

# **TRACKFORCE SAFETY COMPLIANCE SYSTEM**



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# TRACKFORCE SAFETY COMPLIANCE SYSTEM



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## **ABSTRACT**

Trackforce Safety Compliance System is a system that will be used to ensure that all the contractors and employees who are contracted to perform different task are qualified and in good health to perform the assigned tasks. The system will ensure that before the contractor or employee commences their work, they have undergone the necessary physical checkup, test including environmental awareness of the different hazards that they are exposed to in the heavily mechanised environment. Continuous check will be tracked to ensure a healthy workforce

## DECLARATION

I, **Malven Chiduku**, 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: .....

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## APPROVAL

This dissertation, entitled “**TRACKFORCE SAFETY COMPLIANCE SYSTEM**” by **Malven Chiduku** 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: .....

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## DEDICATION

I dedicate this project to my wife Elizabeth, my daughter Tanatswa and my Son Mudiwa for giving the hope and strength I need to face each day.

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# LIST OF ACRONYMS

## List of Acronyms

TFMS	-	Track Force Management System
DFD	-	Data Flow Diagram
EERD	-	Extended Entity Relationship Diagram
GUI	-	Graphical User Interface
ICT	-	Information Communications Technology
LAN	-	Local Area Network
NPV	-	Net Present Value
ROI	-	Return on Investment
SHEQ	-	Safety, Health, Environment Quality
SI	-	Statutory Instrument
WAN	-	Wide Area Network
WUI	-	Web User Interface
Zimplats	-	Zimbabwe Platinum Mines

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# **CHAPTER 1: INTRODUCTION**

## **1.1 INTRODUCTION**

Safety remains an ongoing concern for the mining industries. Mining by nature is inherently dangerous, with a high degree of hazard and risk involved. Mining accidents effects are high in terms of both costs and human suffering. Accidents add a tremendous burden of needless and avoidable expense. Financial loses are pale when compared to bodily injury and in some cases death, resulting in negative human social impacts. This document will introduce Trackforce Safety Compliance System, an integrated solution that will be designed to manage mining contractor safety compliance. Trackforce delivers a comprehensive integrated solution for safety compliance, combining software with value-added audit and training services to give mining companies visibility into contractors safety compliance and help drive continuous improvement to safety culture across their contractor workforce. Trackforce Safety Compliance System will simplify contractor prequalification and management. Trackforce will be used to centrally track and maintain safety statistics and policies for all of the contractors in a single, web-based application

## **1.2 BACKGROUND STUDY**

In today's mining industry creating a cohesive team that can collaborate effortlessly within a big mining organization remains a big challenge. Mining companies subcontract much of their operation thus coordination of workflows across multiple project stakeholder across multiple companies and sometimes countries is considerably more complicated and full of added risks and costs not to mention the stress involved in managing such activities. This is usually witnessed by the problems of missed deadlines, scheduled delays, cost overrun and lost documents that can leave the company projects in a dire state. In addition, it is becoming increasingly important to protect hired contractors from work related illness and injuries and therefore considerable efforts must be expended to develop a framework for contractor inductions and monitoring during the course of the project. Workflow automation can eradicate processing problems by connecting people, procedures and information. This is the brilliance of the proposed Trackforce management system. It turns the workflows into the electronic system that allows management to have a greater real-time view of what is happening in the organization and its contractors. The assumed benefits of

the automated system will lie in the ability to track contractor task, safety compliance and approvals of any project team before work commences. This will ultimately lead to a healthy workforce and a well inducted and environmentally aware workforce.

**1.2.1 BACKGROUND OF ORGANIZATION**

Zimplats is the largest producer of platinum in Zimbabwe and is located on the Great Dyke of Zimbabwe in the Mashonaland West Province, Kadoma District-Mhondoro Ngezi communal lands. The Company is owned by the Impala Platinum Holdings Limited with 87% shares and the remaining 13% shares are owned by Independent shareholders. The shareholding structure is pending finalization of the full implementation of the Government of Zimbabwe indigenization law. It currently employs 4000 employees and a further 5000 on contractor to perform specialized task as required by the mining process. There are also members of the community who provide general labor to the mine and do not belong to any company. These also have to adhere to the high level of safety requirements

Platinum Group Metals are used in auto catalytic converters and play a significant role in reducing air pollution by limiting the discharge of carbon monoxide and other emissions in both gasoline and diesel engines and together with their parent company Implats, Zimplats produce 25% of the platinum requirements.

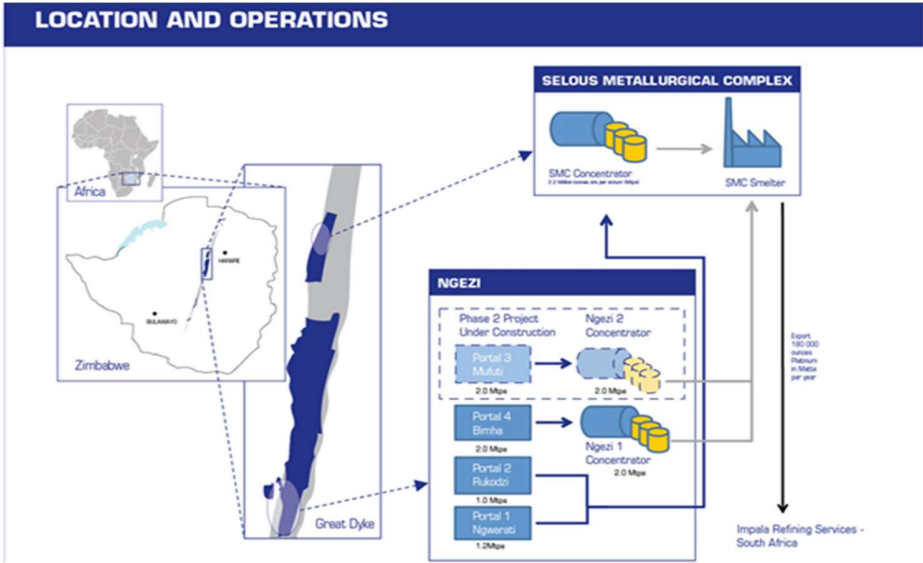


Figure 1.1 Zimplats location (source: www.zimplats.com)

**1.2.2 ORGANIZATIONAL STRUCTURE**

Organizational structure of Zimplats highlights the formal patterns of interaction that link firm’s task, technologies and people. Figure 1.2 below shows the organizational structure of Zimplats Mine with a more inclusive ICT department

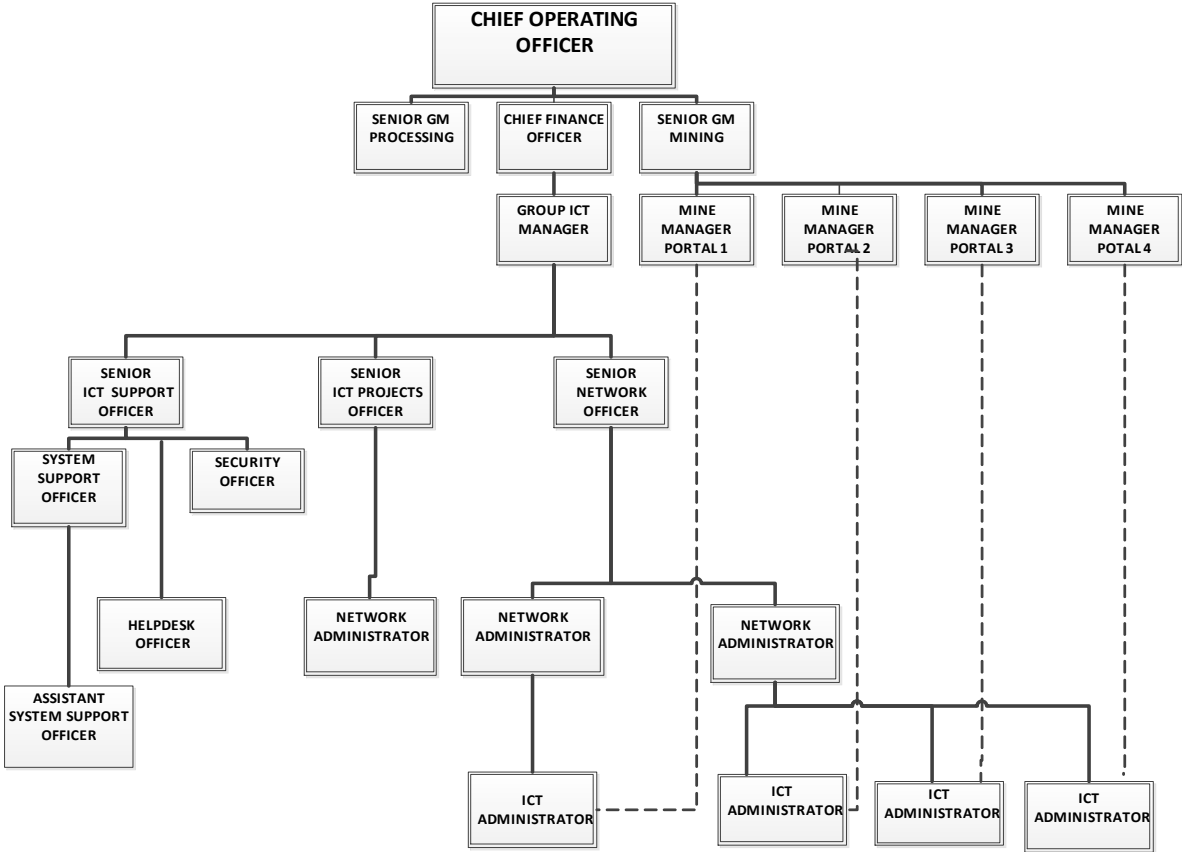


Figure 1.2 Zimplats organogram (source: Zimplats intranet [www.zimplats.co.zw](http://www.zimplats.co.zw))

**1.2.3 VISION**

Our vision is to be the safety and cost leader in the platinum sector with sustainable growth in production, whilst generating superior returns, for the benefit of all our stakeholders. (www.zimplats.com)

**1.2.4 MISSION STATEMENT**

Zimplats business is production of platinum group and associated metals from the Great Dyke in Zimbabwe ([www.zimplats.com](http://www.zimplats.com))

### **1.3 PROBLEM DEFINITION**

Currently there is redundant paper based manual system which involve the submission of contractor information and procedure of work to be performed prior to coming on site with company details and members to visit mine site. Contractor's biological, academic and professional data is submitted and captured for verification by relevant departments. After approval, contractors are required to undergo medical tests for fitness to duty. A printed medical certificate of fitness valid for 3 months, after which the contractor must go through the same process is issued and the contractor is then accepted into mining induction training located 10km away from the medical facility. Upon completion of the training of each module, a hard copy is produced and signed off by both parties and the copy is given to the contractor and upon completion of the entire course, the contractor is issued with a training plotter form which details the course content of the training and the areas discussed in training before proceeding to their respective area where they intend to perform their duties. Because of displaced Mine sites, it is very difficult to visit each area for a responsible authority to check and approve or authorize the stages necessary during induction period which may lead to many delays if the responsible people are not available on site. A contractor file is maintained with documents like Contractor checklist Contractor information, HR and security verification form, Medical certificate, Module training record, training plotter indicating the areas trained, educational certificates and operational procedures. Finally, a permit is issued and the contractor can commence work. The problem identified with the current system is data duplication between departments and there is no tracking of contractor induction status. In the event that any contractor hardcopy document is lost, it pauses the risk of getting through the tedious process of getting the documentation and contractor medical details can be seen by anyone. The manual system is failing to cope with the large numbers of contractors requiring compliance with the Zimplats safety standard.

### **1.4 AIM**

The aim of the proposed project is to design and develop an integrated Trackforce management system that captures the contractor induction status and tracks their validity to ensure compliance to the Zimplats safety standards.

## **1.5 OBJECTIVES**

To implement a system that track medical tests expiry dates and enable automated notification when due dates are close.

To develop a system that monitor contractor and employee's bodily chemical exposure and occupational deterioration rate

To develop a web-based system that enables automated collection, assessment, storage and presentation of contractor data.

To develop a system that enables automated tests booking and training bookings to cater for the increasing number of contractors and allow access to the system for purpose of resource planning based on known figures.

To implement a system that protects contractor confidential information by use of user accounts with access levels and passwords to access system and data stores.

## **1.6 INSTRUMENTS AND METHODS**

While aiming at coming up with a web based compliance database that will be in interaction with safety officers, medical staff, middle and senior level management, with different backgrounds and IT capabilities, the author has proposed the following tools be used in developing the database:

- Programming language: PHP 5 or later. PHP is an advanced programming language that facilitates interactive interface and supports powerful database
- MySQL – an open source database server with a client/server implementation. It is fast, robust, easy to use and has the capability to store very large volumes of data. It is also designed for speed, power, and precision in mission critical, heavy load use (MySQL, 2002,)
- Web Server: Apache 1.3.23 or later
- Operating system: Microsoft Windows 7 or later
- Database Management tool for System administrator: phpMyAdmin
- Querying language : SQL
- Zimplats current contractor compliance forms and any other papers currently being completed by contractors and Zimplats employees in order to ensure compliances.

## **1.7 JUSTIFICATION**

The proposed integrated solution Trackforce Safety Compliance System is capable of contributing to good quality work and significant reduction of costs related to work injuries as many of the human related hazards will be avoided. The amount of time for data collection and dissemination will also be reduced. It will solve the problem of data inconsistency, reduce time between a contractor gets contracted to perform a function and the time he actually starts his duties. It will also solve the problem of lack of data storage for future requirements, the currently hardcopy system does not offer flexibility and growth which will be incorporated in the new system. The correct implementation will proactively manage operations to achieve the project's quality, cost, time, and scope requirements. The in-house development will be the best option since Trackforce Safety Compliance System is not all about the system being used but rather, reshaping all aspects of the mining company to be safety oriented.

## **1.8 CONCLUSION**

This chapter has provided a brief background of Zimplats, and of the current manual system being used for managing contractor compliance and the required paper trail. The chapter goes on to explain the problem definition, aims of the project, objectives and justification of the proposed system. The main purpose of developing the Trackforce management is to automate the process of engaging, scheduling and monitoring contractor compliance at mine sites so as to eliminate risks associated with their tasks. With the company background information and system objectives correctly defined. The next chapter will describe feasibility study of the proposed system.

## **CHAPTER 2: FEASIBILITY AND PLANNING PHASE**

### **2.1 INTRODUCTION**

This chapter entails highlighting an investigation of business value with regard to the Trackforce system, evaluating the alternatives and its functionality. Analysis involves an investigation of the benefits of developing the proposed system as well as paving the way forward for the development team on the subsequent tasks. A feasibility study is carried out to determine if it is possible to proceed with the system. If the proposed system is not feasible, then the project will be aborted to avoid loss of resources. Comprehensive planning together with a good project management structure is to be done and this results in a successful feasibility study.

### **2.2 BUSINESS VALUE**

Business value can be defined as the preferred outcome by stakeholders. A team or product delivers value when the outcome of the product meet the needs of the stakeholders (McDonald and Rains, 2016) It focuses mainly on clearly outlining measurable benefits over the costs, which will be accrued if the system is implemented successfully. An essential part of realizing the desired business value is having the right tools applied to drive quality and cost efficiency. The proposed Trackforce offers several benefits including

- i.** Automated contractor booking for medical examination and induction training for next available free slots, this will greatly save scheduling time.
- ii.** Efficiently analyses, biological monitoring of employee occupational health.
- iii.** Maintaining consistent contractor data and their fast retrieval, process automation provides greater data accuracy and expedites data inputs and data review.
- iv.** Electronic Dynamic Reporting- Real-time information to enhance decision making and in turn this avoids reliance on outdated statistics.
- v.** Protects business profits by maintaining a safer and healthier workforce will save costs associated with work related injury or illness. These costs result from production downtime, injured contractors working slower than usual. There are also the costs associated with possible litigation, every dollar invested in safety and prevention protects an enterprise's profits.

## **2.3 FEASIBILITY STUDY**

(Kendall and Kendall, 2014) in their study noted that management requires data in order for them to make a decision whether to undertake a project or not. Feasibility study is used to gather such data. The collected data then provides platform for analysis outcomes, investigation and assessment for the system under research and concludes whether it is cost effective, profitable, technically feasible or not. Results from the analysis are used in defining if there is any presence of economic viability in developing the system under research and proceed to the implementation plan. Feasibility study will be subdivided into the technical, economic, social and operational feasibility.

### **2.3.1 TECHNICAL FEASIBILITY**

Technical feasibility is performed to assess the proposed solution's technological requirements for setting the new system. Technical feasibility assess the extent to which the system can be successfully designed, developed, and installed by the current ICT team. It is also an analysis that answers the question, can we build the system? (Dennis et al., 2015). According to feasibility analysis procedure the technical feasibility of the system is analysed and the technical requirements such as software facilities, procedures, and inputs are identified and this feasibility analysis helps to determine if new technology is needed and if current technology can support it. The technical requirements of the proposed system were assessed with regards to the availability of the following.

#### **a) Technical expertise**

The expertise with reference to the development of a system as well as with the help of project supervisor, it will be possible to develop a running system. The prospective end-users will be well trained on how the system works and all of them have the potential to become adept within the shortest possible time.

#### **b) Hardware and software requirements**

The system needs to be run on Windows 7 or later operating systems as they appropriately support networking. The analysis carried out indicated that the organisation is in possession of the recommended hardware and much of the software and this makes the solution feasible.

##### **2.3.1.1 HARDWARE AND SOFTWARE REQUIREMENTS FOR SERVER**

Table 2.1 shows the hardware and software requirements for the server to be used with the proposed Trackforce system.



*Table 2.1 Hardware and software requirements for server*

<b>Hardware requirements</b>
Intel core i5 @ 3.0 GHz Processor
4 GB RAM
1 TB HDD
Generic IDE CD-ROM
Generic LCD Monitor
<b>Software requirements</b>
Apache Web server
MySQL Database server
phpMyAdmin database management tool
PHP programming language

### 2.3.1.2 HARDWARE AND SOFTWARE REQUIREMENTS FOR WORKSTATIONS

Workstation hardware and software requirements are show in Table 2.2

*Table 2.2 Hardware and software requirements for users*

Intel core 2 duo @ 2.0 GHz Processor
2 Gig RAM
500 GB HDD
Generic LCD monitor, keyboard and mouse
Microsoft Windows 7 or later
Microsoft office suite 2010 or later
Google Chrome / Mozilla Firefox web browser

### 2.3.1.3 NETWORKING EQUIPMENT

Table 2.3 show the networking equipment that is required by the project

*Table 2.3 Networking equipment*

16 port Ethernet Switch
Router and Firewall
UTP cables CAT 6

## 2.3.2 ECONOMIC FEASIBILITY

Economic feasibility looks at the cost-effectiveness of a project or solution. An economic feasibility ascertains the financial risk associated with a project and answers the question, should we build it? (Dennis et al., 2015). The project is said to be viable if the benefits derived from the system outweigh the costs of development and operation of the system. Payback period of the system is analysed at this stage.

### 2.3.2.1 DEVELOPMENT AND INITIAL COSTS

#### a) INITIAL COSTS

These are costs associated with starting-up the new computerized solution including acquiring needed hardware and software.

#### b) DEVELOPMENT COSTS

Are costs incurred at the time the system is developed for example salaries to systems development team and training costs. Estimated cost of the project are shown in the table 2.4.

*Table 2.4 Estimated development and initial costs*

<b>Description</b>			
<b>Hardware</b>	<b>Quantity</b>	<b>Unit Costs (US\$)</b>	<b>Total Cost (US\$)</b>
Pentium 4 Dell PC	10	700	7000
Main Server	1	1200	1200
Switch	1	500	500
Backup Media	1	500	500
HP laser Jet colour printer	2	350	700
Uninterrupted Power Supply	1	800	800
<b>Software</b>	<b>Quantity</b>	<b>Unit Costs (US\$)</b>	<b>Total Cost (US\$)</b>
Full Dreamweaver CS5 package	1	--	--
Windows 2008 R2 Server	1	500	500
Microsoft Office 2010 suite	1	300	300
MacAfee Antivirus	1	200	200
<b>Development</b>	<b>Quantity</b>	<b>Costs (US\$)</b>	<b>Total Costs(US\$)</b>
Labour- Installations	-	3000	3000
User Training	-	1000	1000

#### c) OPERATIONAL COSTS

Operational costs are costs incurred after the system is implemented and continue to be incurred while the system is in use. These include system maintenance costs, annual licensing costs and compliance costs among others. The table 2.5 illustrates the operational costs of the project for the coming three years.

*Table 2.5 Operational costs*

<b>Description</b>	<b>FY17 (US\$)</b>	<b>FY18 (US\$)</b>	<b>FY19 (US\$)</b>
System maintenance	2000	2000	1800
Training costs	1000	900	900
Stationary and consumables	350	300	300
Conversion Costs	1000	-	-
Licensing fees	500	500	550
Other costs	1500	1300	1200

### **2.3.2.2 BENEFITS**

Benefits that will accrue to the firm due to the implementation of the proposed project includes

#### **a) TANGIBLE BENEFITS**

These are benefits which a monetary value can be attached.

- i. Reduced booking and scheduling time thus contractor will charge Zimplats less labour hours.
- ii. Reduction in travel costs and associated risk as management can access comprehensive data from anywhere within the mine site.
- iii. Reduction of stationary and printing costs as paper based system would be eliminated.

#### **b) INTANGIBLE BENEFITS**

Intangible benefits are those that are related to the qualitative aspect which the system is expected to produce and these cannot be easily measured in monetary terms.

- i. Improved work performance as time between start of induction to start of work is reduced.
- ii. A better corporate image in relation to our contractors.
- iii. Improved safety compliance as only employees and contract employees fit for duty perform tasks.

Table 2.6 shows the tangible benefits that will accrue as a result of adopting Trackforce

*Table 2.6 Tangible benefits*

<b>Benefits</b>	<b>FY17 (US\$)</b>	<b>FY18 (US\$)</b>	<b>FY19 (US\$)</b>
Reduction in wages and salaries	5000	6000	6500
Increased profits	7000	7000	8000
Improved staff productivity	3000	3000	4000
Reduction in stationary costs	500	500	600

The usual quantifiable feasibility indicators used in the economic analysis are the cost-benefit analysis, net present value and payback period.

### 2.3.2.3 COST BENEFIT ANALYSIS

Cost Benefit Analysis (CBA), sometimes called benefit–cost analysis (BCA), is a systematic process for calculating and comparing benefits and costs of a project. Shown in table 2.7 is the cost benefit analysis of the system under study.

Table 2.7 Cost benefit Analysis

Year	FY17	FY18	FY19
<b>Benefits</b>	<b>(US\$)</b>	<b>(US\$)</b>	<b>(US\$)</b>
Tangible	15500	16500	19100
Intangible (estimated monetary value)	4000	4000	4000
<b>Total benefits</b>	<b>19500</b>	<b>20500</b>	<b>23100</b>
<b>Costs</b>	<b>(US\$)</b>	<b>(US\$)</b>	<b>(US\$)</b>
Initial and development costs	5500	--	--
Operational costs	6350	5000	4750
<b>Total costs</b>	<b>11850</b>	<b>5000</b>	<b>4750</b>
<b>*Net benefits</b>	<b>7650</b>	<b>15500</b>	<b>18350</b>

\*Net benefits = Total benefits - Total costs

### 2.3.2.4 RETURN ON INVESTMENT (ROI)

ROI is a performance measure used to evaluate the efficiency of an investment or to compare the efficiency of a number of different investments. To calculate ROI, the benefit (return) of an investment is divided by the cost of the investment; the result is expressed as a percentage or a ratio. The return on investment formula:

$$\text{ROI} = \frac{(\text{Gain from Investment} - \text{Cost of Investment})}{\text{Cost of Investment}} \times 100$$

In the above formula, gains from investment, refers to the benefits obtained from the investment into proposed system. If an investment does not have a positive ROI, or if there are other opportunities with a higher ROI, then the investment should be discarded. ROI for the project in financial FY17 is

$$\begin{aligned} \text{ROI} &= \frac{(19500 - 11850)}{11850} \times 100 \\ &= \underline{64.6\%} \end{aligned}$$

### 2.3.2.5 PAYBACK ANALYSIS

A payback (PBP) period is the time a project takes to generate cash to recoup its initial outlay. If an investment does not have a short PBP, or if there are other opportunities with a shorter PBP, then the investment should be not be undertaken. From the PBP analysis, the project will need nine months to payback the initial investment and this makes it worthwhile to continue with the project.

Year	Cash flow (US\$)	Cumulative balance (US\$)
0		-11850
1	15500	3650

Figure 2.1 Project cash flows

Payback period calculation:

$$\begin{aligned} \text{Pay back period} &= \frac{11350}{15500} \times 12 \\ &= \underline{9 \text{ months}} \end{aligned}$$

### 2.3.2.6 NET PRESENT VALUE (NPV)

This is an evaluation technique which takes into account the profitability of the project and the timing of the cash flow that are produced by discounting future cash flows with a percentage called discount rate. If NPV is negative the project should be discarded, but it is positive, then it is worthwhile to continue with the project. The present value of any future cash flow is obtained by applying the following formula:

$$\text{Present value} = \frac{\text{Value in year } t}{(1 + r)^t}$$

Where  $r$  is discount rate and  $t$  is the number of years into the future that the cash flow occurs.

Year	Cash flow (US\$)	Discount factor @10%	Discounted cash flow (US\$)
0	-11850	1.000	-11850
1	15500	0.9091	14091
2	16500	0.8642	14259
3	19100	0.7513	14350
<b>NPV</b>			<b>\$ 30850</b>

Figure 2.2 Calculated discounted cash flows and NPV.

### **2.3.3 SOCIAL FEASIBILITY**

Social feasibility seeks to assess the impact to the company's society and find out whether it is possible to impact the society positively through the new system (Shelly and Rosenblatt, 2011). Some social and ethical issues will be reinforced by legislation. Ethical issues to consider are copyright legislation, codes of practice relating to occupational health and privacy legislation. The development of this project is deemed feasible socially and ethically because it is in compliance with legislation requirements, some of them are the SI 68 of 1990, SI 41 of 1994 and SI 182 of 1995.

### **2.3.4 OPERATIONAL FEASIBILITY**

This part of feasibility study assesses whether the system will be used if it is developed and implemented. Operational feasibility entails an evaluation on the effects of each alternative on the routine operations of the organization. Management has to be heavily involved in this area of feasibility study because management understands more the operations of the organization. This type of analysis focuses on the changes affecting users, whether users will accept the changes and to what extent they need to change the way they do business and how the operations will be interrupted while setting up the system and whether any changes in one section of the organization adversely affect another section is again considered during operational feasibility study. With the organization's much placed emphasis on quality occupational health to its workforce, this project has gained management support and more importantly all users accepted the changes to be made and no major interruptions will be experienced during system set up, making this project to be operationally feasible.

## **2.4 RISK ANALYSIS**

Every project involves risks of some form. An effective risk management process is an important component of a successful software project. Risk management is the process of identifying risk, assessing risk, and taking steps to address the risk ahead of time (Dennis et al., 2015). A risk is an event that might occur, and will, if it does occur, affect negatively the successful completion of the project. The following risks were identified and analysed during the planning phase. Table 2.8 summarizes the risks associated with the project and solutions proposed to mitigate those risks in order to eliminate or minimise the impact of the risk.

Table 2.8: Risk Analysis

Type of Risk	Severity	Risk Impact	Solution
Impractical budget	Low	Lack of adequate funding may lead to project failure	Scheduled estimation, Incremental development and user involvement especially management
Insufficient expertise and skills within the project team	Low	Development of a system with wrong user functions and delays in project implementation	Training programs, recruiting individuals with top talent, assigning tasks to key personnel at early stages of development
Shortfall in hardware and software resource	Low	Delays project	Contractual agreements with suppliers, analyses of other organizations performance levels.
Constant change of requirements by users	Medium	There will be an increase in time required to complete the project, increase in the scope of the project which will require more days to resolve.	User involvement in requirements specification, incremental prototyping
Computer viruses	Medium	Delays the development as viruses may affect the code	Use updated Antivirus software
Data loss	High	Loss of contractor data when server crashes or unauthorised deletions	Regular data backup, use of passwords and access levels

## 2.5 STAKEHOLDER ANALYSIS

In every project, there are various stakeholders who express their different interests and these interest must be analyzed so that the stakeholders achieve a common goal.

### 2.5.1 ORGANIZATION MANAGEMENT

The organization management desires the project to reduce operational costs and the system to be used as a tool that aids in decision-making. They require the project to be cost saving in the long term.

### 2.5.2 SYSTEM USERS/ CUSTOMER

The users are concerned with user friendliness and easy to use of the system, they expect the project to speed up their day-to-day operations. They recommend that online help should be provided by the system in order for them to better understand the system

### 2.5.3 DEVELOPERS

Developers typically use the architecture as a reference for developing the system and/or assembling system components. In this project, system developers have highlighted that it must be easy to add modules when need arises. This is mainly because they are concerned with extendibility and maintainability of the system.

### 2.5.4 SYSTEM MAINTAINER

The maintainers are mostly concerned with how easy it is to make changes in the system in future. These changes can be initiated by new or different user requirements or changing business requirements. System maintainers highlighted that maintenance should have minimum impact on users.

## 2.6 DEVELOP WORK PLAN

A project plan involves the identification of tasks and the allocation of resources to those tasks. The project will follow the system development life cycle and thus will depict a Waterfall Model. The Waterfall Model was chosen as best model because verification is done at each stage, the progress made is easy to trace and its association with stringent documentation which increases system visibility

### 2.6.1 PROJECT SCHEDULE

The project schedule describes the dependencies between activities, the estimated time required to reach each milestone and the allocation of people to activities. The project time allocation for each individual phase is shown in Table 2.9 and then followed by the Gantt chart.

Table 2.9: Project task schedule

ID	Activity Name	Duration	Start	Finish	Predecessors
1	Project Proposal	1 week	26/06/17	30/06/17	-
2	Planning	1 week	03/07/17	07/07/17	1
3	System Analysis	3 weeks	10/07/17	28/07/17	2
4	System Design	3 weeks	31/07/17	18/08/17	3
5	Implementation	1 week	21/08/17	25/08/17	4
6	Maintenance	2 weeks	28/08/17	08/09/17	5
7	Project Documentation	11 weeks	26/06/17	08/09/17	1,2,3,4,5



The activity Table 2.9 was used to produce a Gantt chart Figure 2.3

**Gantt chart**

A Gantt chart plots the tasks against their timescale into a chart as shown below

ID	Activity	Predecessors	Time in weeks											
			1	2	3	4	5	6	7	8	9	10	11	
1	Project proposal	-	█											
2	Planning	1		█										
3	Analysis	2			█	█	█							
4	Design	3						█	█	█				
5	Implementation	4									█			
6	Maintenance	5										█	█	
7	Documentation	1,2,3,4,5	█	█	█	█	█	█	█	█	█	█	█	█

Figure 2.3 Gantt chart

**2.7 CHAPTER SUMMARY**

In this chapter, the reasons for developing Trackforce were discussed together with the business value expected from implementing the system. A feasibility study conducted helps to decide whether to continue with the project or not which at the end the analysis the project was deemed feasible. Finally, the chapter highlighted the project plan for the proposed system outlining the start, finish dates and the order of scheduled project tasks. The next chapter focus on analysing the current system and identifying methodology ideal for the system under development and it evaluates alternatives to the project.

## **CHAPTER 3: SYSTEM ANALYSIS**

### **3.1 INTRODUCTION**

Analysis refers to breaking a whole into its parts with the intent of understanding the parts' nature, function, and interrelationships. (Dennis, Wixom and Roth, 2012). In this chapter the focus is mainly in conducting a full analysis of the current system by examining how the current system functions and how information flows and the processes involved. Attention will also be paid to the applicable research methods used for the study and how the research was conducted and the findings. Ways of acquiring the new information system will also be highlighted.

### **3.2 INFORMATION GATHERING METHODOLOGIES**

For the purpose of the study, a number of different research methods were employed. The methods include interviews, questionnaires, observations and document reviews and they were used to gather information about the current occupational health and biological monitoring system. Information was gathered on employee pre-placement assessment, ongoing screening and medical retirement or any actions taken for high risk work. Key informants were from three departments (Medical section, Mining and SHEQ departments).

#### **3.2.1 INTERVIEWS**

An information gathering interview employs direct conversation with interviewee using a question-and-answer format. In the interview, the analyst get opinions of the interviewee, his feelings about the current system, organizational and personal goals (Kendall and Kendall, 2014). Interviews were conducted with safety officers as well as nurses who are directly involved in biological monitoring. The aim of the interviews was to understand the framework of the current occupational health and safety monitoring system, identify the roles played by a range of different users and the mechanisms established to ensure compliance across the organization and the expected improvements in implanting the effective occupational health and safety system. Some of the issues raised during interviews include the organizational occupational health policy framework, the extent to which workers are exposed to risks, and key barriers and success factors to implement the best practice in workplace safety compliance.

#### **3.2.1.1 ADVANTAGES OF USING INTERVIEWS**

- i.** During the interviews, the analyst could capture the feelings of the safety officers and the nurses and this helped in understanding better about the Zimplats organizational culture.
- ii.** Opinions and feelings were reviewed about the current state of the system, organizational goals, and informal procedures. This is because opinions may be more important and more revealing than facts.
- iii.** Interviewing the safety and health employees allowed them to describe what is important to them.

#### **3.2.1.2 DISADVANTAGES OF USING INTERVIEWS**

Not all potential health officers were consulted, given the project's overall timeframe. As a result, due to lack of time to carry out many interview sessions, the analyst was not able to solicit required information very well and because the analysts was dealing with health issues, some information could not be disclosed for security reasons, health reasons and fear of abuse.

### **3.2.2 OBSERVATIONS**

Observational research typically takes place in the users' home, workplace, or natural environment and not in a lab or controlled environment. Observation as a research technique that allows the analyst to understand how people naturally interact with products and people and their challenges (Sauro,J. 2015).Observations were carried out by visiting the Ngezi Occupational health clinic and making notes of the system's current functionalities and observing how the system was used by both occupational health officers and medical officers. These findings were recorded and analysed to determine design criteria. This technique also allowed for a visual opportunity to observe what was currently used in the system to screen employees and monitor the effect of hazard exposure of those chemicals absorbed by the body.

#### **3.2.2.1 ADVANTAGES OF USING OBSERVATIONS**

- i.** It was helpful to directly see how the medical team dispatch their duties rather than relying on what they say they do.
- ii.** Visiting the Ngezi Occupational health clinic allowed the analyst to gain information about the environment that is unavailable through any other method. The analyst gets an insight of what actually is done, not explained or documented.

- iii. Observations are relatively inexpensive as compared to other fact-finding techniques. This is because other techniques usually require substantially more employees' release time and copying expenses.

#### **3.2.2.2 DISADVANTAGES OF USING OBSERVATION**

- i. The tasks being observed were subject to various types of interruptions and thus timing was very difficult due to some other commitments such as schoolwork and own job requirements, the scheduling and timing of observations was really difficult.
- ii. It was noted that the medical personnel in some cases felt uncomfortable under observation and they may unwittingly perform differently in such situations.

### **3.2.3 QUESTIONNAIRES**

A questionnaire is a set of written questions used to obtain vital information from participants (Dennis, Wixom and Roth, 2012) The questionnaires were designed with some questions probing for examining how the respondents relate to medical screening and assessment and also the ongoing tracking of workers' exposure to chemicals. The survey method was crucial in gathering information from the users of current system and determining the user needs and requirements for the new system. Close-ended questions were used to increase the response rate.

#### **3.2.3.1 ADVANTAGES OF USING QUESTIONNAIRES**

- i. Questionnaires were cheap means of gathering data from a large number of individuals and they were also used so as to carry out an exploratory study and to gauge overall opinion before the systems project is given any specific direction.
- ii. Reduces chance of evaluator bias because the same questions were asked to all respondents
- iii. Some people feel more comfortable responding to a questionnaire than participating in an interview

#### **3.2.3.2 DISADVANTAGES OF USING QUESTIONNAIRES**

- i. In some of the questions, there were differences in interpretations of questions and this compromised the validity of the information given by the respondents and it has not always been possible to identify all corroborating information.
- ii. Some feedback was not complete so it was difficult to interpret the data.

### **3.2.4 DOCUMENT REVIEW**

Document review involves analysing existing documents internal to Zimplats and other external publications. Document review was used to gather background information and to determine if implementation of the program reflects program plans. Zimplats has a robust archiving requirements and documents reviewed were in hard copies and these included reports, policy documents, procedures (risk and legal registers). The majority of material selected was official documentation, with a small number of pieces of original research. Documents material was supplemented by information collected through the interview process.

#### **3.2.4.1 ADVANTAGES OF USING DOCUMENT REVIEW**

- i.** Good source of background information of Zimplats since establishment
- ii.** Documents brought up issues not noted by other means.

Information contained in extant document(s) is independently verifiable

#### **3.2.4.2 DISADVANTAGE OF USING DOCUMENT REVIEW**

- i.** Some of the information from external sources was difficult to apply in the organisation and also some of the documents expected were unavailable.
- ii.** Zimplats documents reviewed could be biased because of selective survival of information deliberate omission or inclusion of other information is done to perpetuate company self-interest.
- iii.** The quality of data being collected cannot be controlled and must rely on the information provided in the document(s) to assess quality and usability of the sources.

Interviews and questionnaires were mainly used because of simplicity and observations and record reviews were used to guarantee authenticity.

### **3.3 ANALYSIS OF EXISTING SYSTEM**

A thorough analysis of the existing system was done and from the fact findings it showed that the current system being used by Zimplats was not computer based.

#### **3.3.1 MEDICAL TESTS**

Medical scrutiny is the analysis of health fitness to check if employees engaged for work are physically, mentally and emotionally fit for duty at the workplace. Thus, medical test and tracking serves as a feedback loop to the employer. After a medical test is conducted, a contractor is given

a medical fitness certificate valid for three (3) months after which the contractor is obliged to be examined again as long as he/she is coming to site.

### **3.3.2 INDUCTION TRAINING**

The new employees have to familiarize with the mining environment before they work at the company. Initial induction must be attended and the employee has to complete all the modules, which are signed by training officer and SHEQ officer. A training plotter with all completed modules is then issued to the contractor and filed. This induction training is only valid during the contract period, after which the worker must go through the same process.

### **3.3.3 DATA STORAGE**

Medical details of employee are kept in an excel sheet which is used as a database. Data in this excel sheet include the medical test dates and the expected review dates. The rest of all information is on paper. The medical certificates are filed as hard copies and any other information is not retained.

### **3.3.4 BIOLOGICAL MONITORING**

Biological monitoring is the testing and analysis of the presence of a hazardous substance, its metabolisms or a biochemical change in a person's biological materials (e.g. blood, urine) to determine how much chemical has entered the body following exposure. Thus, biological monitoring serves as a feedback loop to the employer and it may be based on a single case or sentinel event, but more typically uses screening results from the group of employees being evaluated to look for abnormal trends in health status. For routine screening, samples of urine are collected and analysed for lead, copper and manganese chemical absorption.

### **3.3.5 REPORTING**

Reports are manually generated from the induction training statistics detailing number of employees scheduled for medical tests, examined, trained and number of employees with expired medical fitness at any given dates. Biological monitoring or surveillance report are produced by comparing and analysing samples for measuring the amount of the chemical or its metabolites using Microsoft excel.

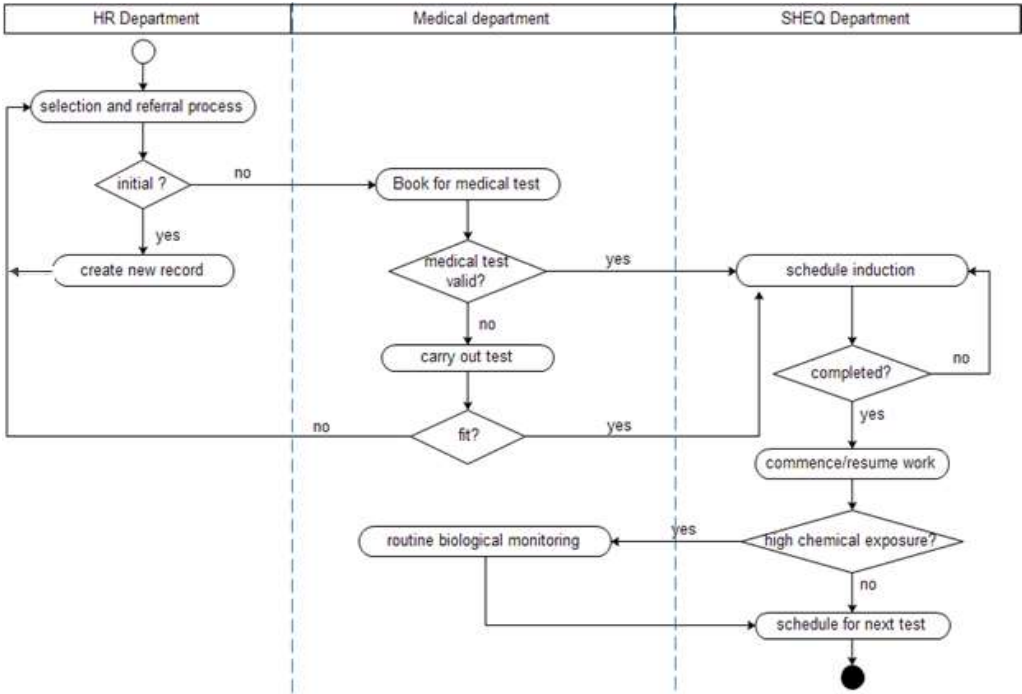
## **3.4 PROCESS ANALYSIS**

A process can be defined as a logical series of related transactions that converts input to results or output. Activity diagrams are useful for analysing the processes by describing what actions need

to take place. The main reason to use them is that they model the workflow behind the system being designed.

**3.4.1 ACTIVITY DIAGRAM OF CURRENT SYSTEM**

Activity diagrams are used to describe a complex system in terms of smaller functional components called activities. An activity represents a dynamic process during which objects are manipulated and transformed. The diagram modelled workflow patterns involved from referring employees for medical tests, scheduling for induction, and then routine biological monitoring.



Key:

- Initial State
- Decision
- Control of data
- Final state
- Process/ Activity

Figure 3.1 Trackforce activity flow diagram.

## 3.5 DATA ANALYSIS

### 3.5.1 CONTEXT DIAGRAM

A context diagram is a process modelling tool that represent the critical interactions between an existing system and its external entities in its environment (Dennis et al, 2012) The Context Diagram shows the system under consideration as a single high-level process and then shows the relationship that the system has with other external entities (systems, organizational groups and external data stores). It simply shows the system of interest, the external entities with which it interacts with, and the data flows between the system and the external entities. Figure 3.2 is a typical context diagram of the current system

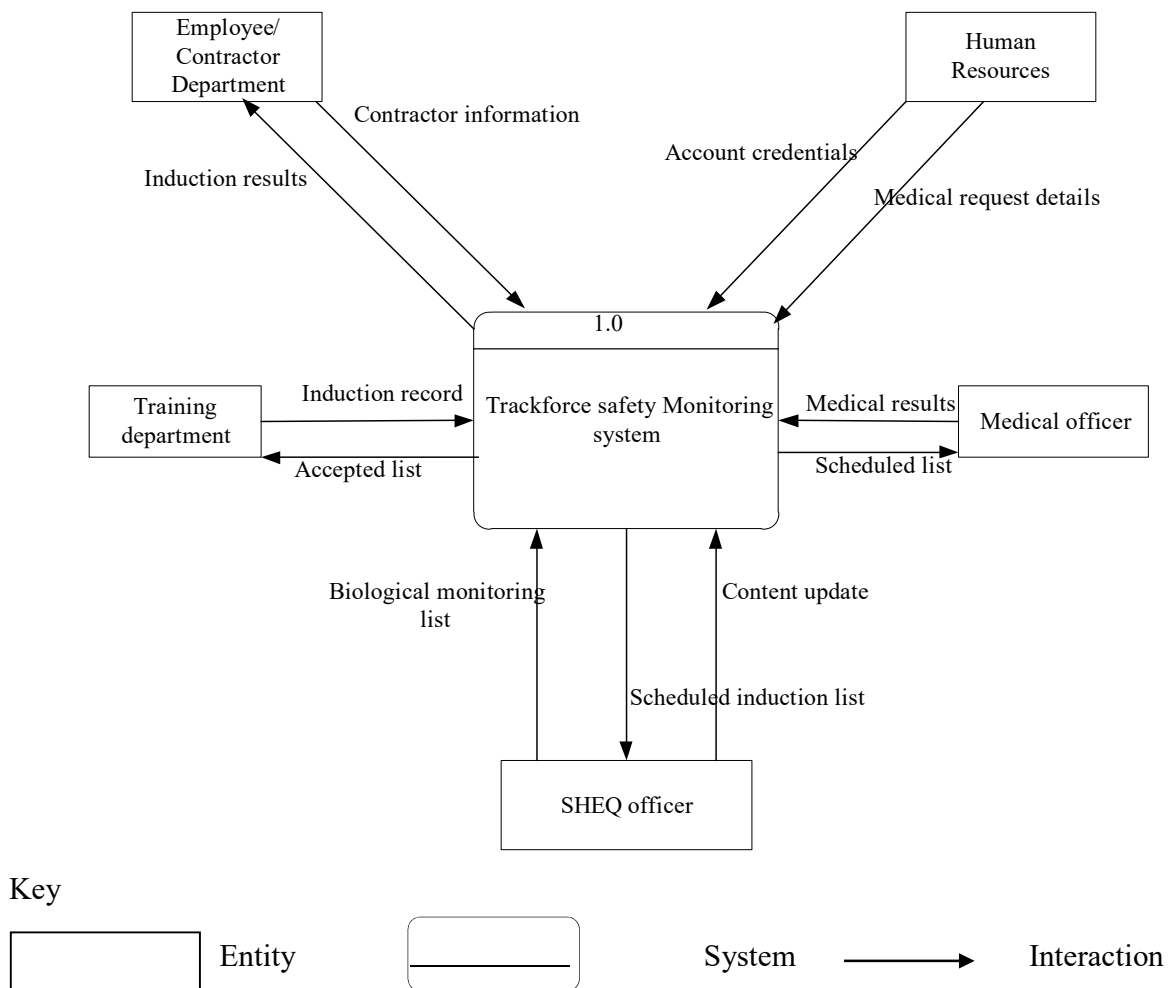


Figure 3.2 Context diagram for the existing system.



### 3.5.2 DATA FLOW DIAGRAM

Data flow diagrams (DFDs) are a way of representing a system's business processes, the flow of data into and out of those processes, and the flow of data between the system and the external agencies with which it interacts. The Figure 3.3 shows the data flow diagram of the existing system

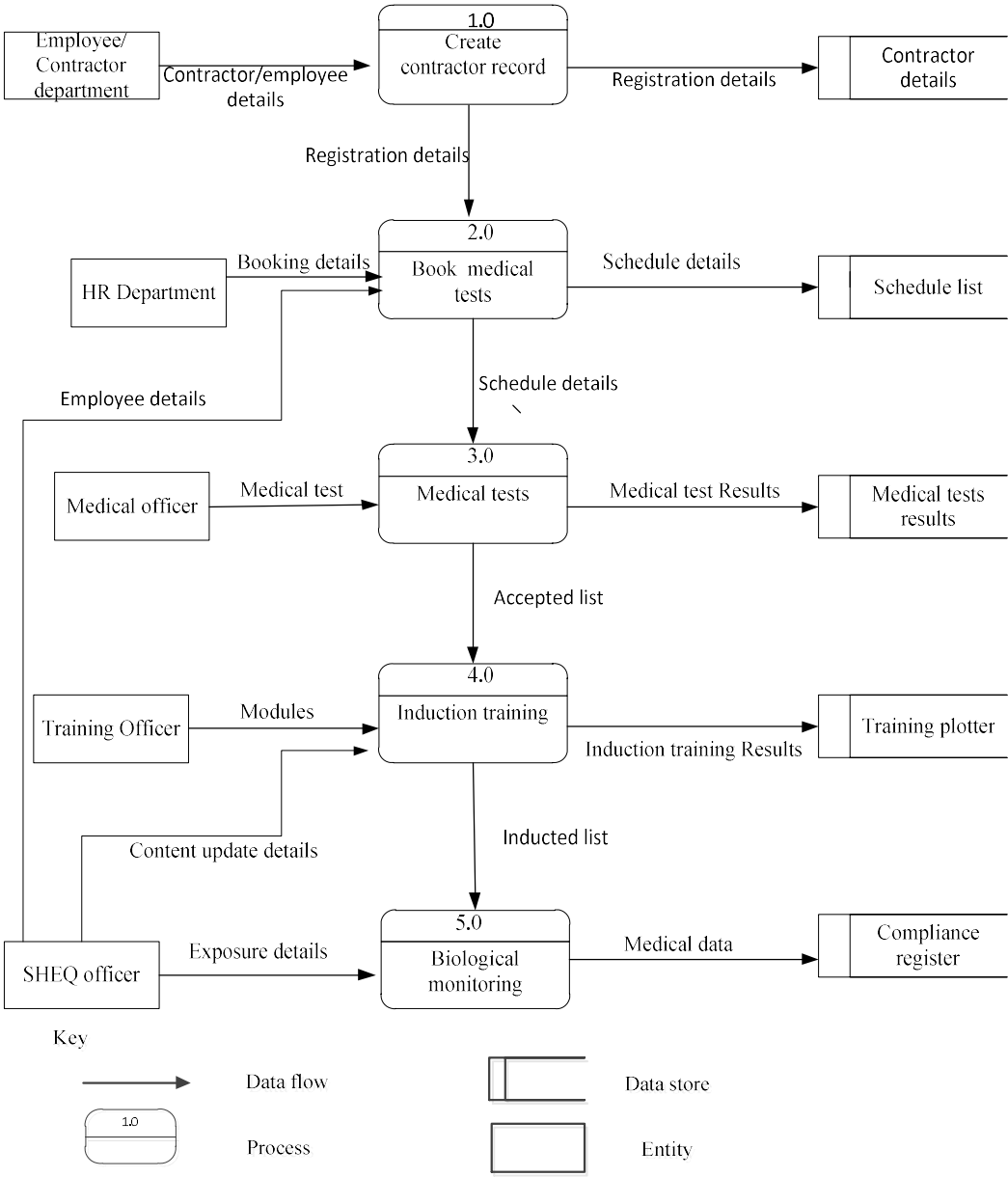


Figure 3.3 Data flow diagram for the existing system

### **3.6 WEAKNESS OF CURRENT SYSTEM**

The following problems associated with the current system were identified.

- i.** Occupational health data is routinely held in static paper storage system and managed with a silo mentality. The information is very difficult to retrieve and to find particular information one has to go through various registers. This results in inconvenience and wastage of time before the employees commences intended task.
- ii.** The information availability depends on how the department keeps it. Some information is destroyed after the contract employee's finishes work and the system fails to provide comprehensive medical information when reference is needed in future.
- iii.** Tracking of medical fitness tests is very difficult for a very big number of contractors and employees like what Zimplats currently have.
- iv.** Scheduling of medical fitness tests is done telephonically and because the number of employee has grown big, some employees are not scheduled in time resulting in serious delays to work thereby affecting production
- v.** Real-time monitoring of the effect of chemicals absorbed in body a difficult task, as information is difficult to collect from various registers. Biological monitoring and analysis of the sample figures with excel for different work groups is time consuming.

### **3.7 EVALUATION OF ALTERNATIVES**

To develop the most cost-effective system possible, a number of different system alternatives were evaluated. The results from feasibility study helped to choose the best alternative that minimizes costs and present the viable alternative to management for a final decision. The alternatives outlined below were considered.

- i.** Outsourcing
- ii.** Improving the current system
- iii.** In-house development

#### **3.7.1 OUTSOURCING**

Involves the organization purchasing software from a preferred outside vendor or engaging individuals or organizations rightful to develop a software product as per the Zimplats specifications

### **3.7.1.1 ADVANTAGES OF OUTSOURCING**

Outsourcing reduces the human resources requirement of Zimplats which include accommodation since the company is situated away from cities and towns.

### **3.7.1.2 REASONS FOR NOT CHOOSING OUTSOURCING**

- i.** Reliance on vendor's technical support to resolve issues
- ii.** Risk of exposing confidential medical data to a third-party which if leaked to the press will have a detrimental effect to the mining company
- iii.** These packages are usually very expensive.
- iv.** The vendor may be simply unqualified for the project or may fail to develop the system that can address the current needs due to the uniqueness of the mining giant

### **3.7.2 IMPROVING THE CURRENT SYSTEM**

Another alternative to deal with the present problems was to improve the current manual system. Improving the occupational health management system would involve labelling all the files and arrange them in order of dates for example years and records can be indexed for easy reference. Few people would be recruited to capture and maintain the records thereby relieving the work load of the present workforce. Again, it would need to train the responsible workers for Advanced Microsoft excel program to use it in data analytics

### **3.7.2.1 REASONS FOR NOT CHOOSING THE SYSTEM**

- i.** This can only be short term solution because as the business continues to expand, the weaknesses of the current system will tend to resurface in the long run.
- ii.** For this paper system to work better, it requires many workers (division of labour) which will end up increasing costs and without doubt duplication of data.
- iii.** Large volumes of space would be required to hold the hard copy files.

### **3.7.3 IN-HOUSE DEVELOPMENT**

The ability for an organization to build its own software package is strong and justified. In- house development means the organization choose to develop its own system from the available resources, or purchase, possibly customize, and implement a software package. Zimplats will maintain

- i.** Complete control of the software.
- ii.** Tailored to its unique business needs

- iii. Ownership of the software code
- iv. Meet constraints of existing systems and existing technology
- v. Development team is very close to the end user, resulting in a high quality product for the end user. This results in a much greater specialized application.
- vi. Business knowledge of the development team increases, reducing the time required for specification and design, as knowledge of the problem domain is pre-existing.
- vii. Using existing technology and resources (sunk costs), it becomes cost effective to develop the system in-house.

#### **3.7.4 BEST ALTERNATIVE**

After a thorough evaluation, the option for in-house development was adopted as attractive. All important considerations were done to ensure satisfying unique business requirements and to make use of the available internal resources and capabilities.

### **3.8 REQUIREMENTS ANALYSIS**

This is the process of exploring the system's properties that emerge from the combination of its parts for purpose of creating a system that would satisfy current user requirements and provide the basis for quick development. Requirements are divided into functional and non-functional requirements. Functional requirements are tasks the system must support, whilst non- functional requirements are constraints on various attributes of these tasks.

#### **3.8.1 FUNCTIONAL REQUIREMENTS**

Functional requirements are observable tasks or processes that must be performed by the system under development. They describe what the system should do, functions that can be captured in use cases, behaviors that can be analysed by drawing sequence diagrams and probably trace to individual chunks of a program.

The proposed system should be able to function in the following ways:

##### **3.8.1.1 REAL-TIME BOOKING**

The new system should support electronic booking for contractors for the next available slot time medical fitness tests or induction training.

##### **3.8.1.2 REPORTS**

Generate weekly, monthly reports on progress of contractor scheduling. Reports should summarise medical tests and induction time slots and valid medical fitness tests.

#### **3.8.1.3 EMPLOYEE BIOLOGICAL PROFILE ANALYSIS**

The system must populate employee profiles that displays all the scheduled time, training he is supposed to go through and the validity of the medical test and the biological monitoring details.

#### **3.8.1.4 COMPLIANCE MONITORING**

Tracking of medical fitness validity, training programmes

#### **3.8.1.5 ELECTRONIC RECORD KEEPING**

The details of all contractors must be treated confidentially. The new system should enable electronic filing, transfer and archiving of all medical and training records.

### **3.8.2 USE CASE DIAGRAM**

The system's behavior in respect to the users can be best presented by a use case diagram. The use case diagram has four elements:

- i. The actors, who are persons or a department. Each actor is associated with several use cases, each of which describes what the actor wants to do with the system (the actor's goal)
- ii. The use cases, represented with ovals with their names on it, that describe a sequence of actions that must be executed (e.g. the doctor can carry out medical test).
- iii. The lines that represent types of relationships between an actor and a use case or between two use cases. The <<include>> relationship, for example, is a directed relationship between two use cases which denotes the invocation of a use case by another one.
- iv. The system boundary which is a rectangle that includes all the use cases which indicate all the system's functionality

### 3.8.2.1 MEDICAL AND INDUCTION SCHEDULING USE CASE

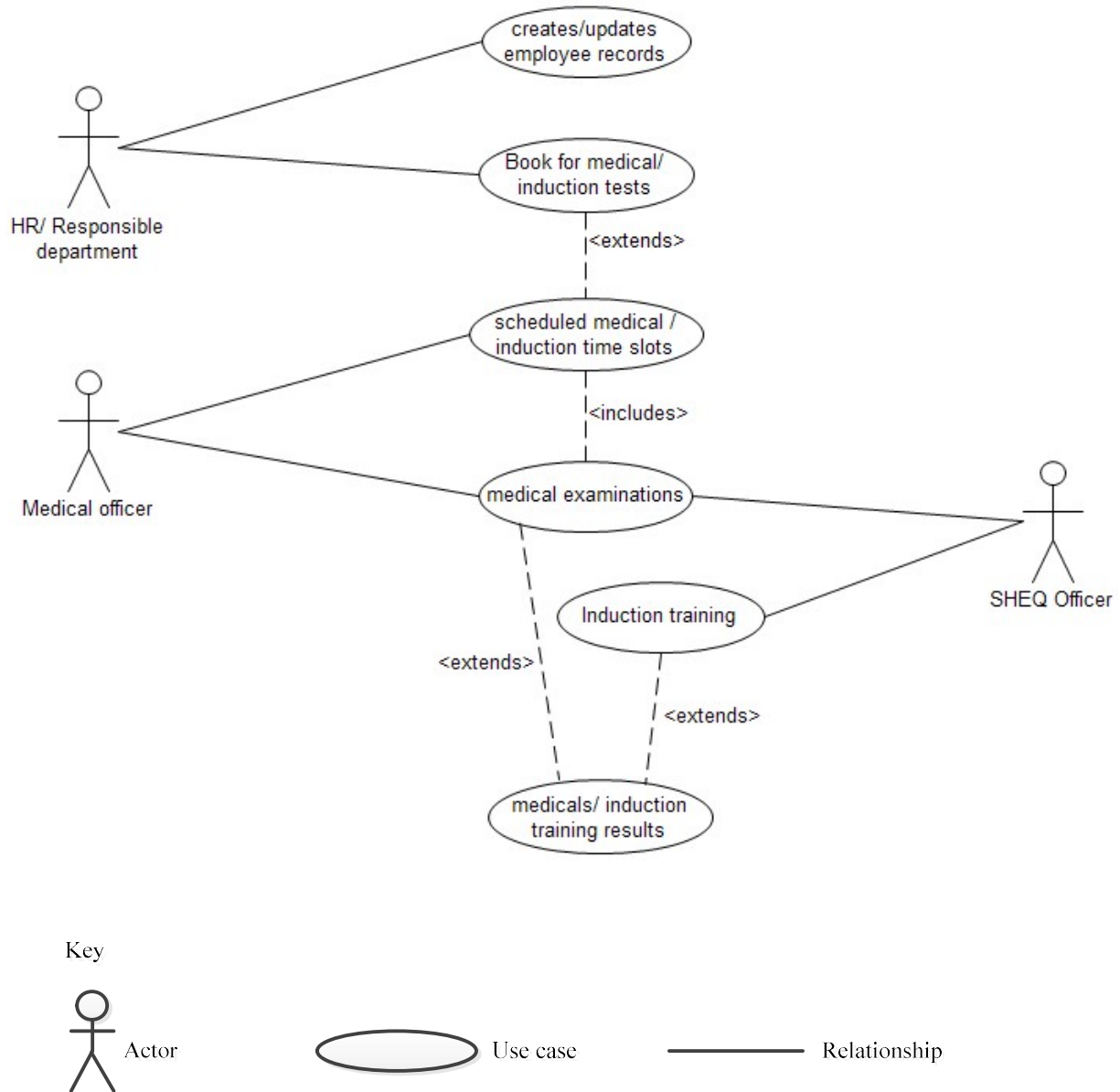


Figure 3.4 Contractor scheduling use case

### 3.8.2.2 BIOLOGICAL MONITORING USE CASE.

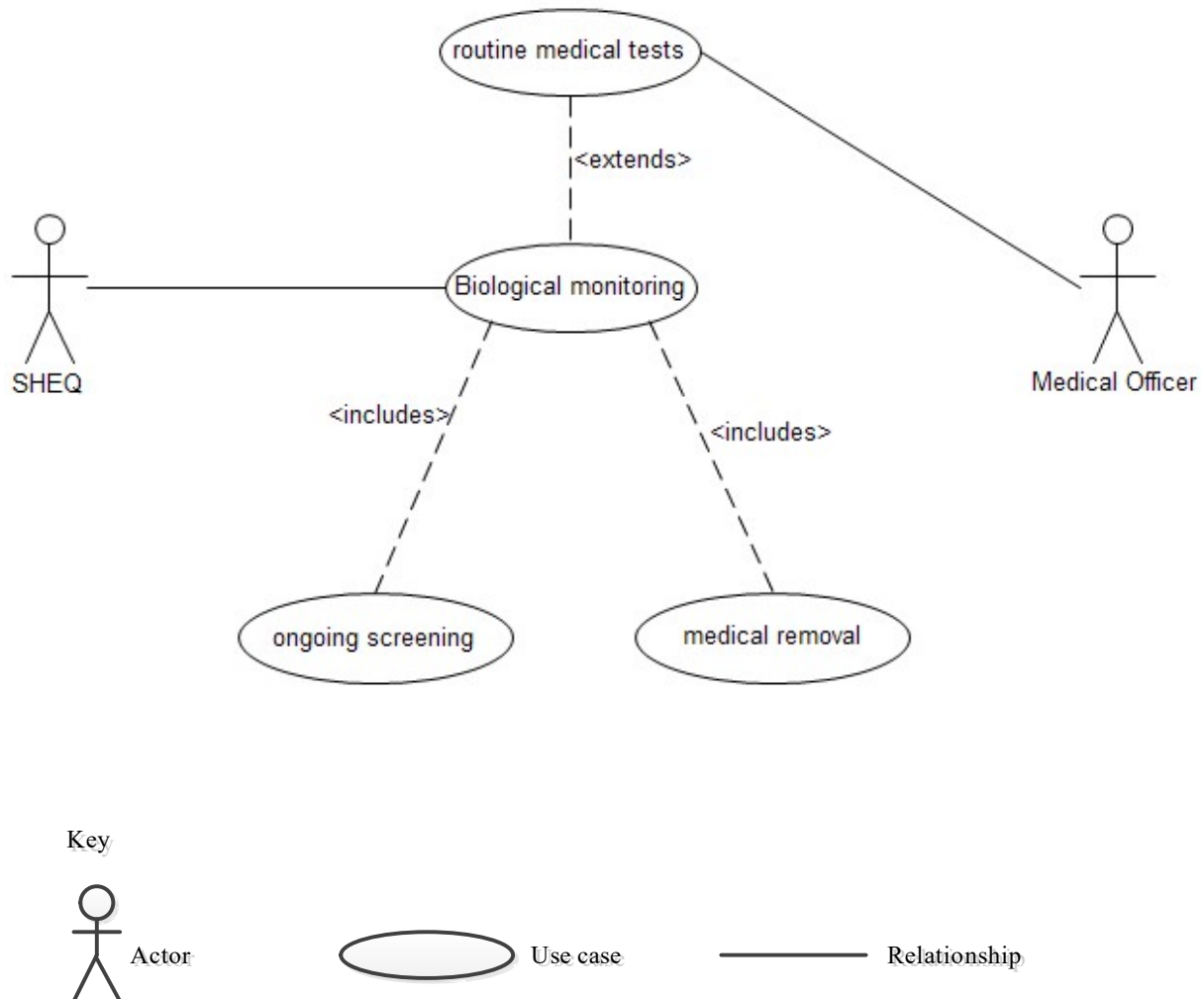


Figure 3.5 Induction training use case

### 3.8.3 NON FUNCTIONAL REQUIREMENTS

Non-functional requirements are global constraints on a software system, that is, they are qualities or standards that the system under development must have or comply with, but which are not tasks that will be automated by the system, for example development costs, operational costs, performance, reliability, maintainability, portability, robustness etc. Often they are known as software qualities and the following were noted

#### **3.8.3.1 INTERFACE REQUIREMENTS**

This describes how easy will the new system interface with other systems and users (user-friendliness) The system should be easy to use and users should be able to get help features however the Graphical User Interface (GUI) is only in English.

#### **3.8.3.2 PERFORMANCE REQUIREMENTS**

The new system should be capable of handling many transactions concurrently, have good response time, throughput and big storage space

Reliability-the availability of information when needed and the integrity of this information maintained and supplied to the system.

#### **3.8.3.3 SECURITY**

The system should offer authentication mechanisms such as passwords and access rights to system users. Robustness of the system as it will need to survive catastrophes like viruses.

#### **3.8.3.4 OPERATING REQUIREMENTS**

If the new system is very big in size (physical constraints) it can affect the convenience for maintenance. Personnel availability should possess necessary skills to support the system. The new system must have the following characteristics:

Modifiability or extensibility—ability to add (unspecified) future functionality

Adaptability of the system to support for new capabilities or ability to exploit new technologies.

#### **3.8.3.5 ECONOMIC REQUIREMENTS**

Cost of technological solution-cost of software, hardware and migration should be within the budget. The new system should restrict on immediate and/or long-term costs.

#### **3.8.3.6 LIFECYCLE REQUIREMENTS**

Maintainability

Enhance ability

Portability



### **3.9 CHAPTER SUMMARY**

In this chapter, several information gathering methodologies were discussed and the findings were used to analyse the existing system. The chapter explored various development alternatives which after in-house development was the best option. The data and process analysis demonstrated in this chapter also present the graphical view of the system, its processes, and its data flows which was used as a basis for discussing the system's weaknesses and requirement analysis.

## **CHAPTER 4: SYSTEM DESIGN**

### **4.1 INTRODUCTION**

This chapter will explain the logical and physical design of the proposed system that satisfies the requirements. System design involves choosing a high-level strategy for solving the identified problem and building the solution. Design issues include the architecture, user interfaces, data representations, process flows, security controls and finally how the system will be deployed.

### **4.2 SYSTEM DESIGN**

Systems design is the process of defining the components, modules, interfaces, and data for a system to satisfy specified requirements. Systems design could be seen as the application of systems theory to product development by defining the processes, models, and methodologies used to develop them. System design features of the proposed system will incorporate the following modules:

#### **i. ELECTRONIC BOOKINGS AND SCHEDULING**

Booking for medical examinations and induction training will do done electronically through the system. Whenever the booking is done, a schedule is automatically generated which can be viewed by the responsible personnel. A training schedule is generated from those people who passed the medical tests.

#### **ii. ELECTRONIC RESULTS CAPTURING**

This module involves capturing results for medical tests and induction training. The data is saved into MySQL database.

#### **iii. REPORTING**

Reports will be generated by the system with induction training statistics detailing number of employees scheduled for medical tests, examined, trained and number of employees with expired medical fitness at any given dates. Biological monitoring or surveillance report are produced by comparing and analysing samples for measuring the amount of the chemical or its metabolites using Microsoft excel

### 4.2.1 CONTEXT DIAGRAM OF THE PROPOSED SYSTEM

The context diagram Figure 4.1 shows the processes and activities to be included in the computerised system.

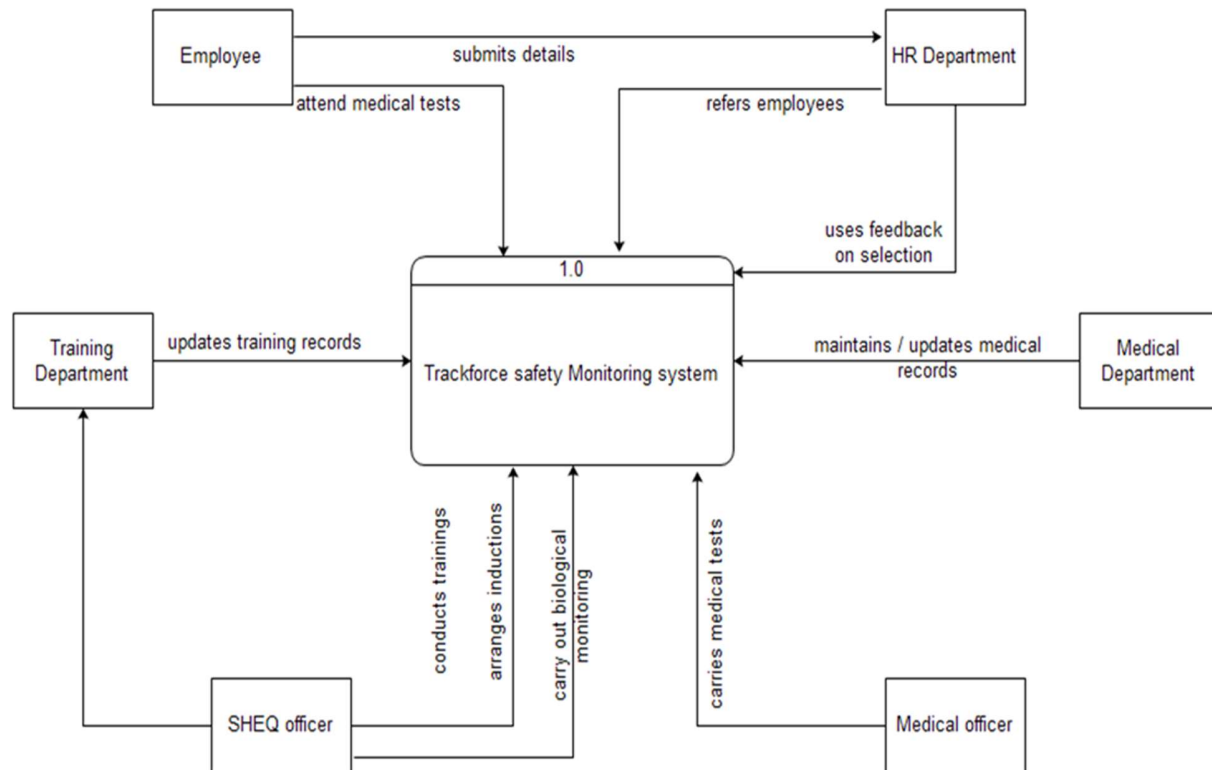
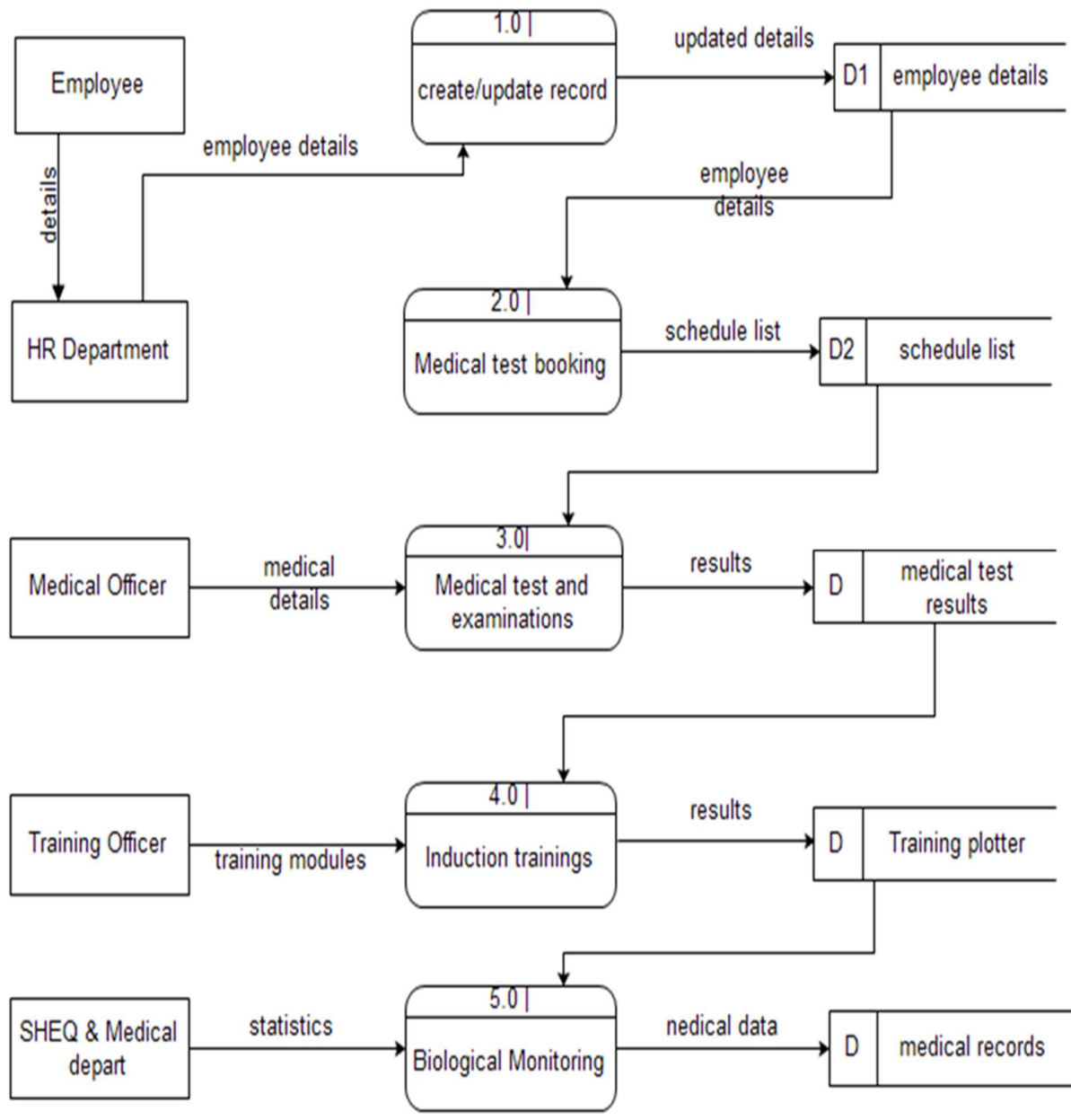


Figure 4.1 Context diagram for proposed system

### 4.2.2 DATA FLOW DIAGRAM

A data flow diagram represents the movement of data between external entities and the processes and data stores within a system. The data flow diagram of the proposed system is shown in Figure 4.2.



Key

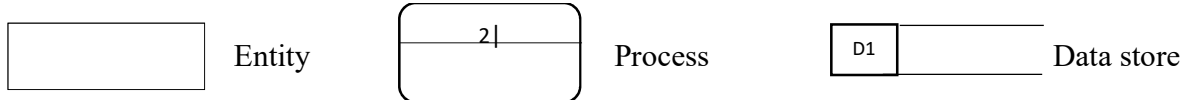


Figure 4.2 Data flow diagram for proposed system

### 4.3 ARCHITECTURE DESIGN

Architecture design involves organizing the structure of program components (modules), the manner in which these components interact, and the structure of data that are used by the components. The architectural design takes in account the structure properties, extra-functions properties and families of related system. The architecture highlights early design decisions that have a profound impact on all software engineering work that follows.

The primary advantages of a Client/Server system arise from the splitting of processing between the client system and the database server. Since most of the database processing is done at the back-end, the speed of the server is not tied to the speed of the workstation. The system architecture arrangement diagram of the proposed contractor data management platform is as shown in Figure 4.3.

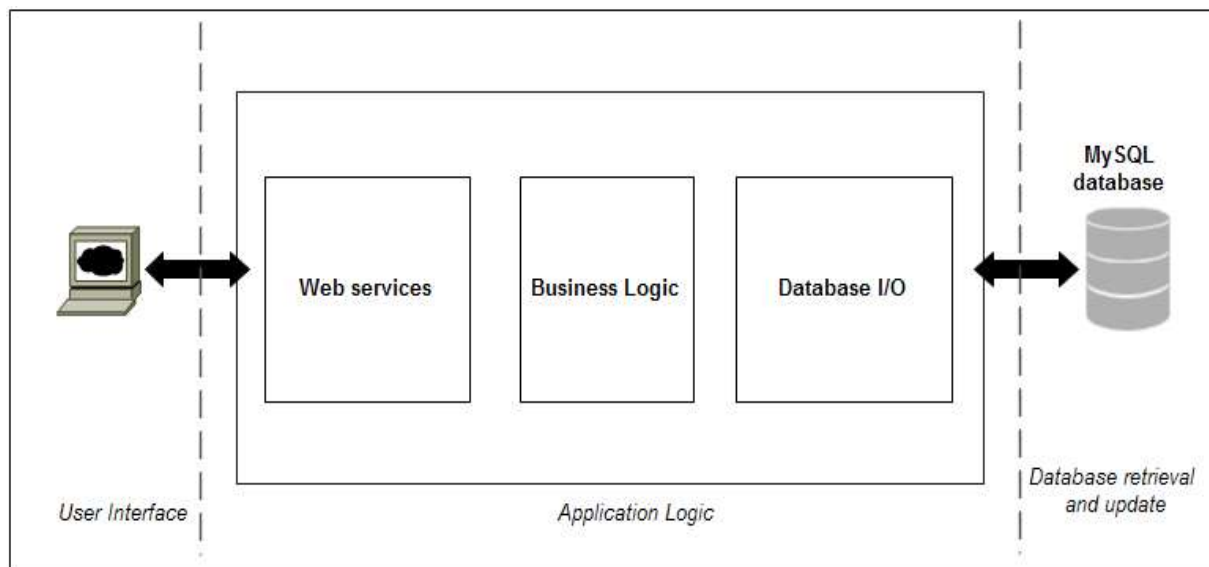


Figure 4.3 Architectural design

### 4.4 PHYSICAL DESIGN

The physical design relates to the actual input and output processes of the system. This is laid down in terms of how data is input into a system, how it is verified/ authenticated, how it is processed, and how it is displayed as output.” The diagram describes the technical environment of the proposed system, which encompasses the hardware that is going to be used and the way it is designed (location of the hardware) and the way in which it is going to be networked. The most

important aspect is that of the interaction between the hardware and the software under development. The system will be integrated in an already existing LAN/ WAN infrastructure.

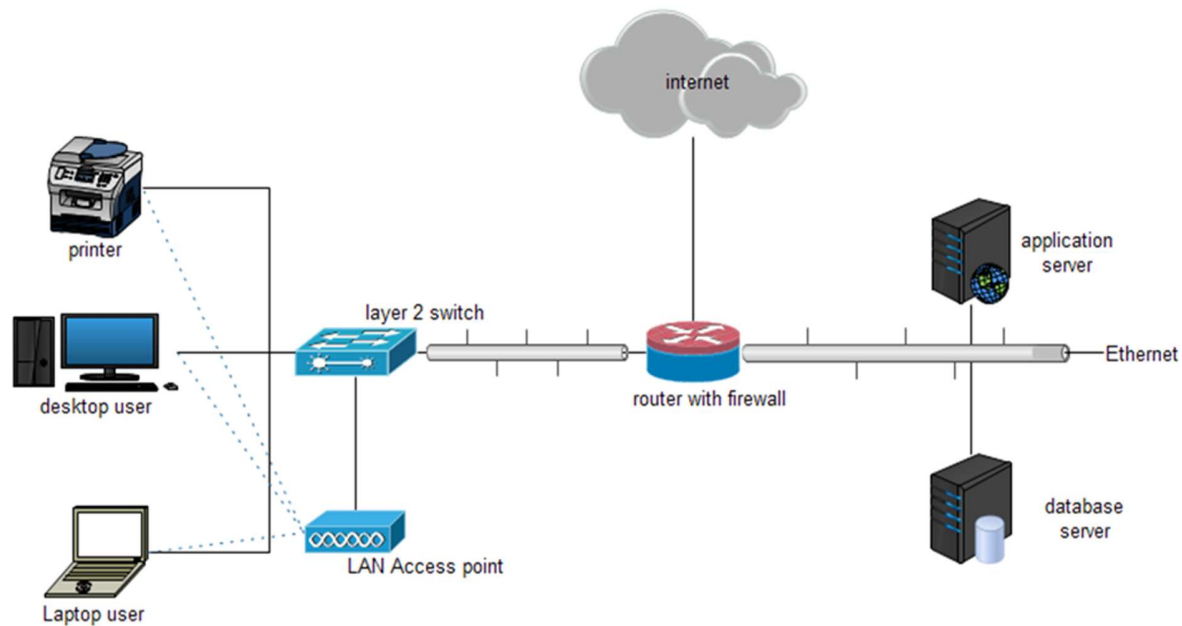


Figure 4.4 Physical diagram

## 4.5 DATABASE DESIGN

For any information management and processing system, database is the backbone or the source of data for the system. Database design is the process of producing a detailed data model of a database. This logical data model contains all the needed logical and physical design choices and physical storage parameters needed to generate a design in a Data Definition Language, which can then be used to create a database.

### 4.5.1 DATABASE SCHEMA

The database is designed from three different viewpoints known as Schema. (Lightstone et al, 2007)

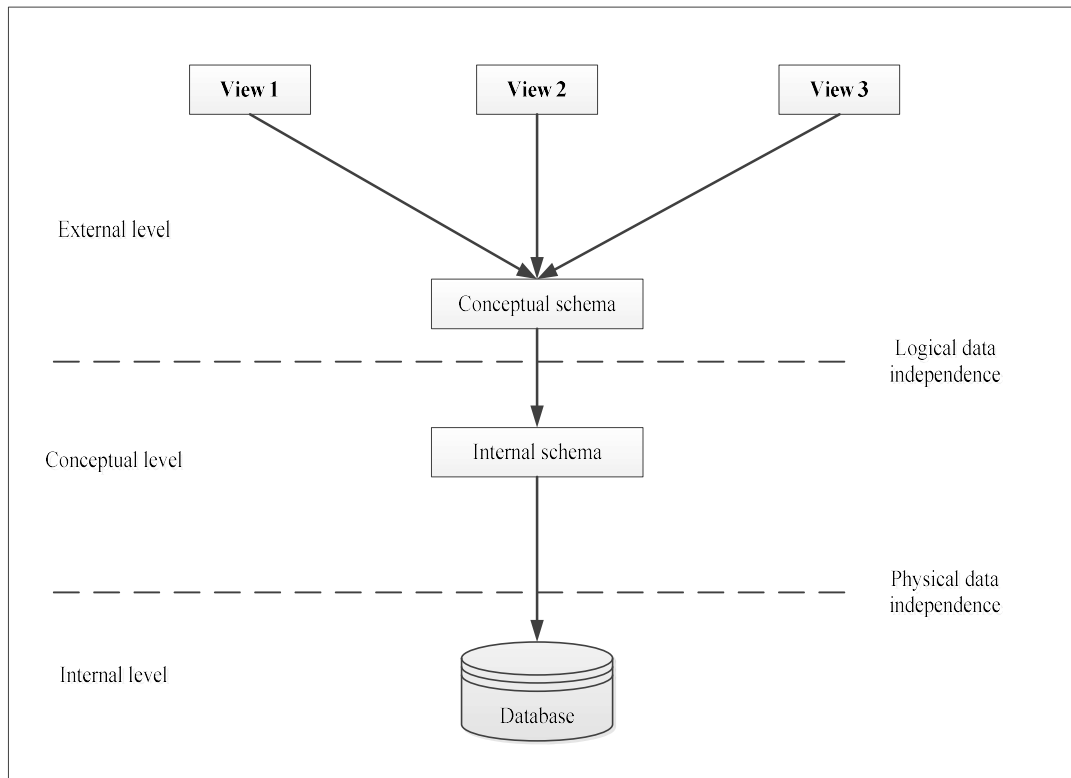


Figure 4.5 Database Architecture. (Source adapted from Lightstone et al, 2007)

**i. EXTERNAL LEVEL**

The user’s view of the database is customised to his/her interests. They only view the data that is relevant to them. In this department can only view the appointments done by their project department. The SHEQ trainer also can only view schedule times only for him or her.

**ii. CONCEPTUAL LEVEL**

This is the community view of the database; it describes the data stored in the database and the relationships among the data.

**iii. INTERNAL LEVEL**

This level mainly depicts the way the RDBMS and OS perceive the data. It describes how data is stored in the database.

## 4.5.2 DATA DICTIONARY

### Medical tests

Table 4.1 medical tests

Field	Type	Null	Key	Extra	Privileges
id	int(11) unsigned	NO	PRI	auto_increment	select,insert,update,references
employee_id	varchar(20)	NO			select,insert,update,references
test	text(11)	NO			select,insert,update,references
result	varchar(11)	NO			select,insert,update,references
status	text	NO			select,insert,update,references
medical_date	date	NO			select,insert,update,references
expiry_date	date	NO			select,insert,update,references
alert_date	date	NO			select,insert,update,references
Comment	Text	Yes			select,insert,update,references

### Employees

Table 4.2 Employees details

Field	Type	Null	Key	Extra	Privileges
id	int(11) unsigned	NO	PRI	auto_increment	select,insert,update,references
name	text	NO			select,insert,update,references
surname	text	NO			select,insert,update,references
national_id	varchar(255)	NO			select,insert,update,references
gender	text	NO			select,insert,update,references
address	text	NO			select,insert,update,references
department_id	int(11)	NO			select,insert,update,references
phone	varchar(255)	NO			select,insert,update,references
email	varchar(255)	NO			select,insert,update,references
date_engaged	varchar(255)	NO			select,insert,update,references
type	text	NO			select,insert,update,references
company	varchar (20)	YES			select,insert,update,references



## Induction training

Table 4.3 Induction table

Field	Type	Null	Key	Extra	Privileges
id	int(11) unsigned	NO	PRI	auto_increment	select,insert,update,references
employee_id	varchar(255)	NO			select,insert,update,references
company	int(11)	NO			select,insert,update,references
induction_type	text	NO			select,insert,update,references
module	varchar(255)	NO			select,insert,update,references
status	varchar(255)	NO			select,insert,update,references
date	date	NO			select,insert,update,references
comment	text	NO			select,insert,update,references
done_by	Text	No			insert

## Chemicals

Table 4.4 Chemical absorbed table

Field	Type	Null	Key	Extra	Privileges
id	int(11) unsigned	NO	PRI	auto_increment	select,insert,update,references
chemical_id	varchar(255)	NO			select,insert,update,references
chemical_name	int(11)	NO			select,insert,update,references
level	text	NO			select,insert,update,references
date	varchar(255)	NO			select,insert,update,references
employee_id	varchar(255)	NO			select,insert,update,references
status	date	NO			select,insert,update,references
comment	text	NO			select,insert,update,references

## System Users table

Table 4.5 System users

Field	Type	Null	Key	Default	Extra	Privileges
id	int(11)	NO	PRI	(NULL)	auto_increment	select,insert,update,references
username	varchar(255)	NO		(NULL)		select,insert,update,references
password	varchar(255)	NO		(NULL)		select,insert,update,references
group	int(11)	NO		(NULL)		select,insert,update,references
email	varchar(255)	NO		(NULL)		select,insert,update,references
profile_fields	text	NO		(NULL)		select,insert,update,references
last_login	varchar(255)	NO		(NULL)		select,insert,update,references
login_hash	varchar(255)	NO		(NULL)		select,insert,update,references
created_at	int(11)	YES		(NULL)		select,insert,update,references
deleted_at	int(11)	YES		(NULL)		select,insert,update,references
is_active	tinyint(4)	NO		(NULL)		select,insert,update,references

### 4.5.3 EXTENDED ENTITY RELATIONSHIP DIAGRAM (EERD)

An enhanced entity-relationship model, also known as an extended entity-relationship model, is a high-level conceptual model that accurately represents the requirements of complex databases. EERD includes subtypes and super types, specialization or generalization, attribute and relationship inheritance. Figure 4.6 shows the entity relation diagram of the system.

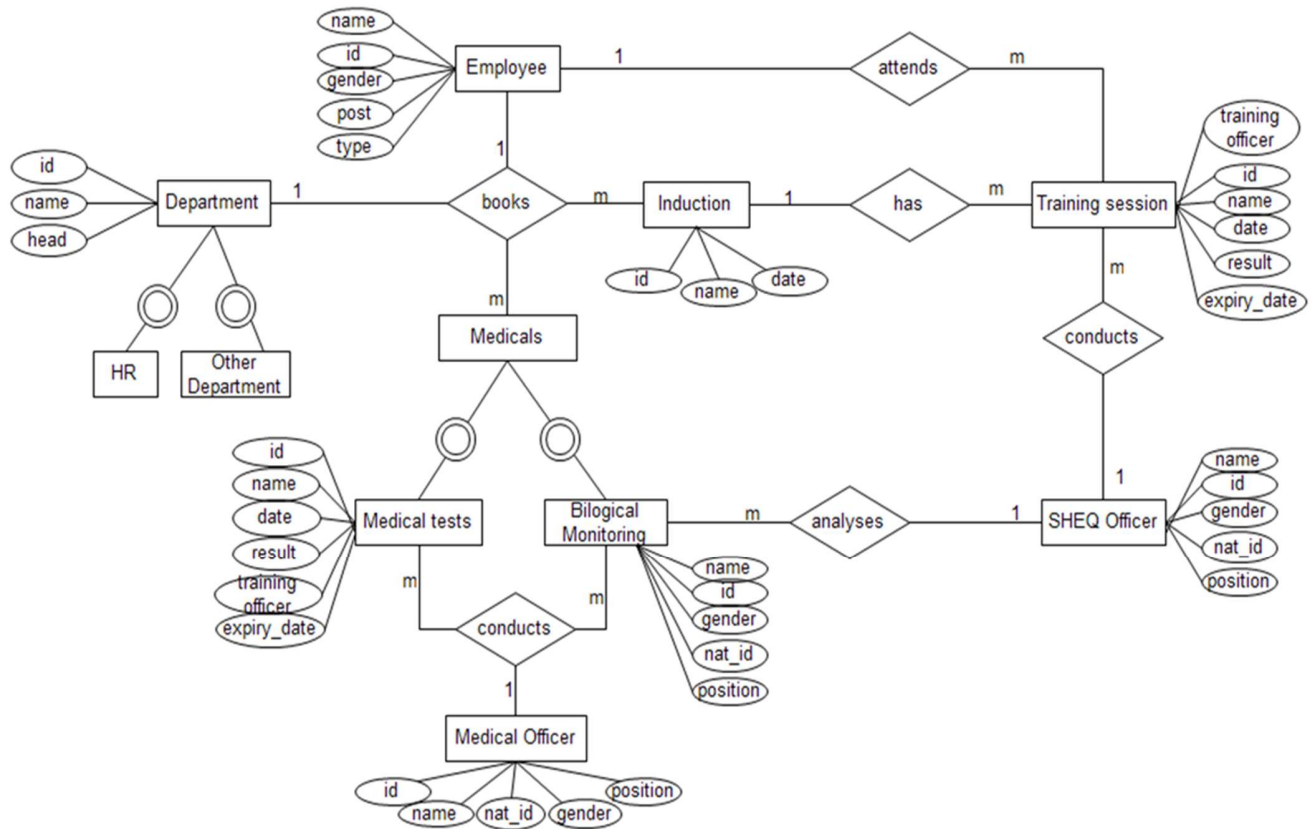


Figure 4.6 Extended Entity Relationship Diagram

## 4.6 USER INTERFACE DESIGN

The interface design “describes how the software communicates with system that interoperate with it, and humans who uses it” (Rojer S. Pressman). An interface implies the flow of information and a specific behavior. The objectives of interface design are to establish a consistent window into the content and functionality, guide the user through some interactions with the system and to organize the navigation options and content available to the user.

### 4.6.1 LOG IN DESIGN

The log in form will be presented for every user before getting started using the system. Every user will be provided with log in details at first from the administrator

The image shows a 'User Login' form with a light blue background. At the top, the text 'User Login' is centered. Below it are two input fields: 'User name' and 'Password'. At the bottom right, there is a 'Log in >' button. A horizontal line with a small circle is positioned above the button.

Figure 4.7 Log in form

#### 4.6.2 MENU DESIGN

The main form is the first form presented to a user after successfully log in. it contains the links to all the system modules for example the link to contractor management form. Where a user is restricted from accessing the link, the message box will be displayed

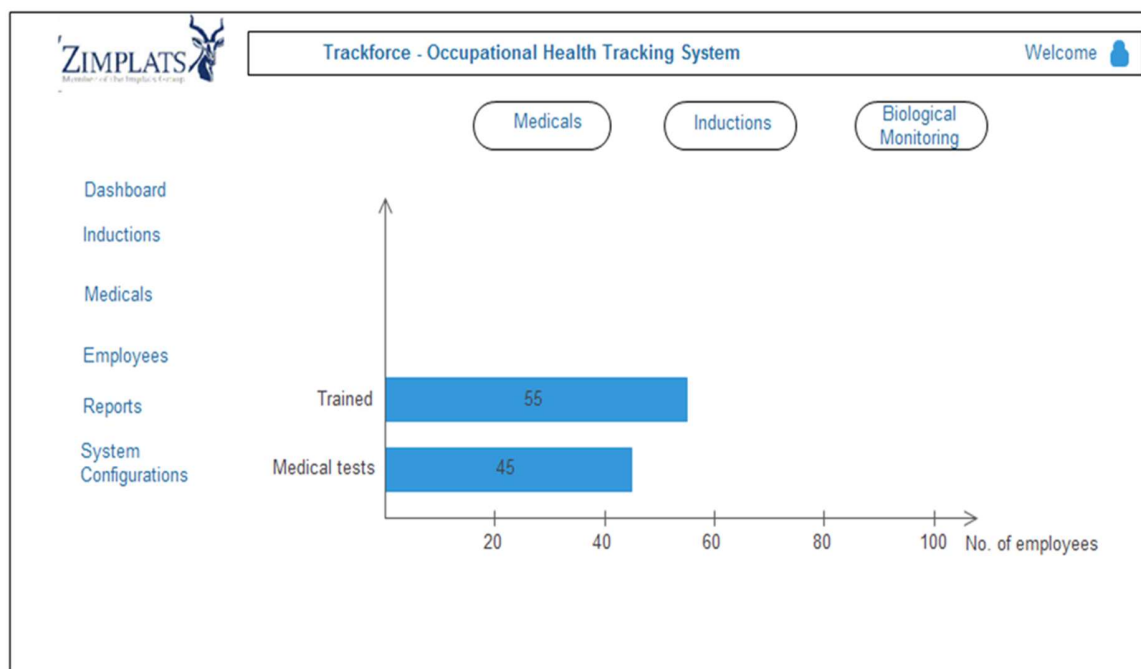


Figure 4.8 System Main Form

### 4.6.3 INPUT DESIGN

The interface should enable automated collection and input of data for example online submission and approval of documents by contractors, project supervisors and SHEQ. Figure 4.9 is a design of registering a new system user.

The screenshot shows a web interface for 'Trackforce - Occupational Health Tracking System'. At the top left is the ZIMPLATS logo. The title 'Trackforce - Occupational Health Tracking System' is centered, and 'Welcome' with a user icon is on the right. Below the header are two buttons: 'Medical Bookings List' and 'Inductions Booking List'. The main form area contains three input fields: 'Employee Number' (text), 'Name' (text), and 'Medicals Test' (dropdown menu). At the bottom are 'Book' and 'Cancel' buttons.

Figure 4.9 Medical Test booking

The screenshot shows a web interface for 'Trackforce - Occupational Health Tracking System'. At the top left is the ZIMPLATS logo. The title 'Trackforce - Occupational Health Tracking System' is centered, and 'Welcome' with a user icon is on the right. Below the header are two buttons: 'Medical Bookings List' and 'Inductions Booking List'. The main form area contains several input fields: 'Employee Number' (text with placeholder 'search by typing employee number'), 'Test Sample' (dropdown menu with 'Urine' selected), 'Medical type' (dropdown menu with 'Initial' selected), 'Lead' (text), 'Mecury' (text), 'Copper' (text), and 'Nickel' (text). At the bottom are 'Save' and 'Cancel' buttons.

Figure 4.10 Medical test form

#### 4.6.4 OUTPUT DESIGN

The system will have a portal to handle key output data in form of reports separated automatically through preset functions such as data of a specific period e.g. number of induction bookings per week

The figure below Figure 4.11 illustrates how induction training and (or) medical tests reports will be displayed

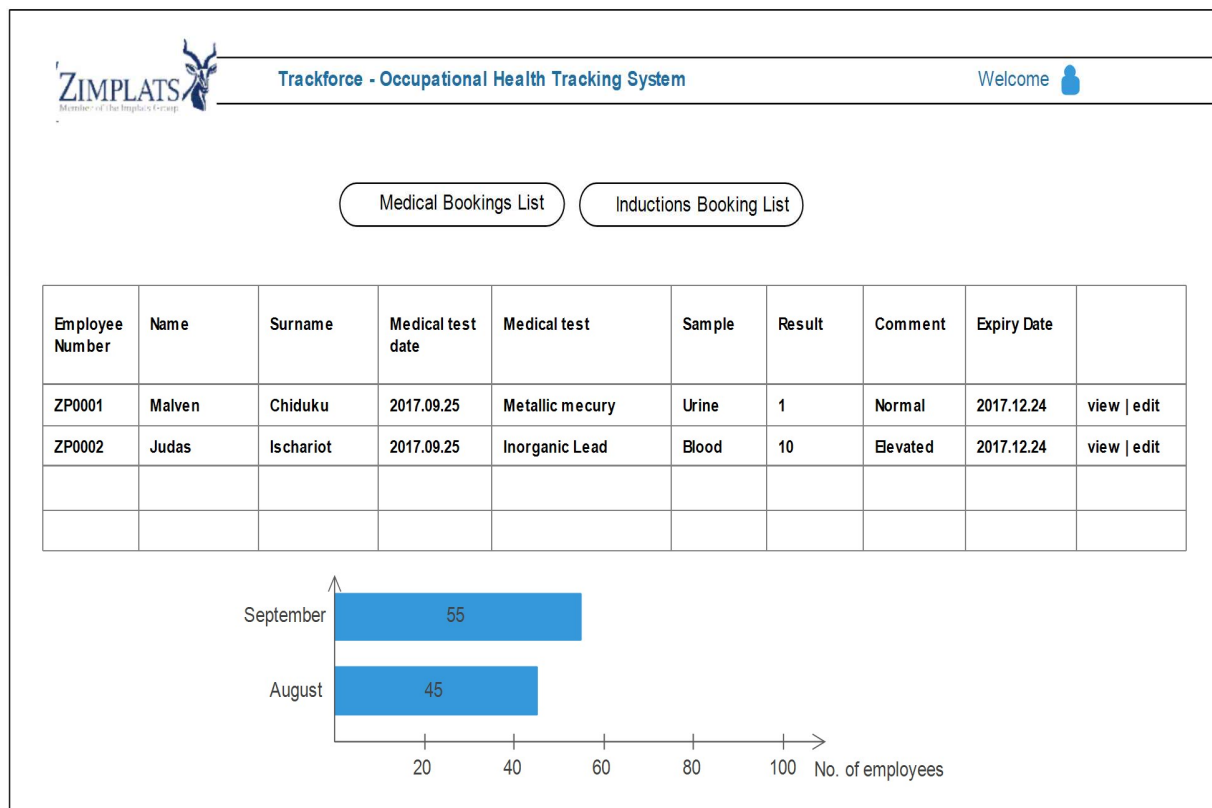


Figure 4.11 Medical tests reports

#### 4.7 PSEUDO CODE

Pseudo code is an outline of a program, written in a form that can easily be converted into real programming statements. Pseudo code consists of short, English phrases used to explain specific tasks within a program's algorithm. The goal of writing pseudo code, then, is to provide a high-level description of an algorithm which facilitates analysis and eventual coding but at the same time suppresses many of the details that vanish with asymptotic notation.

### **Pseudo code for user log in**

Start

Select system

Enter username and password

If (username and password) valid Then

Log in

Main Dashboard show

    Training Schedules menu

    Medicals menu

    Home

    Employee Management

    System Configuration

    Reports

Else

Login failure

Redirect to login page

End if

End

### **Pseudo code for Main menu Form show**

Start

If (Medicals) Then

Medical tests window show

    Booking

    Schedules

    List

End if

Else

If (Induction Training) Then

Trainings window show

    Bookings

    Schedules

    Manage

Else

If (Configuration) Then

Configuration window show

Else

If (Employee Profile Management) Then

Employees form show

    Account management

End if

Else

If (Reports) Then

Reports window show

    Listing training

    Scheduled medicals

    Scheduled trainings

End if

Else

If (log out) Then

Log out

Log in form show



End if

Else

Unauthorised user show

Login redirect

End.

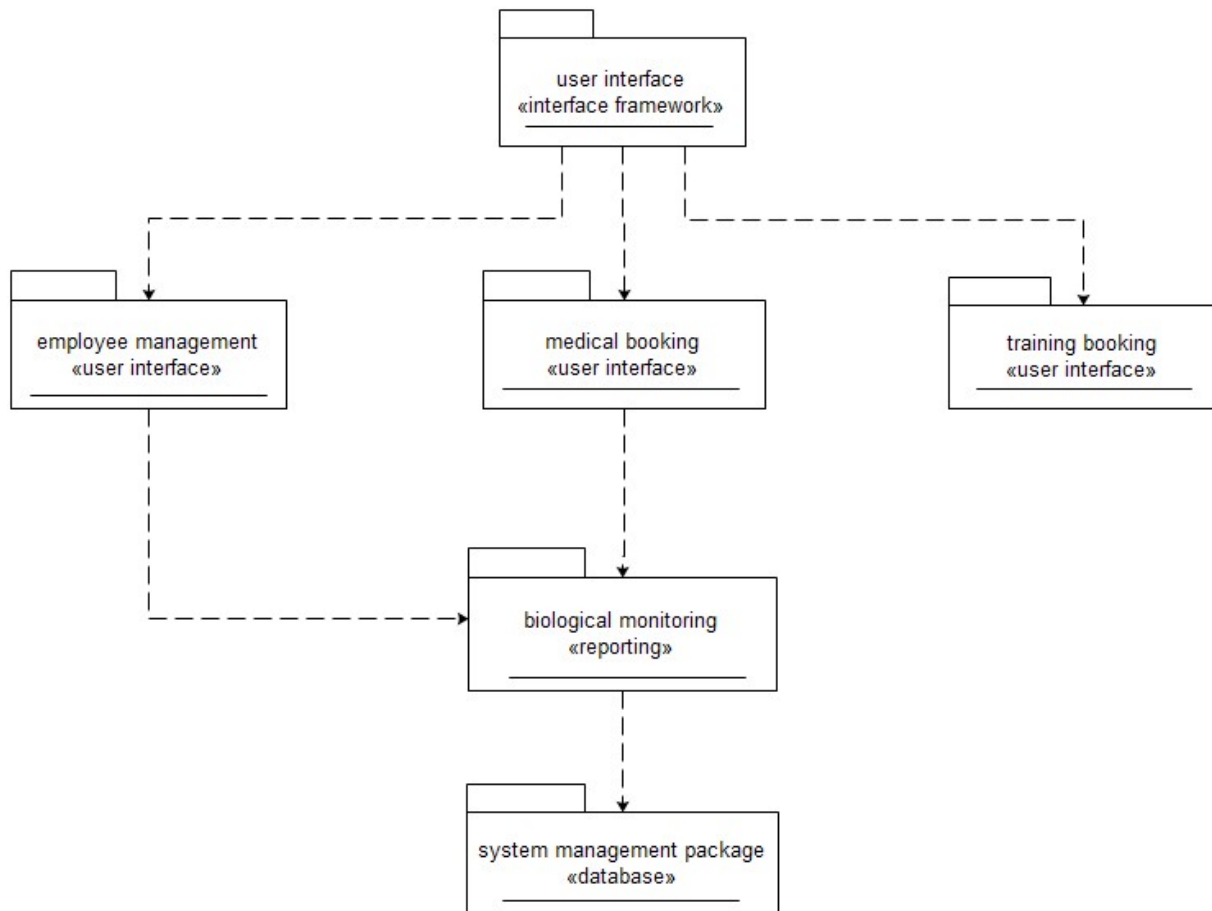
## **4.8 PROGRAM DESIGN**

The system provides the following main functions: online booking and scheduling of induction trainings and medical tests, biological monitoring and electronic notification for medical tests about to expire. The conceptual modelling of the system is depicted by class diagrams, package and sequence diagrams.

### **4.8.1 PACKAGE DIAGRAM**

Package diagrams visualise packages and depicts the dependency, import, access, generalization, realization and merge relationships between them. Package diagram enables you to gain a high level understanding of the collaboration among model elements through analysing the relationships among their parent package (UML Package Diagram Tutorials, 2012). This also helps explain the system's architecture from a broad view. The packages are displayed with a tabbed folder with the package's name written on it.

There is a dependency from one package to another if any class in the first package has a dependency to any class in the other package. The User Interface Package for example contains the classes that interact with the user for data entry, results presentation and user log in. The medical test or induction booking Packages contain the classes for booking and scheduling appointments. The figure below shows the package diagram of the proposed system.



*Figure 4.12 Package diagram*

#### **4.8.2 CLASS DIAGRAM**

A class diagram shows a set of classes, interfaces, associations and generalizations. Classes are depicted as boxes with three sections, the top one indicates the name of the class, the middle one lists the attributes of the class, and the third one lists the methods.

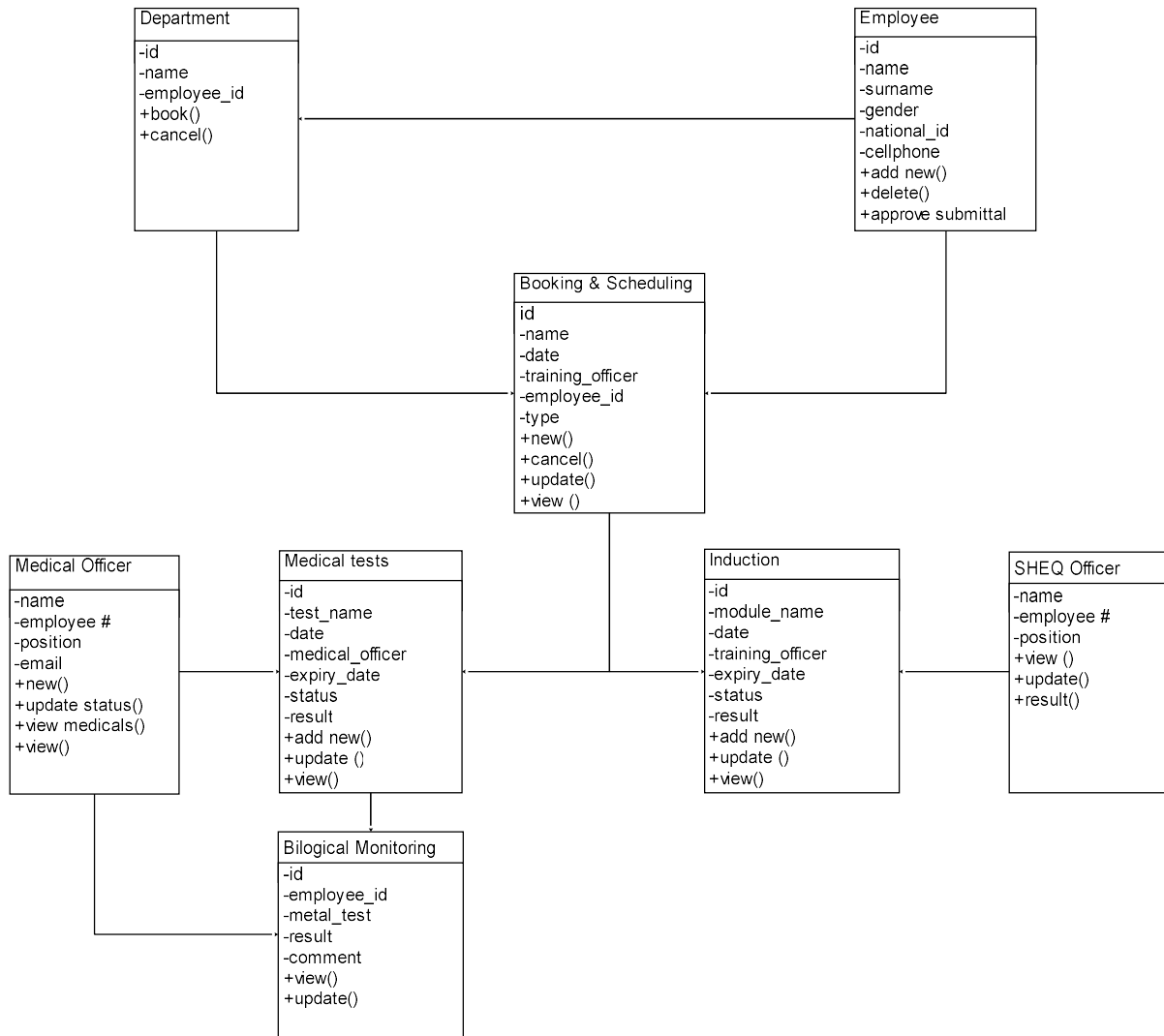


Figure 4.13 Class diagram

### 4.8.3 SEQUENCE DIAGRAM

Mezirow (2012) states that “a sequence diagram shows object interactions arranged in time sequence. It depicts the objects and classes involved in the scenario and the sequence of messages exchanged between the objects needed to carry out the functionality of the scenario.” A sequence diagram is an "interaction diagram" that models a single scenario executing in the system, showing behavior by showing the ordering of message exchange. Key parts of a sequence diagram are

- i. Participant: an object or entity that acts in the sequence diagram and
- ii. Message: communication between participant objects. The Figure 4.14 below shows a sequence diagram for the new system.

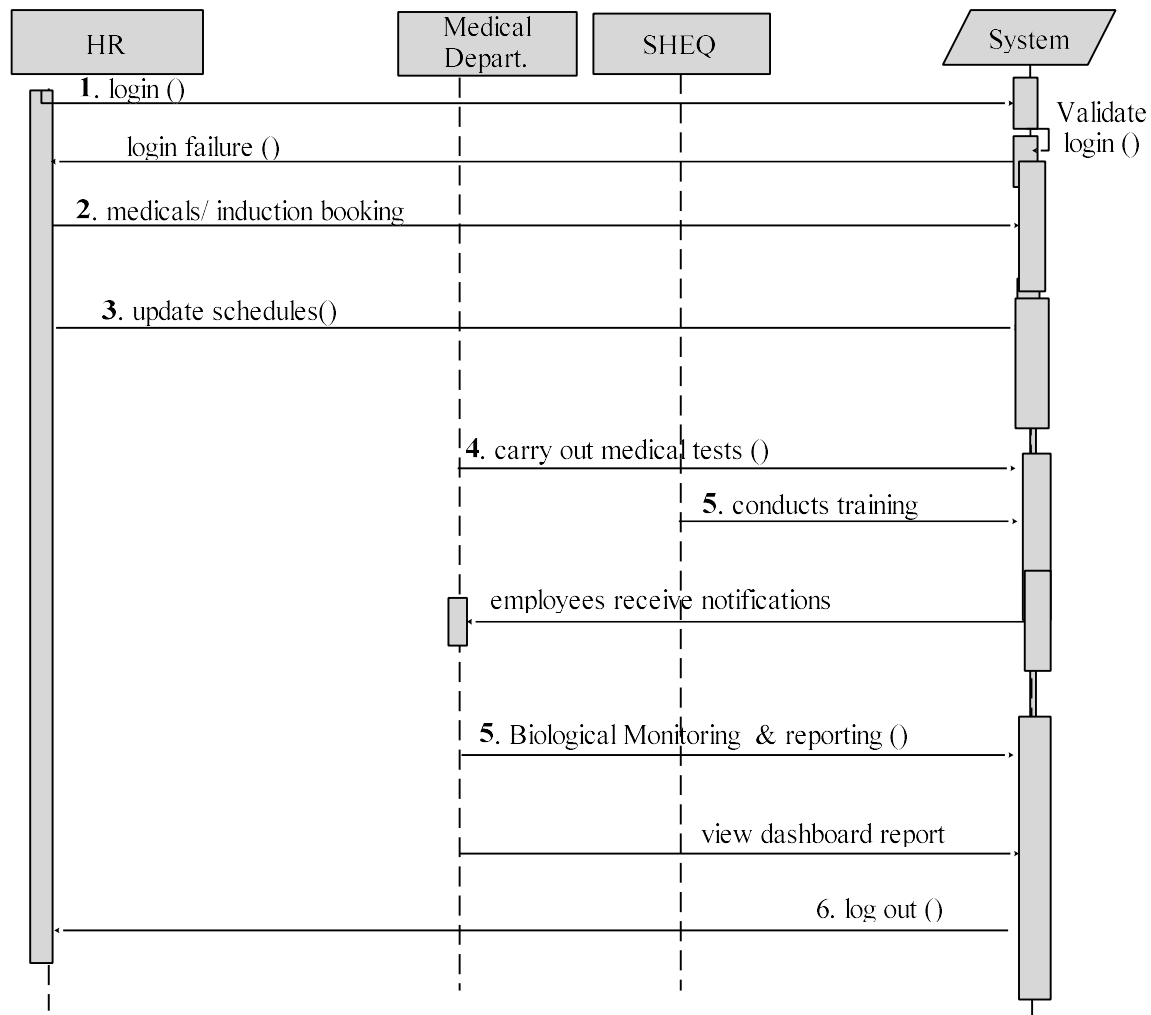


Figure 4.14 Sequence diagram

#### 4.9 CHAPTER SUMMARY

The chapter mainly focuses on a detailed description on the designing of the proposed solution like the layout of the hardware and software, description of the data input and output and the structure of the proposed system. Most of the goals of the system were addressed and illustrated by the use of data flow and entity relationship diagrams. The program, logical, interface, input and output design paved the way for implementation phase, which is the actual development of the proposed solution.

## **CHAPTER 5: IMPLEMENTATION**

### **5.1 INTRODUCTION**

This chapter discusses the implementation and testing of the Trackforce system. The implementation phase consists of many activities including installation, user training, and testing and file conversion. The testing of the system is carried out in order to determine if the system is suitable and whether the objectives have been achieved. To convert final physical system specifications into working and reliable software, to document work that has been done and to provide help for current and future users.

### **5.2 CODING**

Coding is the process of turning physical design specifications are turned into working computer code. During this process, coding is done with future maintenances in the mind. In order to develop the proposed system, PHP was selected as the server-side scripting language. In some instances JavaScript was used to write the code and both PHP and JavaScript are easily embedded into HTML to create interactive and dynamic web pages. The Trackforce system uses server sides scripts for its processing functionality, therefore it was necessary to modularise the code sand distribute it among several interconnected pages. Some considerations during the coding activity include the use of controlled structures, creating understandable source code for example naming conventions and source code organisation (into statements, classes, and other structures).

### **5.3 SYSTEM TESTING**

Testing was done to verify whether the system will meet the requirements that was determined earlier and to check for system inconsistencies. The test strategy has a series of tests that were meant to uncover the system faults and measure the full capabilities of the system. The planned tests are briefly explained as follows

Performance test- ensured that the system's response time which were measured under heavy stress and volume meet the user expectations and does not exceed the specified criteria.

Security test- used to determine the extent to which the system is secure and how unauthorised view and modification of data is prevented. Different users were allowed to log in and verify the users' views and access rights.

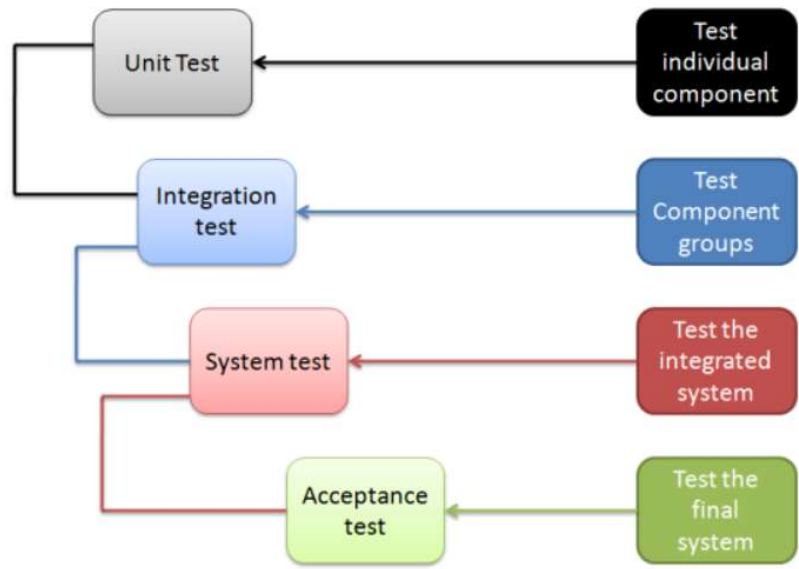


Figure 5.1 testing levels (source [http://www.test-institute.org/Software\\_Testing\\_Levels.php](http://www.test-institute.org/Software_Testing_Levels.php))

### 5.3.1 LEVELS OF SYSTEM TESTING

#### i. UNIT TESTING

Rogers S Pressman (2004) alluded that unit testing concentrates on each unit for example component, class or object of the software as implemented in the source code. Unit testing was done on each system unit to check if the coding worked as intended. The intention was to detect the errors before integrating with other units. Unit testing is performed by using the White Box Testing method. The tester chose inputs to exercise paths through the code and determines the appropriate outputs.

#### ii. MODULE TESTING

A module is any collection of executable program statements that can be called from any other module in the program and has the potential of being independently compiled. A module, which can be a closed subroutine, a procedure or a subprogram, is the primary unit of a program's structure. In this system, a test was performed to see if medical test booking could be successfully transacted.

### **iii. SUB SYSTEM TESTING**

Subsystem testing often called integration testing is a level of the software testing process where individual units which define subsystem are combined and tested as a group. Both functional requirements and non-functional requirements were tested at this level. One way was to search for medical expiry date by employee ID and if the database has the employee requested, the system will display it and can use the data presented to analyse the biological monitoring.

### **iv. SYSTEM TESTING**

System Testing tends to affirm the end-to-end quality of the entire system and it brings together of all the programs that a system comprises for testing purposes. Programs are typically integrated in a top-down, incremental fashion. System test is often based on the functional/requirement specification of the system. Non-functional quality attributes, such as reliability and security are also checked. System testing tests all components and modules that are new, changed, affected by a change, or needed to form the complete application. The emphasis in system testing is validating and verifying the functional design specification and seeing how all the modules work together.

### **v. ACCEPTANCE TESTING**

Acceptance testing occurs when actual users test a completed information system, the end result of which is the users' acceptance of it. User Acceptance Testing also called Beta testing or end-user testing comprises of functional tests, interoperability tests, and regression tests. The purpose of acceptance testing is rather to give confidence that the system is working than to find errors and to evaluate the system's compliance with the business requirements and assess whether it is acceptable for delivery. Usually, Black Box Testing method is used in acceptance testing.

### **vi. SECURITY TESTING**

Security test determines how secure the Trackforce system will be. The test indicated that unauthorised access by a user is prevented. Also the password policy restricts only alphanumeric values for authentication.



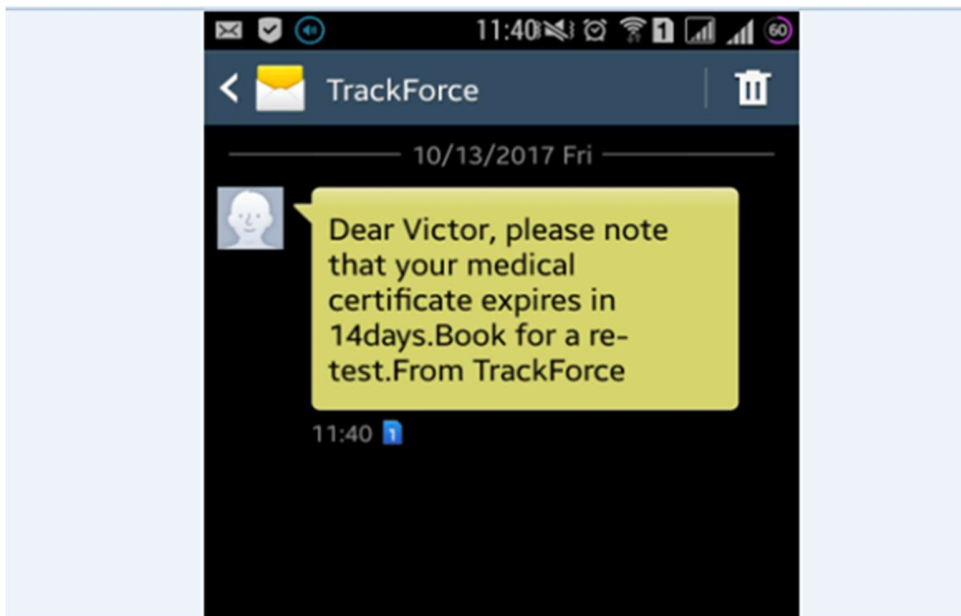
*Figure 5.2 Screen short for system security*

### **5.3.2 SYSTEM VS OBJECTIVES**

The user testing of a completed information system using test data resulted in screen shots being documented as follows

#### **OBJECTIVE 1**

To track medical tests expiry dates and enable automated notification when due dates are close



*Figure 5.3 Preview of system objective 1.*



## System solution

The system can auto-calculate medical tests expiry dates 30 or 60 days from the medical test date depending on the type of such test.

## OBJECTIVE 2

Enable periodic monitoring of individual workers occupational health status.

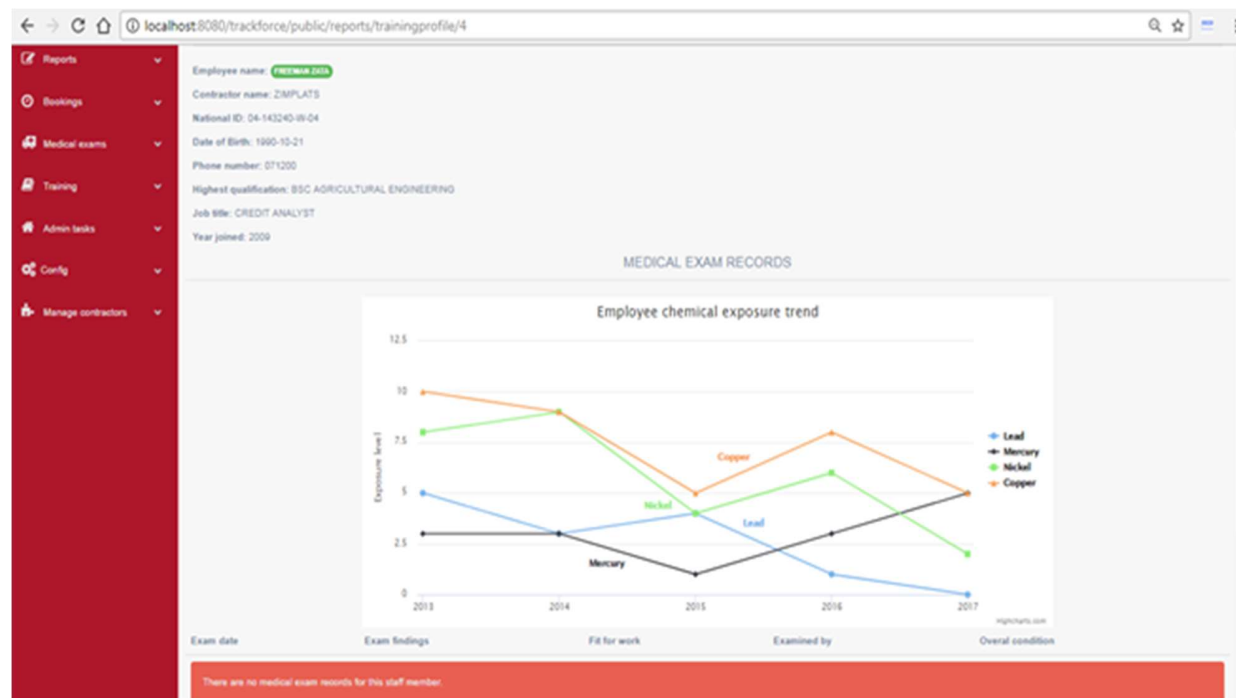


Figure 5.4 Preview of system objective 2

## System solution

The system can present the chemical exposure data in a more meaningful way of graphing the data that shows the trend.

Based on chemical absorption details, the extent to which an employee is exposed to the chemical and internal dose exam can be measured and analysed well which in turn reflects the deteriorating rate of occupational health

### OBJECTIVE 3

To develop a web-based system that enables automated collection, assessment, storage and presentation of contractor data.

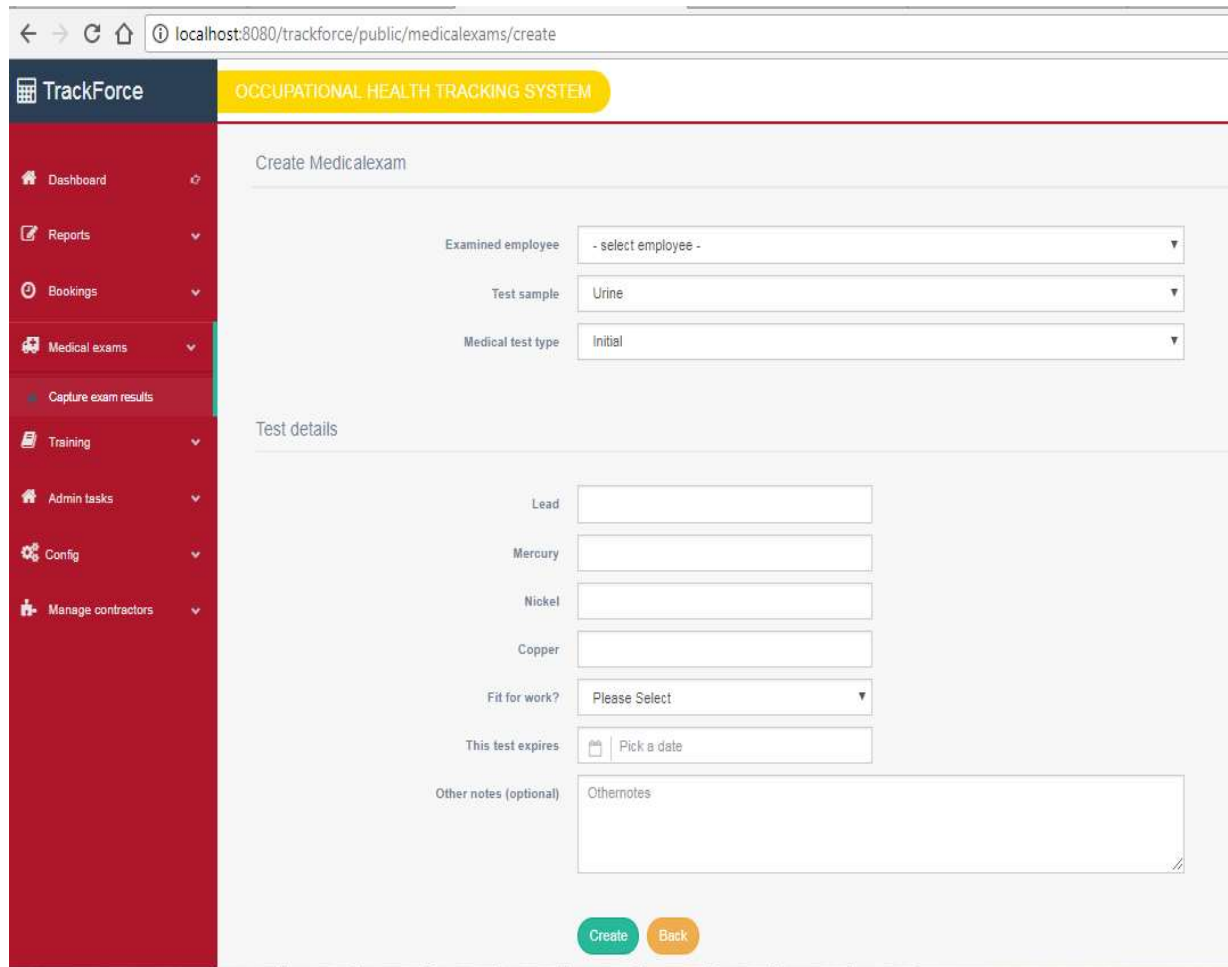


Figure 5.5 Preview of system objective 3

### System solution

The system has the interface to book for induction training and medicals tests and then present instantly the booking schedules

### OBJECTIVE 4

To develop a system that enables automated tests booking and training bookings and allows viewing of booking for purpose of resource planning based on known figures

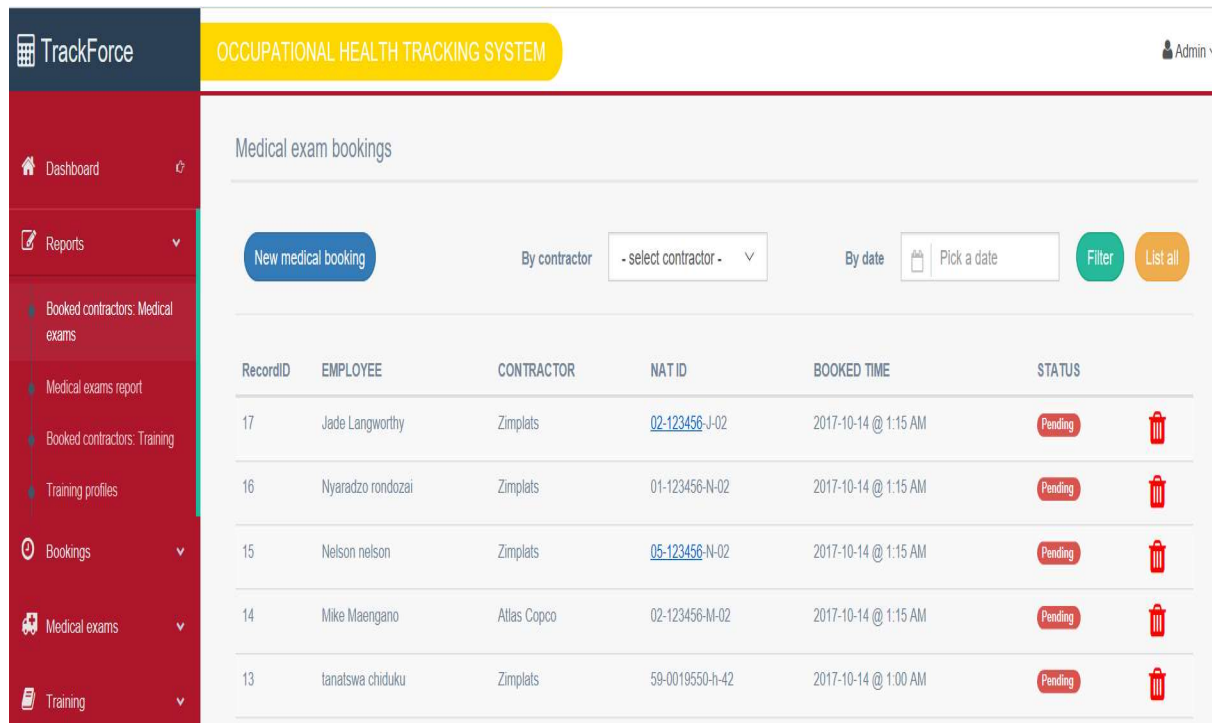


Figure 5.6 Preview of system objective 4

## System solution

The system has an interface that shows the number of employees booked for medical examination as at that day.

## 5.4 INSTALLATION

This is the Process during which the current system is replaced by the new system and ensure it is up and running and ready to give the required services to the users. This will include software and hardware configurations at the site. Steps for the system installation

- i. Hardware installation
- ii. System installation
- iii. User training
- iv. File conversion

### 5.4.1 HARDWARE AND SOFTWARE INSTALLATION

This includes setting up of necessary hardware and software for the proposed system that is installation of the operating system, web browsers, servers, the user computers, the printers and all the network installations.

## System configuration and data migration

In order to build and run the system, the following are the steps that need to be completed.

- i. Install XAMPP and check that it works by typing <http://localhost/phpmyadmin/> in the web browser's address bar.
- ii. Install text editor like Notepad.
- iii. Create a root folder named trackforce in C:\xampp\htdocs\. By default XAMPP is located in C:\xampp\htdocs. Copy all of the data (library, logic, database) into the rootfolder
- iv. Create a new database in phpmyadmin and name it trackforce.
- v. Now go to <http://127.0.0.1/trackforce/> to access the system.

### **5.4.2 USER TRAINING**

Converting from old to new system requires user training and provision of user documentation that guide users. The training will be group training that reduces time and cost, and also encourage feedback towards the system. The three main groups for training are users, managers, and IT staff. The training will be conducted on different days at the organization's premises. IT personnel- IT personnel will support the system during whole of its life cycle, so they will familiarise on troubleshooting the system. The rest of system users will be trained to use the system and produce reports. Management- will be trained on how to produce ad-hoc and custom reporting

### **5.4.3 SYTEM CHANGEOVER**

The process of putting the new information system online and retiring the old system is known as system changeover. There four installation or changeover approaches are

#### **i. DIRECT CUTOVER**

The direct cutover approach causes the changeover from the old system to the new system to occur immediately when the new system becomes operational. It is the least expensive but involves more risks than other changeover methods. The advantages are low operational costs due to the maintenance of only a single recordkeeping system and it is straightforward implementation since all staff is using the same system at all times. The disadvantages of this method are that it involves more risks of total system failure and it is preferred for commercial software packages.

## **ii. PARALLEL OPERATION:**

The parallel operation changeover method requires that both the old and the new information systems operate fully for a specified period. Data is input to both systems and output generated by the new system is compared with the equivalent output from the old system. When users, management, and IT group are satisfied that the new system operates correctly then the old system is terminated. It is the most costly changeover method and involves lower risks. The advantage of parallel system is lower risk of system failure so all the tasks can be done properly at health centre. If the new system does not work properly, the health centre can use the old manual system as a backup until appropriate changes are made. It gives an overview of the old system compared with the new system and it allows errors to be corrected as they are discovered before the new system is made fully operational.

## **iii. PILOT OPERATION**

The pilot changeover method involves implementing the complete new system at a selected location of a company. The group that uses the new system first is called the pilot site. By restricting the implementation to a pilot site reduces the risk of system failure as compared with is less expensive than a parallel system. Pilot operation is combination of both direct cutover parallel operation, which restricts the implementation to a pilot site and reduces risk and of system failure as compared with a direct cutover method. The operation at pilot site is less expensive than parallel operation for entire health centre and all health centres. However, this method is also costly as compared to the direct cutover.

## **iv. PHASED OPEATION**

The phased operation changeover method involves implementing the new system in stages, or modules. We can implement each subsystem by using any of the other three changeover methods. In this approach risk of errors or failures is limited to the implemented module only as well as it is less expensive than the full parallel operation. As we know in this method we have to implement the new system in stages, or modules, which is less prone to risk of system failure or errors at health centres, as failure is limited to the implemented module only. Since the system involves various phased operations like booking and clinic visit authorisation the process become tedious to use both system concurrently.

#### **5.4.4 RECOMMENDED STRATEGY**

The analyst recommended the direct changeover because it is quick and less costly. Also because the testing did not yield many errors, the system was considered perfect and will not cause much downtime.

#### **5.5 MAINTANANCE**

Activities include changes due to new requirements, fixing detected errors and integrating with other software. To maintain quality, Software Quality Activities (SQA) includes multi-tiered testing strategy and control of software documentation and the changes made to it. Also the verification and validation process is applied at every level of maintenance. Various maintenance strategies are outlined below.

**i. ADAPTIVE**

The maintenance focus on changes in the software environment

**ii. PERFECTIVE**

The new user requirements are the main drivers of maintenance

**iii. CORRECTIVE**

This is carried out in order to fix errors

**iv. PREVENTIVE**

The strategy of modifying the system in order to prevent problems in the future for example new patches and updates.

#### **5.6 RECOMMENDATIONS FOR FURTHER WORK**

The goal of this project was to make the occupational health monitoring manageable in a growing organisation as fluid as possible across the organisational departments to ensure the smooth running of the operations. This project has contributed new features in the domain of occupational healthy tracking and biological monitoring. The new areas of investigations prompted in this project are automatic notifications of medical expiry dates and trend analysis of chemical internal dose for every employee. The analyst has recommended some features to be extended as part of

further work. These include the integration with HR attendance system so that when an employee's medical test expired, automatically he/she must be denied access to the work premises because the employee must be examined for fitness first.

## **5.7 CONCLUSION**

Throughout this study, the concept of occupational health and biological monitoring has been reflected. The development of Trackforce was in-line with improving occupational health and biological monitoring by analysing the amount of chemicals absorbed in the employee bodies. This chapter discussed the system testing and implementation in length. It presents the basic testing levels which are unit testing, module testing, sub system testing and integration testing. A direct cutover was used as the conversion strategy and during the process; users were trained to use the new system. The maintenance strategies to be used are corrective, adaptive, perfective and preventive maintenances. As recommendations for further development, the analyst highlighted that the integration with human resources attendance systems is needed.

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## APPENDIX A


### SYSTEM USER MANUAL

1. Log into <http://localhost/trackforce/login> to access the system.

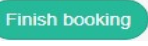
Username: admin

Password: pass123

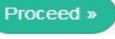
2. To book for medical test navigate to Bookings> Book for Medical Exam

First select the Employer and then click Proceed  button.

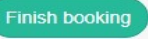
Then select the Employers' staff who should be booked. Select the medical test date and

Click the  button to save the booking.

3. To book for induction trainings, navigate to Bookings> Book for Training

First select the Employer and then click Proceed  button.

Then select the Employer's staff members who should be booked. Select the medical test date and

Click the  button to save the booking.

4. To capture medical results, go to Medical Exams> Capture results. On the form displayed, select the employee, select sample tested, and the medical exam type conducted.

Enter each and every result again the chemical compound tested, and click  button.

5. To capture training scores/ results navigate to Training> Capture training results.


First select the Employer/ Contractor and the course. This prepares you for the final step.


Click the Proceed  button and the next page is displayed.

Select the training participant and course attended to then assign scores for modules taken.

6. To view booked medical, go to Reports> Booked medical Exams



To view booked trainings go to Reports>> Booked trainings.


7. To view employee detailed profiles, go to Reports> Profiles and a list of employee profiles will be displayed. You can filter the profiles by selecting Employer/ Contractor and click the Filter  button

Against each individual profile line click the  button to view detailed information.

## User management

8. To add new systems users navigate to Admin tasks > manage users.

Click the  button and a new window will appear. Enter new deuser details and click the  button to save. A message will appear with user login details.

9. To change password and other user details, go to user menu  Admin (top right corner), while you are logged. Menu > Edit My profile.

Change the details as you desire and save.

**APPENDIX B**

**INTERVIEW GUIDE**

**Section 1: INTERVIEWEE DETAILS**

Department .....

**Section 2: INTERVIEW QUESTIONS**

1. For how long have you been using Occupational health and safety monitoring system?  
.....
2. What processes are involved in employee safety health and biological monitoring  
.....  
.....
3. Biological monitoring is one of the three important tools in the prevention of diseases due to toxic agents in the general or occupational environment, What are the other two?  
.....  
.....
4. Can you briefly explain the system in terms of inputs, outputs and storage?  
.....  
.....
5. Would you mind to briefly explain how you perform exposure monitoring?  
.....  
.....
6. Do you have any reports and if so how are they compiled and how well do you think they illustrate the state of process?  
.....  
.....
7. Looking at the way the current system is operating; as users, are you comfortable with it?

.....  
.....

8. Would you please care to comment on your answer?

.....  
.....

9. What are the relationships among biological, and exposure monitoring, and health surveillance.

.....  
.....

10. Have you ever thought of a computerized system to remind employees on the due dates and time to come for refresh medical examination rather than using conventional telephones?

.....  
.....

11. What do you think needs to be improved on the current system; if any or what are the anticipated changes you expect to see in the new system?

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

**APPENDIX C**

**QUESTIONNAIRE**

*Please complete the questionnaire by giving details and /ticking boxes as appropriate.*

**OH&S POLICY AND MANAGEMENT**

Is there a written company policy on occupational health and safety? YES  NO

Is there a company procedure for biological monitoring or plan for measurement of agents or their metabolites in the body? YES  NO

**OH&S PERFORMANCE MONITORING**

Do you have a procedure for formally recording and reporting work related illness, injuries on duty and medical treatment cases? YES  NO

Is there a system for analysing the amount of the chemical, the body is exposed? YES  NO

5. Are employees regularly provided with information on company health and safety performance? YES  NO

**MEDICAL AND SAFETY DETAILS**

6. Do you keep individual medical records for every employee at your company? YES  NO

7. Do you keep your safety and medical records for employees who have left your organisation? YES  NO

If YES for how long? .....

**HEALTH AND SAFETY TRAINING**

10. Is Health and Safety information/Instruction/Training adequately provided:

a) On commencement as part of induction? YES  NO

b) As required on the job? YES  NO

c) To deal with specific risks? YES  NO

**Thank you for participating!**

11. Has the company prepared safe operating procedures or specific safety instructions relevant to its operations? YES  NO

12. Is a record maintained of all training and induction programs undertaken for employees in your company? YES  NO

Do you provide any health and safety information to the following groups?

Visitors	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>
Contractors	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>
Temporary workers	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>

**PERSONAL PROTECTIVE EQUIPMENT** YES  NO

13. Do all workers have access to all protective equipment which is necessary to do their job?

**BIOLOGICAL TESTS**

14. Is regular biological tests and monitoring a standard procedure at you organisation? If yes, along with examination of general health, does it cover the following metals and other organometallic compounds?

Lead	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>
Chromium (soluble compounds)	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>
Manganese	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>
Nickel (soluble compounds)	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>
Cobalt	YES	<input type="checkbox"/>	NO	<input type="checkbox"/>

**PERIODICAL MEDICAL EXAMINATIONS**

15. Do all employees go for periodical medical examinations? If YES, after how many days? .....

16. How many days before the due date of periodical medical examination should you remind employees? .....

## APPENDIX D

### OBSERVATION SCORE SHEET

**Date**..... **Time**.....

**Department**.....

#### Observation

Inputs:

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

Processes

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

Outputs

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

Conclusion

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

## APPENDIX E

### DOCUMENT REVIEW

**BMSP-4.3.2/02 HUMAN RESOURCES DIVISION LEGAL AND OTHER REQUIREMENTS REGISTER**



Issue	Legislation	Requirements	Compliance Mechanism
Collective job action to avoid occupational hazards	Labour Relations Act (28:01) 1996	Section 104 (4) permits collective job action to avoid occupational hazards which may pose immediate threat to the health and safety of employees.	Periodical medicals
General Safety issues	ILO C174 Prevention of Major Industrial Accidents Convention 1993.	Article 9 Employers to identify any major installations and associated hazards/risks.	Pre task risk assessment, Regular inspections through SSD manager
Contractors	SI 68 of 1990	Section 12 Contractor management	Awareness to all employees with regards to Zimplats SHE standards
Notification of infectious diseases	Public Health Act (15:09) 1996	Part III Section 18 requires notification of infectious diseases	register for all modifiable diseases
Medical examination	SI 68 of 1990	Third Schedule (Section 15) require safe keeping of medical records, Pre-placement medical examinations establishment of OH Services.	Records Room restricted to Medical Personnel
	SI 41 of 1994	Section 14,15 Requires proper medical examination, care and treatment of all employees and residents who are sick / injured.	Certificates of fitness
Dust	Pneumoconiosis Act	Requires medical examinations of employees in dust occupations and removal of employees affected by pneumoconiosis	red tickets for all employees, initial and periodic
X-ray operation	Radiation Protection S.I.132 of 1990 Chapter 15.15 section 14	Requires licencing of radiation equipment, proper handling of radiation apparatus.	X-Ray Operation Procedure HR-MED 7.9.13



## APPENDIX F

### SNIPPET OF CODE

#### Medical test Bookings

```
<div class="col-md-12 col-sm-12 col-xs-12">
  <div class="x_panel">
    <div class="x_title">
      <h2><?php echo $form_label; ?></h2>
      <div class="clearfix"></div>
    </div>
    <div class="x_content">
      <br/>
      <?php echo Form::open(array("class"=>"form-horizontal")); ?>
      <div class="form-group">
        <div class="alert alert-info col-md-12">
          <p>First select the Employer and then choose the Employers's staff
who should be booked</p>
        </div>
      </div>
      <div class="form-group">
        <?php echo Form::label('Contractor/ Employer', 'contractor_id',
array('class'=>'control-label col-md-3 col-sm-3 col-xs-12')); ?>
        <div class="col-md-6 col-sm-6 col-xs-12">
          <?php echo
Form::select('contractor_id', Input::post('contractor_id', isset($contractor) ? $contractor-
>contractor_id : 0), Model_Contractor::get_select_options('- select Employer -'), array('class' =>
'form-control')); ?>
        </div>
      </div>
    </div>
  <div class="ln_solid"></div>
  <div class="form-group">
```

```

    <div class="col-md-6 col-sm-6 col-xs-12 col-md-offset-3">
        <button type="submit" class="btn btn-md btn-round btn-success"><?php echo
$btn_text; ?></button>
        <?php echo Html::anchor('booking/medical_listall', 'Cancel', array('class' => 'btn
btn-md btn-round btn-warning', 'style' => 'text-decoration: none')); ?>
    </div>
</div>
<?php echo Form::close(); ?>
    </div>
</div>
</div>

```

## Step 2 of 2

```

<div class="col-md-12 col-sm-12 col-xs-12">
    <div class="x_panel">
        <div class="x_title">
            <h2><?php echo $form_label; ?></h2>
            <div class="clearfix"></div>
        </div>
        <div class="x_content">
            <br/>
            <?php echo Form::open(array("class"=>"form-horizontal")); ?>

            <legend>Choose staff members:</legend>

            <?php if(count($employees)): ?>
            <table class="table table-bordered">
            <thead>
                <tr>
                    <th><input type="checkbox" />TOGGLE</th>
                    <th>EMPLOYEE NAME</th>

```

```

        <th>JOB TITLE</th>
        <th>NAT ID</th>
    </tr>
</thead>
    <tbody>
    <?php foreach($employees as $emp): ?>
    <tr>
        <td><input name="staff[]" value="<?php echo $emp->id;
?>" type="checkbox" /> </td>
        <td><?php echo $emp->f_name.' '. $emp->l_name;
?></td>
        <td><?php echo $emp->jobtitle->title; ?></td>
        <td><?php echo $emp->natid; ?></td>
    </tr>
    <?php endforeach; ?>
    </tbody>
</table>
<div class="form-group">
    <label class="control-label col-md-3">Booking date and time:</label>
    <div class="col-md-4">
        <input name="date" type="text" class="form-control has-
feedback-left" id="date_picker" placeholder="Pick a date" aria-
describedby="inputSuccess2Status3">
        <span class="fa fa-calendar-o form-control-feedback left" aria-
hidden="true"></span>
    </div>
    <div class="col-md-3">
        <input name="time" type="text" class="form-control has-
feedback-left" id="time_picker" placeholder="Pick time" aria-
describedby="inputSuccess2Status3">

```

```

        <span class="fa fa-calendar-o form-control-feedback left" aria-
hidden="true"></span>
        </div>
    </div>

    <?php else: ?>
    <div class="alert alert-danger">
        <p>The Employer/Contractor does not have any staff members and
therefore you cant book anything. Add employees first.</p>
    </div>

    <?php endif; ?>

<div class="ln_solid"></div>
<div class="form-group">
    <div class="col-md-6 col-sm-6 col-xs-12 col-md-offset-3">
        <button type="submit" class="btn btn-md btn-round btn-success"><?php echo
$btn_text; ?></button>

        <?php echo Html::anchor('booking/medical1', 'Back', array('class' => 'btn btn-md
btn-round btn-warning', 'style' => 'text-decoration: none')); ?>
    </div>

</div>

<?php echo Form::close(); ?>
</div>
</div>

<?php echo Asset::css('timepicker.css'); ?>
<?php echo Asset::js('moment.min.js'); ?>

```

```
<?php echo Asset::js('daterangepicker.js'); ?>
<?php echo Asset::js('bootstrap-timepicker.js'); ?>
```

```
<script>
    $(document).ready(function(){
        $('#date_picker').daterangepicker({
            singleDatePicker: true,
            calender_style: "picker_3",
            //dateFormat: "yyyy/mm/dd"
        }, function(start, end, label) {
            // any logging
        });
        $("#time_picker").timepicker({

        });

    });
</script>
```

### **Induction Training Booking**

```
<div class="col-md-12 col-sm-12 col-xs-12">
    <div class="x_panel">
        <div class="x_title">
            <h2><?php echo $form_label; ?></h2>
            <div class="clearfix"></div>
        </div>
        <div class="x_content">
            <br/>
            <?php echo Form::open(array("class"=>"form-horizontal")); ?>

            <div class="form-group">
```

```

        <div class="alert alert-info col-md-12">
            <p>First select the Employer/ contractor and then choose the staff
members who should be booked</p>
        </div>
    </div>

    <div class="form-group">

        <?php echo Form::label('Employer/Contractor', 'contractor_id',
array('class'=>'control-label col-md-3 col-sm-3 col-xs-12')); ?>
        <div class="col-md-6 col-sm-6 col-xs-12">
            <?php echo
Form::select('contractor_id', Input::post('contractor_id', isset($contractor) ? $contractor-
>contractor_id : 0), Model_Contractor::get_select_options('- select Employer -'), array('class' =>
'form-control')); ?>
        </div>
    </div>

    <div class="form-group">

        <?php echo Form::label('Training course', 'course_idx',
array('class'=>'control-label col-md-3 col-sm-3 col-xs-12')); ?>
        <div class="col-md-6 col-sm-6 col-xs-12">
            <?php echo Form::select('course_id',
Input::post('course_id', isset($contractor) ? $contractor->course_id : 0),
Model_Course::get_select_options('- select course -'), array('class' => 'form-control')); ?>
        </div>
    </div>
</div class="ln_solid"></div>
<div class="form-group">
    <div class="col-md-6 col-sm-6 col-xs-12 col-md-offset-3">

```

```

        <button type="submit" class="btn btn-md btn-round btn-success"><?php echo
$btn_text; ?></button>
        <?php echo Html::anchor('booking/training_listall', 'Cancel', array('class' => 'btn
btn-md btn-round btn-warning', 'style' => 'text-decoration: none')); ?>
    </div>
</div>
<?php echo Form::close(); ?>
    </div>
</div>
</div>

```

## Step2of2

```

<div class="col-md-12 col-sm-12 col-xs-12">
    <div class="x_panel">
        <div class="x_title">
            <h2><?php echo $form_label; ?></h2>
            <div class="clearfix"></div>
        </div>
        <div class="x_content">
            <br/>
            <?php echo Form::open(array("class"=>"form-horizontal")); ?>

            <legend>Choose Employer staff members:</legend>

            <?php if(count($employees)): ?>
            <table class="table table-bordered">
            <thead>
                <tr>
                    <th>&nbsp;</th>
                    <th>EMPLOYEE NAME</th>
                    <th>JOB TITLE</th>

```

```

        <th>NAT ID</th>
    </tr>
</thead>
<tbody>
<?php foreach($employees as $emp): ?>
    <tr>
        <td><input name="staff[]" value="<?php echo $emp->id;
?>" type="checkbox" /> </td>
        <td><?php echo $emp->f_name.' '. $emp->l_name;
?></td>
        <td><?php echo $emp->jobtitle->title; ?></td>
        <td><?php echo $emp->natid; ?></td>
    </tr>

    <?php endforeach; ?>
</tbody>
</table>

<div class="form-group">
    <label class="control-label col-md-3">Booking date</label>
    <div class="col-md-4">
        <input name="date" type="text" class="form-control has-
feedback-left" id="date_picker" placeholder="Pick a date" aria-
describedby="inputSuccess2Status3">
        <span class="fa fa-calendar-o form-control-feedback left" aria-
hidden="true"></span>
    </div>
</div>

<div class="form-group">

```



```

                <?php echo Form::label('Choose a training session', 'address',
array('class'=>'control-label col-md-3 col-sm-3 col-xs-12')); ?>
                <div class="col-md-6 col-sm-6 col-xs-12">

                <?php $sessions = Model_Session::find('all'); ?>
                <?php foreach($sessions as $s): ?>
                <div class="radio">
<label>
                <input type="radio" value="<?php echo $s->id; ?>" name="session" />
                <?php echo $s->start_time.'HRS - '. $s->end_time.'HRS'; ?>
                </label>
                </div>
                <?php endforeach; ?>
                </div>

                </div>

                <?php else: ?>
                <div class="alert alert-danger">
                <p>This Employer does not have any staff members and therefore you
cant book anything. Add employees first.</p>
                </div>

                <?php endif; ?>

<div class="ln_solid"></div>
<div class="form-group">
                <div class="col-md-6 col-sm-6 col-xs-12 col-md-offset-3">
                <button type="submit" class="btn btn-md btn-round btn-success"><?php echo
$btn_text; ?></button>

```

```
        <?php echo Html::anchor('booking/training1', 'Back', array('class' => 'btn btn-md
btn-round btn-warning', 'style' => 'text-decoration: none')); ?>
    </div>
```

```
</div>
```

```
<?php echo Form::close(); ?>
```

```
    </div>
```

```
</div>
```

```
</div>
```

```
<?php echo Asset::css('timepicker.css'); ?>
```

```
<?php echo Asset::js('moment.min.js'); ?>
```

```
<?php echo Asset::js('daterangepicker.js'); ?>
```

```
<?php echo Asset::js('bootstrap-timepicker.js'); ?>
```

```
<script>
```

```
    $(document).ready(function(){
```

```
        $('#date_picker').daterangepicker({
```

```
        singleDatePicker: true,
```

```
        calender_style: "picker_3",
```

```
        //dateFormat: "yyyy/mm/dd"
```

```
    }, function(start, end, label) {
```

```
        // any logging
```

```
    });
```

```
    $("#time_picker").timepicker({
```

```
    });
```

```
    });
```

```
</script>
```

### View Medical test details

```
<div class="col-md-12 col-sm-12 col-xs-12">  
  <div class="x_panel">  
    <div class="x_title">  
      <h2><?php echo $form_label; ?></h2>  
      <div class="clearfix"></div>  
    </div>  
    <div class="x_content">  
      <br/>  
      <?php echo Form::open(array("class"=>"form-horizontal")); ?>  
      <div class="form-group">  
  
        <?php echo Form::label('Examined employee', 'booking_id',  
array('class'=>'control-label col-md-3 col-sm-3 col-xs-12')); ?>  
        <div class="col-md-6 col-sm-3 col-xs-12">  
  
          <?php echo Form::select('booking_id',  
Input::post('booking_id', isset($medicalexam) ? $medicalexam->booking_id : 0),  
Model_Medicalbooking::get_select_options('- select employee -'), array('class' => 'form-  
control')); ?>  
  
        </div>  
      </div>  
  
      <div class="form-group">  
  
        <?php echo Form::label('Test sample', 'booking_id',  
array('class'=>'control-label col-md-3 col-sm-3 col-xs-12')); ?>  
        <div class="col-md-6 col-sm-3 col-xs-12">
```

```
                <?php echo Form::select('booking_id',
Input::post('booking_id', isset($medicalexam) ? $medicalexam->booking_id : 0),
Model_Medicalbooking::get_select_options('Urine'), array('class' => 'form-control')); ?>
```

```
            </div>
        </div>
        <div class="form-group">
```

```
                <?php echo Form::label('Medical test type', 'booking_id',
array('class'=>'control-label col-md-3 col-sm-3 col-xs-12')); ?>
                <div class="col-md-6 col-sm-3 col-xs-12">
```

```
                    <?php echo Form::select('booking_id',
Input::post('booking_id', isset($medicalexam) ? $medicalexam->booking_id : 0),
Model_Medicalbooking::get_select_options('Initial'), array('class' => 'form-control')); ?>
```

```
                </div>
            </div>
            <div class="form-group">
                <legend>Test details</legend>
            </div>
```

```
        <div class="form-group">
```

```
                <?php echo Form::label('Lead', 'findings', array('class'=>'control-label col-
md-3 col-sm-3 col-xs-12')); ?>
                <div class="col-md-3 col-sm-6 col-xs-12">
```

```

                <?php echo Form::input('findings',
Input::post('findings', isset($medicalexam) ? $medicalexam->findings : ''), array('class' => 'col-
md-6 col-sm-6 col-xs-12 form-control', 'rows' => 4, 'placeholder'=>")); ?>
            </div>
        </div>
        <div class="form-group">

                <?php echo Form::label('Mercury', 'findings', array('class'=>'control-label
col-md-3 col-sm-3 col-xs-12')); ?>
                <div class="col-md-3 col-sm-6 col-xs-12">

                        <?php echo Form::input('findings',
Input::post('findings', isset($medicalexam) ? $medicalexam->findings : ''), array('class' => 'col-
md-6 col-sm-6 col-xs-12 form-control', 'rows' => 4, 'placeholder'=>")); ?>
                </div>
        </div>
        <div class="form-group">

                <?php echo Form::label('Nickel', 'findings', array('class'=>'control-label
col-md-3 col-sm-3 col-xs-12')); ?>
                <div class="col-md-3 col-sm-6 col-xs-12">

                        <?php echo Form::input('findings',
Input::post('findings', isset($medicalexam) ? $medicalexam->findings : ''), array('class' => 'col-
md-6 col-sm-6 col-xs-12 form-control', 'rows' => 4, 'placeholder'=>")); ?>
                </div>
        </div>
        <div class="form-group">

                <?php echo Form::label('Copper', 'findings', array('class'=>'control-label
col-md-3 col-sm-3 col-xs-12')); ?>
                <div class="col-md-3 col-sm-6 col-xs-12">

```

```
        <?php echo Form::input('findings',
Input::post('findings', isset($medicalexam) ? $medicalexam->findings : ''), array('class' => 'col-
md-6 col-sm-6 col-xs-12 form-control', 'rows' => 4, 'placeholder'=>")); ?>
```

```
    </div>
```

```
</div>
```

```
<!--<div class="form-group">
```

```
        <?php echo Form::label('General Exam findings', 'findings',
array('class'=>'control-label col-md-3 col-sm-3 col-xs-12')); ?>
```

```
        <div class="col-md-6 col-sm-6 col-xs-12">
```

```
            <?php echo
```

```
Form::textarea('findings', Input::post('findings', isset($medicalexam) ? $medicalexam->findings :
"), array('class' => 'col-md-6 col-sm-6 col-xs-12 form-control', 'rows' => 4, 'placeholder'=>")); ?>
```

```
        </div>
```

```
</div-->
```

```
<div class="form-group">
```

```
        <?php echo Form::label('Fit for work?', 'fit_for_work',
array('class'=>'control-label col-md-3 col-sm-3 col-xs-12')); ?>
```

```
        <div class="col-md-3 col-sm-3 col-xs-12">
```

```
            <?php
```

```
                $arr = array(
```

```
                    0 => 'Please Select',
```

```
                    'Y' => 'YES - is fit to work',
```

```
                    'N' => 'NO - is not fit for work',
```

```
                );
```

```
            ?>
```

```

        <?php echo Form::select('fit_for_work',
Input::post('fit_for_work', isset($medicalexam) ? $medicalexam->fit_for_work : 0), $arr,
array('class' => 'form-control')); ?>

```

```

        </div>
    </div>
    <div class="form-group">
        <label class="control-label col-md-3">This test expires</label>
        <div class="col-md-3">
            <input name="date" type="text" class="form-control has-
feedback-left" id="date_picker" placeholder="Pick a date" aria-
describedby="inputSuccess2Status3">
            <span class="fa fa-calendar-o form-control-feedback left" aria-
hidden="true"></span>
        </div>
    </div>

```

```

    <div class="form-group">
        <?php echo Form::label('Other notes (optional)', 'othernotes',
array('class'=>'control-label col-md-3 col-sm-3 col-xs-12')); ?>
        <div class="col-md-6 col-sm-6 col-xs-12">
            <?php echo
Form::textarea('othernotes', Input::post('othernotes', isset($medicalexam)-
>othernotes : '), array('class' => 'col-md-6 col-sm-6 col-xs-12 form-control', 'rows' => 4,
'placeholder'=>'Othernotes')); ?>
        </div>
    </div>

```

```

<div class="ln_solid"></div>

```

```
<div class="form-group">
  <div class="col-md-6 col-sm-6 col-xs-12 col-md-offset-3">
    <button type="submit" class="btn btn-md btn-round btn-success"><?php echo
    $btn_text; ?></button>

    <?php echo Html::anchor('medicalexams', 'Back', array('class' => 'btn btn-md btn-
    round btn-warning', 'style' => 'text-decoration: none')); ?>
  </div>

</div>
<?php echo Form::close(); ?>
  </div>
</div>
</div>
```



