development costs are expenses that are incurred during and after the development stage of a system. The estimated current monetary value of the development costs incurred at all stages of developing the proposed system were calculated as shown in the table below;

Item	Quantity	Cost (USD$)
500GB hard disk space	1	100
Computer - P3 or better	4	2000
LaserJet printers	1	300
Total hardware costs		**2400**

Table 2.3: Hardware costs

Item	Quantity	Cost (USD$)
Windows 8.1	1	50
Notepad++	1	Free
Total software costs	1	**50**

Table 2.4: Software costs

Item	Cost (USD$)
Transportation	50
Cloud servers	50
Total sundry costs	**100**

Table 2.5: Other sundry costs

Operational costs

Hullet (2016) is of the view that these are the day to day costs incurred during the running of the system in a business environment. The operational costs shown in the table below were calculated using estimated monetary value;

Operational costs	Value (USD$) 2019	Value (USD$) 2020	Value (USD$) 2021
Maintenance	3500	2500	1500
Hardware repairs	500	400	300
Web Hosting	500	500	500
Total	**4500**	**3400**	**2300**

Table 2.6: Operational costs

2.3.2.2 Benefits

Benefits are recognized by Kleynhans (2016) as the advantages which are derived from the successful implementation of the proposed system which the organization gets to experience. The benefits were calculated in the current monetary value and can only be compared against the costs in the cost benefit analysis. Benefits are also categorized into two that is the tangible and intangible benefits.

Tangible benefits

Kleynhans (2016) defines tangible benefits as advantages that can be physically seen and can be measured in terms of the monetary value. These were calculated using estimated monetary value as shown in the table below;

Benefit	Value (USD$) 2019	Value (USD$) 2020	Value (USD$) 2021
Reduction in POS rent costs	500	1200	1500
Rise in market share	2500	4000	4500
Decrease in stationery costs	2500	2800	3000
Increase in productivity	3000	4000	5000
Total benefits	**8500**	**12000**	**14000**

Table 2.7: Tangible benefits

Intangible benefits

Kleynhans (2016) views intangible benefits as advantages that cannot be seen by the physical eye because they are not physical in nature meaning that they cannot be touched. These include goodwill, worker morale and quality of decisions made and brings about merits with them. High worker morale leads to increase in productivity and gaining of competitive advantage and therefore Lobel's Bread as a company will realise more profits than before. Increased goodwill will increase the value of the business attracting more investors and customers since there will be reliability from both the investment perspective and bread quality perspective.

2.3.2.3 Cost Benefit Analysis

	2019 $	2020 $	2021 $
Benefits:			
Tangible Benefits	8500	12000	14000
Intangible Benefits	-	-	-
Total benefits	**8500**	**12000**	**14000**
Costs:			
Development costs	(2550)	-	-
Operational costs =7050	(4500)	(3400)	(2300)
Net Benefit/ (Costs)	**1450**	**8600**	**11700**

Table 2.8: Cost Benefit Analysis

From the table above, the estimated benefits and estimated costs from year 0 to year 2 were compared against each other and a net benefit was produced as a result. This shows that if the proposed system is to be developed, the system will bring more benefits than costs and therefore it is worth developing and implementing.

Return on investment (ROI)

Kleynhans (2016) concludes that ROI is responsible for measuring the total performance of a project to enable evaluation and analysis of all the available alternatives to make an appropriate. Return on investment is also known as the Average Rate of Return (ARR) and is calculated as follows;

$$ROI = \frac{\text{average annual profit}}{\text{total investment}} \times 100$$

$$ROI = \frac{\$[(8500 + 12000 + 14000) - \$(7050 + 3400 + 2300)] / 3}{\$(7050 + 3400 + 2300)} \times 100 = \mathbf{56.9\%}$$

The project is considered feasible if it has a high return on investment and from the above calculations, the return on investment of the proposed project is relatively high making the proposed project economically feasible enough.

Payback Period

Wolfe (2018) defines payback period as the number of years that it takes for the proposed project to return the initial capital invested in year 0 before making any profits. The payback period for the SHEQ system is calculated below;

Year	Cashflow ($)	Payback ($)
0	(7050)	(7300)
1	8600	1550
2	11700	13250

Table 2.9: Payback Period

Therefore, Payback = 1 (1550/8600 * 12) years = **1 year 2 months**

From the above calculations, the initial investment is going to be paid back in the first year in the 2nd month and the positive balance after this period will be profit. The initial investment return period is shorter therefore the project is feasible.

Net Present Value (NPV)

According to Wolfe (2018), Net Present Value is a method that evaluates if the current total value of cash flow in years to come will be of higher increased value in comparison to the start-up expenses of the system. The Net Present Value for this project was calculated as shown below;

Year	Cashflow ($)	Discount Factor	Present Value ($)
0	(7050)	1 / (1.1^0)	(7050)
1	8600	1 / (1.1^1)	7818.18
2	11700	1 / (1.1^2)	9669.42
Net Present Value			**10437.60**

Table 2.10: Net Present Value

The Net Present Value of the proposed system is positive which means the proposed system is economically feasible.

2.3.3 Social Feasibility

Kumar (2016) is of the view that social feasibility is an evaluation that tries to check whether and how the proposed system will influence the general public in a positive way. The implementation of the proposed SHEQ system should not have a negative impact on the people mentioned above. The proposed system should take into consideration the following;

Job creation – the proposed system will create jobs for qualified employees in all sectors, directly and indirectly.

Participation – to a greater extent, people's involvement aids to the chances of the system development success and committee members should be active members.

Time frame – the time frame of the proposed system should be realistic that is it should not be either too small or too big.

Management – excellent leadership style is a necessity if the proposed system is to reach its goal in the planned time frame.

Communication – the committee members should be able to freely communicate their points of views and ideas about the development of the proposed system.

2.3.4 Operational Feasibility

According to Basheikh and Miski (2014), the main purpose of performing an operational feasibility is to confirm the acceptability and ability to operate the proposed system by the end users. In other words, we investigate how the SHEQ department and other involved departments at Lobel's Bread accept the development and use the SHEQ Planning, Monitoring and Evaluation System. Nowadays most people, both young and old appreciate the basic use of smartphones and therefore are computer literate. This leaves most of the employees at Lobel's Bread computer literate especially the end users of the proposed system. For those who are not, training sessions will be conducted in which all end users will be shown how to operate the proposed system. This training sessions will be conducted by the authorized IT consultancy company and the IT team at Lobel's Bread every now and then until the end users understand the proposed system thus the system will be managed properly. The SHEQ system has advanced functions which will improve the relations between Lobel's Bread and its sponsors and the general public.

2.4 Risk Analysis

For every project done, there is always a risk or risks involved which may result in the failure of the project completion. Therefore, there is need to manage the risks that are most likely going to be involved in the development of the system. Risk analysis can also be viewed as a thorough investigation of the potential threats which affects the development and implementation of a project. Some of the risks involved include the technical risks, economic risks and so on.

2.4.1 Technical Risks

The use of the SHEQ Planning, Monitoring and Evaluation System requires all the users to be computer literate. Therefore, after the system is developed, a training session will be conduct by the authorized IT consultancy company to illustrate to the respective users on how the system works and maintained so that they familiarize with the system before its implementation. User friendly interfaces will be designed to accommodate for those who have not had the privilege to be computer literate earlier.

2.4.2 Economic Risks

The economic risks are mostly about the risks involved with the cost of the project. Poor budgeting of money or computer resources by the development team and its management may result in sponsors doubting the viability of the system thereby withdrawing funding.

Therefore, an excellent and properly planned budget should be drawn to minimize the economic risks.

2.4.3 Other Sundry Risks

These include the following:

- There is the risk of lack of adequate confidence from the users which may lead to system failure and therefore, there is need of reassuring users and restoring their confidence.
- When the training sessions are conducted, the development team and its management must fully rely on the IT consultants and the risk of insufficient time to do adequate tests. This is however a minor setback in comparison to the overall factors in consideration.
- Power cuts are occurring at their highest peak and this poses a risk of computer hardware failure or cutting their lifespan short. It is essential that an automatically switching, readily available power source back is always available.
- There will be also the risk of virus attacks since the system will be an online system connected to the internet and therefore the need for an effective anti-virus program.

2.5 Stakeholder Analysis

Wolfe (2018) is of the view that stakeholder analysis refers to an activity of investigating the users of the system and their specific requirements or needs. The proposed system can either have positive effects on the stakeholders or can have negative effects on the stakeholders. Therefore, it is in this analysis where the stakeholders' reactions are observed and considered and adjust on those areas of the proposed system where need be. It is also in this stakeholder analysis where the specific requirements of the stakeholders are made known and considered. These stakeholders include the employees, management and suppliers and external contractors.

2.5.1 Employees

Usually it is difficult for most employees to deal with uncertainty at a workplace and therefore the rise of resistance. When the proposed system was suggested most of the Lobel's Bread in the SHEQ affected areas felt insecure about being replaced by the system. Employees had to be reassured many times that the system would not replace them but rather would aid in the working conditions at Lobel's Bread.

2.5.2 Management

At first, the Lobel's Bread management team was hesitant about the proposed system because it brings with its uncertainties that is whether it will work after implementing or if the development will be done as per due date or the position the team will be left on by the use of the system. But after a deeper analysis, they decided to go ahead and give the proposed SHEQ system a chance and thereby agreeing to the development of the system. The proposed system will produce reports for the management to use in decision making. In addition, the proposed system will reduce the workload especially for the SHEQ employees ensuring that they are more motivated.

2.5.3 Suppliers and external contractors

The suppliers and external contractors viewed the proposed system as efficient and effective because instead of coming in person to give a feedback on the laboratory results or making phone calls on deliveries, there will be an instant communication platform. This will smoothen the flaw of services and transactions.

At the end of the day most stakeholders agreed that the development of the proposed SHEQ system should carry on since it will be more beneficial than non-beneficial.

2.6 Work Plan

A work plan is a blueprint which projects the order in which tasks will be performed that is it partitions the main objectives into smaller tasks and allocates the timelines for their completion. It ensures that the project is executed thoroughly through the precise and convenient project path which utilizes the resources available to their full capacity.

2.6.1 GANTT CHART

Taylor & Francis (2018) are of the view that a Gantt chart is a project management visualization which considers the project's progress and scope which in turn evokes managerial values of certainty and simplicity. The Gantt chart for the proposed system shows the activities which are going to be carried out against their start and end time.

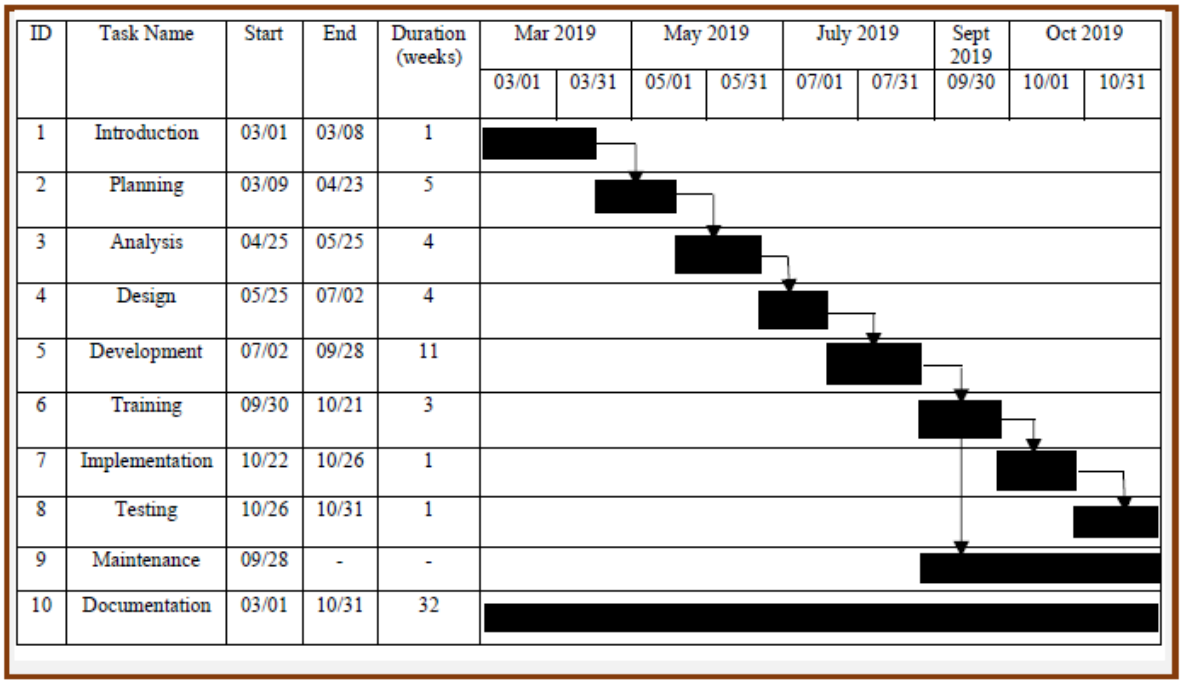


Figure 2.1: Gantt chart

2.7 Conclusion

The relevant well researched activities were properly planned in this chapter with the evaluations completed. The project proved to have an excellent business value, market share and customer value and with the projected work plan, the project team has a realistic goal to achieve in a realistic time space. It is therefore only proper to proceed to the next chapter in which analysis can be done.

CHAPTER 3: ANALYSIS PHASE

3.1 Introduction

Systems analysis is a process of collecting and explaining factual data, identifying problems and recommend improved solutions. Dennis et al (2019) emphasis that the systems analysis phase is one in which ideas and suggestions are developed for ways that IT can support and improve business processes, new business processes that are supported by IT are developed and new IT is designed ensuring that all standards are maintained. The failure or success of the implementation of the system in development highly depends on this study. It is therefore in this chapter where the development team performed a fully detailed study of the existing system and in the end gave an insight on the improvements adequate to have a more efficient and effective SHEQ system. Thus, the SHEQ Planning, Monitoring and Evaluation system as the end solution.

3.2 Information Gathering Methodologies

This part of the analysis phase is essential as it provides the development team with a better understanding of the current system revealing the improvements required to be carried out. During information gathering methodologies which includes questionnaires, interviews, documents review, and observations were used. Data was collected from both the internal Lobel's Bread employees and external Lobel's Bread partnerships enhancing reliability and validity of the information researched.

3.2.1 Questionnaires

Linman (2014) defines a questionnaire as a technique used to gather data where the respondents are given written down questions and provide answer on the spaces available. Both the open and closed questionnaires were distributed to approximately forty (40) employees in the involved departments on the 29th and 30th of April 2019. The questionnaires proved to be more convenient for the busy department managers or supervisors. These employees filled in and responded to the questions asked through ticking and briefly describing where there was need in the spaces provided. The use of questionnaires had its advantages and disadvantages which are listed as follows;

Advantages

- The questionnaires distributed to the Lobel's Bread employees could be answered in private and therefore providing anonymity which provided confidentiality boosting the chances of employees giving genuine responses to the questions asked.
- Questionnaires were less time consuming to both the development team and the employees as they were distributed and later collected at once.
- Short and precise responses were easier for the development team to analyse and have a way forward.
- There was ample time for the respondents to think about the questions before responding and thereby providing the platform to give comprehensive responses.

Disadvantages

- Since the writer or the rest of the development team were not available to give clarity, some questions were either wrongly answered or not answered at all thereby providing with less accurate information.
- Either some of the Lobel's Bread employees were not interested in the questionnaires or they misplaced them as the returned questionnaires were less than the distributed.
- There wasn't help from the development team to the employees as to how they were supposed to answer making it difficult for them to correctly interpret the questions.

3.2.2 Interviews

According to Eid (2015) an interview is a process whereby the interviewee that is the one asking questions asks the respondent a series of questions in a conversation manner setting with the aim of getting information from the questions being asked. The development team sent two (2) representatives, the writer and a system designer, who had excellent communication skills to Lobel's Bread to physically carry out interviews. It took extreme persuasion and convincing to get the outcome they needed from the employees. During the period from the 1st of May 2019 to the 10th of May 2019, both the structure and unstructured interviews were conducted on thirty-five (35) employees.

Structured interviews – in these types of interviews, the interviewer asks the interviewee specific questions which are short and precise and require direct and precise responses.

Unstructured interviews – in these types of interviews, the interviewer asks the interviewee unrestricted open-ended questions giving plenty a room for further clarifications and explanations.

Conducting interviews at Lobel's Bread had its advantages and disadvantages which are listed as follows;

Advantages

- The interviewers, that is the writer and system designer, obtained first-hand information through immediate responses.
- Interviews gave plenty room for the writer and the designer to ask questions and give clarification on the ones which were not understood by the Lobel's Bread employees.
- Interviews gave enough flexibility in question structuring thereby extracting as much fully detailed and needed information as possible.
- Since the writer and the system designer from the development team were there, they were able to read the non-verbal communication cues by the employees being interviewed which gave up some of the answers which would not have been expressed in writing.

Disadvantages

- Carrying out interviews was time consuming as they had to be done in the presence of both the interviewers, the writer and system designer, and interviewee, employee.
- No proper confidentiality was provided and identities of Lobel's Bread employees interviewed were known therefore inaccurate and inadequate information was provided by some employees.
- Not all involved employees were present due to leave days and other unforeseen reasons.
- Difficulties in conducting the interviews were faced by the development team because of the limited "free-time" since Lobel's Bread is a 24-hour bakery.

3.2.3 Observations

Eid (2015) also believes that an observation refers to an inspection, the monitoring or the viewing which one conducts a certain activity seeing surveillance or watching. A few members from the development team took turns to visit Lobel's Bread either moving around with the SHEQ assistant observing the involved employees work or spending time with the assistant in her office observing her work. This therefore provided the development team with

the relevant first-hand information on the current system as it allowed them to participate or watch the employees performing activities. Observing employees at Lobel's Bread work had its advantages and disadvantages which are listed as follows;

Advantages

- The development team gathered more direct information on how the system works as some events can be difficult to express in writing.
- The development team carried out work measurements.
- A good opportunity was provided to experience and observe unforeseen outcomes and thereby making the research more comprehensive.

Disadvantages

- There was bias in some of the outcomes since workers willingly or unwillingly performed differently when they were under observation.
- Selective perception of some of the development team members distorted the data collected.
- Observations required all the relevant stakeholders to be physical present and therefore was more expensive and time consuming.

3.2.4 Documents Review

To have a better understanding of the policies governing the SHEQ department and other stakeholders involved in the current system, SHEQ department documents were provided and analysed. These documents include the SHEQ Legal Register consisting of SHEQ certificates, policies, walkabouts and inspections, Local authority file consisting of EMA, BCC and NSSA records, In-process checks file and Quality assurance file. Through analysis, the development team had the opportunity to fill in some of the gaps that were left out using the other information gathering methodologies. It also made it easier for the development team to know how these policies might affect the proposed system. Documents reviewing had its advantages and disadvantages which are listed as follows;

Advantages

- The writer worked with the employees at Lobel's Bread and therefore it was easier for the management of the organization to trust the development team with most of the SHEQ documents which provided the team with adequate first-hand information.

- More and proper analysis of the greater part of the system was done since the development team had the time to sit and analyse the company documents provided.

Disadvantages

- Information gathered at Lobel's Bread was incomplete as the documentations could not give a detailed explanation of how the system works.
- As much as the management trusted the writer, not all the company documents are always open to the public and this cut down on the crucial information which was provided.

Therefore, the combination and use of the four information gathering methodologies provided the development team with more accurate and reliable information as to how the SHEQ department carries out its operations.

3.3 Analysis of the current system

3.3.1 Description of current system

The current SHEQ system, when the tests and surveys for example the Product Quality Index tests is being conducted, every process has to be done manually. The SHEQ employee request for bread samples through the use of the request book. After the request is authorized by the finance manager, the samples are recorded at the invoicing office and the SHEQ employee collects the samples at the dispatch office. She walks around the rest of the organization with the samples, have other employees test and give feedback on different categories. The SHEQ employee records the feedback on a sheet of paper.

In addition, when the SHEQ department holds workshops and events, the SHEQ employees draft and plan the approximated expenses and agenda and submit their plans for authorization. After the general manager and finance manager approve, the SHEQ employee confirms with the necessary department managers. Emails are sent to appropriate employees and when the workshops or events are done, the SHEQ employee captures and stores or prints the actual activities and expenses.

When the SHEQ department wants to notify the rest of the employees when they see the need to do so, they send emails to the formal employees. For the informal employees to be aware, the SHEQ employee types the notices using Microsoft Word, prints and puts them up on notice boards. She sometimes manually writes the shorter notices on the white boards. When the external Lobel's Bread contractors, for example Gold Star Yeast company, delivers yeast they physically enter the delivery details at the Lobel's Bread gate. It is after the details are

verified by the SHEQ employee and signed off that the contractors can leave their deliveries at the organization.

Furthermore, the SHEQ department is obliged to keep updated information on the Lobel's Bread employees for example accidents records. Therefore, the SHEQ employee types and prints the sheets of papers on which the records will be filled in. The employee manually fills in the required information and data in input through the Microsoft Word or Excel and stored.

3.4 Process Analysis

Process analysis determines how the current system is operating and the data flowing in every activity available in the SHEQ system. The activities include the input, processes and output.

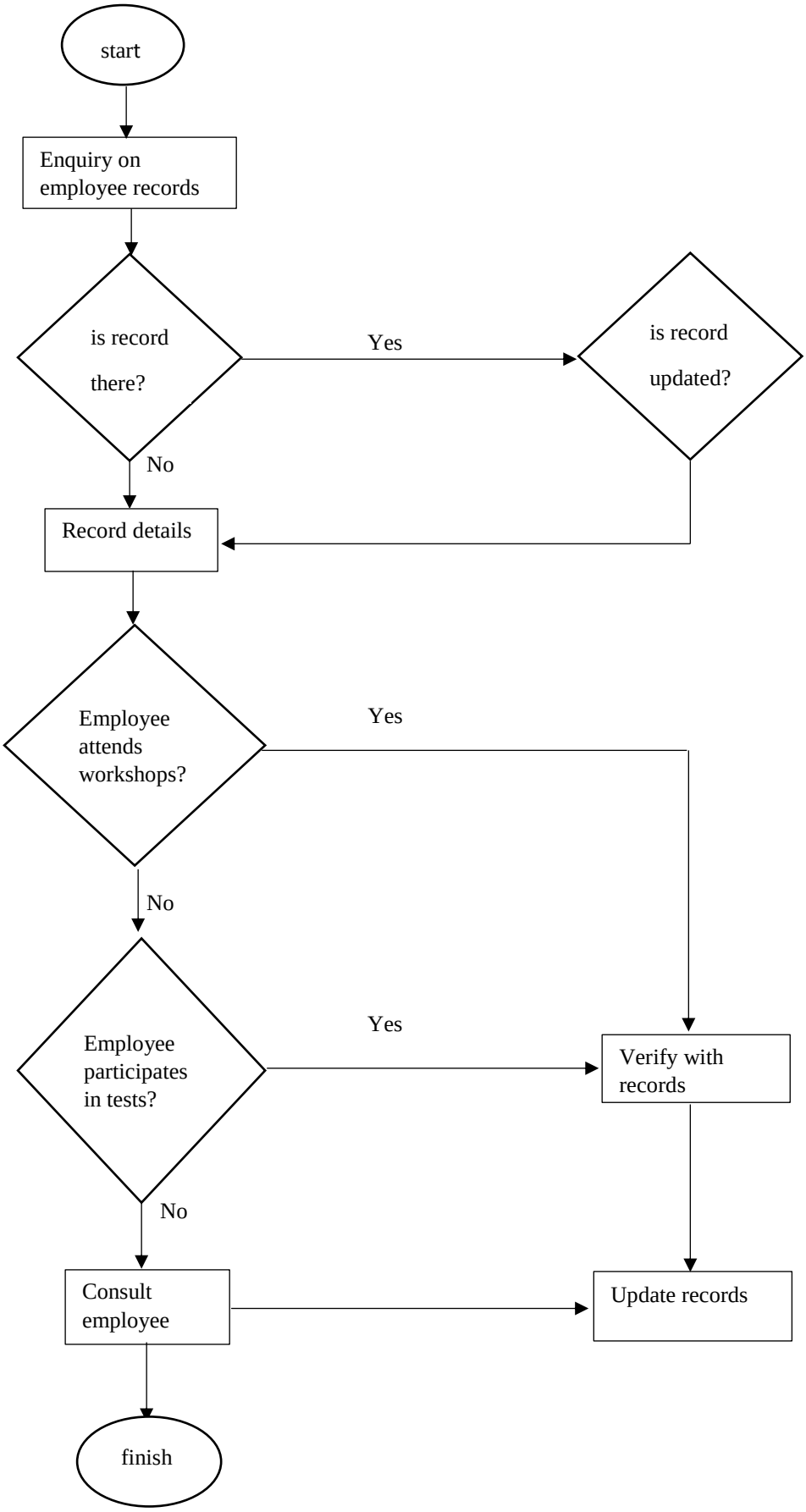
Input- employee records, tests and surveys, events and workshops, announcements, external contractors' details.

Processes- events and workshop budgets, clock in time, clock out time, accidents tracking.

Output- feedback, reports.

3.4.1 Activity Diagram of current system

An activity diagram is a diagram that shows a linear way in which activities in a certain system are conducted. The activity diagram provides the development team with an easier strategy to study the current system and come up with the necessary improved activities. Below is an illustration of the activities which are being conducted in the current SHEQ system at Lobel's Bread;


start
Enquiry on employee records
is record there?
Yes
is record updated?
No
Record details
Employee attends workshops?
Yes
No
Employee participates in tests?
Yes
Verify with records
No
Consult employee
Update records
finish

Key

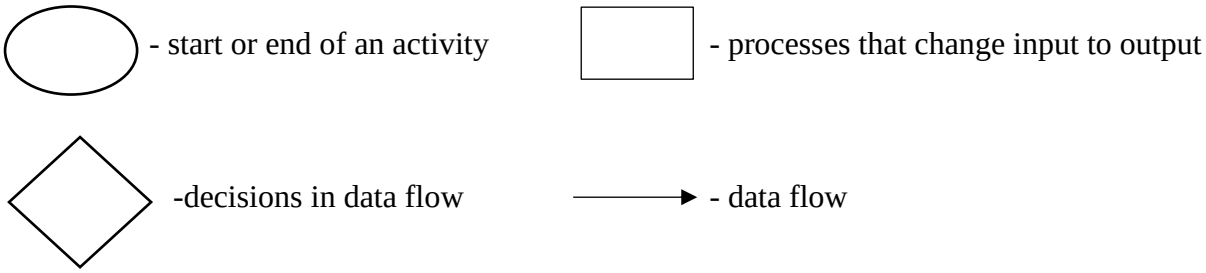


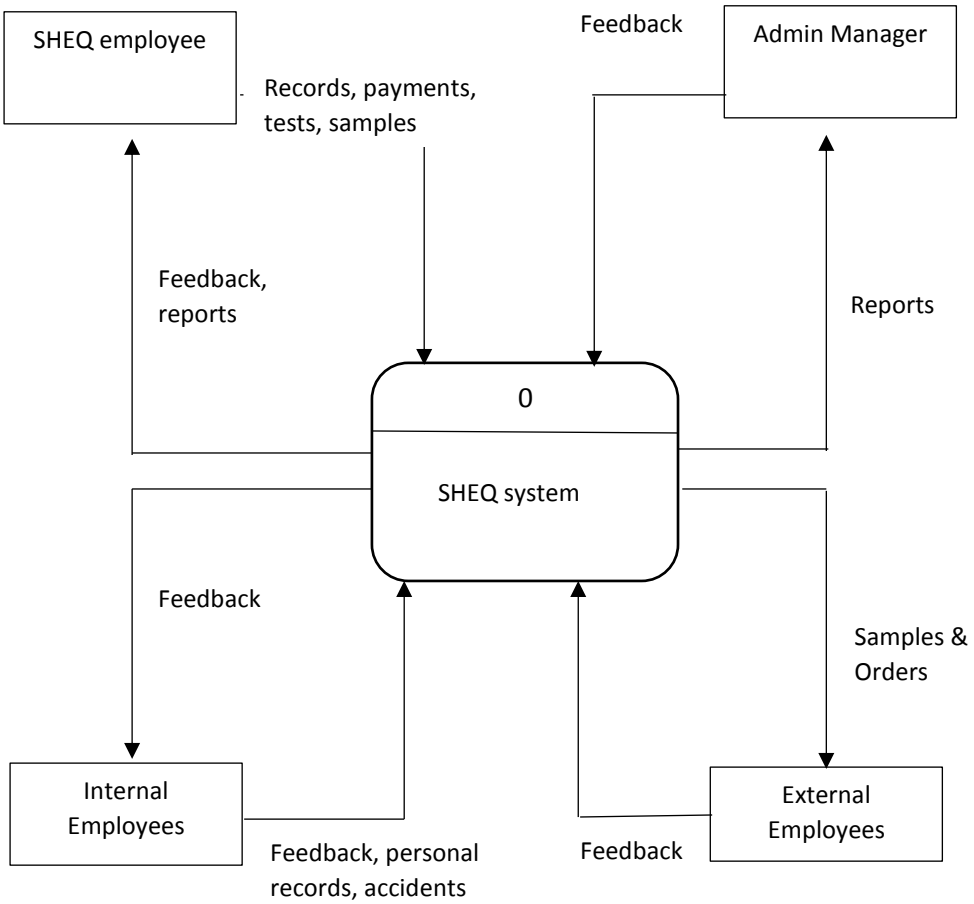
Figure 3.1: Activity diagram of current system

3.5 Data Analysis

Data analysis is the illustration of how data flows and is processed and the output produced in a certain system within an organization. In this analysis the data flow of the current system will be shown through the data flow diagram and the context diagram.

3.5.1 Context Diagram

A context diagram is a visual representation that gives that system boundaries and displays what information is input and extracted from the system by each user or entity. The current system can be illustrated in form of a context diagram as shown below;



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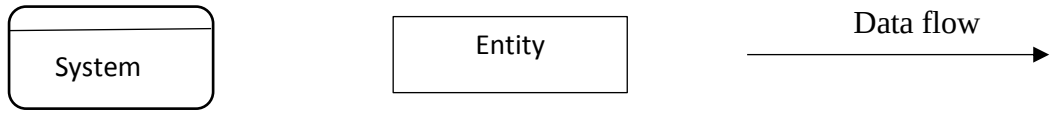
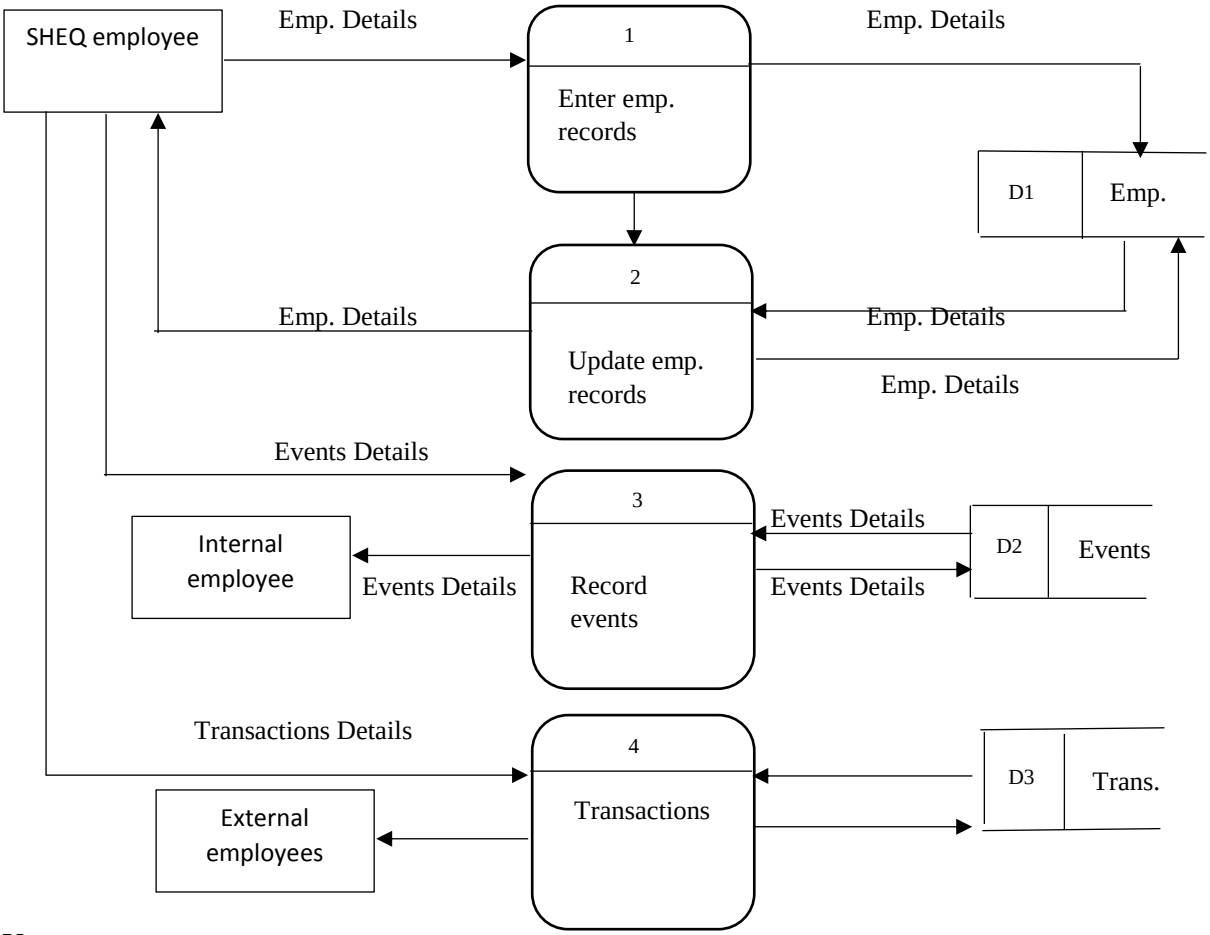


Figure 3.2: Context Diagram of current system

3.5.2 Data Flow Diagram

According to Hathway (2016), a data flow diagram is a graphical representation of information flowing through an expert or information system. The current system can be shown in the form of a data flow diagram as shown in the figure below;



Key

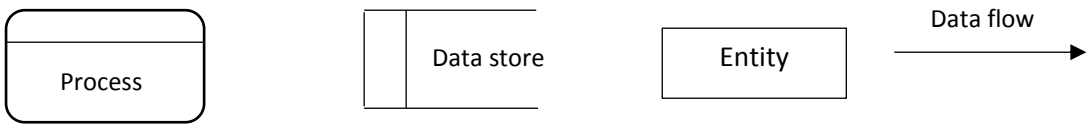


Figure 3.3: Data Flow Diagram of the current system

3.6 Weaknesses of the current system

- The SHEQ assistant must walk a great distance everyday to collect samples and perform surveys and tests through the rest of the employees all around the factory which becomes time consuming and tiresome.
- The SHEQ department must wait for implementation of the workshop ideas for it to know the extent of the effectiveness of the workshops being carried out.
- Therefore, the SHEQ department is left with unclear objectives when it comes to the intensity of the workshops to be conducted and the correct budgets for these workshops.
- Use of white boards and papers for notices is resource consume that is it leads to continuous use and wastage of printing resources and it is time consuming.
- Not all notices put up on noticeboards are read by the day-to-day busy employees.
- Use of manual paperwork to store employees' records and other SHEQ department work records are outdated and has led to the misplacement of most of the records making retrieval of information difficult.
- There isn't a secure back up plan of the manual system and therefore if files are lost through accidental or intentional events, all the information is lost.
- There is absence when it comes to the security concerning the confidential files of the SHEQ department and therefore it means that competitors can gain easy access to the company information.

3.7 Evaluation Alternatives

There are a number of evaluation alternatives from which the company can choose from to solve the challenges the SHEQ department is facing. The alternatives include outsourcing a similar proposed system, improving the current system and in-house development of the proposed system. These evaluation alternatives are fully explained below;

3.7.1 Outsourcing

Outsourcing is when an organization contracts an outside organization to make up a full development team. Outsourcing was not chosen because it becomes an unnecessary wastage of company resources since there are employees, in the Information Systems department, who are qualified enough to be a development team. In addition, as much as outsourcing brings in better ideas, contracting with an external partly is very expensive therefore outsourcing comes at a costly price. There will be increased training costs for the user

training and proposed system maintenance. Outsourcing is not always customized to match every single proposed system which becomes difficult to navigate through the system.

3.7.2 Improvement

Matti (2014) defines improvement of existing system as the process of altering the existing system as an aim to improve the existing functionality and workflow structures. Some of the challenges being faced by the SHEQ department can be investigated and computerized to improve but others can be redefined in the proposed system and done better manually. The SHEQ department can add on to the number of employees in their department to share the workload and thereby requesting for new computers and other work material. However, improvement of the current system was not chosen because it is not secure enough to manually keep confidential files in the office and employment of additional staff members will threaten information security even more. The current system is complicated enough and an upgrade will simply re-introduce the challenges in the future thus the improvement solution is temporary. Furthermore, the SHEQ office already has no adequate material to work with and therefore it will be a challenge to have more equipment bought for them by the company.

3.7.3 In-house Development

Tarhini (2018) is of the view that in-house development is the production of a software product within the organization which is to be used within that organization. In this evaluation alternative, everything is done by the company development team from the planning and designing to the implementation and testing of the proposed system. Every objective of the proposed system which is computerizable is computerized to have a centralized web-based system.

In-house development of the proposed system is well within Lobel's Bread budgetary constraints and it's even less costly since it becomes less expensive when it reaches the implementation, testing and maintenance stages. The developed system will be customized and specific to SHEQ department user requirements at Lobel's Bread and therefore the overriding of the challenges being faced by the current system through improved functionalities. In addition, if the need to upgrade the proposed system arises, an immediate internal upgrade can be conducted by the internal development team without any delays.

In-house development was therefore chosen mainly because not only will it be customized meeting all the different SHEQ department users' requirements but it is less costly compared to other evaluation alternatives.

3.8 Requirements Analysis

Requirements analysis is the process of identifying user requirements of the system being developed. After analysing the existing system, it was concluded that the proposed system could provide all the involved SHEQ stakeholder users at Lobel's Bread with the following functional and non-functional requirements.

3.8.1 Functional Requirements

The functional requirements are the activities the proposed SHEQ system is expected and meant to do to meet the user requirements. Functional requirements can best be shown through the use of the Use Case Diagram which projects a brief description of how the proposed system will perform.

Use Case Diagram

According to Parad (2017), a Use Case Diagram is a visual representation that displays behaviours or actions that a system performs based on the cases of the functional requirements. The Use Case Diagram involves the actor, use case and the link between the actor and the use case. The actors will include the SHEQ employees, admin manager, the finance employees, the rest of the Lobel's Bread internal employees and external employees for example Laboratory Technicians and yeast suppliers. The use case involves the inputs, processes and outputs which will occur as the proposed system is in use.

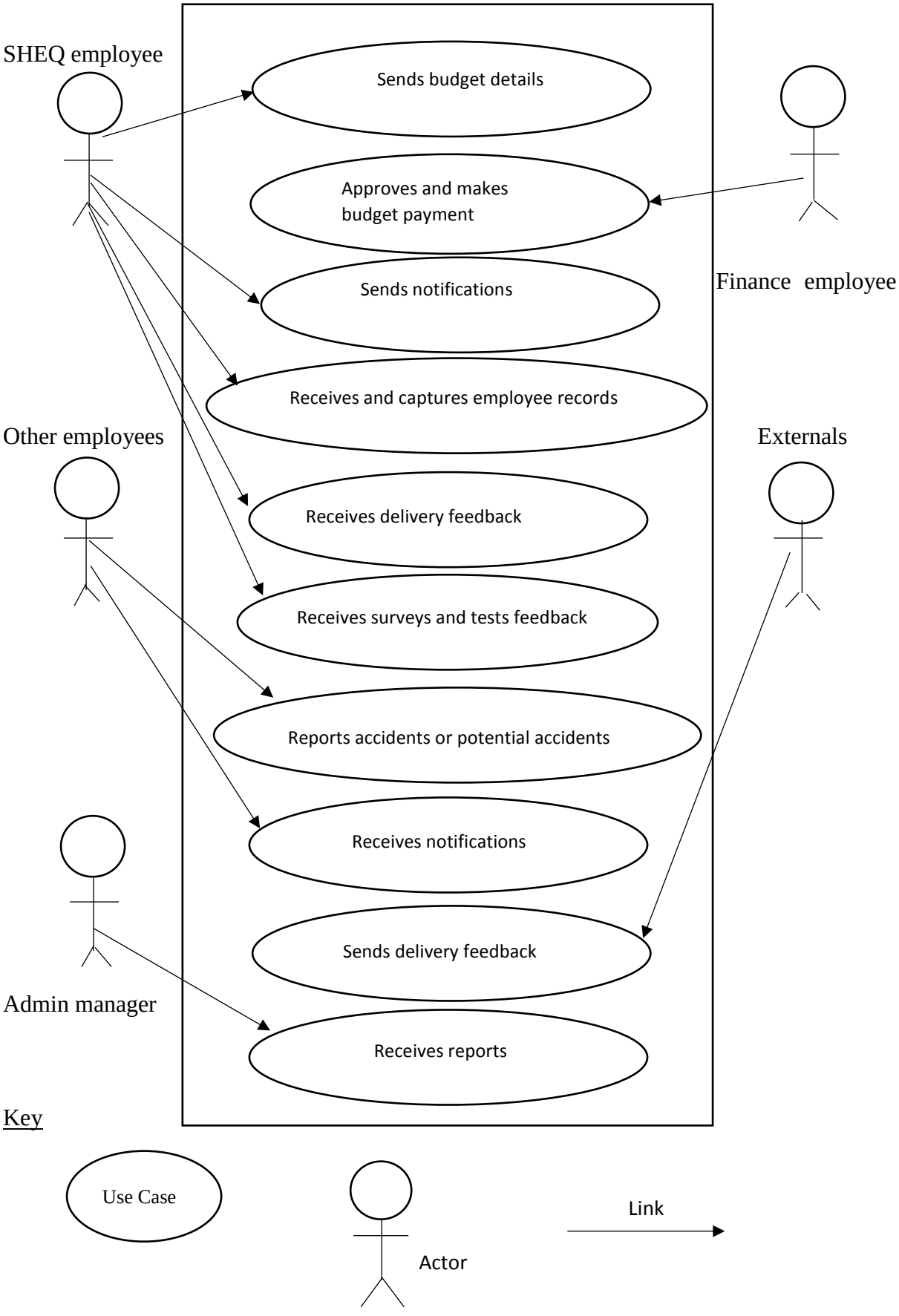


Figure 3.4: Use Case Diagram of the proposed system

3.8.2 Non-Functional Requirements

According to Adam (2015), the non-functional requirements are those factors or rather activities that affect the operating of the proposed system. They may affect both the software and hardware performance when the proposed system is in use and they include error handling, security, storage space utilization and proposed system and power backups.

Firstly, for error handling, when one user is using the proposed SHEQ system and an error or errors occur, it should not affect the running of the system to other users. In other words, the system should provide with a database which will enable all users to work without being affected by other users. Furthermore, the system should have password encryption and different login levels for different stakeholders who will be using the system such that maximize and a tighter security is available. In addition, since there will be as many activities being carried out on the system as possible, there should be enough storage space for the proposed system database and enough RAM size to ensure that the performance speed of the proposed SHEQ system is high. Lastly, the IT employees should ensure that day to day system backups are done on an external hard drive and that the power backup, preferably a UPS, is always charged and readily available for any power cuts.

3.9 Conclusion

After gathering all the necessary and adequate information through interviews, observations and other information gathering methodologies and analysing the current system through context diagram and data flow diagram, a definite improved proposed system will be designed. The next chapter will therefore project the actual design of the proposed system.

CHAPTER 4: DESIGN PHASE

4.1 Introduction

This chapter focuses on designing the proposed improved SHEQ system showing how the system will function with all the activities and processes involved explained further. In the design phase, in-depth details of how the data will flow will be investigated through the data flow and contexts diagrams and in the input and output interfaces. How successful the proposed system implementation will be, is determined by the development of the architecture, databases, interfaces and the physical design.

4.2 System Design

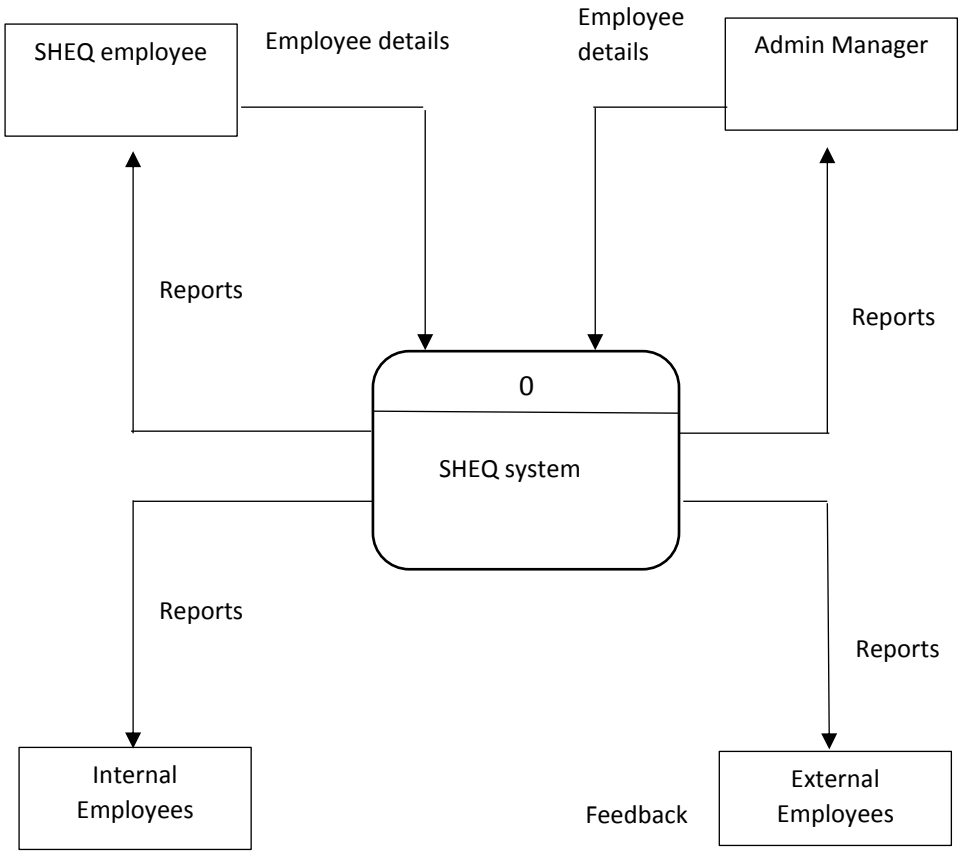
According to Mark and Levin (2015), system design is the process which identifies the system's architecture, its components, modules, interface and all the requirements which are needed for the system to be a success. The major objective of this stage is to ensure that an efficient, effective, maintainable and reliable system is built. The proposed SHEQ system will provide the platform for the SHEQ employee to instantly communicate with any internal or external employee of Lobel's Bread without physically walking to their working places. The system will be web based and allow for electronic budgets to be calculated and reports to be generated. Users can notify the SHEQ department on any overlooked potential accident in the factory anytime of the day or any other problem that would have risen. The system also provides the SHEQ employees with better secured confidential information on employees and so on.

4.2.1 Context Diagram and DFD of the proposed system

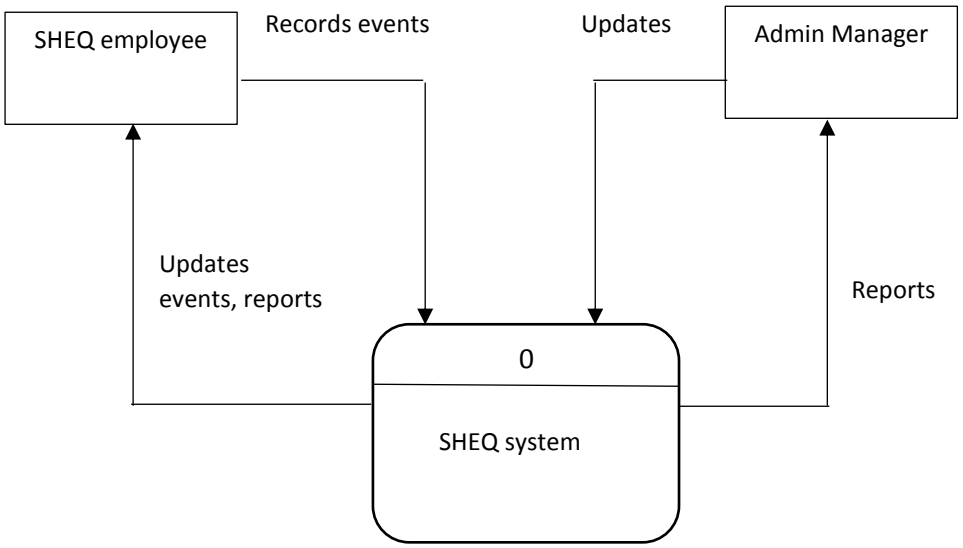
4.2.1.1 Context Diagram

Hathway (2016) defines a context diagram as a visual representation that gives that system boundaries and displays what information is input and extracted from the system by each user or entity. The proposed system can be illustrated in form of context diagrams as shown below;

Employee details



Events details



Tests details

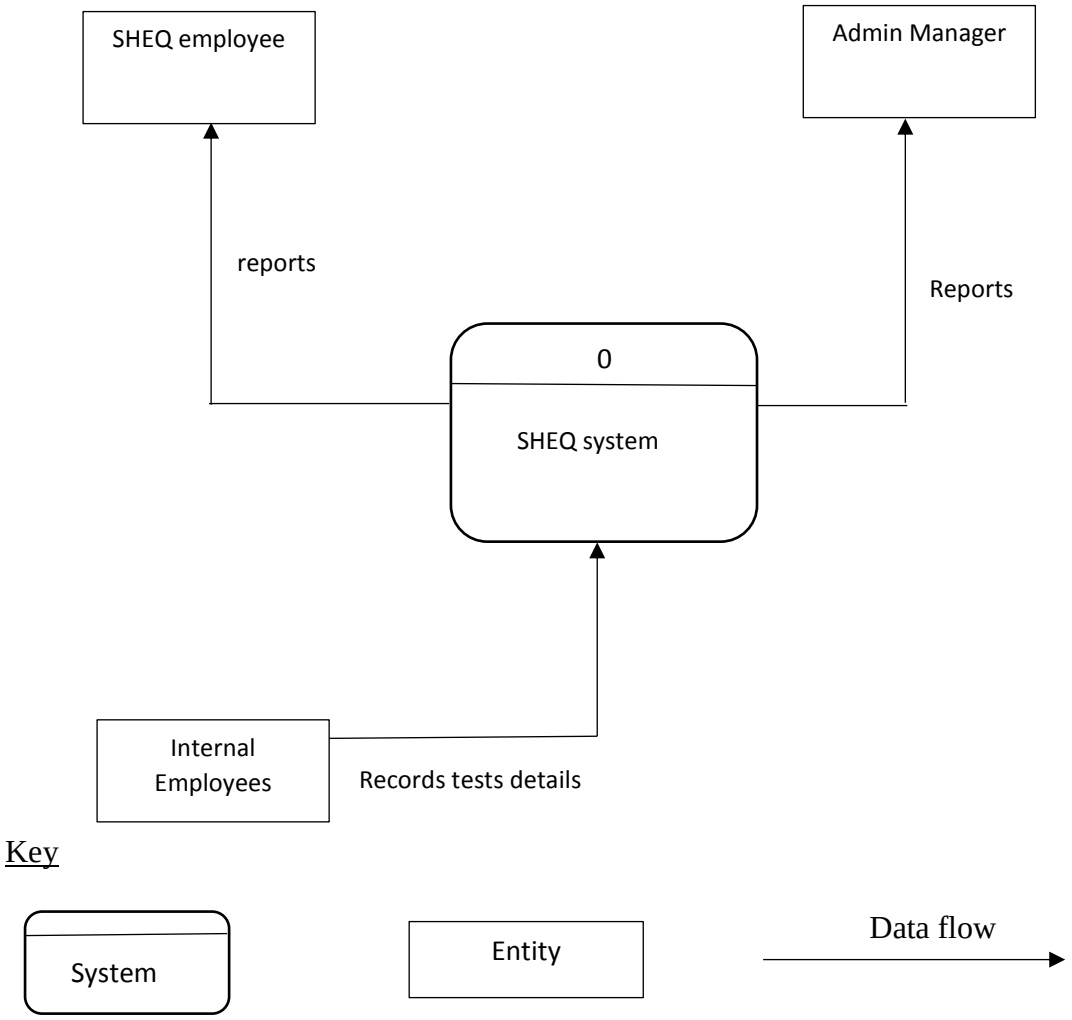


Figure 4.1: Context Diagrams of proposed system

4.2.1.2 Data Flow Diagram

According to Hathway (2016), a data flow diagram is a graphical representation of information flowing through an expert or information system. Below is the data flow diagram of the proposed system;

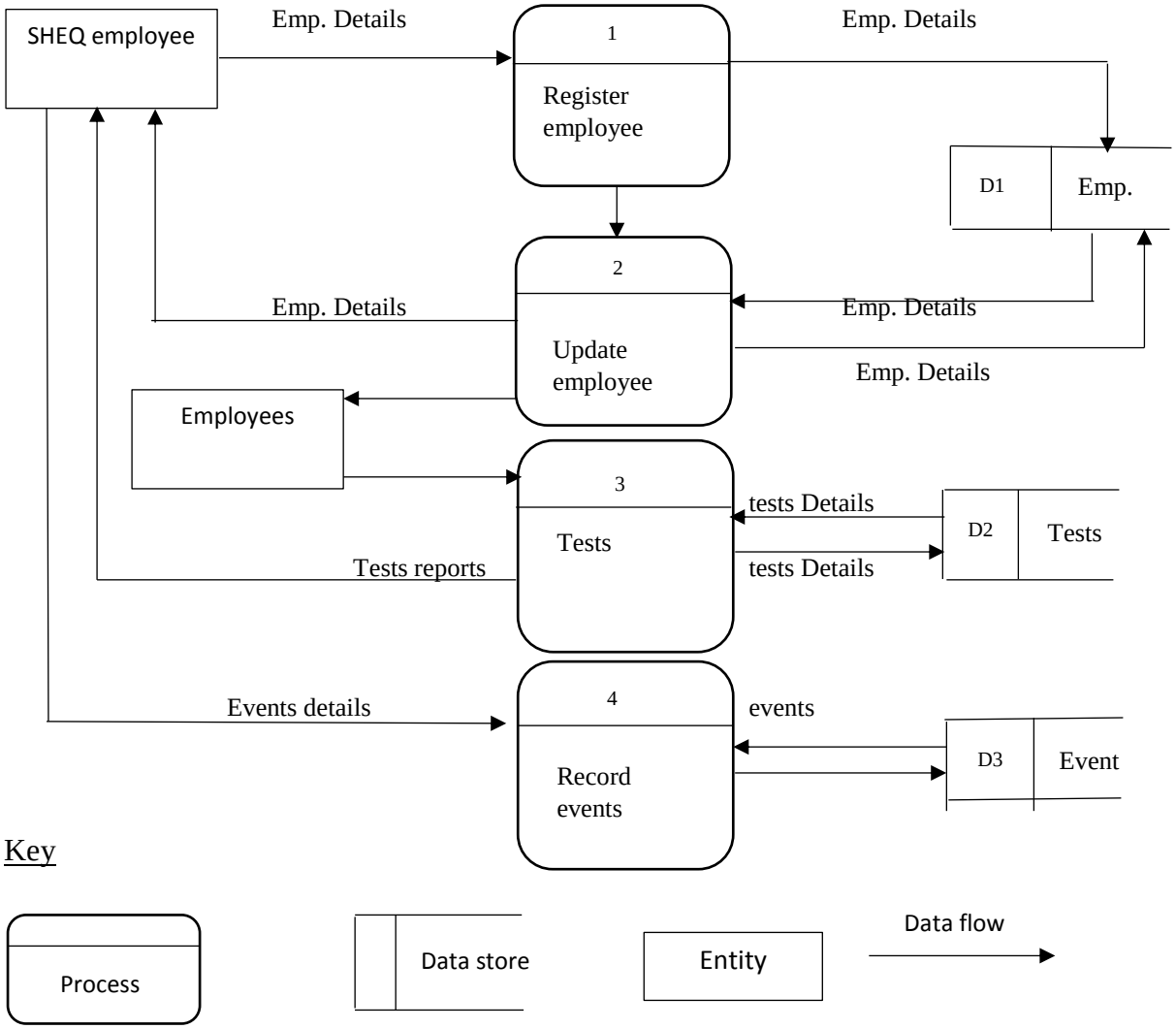


Figure 4.2: Data Flow Diagram of the proposed system

4.3 Architectural Design

According to Scammel and Umanath (2017), architectural design is the process that encompasses the components of a system structure and unifies them into a coherent and functional whole according to an approach in achieving the objectives under the given constraints or limitations. For the new SHEQ system, a Client-server architecture was chosen because even though the costs are very high so is the control, security and ease of development. The Client-server architecture consists of different components which include the network cables, client, printer and server.

Network Cables

The network cables are used to connect two or more computer devices in order to provide a platform where resources for example a printer are shared. Since Lobel's Bread mainly uses a Local Area Network, the network cables are still valid and applicable.

Client

The client is the main computer that will be connected to the server so that files and information in the server can be accessed. This is the computer from which all the computers can be controlled through the domain.

Printer

The printer will be essential on outputting reports stored in the computer as hardcopies at month-end or at any time of the month where need be.

Server

The server will be used to process a request and send data to another device through the internet on the network.

The Client-server architecture for the new SHEQ system can be diagrammatically illustrated in the figure that follows:

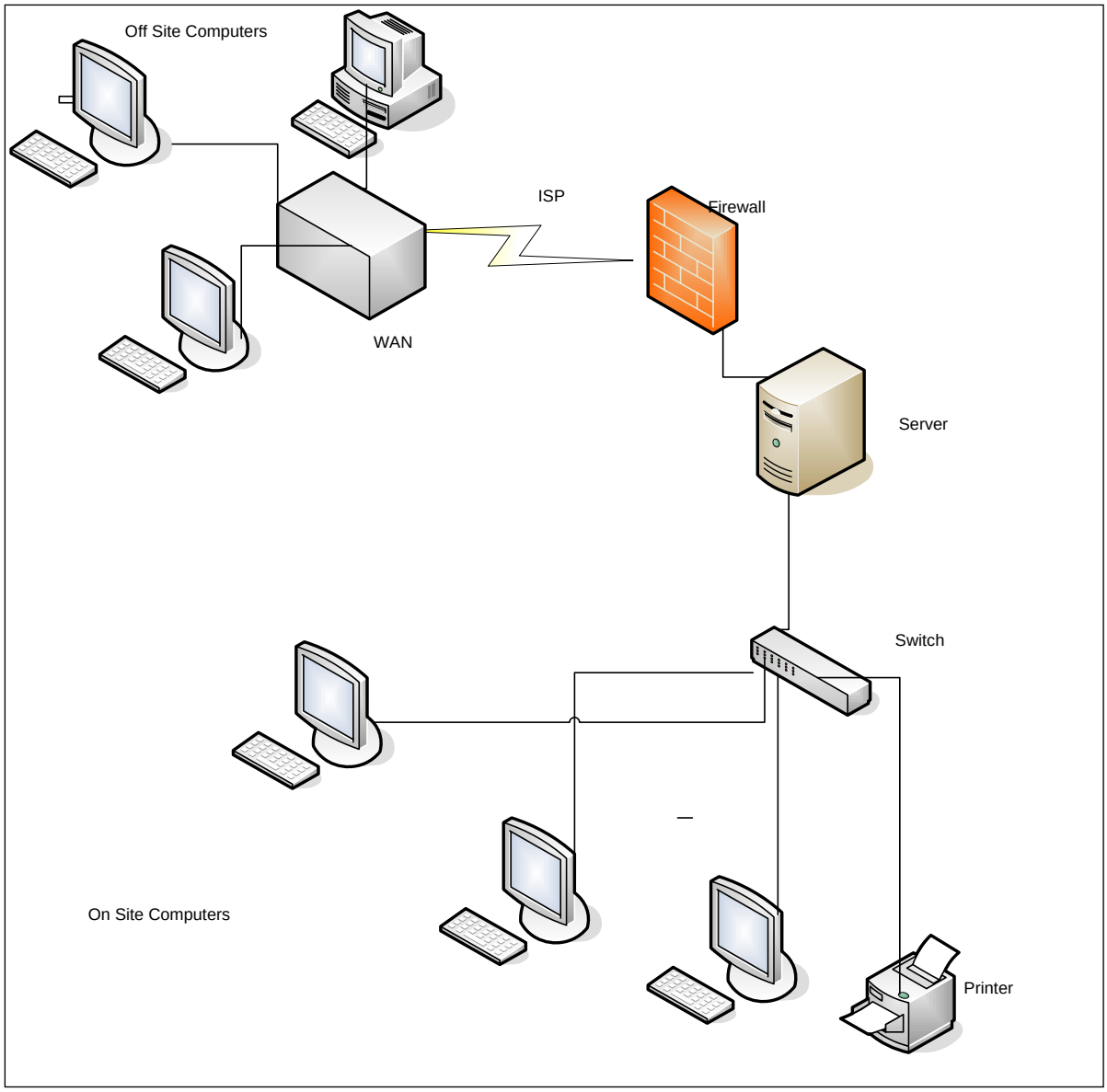


Figure 4.3: Architectural design

4.4 Physical design

Mark and Levin (2015) are of the view that the physical design is a representation of a system identifying the systems internal and external entities and showing the flow of data in and out of these processes. In other words, the physical design shows the relationship between the input, processing and output of data flowing in the new SHEQ system. In addition, the physical design investigates the interaction between the software and the hardware involved for the system to fully function. Below is a diagrammatic representation of the physical design of the new SHEQ system;

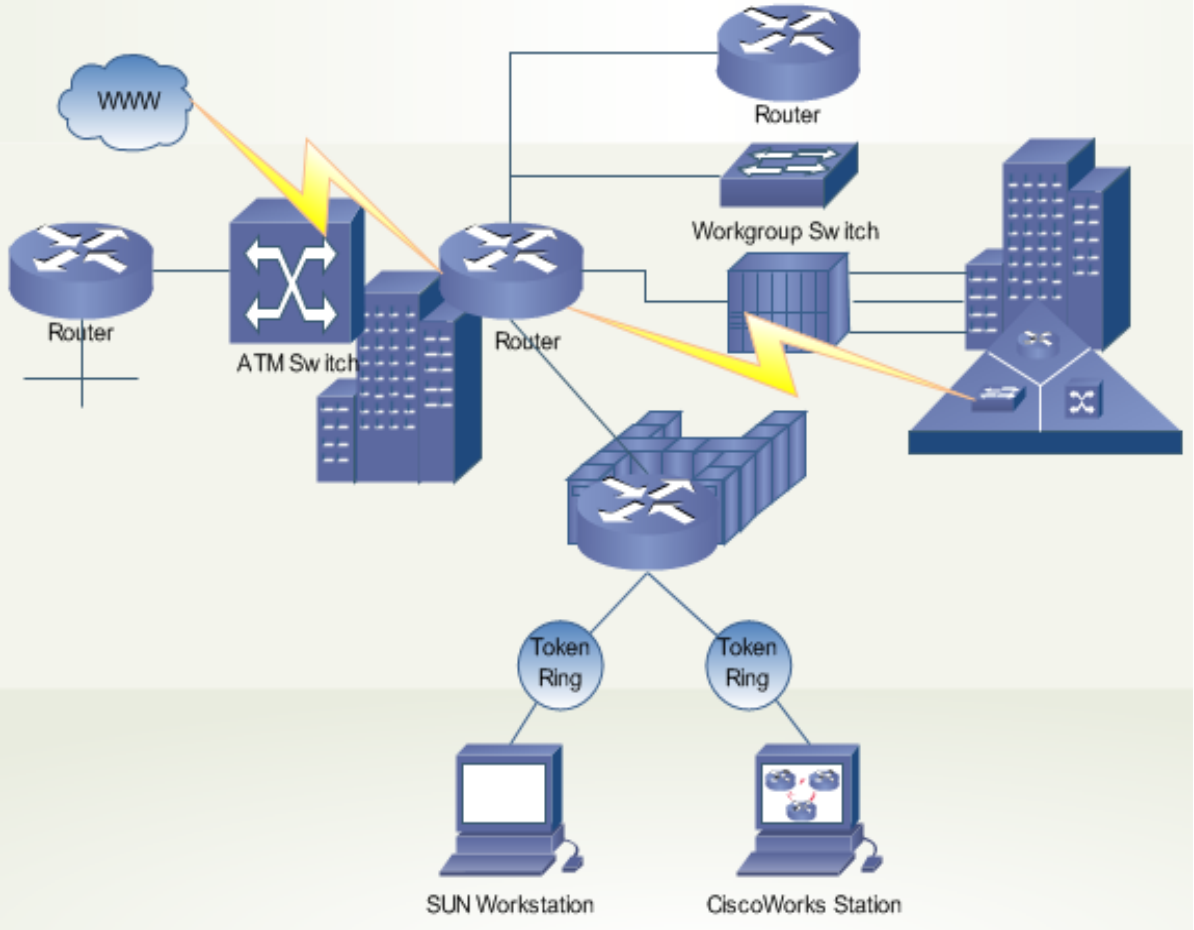


Figure 4.4: Physical design

4.4.1 Hardware requirements

The hardware requirements essential for the functioning of the system include the 500GB hard disk, 2GB RAM, P3 Computers, Surge Protectors, LaserJet printer, UPS, routers and switches.

4.4.2 Software requirements

The software requirements essential for the functioning of the system include the Windows 8.1, XAMPP, MySQL, Notepad++, Microsoft Office, Antivirus Software and Mozilla Firefox.

4.5 Database Design

According to Hernandez (2014), a database is defined as a collection of related data and database design is the process which identifies how data is presented in the database. The speed of data retrieval and maintenance of the information depends on the Database Management System. The Database Management System is a software that manages and controls access to the database. This phase therefore investigates and gives an idea on how

the Database Management System performs its functions. The three level ANSI-SPARC architecture shows the levels which a database consists of.

4.5.1 ANSI-SPARC architecture

The ANSI-SPARC architecture consists of three levels which are shown in the diagram below;

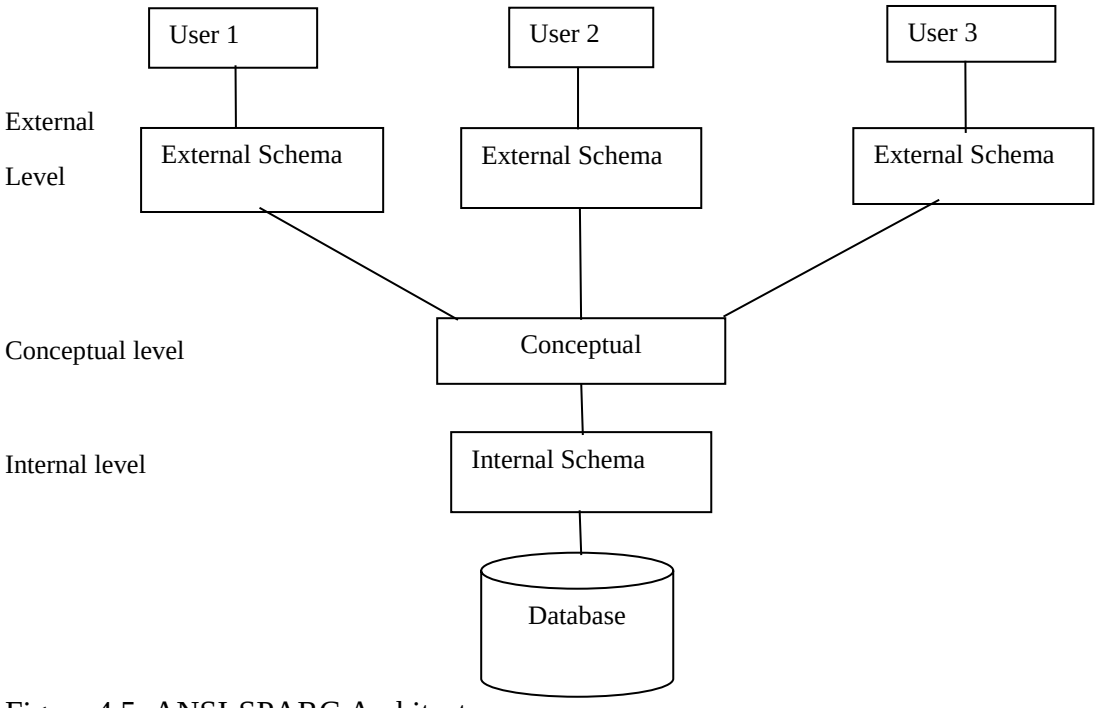


Figure 4.5: ANSI-SPARC Architecture

External Level

Scammel and Umanath (2017) define the external view of the database as where the end users can have access and interact with the system. Users have different views which mean that a user can access data without interrupting other users. There are approximately 500 end users at Lobel's Bread in different departments who will be accessing the system

Conceptual Level

According to Claudius (2014), this level shows how the database was logically structured. The conceptual level provides mapping and the desired independence between the external and internal levels. There are 5 tables that were constructed in the database which include the employee details, events and projects, notifications, check-in/out and users.

Internal Level

Hernandez (2014) is of the view that the internal level is concerned about how the data stored in the database will be presented to the end user. This level also investigates how data is organized.

4.5.2 Database Tables

Hernandez (2014) is of the view that database tables also known as relational databases consist of data that is related and is kept in a database. A database can be made up of single or more tables which have rows and columns. The database tables for the new SHEQ system are shown as follows:

Attributes	**Data types**
Employee ID	Varchar(15) PK
First name	Varchar(30)
Last name	Varchar(30)
Residential Address	Varchar(50)
Mobile Number	Int(11)
Email Address	Varchar(30) PK
Date of Birth	Date(10)
Company	Varchar(30)

Table 4.1: Employee Details

Attributes	**Data types**
ID number	Int(10) PK
Title	Varchar(30)
Venue	Varchar(30)
Date of event	Date(10)
Supervisor	Varchar(30)
Amount Allocated	Int(50)
Amount used	Int(50)

Table 4.2: Events and Projects

Attributes	Data types
ID number	Int(10) PK
First name	Varchar(30)
Last name	Varchar(30)
Email	Varchar(30)
Entry time	Time(10)
Exit time	Time(10)
Status	Varchar(20)

Table 4.3: Checkin/out

Attribute	Data types
Contact id	Int(10) PK
Email	Varchar(30) FK
Message	Varchar(100)

Table 4.4: Notifications

Attributes	Data types
ID Number	Varchar(10) PK
First name	Varchar(30)
Last name	Varchar(30)
Email	Varchar(30)
Password	Varchar(50)

Table 4.5: Users

4.5.3 Enhanced Entity Relationship Diagram

According to Claudius (2014), Enhanced Entity Relationship (EER) Diagram represents complex databases with complex requirements. The EERD for the new system can be illustrated as follows:

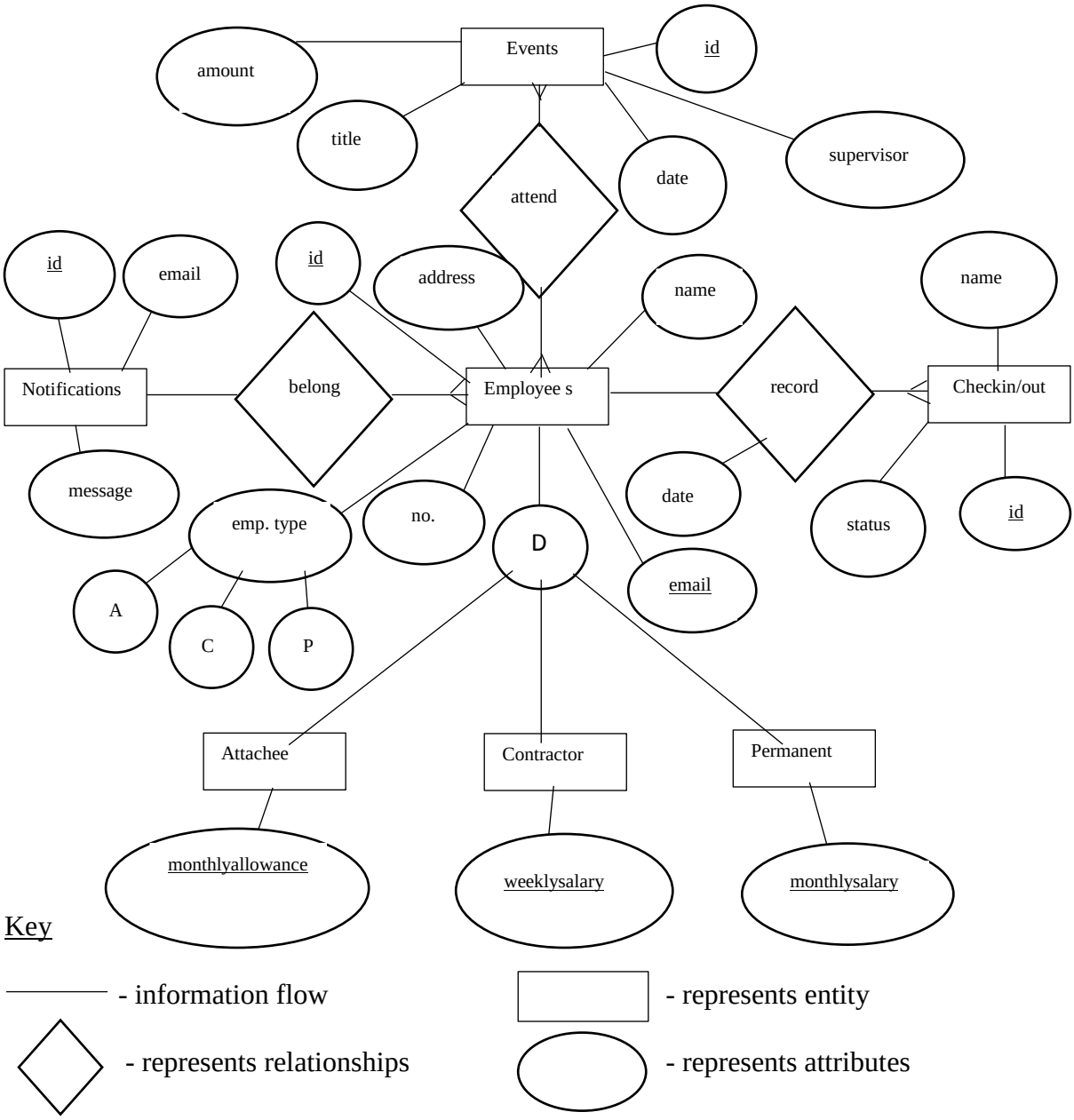


Figure 4.6: Enhanced Entity Relationship Diagram

4.6 Program design

McGuire (2016) defines program design as the way or method that an organization uses to come up or develop an application. In other words, the program design highlights the specifications of what the system should meet. If properly documented, it makes the maintenance of the new system easy. The class, package and sequence diagrams will be used for the program design.

4.6.1 Class diagram

According to Seidi et al (2015), class diagrams are used when illustrating data models regardless of the simplicity or complexity of the system. The class diagram for the new system is shown in the diagram below;

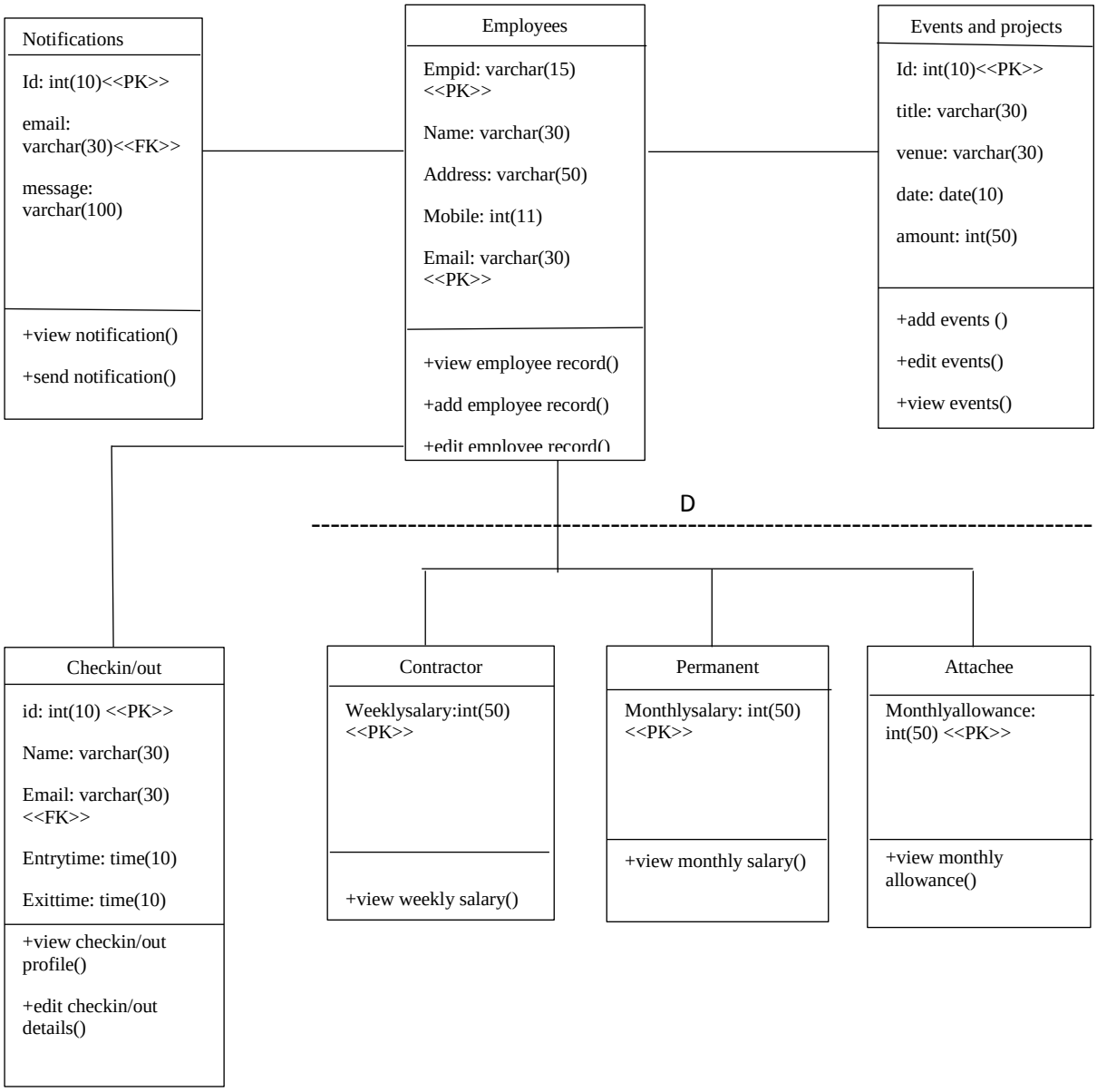
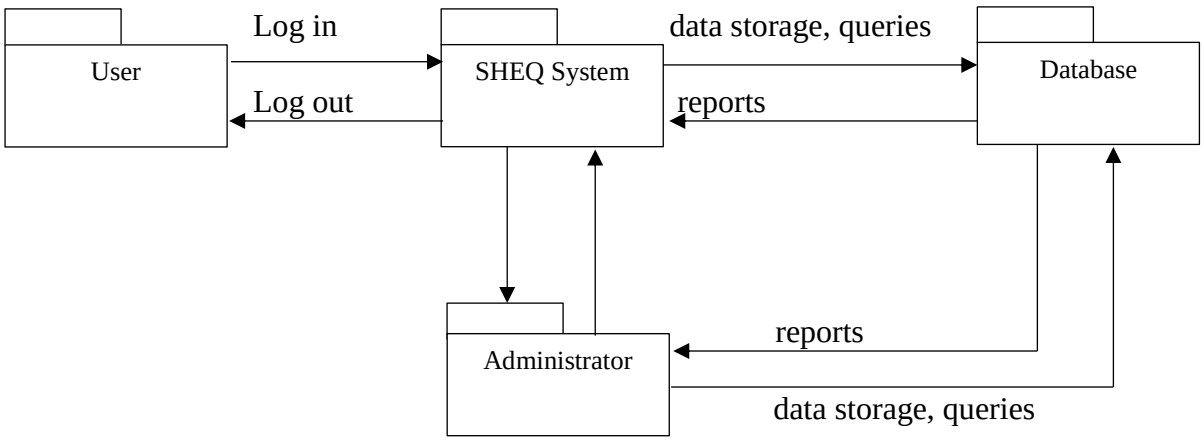


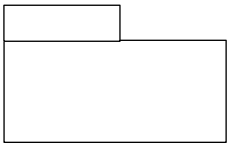
Figure 4.7: Class Diagram

4.6.2 Package Diagram

Scammel and Umanath (2017) states that a package diagram is a structured architectural diagram that shows the relationships between objectives and packages. They represent a namespace identifying all the multiple views of a system for example multi-tiered model. The package diagram for the proposed system is illustrated as shown below;



key



package

process

Figure 4.8: Package Diagram

4.6.3 Sequence Diagram

According to Seidi et al (2015), sequence diagrams are used to model systems in a dynamic format. Sequence diagram interacts with all the objects of the system. The sequence diagram for the proposed diagram is shown below;

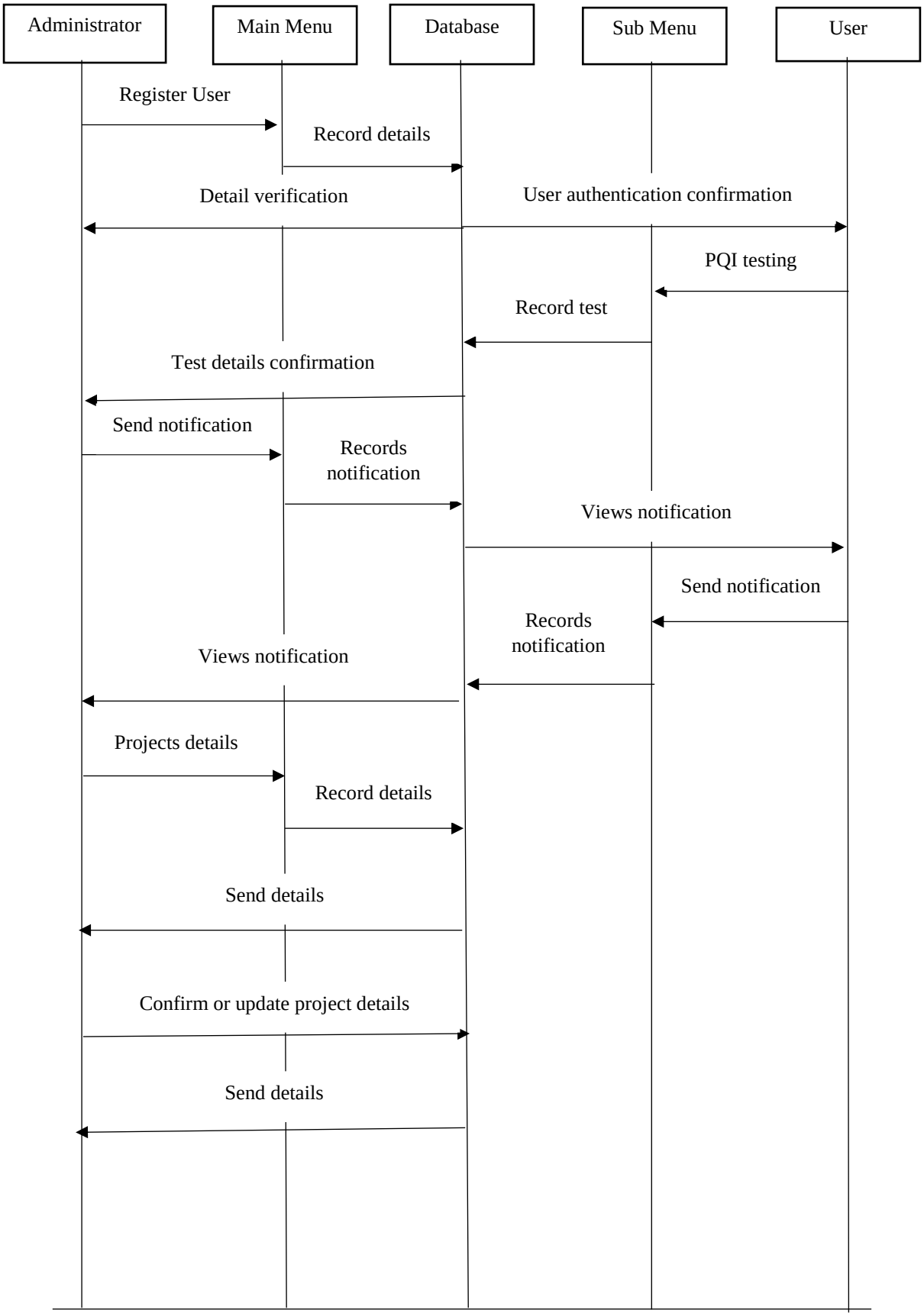


Figure 4.9: Sequence Diagram

4.7 Interface Design

According to Lauesen (2017), interface design is used for modular system development for purpose of connecting and communication. After designing the physical system of the new SHEQ system in development, the different components of the system were designed.

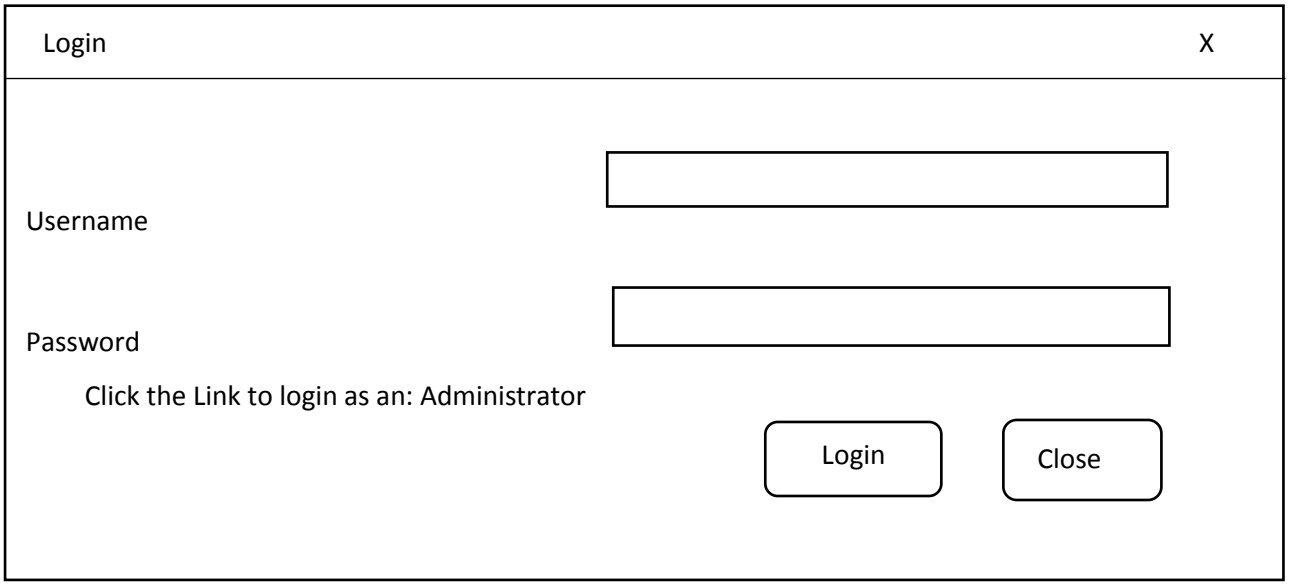


Figure 4.10: User Log In

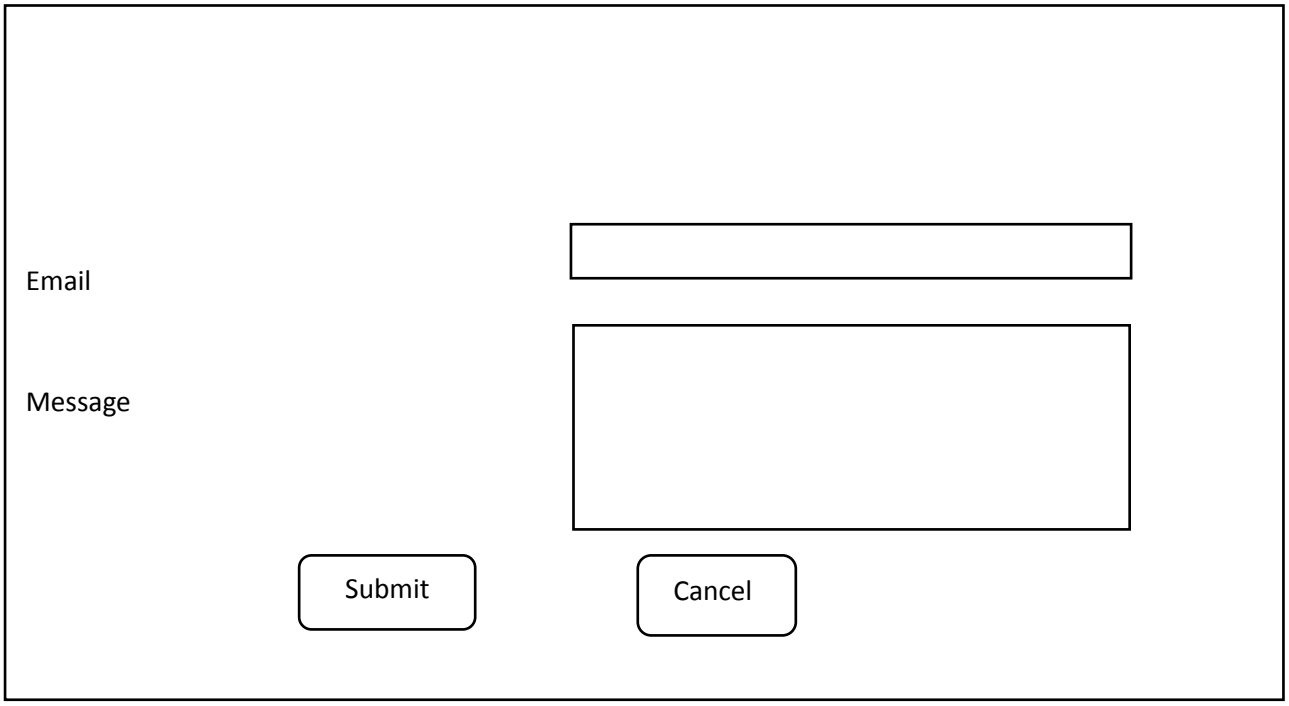


Figure 4.11: Notification Form

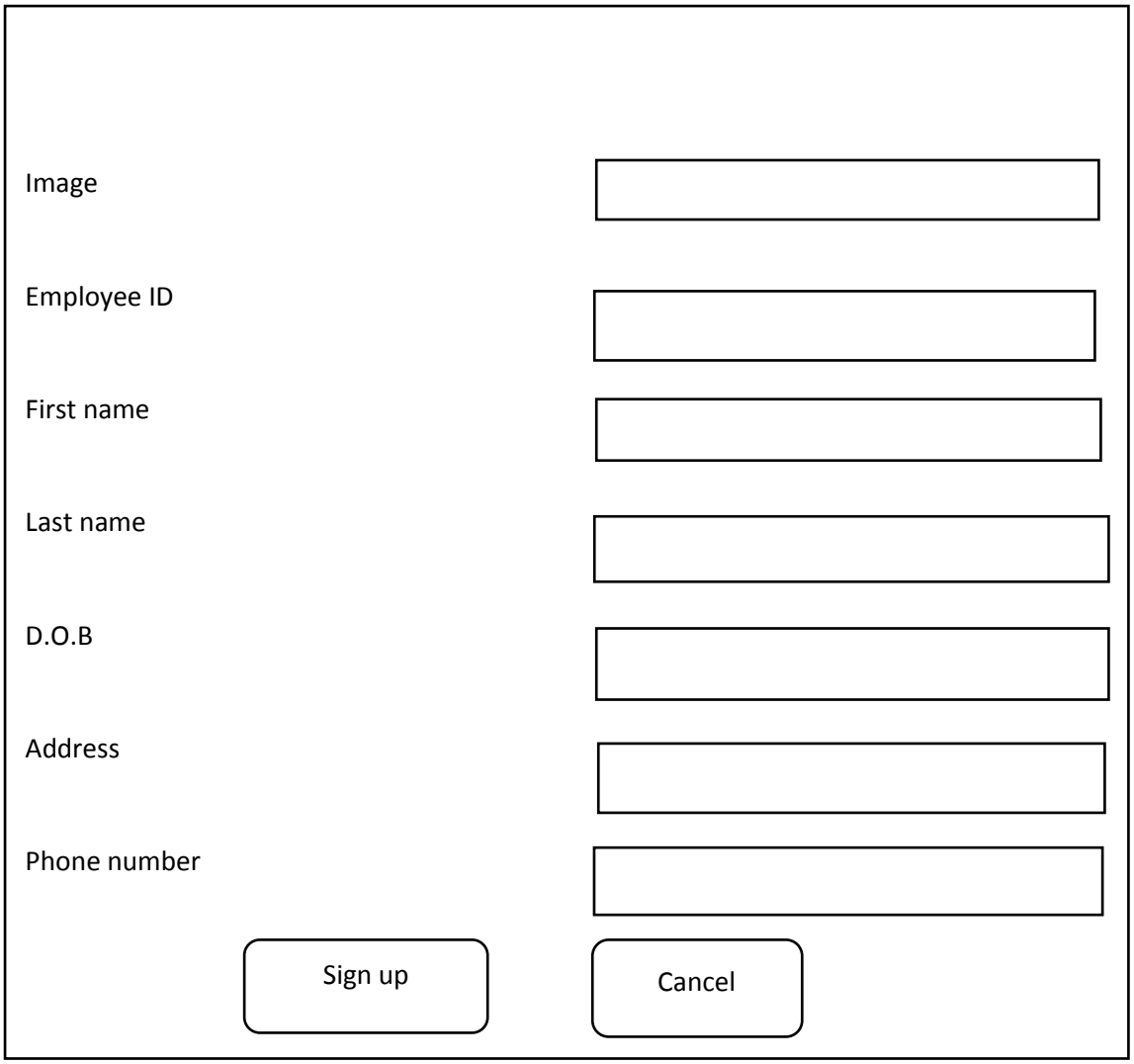


Figure 4.12: Employee Registration

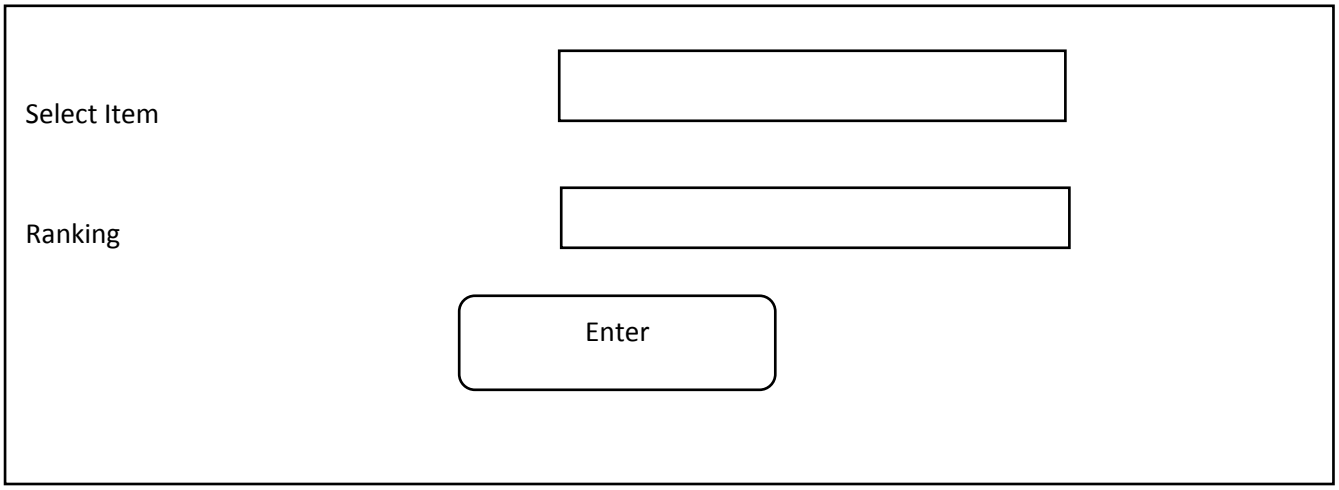


Figure 4.13: Product Quality Index testing

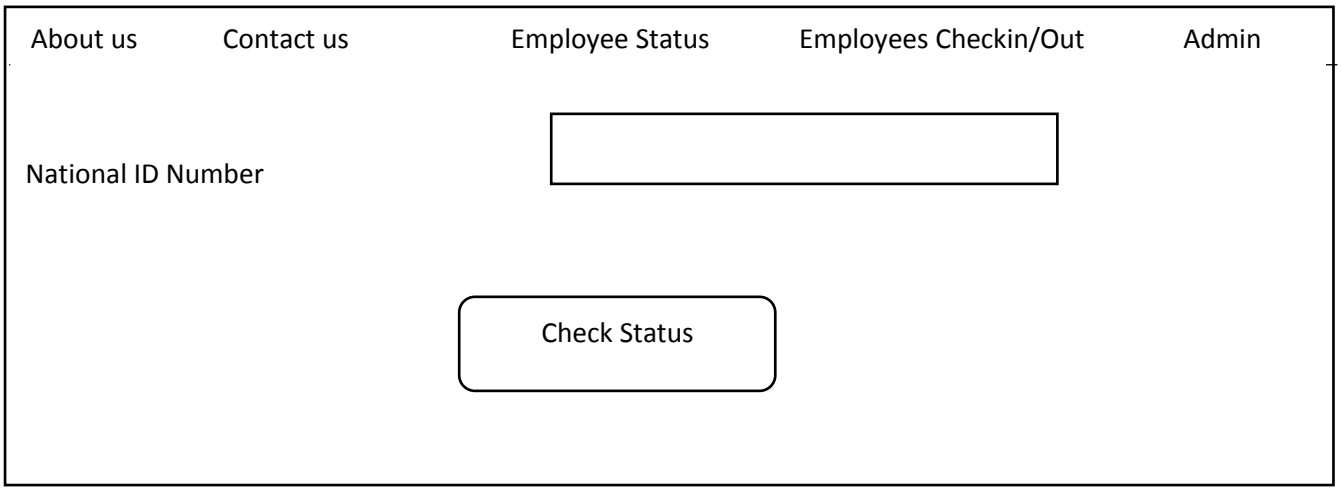


Figure 4.14: Employee Status

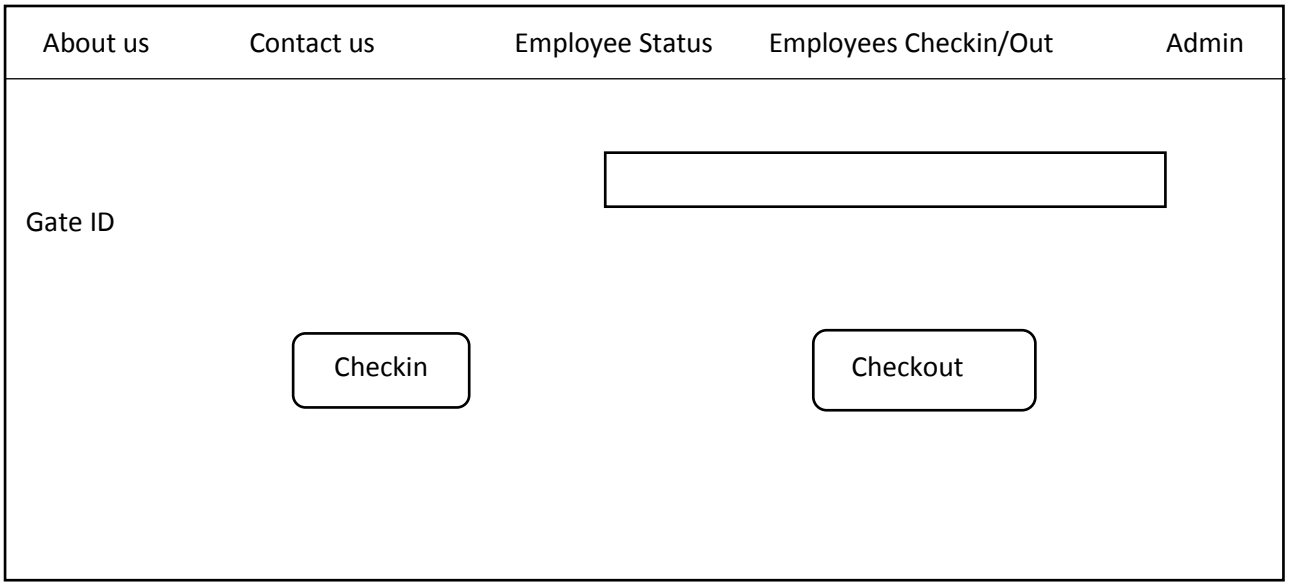


Figure 4.15: Employees Checkin/Out

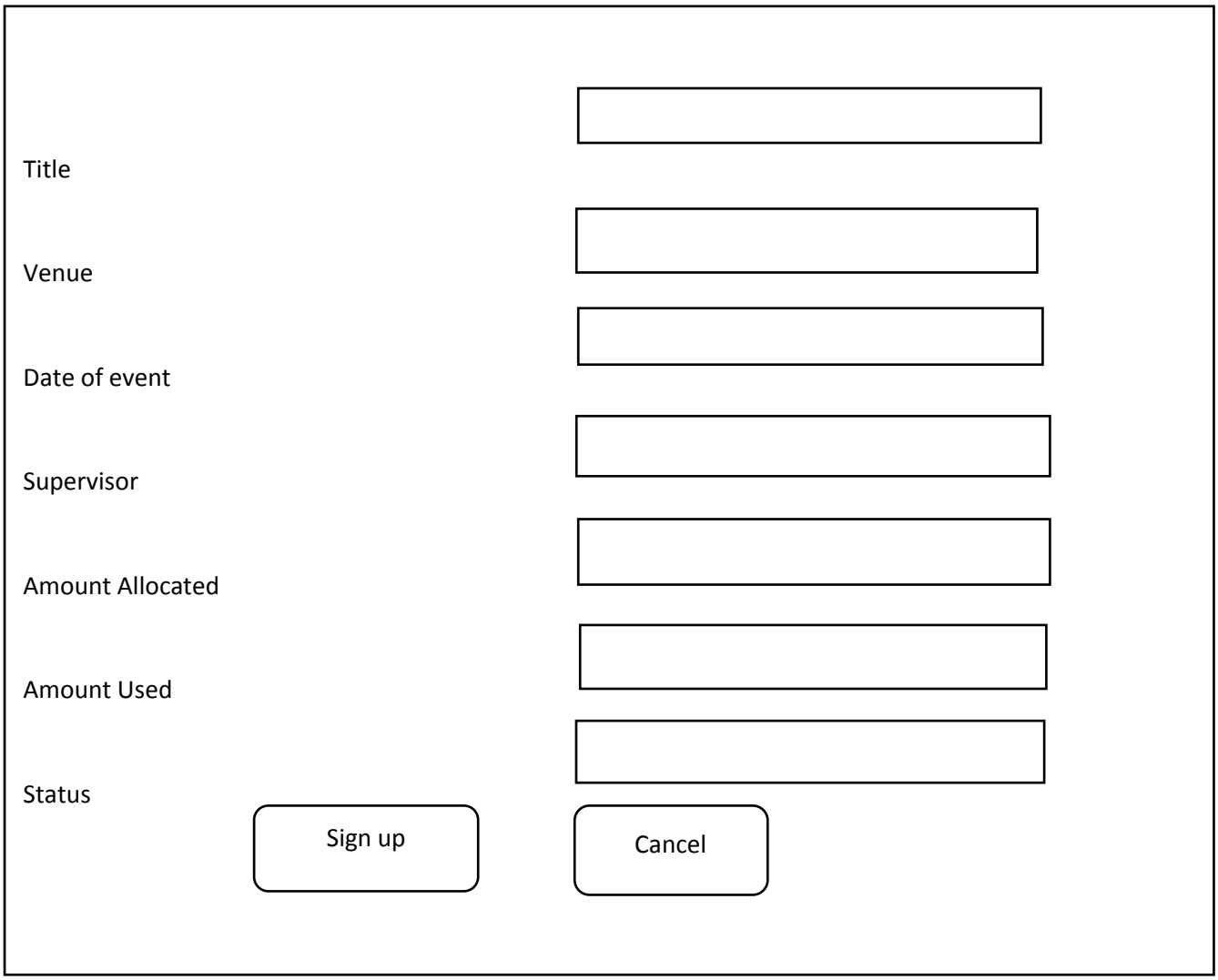


Figure 4.16: Events and Projects

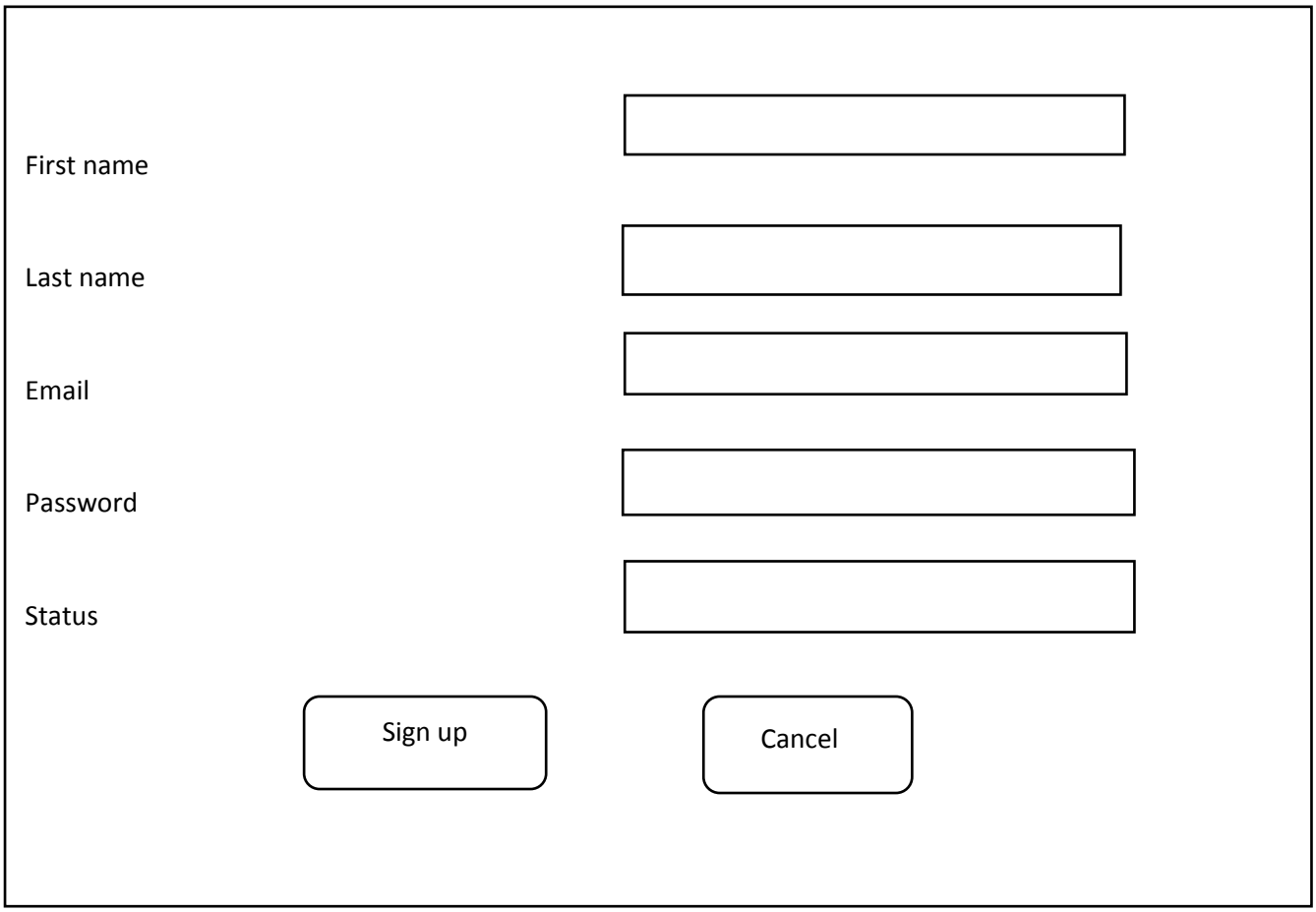


Figure 4.17: User Registration

4.8 Pseudo code

Bard (2018) is of the view that pseudo code is the programming code used in a system, explained in simple ordinary language that is readable and easy to understand for all system users. The pseudo code for the new SHEQ system will be written as follows:

4.8.1 Creating user account

Start

Click home button

Click Admin button

Enter Admin username and password and click login button

Open add users form

Enter user details and click sign up button

If the data is correct Then

{

Create user account

}

Else If data is not correct Then

{

Re-enter the details and click submit button

}

End

4.8.2 User login

Start

Click login button

Enter user username and password and click login button

If the data is correct Then

{

Begin login

}

Else if data is not correct Then

{

Deny access and display login failed message

Re-enter user username and password and click login button

}

End

4.8.3 External employees check in/out

Start

Enter Gate ID

If user is check in is false Then

{

Click check in button

}

Else click check out button

End

4.9 Security Design

According to Shostack (2014), security design refers to the process whereby the developer puts security measures in place during the software development process. Security measures are essential in securing the confidential information that the system holds from being accessed by unauthorized users. The security measures for the new SHEQ system were implemented in three areas that is the physical security, network security and the operational security.

4.9.1 Physical Security

Shostack (2014) defines physical security as the process that includes protecting a system from situations that are physical in nature which can result in the damaging of the software, hardware and all the peripherals through natural disasters such as winds, lighting and floods. The server of the new SHEQ system will be kept in a well-ventilated cool room with a functioning air-conditioner and a heavy reinforced door which can only be accessed by authorized personnel. The rest of the computers and printer and other hardware will be kept in well-ventilated offices which will be locked every day after working hours.

4.9.2 Network Security

Meeuwisse (2017) defines network security as the process which includes ensuring data integrity, data security, accurateness and reliability of data thus resulting in the protection of data. The software maybe affected by malware functionalities, viruses, and spyware and so on and therefore the use of data encryption, firewalls and an antivirus software (ESET NOD32). The use of virtual private network is another measure that is to be established for the security of the new SHEQ system.

4.9.3 Operational Security

Meeuwisse (2017) defines operational security as the process whereby software is protected whilst users are having access to the services provided by the system. Backup file servers will be used to avoid operational failures when users are using the system.

4.10 Conclusion

The design phase enabled the development team to have an in-depth of how the new SHEQ system will function using the data flow diagram and the context diagram. Interfaces designed along with the inputs, processes and outputs shown will make it easier for the team to physically develop the interfaces using Notepad++.The consultations were conducted to avoid a software crisis where the delivered system software fails to meet the user expectations that might cause user frustration. The completion of the design phase paved the way for the implementation phase.

CHAPTER 5: IMPLEMENTATION PHASE

5.1 Introduction

This chapter investigates whether or how the system which was being developed was completed and if the end user specific user requirements were met. The coding used during the development is briefly explained with different types of system tests conducted and illustrated. It is essential for every system documented project to have fully detailed system usage guidelines and it is in this chapter were the installation and maintenance guidelines are illustrated. With these moving times, technology is evolving and therefore the system developed will need to evolve with time and hence the recommendations for further developments of the system.

5.2 Coding

Stueben (2018) is of the view that coding is the process of creating the system foundation by designing the internal structures and architecture of the system through a programming language. The development of the new SHEQ system was done through PHP and the databases were created and designed using MySQL.

5.3 Testing

According to Hooda and Chillar (2015), software testing is the process in which errors are identified before the implementation of the system. Software testing is conducted to ensure that the user requirements are met and system errors are identified and debugged before the new SHEQ system is installed and implemented. The new SHEQ Planning, Monitoring and Evaluation system was tested and analysed in terms of its functionalities and the system errors that were present. The stages that were carried out during software testing can be shown in the figure below;

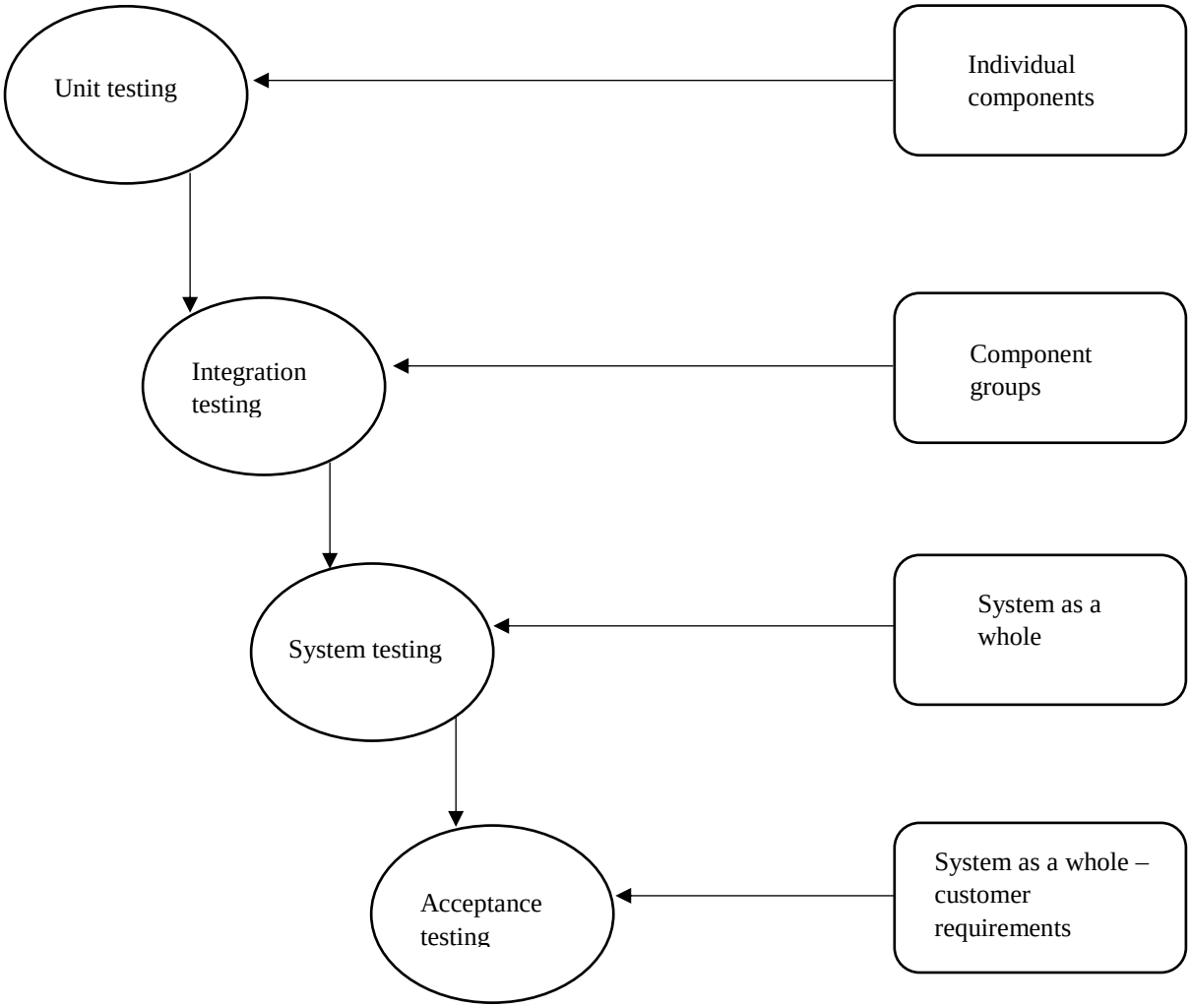


Figure 5.1: Software testing process

5.3.1 Unit testing

According to Seland (2015), unit testing is the process in which the software in development is sub-divided into smaller units with each individual unit tested and evaluated against the expected functionality. Even though unit testing is more time consuming, it allows for thorough software testing and problem elimination since units are examined individually instead of examining the entire system at one go. Some of the units tested in the new SHEQ system include user login and user registration.

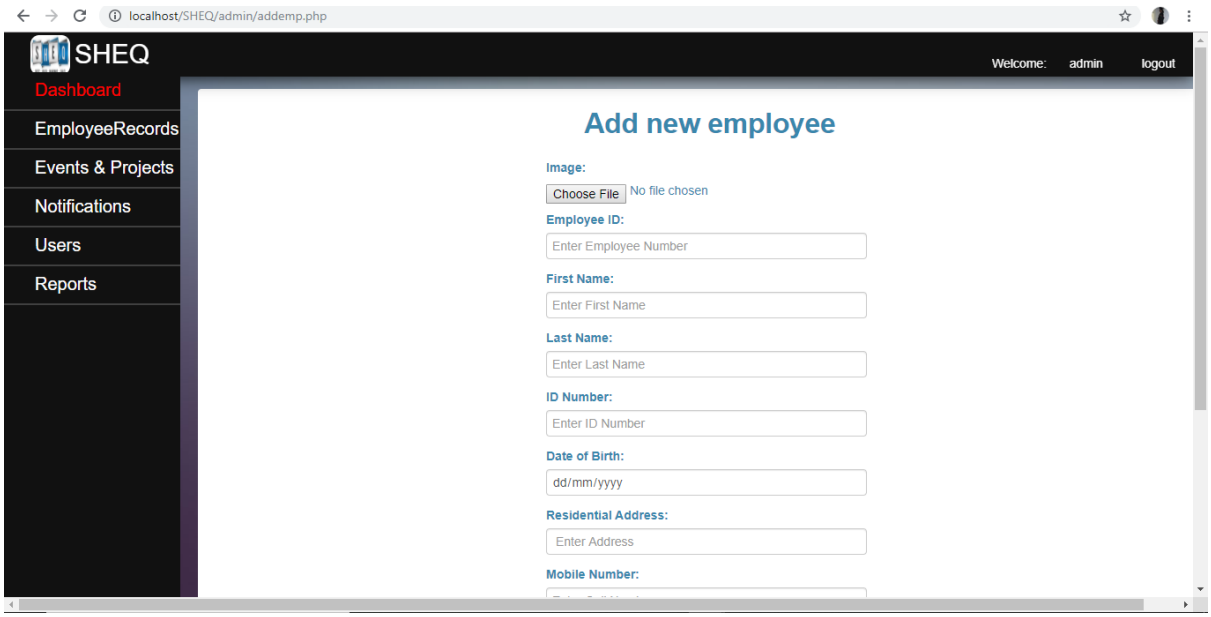


Figure 5.2: Adding an employee record

Adding of an employee record was tested and analysed as a single unit.

5.3.2 Integration testing

Hooda and Chillar (2015) define integration testing as a process conducted after unit testing whereby the previously subdivided units of the software are combined and re-tested as they interact with each other. The main objective is to identify and debug the errors found when all the units of the software system interact as a whole. Either the top-down or bottom-up approach is used during the integration testing.

5.3.3 System testing

Seland (2015) states that system testing is when the combined units are tested altogether as a whole single system. The test is done to investigate whether the system is performing as expected through verifying if the functional and non-functional user requirements have been met. System testing can be carried out in two ways that is the white box testing and the black box testing.

5.3.3.1 White box testing

White box testing is a process in which the back end or internal structures of the code are shown and tested for errors to the system analyst before the software is implemented. It includes analysing data and information flow, coding practises and exception, error handling within the system, testing for the unintended and intended software behaviour.

```
</head>
<body style="background: url(img/sheqq.jpg); background-repeat: no-repeat;background-position: center; background-size:700px;background-attachment: fixed;">
    <div id="header">
        <img src="img/sheqq.jpg">
        <label>SHEQ</label>
            <ul>
                <li><a href="home.php">HOME</a></li>
                <li><a href="#login"   data-toggle="modal">LOGIN</a></li>
            </ul>
    </div>
        <div id="login" class="modal hide fade" tabindex="-1" role="dialog" aria-labelledby="myModalLabel" aria-hidden="true" style="width:400px;">
            <div class="modal-header">
                <button type="button" class="close" data-dismiss="modal" aria-hidden="true">x</button>
                <h3 id="myModalLabel">Login...</h3>
            </div>
                <div class="modal-body">
                    <form method="post">
                    <center>
                        <input type="email" name="email" placeholder="Email" style="width:250px;" required>
                        <input type="password" name="password" placeholder="Password" style="width:250px;" required>
                    <h6>Click the link to Login as an:<a href="admin/admin_index.php">Administrator</a></h6>
                    </center>
                </div>
            <div class="modal-footer">
                <input class="btn btn-primary" type="submit" name="login" value="Login">
                <button class="btn btn-danger" data-dismiss="modal" aria-hidden="true">Close</button>
                    </form>
            </div>
        </div>
                    </form>
            </div>
    <br>
<div id="container">
```

Figure 5.3: Login source code

Login source code was tested and analysed.

5.3.3.2 Black box testing

Black box testing is a process in which the front end or external structures of the system are shown and tested for errors and functionalities by end users who do not have any knowledge as to how the system was designed and developed. The end users make use of the user interface to input data, observe functionality and view the output. During black box testing, no source code or knowledge of the code is required.

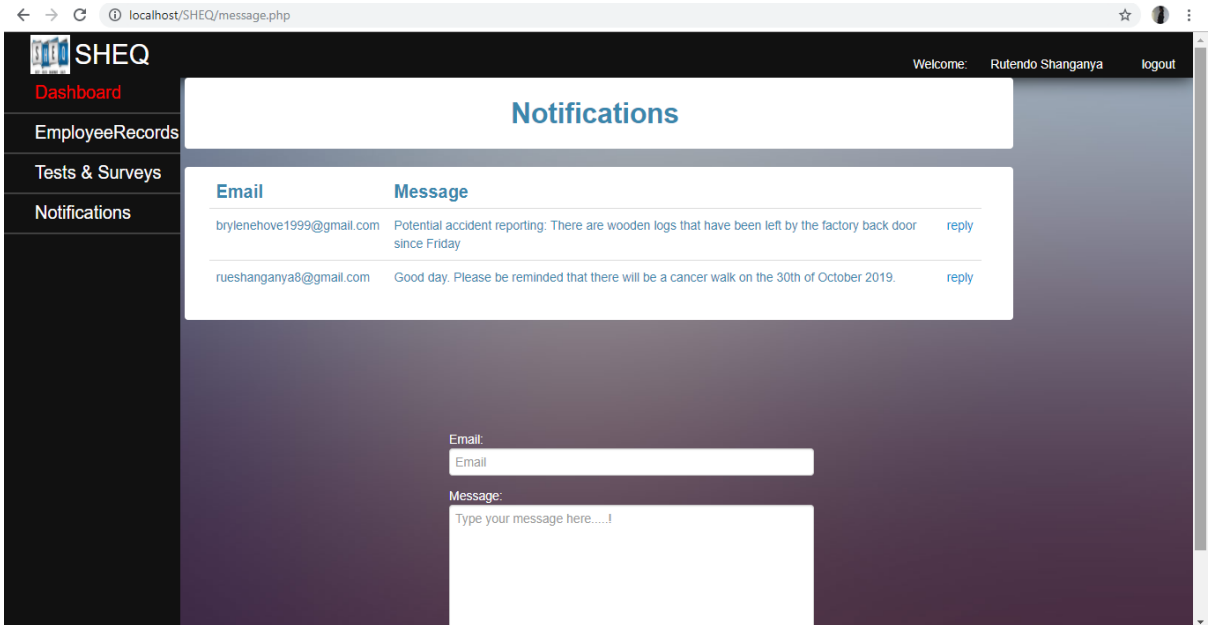


Figure 5.4: Notifications form

Testing of the instant notification platform was carried out and proved to be a success.

5.3.4 Acceptance testing

According to Amirian (2015), the acceptance testing is carried out to determine if the designed system is ready to be implemented into the organisation's working environment. Acceptance testing is only conducted and given to the users for implementation after all the errors are debugged. In other words, if the test is successful, the system is implemented but, if the test is a fail, more designing and tests are carried out. The different types of acceptance testing include alpha testing and beta testing.

5.3.4.1 Alpha testing

Kumar (2016) defines alpha testing as the process that is carried out by the programmers within the organisation to identify and fix bugs and errors found. This type of acceptance testing is based on system crashes, errors found and additions to functionality modules of the system.

```php
<?php
    include("../function/session.php");
    include("../db/dbconn.php");
    if (isset($_POST['signup']))
    {
    $visitor_code = $_POST['visitor_code'];
        $firstname = $_POST['firstname'];
        $lastname = $_POST['lastname'];
        $idnumber = $_POST['idnumber'];
        $address = $_POST['address'];
        $phone = $_POST['phone'];
        $email = $_POST['email'];
        $dateofvisit = $_POST['dateofvisit'];
        $purpose = $_POST['purpose'];
        $status = "Pending...";
        $category = $_POST['category'];
        $code = rand(0,98987787866533499);


            $name = $code.$_FILES["visitor_image"] ["name"];
            $type = $_FILES["visitor_image"] ["type"];
            $size = $_FILES["visitor_image"] ["size"];
            $temp = $_FILES["visitor_image"] ["tmp_name"];
            $error = $_FILES["visitor_image"] ["error"];

            if ($error > 0){
              die("Error uploading file! Code $error.");}
            else
            {
              if($size > 300000000550) //conditions for the file
              {
                die("Format is not allowed or file size is too big!");
              }
              else
              {
```

Figure 5.5: Adding of an employee record

Testing of source code was done on the adding of the employee to check for errors and bugs.

5.3.4.2 Beta testing

Kumar (2016) defines beta testing as the process that is carried out by a few end users within the organization to test the functionality of the system being developed and, in the end, give

feedback according to their initial requirements. If the feedback is positive and end users are satisfied, the system can be implemented.

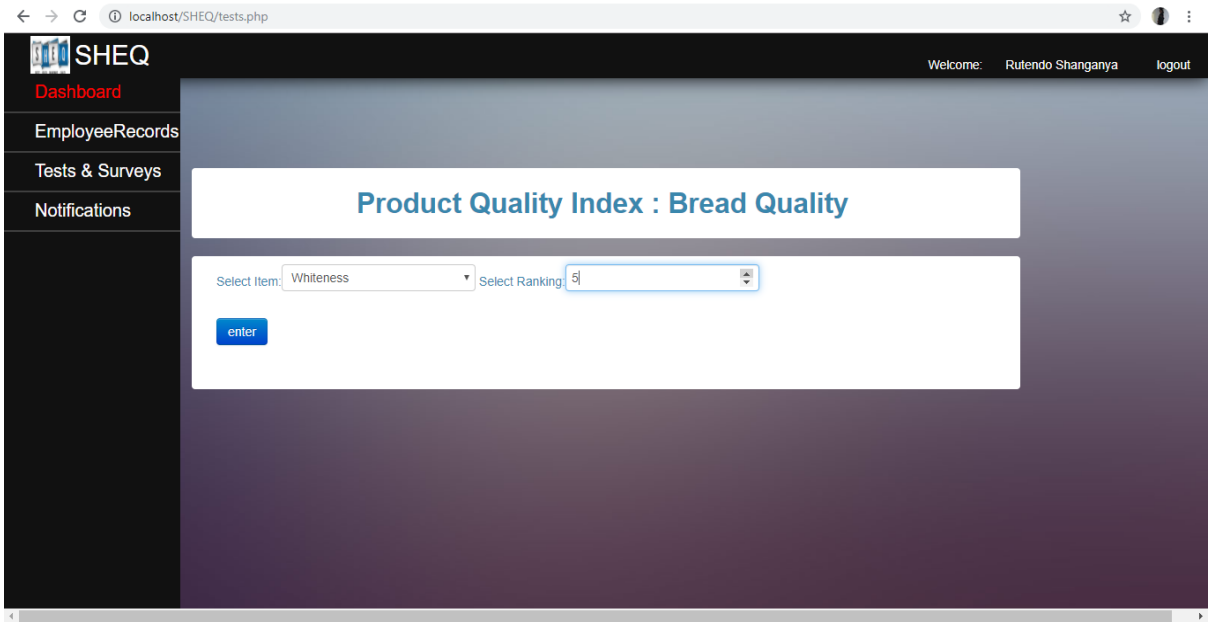


Figure 5.6: PQI testing

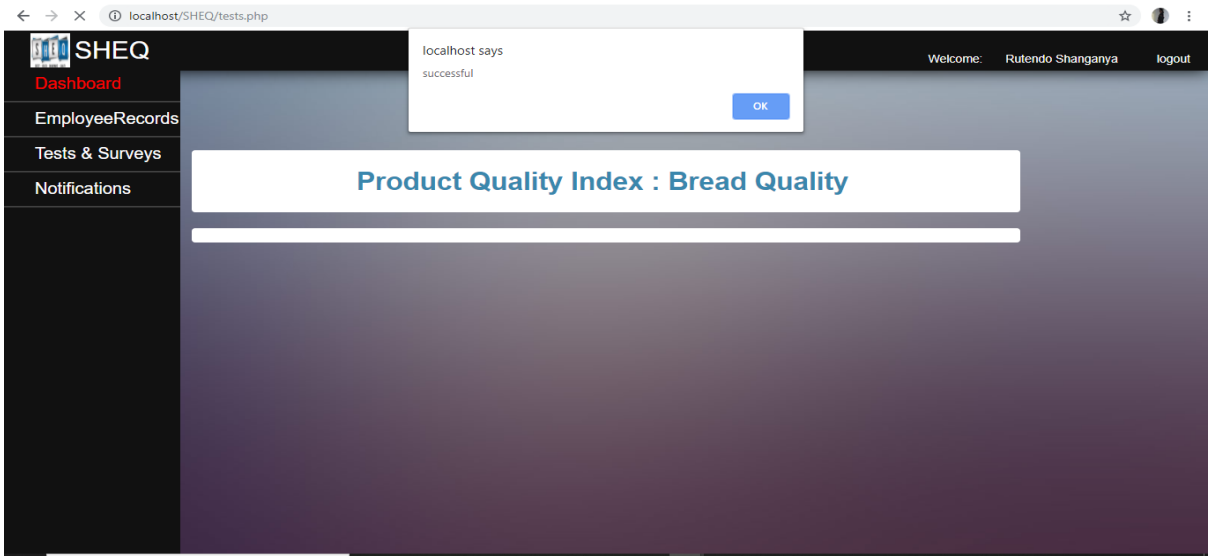


Figure 5.7: Successful PQI testing

Functionality of the system PQI testing was carried out by allowing users to enter their rankings on the different bread ranking categories and it was successful.

5.3.5 Validation

Hooda and Chillar (2015) defines validation as the process of investigating the integrity and security of the system. Data input is validated to ensure that correct information and its regulated data format is constant to protect integrity of the entire system.

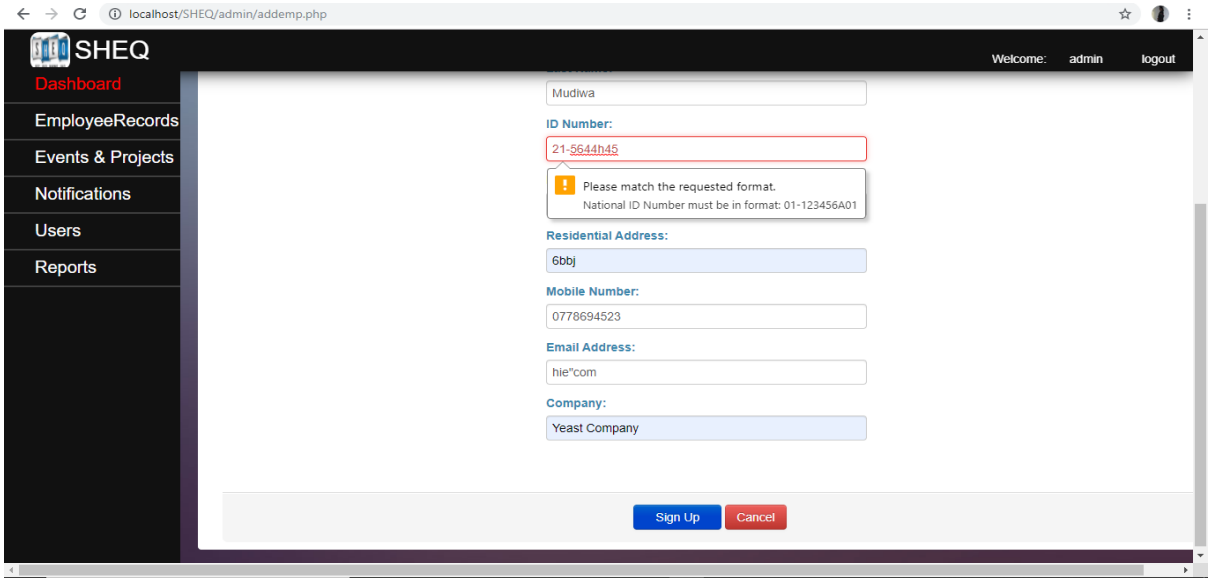


Figure 5.8: Adding an employee record

Adding of an employee record was tested and validated to see if the ID number format stored in the database matches the one being input.

5.3.6 Verification

According to Hooda and Chillar (2015), verification is the process carried out to investigate the functionality of the system against its stated rules or standards. Verification can be done to analyse if the syntax was properly followed during system development or to analyse all the input by the end users.

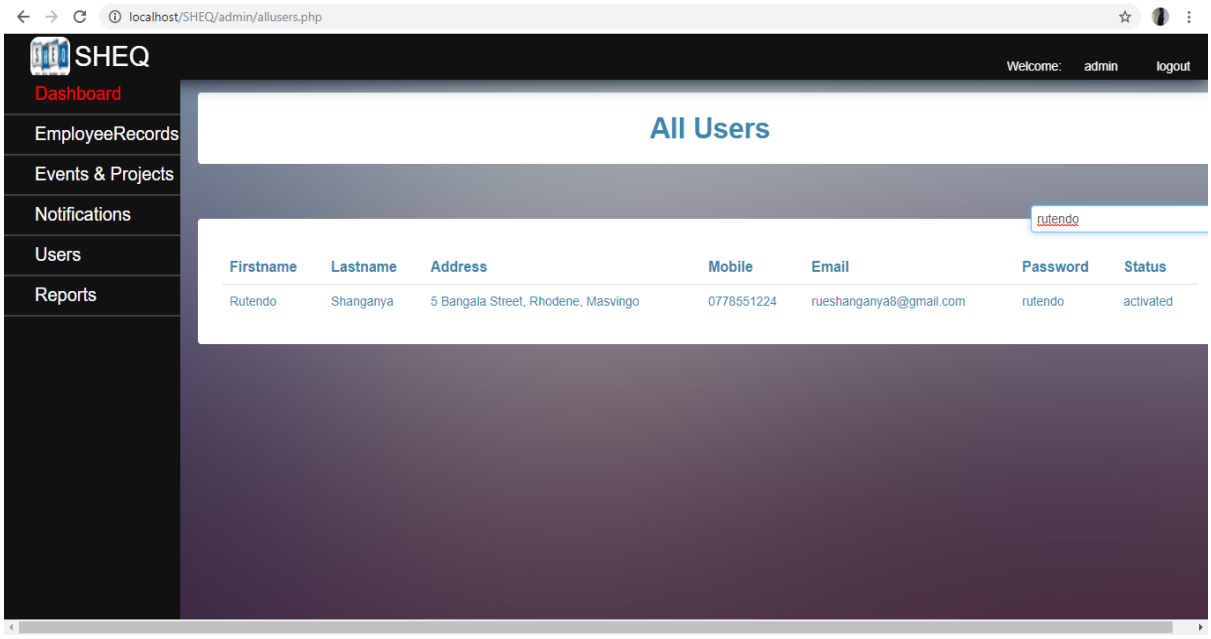


Figure 5.9: Searching for a user

The search bar was utilized to verify that a user was already added in the database.

5.4 Installation

According to Somerville (2016), installation is the step by step procedure taken to implement the developed new system into the actual working environment. The new SHEQ system has been analysed and tested and therefore the next step is to install the system at Lobel's Bread on the end users device. With management authorization the system has to be set up and incorporated into the system server to allow user access.

5.4.1 User training

Somerville (2016) defines user training as the technique of passing down knowledge of the system use to the intended end users that will make use of the software being implemented. The new SHEQ system functionalities were taught and learnt by the Lobel's Bread end users and they got to utilize the information being processed. As shown by the Gantt chart in chapter two, user training lasted for approximately two weeks. The employees in the SHEQ department, top management and other necessary departments were trained in the first one and half weeks. The system level training was carried out in the rest of the days whereby functionality was measured against development procedures.

5.4.2 Data migration

There were steps involved in data migration and these are listed as follows:

- PHP and MySQL server were installed to support the system.
- The zipped system files were extracted and transferred into the server computers using the external hard disk drive.
- Configurations and web domains were created.
- Database of the system was imported into the file server to connect sources of data.
- A network was setup to connect the end user computers to the SHEQ system.
- A brief test was carried out to ensure that data was correctly migrated.

5.4.3 System changeover strategies

Robertson (2018) defines system changeover strategies as the processes of removing a software or system that is out-dated. It is placing the new developed SHEQ system whilst removing the existing SHEQ system. The changeover strategies, from which the best for the SHEQ department was chosen, consists of the direct changeover, parallel changeover, pilot changeover and phased changeover.

5.4.3.1 Direct Changeover

On this changeover strategy, the new system is implemented and it starts being operational immediately whilst the old system is completely removed, (Robertson 2018). Basically, if the new system starts functioning the old system is shut down. This changeover strategy is very risky because if there is a mishap with the new system, the organisation as a whole will be at a standstill that is the whole organisation suffers though it is the least expensive strategy.

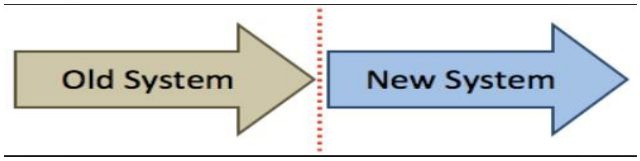


Figure 5.10: Direct changeover

5.4.3.2 Parallel Changeover

According to Robertson (2018) parallel changeover is a strategy where the old system and the new system will operate simultaneously at the same time. Both systems will be operating fully for a certain period of time. This gives room for the management and the development team to analyse and evaluate the efficiency of the new system. Once the development team and the management become satisfied about the way the new system operates then the old system is terminated leaving the new system to operate on its own. Risk is very low due to the fact that if the new system does not operate correctly, there

are no disruptions encountered since the users are able to continue operations using the old system. However, it is very costly since there is need to input data in both the systems. High workload for the employees is usually the result since in most cases have to use both systems.

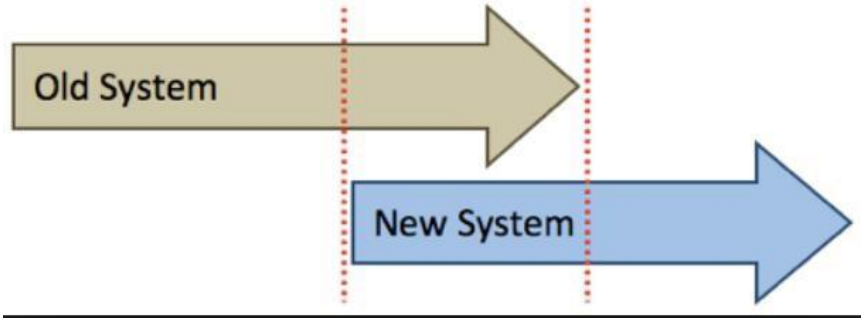


Figure 5.11: Parallel changeover

5.4.3.3 Pilot Changeover

Pilot changeover is when the new system is tried at a test site before implementing it in the whole organisation says Robertson (2018). The new system is given to a part of the organisation that is a branch or a department to first try it out. The part of the organisation were the new system is implemented is known as the pilot site. The old system continues to be operational in the whole organisation as well as in the pilot site. If the new system proves to be functional at the pilot site, it is the implemented at the whole organisation. Pilot changeover is also known as a combination of parallel changeover and direct changeover strategies. Pilot sites reduce the risk of failure of the system and it is less costly compared to parallel changeover. Any failures of the new system are dealt with at the test site before implementing the system in the whole organisation.

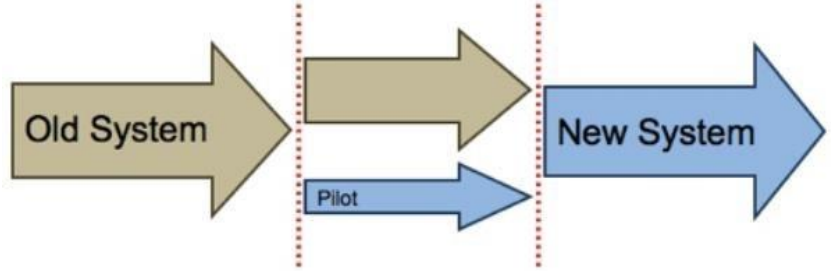


Figure 5.12: Pilot changeover

5.4.3.4 Phased Changeover

Robertson (2018) also says that phased changeover implementation strategy refers to the process whereby a unit of the old system is changed through the replaced of the new unit system. The units are implemented one phase at a time. Also it is a combination of direct changeover and parallel changeover. Only a unit of the system is provided to a few users to try it out. Risk is limited since it affects the part were a new unit was implemented. It is less costly compared to the full parallel changeover strategy. However it can be costly if the new system consists of a lot of separate units which will need to be implemented individually in a phases. The units being implemented will be replacing the old ones automatically.

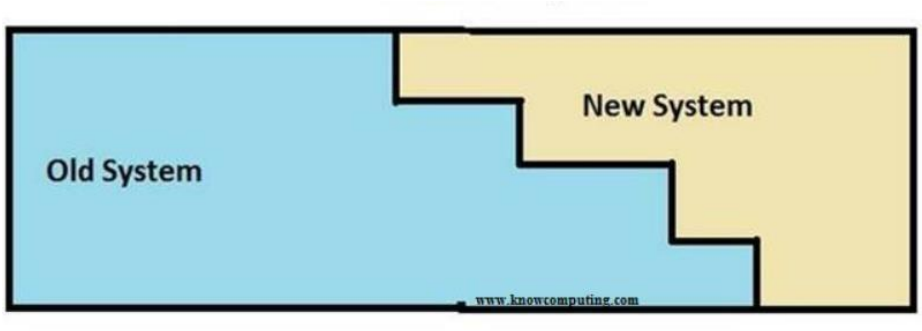


Figure 5.13: Phased changeover

The best changeover strategy that was chosen in the implementation of the new SHEQ system was the parallel changeover. The current SHEQ system is mostly manual meaning there is little computerization of the data therefore running both systems parallel to each other allows to measure other modules that may need amending before the system is fully implemented.

5.5 Maintenance

Ahmed (2016) is a process done on a regular basis to ensure that the newly implemented system meets its addressed objectives. Software maintenance compromises corrective, adaptive, perfective and preventive maintenances. Maintenance is essential so as to eliminate errors and adjust the system functionalities in response to the ever-changing technological environments.

5.5.1 Corrective maintenance

According to Ahmed (2016), corrective maintenance involves dealing with errors found and debugging the errors. With time the SHEQ system will mostly likely be submerged to more user errors as the users will be getting to know the system better and experimenting further.

Therefore, more costly redesigning will be needed to meet the improved user requirements. Other than the ever-changing user requirements, the system will need to be adjusted according to the new improved hardware and software platforms present at that moment. The functionalities currently being offered by the system will prove to be inadequate at some point in years to come and therefore the corrective maintenance is an ongoing process.

5.5.2 Adaptive maintenance

Ahmed (2016) views adaptive maintenance as the type in which the software must be able to adopt changing operating environments. The system should be able to operate in mobile cell phones on android or iPhone and any other devices and not only as web-based. Therefore, due to the ever-changing business values and goals, upgrades and amendments will have to be carried out to the system in the future.

5.5.3 Perfective maintenance

According to Somerville (2016), perfective maintenance is done to rectify the identified functionalities of the system that was not entirely completed when installed. Even though the system is up and running, it does not mean that all the modules are working perfectly. A few modules within the structure of the system are incomplete.

5.5.4 Preventive maintenance

Somerville (2016) defines preventive maintenance as a steps and procedures performed on the system to prevent future system integrity issues or to prevent the user requirements being met in the future. Maintenance is therefore done before any future issue arises.

The best maintenance strategy is the adaptive maintenance because as the working environment in the SHEQ department changes, so should the user requirements so as to meet the objectives of the system.

5.6 Recommendations for further development

Research has been done and the system has been cleared as a viable project which can be implemented in a working environment of the SHEQ department. Even though the system has been cleared, there are adjustments that will have to be done in the future. The system should be able to operate on android or iPhone and any other devices and not only as web-based. The SHEQ system may be utilized for promoting Lobel’s Bread as a whole.

5.7 Conclusion

The implementation phase marked the end of the system development and system tests were conducted to make sure that any errors in the system were debugged before implementation. Installation was carried out and shown and it is during the implementation stage that the best changeover strategy and maintenance strategy were fully explained chosen. This phase proved that the implementation of the new SHEQ system was a success.

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APPENDICES

Appendix A: User manual

a) Running XAMPP

The administrator has to run the XAMPP by clicking start on the Apache and MySQL start buttons.

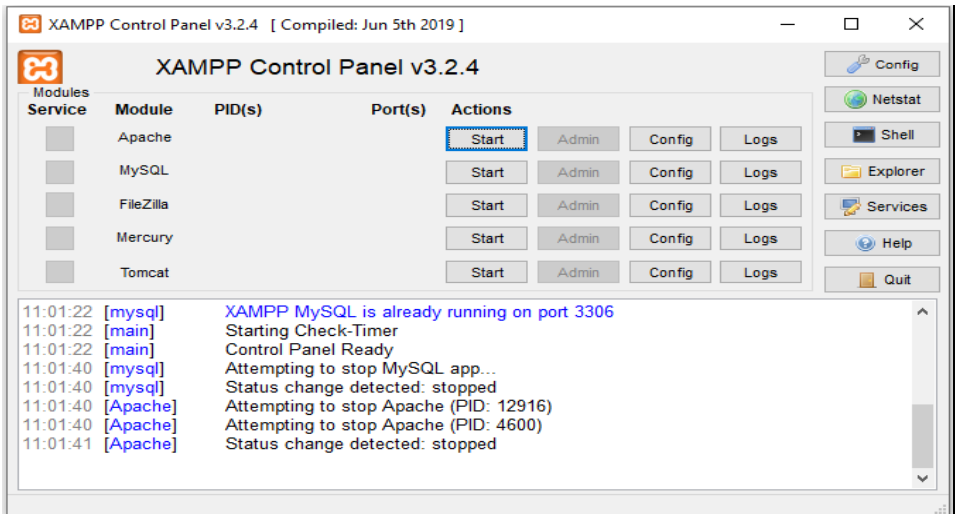


Figure A1: Running XAMPP

b) Running the website

The website is accessed through Local host as shown below;

Figure A2: Running the website

c) Adding a user record

A user record can only be created by the administrator and to do so, click on the Home then click on Admin. It will lead to the admin homepage.

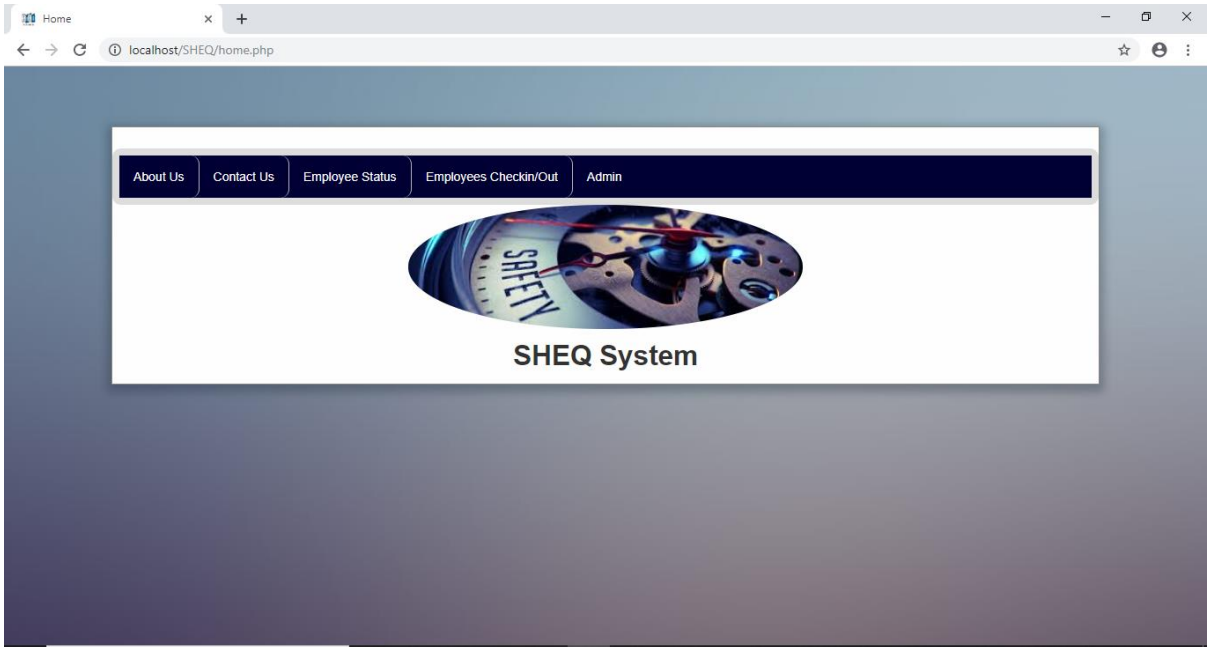


Figure A3: Adding a user record

d) Administrator login

For the administrator to be able to access the portal, login using the password given by the system developers.

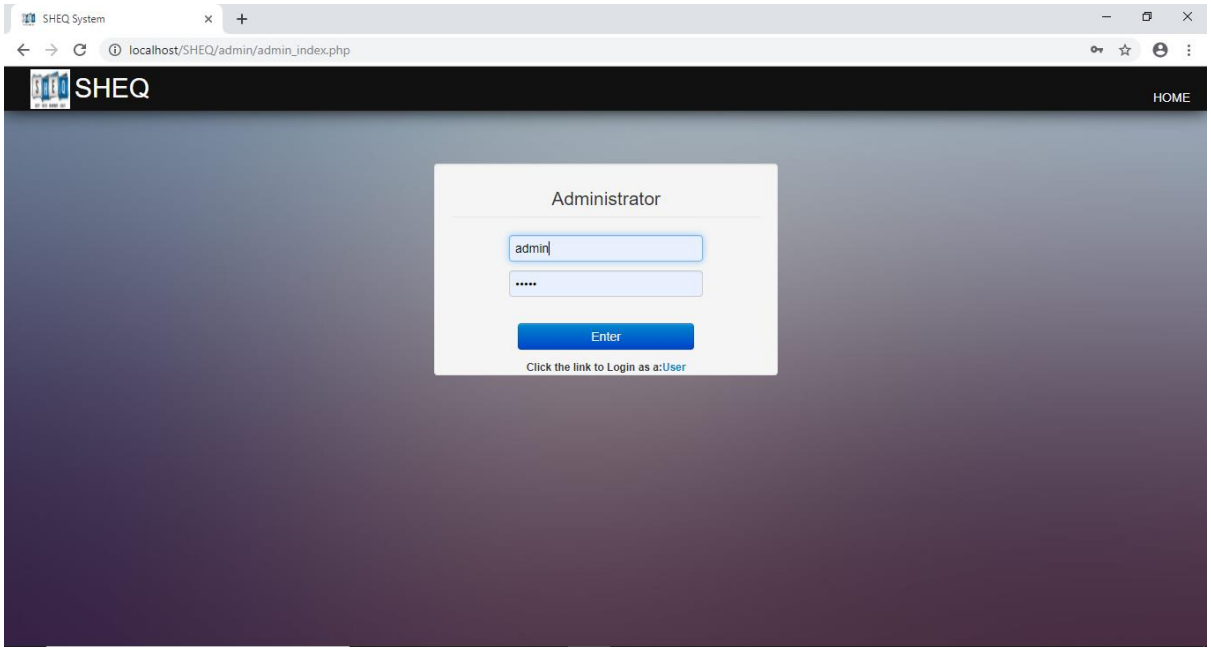


Figure A4: Administrator login

e) Administrator portal

After log in the admin's portal will appear as shown below;

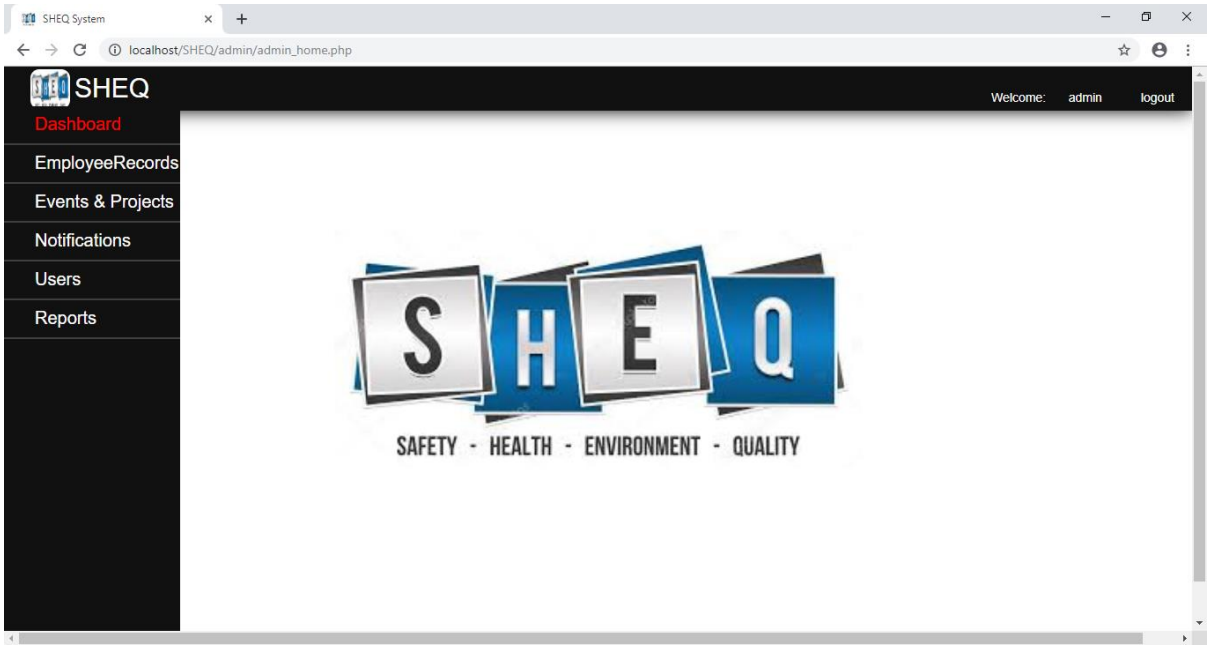


Figure A5: Administrator portal

f) Adding a user

To add a user, the administrator has to enter the necessary details as reflected on the registration page as shown below;

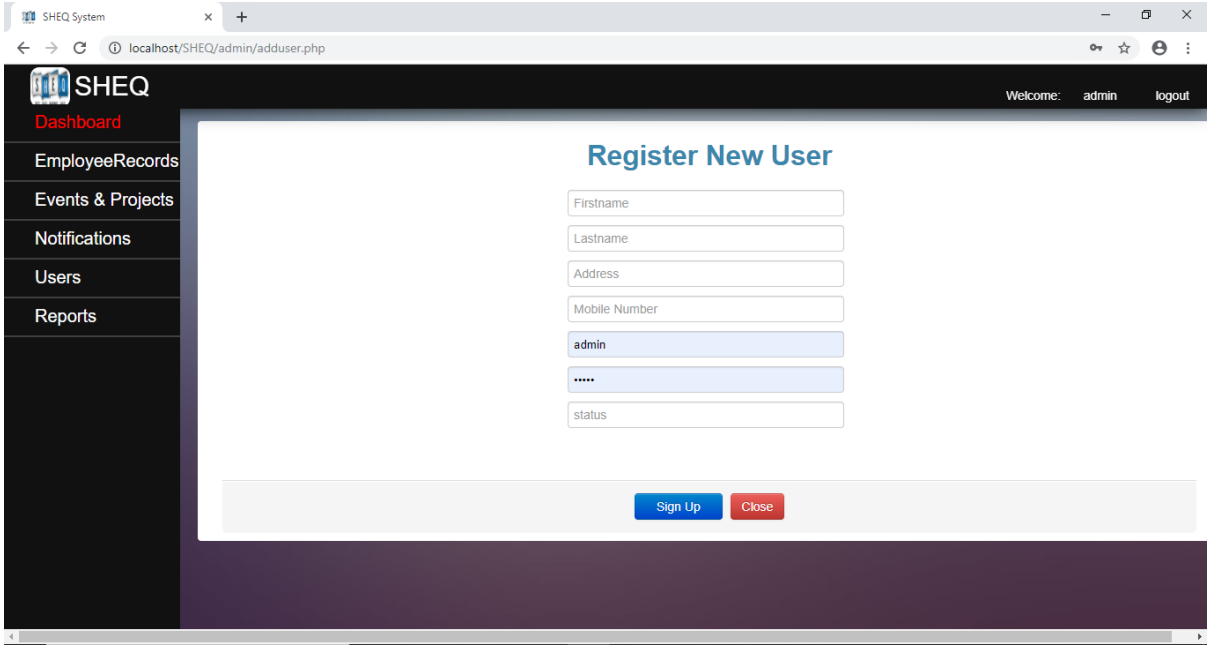


Figure A6: Adding a user

g) User access

It is after the user account has been created that the user can access their portal and to do the PQI test, click on Test and Surveys and rank the categories according to preference.

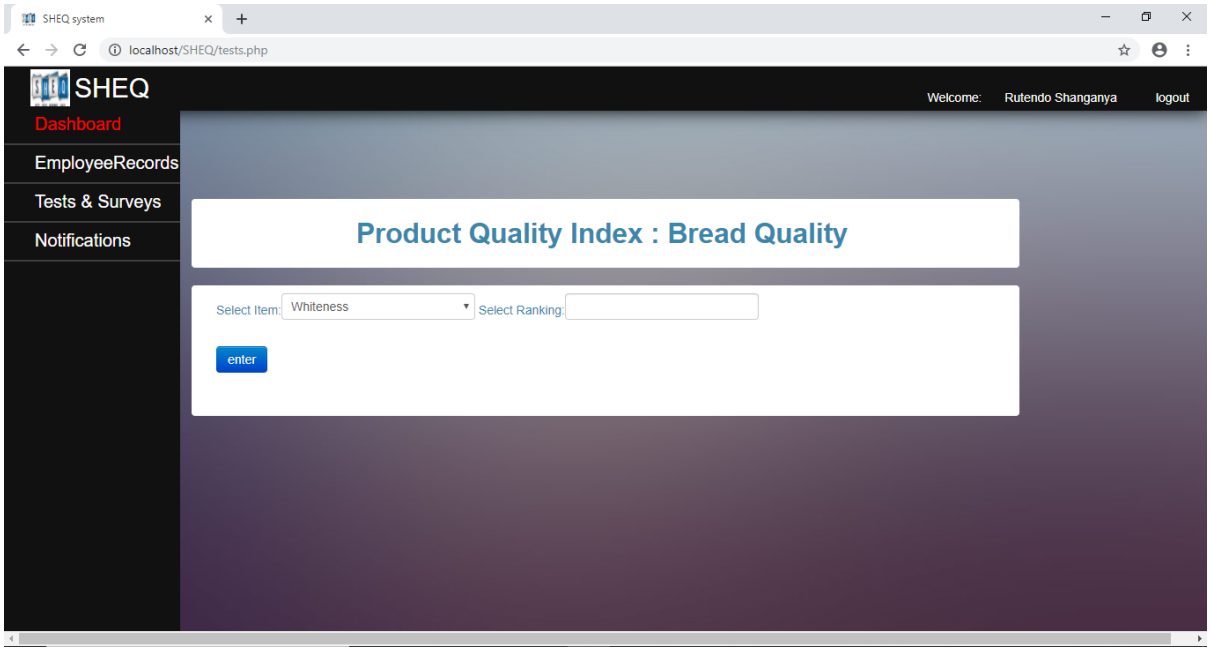


Figure A7: User access

h) Notifications

To post notifications, the user should enter their email address and type in the notification in the message box.

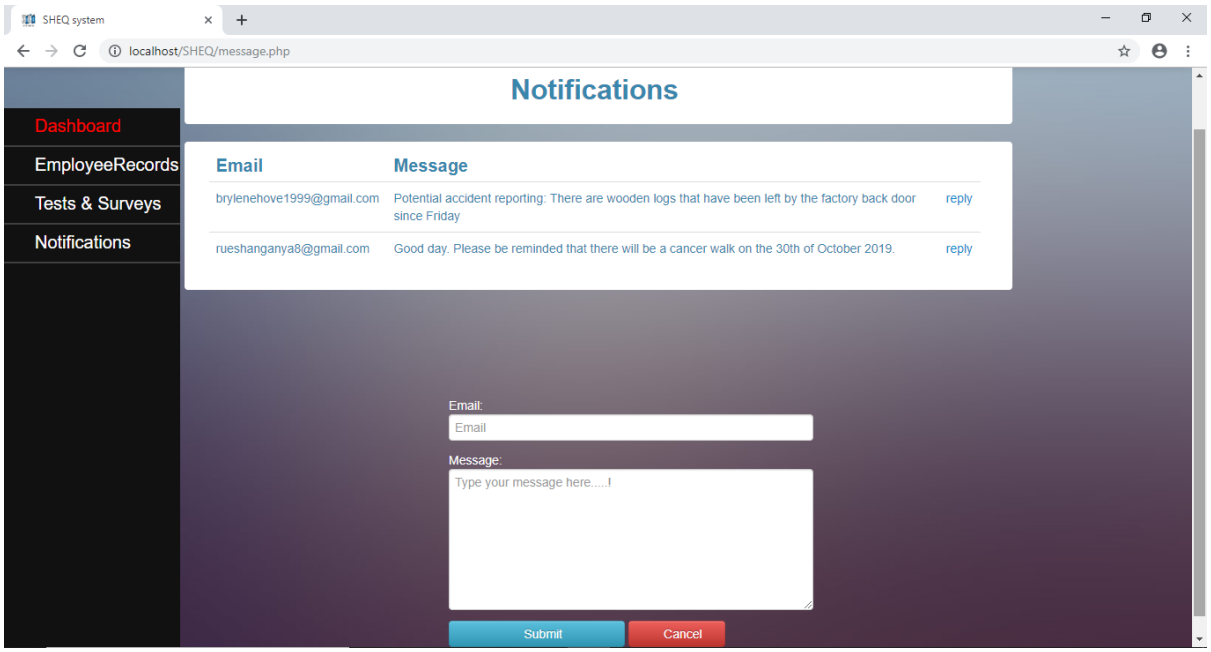


Figure A8: Notifications

i) Editing Employee details

The interface below is used to edit employee details according to administrator preference that is the employee status or to edit the user record.

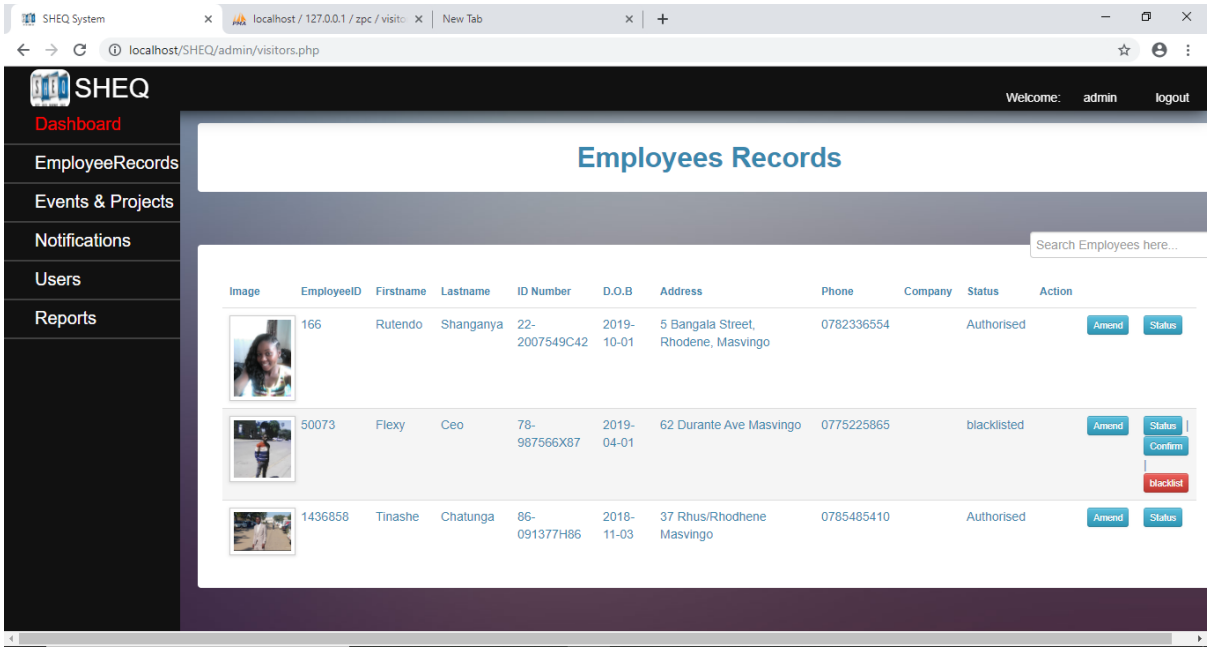


Figure A9: Editing Employee Details

j) Events and Projects

To access the events portal, the administrator has to click on the events and projects link which is shown and if an event has to be edited the edit button is used.

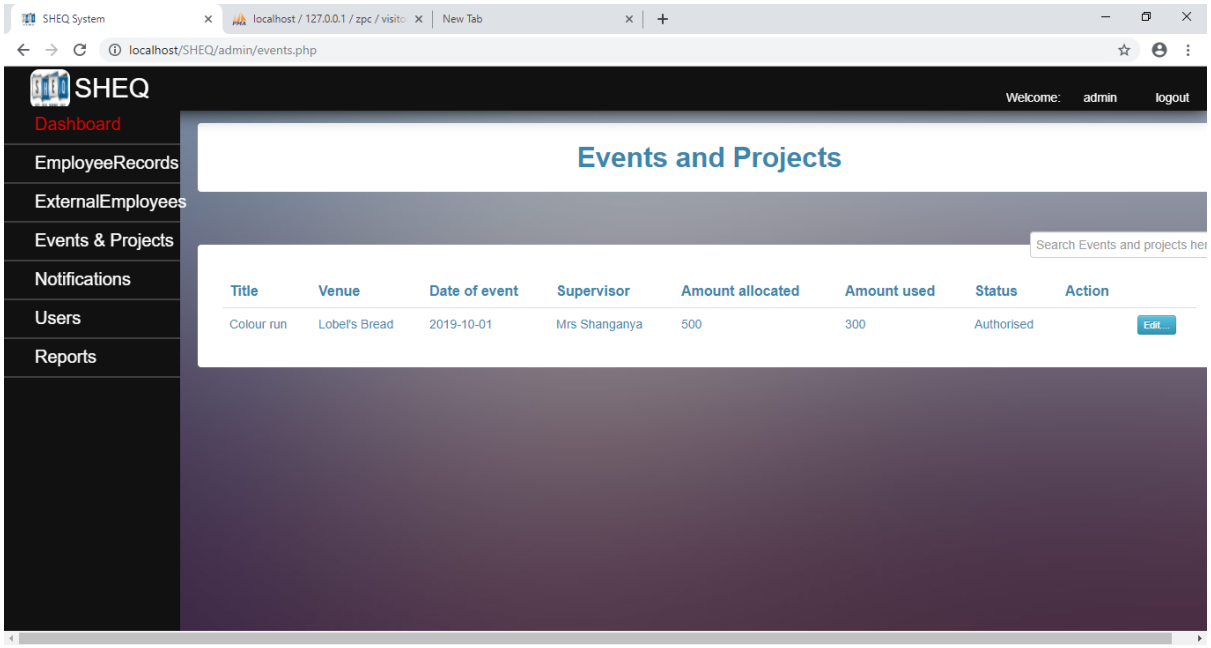
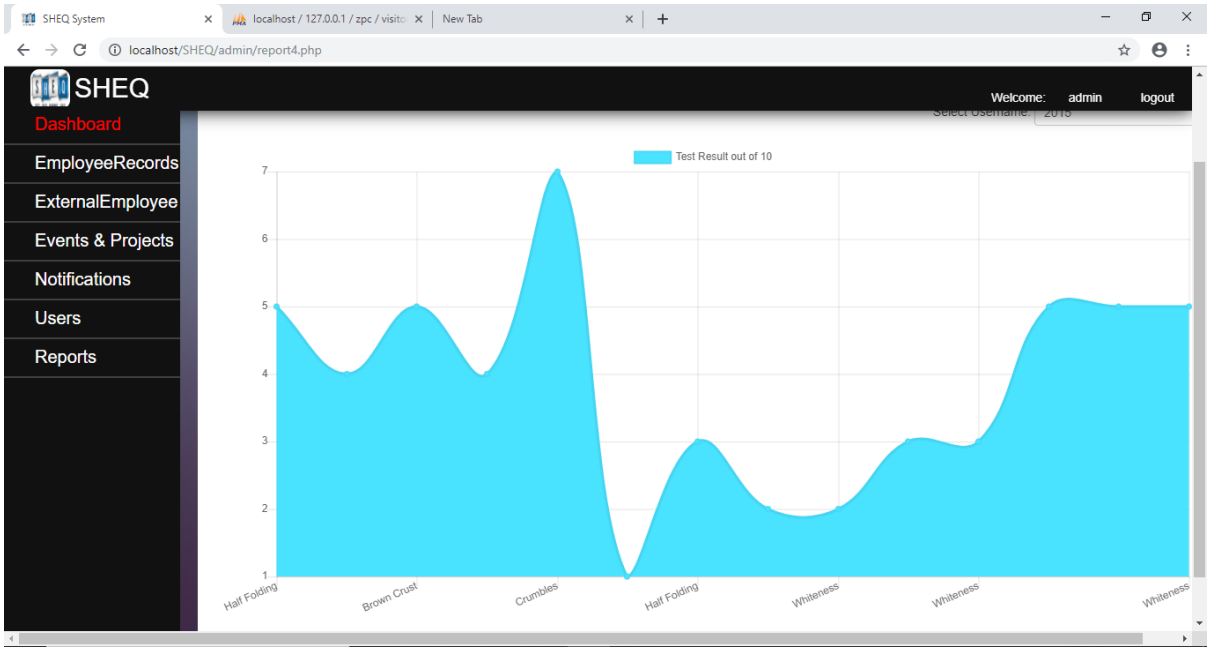


Figure A10: Events and Projects

k) Tests and survey report

After the user ranks the bread quality, the administrator accesses the data through the tests and survey report link which outputs a graph like the one shown below;



Appendix B: Interview Checklist

Place…….....

Date…….

Please fill in where applicable.

1. How do you rate the effectiveness of the workshops and events held by the SHEQ department?

……

……

……..

2. What description can you give on the current SHEQ system?

……

……

…….....

3. How do you communicate with the rest of the employees when it comes to notifications?

……

……

……..

4. Can you briefly describe how tests and surveys are conducted in the organization?

……

……

……..

5. What would you recommend or suggest as an improvement to the current SHEQ system?

……

……

……..

Appendix C: Questionnaire Checklist

Place…….....

Date……..

Please tick where it is applicable

1. Do you think that the current system is reliable, efficient and contributing to your organizational goals effectively?

☐ Excellent ☐ Fair ☐ Ineffective

2. Do you ever experience inconveniences when conducting the Product Quality Index test or notifying formal and informal employees on urgent matters?

☐ Very often ☐ Sometimes ☐ No

3. Is the current system reliable for storing both confidential and non-confidential files?

☐ Very reliable ☐ Reliable ☐ Not reliable

4. Would you appreciate airing your complaints or notifying the SHEQ department on your grievances or observation about your working conditions with a shorter communication channel?

☐ Yes ☐ No ☐ Maybe

5. Would you appreciate having an instant communication platform?

☐ Yes ☐ No ☐ Maybe

Appendix D: Observation Score Sheet

Name of the observer……...…

Date of observation…….

Time of observation……

Place of observation…….

Object being observed……..

Observation……

……

……

……

……

……..

.....

Conclusion……

……

……

……

……

……

……

……

Appendix E: Snippet of code

Login code

```
<?php
	include("function/login.php");
	include("function/user_signup.php");
?>
<!DOCTYPE html>
<html>
<head>
	<title>SHEQ System</title>
	<link rel="icon" href="img/sheqq.jpg" />
	<link rel = "stylesheet" type = "text/css" href="css/style.css" media="all">
	<link rel="stylesheet" type="text/css" href="css/bootstrap.css">
	<script src="js/bootstrap.js"></script>
	<script src="js/jquery-1.7.2.min.js"></script>
	<script src="js/carousel.js"></script>
	<script src="js/button.js"></script>
	<script src="js/dropdown.js"></script>
	<script src="js/tab.js"></script>
	<script src="js/tooltip.js"></script>
	<script src="js/popover.js"></script>
	<script src="js/collapse.js"></script>
	<script src="js/modal.js"></script>
	<script src="js/scrollspy.js"></script>
	<script src="js/alert.js"></script>
	<script src="js/transition.js"></script>
	<script src="js/bootstrap.min.js"></script>
</head>
<body style="background: url(img/sheqq.jpg); background-repeat: no-repeat;background-position: center; background-size:700px;background-attachment: fixed;">
	<div id="header">
		<img src="img/sheqq.jpg">
```

```
                <label>SHEQ</label>
                        <ul>
                                <li><a href="home.php">HOME</a></li>
                                <li><a href="#login"   data-toggle="modal">LOGIN</a></li>
                        </ul>
        </div>
                <div id="login" class="modal hide fade" tabindex="-1" role="dialog" aria-labelledby="myModalLabel" aria-hidden="true" style="width:400px;">
                        <div class="modal-header">
                                <button type="button" class="close" data-dismiss="modal" aria-hidden="true">x</button>
                                <h3 id="myModalLabel">Login...</h3>
                        </div>
                                <div class="modal-body">
                                        <form method="post">
                                        <center>
                                                <input type="email" name="email" placeholder="Email" style="width:250px;" required>
                                                <input type="password" name="password" placeholder="Password" style="width:250px;" required>
                                        <h6>Click the link to Login as an:<a href="admin/admin_index.php">Administrator</a></h6>
                                        </center>
                                </div>
                        <div class="modal-footer">
                                <input class="btn btn-primary" type="submit" name="login" value="Login">
                                <button class="btn btn-danger" data-dismiss="modal" aria-hidden="true">Close</button>
                                        </form>
                        </div>
                </div>
                                        </form>
                        </div>
        <br>
<div id="container">
```

```
        <div id="content">


                </div>
        </div>

        <br />
</div>
        <br />


</body>
</html>
```

Adding a user record code

```
<?php
        include("../function/session.php");
        include("../db/dbconn.php");
        if (isset($_POST['signup']))
{
        $firstname=$_POST['firstname'];

        $lastname=$_POST['lastname'];
        $address=$_POST['address'];

        $mobile=$_POST['mobile'];

        $email=$_POST['email'];
        $password=$_POST['password'];
        $status =$_POST['status'];
        $query = $conn->query("SELECT * FROM `users` WHERE `email` = '$email'");
        $check = $query->num_rows;
            if($check == 1)
                    {
                        echo "<script>alert('EMAIL ALREADY EXIST')</script>";
```

```
                }


                else

                        {

                                $conn->query ("INSERT INTO users (firstname, lastname, address,mobile,email,
        password,status)

                                VALUES ('$firstname','$lastname', '$address', '$mobile','$email', '$password',
        '$status')")

                                or die(mysqli_error());

                        }


}


?>
```