Zimplats Safety Health Environment Quality (SHEQ) – Behavior Based Initiative (BBI) Monitoring and Tracking System

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By

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Submitted in partial fulfilment of the requirements for the degree of

BSc Honours Information Systems

Department of Computer Science and Information Systems

in the

Faculty of Science and Technology

at the

Midlands State University

Gweru

May 2018

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Abstract

The main aim of the research was to develop a Safety Health Environmental and Quality (SHEQ) and Behaviour Based Initiative (BBI) monitoring and tracking system which creates a culture of safety awareness and accountability and an atmosphere of trust involving more worker involvement. A background study of the organisation was carried out as well as a comprehensive problem definition was deduced. The proposed system was developed using PHP programing language and MySQL database. The researcher undertook a feasibility study of the proposed system and also a business value of the proposed system to the organisation. A number of data gathering methodologies were used to carry out a conclusive research on the current system that is in place at the Zimbabwe Platinum Mines as well as find out the changes that would assist in a better system. A number of alternatives were available for Zimplats and in-house development was best considering the benefits. These methodologies included observations, interviews and questionnaires. In order to meet the user requirements, a design of the proposed system was done highlighting all the input and output designs as well as the architectural and physical design of the proposed system. Testing, validation and verification of the new system were undertaken in an aim to see if the system was working as expected. Maintenance strategies were also devised and the researcher highlighted the various future recommendations for the system users. A comprehensive user manual was made available for all the system users.

Declaration

I, **Tendai Patience Ngwenya (R144484H),** 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 **"Zimplats Safety Health Environment Quality –Behavior Based Initiative (SHEQ-BBI) Monitoring and Tracking System"** by **Tendai Patience Ngwenya** 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's Signature: …….

Date: ……..

Acknowledgements

I give all the praise to the Almighty God for it is only by his grace that I gave reached this far. My deepest appreciation goes to my loving family for all the sacrifices and support that they have given me up to this stage. Special thanks to my supervisor Mr S. Musungwini for all the support and guidance throughout the research project. I would also like to thank my special friend Cecilia, who has become a sister for her encouragement. All my friends who have stood by me when I felt like quitting you are most appreciated. Lastly I would like to thank the Zimplats SHEQ department and IT department for the useful information that they gave to assist with my research.

Dedication

I dedicate this dissertation to my loving family.

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List of Acronyms

Zimplats - Zimbabwe Platinum Mines

SHEQ – Safety Health Environment Quality

LTI – lost time injury

BBI – Behaviour Based Initiative

SMC – Selous Metallurgical Complex

CEO – Chief Executive Officer

CFO – Chief Financial Officer

CTO – Chief Technical Officer

COO – Chief Operations Officer

GM – General Manager

GHz – Gigahertz

RAM – Random Access Memory

GB – Gigabytes

UTP – Unshielded Twisted Pair

TB – Terabytes

CBA – Cost Benefit Analysis

ROI – Return on Investment

NPV – Net Present Value

SDLC – Systems Development Life Cycle

DFD – Data Flow Diagram

EER – Enhanced Entity Relationship

API – Application Programming Interface

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Chapter 1: Introduction

1.1 Introduction

As the world is shifting towards the technology advanced era, it is critical that organisations adapt to the frequent changes in technology in order to gain a competitive advantage over its rivals. This chapter is introductory to the major objective that is developing a Safety Health Environmental Quality (SHEQ) and Behaviour Based Initiative (BBI) monitoring and tracking system for Zimbabwe Platinum Mines (Zimplats). The introduction of the SHEQ-BBI monitoring and tracking system is to help the organization with easy incident management. This is due to the feature of being able to come up with root cause analysis and the counter measures that will reduce the occurrence of similar incidences. The system's automated functionality ensures that there is quicker data gathering and decision making. There will be accountability of all the incidences reported and those observed by the observers. More light is shed on the background of the company, the current system problem identification as well as the objectives of the proposed system. Clarification is given with emphasis on the different instruments required in developing it. Justification for developing the system is provided bringing out the benefits of the proposed system.

1.2 Background of study

Zimbabwe Platinum Mines operations are high risk and accidents can occur any time. The working environment requires the workers to be very aware of the dangers that might arise. To counter this there are SHEQ briefs that are done by each department before the commencement of a shift. However, dangers still arise and they have to be documented by the SHEQ department. The current system involves the SHEQ representative having files to record the SHEQ brief registers, lost time injuries (LTI), fatalities, medical conditions and other incidences that would have occurred. Auditors who come for audits yearly will have to go through the tiresome process of reviewing the files. There is no room for easy comparison between targets and the actual safety results. There is also need to monitor the behaviours of the employees as they work towards achieving the Bradley curve's Interdependent stage.

1.2.1 Background of organisation

The organisation was established in 1998 by Delta Gold Limited. In 2005 it changed its name from Makwiro Platinum mines to Zimbabwe platinum mines. The organisation operates both underground mines and open cast in Mhondoro Ngezi. There are three underground portals (Mupfuti, Bimha and Mupani) and two open pit portal (Rukodzi and Ngwarati). Rukodzi and Ngwarati are currently undergoing shut and being replaced by Mupani mine. Bimha mine is also undergoing redevelopment after a collapse. The Selous Metallurgical Complex (SMC) is the processing division of Zimplats where the ore is concentrated and smelted. Underground mining employs the conventional belt and pillar mining method.

Zimplats holds around two thirds of the largest platinum hosting centres of the Great Dyke, Hartley Complex. This therefore places Zimbabwe platinum mines as a critical developing supplier of platinum since it is growing into a key player in platinum industry.

1.2.2 Organizational structure

The organizational structure is defined by Rouse and Smith (2005) as the system which defines a chain of command within an organization. The structure defines the jobs, functionality as well as the reporting channels to be followed. Zimplats used hierarchical organizational structure whereby the top management is at the very top of the structure and the levels decrease as we go down the structure. Below is the organizational structure of Zimplats.

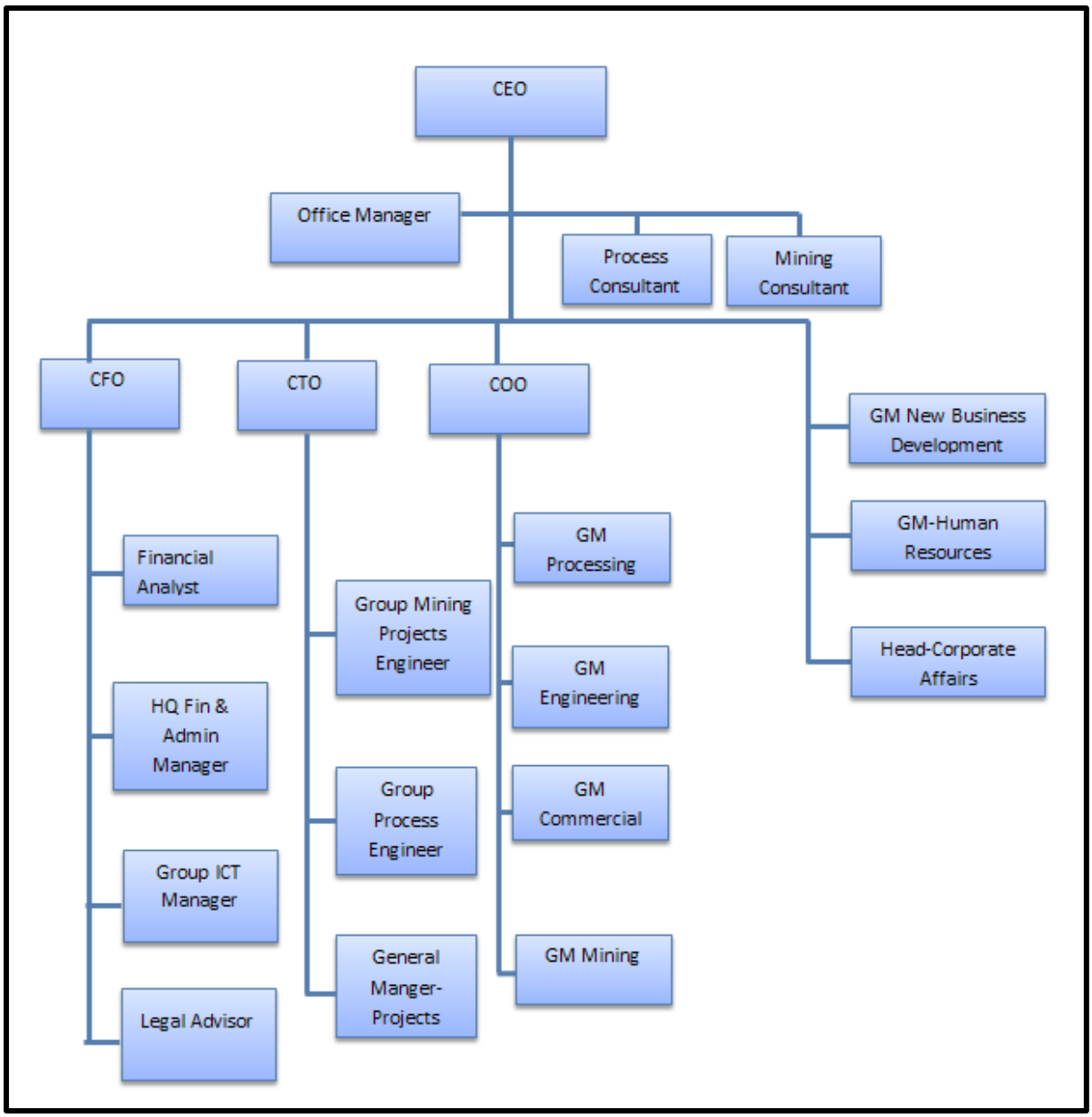

Fig 1. 1 Zimplats organogram (adapted from www.zimplats.com)

1.2.3 Vision

To be the safety and cost leader in the platinum production sector with sustainable growth in production, whilst generating superior returns for the benefit of shareholders. The introduction of the system will help in attaining the vision in that all safety issues will be addressed and there is accountability of all the lost production time and counter measures can be deduced.

1.2.4 Mission statement

Zimplats' business is production of platinum group metals from the Great Dyke in Zimbabwe. The system will assist in ensuring that there is a safe working environment which will in-turn result in the production of quality platinum group metals.

1.3 Problem definition

The current system is manual and the SHEQ representatives get Departmental SHEQ brief meeting registers from various departments and have to compile a report based on the number of topics that would have been covered during a given period. Incident investigations are difficult to pinpoint the total costs of carrying out the investigation. Also there is need to track the lost time during the injury that would have occurred.

BBI coaches also have to monitor the working procedures of the employees and compare the results against the Bradley curve's stages to monitor which stage the employees are operating on. Currently this is done through sending out manual survey questions to the employees and populate the findings in excel proving to be time consuming.

There is no central data repository of the findings from the SHEQ department and the BBI coaches. Manual files storing these files and they are difficult to reach a solid conclusion. Workers avoid reporting incidents related to their co-workers as they believe it might take away their rewards.

1.4 Aim

To develop a Safety Health Environmental and Quality (SHEQ) and Behaviour Based Initiative (BBI) monitoring and tracking system which creates a culture of safety awareness and accountability and an atmosphere of trust involving more worker involvement.

1.5 Objectives

The system must be able to perform the following functions:

1. To provide a system that will allow for the creation and management of user accounts
2. To provide easy access to a vast knowledge base of ranked articles that include but not limited to safety, work risks and measures to take in case of accidents and injuries.

3. To enable SHEQ representatives to administer surveys that can be responded by workers either anonymously or with identity.
4. To enable SHEQ officers to launch investigations from survey responses and capture results that can be used to analyse accident root cause, injuries, lost production, damaged materials and pin point areas that are mostly affected over time that may need special attention.
5. To provide metrics that enable easy calculation of production costs incurred and lost potential revenue due to injuries.
6. To allow BBI coaches to track employee behaviour and compare the results with Bradley curve standards.
7. To provide comprehensive reports (detailed and summarised) that are simple and easy for management and other stakeholders on survey responses, investigations, injuries, cost incurred and lost potential revenue.

1.6 Instruments

To assist in the attacking of the identified problems with the current system as well as successfully meeting the stated objective of the proposed system, the following instruments will be used in the development of the system.

- MySQL database server for the project's database creation, data storage and retrieval.
- PHP programming language for the development of the system.
- Web browser to download and access materials relevant to the project as well as run the system on.
- Ms Word for documentation.

1.7 Justification

The proposed Safety Health Environmental and Quality (SHEQ) and Behaviour Based Initiative (BBI) monitoring and tracking system will help in keeping a central database for the operations of the Zimplats SHEQ department. There will be easy monitoring and tracking of the incidents that occur during a given period of time. Decision making will be easier based on the findings from investigations.

Employee involvement will be achieved as clearly outlined targets agreed by both management and employees will be measured at the end of a given period. Improved efficiency in coming up with action plans from the system inputs will be made easier. Reporting, investigating and tracking of issues will be made easier. Easy report generation is also a benefit of the proposed system.

1.8 Dissertation structure

This chapter has brought about all the highlights of the problems of the current system in place at Zimplats organisation and gave a brief overview of the solutions to encounter the recognized problems through developing the proposed system. A full detail of the proposed system's benefits has also been given as well as relevance of the system to the organisation. The next chapter will focus on the planning phase of the system taking into account the feasibility of the system development. In chapter three, the researcher will be highlighting on the analysis of the current system in place and also focusing on its weaknesses and strength as well as highlighting the data gathering methodologies used. Chapter four will then focus on the design of the new system and how the interfaces will look like and module relation. The final chapter is on the implementation of the new system as well as the methods of conversion to be used.

Chapter 2: Planning Phase

2.1 Introduction

The previous chapter gave a clear insight of the reasons behind the development of the proposed system through an in-depth of the system justification. According to Dennis, Wixon and Roth (2012) planning is a critical process of making clear why a system built as well as outlining the steps to be taken by a project team in coming up with the proposed information system. A feasibility study of the proposed system is carried out as well as risk analysis of the risks that might arise during the development of the system. Stakeholder analysis is also carried out to assess all the stakeholders' interest and expectations. A work plan is to be established for a goal and deadline oriented system development.

2.2 Business value

A business value as cited by Munsaka (2013) is the fulfilment of the customer's requirements at an affordable procurement cost, proprietorship and use. These business values are the benefits to Zimplats as an organisation in particular the SHEQ department due to the introduction of the SHEQ-BBI monitoring and control system. The benefits are either tangible or intangible. The business values of the proposed system are:

- Benefit to the organization – the introduction of the system will ensure that Zimplats is in a position to monitor incidences as wee as the employee behaviour. They are also in a position to account for every lost production time and costs associated. Decision making is also made easier through the use of a centralized database.
- User value – the BBI coaches will be able to easily monitor the employee working procedures as well as get timely responses to the questionnaires they would have sent. The SHEQ representatives can easily keep track of the meeting minutes and attendances. Easy investigation of incidences and calculation of costs and lost time is made possible through the new system.
- Managerial value – the introduction of the monitoring and control system will benefit management in easy monitoring of the SHEQ and BBI activities. They can also pull out reports for a given period easily and make decisions on pressing issues easily.
- Improves productivity – the introduction of the new system ensures that all set deadlines and objectives are met and progress can be monitored. By monitoring the

progress of a given activity, the BBI coaches are then able to make sure that all employees adhere to the set targets and comply.

- ¾ High staff morale – through the use of technology in the operations of the SHEQ representatives and BBI coaches there will be elimination of repetitive and boring processes. Fast, accurate and efficient methods of operation are implemented.
- ¾ Improves productivity – since more time is created from the fast and efficient new system. Easy monitoring of targets is made possible and hence the BBI coaches can compare actual results against proposed.

2.3 Feasibility study

Somerville (2007) stipulates that feasibility study determines if the proposed system is technically, operationally, economically and socially feasible as well as looks at whether the benefits outweigh costs which will be incurred. After a thorough analysis of the various constraints a decision on whether to proceed with the project or not is made. Kendall and Kendall (2005) also cites that the feasibility study is used as a guide to a conclusive decision on if the project should be carried out or not. To reach a conclusive decision we look at the technical, economic, social an operational feasibility. The feasibility study determines both the positive and negative outcomes of the proposed new project before time and resources are invested into it.

2.3.1 Technical feasibility

This feasibility study focuses on laying down the facts on how the service of the proposed system will be delivered. This includes the labour, material and technology needs. Kendall and Kendall (2005) stipulates that technical feasibility is when we compare the requirements of the new system are compared to the technical capacity of the organisation. This will therefore mean that the project is only feasible if the technical capacity of the company is able to support he requirements of the proposed system.

2.3.1.1 Technical expertise

The personnel required for the operation of the proposed system are available within the organisation. Training for the available SHEQ officers and BBI coaches on the operation of the new system is required. A strong system development team is to be hired for the

development of the new system. This team could be an in-house development team or external team.

2.3.1.2Hardware requirements

Below is a table to show hardware requirements needed for a successful implementation of the proposed system.

Table 2.1: Hardware requirements

Item	Description	Quantity	Available
Laptops	Core i5 processor, 3.5GHz speed, 4GB RAM, 500GB hard drive	10	5
Network cables	UTP Cat 6	5*100m	3*100m
LaserJet Printer	HP LaserJet Pro P1102	7	5
Server	14GB RAM, 4GHz speed, 2TB	1	yes
Patch panel	24 Port	1	No
Hub	24 port	1	16port

2.3.1.3Software requirements

The table shows the software required for the project.

Table 2.2: Software requirements

Software Name	Version required	Software available
MySQL database	5.5	5.6
Windows server	2012	2016
Adobe Dreamweaver	CS6	CS6
Macromedia dreamweaver	8.0	8.0

2.3.1.4 Overview of Technical Feasibility

Having carried out the technical feasibility study and noted that the requirements could be met, the proposed SHQ-BBI monitoring and control is found to be technically feasible.

2.3.2 Economic feasibility

This feasibility study weighs the benefits of carrying out the project against the costs that are to be incurred. Georgallos and Maris (2009) highlight that this study aims at ensuring a conclusive decision of whether there are enough funds to carry out with the projects and if a high return can be attained. A project is found to be financially or economically feasible if the benefits exceed the costs.

2.3.2.1 Cost benefit analysis (CBA)

Wood (2001) stipulates that CBA is the difference between all the benefits and all the costs which are subject to specified constraints. Some of the benefits are not directly monetary hence there is need to convert these benefits to an estimated monetary value. Costs are divided into two categories which are development costs and operational costs. Development costs are those estimated at the start of a project and cease once the implementation stage has been reached. These costs include the training, supply, personnel and equipment costs. Operational costs however are those costs which are incurred on a day-to-day basis during the use of the system. These costs include software upgrading costs, server back-up and upgrades. The table below shows the expected development and operational costs.

Table 2.3: Development and Operational cost

Item	**Cost (US$)**	**Total (US$)**
Development costs		
Training	5000	
Supply	1200	
Personnel salaries	8000	
Equipment	3500	**17 700**
Operational costs		
Software upgrading	1000	
Server backup	1200	
Server upgrade	1000	
Conversion cost	3200	
Maintenance cost	3500	**9900**
Total costs		**27600**

Benefits are the profits to Zimplats that come with the introduction of the new system. The tactical benefits are recognised by top level management and these benefits assist the evolution of the organisation in the business environment and as such affect productivity. Strategic benefits exert a decisive influence to Zimplats' future success. Benefits are further classified into tangible and intangible benefits. Tangible benefits or direct benefits have a known monetary value and accumulate directly from the propose SHEQ-BBI monitoring and control system. Some of the direct benefits are:

- Improved information accuracy and availability
- Reduced processing errors
- Improved periodically oriented reports and timely report production
- Reduced incident investigation time

Intangible benefits or indirect benefits on the other hand have no monetary value attached to them and hence are difficult to quantify. Some of the intangible benefits are:

- Increased staff moral
- Improved information technology appreciation by the organization
- Improved decision making management
- Competitive advantage of the organization through differentiation

The table below shows the benefits that are to arise through the introduction of the new system.

Table 2.4: Tangible and Intangible benefits

Item	**Cost (US$)**	**Cost(US$)**
Tangible benefits		
Improved information accuracy and availability	3000	
Reduced processing errors	1000	
Improved periodically oriented reports and timely report production	2500	
Reduced incident investigation time	10000	
Improved overall productivity and efficiency	10500	**27000**
Intangible benefits		
Increased staff moral	1000	
Improved IT appreciation by the organisation	4000	
Improved decision making management	6000	
Competitive advantage of the organisation through differentiation	5000	**16000**
Total benefits		**43000**

2.3.2.1.1 Overview of Cost Benefit Analysis

Table 2.5: Cost Benefit Analysis

Costs and benefits	**Amount (US$)**
Total costs	(27600)
Total benefits	43000
Net benefits	**15400**

Having highlighted the costs and benefits, it is notable that the benefits outweigh the costs hence proving the project to be viable.

2.3.2.2 Return on Investment (ROI)

This is defined by Wood (2001) as a percentage that is obtained by comparing the total costs and benefits involved in the project. It is calculated as:

$$\textbf{ROI} = \frac{\textbf{(benefits – costs)}}{\textbf{Costs}} * 100$$

$$= \frac{(43000-27600)}{27600} * 100$$

$$= 55.8\%$$

A positive ROI shows that the project is viable.

2.3.2.3 Net Present Value (NPV)

Wood (2001) cites that this is the total loss or benefit that is attained from a project or investment. This discounted investment appraisal method assumes that a dollar spent today is greater in value as compared to a dollar spent in future. The following formula is used for calculating the NPV:

$$\textbf{NPV} = \frac{\textbf{Annual total benefits}}{(1 + r)^n}$$

Where 'n' is number of years and 'r' is the discounting rate

Table 2.6: Net present value

Year	Cash flow($)	Discount factor (10%)	Present value($)
0	(27600)	1	(27600)
1	27500	0.909	25000
2	25000	0.826	20661
3	26700	0.761	20060
4	30000	0.683	20490
NPV			**58611**

A positive NPV of $58,611 proves the project to be economically feasible.

2.3.2.4 Payback Period

This is the time taken for the cash flows from a capital investment to equal the cash outflows and this is expressed in years. Wood (2001) support this as they assert that the payback

period is the shortest period to recover the initial investment. The shorter the payback period, the more viable a project is thought to be. Below is the payback period calculation for the proposed project.

Table 2.7: Payback period

Year	Cash inflow (outflow)	Cumulative outflow
0	(27600)	(27600)
1	27500	(100)
2	25000	___

The project takes approximately a year and 1 month to recover from the initial investment. This therefore makes it economically feasible.

2.3.3 Social feasibility

The social feasibility as stated by Dennis et al (2008) determines the impact of the project on its stakeholders. Social feasibility looks at both the negative and positive impacts of the proposed system on the interested parties. The positive impacts of the proposed system include advancement in the appreciation of information technology within the operations of the organisations. The various stakeholders of the proposed system will have a system that directly meets their various business needs. Zimplats as an organisation will improve its service delivery and this in turn will result in long term quality service delivery to the society.

2.3.3 Operational feasibility

It is defined as the ability to support, make use of and execute the required tasks of a system. Franchetti (2011) cites that this study ensures that there is need for full stakeholder support regarding the proposed system and how it will meet the set objectives. The propose SHEQ-BBI monitoring and control system is said to be operationally feasible if it manages to improve the efficiency of service delivery within the organisation's operations. A user friendly interface is required to ensure that the users can easily navigate through it without facing any challenges. There should also be the provision of a user manual that guides new users on how to execute the various tasks on the new system. Management is also to be offered with a platform to easily manage the operations of the SHEQ department as well as the BBI coaches.

2.3.5 Overview of feasibility study

After carrying out the economic, technical, social and operational feasibility study, it is recognised that it is feasible to continue with the project.

2.4 Risk analysis

Birch and McEvoy (1992) proposes that risk analysis involves evaluation of threats and vulnerabilities and coming up with measures to mitigate these risks. Risk analysis is a vital process during project development as it highlights all the grey areas that might lead to failure in the project. Risks however cannot be fully eliminated but they are reduced to a level which is acceptable and does not affect the overall project development. These risks have mitigation controls that are introduced and help with somewhat eliminating them and operating at an acceptable and positive level.

2.4.1 Economic risks

These risks are concerned with the funding of the project. These economic risks include:

- Conflict of interest as to which project requires funding. This risk arises from when there are many projects to be funded and priority is given to the earlier propose systems resulting in late or no funding of the proposed system.
- Estimated costs regarding the requirements of the project might less that the actual prices. This could be due to inflation or poor estimation by the project team. In the end there will be shortfalls in the funds required.

2.4.2 Technical risks

These arise from failure to meet the requirements of the proposed system. These risks include the following:

- User requirements no met due to unclear requirements or unskilled development team. This will mean constant complaints by the user regarding the functionality of the system.
- Low maintenance of the system which will in turn result in the users aborting the use of the new system as it will not meet their changing requirements.

2.4.3 Other risks

These risks arise from either within the organisation or from an external level. These include:

- Resistance to change by the users.
- Virus attacks.
- Hacking.
- Loss of data.

2.4.4 Mitigation controls

These are the controls that are put in place to reduce the number of risks within the project. These controls include:

- There is need for the project team to have realistic budget figures that can sustain the project needs.
- User training to ensure that all the users are aware of the project functionality.
- Prototyping of the system and sending it to the users for their evaluation and feedback.
- Constant data backups to reduce data loss.
- Anti-virus should be up to date to ensure that no virus attacks are experienced.
- Privacy control measures to eliminate hacking.

2.5 Stakeholder analysis

This is an evaluation of the stakeholders and their interests or expectations from the project.

- Development team – these are concerned with ensuring that they meet all user requirements and produce a well-deserved easy to use system. The team is also concerned with building an error free system that proves to be better than the current system in place.
- Users – the users would require a system that meets their current needs and if possible exceed their expectations. The interface must be user friendly and easy to navigate.
- Management (I.T) – these are the major stakeholders as it is their department's reputation on the line. They expect the system to meet the changing technological needs.
- Management (finance) – they are concerned with ensuring that they make savings from the transition from the current way of operation. A noticeable savings margin is to be recognised as there will be accurate calculations of incident related costs.

- Management (operations) – these stakeholders are there to ensure that the proposed system eases the pressure on the employees that is brought about with the current system. These stakeholders also have to be in full support with the implementation of the proposed system as their meeting briefing regarding SHEQ and employee wellbeing are dependent on the findings of the system.

2.6 Work plan

Brown (2000) states that this is a comprehensive account of the project completion stages. This work plan shows the recommended time frame for each stage during the project's development.

2.6.1 Project schedule

This is defined by Brown (2000) as a tool which shows the tasks to be done as well as their respective time frames.

Table 2.8: Project schedule

Phase	Start date	End date	Number of weeks
Introduction	18/02/2018	24/02/2018	1
Planning	25/02/2018	10/03/2018	2
Analysis	11/03/2018	24/03/2018	3
Design	25/03/2018	07/04/2018	3
Implementation	08/04/2018	28/04/2018	3
Documentation	18/02/2018	28/04/2018	12

2.6.2 Gantt chart

Brown (2000) highlights that a Gantt chart is a scheduling chart which shows all the phases in the project displaying the project stages against their durations.

Table 2.9: Gantt chart

Stage	1	2	3	4	5	6	7	8	9	10	11	12
Introduction												
Planning												
Analysis												
Design												
Implementation												
Documentation												

2.7 Conclusion

This chapter gave a deep insight of the expectations of the stakeholders from the project. There was also a feasibility study to show how viable the project is as well make it easy to decide on abandoning the project or not based on the findings of the feasibility study. The propose system proved to be economically, socially, technically and operationally feasible hence giving a green light to the development team. Also risks were identified and mitigation controls were drafted to ensure that these risks were low. All the benefits and challenges of the system were highlighted in this chapter. The next chapter will therefore shed light on the analysis of the current system in place.

Chapter 3: Analysis phase

3.1 Introduction

In the previous chapter there was a highlight on the major feasibility areas of the proposed system and its requirements. This chapter will therefore aim to carry out a thorough analysis of the current system. This includes the data gathering methodologies; processes involved in the current system, an evaluation of alternatives a well as the requirements of the system. Godfrey (1999) cites that system analysis aims at modelling, transforming and inspecting with the goal of obtaining relevant information which helps at developing a product that meets the user requirements. The systems development life cycle (SDLC) considers the analysis phase as the most critical stage of systems development as it answers the "what is the main functionality of the system" question. Process flows of the current system and how the activities of the current system interact with each other is analysed as well as a full scrutiny of the inputs, processes and outputs of the system currently in place.

3.2 Information gathering methodologies

Information gathering is a technique that is used to obtain all the relevant information from its direct stakeholders or users as cited by Nayar and Stanley (2014). The methodologies highlight the various steps that were taken in gathering all the required information. The methodologies used by the researcher include questionnaires, interviews and observations.

3.2.1 Questionnaires

FitzGerald (2009) highlight that these are a series of pre-written questions given to the target group in order to gather information. Questionnaires are there to cater for those users who are too occupied such that they cannot take interviews and also in cases where individual interviewing is not possible. There are two types of questionnaires which are close-ended and open-ended questionnaires.

- **Close-ended questionnaires**

These types of questionnaires are structured in such a way that the responses are restricted and one can only choose from the provided responses. Close-ended questionnaires suit a specific category targeted by the researcher. Nominal data is obtained from these questionnaires. The responses offered can easily be converted into quantitative data.

- **Open-ended questionnaires**

These are a type of questionnaire that has more than a "yes" or "no" for an answer. Responses to the questions are in various forms which include a list, paragraph or essays. They are designed in such a way that one collects full and meaningful responses from the knowledge of the involved parties. Usually the questions are in the form of "how" and "why" to give room for explanations.

Advantages of questionnaires

- Saved on time as many questionnaires were answered in a short period of time.
- Anonymous capabilities allowed for more honest responses.
- Questions were planned for ahead of time.
- Accommodated people to respond at a time that was convenient for them.
- There was the provision of quantifiable responses on a research topic.

Disadvantages of questionnaires

- Inaccurate as some of the questions were misinterpreted.
- Difficult to structure the questionnaire.
- Lack of human interaction.
- Not everyone will respond to the questionnaires.

Findings from questionnaires

Some of the responses to the questionnaires were mediocre answers as the people were not putting their all into responding to the questions. However, there were some responses that proved that the users were well aware of the operations of the current system and this offered help to the analyst. Rate of response for the questionnaires was calculated as follows:

$$\frac{\text{Number of questionnaires returned}}{\text{Number of questionnaires}} * 100$$

$$(9/20)*100 = 45\%$$

The 45% return on the questionnaires was a fair return.

Below is a summary of the responses that were obtained from the returned questionnaires.

Table 3.1: Questionnaire findings

Question	**Most common response**
Briefly describe the current system	Straining and monotonous
How do you rate the service of the current system	Time consuming
Does the system meet your expectations	Not all of them
Are you satisfied with the current way of operation	No
Do you think there should be a new system put in place	Yes, one that lifts the burden of the current system

3.2.2 Interviews

Blaxter (2006) postulates that an interview is a dialogue between two parties: the interviewer and the interviewee in an aim to gather information on a certain area of study. The two types of interviews are structured and unstructured interviews.

¾ **Structured interview**

This interview structure allows different interviewees to answer the same predetermined questions and in the same order. It is an assessment method in which asks hypothetical job-related questions in the employee's area of work in-order to find out how they react to the different situations.

¾ **Unstructured interview**

The interview questions are not predetermined and hence they give room for the interviewer to ask follow-up questions if there is need to. This helps in gathering as much relevant data as possible from the interviewee.

Between the unstructured and structured interviews it is recommended that the researcher makes use of unstructured interviews as they give more in-depth information on the current way of operation.

Advantages of interviews

- ¾ There is room to ask follow up questions.
- ¾ Misunderstanding gaps are overcome as there is room to ask explanations on unclear points.
- ¾ There is room for discussion on areas that would not have been planned for by the interviewer.
- ¾ Interviewees feel part of the project team through their contributions.

Disadvantages of interviews

- ¾ Time consuming and at times costly.
- ¾ Their success depends on how the interviewee's willing to participate as well on the communication skills.
- ¾ Security reasons lead to some information not availed.

Findings from interviews

Some of the responses were one sided as the respondents only looked at their side of operation and not the whole system. However, it was clear that the proposition of the new system would bring about more benefits and solutions to the current way of operation within the whole organisation. All the stakeholders realised that their current problems with the current system can be overcome through the new system's introduction.

3.2.3 Observations

McNamara (1999) highlights that observations are a technique that is mostly made use of in case studies. The researcher overlooks the employees as they are working with the current systems and makes observation notes on areas of concern. The observer has to know the points to be brought up for observation and focus on those areas and others which might be relevant in the data gathering. In observations one needs to be aware of the Haw Thorne effect and overlook it as it distorts the validity of the results.

Advantages of observations

- ¾ It does not disturb the carrying out of tasks by the employees as the observer does the observations while the tasks are being done.

- Less bias and less demanding in nature.
- ¾ It is advancement in the precision of research results.
- ¾ Accurate results from monitoring human behaviour during their interaction with the current system.

Disadvantages of observations

- ¾ The Haw Thorne effects where by the employees behave in a different manner as they know they are being observed.
- ¾ Time consuming as the observer waits a long time for the events to occur.
- ¾ It is difficult to study the past problems with the system.

Findings from observations

During the observation process, the observer realised that operations on the current system were time consuming as some of the required data was stored in different areas and hence made it difficult to efficiently compile it. the observation was for a few days and this would have hindered having the most accurate picture of the employees interactions with the current system and also hid the short comings of the current system in place.

3.3 Analysis of existing system

The analysis involves taking a look at the current way of operation. This involves the inputs, processes and outputs. In the current system there are questionnaires and observation sheets that are filled in by the BBI coaches and these are then used in monitoring employee behaviour. SHEQ officers investigate the various incident scenes to find the root cause. Reports are generated and meetings are called for by management to discuss the findings of the investigations as well as the way forward. Auditors draw out audit reports for the specific area of concern. The current system's processes include:

Input

- ¾ BBI coaches' employee observation form.
- ¾ Questionnaires sent to employees.
- ¾ SHEQ officer's investigation sheet.
- ¾ Management view on operations to be carried out.
- ¾ SHEQ brief minutes.

Processes

- Meeting scheduling.
- Calculation of lost time during incident investigation.
- Compilation of all the LTI, fatality and investigation costs.
- Establishing measures to minimize the occurrence of incidents.

Outputs

- Periodic reports.
- Total costs of the investigations and lost time.

3.4 Process analysis

Shelly, Cashman and Rosenblatt (2005) highlight that this is a chronological manner in which activities are broken down during a system's development. The flows of data as well as the processes involved are highlighted during process analysis. An activity diagram as stipulated by Shelly et al (2005) is a Unified Modelling Language diagram which highlights the sequence of processes as well as the state of the flow.

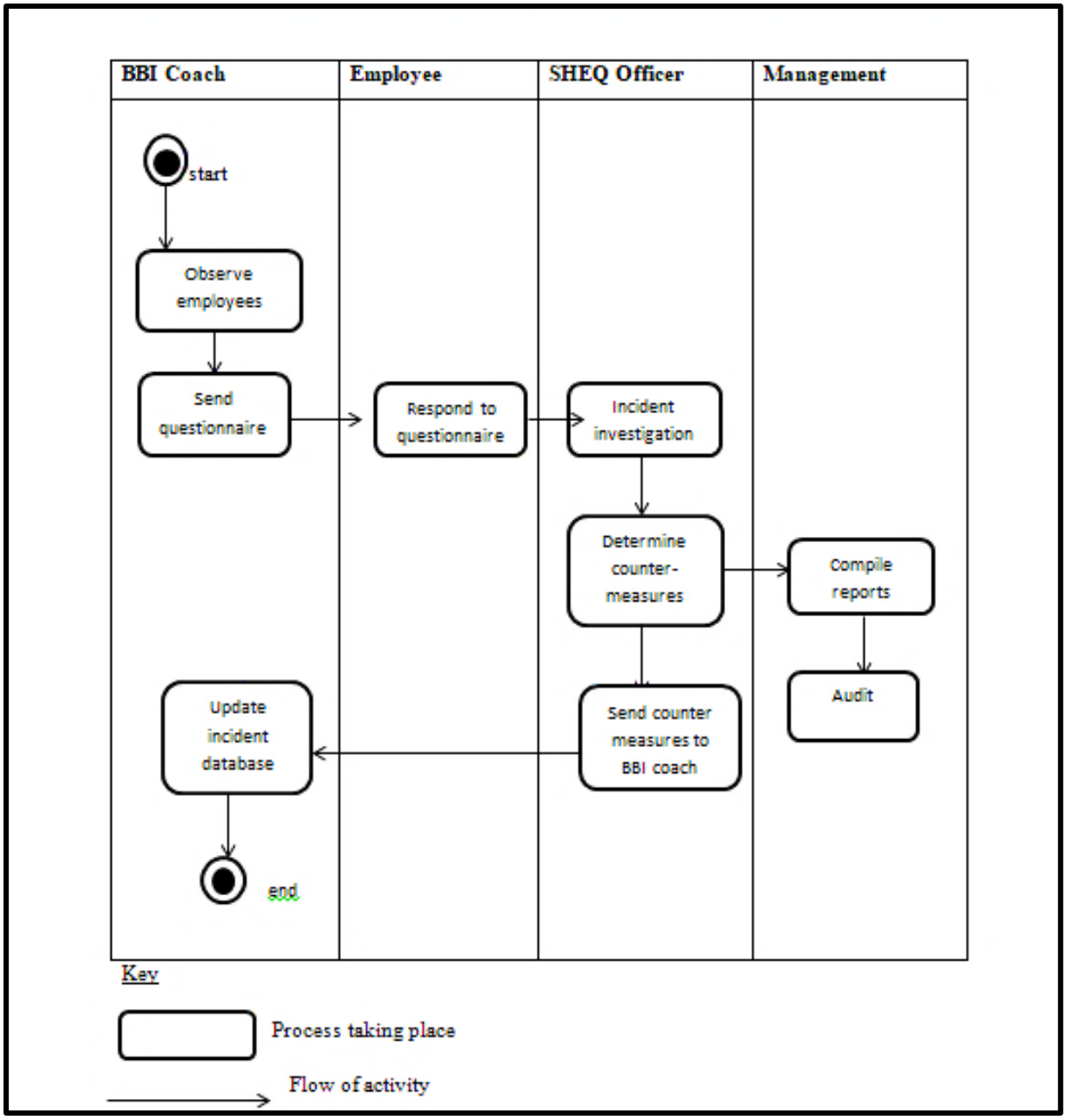

Fig 3. 1: Activity diagram of current system (designed by author)

The activity diagram above activity diagram begins with the BBI coach observing the employees and sending questionnaires to the employees who then respond and send their responses to the SHEQ officer. The responses are used for investigations and coming up with root cause analysis. This sequence of activities is not ideal as employees might not give honest questionnaire responses and this will affect the reliability of root cause analysis deduced from the investigations.

3.5 Data analysis

According to Berthold and Hand (2013) data analysis as a process involves data gathering, organizing and ordering in such a way that it is useable as well as valuable to the various needs required. This includes context diagrams and data flow diagrams.

3.5.1 Context diagram

Scott (1999) highlights that this is a simple representation which shows the flow of information through a system and it models its process aspects. It also outlines the degree to which the external environment relates to the external environment.

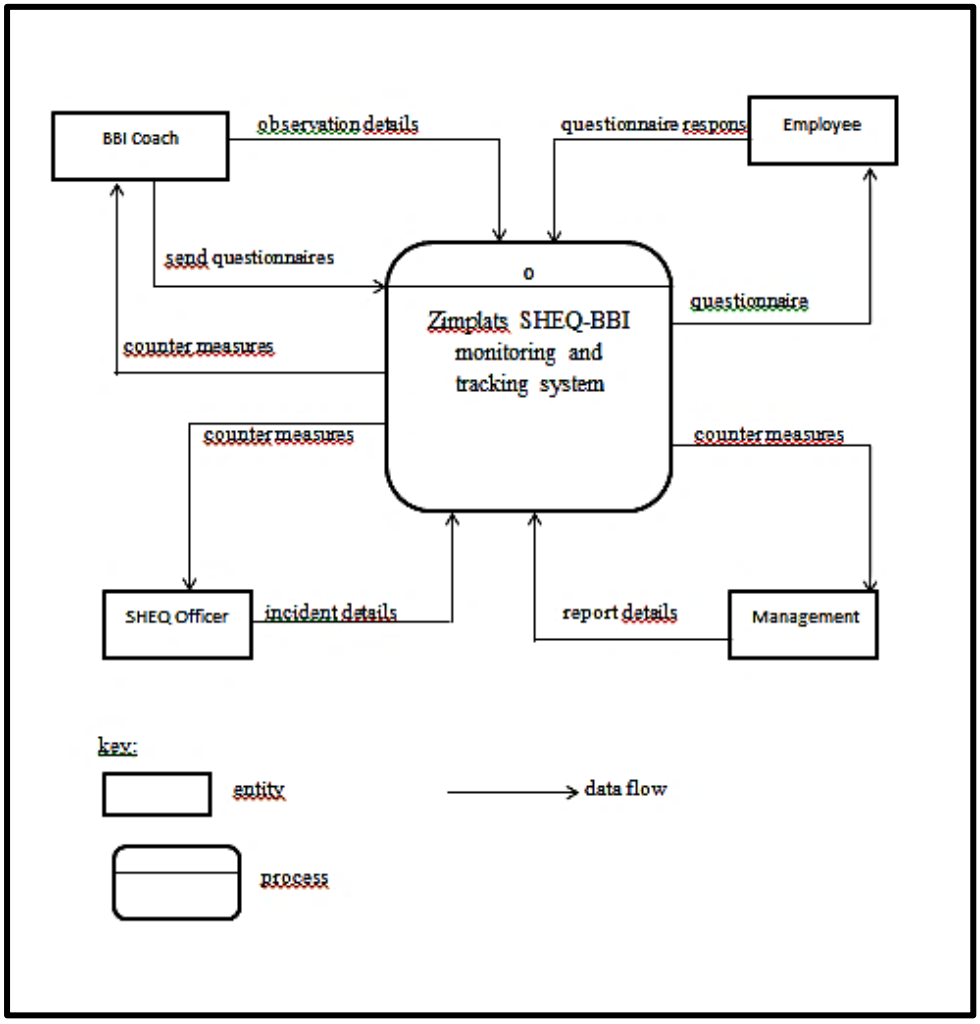

Fig 3.2: Context diagram of current system (adapted from Valacich, George and Hoffer, 2012)

The above context diagram is a representation of the entities and their relationship to the system that is currently in place. The BBI coach feeds in questionnaires as well as the observations and they retrieve the counter. The management is more focused on the reporting while employees respond to questionnaires. The SHEQ officer will be feeding in incident information.

3.5.2 Data flow diagram

A data flow diagram (DFD) as highlighted by Chowdory (2005) is a graphical presentation of the processes, components and how data flows within a system. The DFD vividly shows the functionality of the represented system.

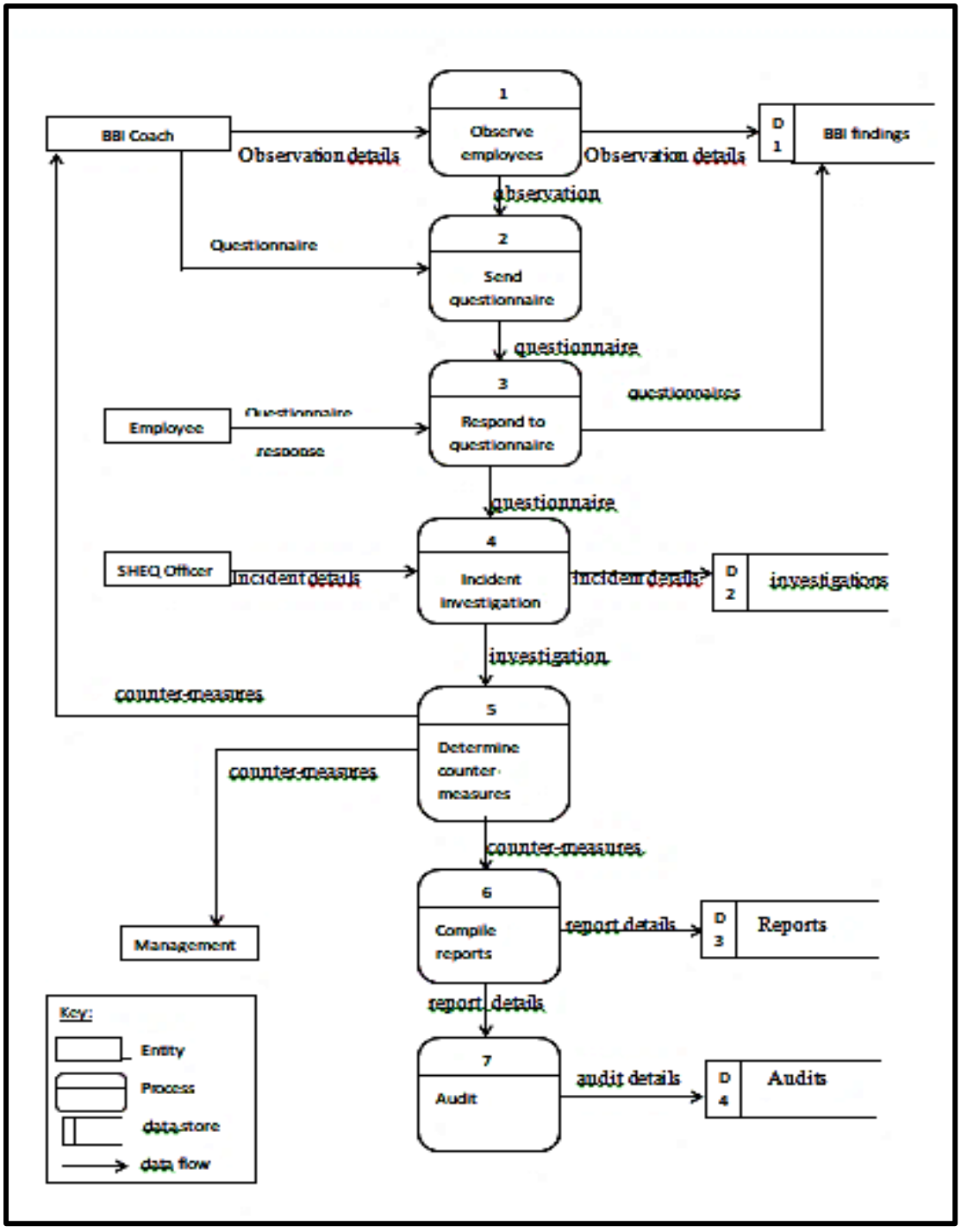

Fig 3.3: Data flow diagram of current system(adapted from Valacich et al, 2012)

The data flow diagram highlights the feeding in of observation and the sending of questionnaires by the BBI coach. The employees respond to these questionnaires and they are then used during investigations by the SHEQ officer. Counter measures are determined and these are sent to both management and the BBI coach. Supporting data stores are given for each entity. The current data flow however lacks the highlight on the calculation of lost time

as well as the determination of root causes to the incidences. Also there is room for obtaining biased questionnaire responses from the employees.

3.6 Weakness of current system

- Fraud is high as there is no monitoring of funds that would have been used during investigations.
- The system does not allow group interaction by management within the organisation.
- There is no automatic generation of reports for a specific period.
- There is no central repository of the incident investigations.
- The processes are repetitive and this results in the increase in errors.

3.7 Evaluate alternatives

Kezner and Harold (1995) highlights that this is the stage at which the organization decides on whether to develop the system themselves or look for external alternatives. The management is provided with all the information that is relevant to deciding whether the system should be in-house developed or outsourced. They will then make the final decision based on the information provided by the researcher.

3.7.1 Outsource

According to Kezner and Harold (1995), this is when an organisation employs an external development team who will then assist during the software development. These external developers can develop part of the system or the whole system based on the choices by the organisation.

Advantage of outsourcing

- There is room to concentrate on other projects as the current project will be carried out by a third part.
- There is production of high quality software.
- If the external company comprises of experts in the development field, it will then result in a competitive advantage to the organisation.
- Risk sharing between Zimplats and the developing company.

Disadvantages of outsourcing

- Confidential organisational information could be misused.
- Outsourced software makes it difficult to accommodate the future changes.
- Expensive and high maintenance costs in the long run.
- There is also a risk in failing to meet the changing user requirements.

3.7.2 Improvement

Improvement of the current system involves making the necessary changes on the current system in an aim to make it more suitable to the current needs. The organisation will look at areas which are necessary to make changes to which will in turn improve the current working environment of the employees.

Advantages of improvement

- Few development costs as only the areas of concern are improved.
- Maintenance costs are minimum as the maintenance is internal.
- Familiar user interface for the employees.

Disadvantages of improvement

- The solutions are short lived due to changing requirements.
- Resurfacing of errors in the current system.
- Bugs ay be found and some may not permit the use of old files.
- Costly in the long run as the occurrence of upgrades may increase.

3.7.3 Development

Development also known as in-house development is defined by Biafore and Stover (2012) as the process in which the organisation makes use of the internal development team to come up with the proposed system.

Advantages of development

- User requirements have greater chances of being met.
- Total control of the system is within the organisation.
- A thorough elimination of all the problems that are within the current system.

- Confidential information is secure as it is not shared with external parties.
- Organisational standards are upheld as the development team is well versed with them.
- Cost effective as the developer works within the budget highlighted during the economic feasibility study.

Disadvantages of development

- System completion might take long as the development team might have other tasks at hand.
- Budget constrains might arise during the development.

3.7.4 Conclusion of alternatives

It has been recommended that in-house development be carried out as its benefits outweigh those offered in improving the current system as well as outsourcing it. with in-house development there are higher chances of meeting all he user requirements as well as go over he expected.

3.8 Requirements analysis

Roseblatt (2013) highlight that this is the process by which the system's duties in terms of operation are established. These requirements include functional as well as non-functional requirements.

3.8.1 Functional requirements

Valacich et al (2012) highlights that these functional requirements are the process of identifying user expectations of the system. An analysis of the major functionality and objectives of the current system is carried out. He various system functionalities are highlighted below:

- Be able to carry out surveys both anonymously and with identity.
- Provide comprehensive reports.
- Track employee behaviour and make comparisons against the Bradley curve standards.
- Allow for multi-user operations without overwriting the other.
- Be secure in such a way that only authorised personnel access the system.

3.8.1.1 Use case diagram

The use case diagram is defined by Pilone and Pitman (2005) as a vivid graphical representation of the interaction between the entities and it specifies the role of each entity.

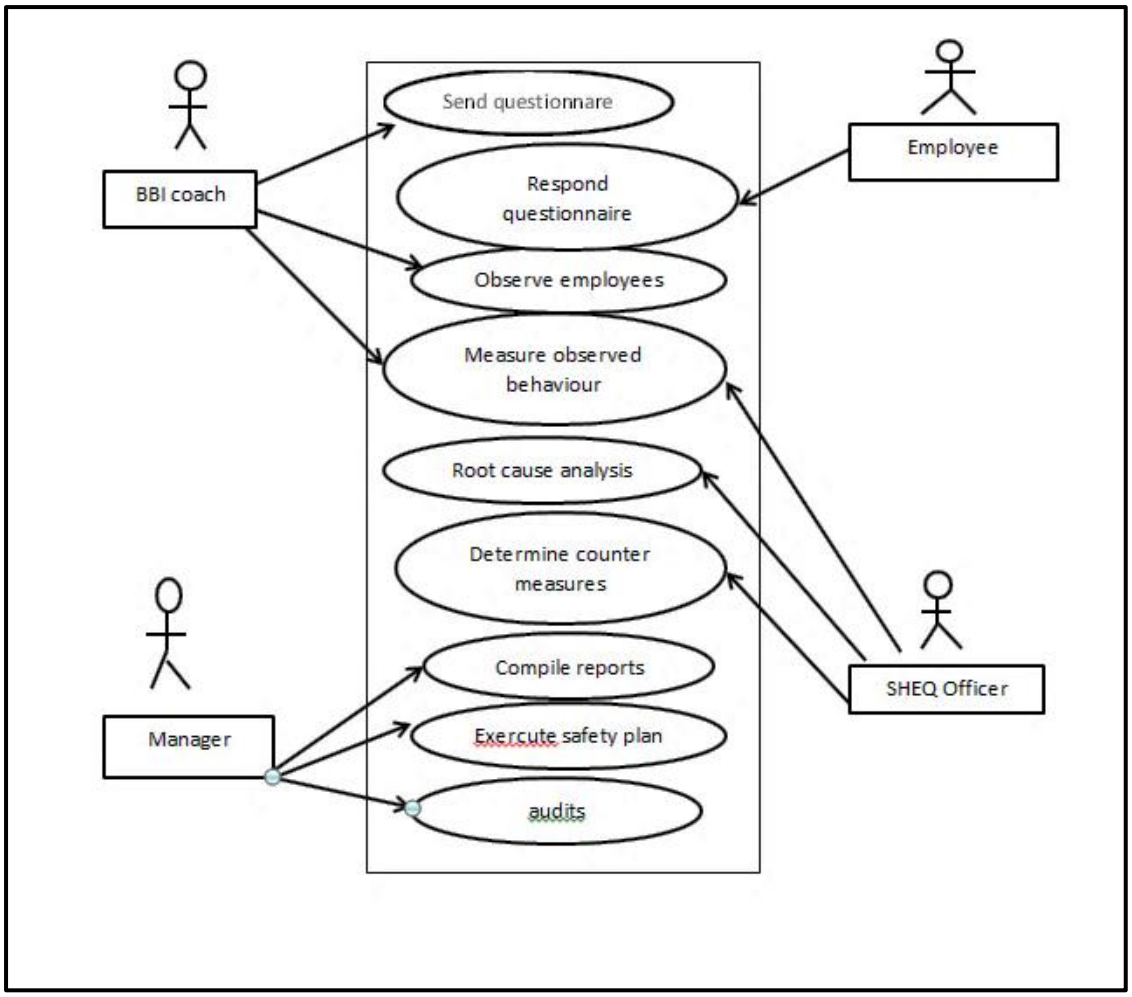

Fig 3.4: Use case diagram

The use case diagram represents the flow of relationships within the entities and the role played by each entity within the system.

3.8.2 Non-functional requirements

Valacich etal (2012) highlights that these requirements are not code specific but they arise during the development process of the system. These are the overall attributes and qualities of the proposed system. The following non-functional requirements are highlighted for the proposed system:

¾ Ease of use – the proposed system must be able to carry out tasks easily.

- User friendly – the user interface must allow for easy navigation through the various pages.
- ¾ Response time – there should be timely response offered after a user requests for any feedback.
- ¾ Security – various security measures must be put in place which includes assigning access levels which means confidential information is kept confidential.
- ¾ Error handling – the system should easily recover from errors as well as identify when wrong information is input.
- ¾ Reliability – it should allow room for convenience and accuracy.
- ¾ Professional interface – the system's main interface should be self-explanatory.

3.8.2.1 Constraints

- ¾ Costs – the various development costs might not be met due to budgets being under estimated.
- ¾ Time frame – delays might occur which will affect the proposed system delivery date.
- ¾ Resistance to change by users.

3.9 Conclusion

The current chapter established a thorough analysis of the existing system using inputs from both the development team and fact finding techniques. This helped in ensuring that the researcher has all the required information concerning the challenges being faced by users with the current system and at the same time look for ways to overcome these functional challenges. The next chapter will then therefore take a closer look at the design of the proposed system.

Chapter 4: Design Phase

4.1 Introduction

Ulrich, Karl, Eppinger and Steven (2000) highlight that the design phase is a process of applying multiple techniques and principles in an aim to clearly define a system in detail allowing its physical realisation. Both the logical and physical design aspects of the proposed SHEQ-BBI monitoring and tracking system. The propose system is designed in accordance with the organizational objectives. This stage will highlight the functionality of the system and the construction. This chapter will give an insight on the interaction between the various modules that are found in the system in-order to come up with an effective and reliable system that is goal driven.

4.2 System design

Schach (1999) acknowledges that this is a process in which modules, data, components and interfaces are defined all in an effort to ensure that there is satisfaction on the user specified requirements. Functional specifications that were produced during the system requirements analysis are then accurately translated into a physical architecture in the system design phase. User-oriented functional design is converted into technical, computer-oriented system design specification. The Zimplats SHEQ-BBI monitoring and tracking system is broken down into system inputs, system processes and system outputs. These are explained below:

¾ **System inputs**

- Observation sheets that are filled in by the BBI coach.
- Investigation sheet accumulated from survey responses.
- Survey responses from all employees.
- Articles with the current issues of concern in various fields of work.

¾ **System processes**

- Creation of new system users and assignment of roles.
- Ranking of survey responses.
- Tracking of employee behaviour.
- Calculation of production costs incurred and lost revenue due to incidents.

- **System outputs**
  - Comprehensive investigation reports.
  - Tracking and monitoring of all safety issues and employee relations.

4.2.1 Context diagram of proposed system

As defined in Chapter 3, Section 3.5.1. The proposed system's context diagram below is constructed by author. This had been an improvement to the current context diagram given in the previous chapter as it gives a clear user relationship with the system and all major stakeholders have their roles clearly defined.

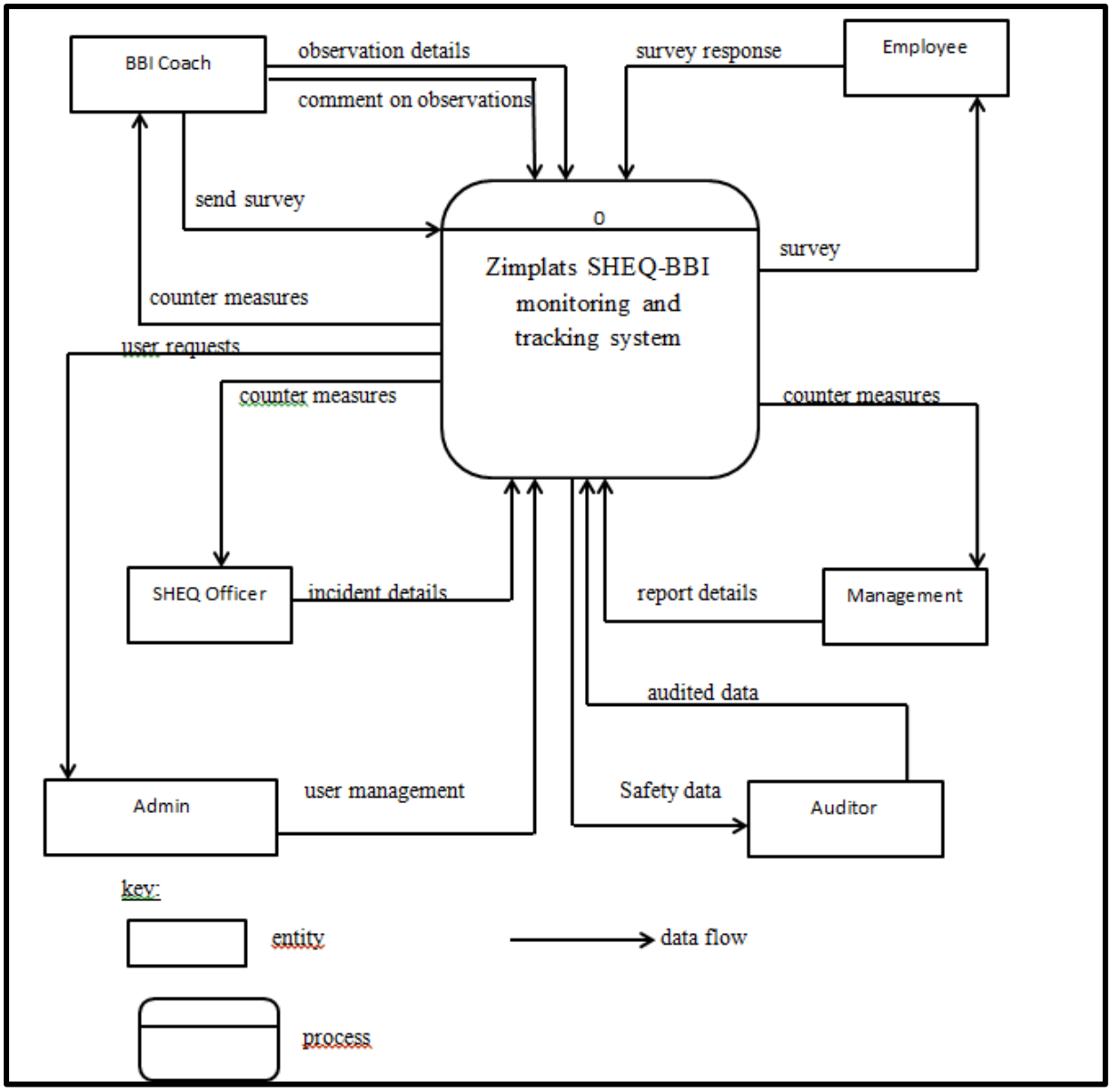

Fig 4.1: Context diagram of proposed system (designed by author)

The context diagram shows the SHEQ officer obtaining the required SHEQ information from the system. There is an analysis of the investigation from the filled in observation sheets that were made available. The employee will fill in survey questions and view all submissions as well as their ratings. The BBI coach will fill in the observations and provide comments to be used during counter measure development. The auditors and management will draw out reports and other areas of concern.

4.3.2 Data flow diagram of proposed system

This has been defined in Chapter 3, Section 3.5.2. Zimplats SHEQ-BBI monitoring and tracking data flow diagram is given below as constructed by author. The current is an advancement to the current DFD given in the previous chapter as it ensures that all the stakeholder requirements are met and well addressed.

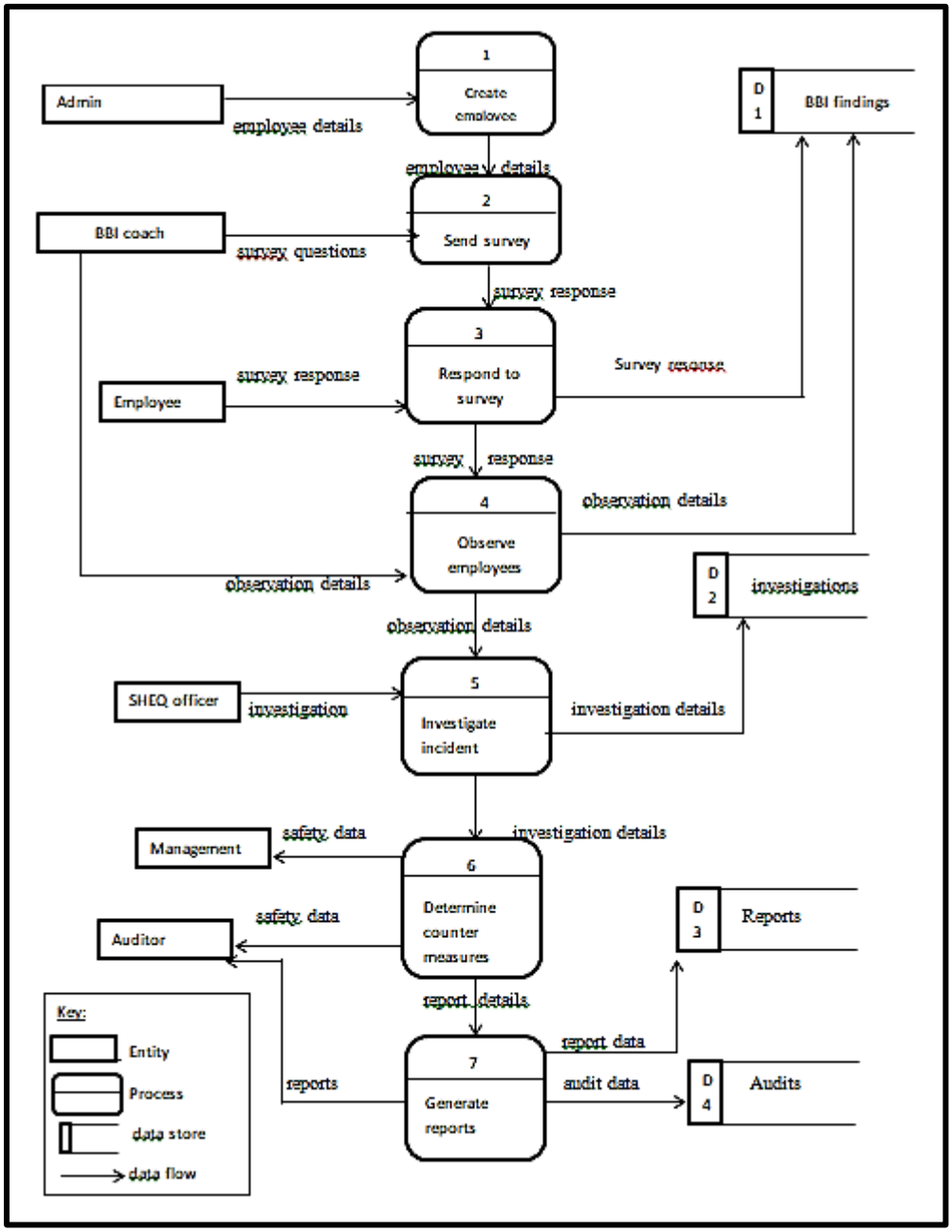

Fig 4. 2: Data flow diagram of proposed system (designed by author)

The DFD highlights that the employee responds to the survey questions which are then sent to the BBI coach. The BBI coach observes employees and fills in an observation form that is used to investigate incidences and come up with the root cause. Audit reports are sent to the auditors. Managers will access the investigations and observation s and compile detailed incident reports.

4.3 Architectural design

Sommerville (2004) states that this is the provision of a description of the technical environment including the software, hardware, users and the procedures. The architectural design in Ulrich, Karl, Eppinger and Steven (2000) is a set of vital decisions on the interaction of system software, selection of structural elements as well as the interfaces on which the system is composed and their behaviour as specified in the elements' collaboration. The major aim of this design is to come up with modular program structure of the system. The system architecture will comprise of:

- Server – all processes will pass through the server as there is need for storage of configurations and system data.
- Client machine – these are the workstations use by individuals.
- Networking cables – for provision of links between the organization's network.

4.3.1 Client server approach

This is defined by Coronel and Morris (2014) as the way in which client users use different mediums for communication with the database. The client server approach is the communication between the clients and the server. Every query made by a client is processed through the database which hence defines the approach.

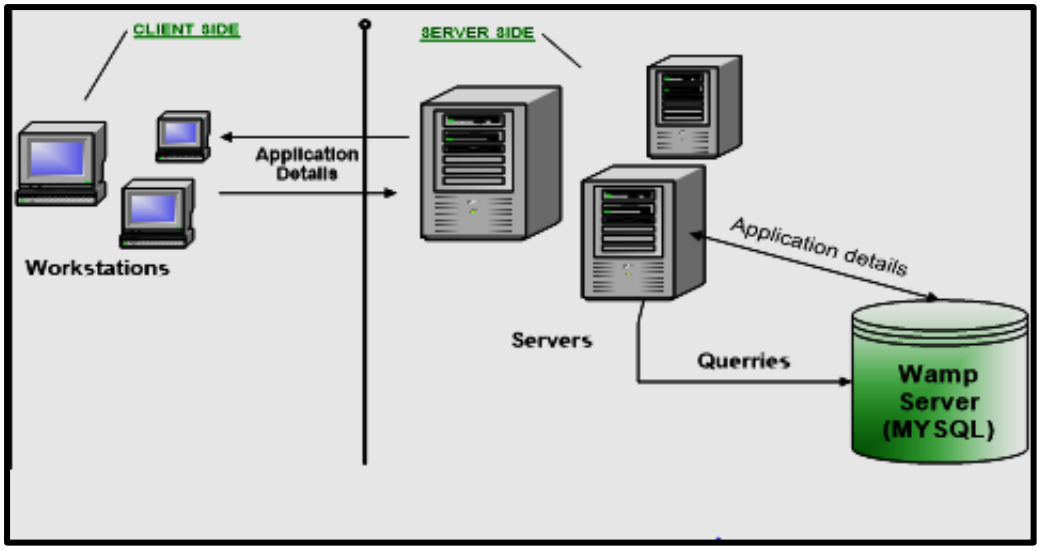

Fig 4.3: Architectural design of proposed system(adapted from Coronel and Morris (2014)

4.4 Physical design

Schach (1999) states that this is the proposed system's hardware and software design and interaction. The physical design describes the technical environment and it is made up of hardware to be used as well as its structured way of use. The Zimplats SHEQ-BBI monitoring and tracking system will operate within a LAN as it will enable internet sharing; it is also a means to provide cheap communication and data security. There are switches, wireless router, network cables, a firewall and an application server found within the LAN.

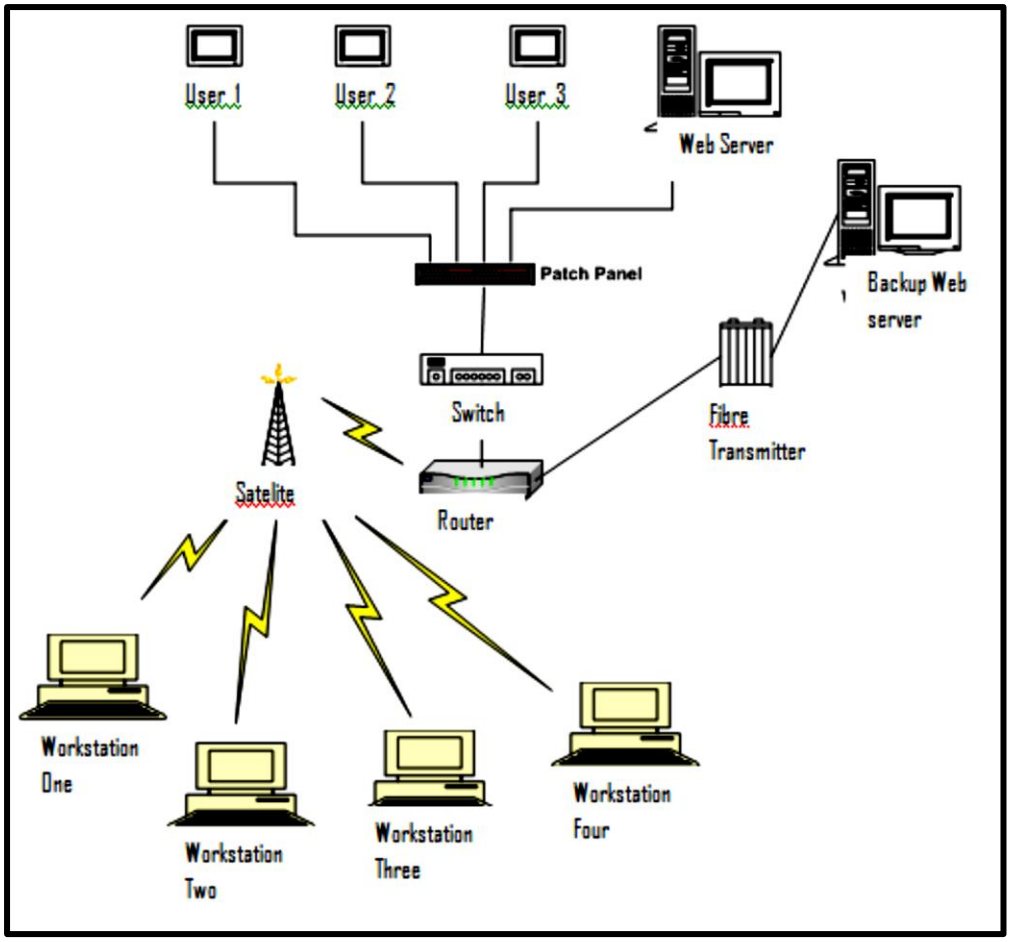

Fig 4. 4: Network architecture (adapted from Coronel and Morris (2014))

4.5 Database design

This is defined by Coronel and Crocket (2008) as the process of creating a detailed modelling of a database. Wesley (2005) highlights that this is the process of coming up with a design which supports the organisation's mission statement and objectives for the required database system. It deals with the adaptation of the business model into an optimally structured database model. There should be data redundancy minimization as well as consistency and integrity within the database.

4.5.1 Database architectural design

It shows the logical representation or view of the database management system. Components of the schema architecture are the internal layer, conceptual layer and the external layer.

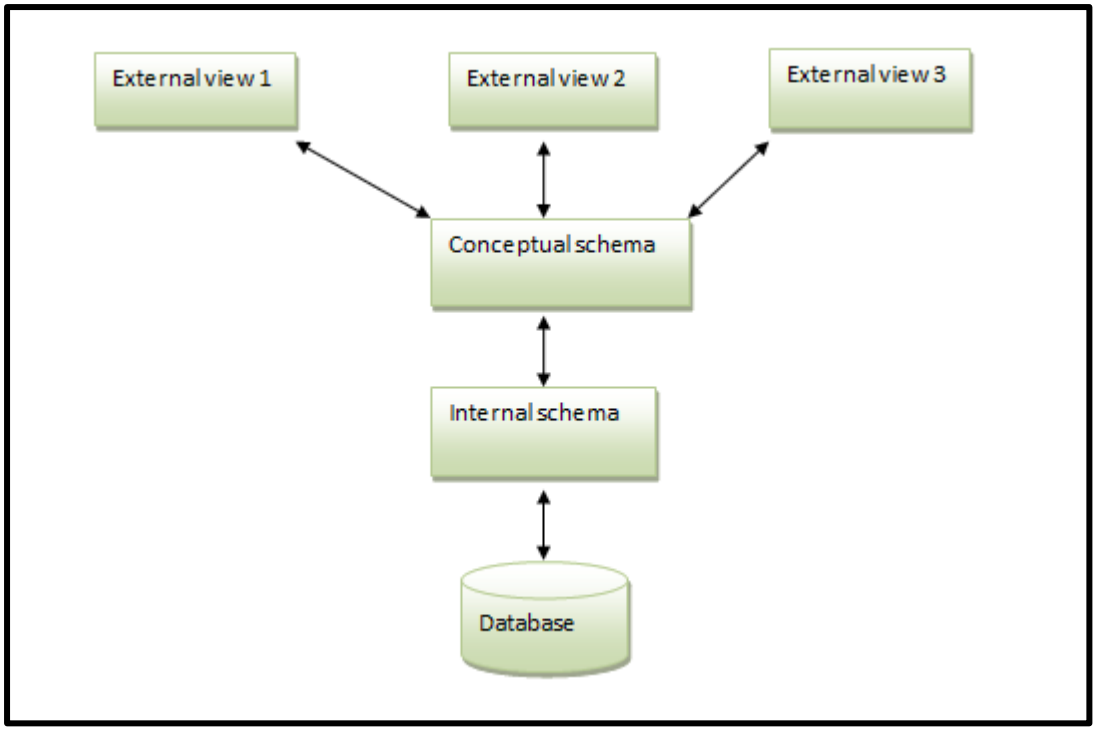

Fig 4.5: Database schema (adapted from http://datafiletech.blogspot.com/2012/09/three-level-architecture-of-dbms.html.)

The diagram highlight that the external view is related to the data viewed by individuals as well as describes the segment of the database required by a specific user group and hides the rest from the user. The conceptual level describes the relationship existing on the data as well as how it is stored. Major focus is on the description of entities, data types, relationships, user operation and constraints that are associated with the schema. The physical layer is responsible for the data storage in different forms of storage. Data is stored in a way that can only be read by the database management system.

4.5.2 Data modelling

This is the process of analysing and defining of the data requirements in an aim to support processes of the business and matching against the organizational information system. This is done through the entity relationship diagram or tables and the enhanced entity relationship diagram.

4.5.2.1 Tables of the system's database

Employee details table

This table is used for the creation of employees within the system and modification of their details.

Table 4.1: Employee details

Field name	Description	Data type and length
Employee id	Key field	Integer (5)
Department id	Department of employee	Integer (2)
Title	Prefix to employee name	Varchar(4)
Name	Name of employee	Varchar(15)
Phone number	Contact details of employee	Integer (11)
Password	User login password	Varchar (8)
Email address	Employee email	Varchar (20)
Role	Designation in system	Varchar (10)

Departments table

The table is used to capture various departments within the organisation.

Table 4.2: Departments table

Field name	Description	Data type and length
Department id	Key field	Integer (2)
Name	Name of the department	Varchar (10)
Description	Brief description of services offered by department	Varchar (30)

Articles table

This is a table to capture details of all articles uploaded to the system.

Table 4.3: Articles table

Field name	Description	Data type and length
Article id	Key field	Integer (2)
Topic	The article title	Varchar (10)
Description	Brief notes on the article	Varchar (30)
Date created	Date when article was created	Date
Created by	Who created the article	Varchar (15)

Injuries table

The table is used to capture details of incidences that would have occurred.

Table 4.4: Injuries table

Field name	Description	Data type and length
Injury id	Key field	Integer (2)
Investigation id	Identity column of investigation	Integer (2)
Hours affected	Duration of incident	Integer (2)
Hourly cost	Lost time cost	Double (5)
Hourly revenue	Revenue per hour	Double (5)
Total employees	Employees affected	Integer (2)
Created by	Who investigated	Varchar (15)
Date created	Date of incident	Date

Investigations table

This table is used to capture investigation details by the SHEQ officer.

Table 4.5: Investigation details

Field name	Description	Data type and length
Investigation id	Identity column, key field	Integer (2)
Observation id	Identity column of observation	Integer (2)
Title	Title of investigation	Varchar (10)
Description	Brief notes on the investigation	Varchar (30)
Findings	Investigation outcome	Varchar (30)
Created by	Who investigated	Varchar (15)
Date created	Date of investigation	date

Observations table

This table is used for capturing all observation details.

Table 4.6: Observation table

Field name	Description	Data type and length
Observation id	Key field	Integer (2)
Name	Observation name	Varchar (10)
Description	Brief description of observation	Varchar (30)
Date created	Date of observation	Date
Created by	Who observed	Varchar (15)

4.5.2.2 Enhanced entity relationship

Bagui and Earp (2011) states that the enhanced entity relationship (E-ER) diagram is a preferred logical data model which accurately depicts entities and their relationships. The E-ER diagram is a specialized model that originates from common entity diagrams.

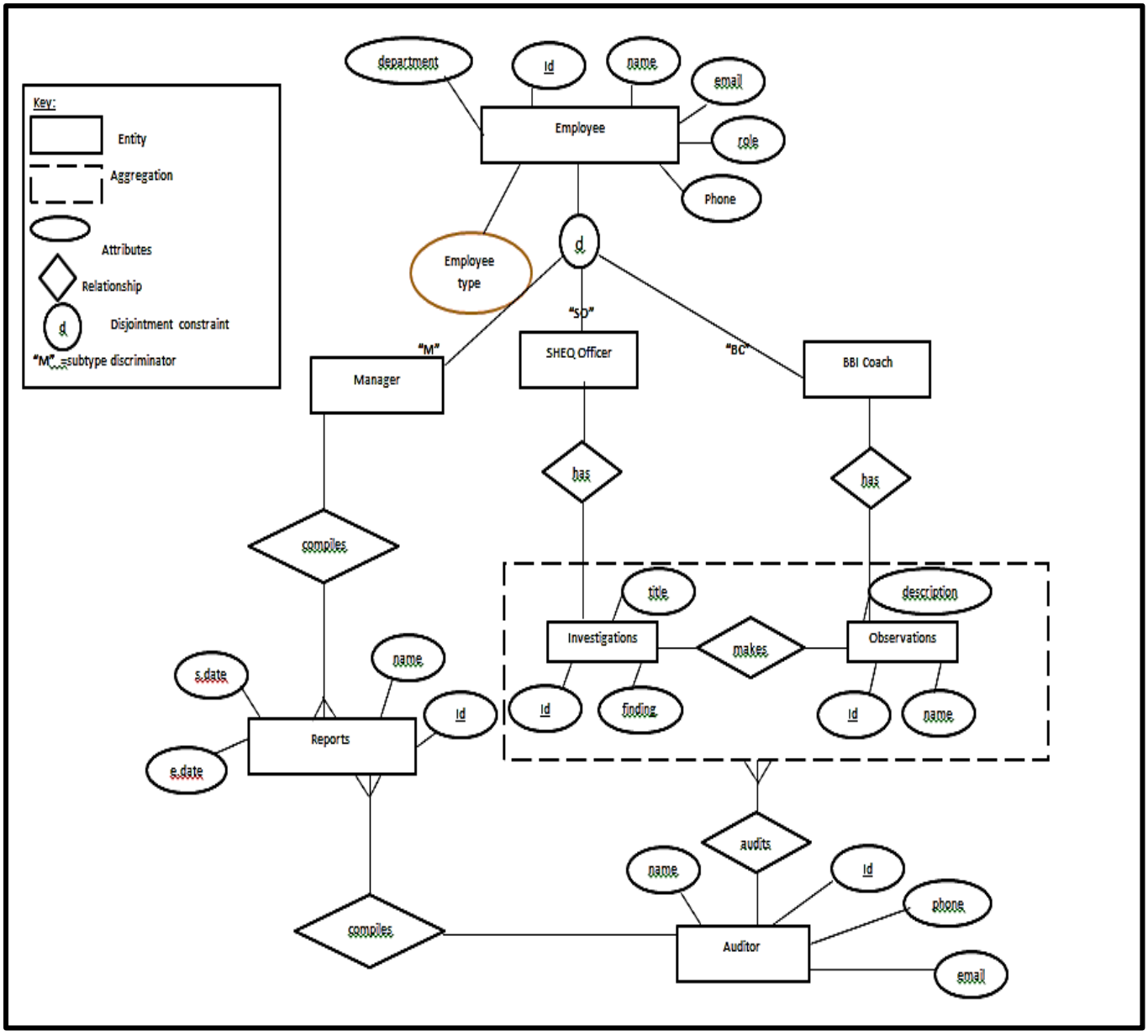

Fig 4. 6: E-ER diagram of proposed system (designed by author)

The E-ER diagram how the entities interact and the type of relationships that they each have. The aggregation aims to highlight how the auditor overlooks both the investigations and

observation. The subtype discriminator is there to indicate the differences in the subtypes from the super entity.

4.6 Program design

This is the process of defining classes, modules as well as functions of the proposed system (Ulrich et al, 2000).

4.6.1 Package diagram

According to Keyes (2002) a package diagram is a reflection of the organisation's packages and elements. Coronel and Crocket (2008) highlights that this is a modular structure of the system which shows the breakdown of system modules as well as their interaction.

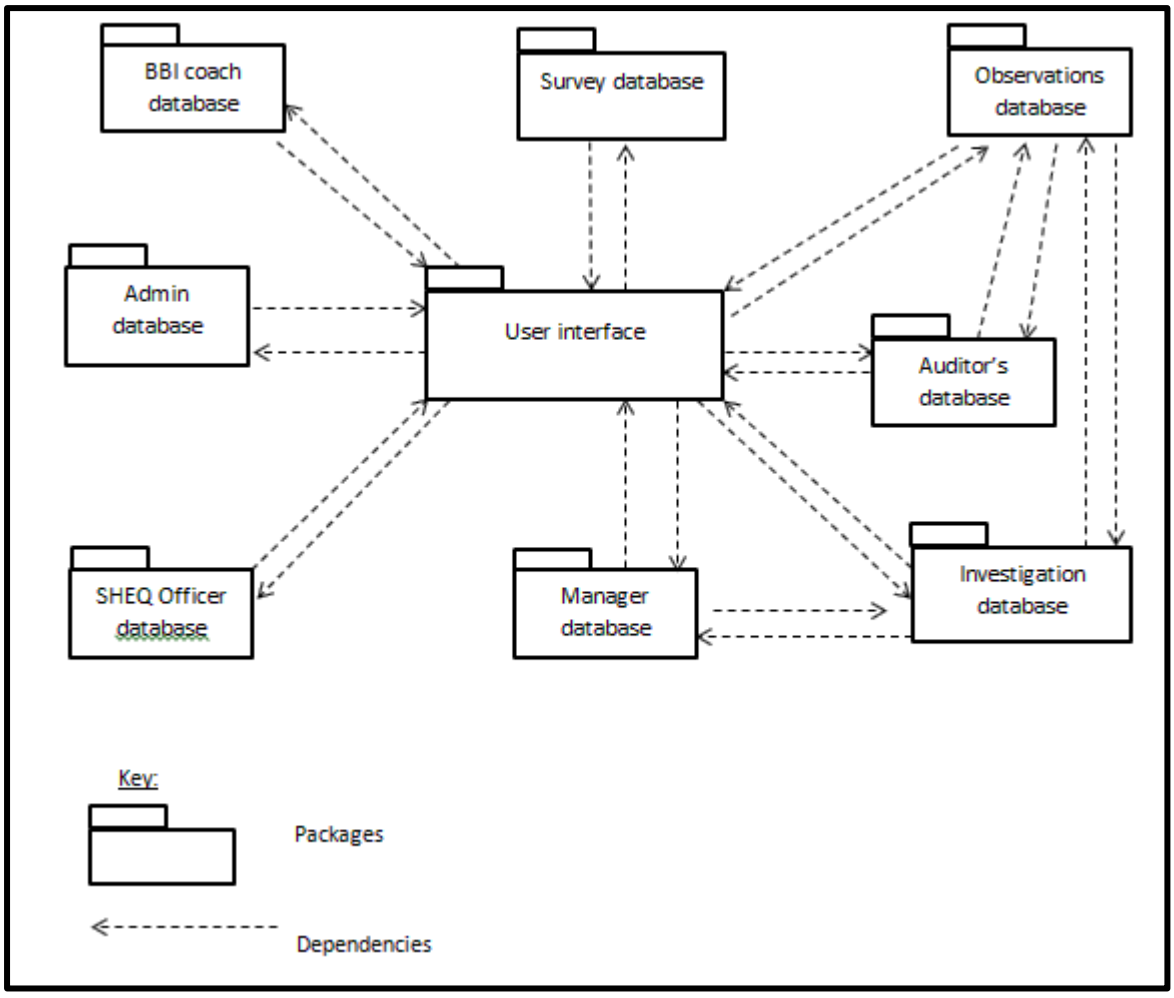

Fig 4.7: Package diagram (designed by author)

The package diagram highlights the interaction on packages and their dependencies on each other. All the packages require the user interface for them to be accessed and written to or read from. Some of the packages like the investigations and the observations require direct access as they depend on each other for their data gathering.

4.6.2 Class diagram

The class diagram according to Coronel and Crocket (2008) is a static structure diagram which defines the construction of a system by highlighting the classes, attributes and relationships among the classes. It shows the interaction between behaviours of the expected classes and their expected states.

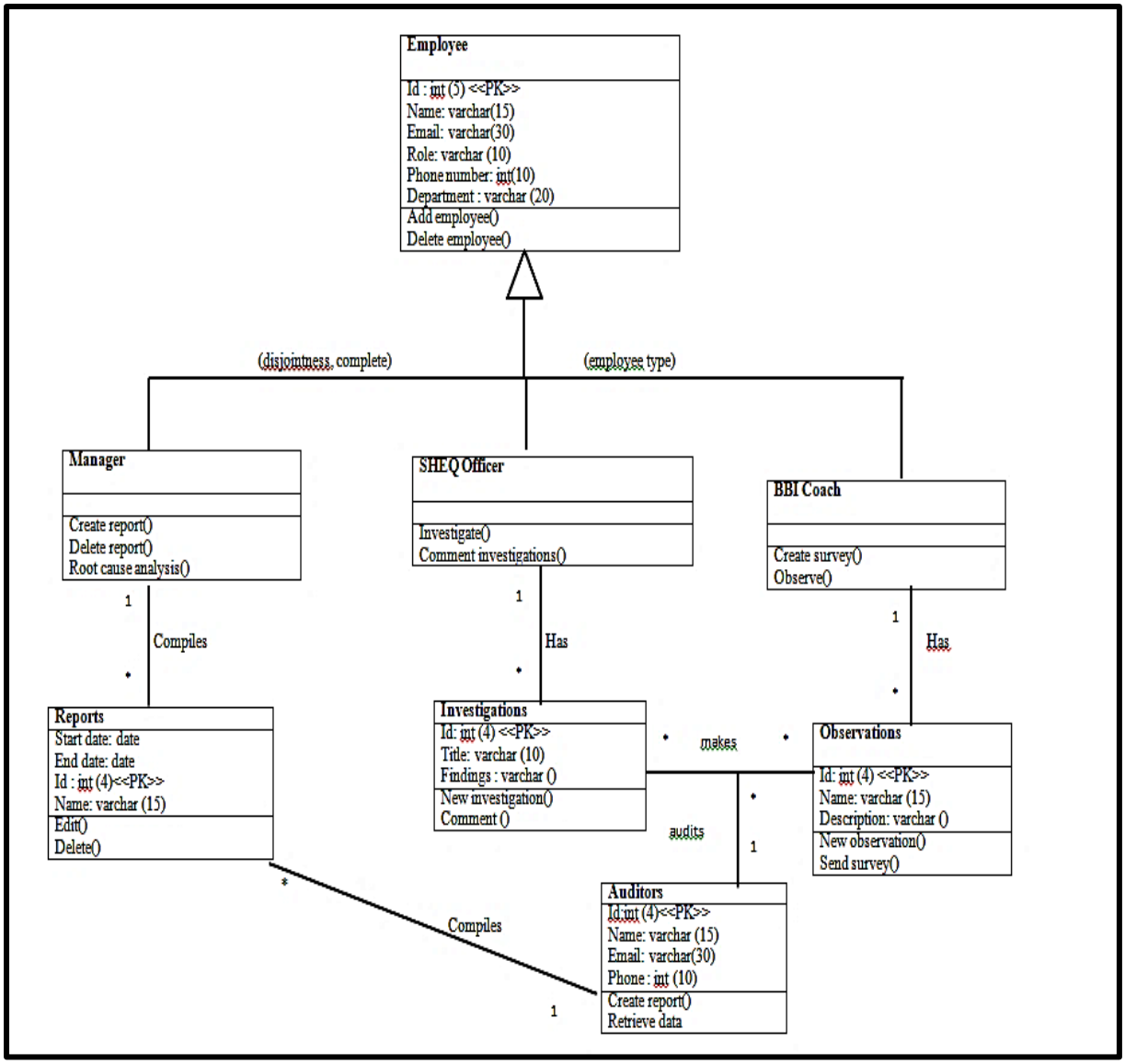

Fig 4.8: Class diagram

The class diagram highlights the entity relationships as well as the methods or actions to be performed by each entity. The relationships on the entity relationship diagram reflect on those highlighted in the entity relationship diagrams.

4.6.3 Sequence diagram

A sequence diagram as stated by Unhelkar (2000) is the interaction among objects within a system. Coronel and Crocket (2008) postulates that it is a model of flow of logic in a system in a visual manner, hence enabling the validation and documentation of logic.

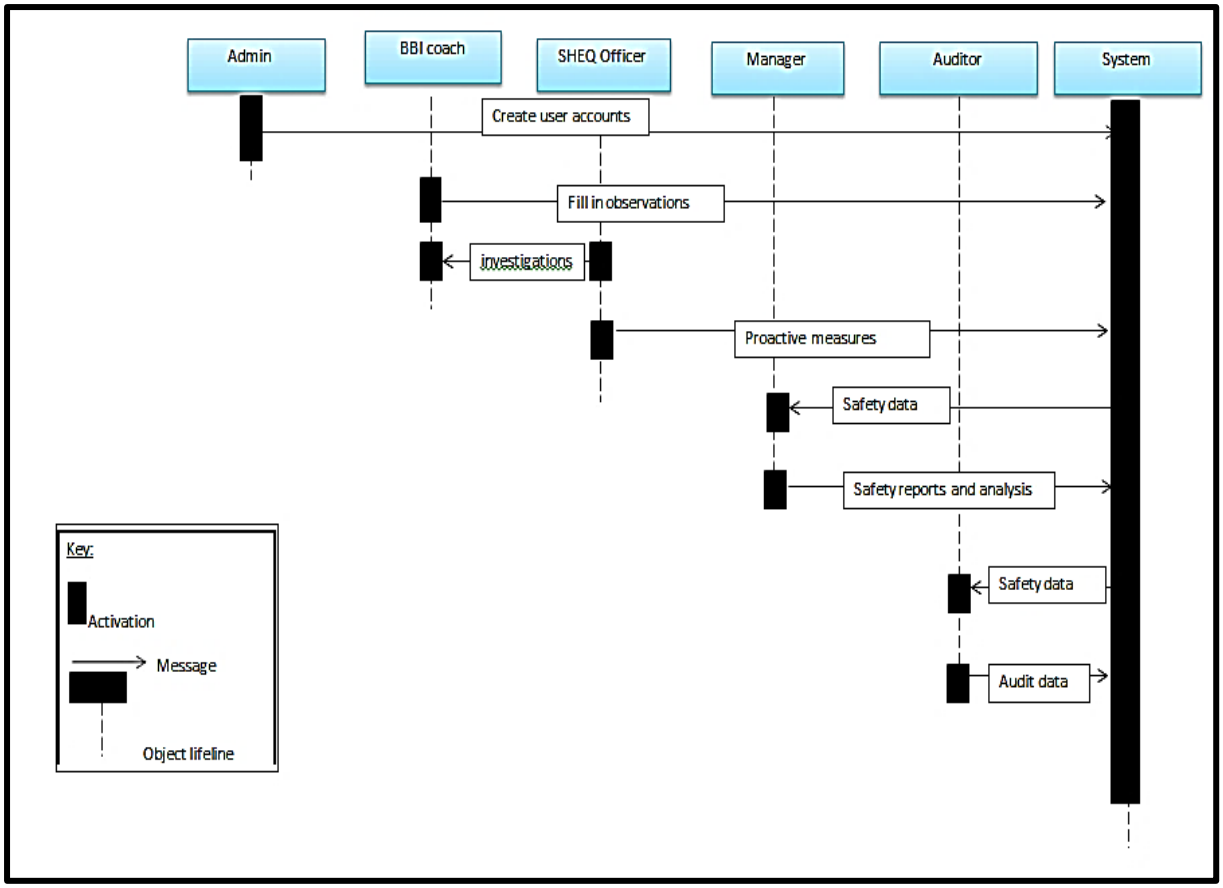

Fig 4.9: Sequence diagram of proposed system

In the sequence diagram above, users have to first log into the system inorder to carry out their tasks. The BBI coach fills in the observation form which is then accessed by the SHEQ officer for investigations. Proactive measures are deducted and fed into the system. The management and auditors access the safety data and use it for reporting and auditing respectively.

4.7 Interface design

As highlighted by Sommervile (2004) this is the provision of a platform to perform specific services or tasks on the system. An interface is the mediator between the user and the computer. The interface should be easy to understand and user friendly and also bring out the organisation's way of operation.

4.7.1 Menu design

The menu design is the design of the system's home page which is the view that is available to all the users of the system. It also consists of the submenus and what each entity is authorised to access within the system. The following is the menu design of the proposed system.

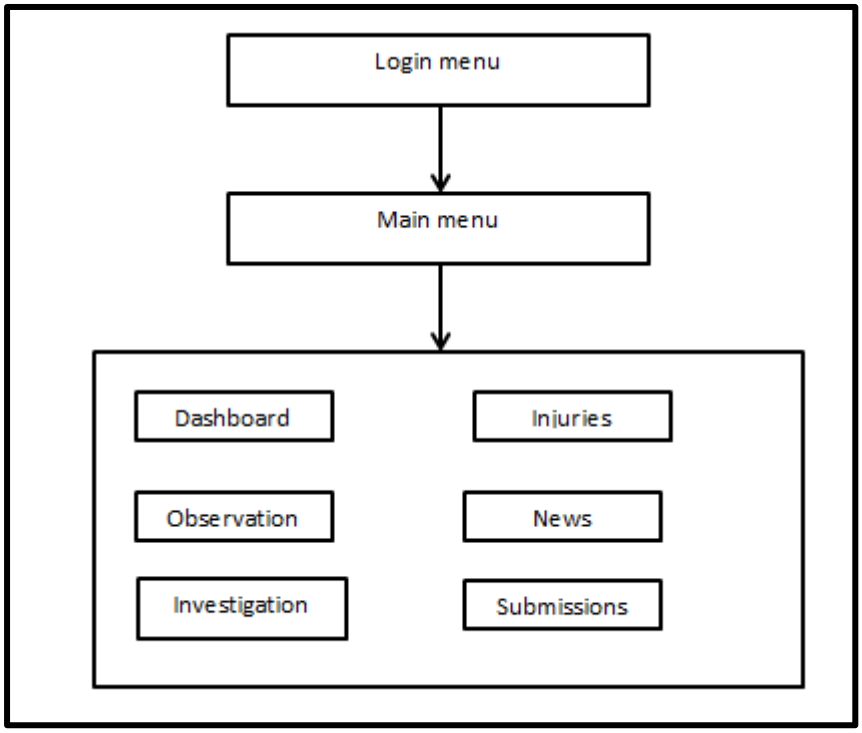

Fig 4.10: Menu design

4.7.1.1 Main menu

The main form allows users to interact with the SHEQ-BBI monitoring and tracking system. It allows for the users to respond to survey questions and also be able to view the top articles posted. The main menu gives room for users to view their profile details and submissions made to the system.

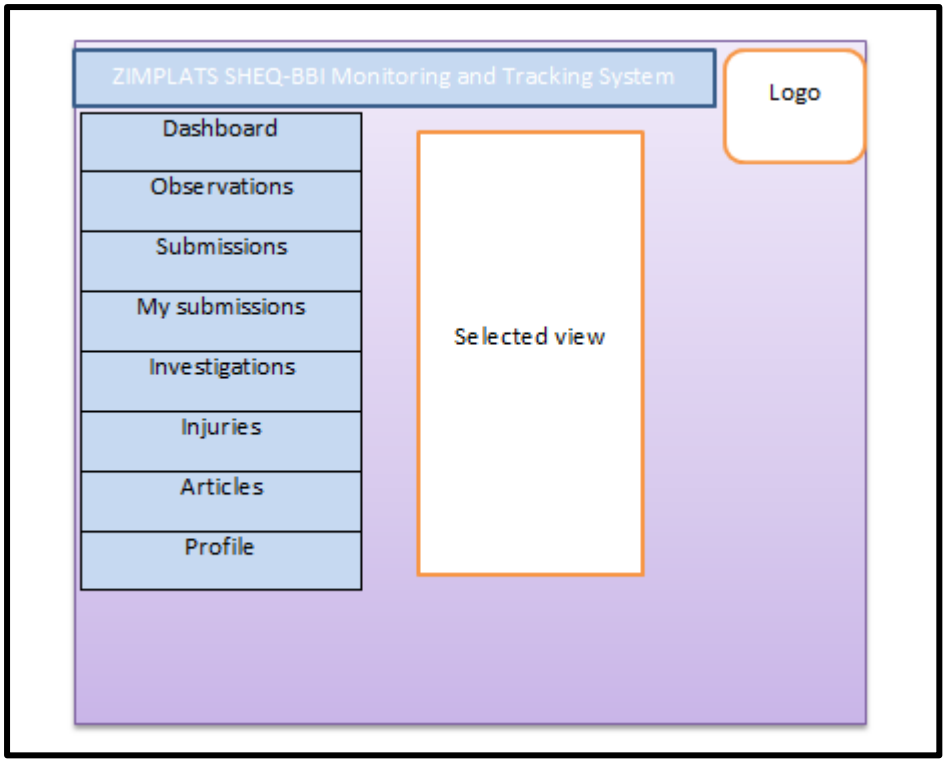

Fig 4.11: Main menu

4.7.1.2 Sub-menus

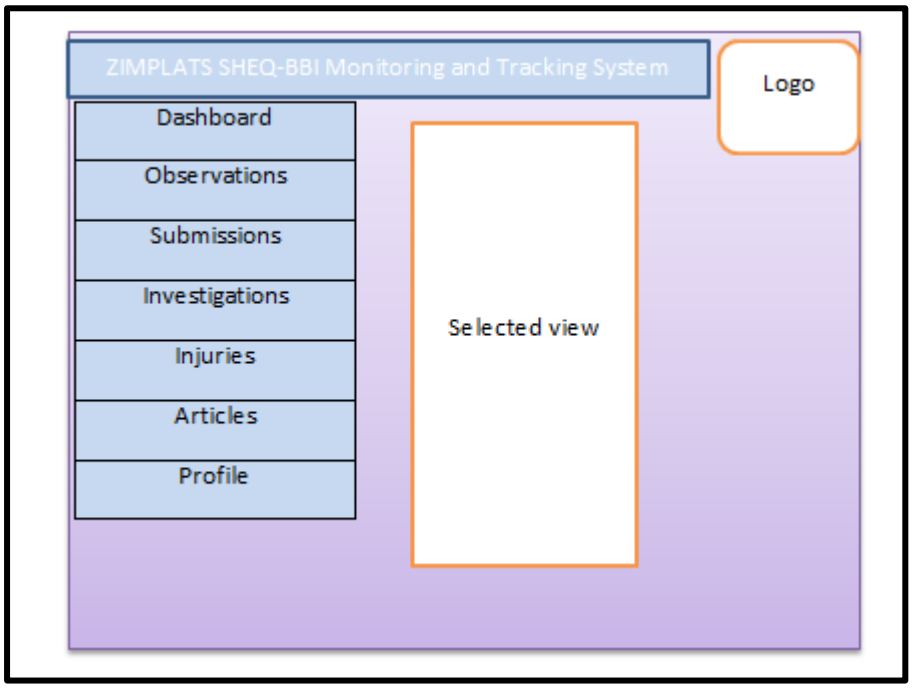

Fig 4.12: Auditor's menu

Auditor's menu does not have "my submissions" tab as the auditor only accesses data input to the system for auditing purposes.

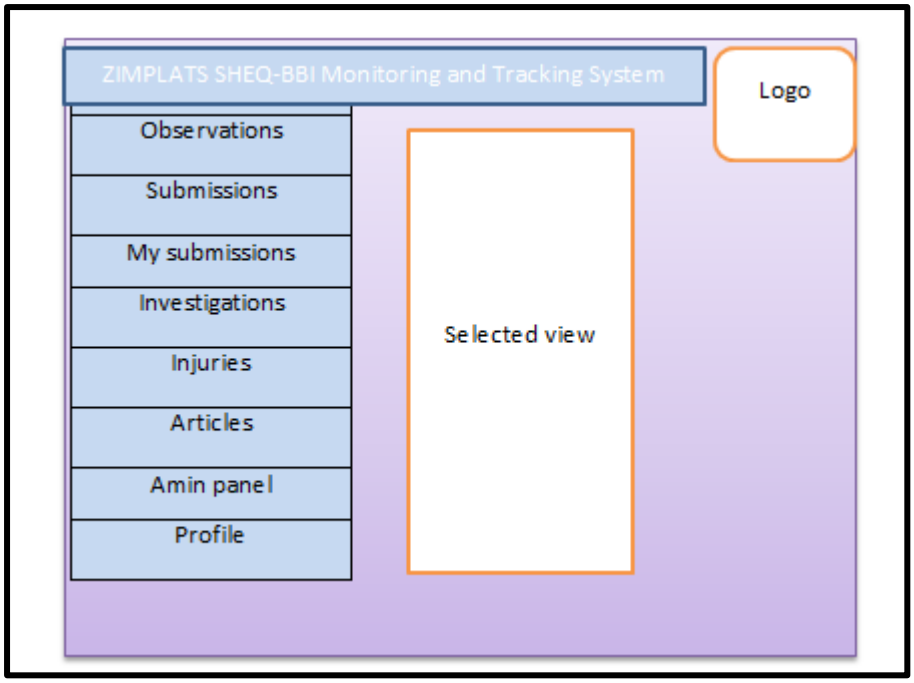

Fig 4.13: Admin menu

The admin menu has an added “admin panel” tab for the creation and management of user accounts.

4.7.3 Input design

Input design according to Valacich, George and Hoffer (2012) is the conversion of user-oriented description into computer based system. Validation of fields is of major importance when designing he input forms.

Login form

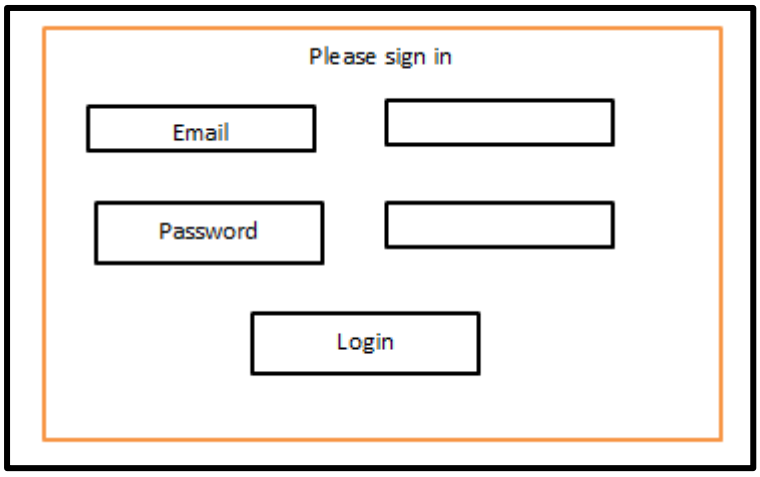

Fig 4.14: Login form

The form allows users to access the system after providing the correct login credentials.

Add new user

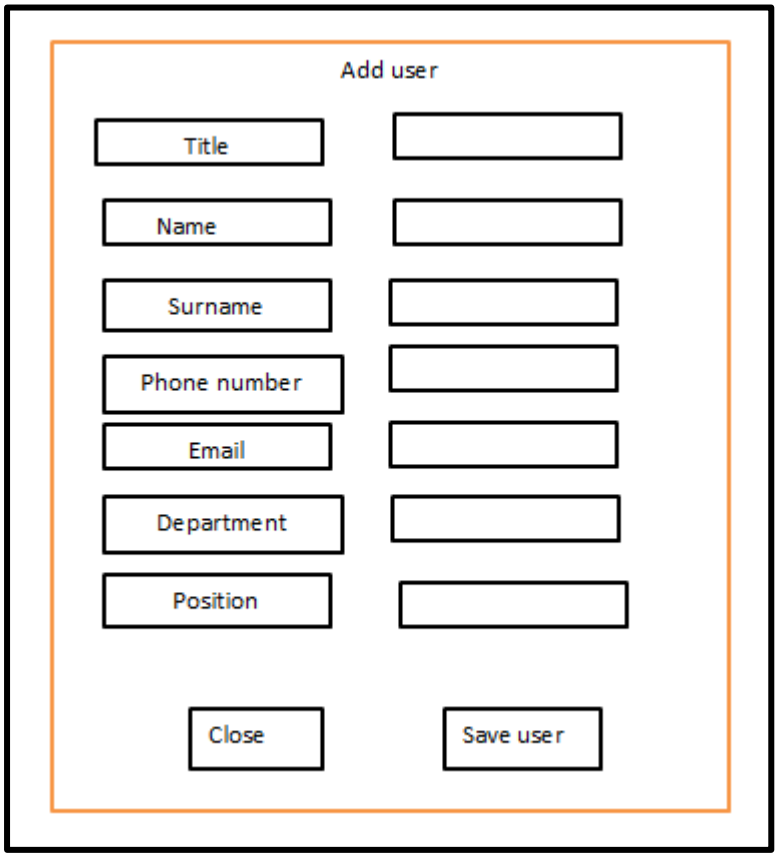

Fig 4.15: New user

The form allows the administrator to add new users to the system. The administrator also has to ensure that the correct validation is input on the fields and assign the individual access levels through the “position” tab.

Add department

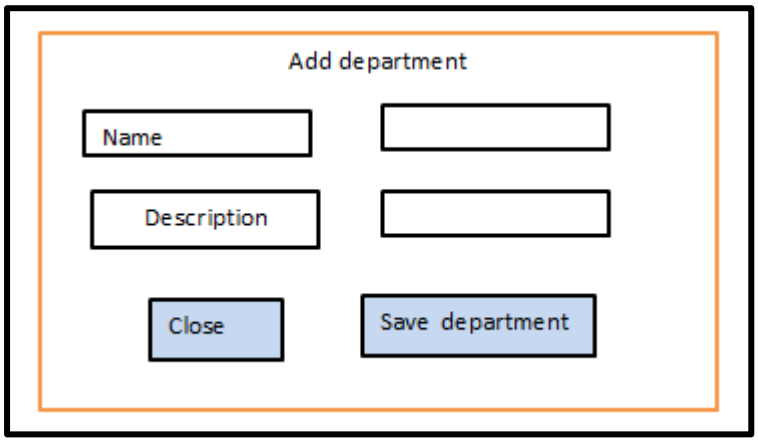

Fig 4.16: New department

The form allows for the creation of a new department into the system.

New observation

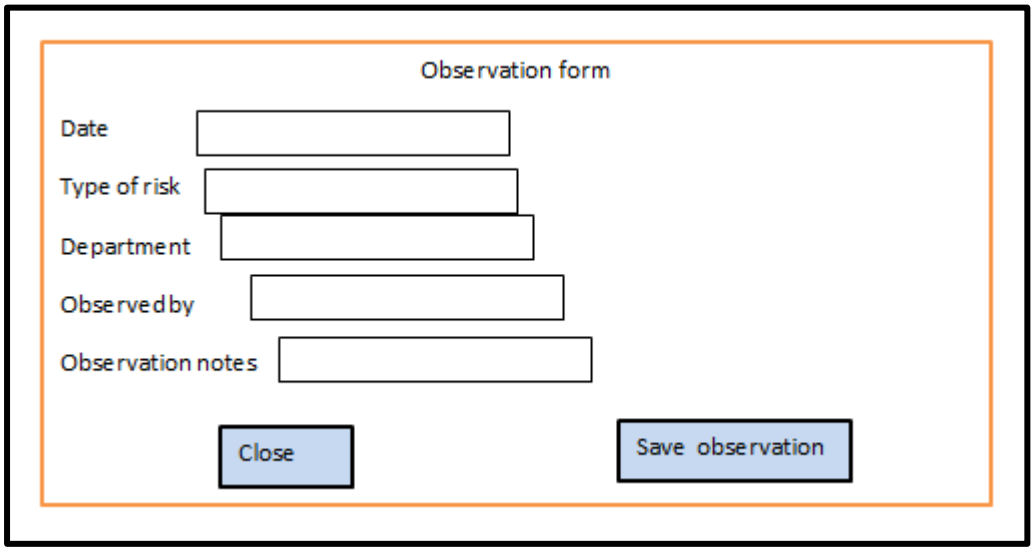

Fig 4.17: New observation

The form allows for the capturing of observation details to be used during investigations.

New survey

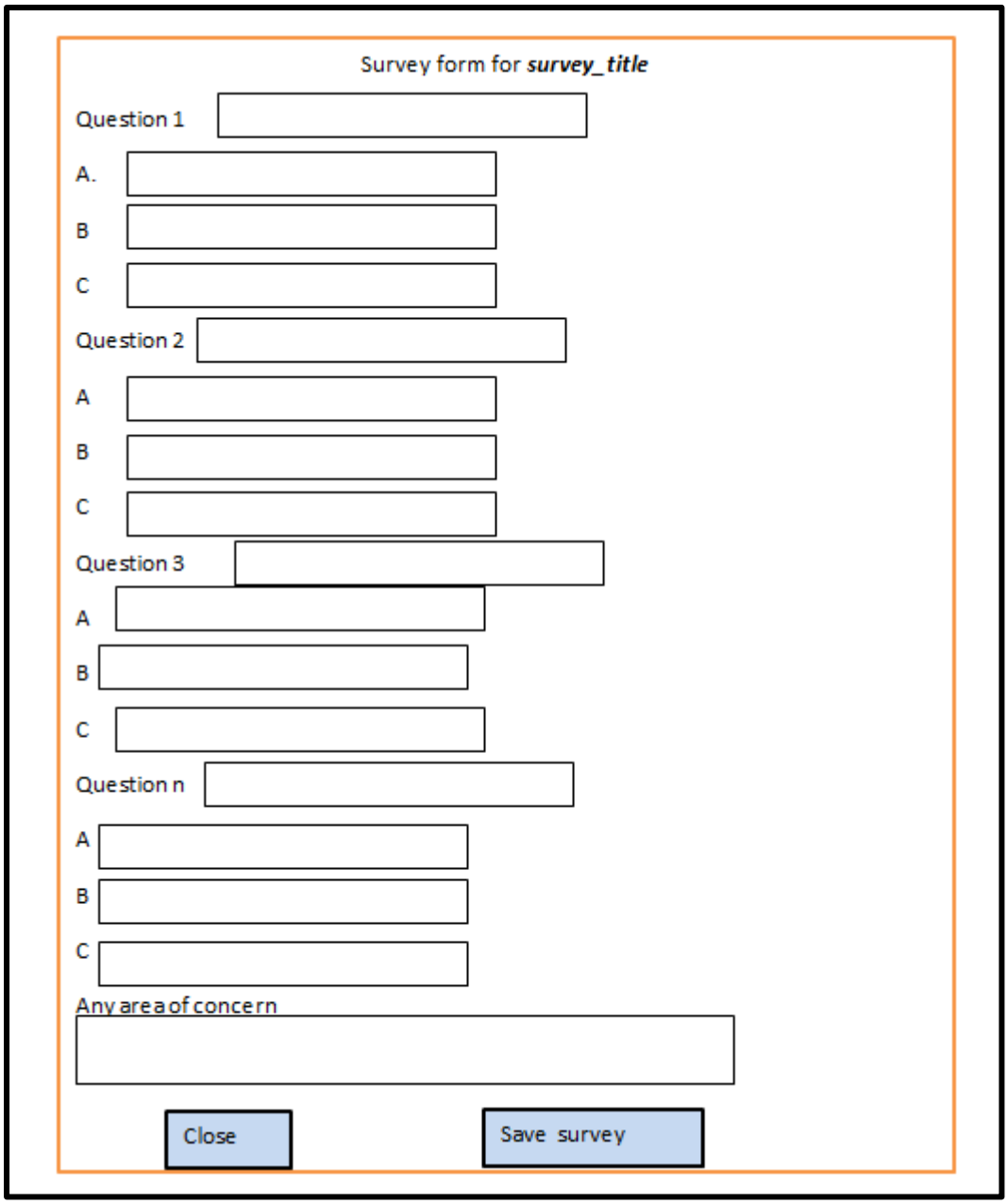

Fig 4.18: New survey

This form allows for the sending of new surveys to the users of the system. the survey responses have different priority levels given to each question to allow for ranking.

5.7.3 Output design

Valacich et al (2012), stipulate that this is the system output production after processing the inputs. The focus is mainly on the reports that are to be generated by the system.

Safety reports

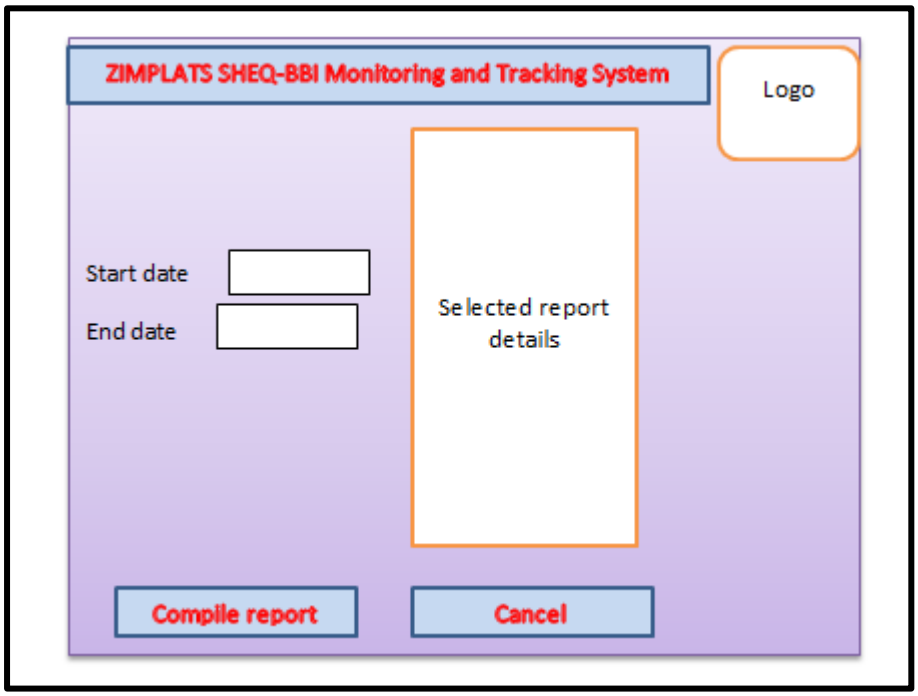

Fig 4.19: Report generation

This form is used for the creation of reports that are within a system after opening the required tab.

Injuries summary

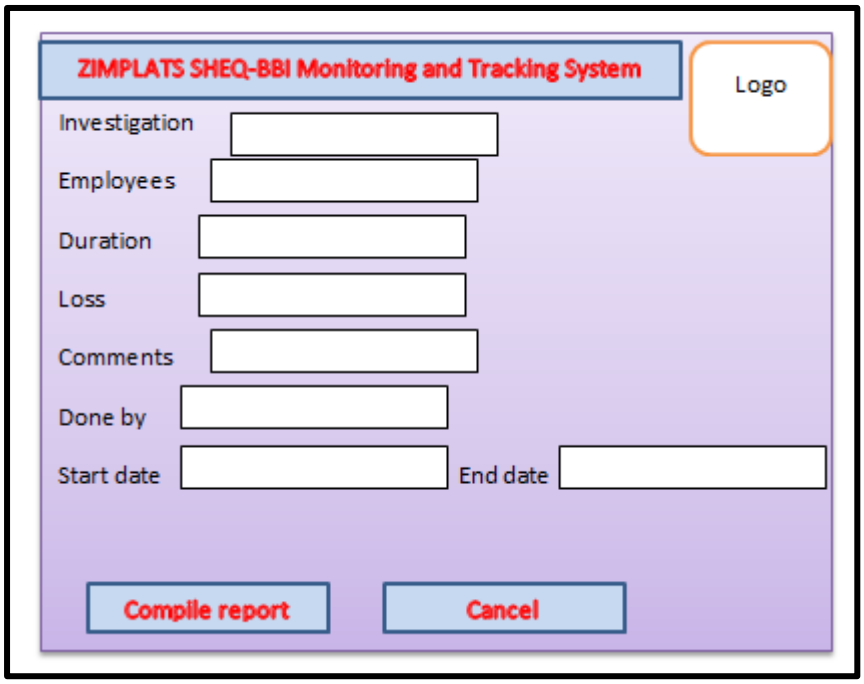

Fig 4.20: Injuries listings

This output form gives a summary of injuries as well as the lost revenue and lost time.

4.8 Pseudo code

This is defined by Chonoles and Schardt (2011) as the use simple language to express the system's functionality in a way that can be easily understood by a third part. Pseudo code omits detailed language-specific syntax and cannot be compiled into an executable program. The pseudo code is used as a way to create a rough draft of a program before it is converted into an executable program. Below is the pseudo code for selected modules within the system.

User login

- This is responsible for the authentication of login credentials into the system.

Enter the username and password

If correct Then

Login

Else

(UURU PHVVDJH VKRZLQJ ³,QYDOLG ORJLQ 3OHDVH WU

Refresh page and retry

End if

New user addition

- This is responsible for adding new users to the system.

Fill in all required fields

Click submit button

//validation of the entered fields

If all fields are correctly validated Then

Execute query

Records saved to database

Terminate connection

Popup confirmation message

Else

Error message with incorrect validations highlighted

End if

Report generation

- This is for the creation of reports within the system.

Select the range of dates

//Validation of date range

If selection is correct then

Report gets generated

Else

Report generation error

End if

4.9 Security design

Stephen and Schach (2002) highlights that security design is the principle of building or designing software which can secure information against threats or attacks. Various technologies are put in place to ensure the safety of confidential organisation information. Physical, network as well as operational security mechanisms is put in place.

4.9.1 Physical security

Green, Gibson and Hughes (1994) stipulate that these are measures which are put in place to ensure that no unauthorized access is granted to system facilities, hardware and resources through the enforcement of physical barriers. To ensure the physical security of the system there has been put in place surveillance system in all data centres and server rooms. Also there is the use of biometric access control to access points. The traditional lock system to all offices has also been put in place. All these measures made the researcher conclude that there is no intrusion to the system and its hardware.

4.9.2 Network security

Wiley, Shelly and Rosenblatt (2010) define this as the use of networking infrastructure to prevent intrusion. The use of login credentials is one of the effective ways in which the system will be kept secure. Data encryption during transmission is also another way in which security of data can be achieved.

4.9.3 Operational security

Whitten, Bentley and Dittman (2004) state that these are procedures put in place by individuals or organisations to protect their confidential information. To ensure that operational security is attained the researcher put in techniques that guard the database information from the public users.

4.10 Conclusion

The chapter gave a detailed insight on the design and functionality of the SHEQ-BBI monitoring and tracking system. There has been a clear indication of flow of data from one module to the next as well as all the designs of both input and output forms. All this has paved way for the next chapter whereby the author will look at the implementation phase.

Chapter 5: Implementation Phase

5.1 Introduction

Coronell and Morris (2014) highlight that implementation is the process of ensuring that the product is delivered to its intended users with all their requirements being met. Watts and Humphrey (1999) stipulate that it is the process in which the administration technical and personnel issues are addressed. This involves software and hardware review, physical installation, procedure documentation and user training. Implementation is a systematic stricter with the aim of effectively integrating the developed system into the current workflow of the organisation. the main purpose of the implementation phase is to ensure that the system is integrated into the production workflow that it was designed for.

5.2 Coding

Rouse and Smith (2005) cite that coding is the encoded statements and scripts that are involved in the development of a program. It is also highlighted by Stephen and Schach (2002) that coding is the phase in which the developers use a source code to compile a software program. The module integration and database connection are carried out through the code. Coding is a critical element of the system as this is where the operations and functionalities of all modules are determined. The development of the Zimplats SHEQ-BBI monitoring and tracking system was done using PhP programing language and MySQL application used for the building and manipulation of the database. The data dictionary elements were conceptualized during database design and mapped into appropriate tables assigning attributes.

5.3 Testing

Dustin (2002) states that this is the process of verifying and being certain that the produced product meets the user specifications, requirements and purpose. Somerville (2004) highlights that this is the process by which there is evaluation of the system to see if it meets all the requirements as well as detecting errors present. There are various testing levels that are made available. The diagram below shows the testing strategies that are involved.

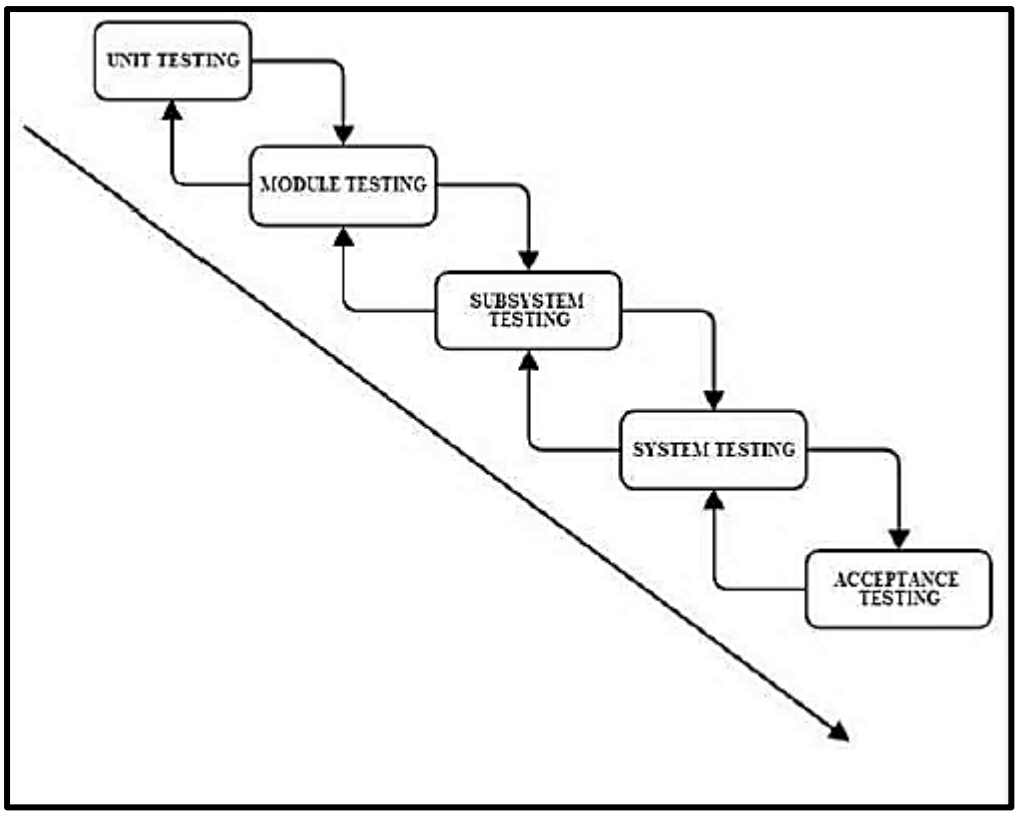

Fig 5.1: Testing stages (adapted from Dustin, 2002)

5.3.1 Unit testing

According to Stair (2013) unit testing is the process by which tests are carried out differently on the different modules of the system. Verification of the functionality of specific sections of code is carried out during unit testing. Whitten and Neal (1993) refer to unit testing as a strategy which focuses on the verification of the smallest units of software design and software modules or components. There are two types of unit testing which are black box testing and white box testing.

5.3.1.1 Black box testing

Krugman (2005) state that this is a testing strategy in which there is non-functional and functional testing without referencing the workability of components or the internal structure of the system. The individual testing has no access to the source code of the module or unit that is being tested. The "big black box" is the source code and the individual testing does not know its contents and they only test the functionality of the system. The major focus of black box testing is on the front end system rather than the back end system.

5.3.1.2 White box testing

Eppinger (2008) stipulates that this is testing which mainly focused on the innermost details of a component.it is also referred to as glass box testing or structural testing. The strategy takes into account the internal mechanism of the system. This type of test is mostly carried out by the programmers to check the code and how it performs the intended instructions. Parameterized methods are used to test the different variations of the code and how it will produce the required output.

5.3.2 Module testing

Keyes (2002) highlight that this is also referred to as the integration testing and it is a logical extension of the unit testing. The sub-units are tested for functionality of each one and they are then combined together to form one module that is then tested to check if it is performing in the required manor. Various test cases are deduced after a code has been written by the developer.

5.3.3 Subsystem testing

This is a testing strategy that is also known as link testing due to the collection of various unified modules being tested into a prescribed sub-system. it focuses on testing the external Application Programming Interfaces (API) that are within the system.

5.3.4 System testing

It is when the behaviour of the completed system is tested is tested as highlighted by the project development scope. Integration of all the modules assists in coming up with one complete system to be tested. Efficiency and effectiveness of the system are tested. The system testing stage tests on the system and how it has managed to meet the set objectives. Also to take into account is the compatibility of the system to the available hardware.

5.3.5 Acceptance testing

Stair (2013) stipulates that this is testing where there is implementation of the system to be tested for acceptance by the various stakeholders. The acceptance testing's major objective is to establish confidence in the proposed system. It enables the developer to carry out quality

control tests and how the user expectations are met in an effort to replicate the anticipated system functionality. Users can log on to the system with different roles and test if all their specified functions can be successfully executed. There is alpha testing and beta testing in acceptance testing.

5.3.5.1 Alpha testing

Dixit (2007) highlights that this testing is carried out by the developers. Alpha testing is also known as internal acceptance testing as the developers or stakeholders directly linked to the development process are the ones that carry out the testes. Alpha testing is done prior to the completion of the system and there are minor alterations done to the design of the final system.

5.3.5.2 Beta testing

This is defined by Dixit (2007) as the external acceptance testing and it is carried out by the system users. The external users are given access to the system and they use it under real world conditions. The beta testing is done after alpha testing has been done and the users will take into account those areas that require change in terms of the system's functionality. Also there is the detection and correction of bugs to the system.

5.3.6 Testing strategies

These are strategies put in place to measure the system effectiveness. The testing helps in identifying errors and developing source codes to correct the errors.

5.3.6.1 Validation

Wiley et al (2010) stipulates that this is a set of actions used to check the system's compliance with the functions and the actions are carried out throughout the system's life cycle. The major objective of the system validation is to ensure that the system meets the pre-determined specifications ad attributes as well as ensuring that it is delivered to the end users without any errors.

Log in validation

The log in is where the system users enter their credentials in order to gain access to the system. Incorrect user log in credentials generate an error message whilst the correct credentials direct the user to their pre-determined platform where they will carry out their operations. The fig below shows the login page that is used by all the users to gain access into the system.

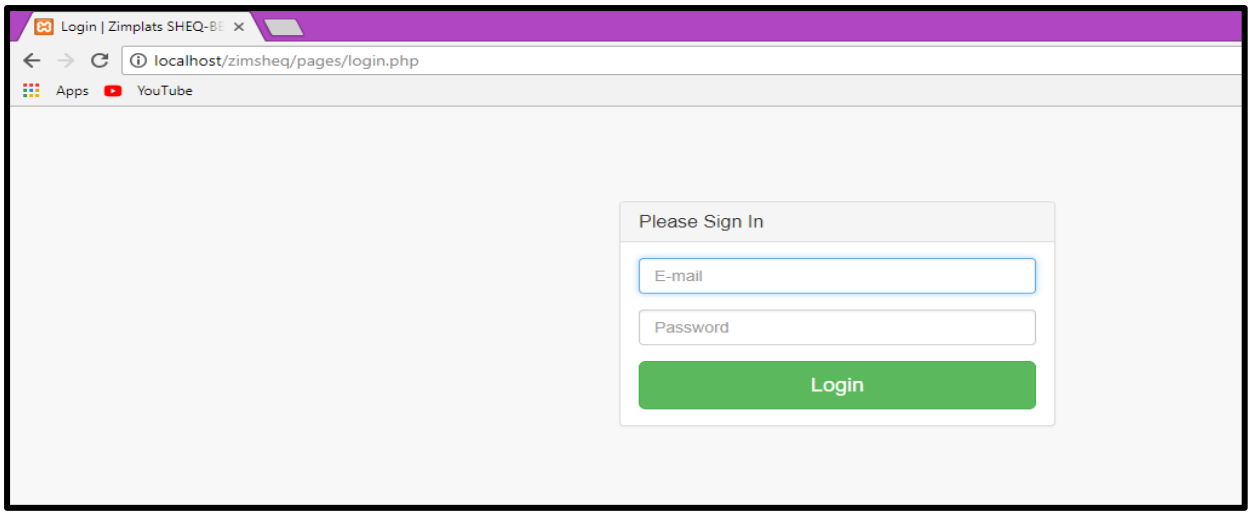

Fig 5.2: Log in page

If the user is to input incorrect credentials the following error message will pop up.

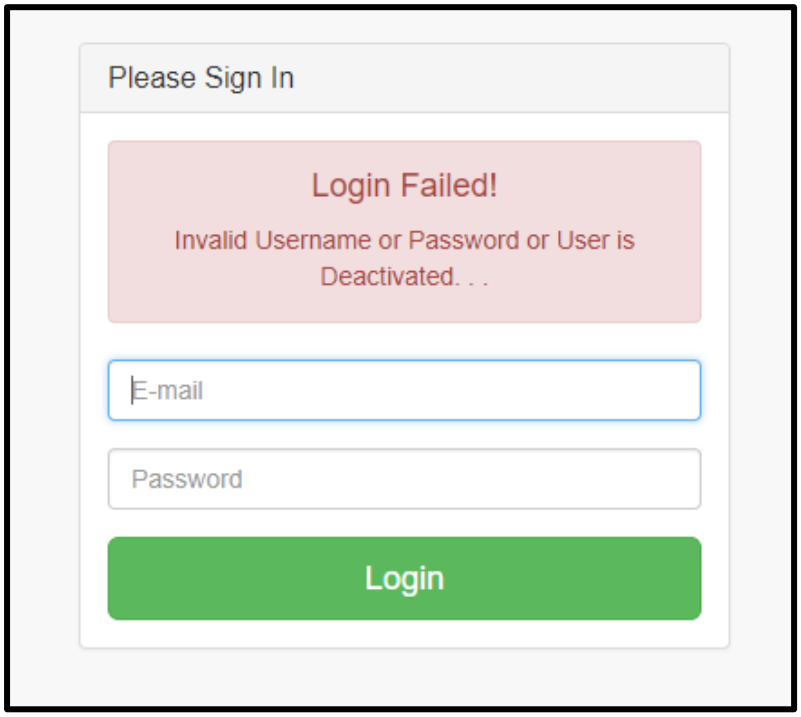

Fig 5.3: Invalid log in

User input validation

This validation technic focuses on the correctness of the information that is being entered into the system. It takes into account the characters that are allowed and the fields that need to be filled in. Below is a form that is used to input the new user details.

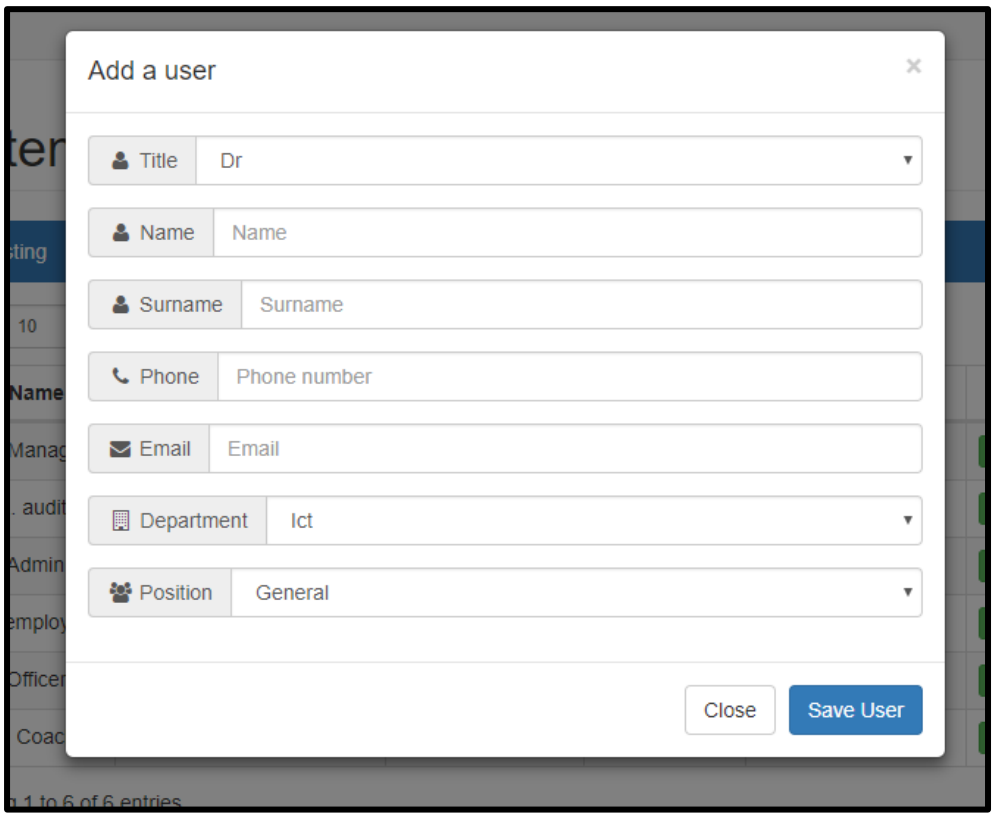

Fig 5.4: New user form

If a field is left blank or has the incorrect input format a popup message is generated. However if the registration has been successful another pop up message indicating a successful registration is generated together with a password to be used.

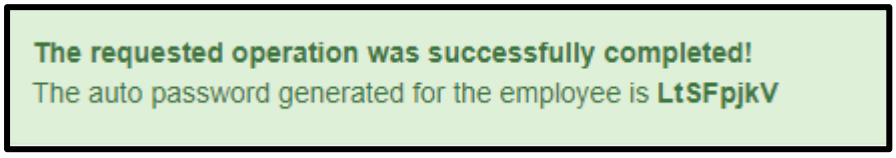

Fig 5.5: Successful user registration

5.3.6.2 Verification

This is the correctness of the system in meeting the user requirements. Verification is also defined as the ability of the system to be built right.

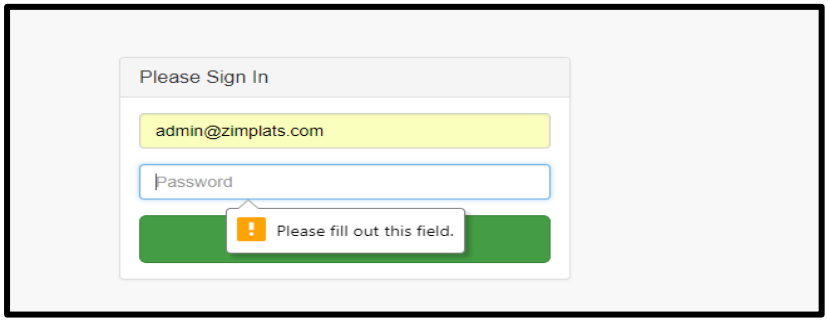

Fig 5.6: Missing user input

5.4 Installation

Coronel and Croket (2008) state that this is the process of setting up and configuring the system and making ready for use or execution. The records from the old system are added to the new system prior to conversion. A data clean-up is done to avoid migrating unwanted data to the new system. Reports were ran to ensure that the system was migrated without a deviation from the old system data.

5.4.1 User training

Laplante and Phillip (1999) state that this is the process of introducing the new system to the users highlighting its functionality. Users are also trained on the operation of the system as well as how they can access the various modules that they require. The lack of user training results in incomplete implementation of the system. The use of visual aids during training is also a vital part of the user training sessions as it gives users a visual representation of the whole system as well as how each stage of operation is carried out. User training is required together with a user manual to help with the training of the users. The system administrator required training on the backup and system security. The management and other stakeholders got training in areas of concern as well as the importance of IT in business.

5.4.2 Conversion

Shelly (2005) cites that this is the process in which the new system is implemented into the operational environment after there has been user training. The conversion phase is when the

organisation changes from the current system that is in place to the new system that is being developed by the researcher. Conversion usually takes place in the following techniques which are pilot, direct, phased and parallel conversion.

5.4.2.1 Pilot conversion

Ghezzi, Jazayeri and Mandrioli (2004) highlight that this is the introduction or implementation of the new system to a selected department or location of the organisation referred to as the pilot site before it is implemented in the other parts of the organisation. Pilot conversion is used to determine whether the new system is efficient, successful and productive in a pilot site before it is implemented across the whole organisation.

Advantages of pilot conversion

- ¾ Monitoring is made easier due to a small focus area.
- ¾ Cost efficient as only a single site will be using the new system.
- ¾ There is room for alteration and redesigning before implementing to the whole organisation.
- ¾ Drawbacks affect only the pilot site and not the whole organisation.

Disadvantages of pilot conversion

- ¾ Time consuming.
- ¾ Demands both system interfaces.

5.4.2.2 Direct conversion

Godfrey (1999) stipulates that this is a method of changeover in which the old system is completely replaced by the new system. All the operations of the current system will be overridden by those of the new proposed system.

Advantages of direct conversion

- ¾ Cost effective as only a single system is in use.
- ¾ No need for both systems interfaces.
- ¾ Less time is required as only a single switch between the systems is required.

Disadvantages of direct conversion

- ¾ Risky as no backup is available.
- ¾ User acceptability risk.
- ¾ Substantial, meaning the old system cannot be used as a reference point as it would have been eliminated.

5.4.2.3 Phased conversion

Ghezzi et al (2004) highlight that this is a conversion method in which the new system is implemented in phases. Modules are implemented bit by bit thereby slowly phasing out the old system and introducing the new system. The users will be familiarizing with the new system while they are being productive with the old system.

Advantages of phased conversion

- ¾ Cost effective as compared to parallel conversion.
- ¾ Allows for users to be familiar with the system in phases.
- ¾ Risk off failure affects only a specific phase and not the whole organisation.

Disadvantages of phased conversion

- ¾ Time consuming as more time is required to implement the system across the whole organisation.
- ¾ Costly if there are too many phases to be implemented.

5.4.2.4 Parallel conversion

Shelly (2005) postulates that this is a conversion method in which both systems are in operation. The conversion allows for the comparison of the results from both systems. The old system will only be phased out after all the users are familiar with the operations of the new system and hence minimizing the risk of users not being willing to use the system.

Advantages of parallel conversion

- ¾ Less risk as both systems are in place.
- ¾ There is room for result comparison.
- ¾ Allows for reversal of the implementation if the new system does not meet the objectives.

- No data loss as a backup is available and also a reference point from the old system.

Disadvantages of parallel conversion

- Expensive as there is need to maintain both systems.
- High degrees of errors as transactions have to be entered twice.

5.4.2.5 Recommended conversion method

It recommended that there is the use of parallel conversion in the implementation of the new system. This is due to the fact that parallel conversion allows for reverting back to the old system if the users are not impressed with the operations of the new system. Also the availability of a reface point allows for easy comparison of how the system is supposed to work and readily functional back up system.

5.5 Maintenance

According to Sommerville (2004) maintenance is a continuous process in which there is correction of errors, upgrades and ensuring that the system is operating in the expected way. Maintenance involves the identification of changes and making the changes in the operations hence there might be identified alterations which may be observed during the maintenance process. The corrective, adaptive, preventative and perfective maintenance are used in the maintenance of the new system.

5.5.1 Corrective maintenance

This is maintenance which refers to the changes necessitated by the actual software product error hence hindering the meeting of the system objectives. It focusses on defects in design, implementation or coding of the system. Corrective maintenance is done after recognising the faults hence restoring it back to the previous working state.

5.5.2 Preventative maintenance

This type of maintenance is focused on the modification which is necessitated by detecting potential errors and the right latent faults in the software product before they are effective faults.

5.5.3 Adaptive maintenance

This is the modification of a software product which is performed after the delivery in a bid to accommodate the dynamic business environment and the changing environment. Changes mainly targeting the functionality of the system and the user requirements of the system being met. Changes can be made to the system functionality even though there are no errors present.

5.5.4 Perfective maintenance

Krugman (2005) highlights that this is a maintenance strategy which is aimed at ensuring that there is implementation of a version which is better than the current one. This is all in terms of the functionality of the system. Direct users of the system trigger the need for perfective maintenance. They help with keeping up to date with the user requirements and variations which will result in the improvement of the overall performance.

5.5.5 Disaster recovery

It is a vital tool in the operation as negative impacts to the system cannot be predicted. Due to the difficulty in pinpointing the occurrence of a disaster, there are measures that are pre-determined which will help in the organisation getting back to a fully functional operation state.

5.6 System vs objective

1. To provide a system that will allow for the creation and management of user accounts

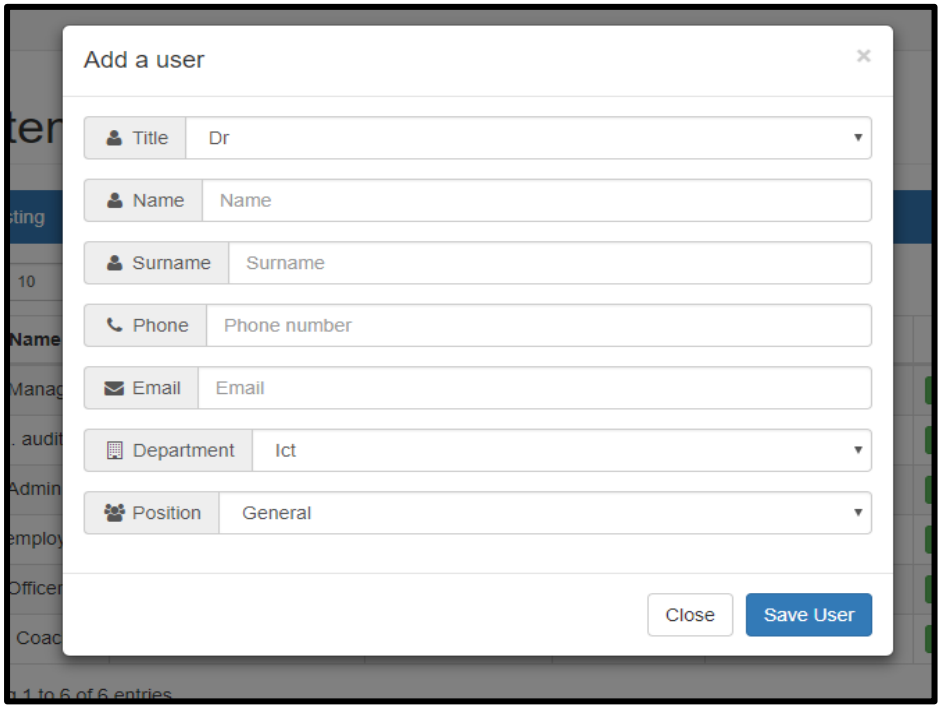

Fig 5.7: Creation of users

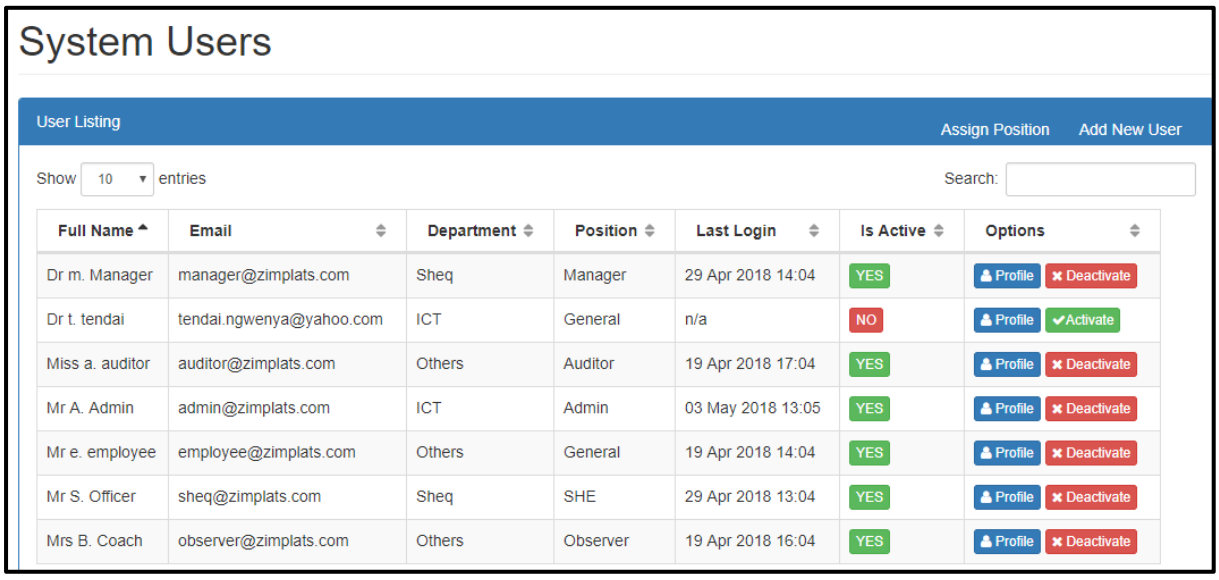

Fig 5.8: User management

2. To provide easy access to a vast knowledge base of ranked articles that include but not limited to safety, work risks and measures to take in case of accidents and injuries.

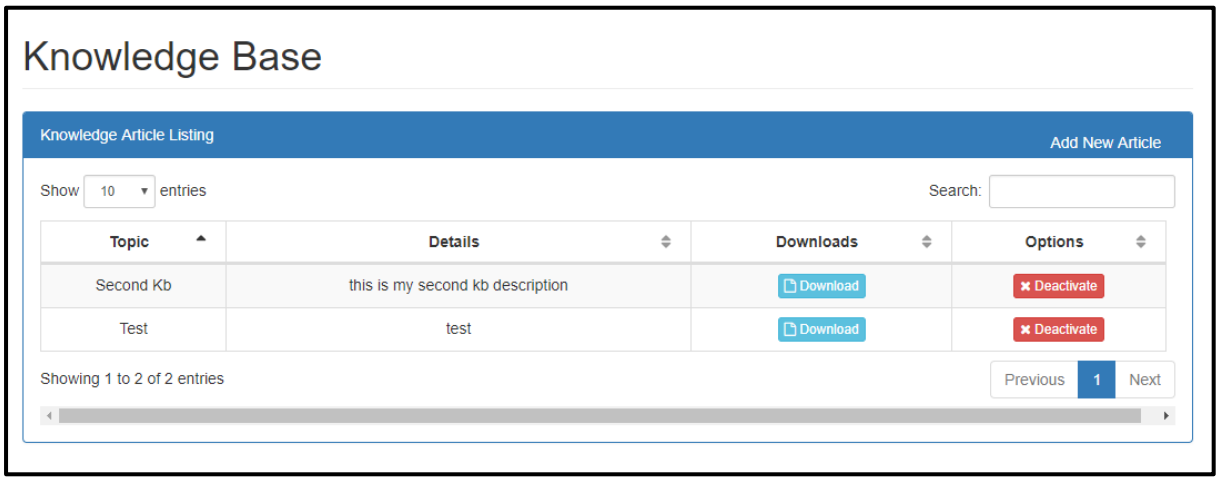

Fig 5.9: Knowledge base

3. To enable SHEQ representatives to administer surveys that can be responded by workers either anonymously or with identity.

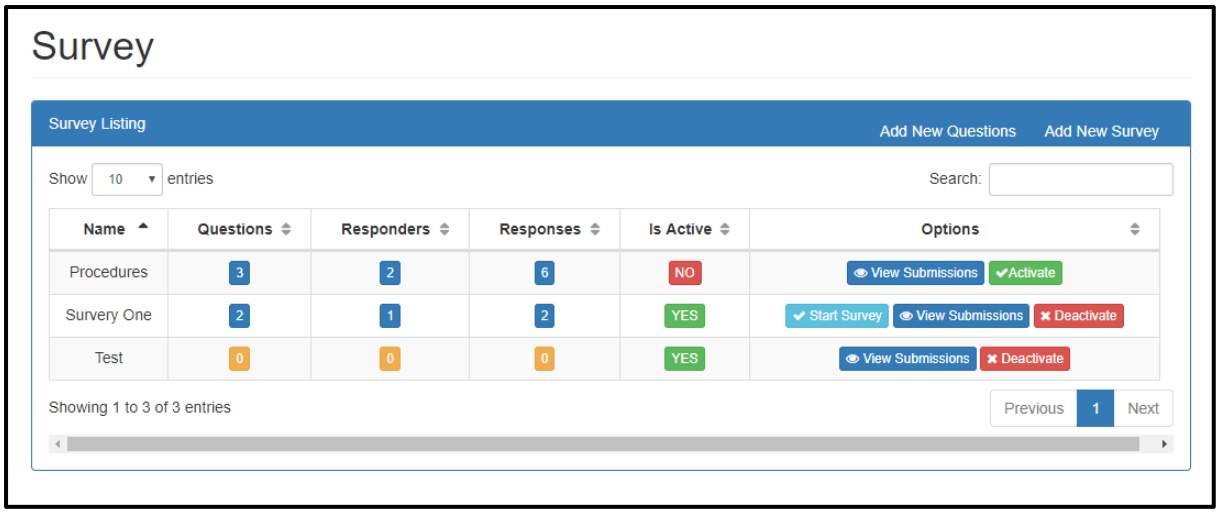

Fig 5.10: Survey administration

4. To enable SHEQ officers to launch investigations from survey responses and capture results that can be used to analyse accident root cause, injuries, lost production, damaged materials and pin point areas that are mostly affected over time that may need special attention.

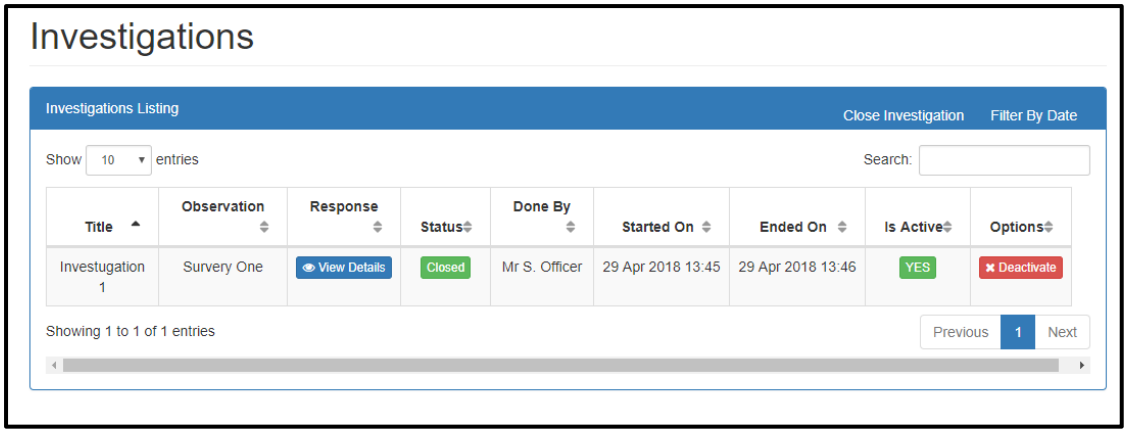

Fig 5.11: Investigation

5. To provide metrics that enable easy calculation of production costs incurred and lost potential revenue due to injuries.

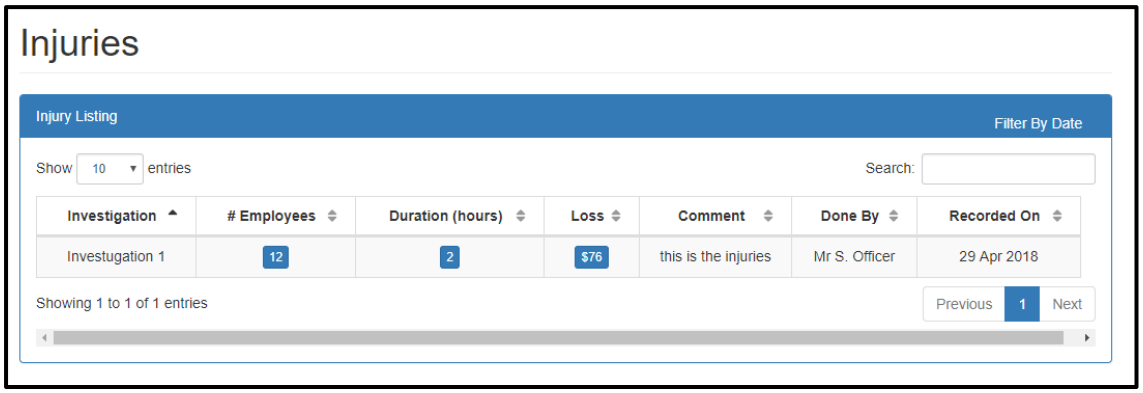

Fig 5.12: Injury calculation

6. To allow BBI coaches to track employee behaviour and compare the results with Bradley curve standards.

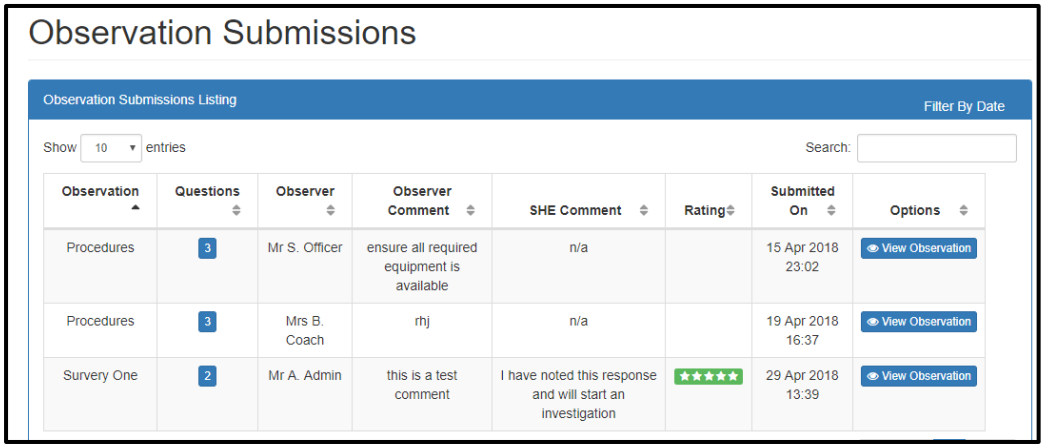

Fig 5.13: Observation to track employee behaviour

7. To provide comprehensive reports (detailed and summarised) that are simple and easy for management and other stakeholders on survey responses, investigations, injuries, cost incurred and lost potential revenue.

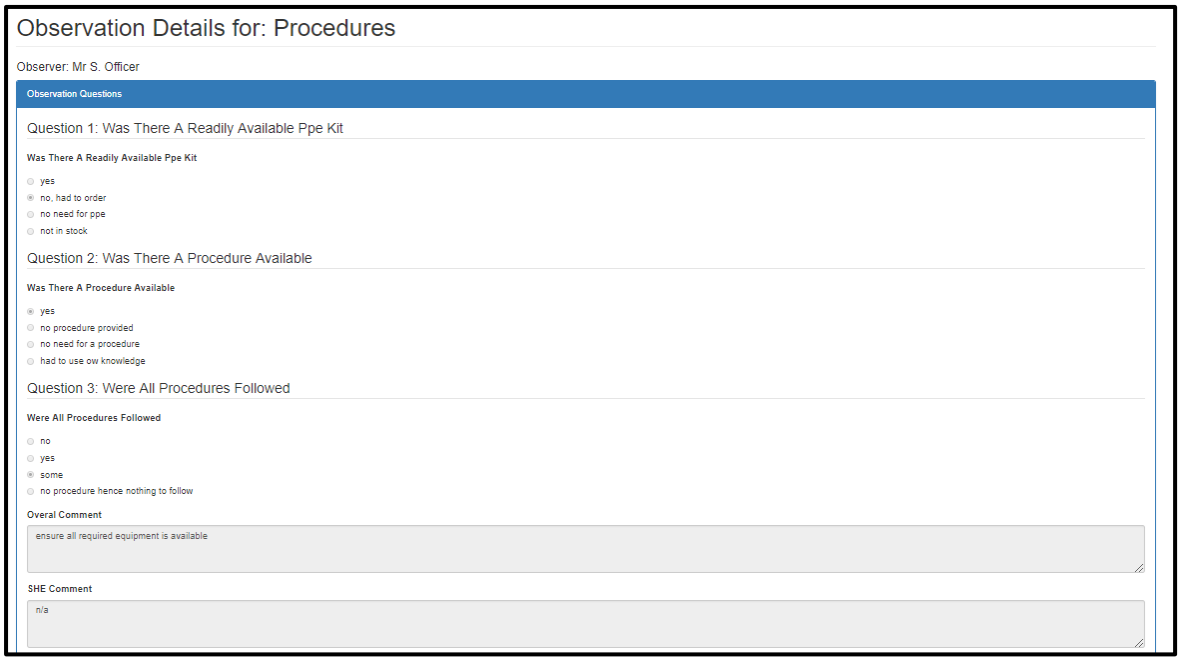

Fig 5.14: Sample report

5.7 Recommendations for future development

The following recommendations were brought about concerning the system:

- There should be regular antivirus check-ups on the system as a means to overcome some uncertainties.
- Training for the IT department members as they will act as the support team when there are minor areas that require their input before calling the developer.
- A documentation and user manual to be present and updated every time there is a change made to the system and work flow.
- New users to the system should undergo training in their areas of concern.
- Regular system updates should be done to ensure system confidence.
- Maximum security measures should be put in place.

5.8 Conclusion

The chapter highlighted the successful implementation of the system. An overview on the aspects that were highlighted in the previous chapters was also given proving how the system is meeting the set objectives. A successful testing stage was carried out. There is however need for a continuous research on how the system can be improved to meet the changing user requirements. A comprehensive user manual will also be made available to assist users with how to navigate through the system.

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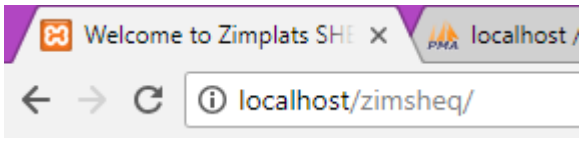
Appendix

Appendix A: User Manual

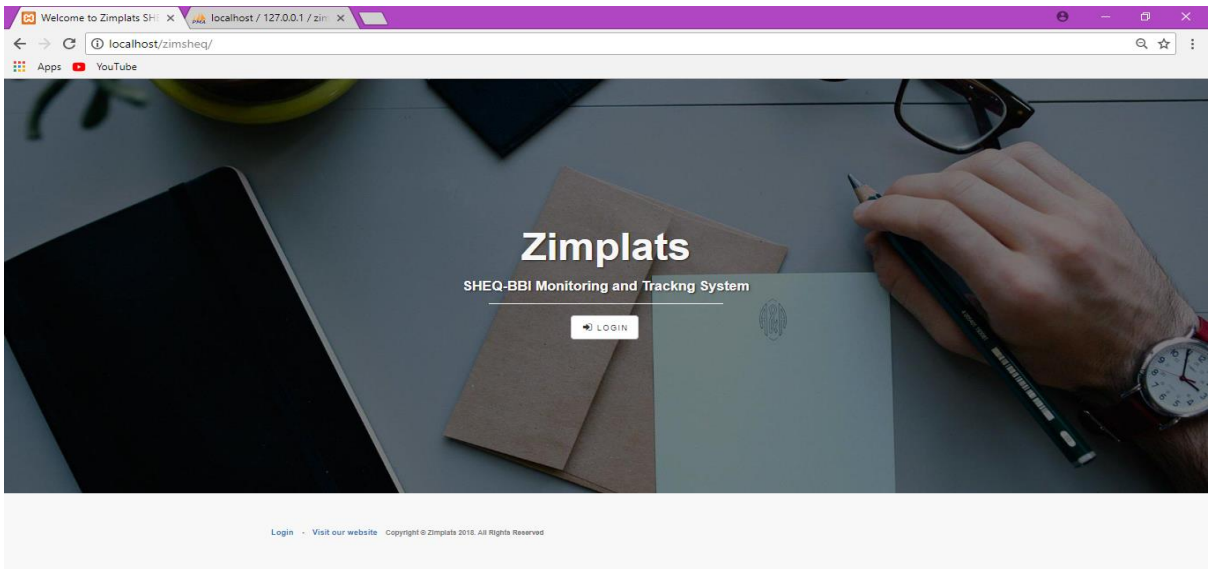
The user manual is a high level view of functionality. It is designed to enable users of the system to have a reference point when they do not know how to navigate through the system. The user manual presents the functionality of the system.

Getting access to the system

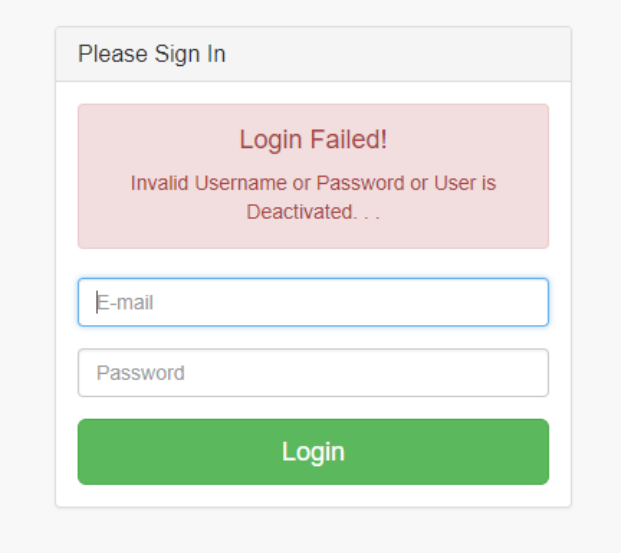
Users type in the url in the address bar as shown below.



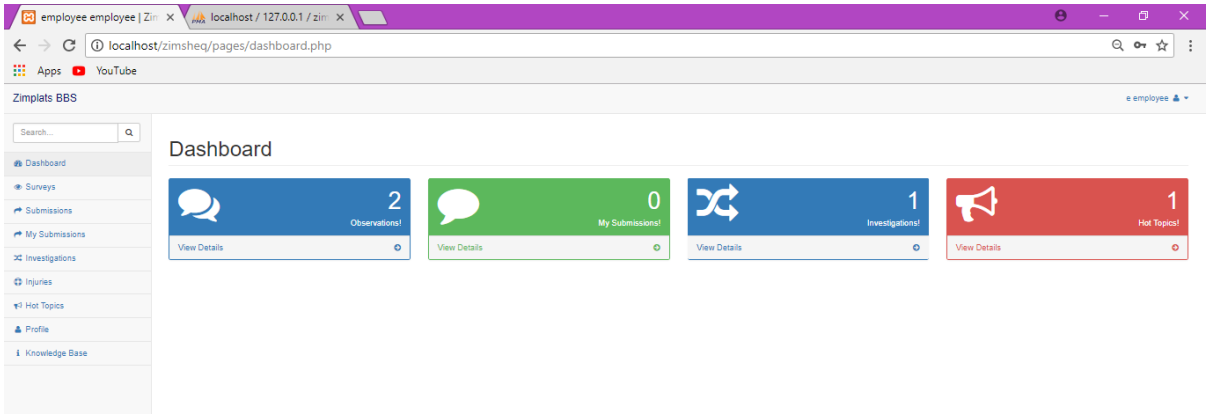
They will then be directed to the home page for the system



The submission of the correct login credentials grants the users access to the system. The credentials comprise of the correct email address and password. A user also needs an activated account; else they are denied access to the system.

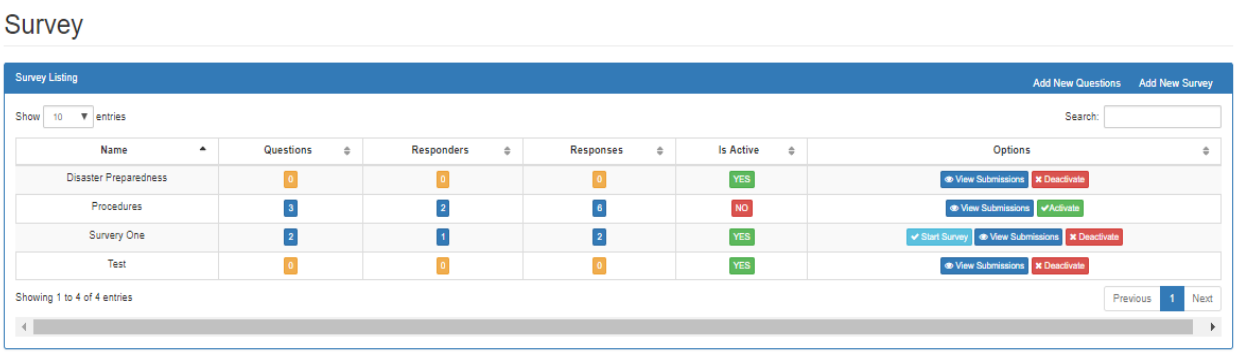


Provision of the correct login credentials redirects them to the main menu.



- The dashboard gives a summary of the activities that would have happened on the system.
- Users have access to view submissions by themselves and those that were submitted my other employees.
- A knowledgebase is also made available to view all the interesting articles that were submitted.

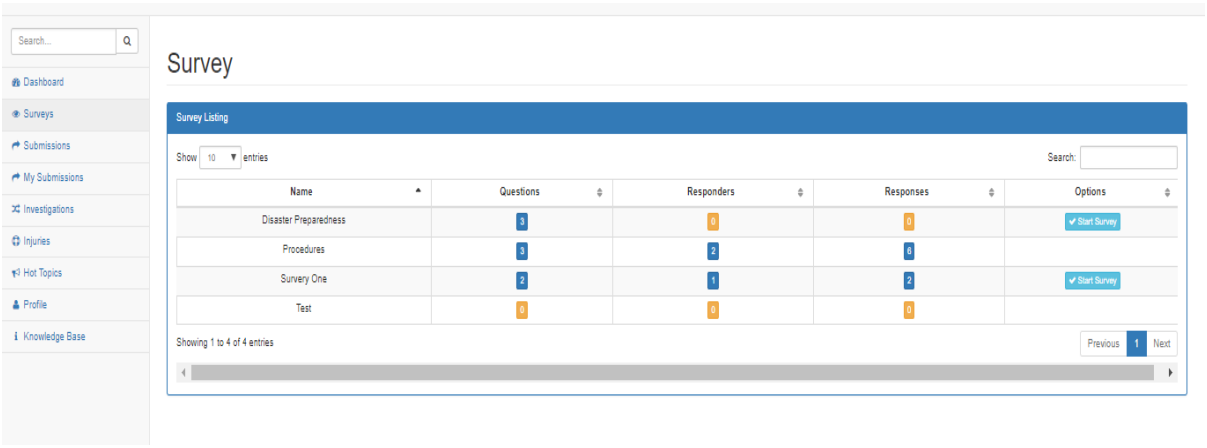
The SHEQ officer has the role to create a new survey that will be sent to the users for investigation purposes.



¾ First the SHEQ officer selects the "Add New Survey" tab and enters the survey name and a brief description.

¾ He then moves on to the "Add New Questions" tab where he will specify the number of questions to be included. Each question and response has to be specified the priority level with 1 being minimum and 5 being maximum.

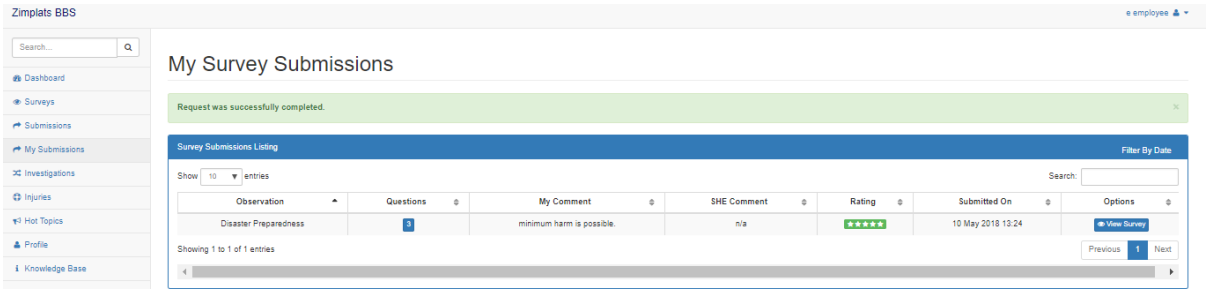
The next step will be for the employees to respond to the sent survey.



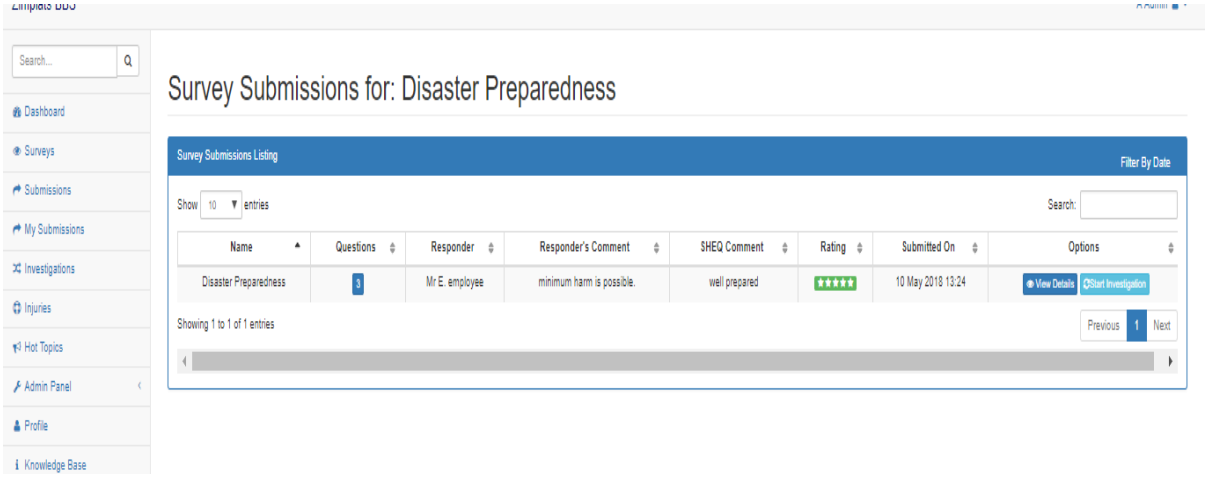
¾ Select the "Start Survey" tab and respond to the available questions and add a general comment on the survey at the end of the survey.

¾ After responding select the "Send Survey" tab at the bottom of the survey questions.

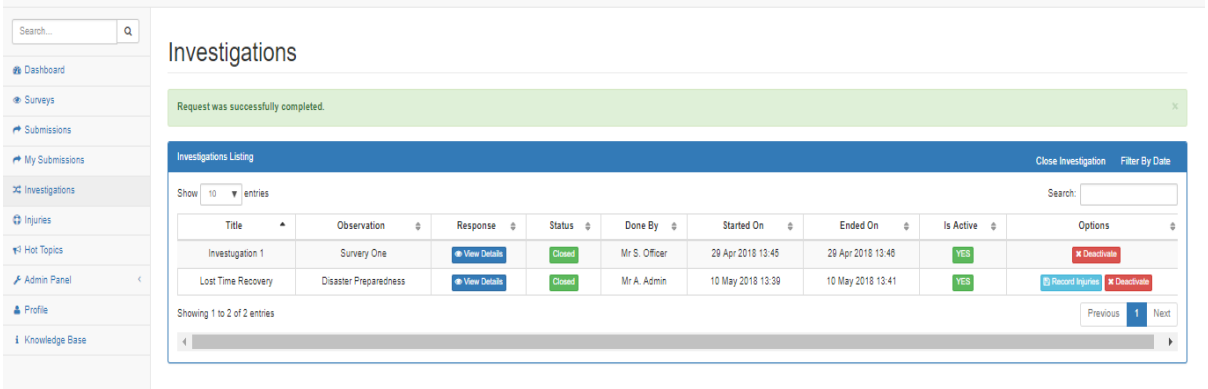
The page below shows up with a summary of the survey that would have been responded to together with a rating given according to the responses.



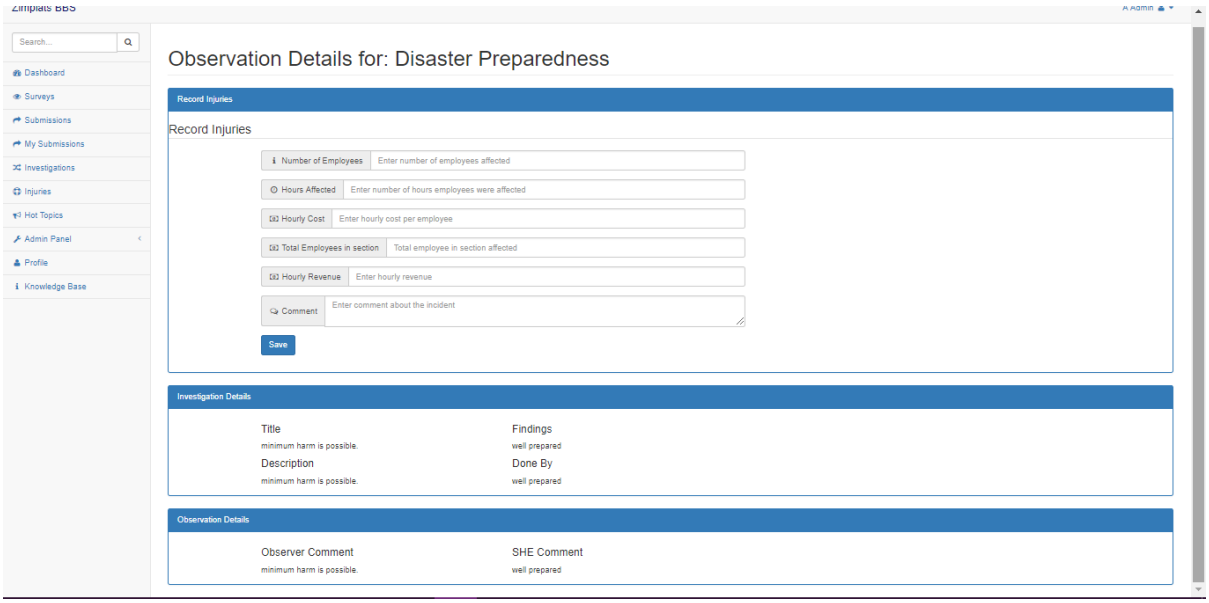
The SHEQ officer adds an overall comment on the survey and closes it for investigations.



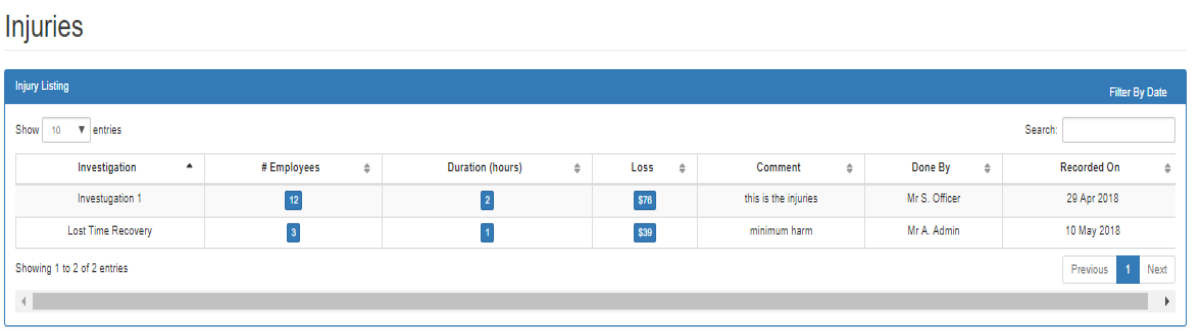
Investigations are done on site and findings input to the system. The investigation is then closed.



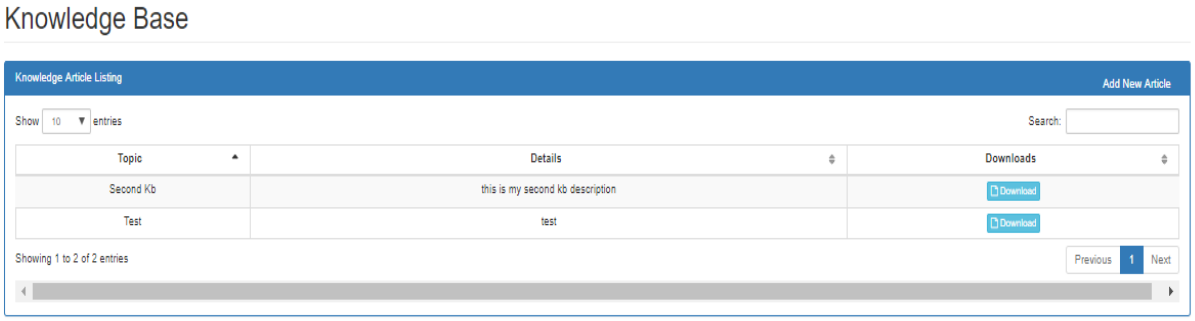
Next step will be to record the findings of the investigations into the system to allow for calculation of lost time and lost revenue.



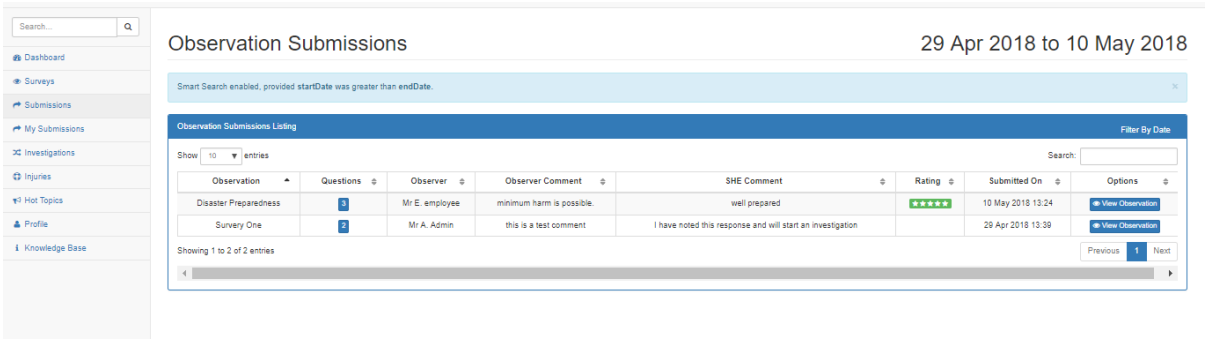
After completing all the missing fields they will be redirected to the following page with the loss calculations being computed.



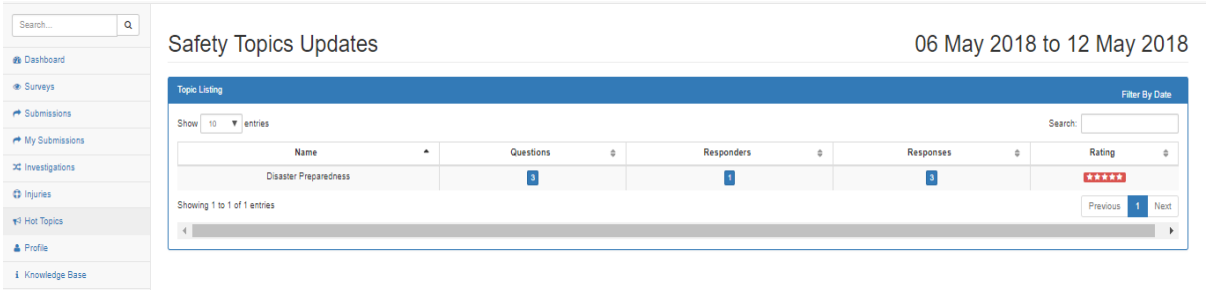
Employees can also add articles that they find useful to the other employees in the knowledge base.



Filtering of reports is also possible to allow or easy data search. Smart date search filter is also made available.



The hot topics section gives a brief update of the surveys that would have been sent during the week.



Appendix B: Interview Checklist

1. How do you record, monitor and track incidences that would have occurred?

   ……
   ……
   …….

2. How are you coping with the current system? Are there any challenges you are facing with the system?

   ……
   ……
   ……
   ……

3. How do you rate the current system?

   ……
   ……
   ……

4. What are the major problems that are faced by the current system?

   ……
   ……
   ……..

5. Are there any areas you feel should be addressed for the system to perform better?

   ……
   ……
   ……

6. Do you support the idea of a new computerised system?

   ……

7. What are your expectations from the new computerised system?

   ……
   ……
   ……
   ……..

Appendix C: Questionnaire

I am Tendai Ngwenya, a student at Midlands State University under the department of science and technology, studying Information Systems. It is a requirement for the completion of the degree to carry out a research study and develop a system which addresses problems found. This questionnaire is designed to gather as much data as possible about the Zimplats SHEQ and BBI ways of operation.

I kindly ask for your cooperation and promise to keep the given data confidential.

NB: <u>Please tick where appropriate and explain when required to. Feel free to give honest responses.</u>

1. What kind of system is the organisation using when recording the incidences and accounting for the related costs such as investigation cost and lost revenue?

   Manual ☐ Automatic ☐

2. Is the current system efficient?

   Yes ☐ No ☐

3. Describe the current system

   .....

   .....

   .....

4. How effective are the incident reporting and investigation channels?

   ……

   ……

   ……..

5. Are you satisfied with the current way of operation?

   ……

   ……

   …….

6. Is the current system matching your expectations as a user?

   ……

   ……

   ……

7. What problems are being faced by the current system?

   ……

   ……

   ……

   ……..

8. How do you think these problems can be addressed?

   ……

   ……

   ……

   ……..

Thank you for your input.

Appendix D: Observation Score Sheet

Observation guide schedule.

Date: ……

Time: ……..

Department: ……

Observation focus: …….

Observation:

……
……
……
……
……
……
……

Comment:

……
……
……
……
……..

Appendix E: Code Snippet

Login:

```
<?php
    //Start the session
    session_start();

    //Auto Loading all the required classes
    spl_autoload_register(function ($class_name) {
        require_once 'includes/' . $class_name . '.php';
    });

    // Redirect the user if he is logged in
    if (isset($_SESSION['loginKey']) && isset($_SESSION['loginId'])) {
        //Check if the user was redirected to login to access a certain web page
        $nextUrl = (isset($_SESSION['nextUrl']) && !empty($_SESSION['nextUrl']))
                    ? $_SESSION['nextUrl'] : 'dashboard.php' ;

        $location = "Location: " . $nextUrl;

        unset($_SESSION['nextUrl']);

        //Redirect to the next page
        header($location);
    }

    //The temp variable to store login result
    $loginResult = '';
```

```
    //Process a login request
    if (isset($_POST['submit'])) {
        $email = Helper::cleanData($_POST['email']); ;
        $password = md5(Helper::cleanData($_POST['password']));

        //Creating an object for authentication
        $authenticate = new Authentication();

        //Authenticating the user
        $loginResult = $authenticate->loginUser($email, $password);

        if(is_bool($loginResult) && $loginResult == true){
          //Check if the user was redirected to login to access a certain web page
          $nextUrl = (isset($_SESSION['nextUrl']) && !empty($_SESSION['nextUrl']))
                    ? $_SESSION['nextUrl'] : 'dashboard.php' ;

          $location = "Location: " . $nextUrl;

          unset($_SESSION['nextUrl']);

          //Redirect to the next page
          header($location);
        }
    }
?>
<!DOCTYPE html>
<html lang="en">

<head>
```

```
    <meta charset="utf-8">
    <meta http-equiv="X-UA-Compatible" content="IE=edge">
    <meta name="viewport" content="width=device-width, initial-scale=1">
    <meta name="description" content="">
    <meta name="author" content="">

    <title>Login | Zimplats SHEQ-BBI Monitoring and Tracking System</title>

    <!-- Bootstrap Core CSS -->
    <link href="../vendor/bootstrap/css/bootstrap.min.css" rel="stylesheet">

    <!-- MetisMenu CSS -->
    <link href="../vendor/metisMenu/metisMenu.min.css" rel="stylesheet">

    <!-- Custom CSS -->
    <link href="../dist/css/sb-admin-2.css" rel="stylesheet">

    <!-- Custom Fonts -->
    <link href="../vendor/font-awesome/css/font-awesome.min.css" rel="stylesheet" type="text/css">

    <!-- HTML5 Shim and Respond.js IE8 support of HTML5 elements and media queries -->
    <!-- WARNING: Respond.js doesn't work if you view the page via file:// -->
    <!--[if lt IE 9]>
        <script src="https://oss.maxcdn.com/libs/html5shiv/3.7.0/html5shiv.js"></script>
        <script src="https://oss.maxcdn.com/libs/respond.js/1.4.2/respond.min.js"></script>
    <![endif]-->
```

```
</head>

<body>

  <div class="container">
    <div class="row">
      <div class="col-md-4 col-md-offset-4">
        <div class="login-panel panel panel-default">
          <div class="panel-heading">
            <h3 class="panel-title">Please Sign In</h3>
          </div>
          <div class="panel-body">
          <?php
              //Display the access denied error message when a user request a resource withou logging in
              if (isset($_SESSION['unauthentic'])) {
            ?>
                <div class="alert alert-danger">
                  <h4 class="alert-heading text-center">Access Denied!</h4>
                   <p class='text-center'>Login to access the resourse . . .</p>
                </div>
            <?php
              unset($_SESSION['unauthentic']);
              } elseif (is_bool($loginResult) && $loginResult == false) {
                  //Display the login failed when the provided credentials are not valid
            ?>
                <div class="alert alert-danger">
                  <h4 class="alert-heading text-center">Login Failed!</h4>
                  <p class='text-center'>Invalid Username or Password or User is Deactivated. . . </p>
```

```
                    </div>
                <?php
                   }
                ?>
                <form role="form" method='post' action="">
                   <fieldset>
                      <div class="form-group">
                        <input required class="form-control" placeholder="E-mail" name="email" type="email" autofocus>
                      </div>
                      <div class="form-group">
                        <input required class="form-control" placeholder="Password" name="password" type="password" value="">
                      </div>
                      <!-- Change this to a button or input when using this as a form -->
                      <input type='submit' name='submit' value='Login' class="btn btn-lg btn-success btn-block"/>
                   </fieldset>
                </form>
             </div>
          </div>
       </div>
    </div>

    <!-- jQuery -->
    <script src="../vendor/jquery/jquery.min.js"></script>

    <!-- Bootstrap Core JavaScript -->
    <script src="../vendor/bootstrap/js/bootstrap.min.js"></script>
```

```
    <!-- Metis Menu Plugin JavaScript -->
    <script src="../vendor/metisMenu/metisMenu.min.js"></script>

    <!-- Custom Theme JavaScript -->
    <script src="../dist/js/sb-admin-2.js"></script>

</body>

</html>
```