University of Zimbabwe Industrial Attachment Web-based Supervision System

By

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UNIVERSITY OF ZIMBABWE INDUSTRIAL ATTACHMENT WEB-BASED SUPERVISION SYSTEM

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Abstract

University of Zimbabwe Industrial Attachment Web-based Supervision system was developed to computerize the processes involved in the work-related supervision system. The institution was using a manual system in the supervision of students on attachment which means students were manually submitting their logbooks in hand, supervision was done manually, and therefore time consuming. The main aim of this research was to come up with a computerized web-based supervision system that rectifies all the problems associated with the manual system that was being used. The data was gathered using three different research techniques to have enough knowledge about the manual system that was being used and to find out if the users were comfortable with a computerized one. Questionnaires, interviews and focus groups were used to have a rich research and possibly to reach different users. Additionally, to develop a user friendly and interactive web-based solution system, PHP programming integrated with some java scripts and HTML5 was used. The database was designed through the use of MySQL server since this database designing tool enables data to be stored, manipulated, edited, deleted and updated. The system was tested and successfully installed. The system was implemented using a pilot changeover approach to minimize risks of failure. The main system functionality is that, it allows three types of users, that is, students on attachment, work supervisors and academic supervisors to be registered on the platform. Work-related supervisor assigns tasks/duties to attachés online and view completed tasks, giving feedback, supervising students as well as assessing the performance of the students. Student can view assigned tasks and update them upon completion on a daily basis. Various measures such as user identification, user authentication and access control have been put in place in order to counteract unauthorized users from using the system. For more security features, the system can be further developed using Java programming language or using Android Programming Language and or IOS for easy access and convenience purposes.

Declaration

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

Signature _____ Date _____

Approval

This dissertation entitled **"University of Zimbabwe Industrial Attachment Web-based Supervision System"** by **Abraham Mahoko** meets the regulations governing the award of the degree of **BSc Information Systems Honours Degree** of the **Midlands State University**, and is approved for its contribution to knowledge and literal presentation.

Supervisor's signature: _____

Date: _____

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"Not unto us O LORD, not unto us, but unto thy name be the glory, because of your love and faithfulness." Psalms 115:1.

First of all, I would like to join King David in glorifying our heavenly Father, without Him our existence would never have been. I am grateful to the LORD, who have taken me this far in my academics and allowing me the opportunity to complete this project.

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God, bless you all!

Dedication

This project is dedicated to the Midlands State University.

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List of acronyms

ANSI	American National Standards Institute
CAT	Computer Assisted Translation.
CBA	Cost Benefit Analysis
CD	Compact Disc
CF	Cash Flow
CPU	Central Processing Unit
DB	Database
DBA	Database Administrator
DBMS	Database Management System
DC	Domain Controller
DDL	Data Definition Language
DFD	Data Flow Diagram
DML	Data Manipulation Language
DVD	Digital Video Disc
EER	Enhanced Entity Relationship
ER	Entity Relationship
FRs	Functional Requirements
GB	Gigabytes
GUI	Graphical User Interface
HDD	Hard Drive Disk
HR	Human Resource
IAWBS	Industrial Attachment Web-based Supervision System
IP	Internet Protocol

IT	Information Technology
LAN	Local Area Network
MS	Microsoft
NFRs	Non-functional Requirements
NPV	Net Present Value
OS	Operating System
PC	Personal Computer
PHP	Hyper-text Processor
PV	Present Value
RAM	Random Access Memory
ROI	Return on Investment
SQL	Structured Query Language
SPARC	Standards Planning and Requirements Committee
UTP	Unshielded Twisted Pair
US	United States
UZ	University of Zimbabwe
WAN	Wide Area Network

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Chapter 1: Introduction

1.1 Introduction

University of Zimbabwe (UZ) is the oldest and leading university in Zimbabwe which is involved in teaching and research and it offers a variety of degrees, diplomas and certificates in various disciplines such as arts, agriculture, law, medicine, social studies, science, engineering, education, commerce and veterinary sciences. However, regardless of being the finest university in Zimbabwe, UZ is currently doing most of its processes manually, such as work related learning supervision. To keep up with technology, the developer has come up with an idea to develop a web based supervision system to mitigate all the issues associated with the current Work Related Learning Supervision system.

This chapter highlighted the background of UZ and its essence business values. The profundity of the subject problem was then resumed, showing that this project was done because there was a conscious understanding of business difficulties. Objectives were then formulated suggesting how the proposed system would resolve the perceived problems. A hypothesis on development methodology and tools for the project was made. The chapter also justified the development of the proposed project.

1.2 Background of the study

Education has been always a key to success and coming up finest graduates, UZ is considered to be the best. However, when it comes to technology, UZ has not done much on its systems and processes. It offers different degree programmes and under graduate students are expected to go under industrial attachment at the level of three (3) if they are fulltime student or at level two (2) if they are part time students in order for them to complete their degree programmes. During industrial attachment, students are expected to write log books and submit to their respective supervisors and student monitoring is done manually. However, these days almost every service is now computerized and maybe done online due to the fastest growing of web application and technology. Since API web applications are growing fast, Industrial Attachment Web-based Supervision system (IAWBS) was developed to be the most genuine and proficient system the institution could adopt to computerise all the processes involved in industrial attachment assessment.

1.2.1 Background of the organization

The University of Zimbabwe (UZ) located in Harare, is the oldest and formerly largest university in Zimbabwe. It was founded through a superior relationship with the University of London and it opened its doors to its first students in 1952. The university has ten faculties (Agriculture, Arts, Commerce, Education, Engineering, Law, Science, Social Studies, Veterinary Sciences and College of Health Sciences) offering a wide variety of degree programmes and many specialist research centres and institutes. The university is accredited through the National Council for Higher Education, under the Ministry of Higher and Tertiary Education. English is the language of instruction. Although once a very successful university, UZ has been facing challenges since 2008 and now the University is on a rebounding drive. Major work is being done to uplift the status of the University. Refurbishments are being carried out on the main campus and many facilities are being upgraded to make the university an International Academic Brand. Students from the faculties such as Commerce, Engineering and Science are required to go under industrial attachment in order to complete their degree programmes. Normally industrial attachment is done at level 3.

1.2.2 Organizational structure

Borrington (2013) put forth that an organogram is a chart showing the lines of responsibly between departments in an organisation that is, it is a chart that shows the flow of authority from top to bottom in an organisation, indicating out how positions, responsibility and power are regulated and assigned in the organization. The university is an academic institution directed by President R.G Mugabe, the Chancellor of all state Universities in Zimbabwe. The Vice Chancellor is selected by the Chancellor bearing accountability of seeing how the university is running on its daily bases.

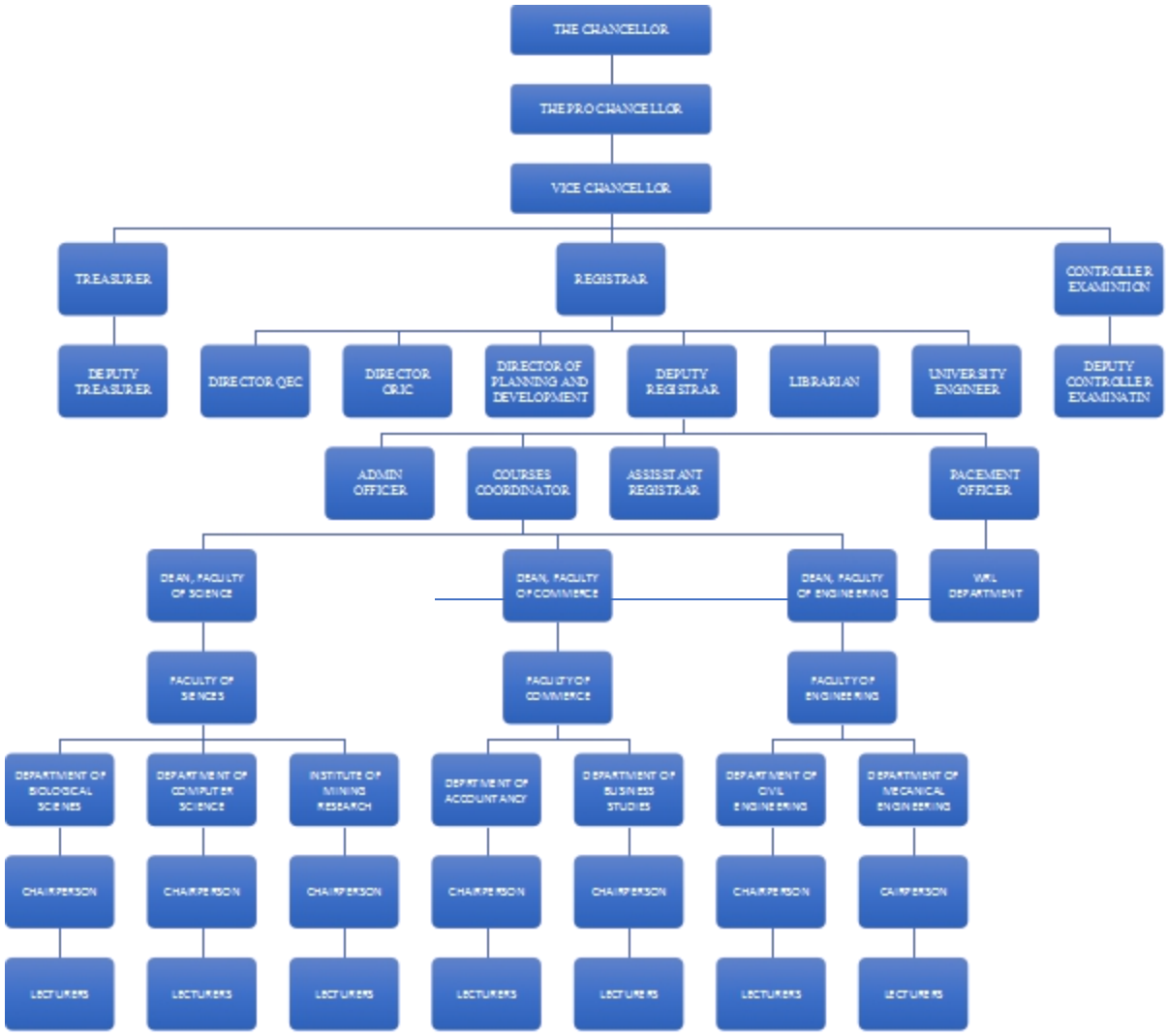


Figure 1.1: University of Zimbabwe organogram

1.2.3 Vision

To be the top University among all universities in Zimbabwe and beyond.

1.2.4 Mission statement

Enabling our clients and customers to make meaningful contributions to sustainable development in Zimbabwe. To this end we provide high quality education, training and advisory services on a needs oriented basis. We guarantee the above by maintaining excellence in Teaching, Learning, Research and Service to the community.

1.2.5 Company core values

- Intelligence,
- Diligence
- Integrity

1.3 Problem definition

Riley and Hunt (2014) mentioned that problem definition is a brief document that designates the particular type of the problem and offers wide statements regarding how the anticipated system will help the institution.

The system that was being used had a number of problems:

- Students were manually submitting their logbooks in hand which sometimes was not convenient when the supervisor is absent.
- Supervision was done manually, and therefore time consuming.
- Too much hierarchies that was sometimes-hindering communication.
- Student on attachment records were kept as papers which was risky in case of disasters like fire.

1.4 Aim of the research study

The aim of this research was to come up with a computerized web-based supervision system that rectifies the identified problems associated with the manual system that was being used.

1.5 Objectives of the research study

The major objective of the new system was to computerize the work-related learning supervision process and address the major problems noted above. The newly proposed system is a web based and it allows the supervisors to supervise the students on industrial attachment online.

The objectives were;

a) To develop a system that enables work-related supervisors to assign tasks to attachés online.
b) To develop a system that enables the students on attachment to upload their daily duties online.
c) To develop a system that allows work-related supervisors to monitor performance of an attaché, giving feedback as the student logs duties
d) To develop a system that enables the work-related supervisors to complete required academic reports online.
e) To develop a system that enables the academic supervisors to view the student log books.
f) To develop a system that enables the academic supervisor to view the work-related supervisor's assessment report and other reports that may be required.
g) To develop a system that facilitates communication between the academic supervisor and work-related supervisors, as well as between the students and the 2 sets of supervisors.
h) To maintain a record of all attachment students and performance for reference.

1.6 Instruments and methods

The problems that were being faced by UZ can be determined through the execution and use of some component rich, viable IAWBS system. The proposed system ought to have the capacity to cover every one of the issues that exude from the usage of the present framework and takes care of these issues.

In order to undertake the proposed system, the following tools were required.

Dreamweaver Creative Cloud - This is an adaptable and basic RAD device which empower outlining graphical web application interfaces

PHP - A programming dialect utilized for the development of web-based applications otherwise called Hyper-Texting Processor Language.

MySQL - Is most ordinarily used for Web applications and for installed applications and has turned into a prominent contrasting option to exclusive database frameworks on account of its rate and dependability. It is openly available for use.

1.7 Justification and rationale of the study

The indicated framework spares a great deal of time, it exterminates the separation obstruction and this enhances effectiveness.

- The Industrial Attachment Web-Based Supervision system which was under study attempted to let students on attachment to upload their logbooks and reports wherever they are attached, online irrespective of their physical areas via any networked device to the internet, the same as the respective supervisors to views these materials.
- The proposed IAWBS system tries to find ways to cut the workload and the use of paperwork since all the process will be computerized.
- The anticipated system have a central database that permits easy, quicker retrieving of information and it has a decreased level of data idleness.
- The use of JavaScript enables efficiency of operations of the IAWBS system which include validation of the system. The anticipated IAWBS system allows efficiency, correctness and safe flow of the student information.
- The use of HTML5 also enables the production of clear visual charts and will lead to efficient analysis and report.
- Modification of records can only be performed by suitable approved staffs from time to time.
- The system ensures a solid data security structure.

1.8 Conclusion

Every one of the issues associated with the manual system that was being used were noted and the targets of the task were expressed. The next chapter, the planning phase was mainly focusing on the feasibility study, risk analysis and this research prompted the generation of a work plan and calendar.

Chapter 2: Planning

2.1 Introduction

This chapter was mainly focusing on how the time plan was going to be applied in the development of the project, and additionally putting down every activity that was going to be carried out. At this phase, the developer analysed whether it was feasible for the university to embark on the idea of this project or not, by critically undertaking project feasibility study and risk analysis.

2.2 Business value

Schwartz (2016) suggested that business values are referred to as the estimated benefits to the whole functionality of proposed system that will affect the goodwill of the University positively in terms of efficiency. Some of the values that were anticipated to be brought by the proposed system are as follows:

2.2.1 Work supervisor value

- The system will enable the work supervisors to assign the attachés tasks without necessarily meeting them thus time saving.
- The supervisor will be able to view the uploaded students' logbooks on the go, that is wherever there is internet connection.

2.2.2 Student value

- Students will be able to log their duties on the system even when the industrial supervisor is absent at the workplace. In other words, the students will be able to upload their logbooks on the go.

2.2.3 Employee value (University supervisor)

- The implementation of this new system is going to fundamentally reduce the cost of working time.
- Use of automated database system for information decreases printed material and information repetition which enhances the effectiveness of the system.

2.2.4 Managerial value

- Improvement on administration arranged reports and auspicious report generation will help basic leadership prepare along these lines helping in the fulfillment of authoritative expressed objectives.

2.3 Feasibility study

Wallace and Webber (2015) revealed that feasibility study is the way of finding out if the costs of developing the system will be exceeded by the benefits of developing the project. This concocted a choice whether to go for the proposed system or to dispose of it. It can be sub partitioned as technical, economic, social and operational feasibility.

2.3.1 Technical feasibility

Bharat and Pratash (2007), proposed that technical feasibility is concerned about the intensive examination of the availability of technical expertise within the institution. Technical feasibility was carried out to assess whether the institution had technical resources enough to support the project in terms of software, hardware and technical expertise. Mostly it was concerned about the following questions:

a) Are the technologies required by the proposed system available within the institution?
   - The technologies to be used are found in Zimbabwe subsequently open to the institution and already the institution was equipped enough for the project to be carried on.

b) Does the institution have the required technical expertise?
   - There is a development team that is already employed that can further undertake the project.

c) Are the required technical resources available?
   - All required technical resources were available.

2.3.2 Technical expertise

Amman (2008) suggested that technical expertise is concerned with taking note of the request, for instance, 'is there enough human resources within the university, and is the readily available staff possess the required expertise.'

2.3.2.1 Hardware

For, effectively use of the new system, the following hardware requirements were met.

Table 2.1: Configuration of the work station

Component	Lowest Limit Required	Available
Type of processor	Intel 1.24 GHz Processor	Intel® Core™ 2 Duo CPU L7500 @ 1.75GHz
RAM	2GB	4GB
Hard Disk Drive (HDD)	30GB	320GB
Network Adapter Card	10/100 LAN	10/100 LAN
Printer	Dot Matrix	Laser jet printer

Table 2.2: Server configuration

Component	Lowest Limit Required	Available
Type of processor	Intel® 1.4GHz P_4 Celeron Processor	1.7 GHz Intel® P4 Processor
RAM	2GB	8GB
HDD	30GB	1TB
Tape Drive	40/80	40/80
CD/DVD R/W Drive	48x Read/12x Write	52x Read/24x Write
Network Adapter Cards	10/100 LAN	100/200 LAN
Printer	Dot Matrix	Laser Jet

2.3.2.2 Software

The following softwares were required and they were readily available for the development and execution of the new system.

Table 2.3: Software specifications

Software	Required Version	Available Version
Work Station OS	Microsoft Windows 7 or better	Microsoft Windows 10
Server OS	Windows 2003 server or better	Windows 2007 Server
MS Office	MS 2003	MS 2013
Microsoft Security Essentials	2009	2011
Adobe Dreamweaver	CS3	Creative Cloud 2015
MySQL	5	7.5.2

Table 2.4: Network specifications

Item	Minimum required	Available
HUB	4 port	8port
Connecting Cables	UTP CAT 5, Fly leads patch codes	UTP CAT 5, Fly leads patch codes
Cabinet	3U	3U
Patch panel	12 Port Patch Panel	12 Port Patch Panel
Uninterrupted Power Supply	Power Backup 220v	Power Backup 220v

An examination of the present foundation at UZ was adequate for the system to be considered as specialized doable to be produced and executed.

2.3.3 Economic feasibility

Foster (2014) describes economic feasibility as a way of assessing the benefits of the system over the costs. It tries to figure out if the expense brought about in the development of the system will be exceeded by the benefits of the system as a complete package. According to Dines (1998) the profit of the project is realised after deducting all the expenses. The project is said to be economic feasible when the net benefit outweighs the costs and unfavourable when the net benefit is negative. A few procedures were utilized to weigh economic plausibility using Return on Investment (ROI) and Net present value (NPV).

2.3.3.1 Cost benefit analysis

Johansson and Kriström (2015), mentioned Cost Benefit Analysis (CBA) is carried out to find out if it is worth to embark on the proposed system or not. It gives a clear chart of the cost associated with execution of the project.

Advantages of the purported system

These are the positive picks up that the institution will get from utilizing the system. These advantages can be ordered as tangible advantages and intangible advantages.

Tangible benefits

Beveridge (2007) hypothesizes that these are measurable benefits that can be seen right away. Tangible benefits are quantifiable, and ought to be incorporated into the CBA:

- Increased income through sponsors who might have helped their trust in the institution.

- Reduced work costs because of disposal of extra time hours
- Increment in income

Table 2.5: Tangible benefits

Year	**2017**	**2018**	2019
Currency	**US$**	**US$**	US$
Benefits			
Increased revenue	800	1 200	1 500
Hardware cost savings	700	900	1 000
Resource cost savings	700	1 000	1 200
Software cost savings	500	900	1 100
Reduced transport costs	600	800	1 000
Process Improvements	400	500	900
Productivity gain	200	500	700
Reduction in stationary costs	400	600	900
Total Benefits	**4 300**	**6 400**	**8 300**

Intangible benefits

These are the focal points that the institution will acknowledge from using the framework, which cannot be computable in money related terms however they must be observed. These benefits include:

- Better nature of information and service conveyance.
- Improved proficiency to the extent dispersal of data is concerned.
- Increment in goodwill and stakeholder fulfillment.

Tangible costs

Typically, these costs include all things the institution can buy directly for specific costs, such as labour, materials and space. These include:

- The salary of the system administrator.

- Transportation
- Expenses of equipment overhauls and programming redesigns.

Development costs

Trivedi (2002) puts on that these are cost that incurs during the development of the system, and additionally upkeep the system's life-cycle. Development expenses are expected to deal with the costs achieved in the midst of the system change. These include:

- Costs of stationary
- Research and travelling costs.
- Communication expenses
- Purchases of equipment, programming and systems administration hardware.

The vast majority of the development expenses are those costs that are just brought about once in the project's life cycle. Development costs are illustrated below:

Table 2.6: Development costs

Developmental Costs	**2017**	**2018**	**2019**
Salary (Including overtime)	1 000	900	900
Travel and research	800	0	0
Communication	750	0	0
Photocopying and printing	500	100	100
Computers (Application & Database Server)	0	0	0
Networking equipment	0	0	0
Total Development Cost	**3 050**	**1 000**	**1 000**

Operational expenses

These are ongoing costs for running the system. Expenses like stationary costs, cost of printing and other PC consumables like printer cartridges will be incorporated.

Table 2.7: Operational cost

Operational costs	**2017**	**2018**	**2019**
Currency	**US$**	**US$**	**US$**
Equipment maintenance	100	250	150
Analyst programmer	200	150	150
Software licence	100	120	110
Hardware maintenance	600	480	200
Staff training	700	300	100
Stationary	1000	600	400
Total	**2 700**	**1 900**	**1 110**

Below is a table that illustrates the projected cash flows over a period of three years:

Table 2.8: Cost benefit analysis

Year	**2017**	**2018**	**2019**	**Total**
Currency	**US$**	**US$**	**US$**	**US$**
Benefits				
Increased revenue	800	1 200	1 500	**3 500**
Hardware cost savings	700	900	1 000	**2 600**
Resource cost savings	700	1 000	1 200	**2 900**
Software cost savings	500	900	1 100	**2 500**
Reduced transport costs	600	800	1 000	**2 400**
Process Improvements	400	500	900	**1 800**
Productivity gain	200	500	700	**1 400**
Reduction in stationary costs	400	600	900	**1 900**
Total Benefits	**4 300**	**6 400**	**8 300**	**19 000**
Developmental Costs				
Salary (Including overtime)	1 000	900	900	**2 800**
Travel and research	800	0	0	**800**
Communication	750	0	0	**750**
Photocopying and printing	500	100	100	**700**
Computers (Application & Database Server)	0	0	0	**0**
Networking equipment	0	0	0	**0**
Total Development Cost	**3 050**	**1 000**	**1 000**	**5 050**
Operational Costs				
Equipment Maintenance	100	250	150	**500**
Analyst Programmer	200	150	150	**500**
Software License	100	120	110	**330**
Hardware maintenance	600	480	200	**1 280**
Staff training	700	300	100	**1 100**
Stationary	1000	600	400	**2 000**
Total Operational Costs	**2 700**	**1 900**	**1 110**	**5 710**
Total cost	**5 750**	**2 900**	**2 110**	**10 760**
Net Benefits/(Costs)	**(1 450)**	**3 500**	**6 190**	**8 240**

In the year one of the system implementation, it is noted that there is high net cash outflow. The practicality of the framework can be assessed making use of the following methods:

- Return on Investments (ROI)
- Net Present Value (NPV)

Return on Investment

Trivedi (2002), mentioned that ROI is a cost-effectiveness ratio that computes the profits of an investment as a fraction of the initial cost. In other terms, it determines how much income was made on the capital spending as a percentage of the development cost. It shows investors how well each dollar capitalized in a project is at making a revenue.

$$\text{ROI} = \frac{\text{Total Benefits} - \text{Total Costs}}{\text{Total Costs}} \times 100\%$$

$$= \frac{19\,000 - 10\,760}{10\,760} \times 100\%$$

$$= 76.58\%$$

Comment

The ROI rate of 76.58% is fundamentally positive and is ideal. It shows that the project is feasible to undertake as it will bring benefits to the institution in the downstream.

The benefit of using ROI as an evaluation technique is that it is simple to calculate.

Disadvantages

- The extent to which ROI exaggerates the fundamental economic value depends on the life span of the project, that is, the longer lifespan of a project, the more likely the ROI is going to be exaggerated.
- It can be easily manipulated, that is, the estimate of ROI can be easily altered centered on the analysis objective

Net present value

According to Namanda (2016), Net Present Value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows. NPV is used in capital budgeting to analyse the profitability of a projected project. A positive NPV indicates that the projected earnings generated by a project exceeds the anticipated costs. Generally, an investment with a positive NPV will be a profitable one and one with a negative NPV will result in a net loss. The formula to calculate NPV is as follows:

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

r = discount-rate as a percentage or decimal.

t represents the length of the period (in years).

Table 2.9: Net Present Value

Year	Discount Factor (10%)	CF	PV
2017	0.909	(1 450)	(1 318.05)
2018	0.826	3 500	2 981
2019	0.751	6 190	4 648.69
Net Present Value			**6 311.64**

Comment

Using the NPV project evaluation technique, the project proves to be viable because it had a positive value of $6,311.64 using the discounting factor of 10%. Below were the advantages and disadvantages of using NPV:

Advantages

- It considered profitability.
- It took into account the timing of payments.
- It took into account financial circumstances through discount rate.

Disadvantages

- It was difficult to come up with a suitable discount rate.

Overview of economic feasibility

Looking at the analysis of the project it was noted that the economic benefits were favourable since they outweighed the costs, therefore, therefore the project was said to be economic feasible.

2.3.4 Social feasibility

Buragga and Zaman (2013) highlighted that social feasibility assesses whether the system users easily adapt the changed system or the new system. It was a detailed study on how each user would interact with others within the system or the organization.

- This project should create employment opportunities to qualified individuals and general laborers in the society. This will only benefit individuals with programming capabilities for further development of the system.

2.3.5 Operational feasibility

Burraga and Zaman (2013) indicated that operational feasibility refers to a measure of resolving problems with the aid of a proposed system. It expressed whether the system would be used at its best if implemented. The main aim for performing operational feasibility was to assess if the development of proposed project fits in with the existing business environment and objectives with regard to development schedule, delivery date, corporate culture and existing business processes. The following are some of the essential questions that helped in testing the operational feasibility of the proposed system:

- Does the existing system deliver end users and managers with appropriate, relevant, correct and valuable structured information?
- Does the existing style of operation deliver profitable information services to the University?
- Possibly will there be a decrease in cost and or a boost in profits?

- Does the existing style of operation utilize the existing resources, including human resource, time, and flow of forms?
- If the system is developed, will it be used?
- Are the users not pleased with the existing business procedures?

The developer found out that the proposed system would bring the following benefits:

- Relations between the institution and its customers, and the overall population will be improved through the use of this proposed system.
- The daily running of business and flow of information will be improved.

As described by (Ibid), a system that is operationally feasible will be easily used and supported. Fortunately, workers, stakeholders and administration comfortably welcomed the requirement for it therefore the project was operationally feasible.

2.4 Risk analysis

Virine and Trumper (2017) hypothesizes that, risk analysis is a process that helps in identifying and manage potential problems that could undermine key business initiatives or projects. To carry out a risk analysis, the developer first identified the possible threats that would be faced, and then estimated the likelihood that these threats would materialize. Some of the threats that the developer identified were:

- Human – Sickness, death, injury, or other loss of a vital person.
- Operational – Interruption to provisions and operations, loss of entry to vital resources, or failures in supply.
- Reputational – Loss of client or member self-assurance, or damage to market reputation.
- Procedural – Failures of responsibility, interior systems, or regulations, or from fraud.
- Project – Going beyond the budget, consuming much time on vital activities, or suffering problems with product or service quality.
- Financial –Unavailability of funding.
- Technical – Changes in technology, or from technical failure.
- Natural – Weather, natural disasters, or disease.

Table 2.10: Risk management plan

Risk Item	Risk management technique
Loss of team member	Files were backed up and integrated consistently and also use knowledge management tactics such as pair programming to understand each other's work to ensure that the all key project files are accessible.
Loss of entry to vital resources	Resources where made available before commencement of the project
Difficulty integrating work	Increase communication, integrate often.
Going beyond the budget	Detailed milestone cost and schedule estimation, design to cost, incremental development, software reuse, requirements scrubbing
Changes in technology	The developer took time to learn tools and technologies
Natural	Computers were kept in a place where there was no direct sunlight and away from moisture as well. Also, the use of fire guard around the building to avoid the spreading of fire and installation of fire extinguishers in case of fire outbreaks.

2.4.1 Economic risks

As indicated by Virine and Trumper (2017) this risk is to a great extent connected with the expense of the project. Because of the absence of enough sponsors, the framework is in danger of termination. In the event that the association truly needs the project, it needs to budget for it to keep away from deficiencies in the advancement procedure. Every one of the resources must be accessible first and on schedule for the project to be completely utilitarian.

2.4.2 Other risks

- The staff may find it exceptionally difficult to adopt to the new system, therefore they need to be trained.
- There is need to guarantee the representatives that no employments have been undermined.
- There might be a risk of not getting enough time to do sufficient tests.

2.5 Stakeholder analysis

According to Kimmich et al (2012) a stakeholder analysis is the process of identifying the individuals or groups that are likely to affect or be affected by a proposed system, and sorting them according to their impact on the project and the impact the project will have on them. It provides a means to identify the relevant stakeholders and assess their views and support for the proposed project. However, stakeholder needs are framed by the context within which they operate at a point in time, by that, this simply means that a stakeholder may have different communication needs at different times. Stakeholder analysis and communications planning are not static, or "set and forget" activities, they are fluid, live and constantly being influence by events and the environment in which they operate. Therefore, the stakeholder analysis activity as an ongoing activity that needs to be done during the product life cycle to adopt to different stakeholder interests.

2.5.1 Stakeholders

The main aim of the proposed system is to improve how the current system is working, its operations and reduce costs, hence the stakeholders have found it ideal to commence with the project.

2.5.2 Management

The management did the arranging of assets that were being used in the project development, for instance, time and finance.

2.5.3 Employees

- A few delegates were contradicting the change since they had a fear of losing their occupations as the system requires people with IT capacities.
- Other representatives were comfortable with this change since use of an advanced system is less monotonous, ease of use, and offers fast reaction time to their solicitations.

The project was exceptionally supported by every one of these stakeholders thus the risk was low.

2.6 Work plan

According to Mistrik (2012), work plan is an outline of activities and processes by which the developer is aiming to accomplish those activities, and offering a better understanding of the scope of the project. Through the work plan, the developer decided to break down the activities into phases in order accomplish the project. The table below shows the work plan of the proposed project.

Table 2.11: Proposed work plan

Phase	Start Date	End Date	Duration (Weeks)
Proposal	27/09/ 2016	04/10/2016	1
Planning	05/10/ 2016	11/10/2016	1
Analysis	12/10/2016	21/10/ 2016	2
Designing	22/10/2016	28/10/ 2016	1
Implementation	29/10/ 2016	20/11/2016	3
Maintenance	21/11/2016	Ongoing	1++
Documentation	27/09/ 2016	Ongoing	9++

2.6.1 Gantt chart

According to Crookshanks (2012), Gantt chart is a horizontal bar chart developed as a production control tool in 1917 by Henry L. Gantt. Frequently used in project management, a Gantt chart provides a graphical illustration of a schedule that helps to plan, coordinate, and track specific tasks in a project. The developer used to demonstrate the assessed time that was taken to do the exercises that were gathered into various stages.

Table 2.12: Gantt chart

Phase/Period(Weeks)	Wk.1	Wk.2	Wk.3	Wk.4	Wk.5	Wk.6	Wk.7	Wk.8	Wk.9
Project Proposal									
Planning									
Analysis									
Design									
Implementation									
Maintenance									
Documentation									

2.7 Conclusion

After doing a thorough feasibility study and analysing all the possible risks, the developer has come to a conclusion that the proposed system was worthwhile to undertake. The following stage is the analysis of the current system where data was accumulated to discover how it worked.

Chapter 3: Analysis phase

3.1 Introduction

The analysis stage is like an interview of a journalist as it asks and answers the essential questions, like, who will be using the system, what the system tends to accomplish, as well as when and where it will be executed (Rainer et al, 2011). The analysis stage helped in solving the essential question, "What the current system does?" It encompassed all the system requirements planned to be met. The study helped to come up with a system that addresses the deficiencies of the system that was being used. The goal was to have the knowledge on how the system that was being used operated and to determine the significance of its problems. The developer used different techniques to acquire full knowledge about the current system and address what the proposed system was expected to do, to solve the problems that were being experienced by the users.

3.2 Information gathering methodologies

Karathiya (2014) described information gathering as the act of collecting information about the research topic in question from different sources using various techniques. The main reason for information gathering was to know if the current system was meeting all user requirements. In order to collect all the necessary information, the developer used three different techniques, that is interviews, questionnaires and focus groups with a specific goal to review information about the current system. The developer likewise gathered information from interior and outside sources which enhanced the quality and feasibility of the findings analysis.

3.2.1 Questionnaires

O'Neill (2012) alluded a questionnaire as a general form to include all data collection methods in which every single individual is entreated to respond to the same set of questions in a programmed order. This involved the preparation of standard questions that are printed and issued to the system end users, who answered the questions in the spaces, provided using structured responses that would be summarized into statistical distributions.

The developer distributed questionnaires to certain individuals in the department of computer centre aiming to get information to those who may have been skipped out during interviews. The questions were largely directed on the operational challenges, recommendations and suggestions on the development of the proposed system.

Motives for using questionnaires

- Ease and success of use of questionnaires
- User requirements, anticipations, perspectives, main concerns and preferences were easily represented in the paper
- they were user satisfaction with collections and services
- questionnaires were relevant as they shift in user states of mind and assessments

Managerial questionnaire: This was specifically designed for the managers and the control as a whole in a bid to apprehend what they anticipate from their workers to achieve.

Lecturer/Supervisor questionnaire: This was distributed to the lecturers to collect all their thoughts about the current system.

Student questionnaire: This was given to students to understand what they anticipate from the organisation pertaining the current system.

Forty-five questionnaires were issued with fifteen to every target reflected above and users were given a due date to submit the answers, out of the forty-five questionnaires issued we managed to have thirty-six back.

The following are the merits derived from the use of questionnaires:

- They were generally simple to break down.
- A great sample of the group populace was contacted at reasonably low cost.
- They were so easy to manage.
- The layout was generally common to most respondents.
- They were easy to understand and brief for the respondent to finish.
- The developer was able to collect information in a standardized manner.
- The developer was able to do straightforward analysis.

- They helped the developer to explore sensitive subjects which users might also felt uncomfortable talking to an interviewer approximately.
- Respondents had time to consider their answers, they were not expected to reply instantly.

However, the following setbacks were also noted:

- In case of forgotten questions on the questionnaire, it was impossible to go back to respondents, especially since they were unknown.
- In some cases, it was difficult to get enough wide variety of reactions, in particular from postal questionnaires
- Respondents were ignoring some of the questions.
- Some questions were incorrectly completed.
- The developer was not able to investigate long, complex issues.
- Some respondents were misunderstanding some of the questions in light of perhaps poor outlining and additionally vague dialect.
- Questionnaires were unsuitable or a few sorts of respondents, for example. visually impaired students.
- There was the risk of questionnaire fatigue because the surveys were carried out too frequently.

Findings from questionnaires

- Questionnaires took into account unknown information and in this way created exact data in a few occurrences.
- The findings showed that the current system has some problems leads to loss of much time on as university supervisors will be moving from one place to another.
- The questionnaires demonstrated that the respondent matches precisely what should be gathered by the developer in order to carry on with the project.

Below is a graph which shows the responses for and against the implementation of the new system.

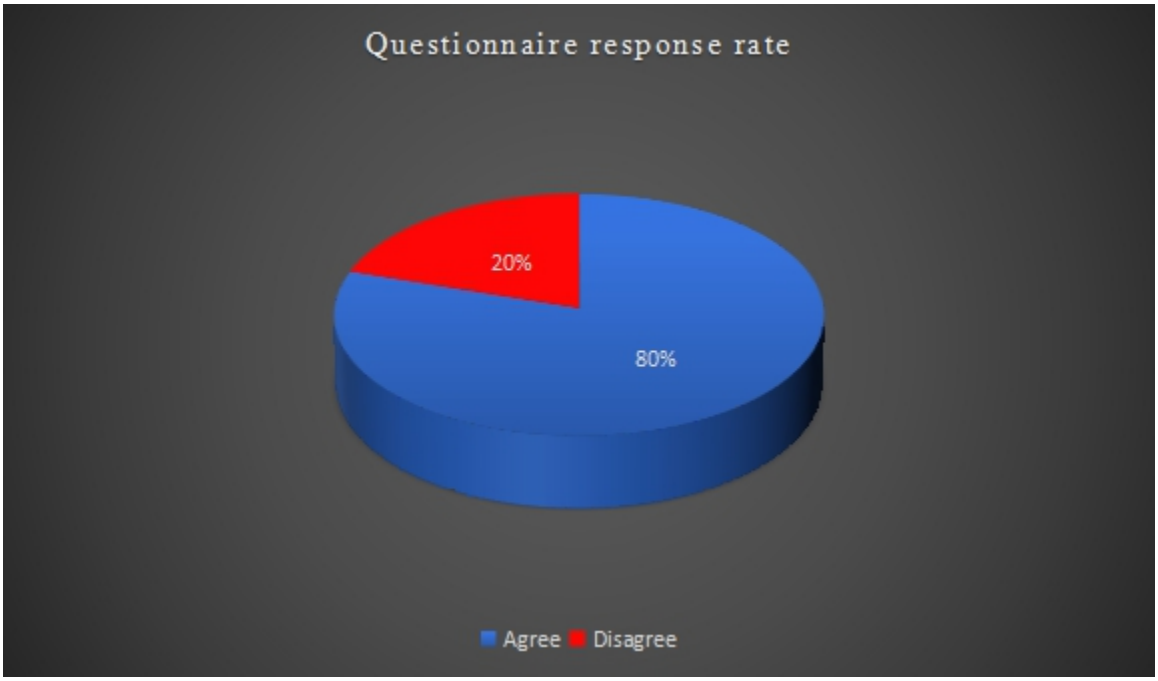


Figure 3.1: Responses for and against the implementation of a new system

80% of the respondents were in favour of the new system thus thirty-two of the ones received back and the eight were not thus 20%. Probably those who were in agreement with the idea of a new system were sure that the system would not affect their jobs in any way since it was noted that there was great fear in the employees of the unknown out comings of the systems. Also, maybe resistance to change especially to technical systems was the major reason for the ones who were against the idea of implementing a new system.

3.2.2 Interviews

Slide (2012) defined an interview as a conversation with a specific purpose. The developer carried out structured interviews with users of the system to gather all the much-needed

information about what they think of the existing system as well of the proposed system. In this fact-finding technique, all the potential interviewees were selected and appointments were made. A set of questions were drafted for each particular user. The selected persons were then interviewed individually and their responses were recorded.

Reasons for using interviews

- The researcher wanted to dig down and exhaust all the information about the problems related to the current system.
- To discover in what way individuals, think and feel regarding the current system and why they have certain thoughts.
- To research the use, effectiveness and usability of specific library collections and facilities
- Inform decision making, allotment of resources and strategic planning.
- To ask sensitive subjects which individuals may feel embarrassing talk over in a focus group.
- To add a human aspect to impersonal facts.

Advantages of interviews

- They were valuable for the researcher to acquire comprehensive information regarding personal feelings, insights and thoughts.
- The researcher was able to ask detailed questions and discuss them.
- A high response rate was achieved.
- Respondents' own words were recorded.
- Ambiguous answers were clarified and the developer was able to follow up on incomplete answers.
- Interviewees were speaking upon themselves without being influenced by others as compared to focus groups.

Disadvantages of interviews

- They were really time-consuming in sense of setting up, interviewing, transcribing, analyzing, feedback, reporting.

The developer interviewed staff from the Computer Centre and Technical Departments. Generally, the staff indicated dissatisfaction and had no confidence with the current system.

Interview questions (Framework)

- Briefly explain how your current industrial learning assessment system works?
- How long have you been using the current system?
- Does the current system meet your organizational needs?
- Are there any weaknesses that you can highlight on the current system?
- Do you have any suggestions you think can help to improve the current system?
- Do you feel comfortable to change the system completely to a computerized one, or do you want to improve the manual system?
- Do you think all staff members are going to accept the change of the manual system to a computerized system?

Findings from interviews

The Computer Centre Director specified that their main activity was to assess students on attachment at the most convenience manner.

- The department give information about the time being spend by the students on house searching and they gave also some proposals on how best to build this house searching system.

3.2.3 Focus groups

As indicated by Phillips and Stawarski (2008), a focus group discussion is a composed discussion that typically involves 5 to 10 participants. The developer used focus group dialogs as they furnish members with a space to discuss, in a context where they were allowed to agree or disagree with each other. Focus group discussions permitted the researcher to investigate how a group contemplates an issue, the scope of feelings and thoughts, and the irregularities and varieties that exist in a specific group as far as beliefs and their encounters and practices.

Reasons why the developer used focus groups

- To examine complicated actions.
- To find out in what manner different groups, view and consider the current system and why they have particular views.
- To pin point changes in behavior.
- To check or potentially elucidate the outcomes from the reviews.
- To see if there are suggestions on potential solutions to problems identified.
- to add a human aspect to impersonal data in order to intensify understanding and clarify statistical facts.

Advantages of using focus groups

- They were helpful to acquire comprehensive information regarding personal and group feelings, insights and thoughts.
- Time and money was spared when contrasted with individual interviews
- They provided a more extensive scope of data
- The developer could look for clarification.
- They gave helpful material, for example quotes for presentations.

Drawbacks of using focus groups

- At times, they were some arguments and inappropriate discussion which were diverting from the key focus
- They were difficult to run and oversee.
- They were truly tricky to break down.
- It was hard to inspire a scope of individuals to take an interest in the group.
- A few members found focus groups state frightening or offensive therefore some partakers felt under pressured to come to an agreement with the prevailing view.
- Since they were self-selecting groups, the outcomes may not be illustrative of non-users.

Overview of information gathering:

After every one of the strategies were utilized it has been found that the survey had low reaction when contrasted with the other two techniques for which interviews and focus groups had all around approved, abridged data upheld by the record testing.

3.3 Analysis of existing system

Dixit (2007), defined analysis of the existing system as an organised analysis and appraisal of facts or information, by means of breaking it into its module parts to find out their interrelationships. It encompasses the analysing of the processes and the data that is being processed by the system.

3.4 Process analysis

Process analysis solves the question: "How?" Process analysis clarifies in what way the chronological phases of a formula direct to its completion; or, in what way a particular sequence of events occurred. Here are the two classes of process analysis: directional and informational.

The developer used descriptive process analysis which tries to find out, how does the present system works? How is it done? This sort of examination clarifies how the system is, or was, proficient. The analysis gives data, as in the layout of a natural procedure, or portrays how (not why) certain occasions prompted a specific result.

The analysis of the present system was best performed through an inside and out survey of how the work-related supervision process was being done at the University. This was led by specifying the sources of info, procedures and yields of the present system.

Inputs: Contract form, student details, student daily tasks, project topic details, weekly logbook, project progress

Processes: Signing of contract, assigning of duties, student assessment

Output: Student's project, contract details, student marks, printed logbook, project documentation

3.4.1 Activity diagram of current system

Heath (2016), an activity diagram outwardly presents a series of activities or stream of control in a system like a flowchart or a dataflow chart. Activity diagrams are commonly used as a portion

of business process forming. They can similarly portray the steps in a use case outline. Activities showed can be sequential and concurrent. In mutually cases an activity diagram will have a beginning point and a closing point.

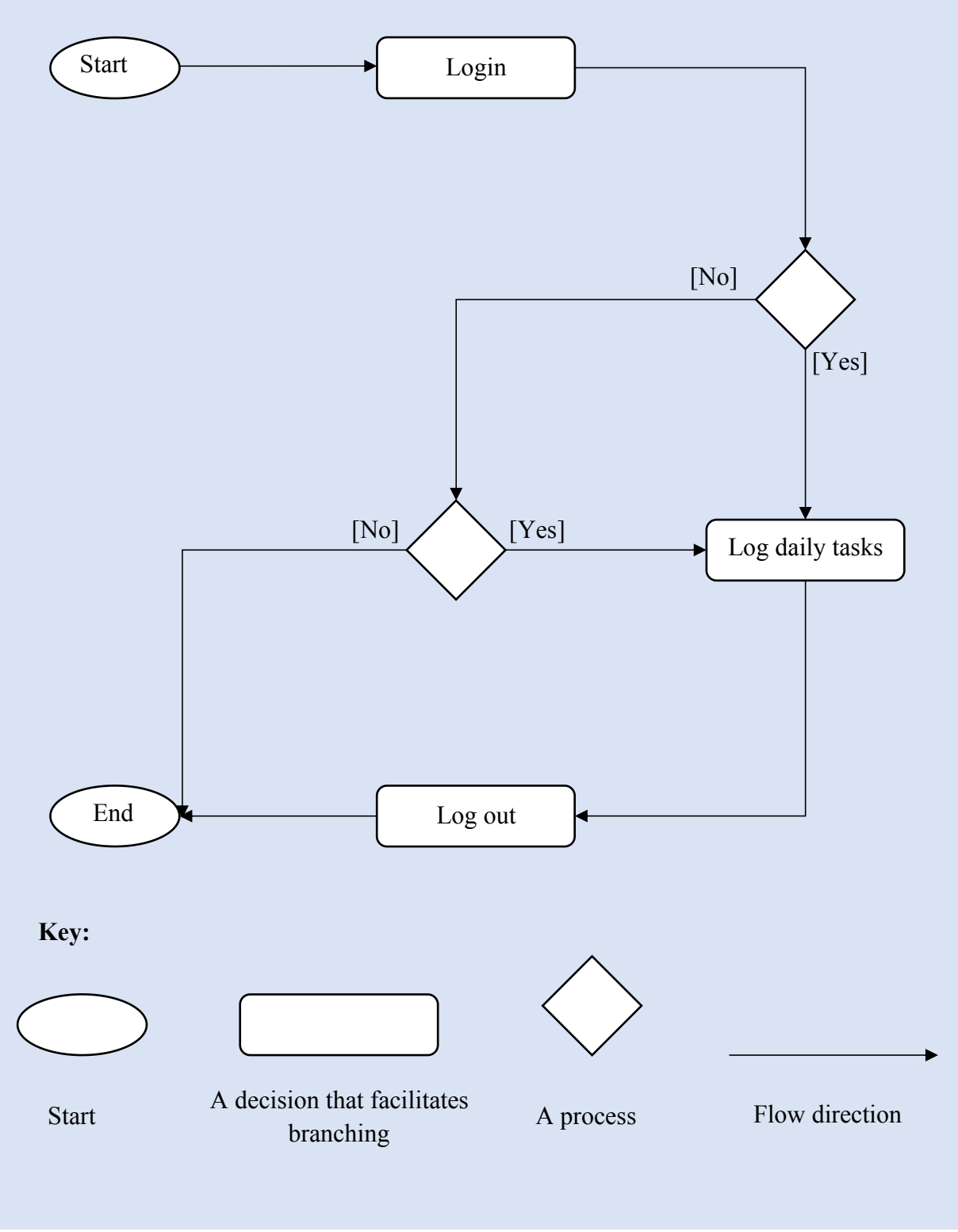


Figure 3.2: Activity diagram

3.5 Data analysis

Linoff (2015), suggested that the procedure of appraising data using an organised and coherent thinking to assess every single part of data given is known as data analysis. When conducting research experiment, data analysis stage should be seriously taken into consideration and make sure it is done and completed. Data from numerous sources is collected, evaluated, and then analysed to form some sort of discovering or conclusion.

3.5.1 Context diagram of the current system

Rosenblatt (2014) revealed that a context diagram is a level 0 data flow diagram that shows the top level of the system. There is only one process node that can be seen at this level stand for the functions of the whole system in regards to how it interrelates with exterior entities.

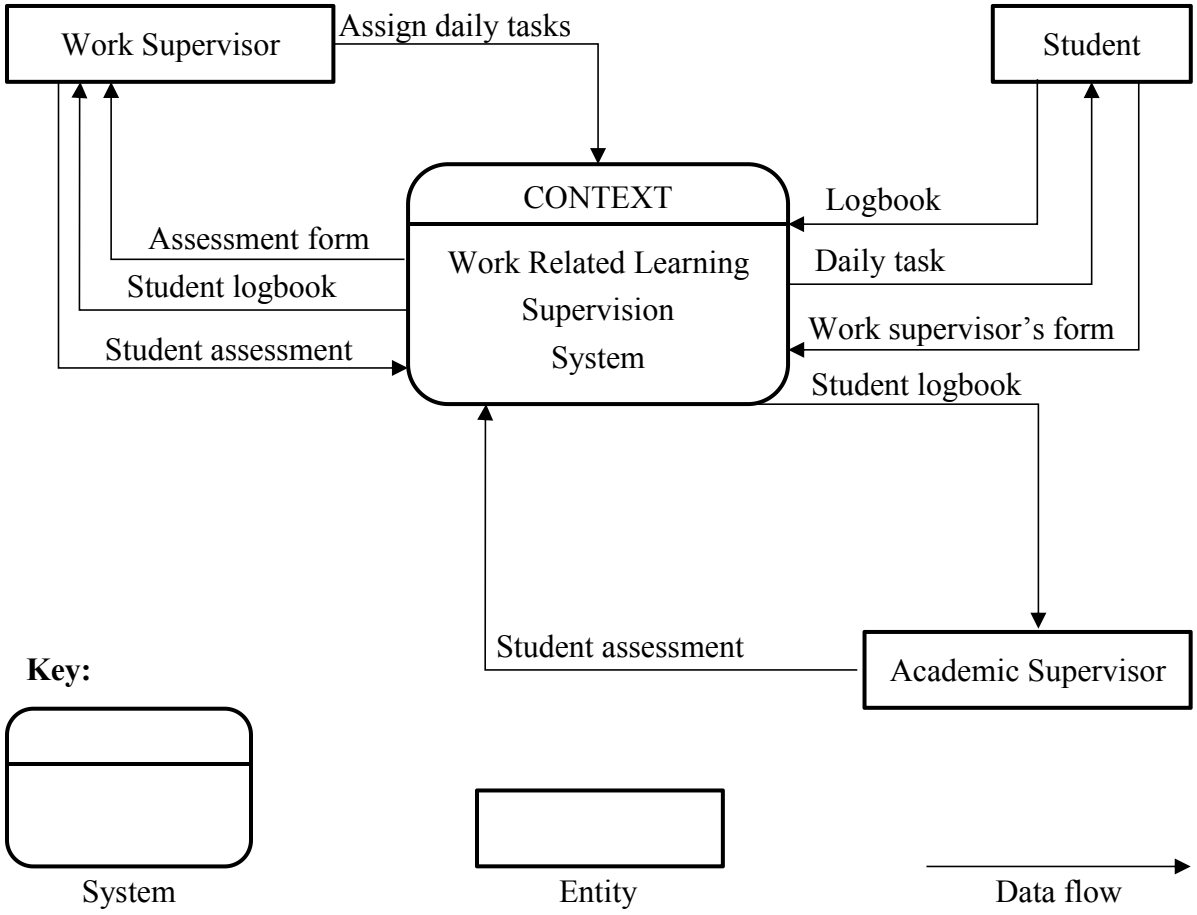


Figure 3.3: Context diagram

3.5.2 Dataflow diagram of the current system

Miller et al (2010), defined Data Flow Diagram (DFD) as a diagram that illustrate module processes of a system and how data flows from on process to another in a system. DFD shows the movement of data into an information system and how the exchange of data is processed graphically. DFD is more like a flowchart but in terms of comprehensive illustration, DFD is regarded to exhibit a more comprehensive diagram.

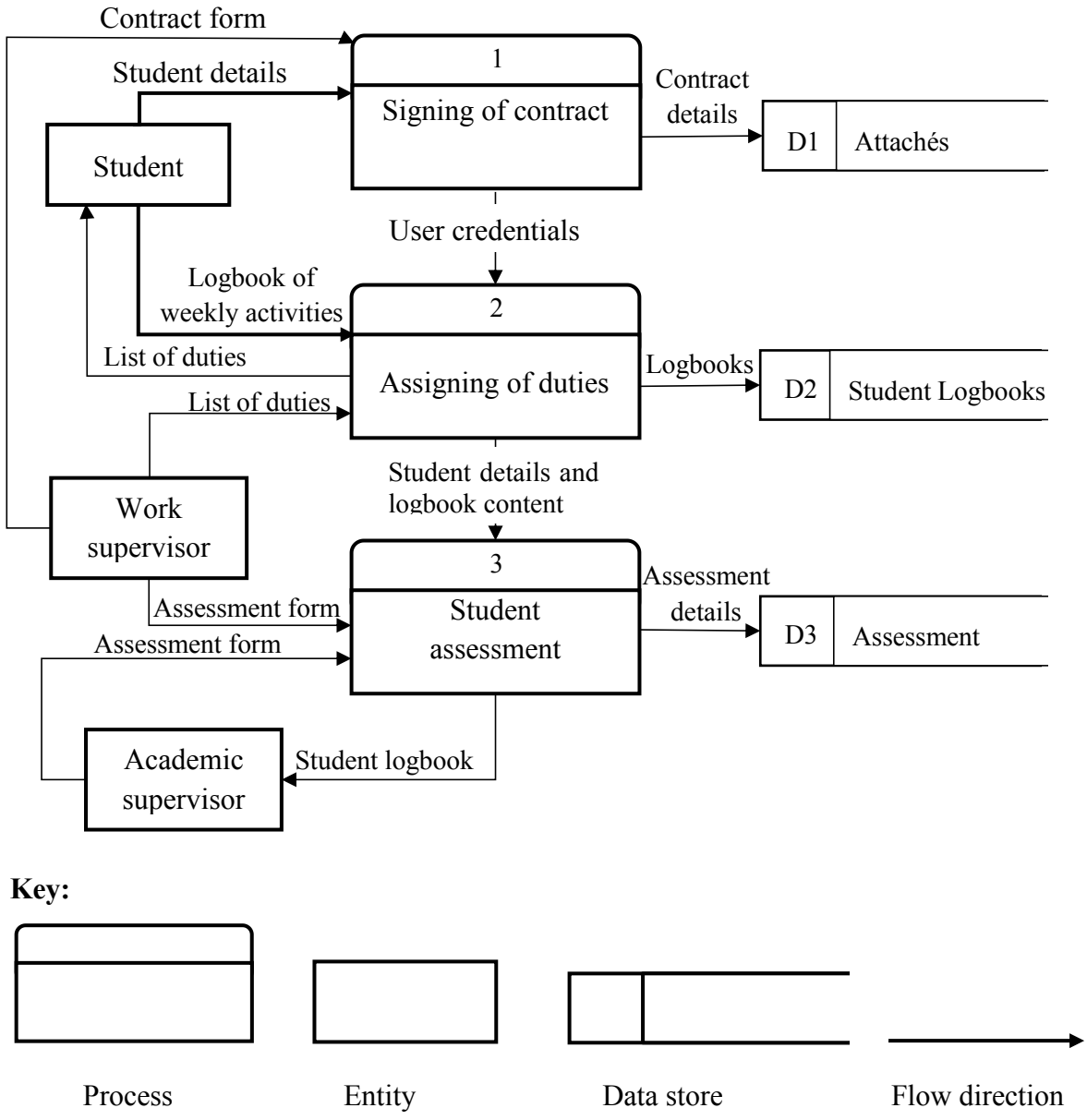


Figure 3.4: Dataflow diagram

3.6 Weaknesses of current system

- Students were manually submitting their logbooks in hand which sometimes was not convenient when the supervisor is absent.
- Too much hierarchies that sometimes were hindering communication.
- Student on attachment records were kept as papers which was risky in case of disasters like fire.

3.7 Alternatives evaluation

Alternatives were assessed to reveal their effectiveness in attending to the difficulties, taking advantage the of chances, and achieving goals of the proposed system. This was done by carefully examining the merits and demerits of each option. The developer considered the effects and the impacts of each option. The options were assessed to benchmark conditions to weigh if they can solve problems, meet quality standards and meet the goals of the project. The developer evaluated the three alternatives which are outsourcing, improvement and in-house development.

3.7.1 Outsourcing

Henderson (2010), hypothesized that outsourcing happens when an organisation purchases a software package from an external supplier, instead of developing their own using its own facilities, for it to reduce costs. The choice to outsource is a vital one for most organizations, since it includes measuring the possible cost savings against the results of a loss in control over the software package. Outsourcing most commonly known as offshoring has pros and cons to it.

The advantages of outsourcing

- Better quality output can be developed as far as timeliness is concerned. Outsourced venders have got better advanced equipment and technologies and they have experience since the specialize on developing softwares hence better quality packages can be produced.
- Risks can be shared between the institution and contracting company since the outsourcing sellers are masters they can arrange their risks relieving components better.
- There is reduction in operational and recruiting costs since the individuals who will be working on the project are enrolled by the developing company.

The disadvantages of out sourcing

- Confidential information may be exposed to third-parties.
- Synchronizing the deliverables: In case a choice for the right partner for outsourcing was poorly done, a portion of the basic issue areas include stretched delivery time periods, poor quality output and improper classification of duties.
- Not Sustainable: They ordinarily have a limited number of developers, and when they get a new contract they usually push yours back contingent upon project cost.
- Due to different time zones communication between the developer and the institution might be difficult if they choose developers from overseas.
- Fake Profiles: Some organizations/individuals misrepresent their ability in marketplaces that can lead to uncertain outcomes.

Reasons why not accepted

The developer rejected the outsourcing alternative because of the threat to security and confidentiality since there is a risk of revealing private university's information to third parties and also it is probably going to be costlier to execute this methodology weigh against in-house development.

3.7.2 Improvement

Improving the current system would have been advised but because there are some problems that cannot be solved even if the current system is improved, since the current system is a manual system which is the reason why the it needs to be computerized. Through computerising and improving the current system, most of the problems that are being faced can be solved in an effective way.

Advantages

- Fear of the unknown will be eradicated since the system will be easy and quite simple to use.
- Upgrading the current system will reduce development costs and time will be saved.
- Since the development will be done within the facilities of the university, maintenance and support will not be an issue to the institution.

Disadvantages

- Since the current system is a manual system therefore it will be difficult to improve because there is need to computerize the whole system.
- Improvement in some sort is just a short-term solution as the current problems might resurface in the downstream.

Reasons why not accepted

The traditional system that was being used was a manual system; hence improvement was not ideal and also the solution was a short term one.

3.7.3 Development

Langer (2012) hypothesized that development is the process of writing and retaining the ownership of the source code, however in a sensible way, it encompasses everything from the initial state of the software/project to the final product in an organized manner. Thus, development may combine research, new amendment, prototyping, modification, reprocess, re-developing, support, or whatever extra tasks that result in software projects. Two techniques were picked to review which one of them is cost effective, and these are:

- Purchase a software package (off shelf-package)
- Developing in-house.

3.7.3.1 Buying a software package (off-shelf-package)

According to Zykov (2016) off-shelf-package includes the buying of software packages which are already on the shelves and afterward adjusted to fulfil the necessities of the obtaining organisation, instead of the authorizing of hand crafted ones. This includes the acquiring of perfect equipment for the product being purchased furthermore hiring of specialized expertise might be required for the support and software installation. The merits and detriments of this alternative are listed below:

Merits

- Ready-made solutions, available when needed
- Greater flexibility and adaptability

- Thousands of hours have already gone into developing the application and working out the kinks
- Expert support and training are available to existing and future staff with no additional burden on your IT team
- Typically, functionality is enhanced through customer feedback, anticipating changing business needs rather than reacting to them.
- There is really no need to develop some that has already been developed before, there some software in the market that can meet the organization's needs.

Demerits

- Developer retains the rights to the source code hence there is no ownership.
- Product functionality is determined by the vendor, and may not fit the institution requirements.
- Readymade software packages or solutions may seem to be cheap in short terms, but over time they will be expensive as their licenses expires over a given time period.
- Rely on vendor's support to fix issues may take long.
- The software bundle might be overstuffed with redundant elements, yet misbehaving in some significant areas.

Reasons why not accepted

Purchasing of an off-shelf package was not ideal because their expensiveness and they may become obsolescence as some softwares may become outdated or phased out and there will be no systems support for such softwares. On the other hand, the institution may need to purchase a new licence key to continue using the upgraded one. The institution will be required to upgrade to a newer version or continue using the unsupported, out-dated version of the software.

3.7.3.2 In-house development

According to Langer (2012), in-house development is the development of a software within the facilities of a particular institution with the intend of using it. Building up the system in-house will enormously guarantee that all tweaked client prerequisites are mulled over and are fulfilled. The system is thoroughly tried before it is executed over the spectrum, thus there is a great

chance that the system will meet the particular business needs. Building up a system has a tremendous beginning capital yet benefits acknowledged over the downstream make this cost worthy

Advantages

- The institution will have full control of the system as it will retain the ownership of the source code.
- The development costs were perceived as being cheaper.
- There is intensive user involvement hence a better-quality output will be obtained and user requirements will be met.
- The system will be built to fit the existing environment and system requirements.
- Training can be easily offered if there is any need since the development team is within the organization.
- User support will be available at any given time.

Disadvantages

- The project may take long to complete as user requirements changes and due to excessive user involvement.
- The available IT team may not have the needed skill to perform the task.
- It is costly spending valuable money developing something that has been made before.

Reasons for acceptance

According to the feasibility study that was carried out, all the software and hardware requirements and technical expertise of the project matches with the already available equipment therefore in-house development is the best alternative.

3.7.4 Alternative selection

Given all the advantages of all the alternatives that were available in-house development alternative was chosen because it was cheaper to have an in-house developed system as the costs revealed in the Table 2.8 of Chapter 2 outweighed by the benefits and in-house development had some advantages

- The institution has full proprietorship and control of the final output and in addition its source code and the knowledge picked up while developing the product.
- Upgrades can be done within the institution without buying new licenses since the technical expertise is already there.
- Institutional data is secured as far as confidentiality is concerned.

3.8 Requirements analysis

- The major requirements of the proposed system were to computerize the work-related learning supervision process and address the major weaknesses noted above in Chapter 3.6. The newly proposed system is a web based and should allow the work-related supervisors to monitor students on industrial attachment online.

3.8.1 Functional requirements

Functional requirements (FRs) stipulate all the functions that a system should do or all the objectives that should be met by the system. Adams (2015), described FRs as what the system should do. It can be documented in various ways. A use case signifies a part of the functionality of the system and allows the user (referred to as an actor) to gain entry to this functionality.

The requirements are;

- To enable the student on attachment to upload their daily duties online.
- To enable the academic supervisor from any of the universities to view the log book of any selected student under their supervision.
- To enable the work-related supervisors to complete the student assessment form online.
- To enable the academic supervisor to view the work-related supervisor's assessment form and other reports that may be required.
- To facilitate communication between the academic supervisor and work-related supervisors, as well as between the students and the 2 sets of supervisors.
- To allow work-related supervisors to monitor performance of an attaché, giving feedback as the student logs duties
- To maintain a record of all attachment students and performance for reference.

Actors

An actor is a user of the system either a human user, a machine or even another system. Anything that interacts with the system from outside the system boundary is termed an actor. In this case, there are four actors namely student, work supervisor, academic supervisor and administrator.

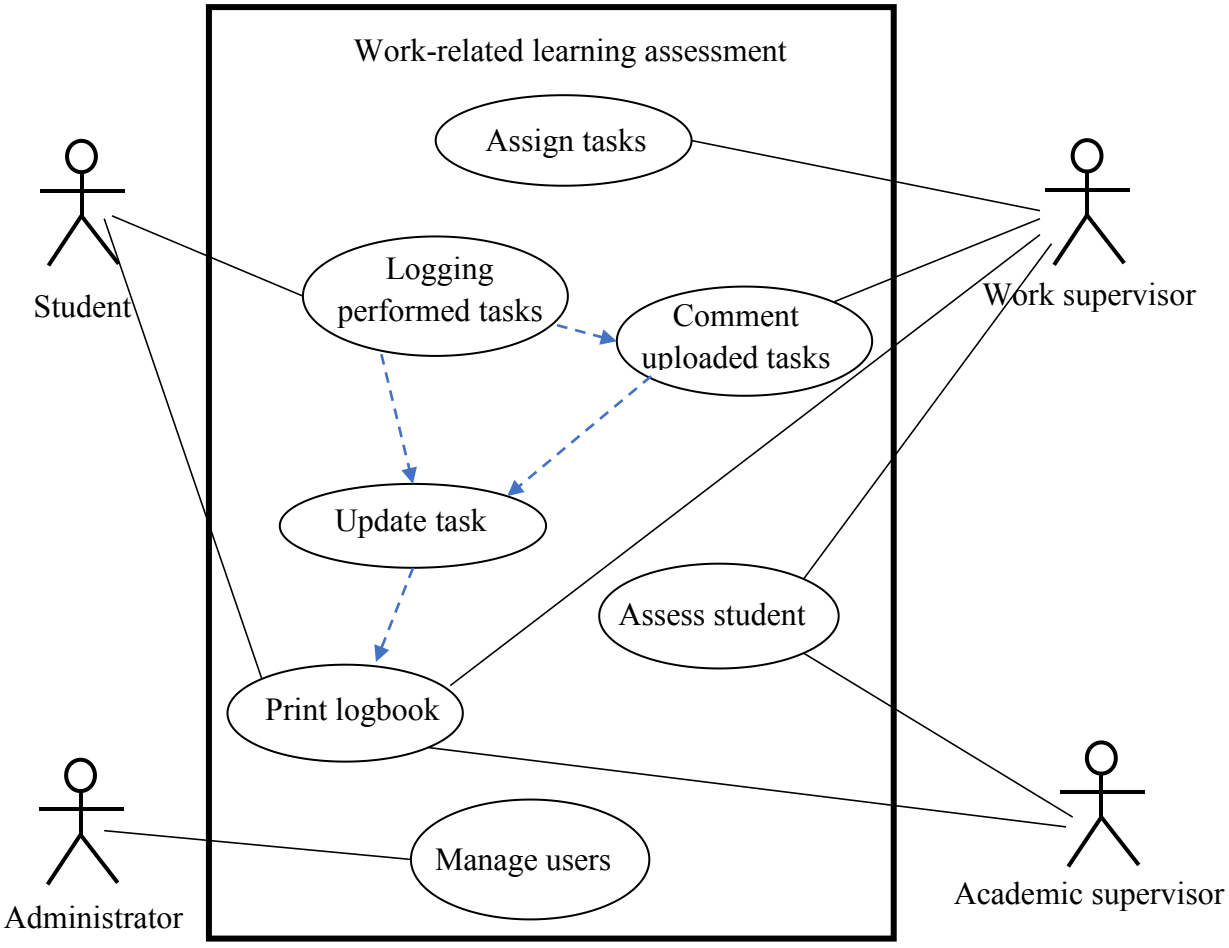


Figure 3.5: Use case diagram

3.8.2 Non-functional requirements

Non-functional requirements (NFRs, or system qualities) are sometimes referred to as global constrains as they cannot be implemented in a single module of a program such as security, reliability, maintainability, scalability, robustness, understandability, modifiability and performance (Adams, 2015). These non-requirements constraints are sometimes vital to the

performance of the entire system as they help to meet the system objectives. Examples of required service levels are:

- Response times
- Security and access requirements
- Technical constraints
- Users' desired interfacing and other systems;

3.9 Conclusion

In conclusion, this phase has showed to be productive as the developer was able to evaluate the results from the findings, assessing the current system and evaluate two development techniques and finally come up with the conclusion to proceed with the proposed system. In the following phase, the developer was looking at the design of the proposed system.

Chapter 4: Design phase

4.1 Introduction

The process of using numerous techniques and principles with the aim of outlining the system into detail to allow its physical attainment is referred to as system designing (Rosenblatt, 2014). The focal point of the designing phase was mainly on functional requirements showing how were they going to be transformed into physical functions. It was a framework of how the proposed system should work and focus on exactly how to design an effective, consistent and sustainable system. This phase encompassed the architectural design, database design, user interface and the design of the program and this was the most vital phase in the development of this system.

4.2 System design

Maier et al (2013) view system design as the process of satisfying the specified requirements of an organisation by defining the system's structural design, mechanisms, modules, interfaces and the data to be processed. System design strived to produce a well-designed system with features like effectiveness, reliability and maintainability. The new system performs the following:

Effectiveness: The system was designed in such a way that it is able to achieve its objectives within its predefined condition and it should result in some benefits or reduction of costs and work load. The system was able to satisfy user requirements as they are defined by the objectives. The system will be completeness, consistency and robustness.

Security: The system was constructed in such a manner that no unauthorized users will be granted access to its content. This was done in order to provide privacy and confidentiality, so only authorized users will enter their login credentials to enter into the system.

Reliability: Moderately a number of computer systems are vulnerable to flop. In situations where UZ may experience power cuts or power failures, this system was designed in such a way that it can position itself to uphold a certain level of consistency. The DBMS is in a position to guarantee four properties of database transactions to keep up data when there is simultaneous access and system failure.

Efficiency: The system was designed in such a way that it uses a few resources in terms of processing time, memory, network access and so on.

User friendliness: The system is ease to use even with or without user support.

Maintainability: Since technology is changing each and every day, the system was designed in such a way that it is able to uphold and update in cases where there are changes in technology and or when the business need changes.

Overview of the proposed system

Industrial Attachment Web-based Supervision system (IAWBS) is a web application where UZ students on industrial attachment will be able to upload their logbooks and other attachment materials online. Students on attachment will be registered on the platform for them to be able to upload their log books and supervisors will be able to view the log books as well as assessing the performance of the students. The system will provide interaction between users through the use of chat room.

How the system works

The system has four (4) different types of users that is the administrator, student, work supervisor and university supervisor.

Table 4.1: Users and their roles

User	Role
Administrator	The role of the administrator is to monitor the system as a whole
Student	Student should login to the system to see their daily assigned tasks and give feedback by uploading their logbooks for their respective supervisors to view, comment and assess the assigned duties. Students are also able to communicate with both of their supervisors.
Work supervisor	Work supervisor are the ones to assign tasks to the student, and to comment on the student's performance as well as assisting the student where necessary.
Academic supervisor	This user is there to assess the student's logbook, downloading all useful reports including the student's attachment report.

4.2.1 Context diagram

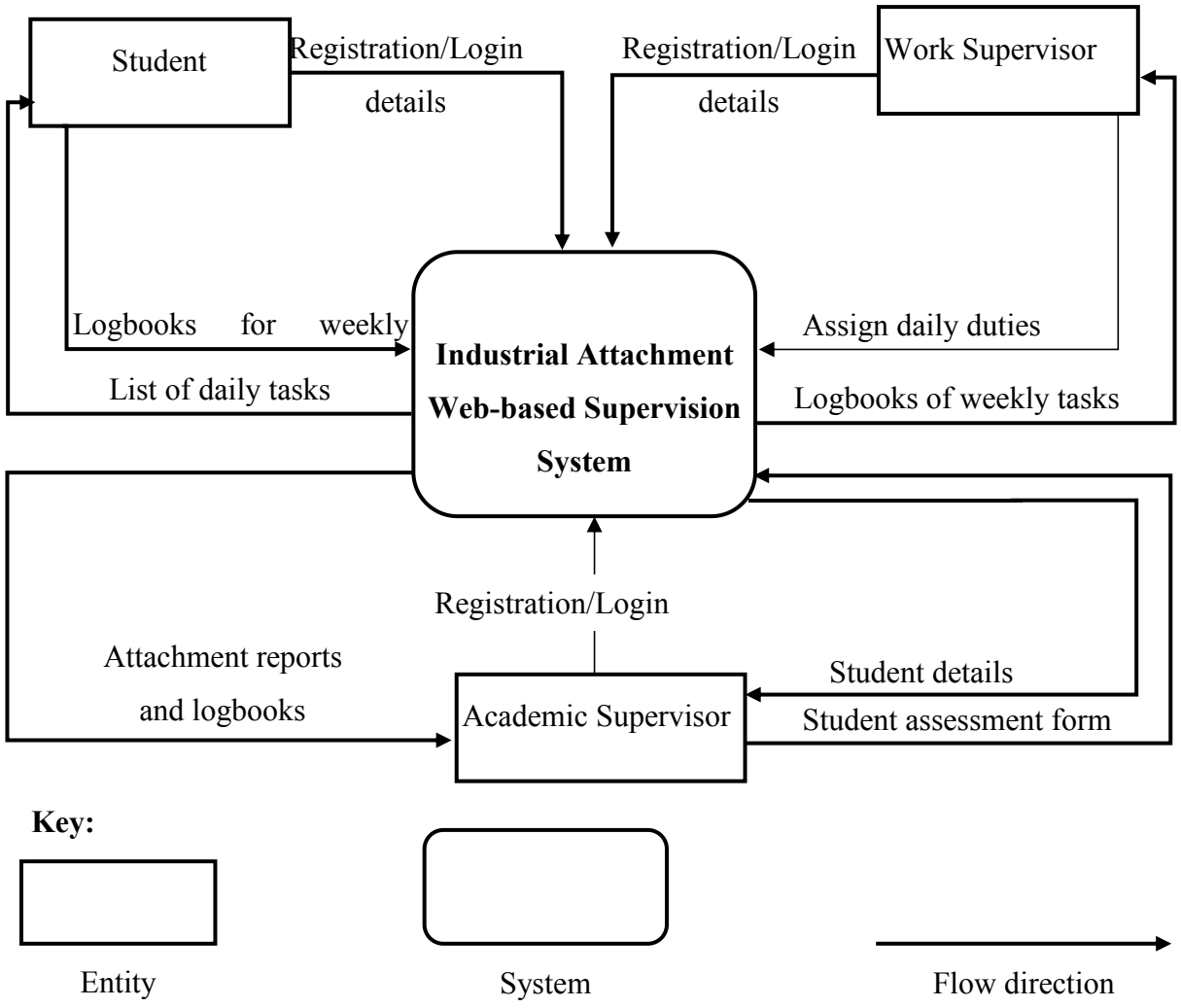


Figure 4.1: Context diagram

4.2.2 Data flow diagram

Manning (2014) referred a data flow diagram as an illustration of how input data is converted to produce output at the end of each process and how data is flowing between entities and processes in a system. All files that needs to be stored for future reference are saved in data stores. The system in place was manually done and it was using a lot off paper work and time was not been utilized properly. Logbooks were printed and they were given to respective supervisors as printed copies by hand.

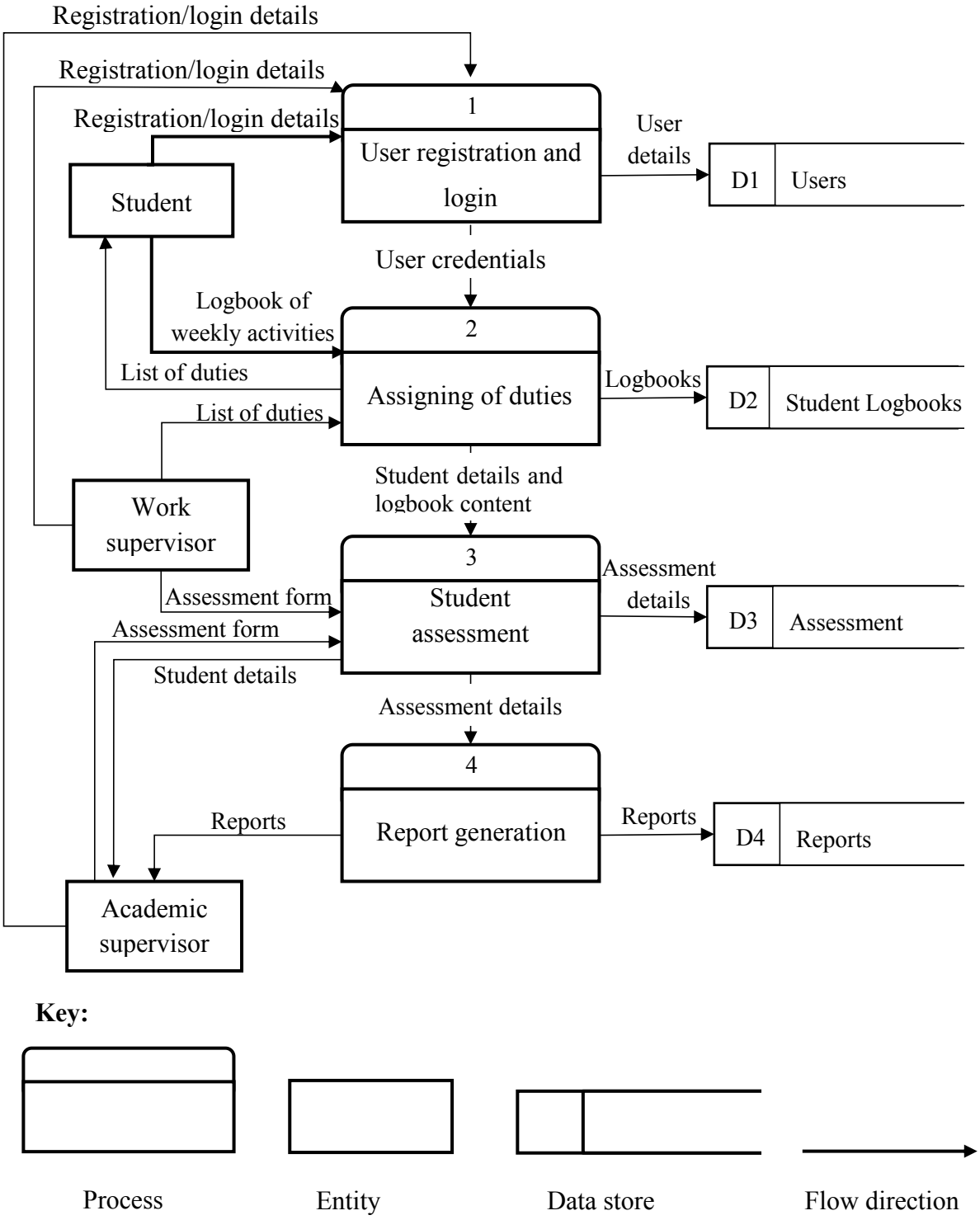


Figure 4.2: Data flow diagram

4.3 Architectural design

Duncan (2009) mentioned that architectural design is a process whereby an abstract logical model is translated into exact technical design. This can also be referred to as the design of the hardware and software environment where the system is going to be implemented. Referring to the feasibility study most of the software and hardware requirements were readily available in the institution. The design encompassed the network constitution of the entire organisation so that the system can run on the Local Area Network (LAN) for use by company academic supervisors. The system has a centralized MySQL 5.5.16 database, coupled with PHP5 sever and Apache sever. The security system is operating on an existing LAN. Separately, from running on the LAN, the system is also available on the internet for the users.

4.4 Physical design

Duncan (2009) suggested that the process of designing how the physical or hardware mechanisms of the anticipated system are going to be placed at the site of automation and how they are going to interconnect is referred to as physical designing. The actual input and output processes of the system were usually linked through physical design. This was done to show in what way the data is placed, verified, processed into the system and how data is presented following the requirements of the system. Under this physical design there was a need to carefully take account of the new system with the current environment and all other environment factors included. The system spreads over a Wide Area Network (WAN) so that users in different geographical areas can log into the system.

The creation of the physical process models and the physical data models was done under the designing process, to show the implementation of the system and how it operates.

4.4.1 Interaction between hardware and software

This is how the hardware and software infrastructure of the anticipated system were linked and how the design of the system looks like to interact with the database. The diagram below shows the interaction of the hardware and the software.

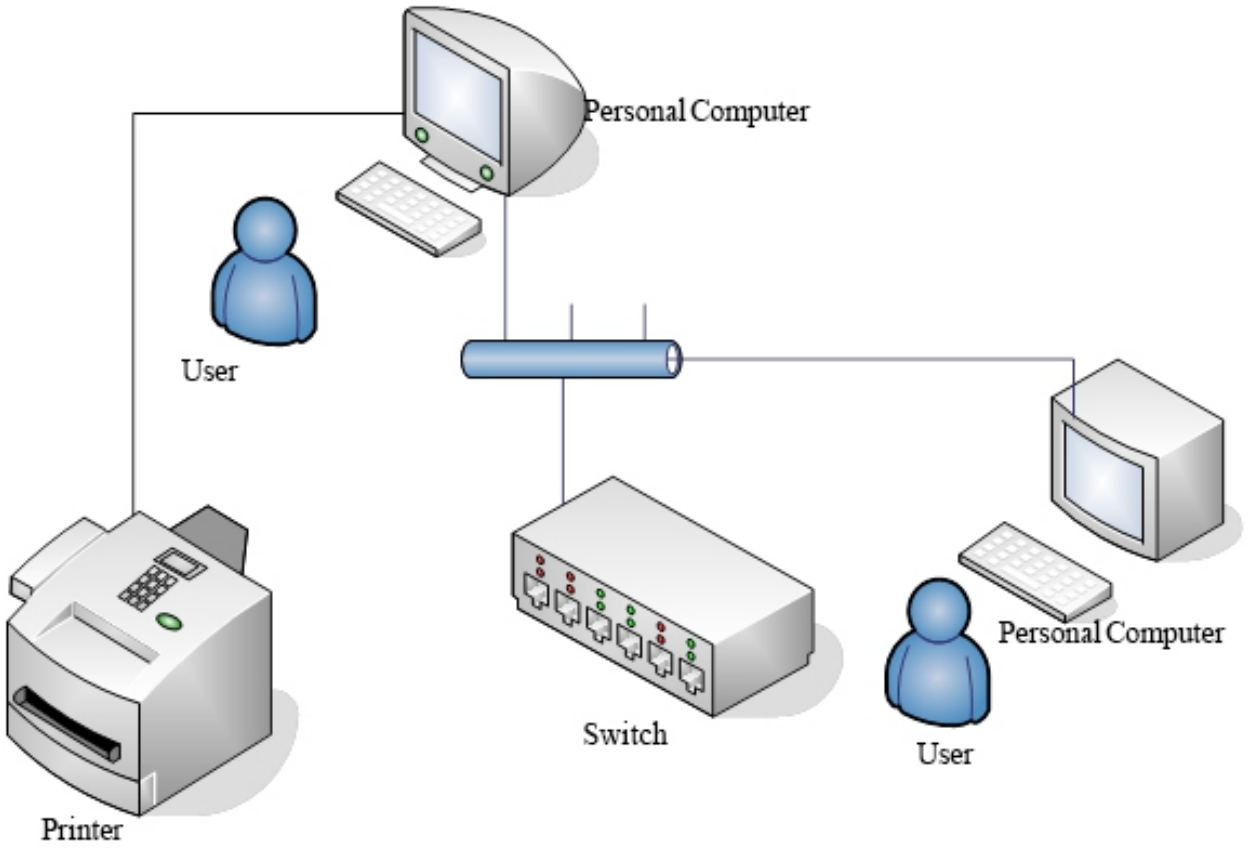


Figure 4.3: Physical design.

4.5 Database design

According to Adams (2010), the process of producing a full data model of a database is known as database design. This data model incorporates logical and physical design, and physical storage constraints needed to create a design in a data definition language which can later be utilized to build the database. Data in the system is centralized and distributed across multiple applications and retrieval of data from the database can also be done. The success of the system is determined by the structure and functionality of the data repository. The constraints such as data integrity, data reliability and reduction of data idleness and efficiency in the processing of database queries was enabled for the construction of a successful repository. The database was designed through the use of MySQL server since this database designing tool enables data to be stored, manipulated, edited, deleted and updated.

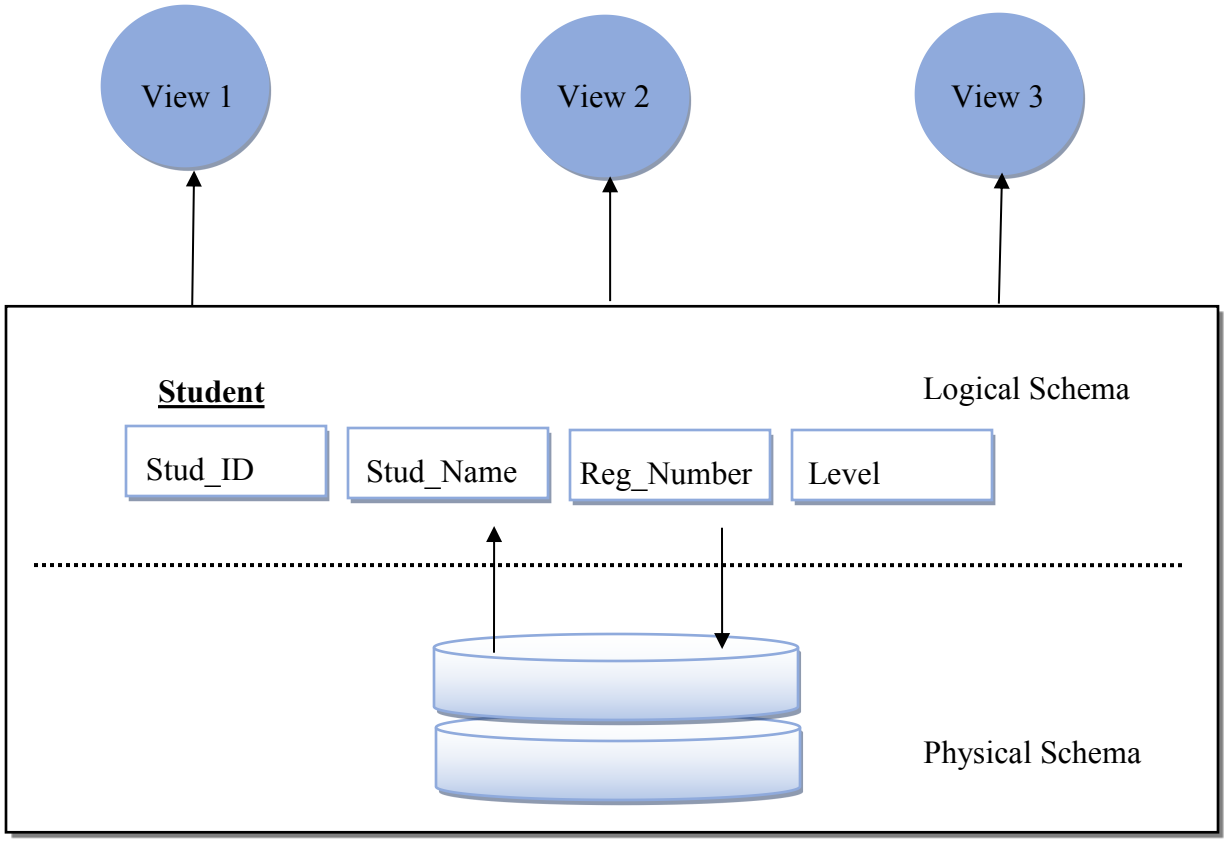


Figure 4.4: Database schema

4.5.1 Physical database design

Bleisch (2013) revealed that, this is the real construction of the database schemas, that is, the description of the database. Sometimes a database schema is referred to as the basic structure that denotes the logical view of the whole database. The actual storage of data in form of files or indices is related to this schema. There are three schemas that were specified during the design of the database namely the physical, logical and application schemas. The database design architecture of the proposed system is illustrated by the following diagram.

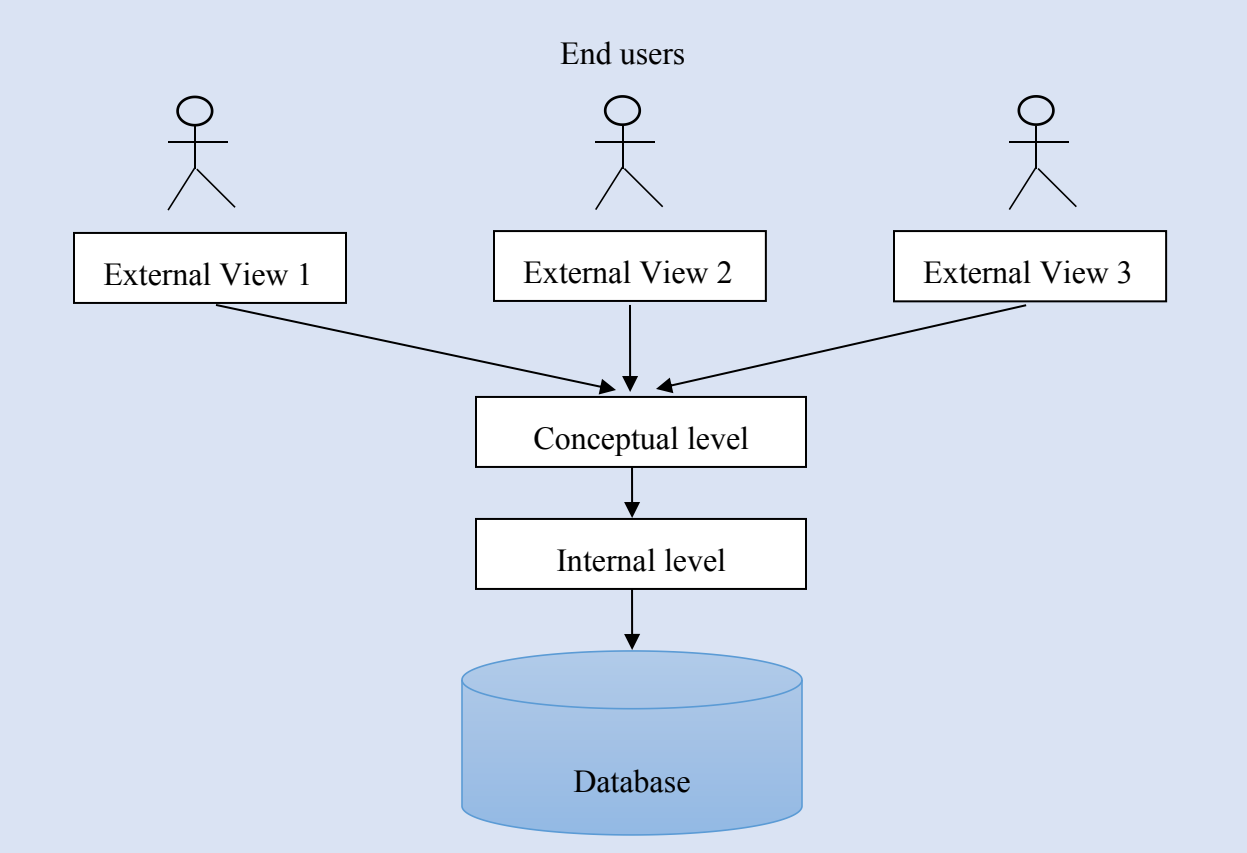


Figure 4.5: Data architecture design

External schema

This is the point where users can view the database in other words it describes part of the database that is useful to a given group of users. A number of different views of the database are contained here, that is, users have different view depending on their levels and departments. Only the important part of the database is shown to the user in the external schema.

Conceptual schema

According Coronel and Crockett (2008) data stored in the database and their relationships is displayed in the conceptual schema. The structure of the whole database to all users is described in this schema.

Internal schema

The physical representation of the database on the computer is explained on the internal schema. It describes physical storage structure of the database.

Database

According to Elmasiri and Navathe (2011) a database is a pool of data stored logically in form of tables. The developer used MySQL to design the database to store all the information that may be entered in the Industrial Attachment Web-based Supervision system. MySQL is freely available for use and it is an open source tool. With its verified performance, reliability and ease of use, the developer found MySQL as the best choice for the proposed system since it is a web-based application.

4.5.2 Logical database design

Tucker et al (2011) mentioned that this is the process of identifying all the entities involved and the relationships between them. All logical constraints that were required to be employed on the stored data were defined in this schema. All attributes of the entities were recorded clearly indicating the primary key. An entity relationship table below was given to illustrate the entities of the system and their respective attributes.

Table 4.2: Student entity relationship table

Attributes	Description	Type
Name	Name of the student	Varchar (20)
Surname	Surname of the student	Varchar (20)
Reg Number	Registration number	Varchar (14)
Level	Level of the student	Int (7)
Programme	Degree programme name	Varchar (50)
MOD	Mode of entry	Varchar (25)
Company	Company name where the student is attached	Varchar (50)
Start Date	Attachment Start Date	Date (15)
End Date	Attachment End Date	Date (15)
Email Address	Email Address	Varchar (50)
Password	Student's password	Varchar (20)

Table 4.3: Work supervisor entity relationship table

Attributes	Description	Type
WR Number	Work supervisor work related number	Int (11)
Name	Work supervisor's name	Varchar (20)
Surname	Work supervisor's surname	Varchar (20)
Company Name	Company name	Varchar (30)
Department	Work supervisor's department	Varchar (20)
Email Address	Work supervisor's email	Varchar (50)
Username	Work supervisor's username	Varchar (20)
Password	Work supervisor's password	Varchar (20)
Access Level	Privilege control	Int (10)

Table 4.4: Academic supervisor entity relationship table

Attributes	Description	Type
EC Number	University supervisor EC number	Int (11)
Name	University supervisor's name	Varchar (20)
Surname	University supervisor's surname	Varchar (20)
Department	University supervisor's department	Varchar (30)
Email Address	University supervisor's email	Varchar (60)
Username	University supervisor's username	Varchar (22)
Password	University supervisor's password	Varchar (22)
Access Level	Privilege control	Int (10)

Table 4.5: Company entity relationship table

Attributes	Description	Type
ID	Company ID	Int (11)
Name	Company name	Varchar (50)
Address	Company physical address	Varchar (150)

4.5.3 Entity relationship diagram

According to Bagui and Earp (2011) an entity-relationship diagram (ER) is a data modelling method that graphically demonstrates an information system's entities and the relationships between those entities. An ER diagram was constructed to clearly show how the entities in the database interacts.

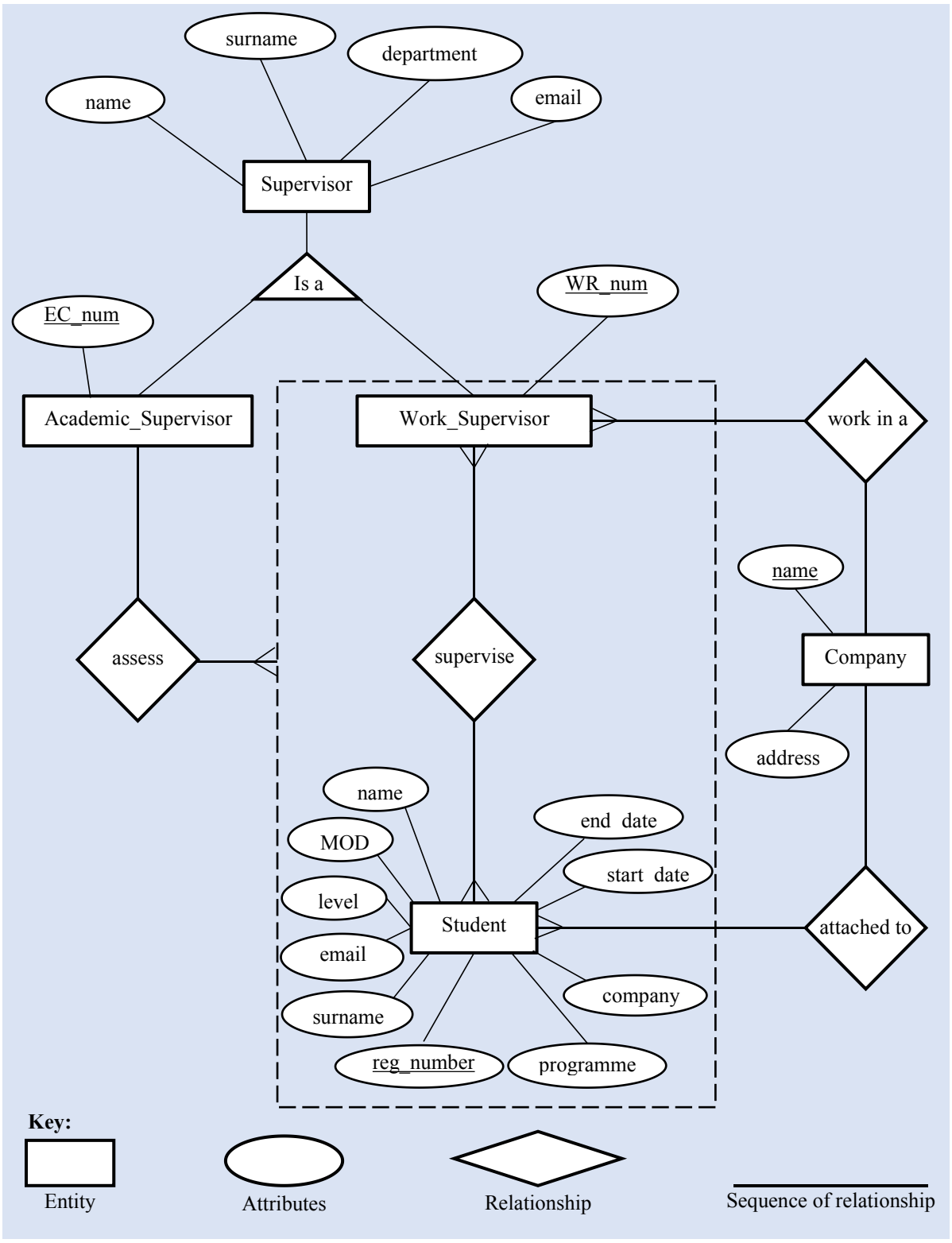


Figure 4.6: Entity relationship diagram

4.5.4 Enhanced entity relationship model

Date (2014) described an enhanced entity-relationship (EER) model as an advanced-level abstract model that precisely signify the requirements of complex databases. An EER diagram, is a dedicated diagram that deviates from traditional entity-relationship diagrams in other words it is an extension of the entity relationship diagram. It uses a number of philosophies that are closely linked to object-oriented design and programming. EER diagrams include the same concepts that normal ER diagrams incorporate. Additionally, EER diagrams include:

- Specialization or generalization
- Category or union type
- Attribute and relationship inheritance
- Subtypes and super types (sometimes known as subclasses and super classes)

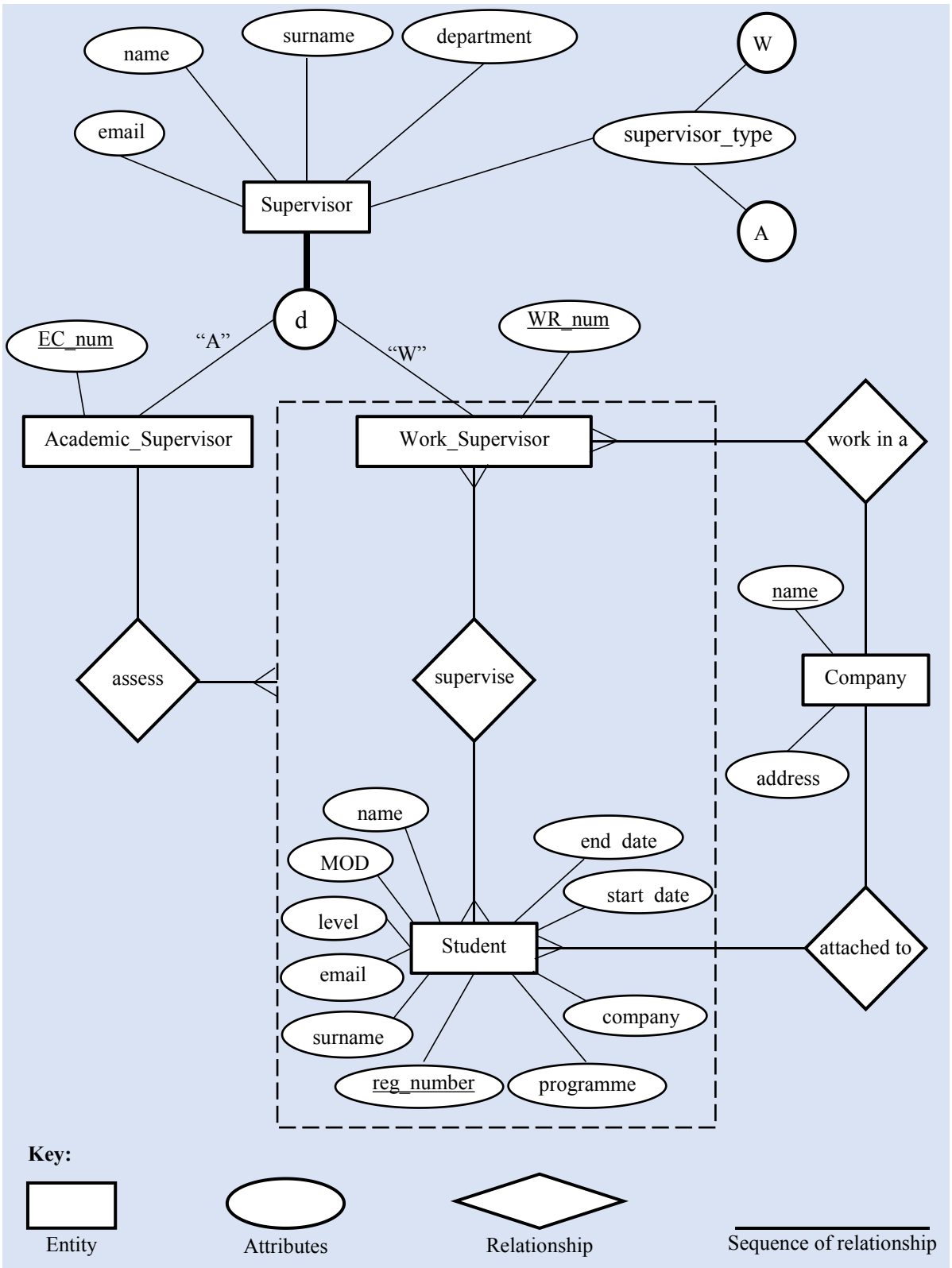


Figure 4.7: Enhanced entity relationship model

4.6 Program design

Waldo (2006) suggested that program design is where all known user requirements are converted into a practical software structure. Numerous activities were included, that is, designing of user interfaces, the knowledge base, database and other programs. The reports and other outputs that the system generates are defined in the following sections.

4.6.1 Class diagram

Hoffer et al (2009) agreed that a class diagram is designed to give an outline of the target system by clearly showing the relationships between the objects and classes inside the system. The developer used a class diagram to illustrate how objects in a system are connected to each other. Class diagrams were an easy way to express all the classes, packages, and interfaces that set up a system and how they are related with each other. Also, comprehensive class diagrams were used as a prime reference for the conversion of a designed system into a programming code.

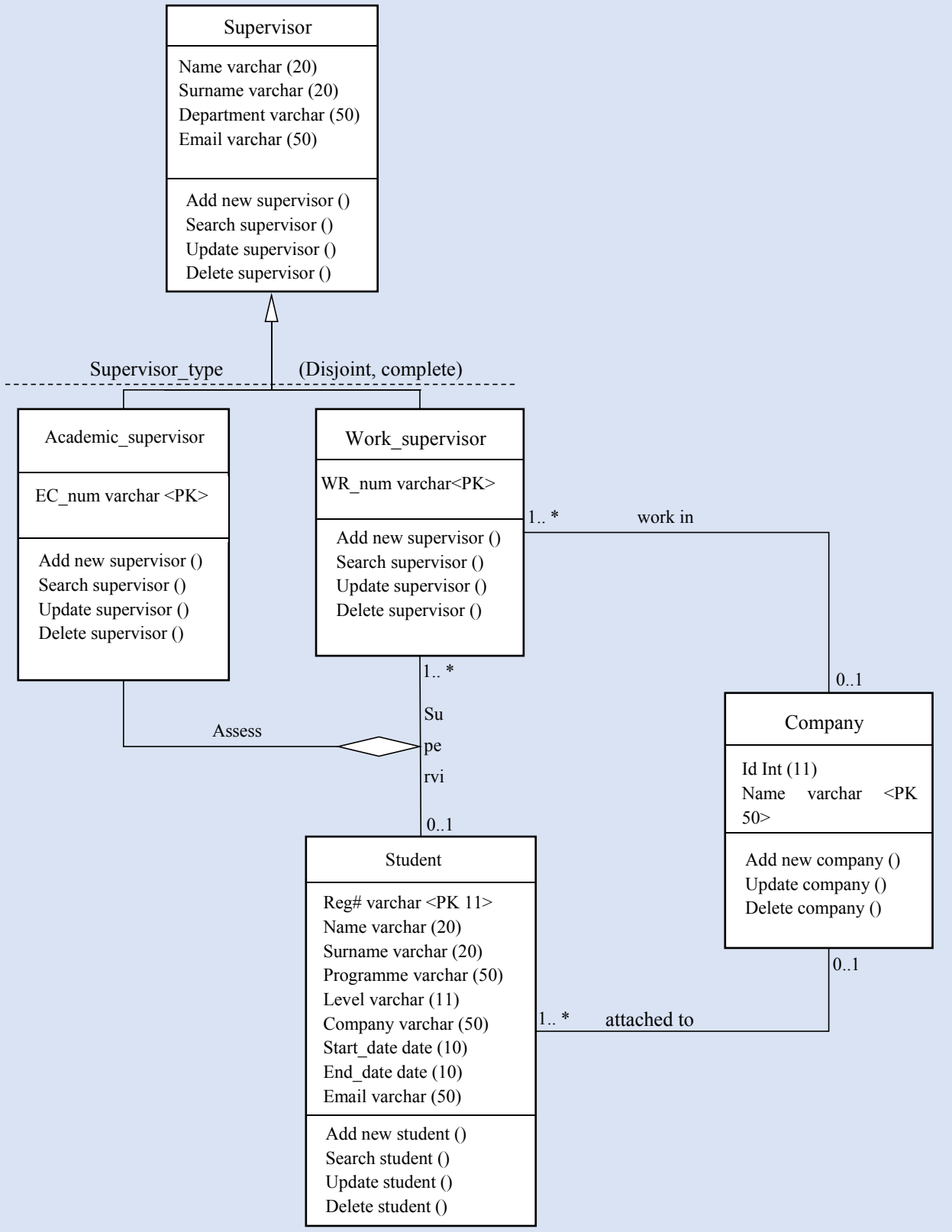


Figure 4.8: Class diagram

4.6.2 Package diagram

Rosenblatt (2012) mentioned that a package diagram shows the breakdown of system modules and arrangement of model components in a software project. Both structure and dependencies are indicated between sub systems or modules to reduce complexity, thus giving a clear understanding of the projected system.

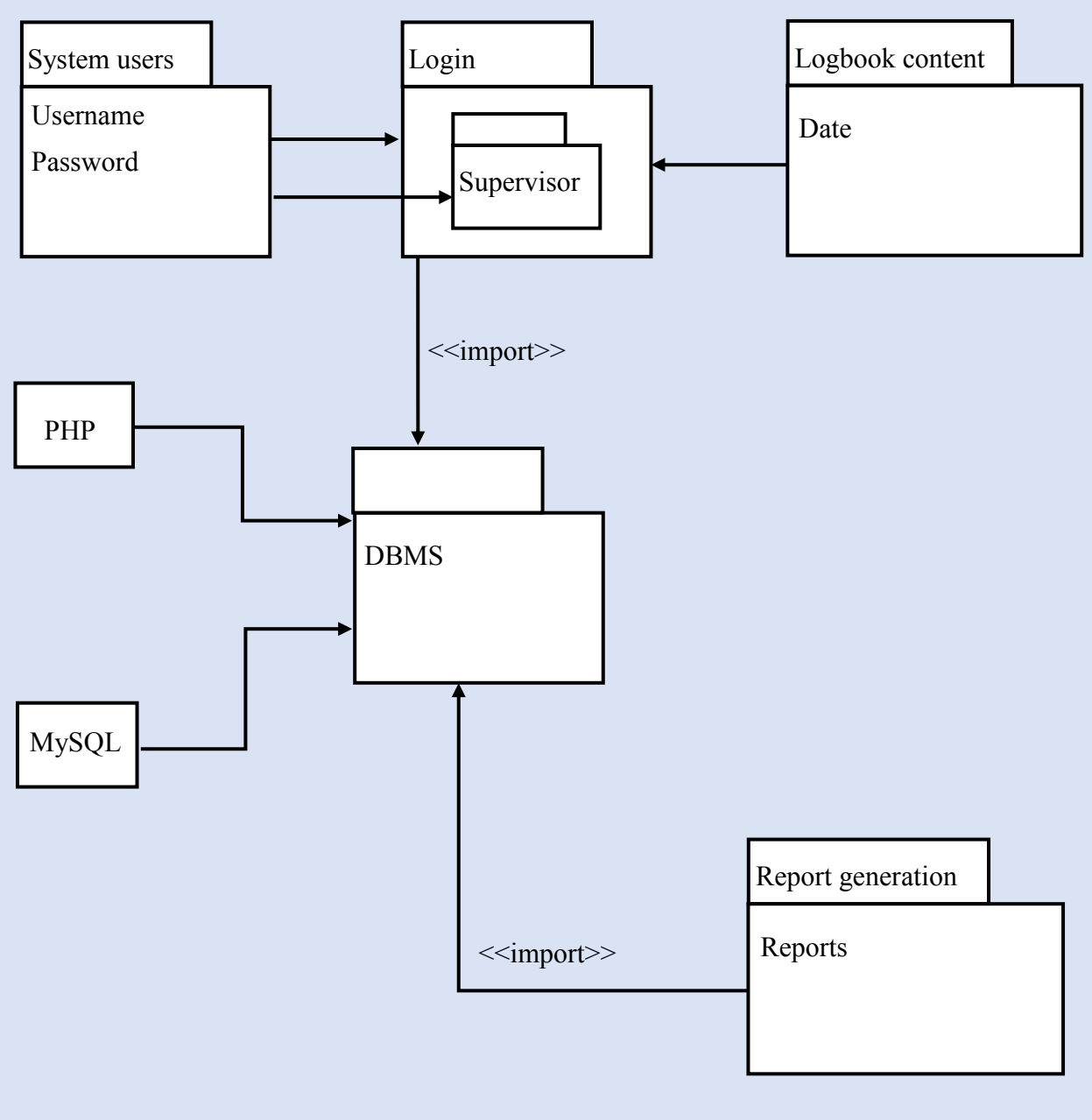


Figure 4.9: Package diagram

4.6.3 Sequence diagram

Rosenblatt (2012) described a sequence diagram as an illustration of classes and how messages are exchanged between a number of lifelines in a diagrammatic way. It describes the communication by concentrating on the order of message that is being exchanged, along with their equivalent occurrence conditions over a period of time. This is illustrated on the diagram below:

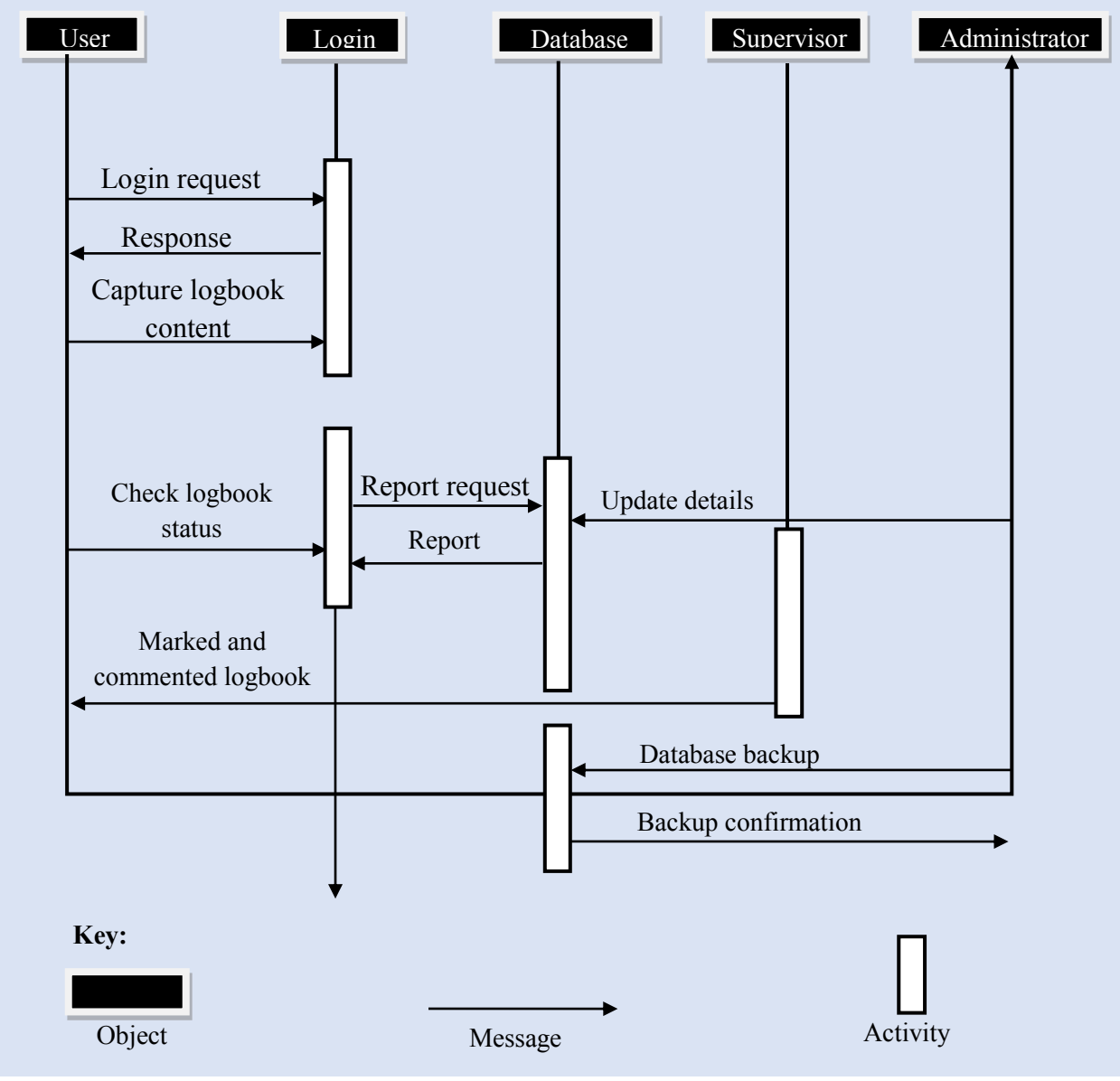


Figure 4.10: Sequence diagram

4.7 Interface design

According to Tidwell (2010) interface design can be defined as the creation of web-applications or software applications mainly focusing on experience and interaction of users. Johnson (2010) mentioned that the design of an interactive web-based user interface system is not only an art, but, at least aspirationally, a science. The main goal of designing an interface was to make it easier for the user to interact with the system at the same time achieving their goals. Interface design was actually taken as an objective way to communicate to users. The result was an interface that is simple, beautiful and easy to use. It also involved the choice of colours, font-family and font-size to come up with a more attractive interface. All these requirements were taken into consideration by the developer.

Navigation mechanism

The system is comprised of the navigation bar and drop-down buttons for easy navigation to different pages and tools.

Choice of language

The programming language that was mainly used is PHP. The developer used this language because of its capabilities to produce a better web based application.

Choice of environment

The system runs on any device that has a browser such as Mozilla fire-fox, Opera, Chrome and Safari among others.

4.7.1 Menu design

A menu is a control component which can be presented as an image or text for easy system navigation. It is a list of selections or actions that a user can use to navigate through the system. It is an on-screen list of available actions that a user can perform on the web application. The menu titles are to appear as text, icons or both, and selection is going to be done by clicking or tapping the title and selecting from the list.

4.7.1.1 Main menu

Main menu is the primary list of options available to the user on the system. It is the starting point, where users can navigate to see all the options that are available in the system (Tidwell, 2010). Generally, this show users a complete set of actions, organized in a mostly predictable way.

Figure 4.11 Menu desing

4.7.1.2 Sub-menus

Sub-menus were organized in a hierarchical manner, letting navigation through different points of the menu structure. The menu can expand upon selection showing all the links under that menu in this case which are sub-menus.

Figure 4.12: Sub menus

4.7.2 Input design

This was the design of all the input forms necessary for the system to accept required data from users.

- Validation takes place as the user enter the system
- A user is able to make us of the Tab key to proceed to the next field as well as the Enter key to save the input.

Supervisor registration form: - a form where a new supervisor can be added to the system.

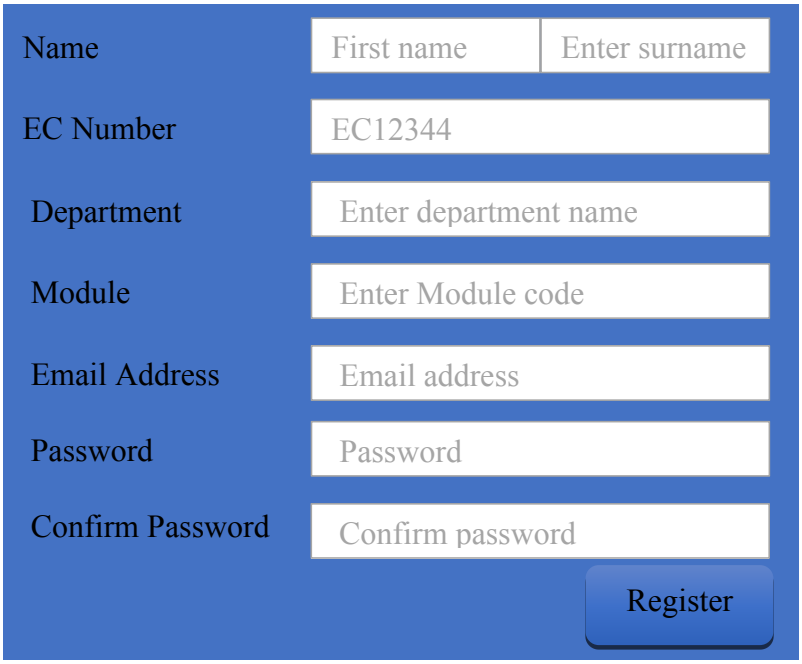


Figure 4.13: Academic supervisor registration form

Work related registration form - this is where a new work related supervisor can be added to the system

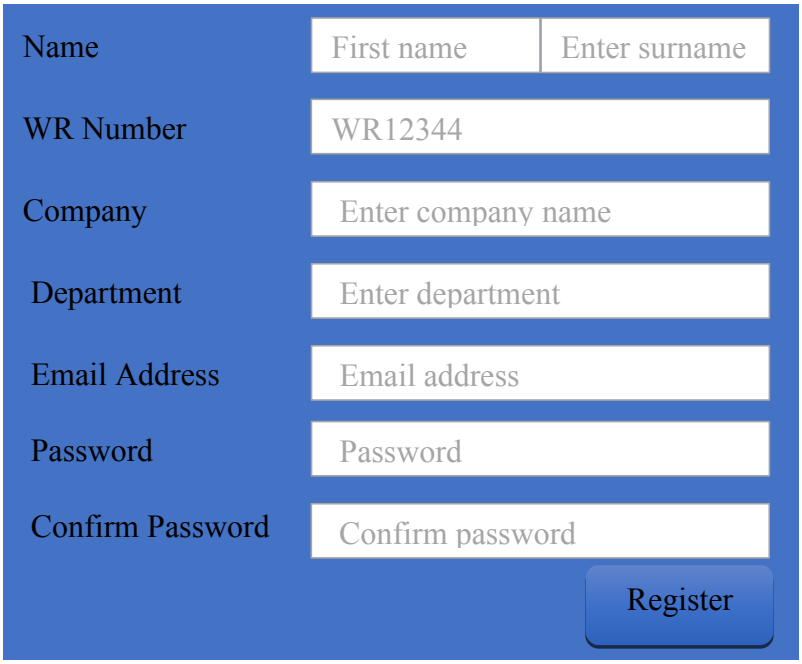


Figure 4.14: Work related supervisor registration form

Student registration form: - a form where a new student can be added into the system.

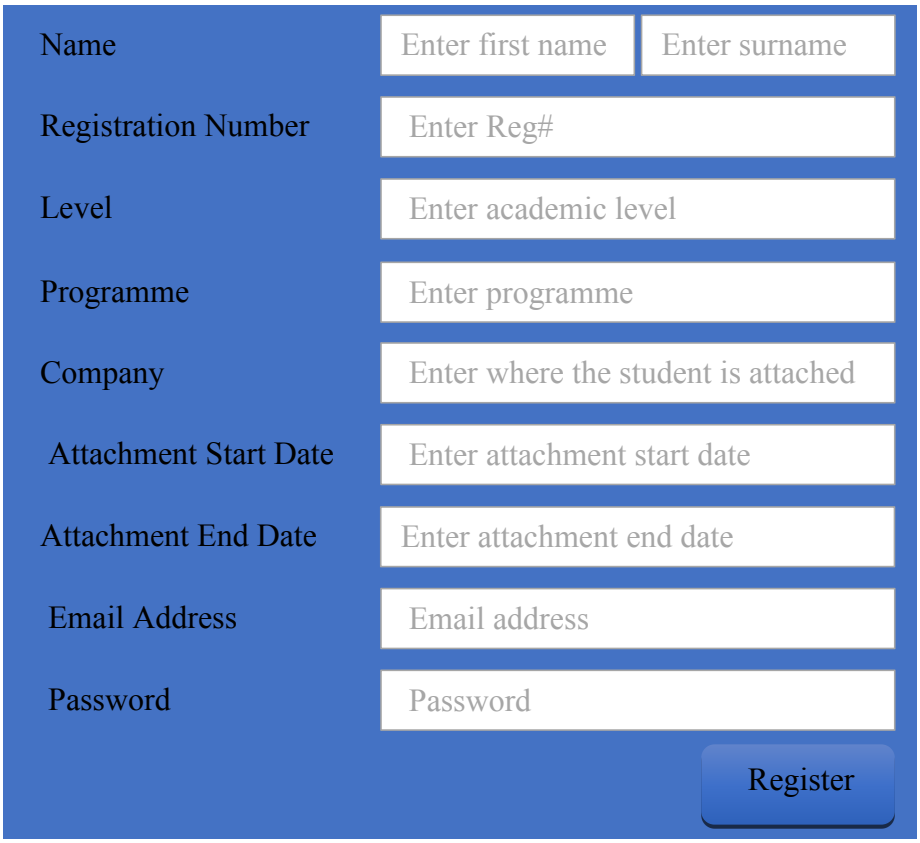


Figure 4.15: Student registration form

Login form: - a form where users can enter their access account details to enter into the system.

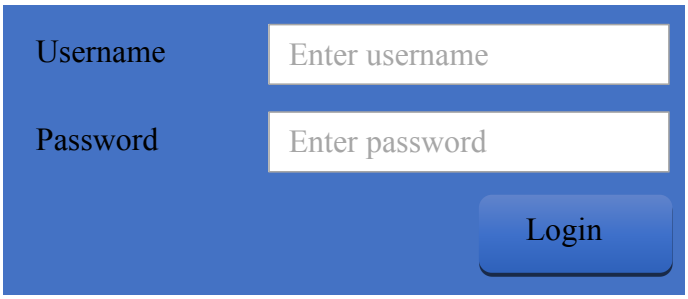


Figure 4.16: Login form

Password recovery form: - when users forgot their passwords this form will enable them to set a new password.

Figure 4.17: Password recovery form

4.7.3 Output design

These forms were representing how the output of the system and reports should look like.

Table 4.6: View logbook

Assigned Date	Task Detail	Status	Student Comment	Supervisor Comment	Rating

Table 4.7: List of students

Reg Number	Full Name	Contact	Programme	Operation

Table 4.8: Current students for supervision

Reg Number	Full Name	Email	Address	Contact	WRL Supervisor	Operations

Table 4.9: Assigned task

Task Date	Task	Priority	Details

Table 4.10: Work related supervisor's view of task list

Reg Number	Task Detail	Assigned Date	Status	Seen by Student	Student Comment	Supervisor Comment	Operations

4.8 Pseudo code

- **Register new user**

Check if all fields are filled with correct input

If yes, then

Register

Else

Fill all fields with the required input

- **Login**

Enter username and password

If successful

Go to user homepage

Else

Try again

- **Creating a new task**

Validate the input

If the input data is invalid

Show error message

Else

Save details

- **Updating data in the database**

Get the key fields

Check if there is matching record

If not, then

Show error message

Else

Validate all the information

If the input is not valid

Show error message

Else

Save data

- **Searching for a student**

Get the student reg number

Retrieve data

If there is no match, then

Show error message

Else

Show data

Permit the user to edit

4.9 Security design

Gasser (2012 put forth that security is a fusion of procedural, logical and physical actions designed to prevent, detect and correct certain kinds of misuse, together with instruments to mount, operate and uphold these actions. Security is a property of a system that assures right status, behaviour, accessibility and reliability. Security design is an art of making sure the information confidentiality, availability, integrity and system data is being maintained properly by putting standard security measures such as physical security, personal security, operational security, database security and network security.

4.9.1 Physical security

Gasser (2012) cited that physical security is the physical protection of the facility/building and the surrounding premises to prevent theft, data damages fire, water and any other physical threats. The measures that were used for physical security include fencing, locks, access control cards, biometric access control systems and fire suppression systems

4.9.2 Network security

All access to the network are restricted by the domain controller (DC), which is a server that handles network access leases, levels and privileges. All network logins are authenticated by this DC and IP address of requesting client must be within the specified range, otherwise access will be denied.

4.9.3 Operational security

Operations security which sometimes can be abbreviated as OPSEC is a process of identifying and protecting uncategorized critical information from being accessed or used by a competitor (Gasser, 2012). Even though the information is unclassified under the OPSEC, it might be an advantage to a competitor or other threats. Operational security mainly focusee on identifying and protecting information that could give rivals hints to put the university at a disadvantage.

4.9.4 Database security

Elmasri and Navathe (2011) emphasized that database security indicates all the measures used to protect a database from unlawful/illegal use, alteration of data and malicious threats and or attacks. It incorporates a collection of processes, instruments and procedures that guarantee security within the database atmosphere. It ensures and imposes security measures on all features and mechanisms of the database. Which are data stored in database, database server, database management system (DBMS) and other database workflow applications

The database administrator is responsible for the planning, implementation and maintenance of database security. Database is placed on the system sever and its access is through a password protected phpMyAdmin, which is installed on that machine only. Backup will be done periodically in the event of a crash. The database is password protected as well.

4.9.5 User security

The system decides who has access to the system through the use of a unique identifier in this case which is a username. The username must be unique; this is the only way the system can identify users differently. Users have passwords known to themselves. Also, users are able and encouraged to regularly change their passwords. The use of access control also work as a security key to users, as the system have three different access control tasks which are:

- Permission: defining which users are permitted to have access to which objects
- Controlling right of access; this encompasses the right to write, read, execute, delete, and append.
- Imposing the right of entry

Accessibility

The system is online 24/7 and accessible wherever there is internet access.

4.10 Conclusion

During the designing phase, the developer transformed the baselined requirements into a detailed system design. All the needed designs have been carried out including system design, physical design, database design, interface design and security design, and the proposed system was supported within the existing infrastructure environment. It was clearly safe for the new system to be coded and tested. The next chapter is going to cover the implementation phase.

Chapter 5: Implementation phase

5.1 Introduction

The process of taking the system into the working environment, testing it to verify and confirm that the system components have been accurately done is sometimes referred to as system implementation. This phase focused on the creation of the actual system, system testing, security, validation, verification, installation, user training and maintenance.

5.2 Coding

According to Medard and Sprintson (2012) coding is a process of converting what is on the designing phase to the format that a computer understands thus writing a program. This was done through the use of PHP programming language and MSQL for SQL statements for database communication. Pseudo code is a short statement that is used to show the flow of the system in an understandable manner (Goel, 2010).

5.3 Testing

According to Parsons and Oja (2014) application testing is a process is the process of trying out various sequence of input values and checking the results to verify that the application system works correctly. The idea behind system testing was to check all potential circumstances that are likely to occur in the future. It is an on-going procedure that should be done on an incremental basis at every suitable level. Testing was also used to identify any and all functionality problems

and therefore the testing involved inputting known data to investigate whether the results were as expected.

5.3.1 Validation

Murray-Smith (2015) highlighted that validation is when the application is tested with regard to its distinctive working environment. Subsequently, for many procedures no clear partition among validation and system testing can be made. A search was done to see if the system would give results according to user specifications. The output of the system was the expected result hence the system is valid to use.

5.3.2 Verification

According to Honour (2013), verification is checking whether an item or artefact has been designed/built to conform with requirements. This was applied to the final system. Performance testing - This is when the function requirements, if any were tested these including the response time of the system on searching. A search was conducted to observe how long it takes for the system to produce results. It only took us a few seconds to run and compile the system source code. The system's response and searching time were very high.

5.3.3 Testing processes

The system was tested in different ways such as unit testing, module testing, login testing, sub-system testing, system testing and acceptance testing. The summary of these tests is shown on the diagram below:

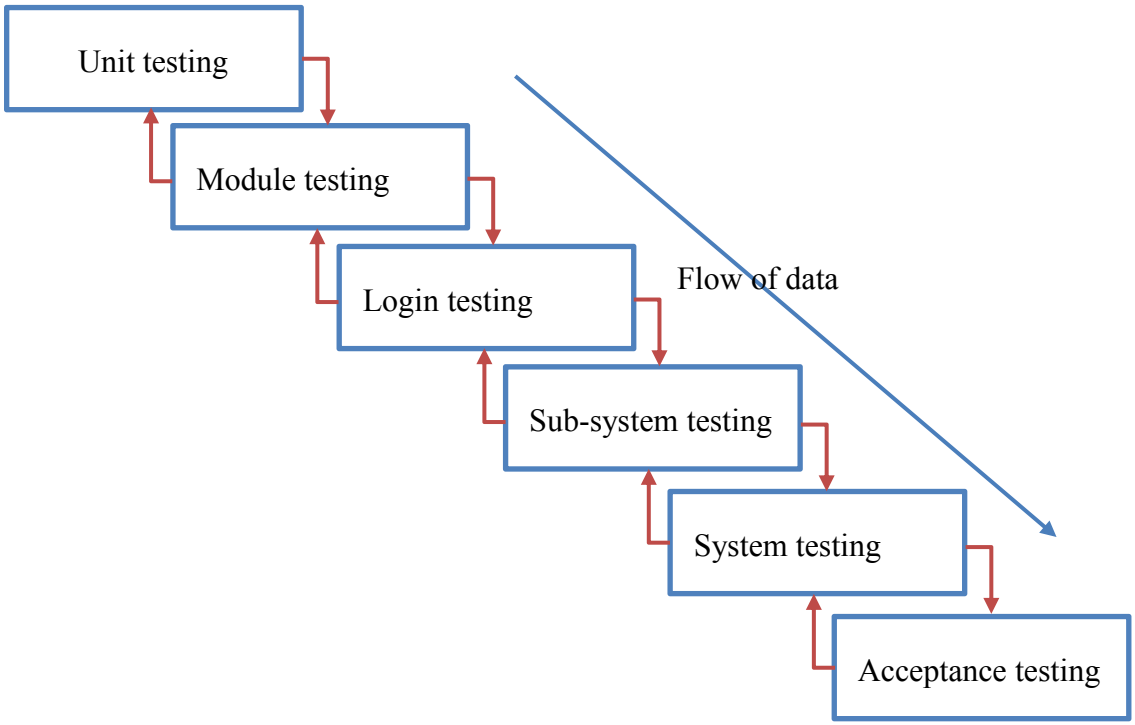


Figure 5.1: Testing process

5.3.3.1 System testing

The system was tested as a whole to test if its components will function effectively when integrated as a system. The inference engine, knowledge base and interfaces were tested together to ensure that they could function effectively when brought together as a system. The system was able to query the ontology and store the results in the database.

5.3.3.2 Unit testing

Unit testing was also performed where the different components of the system were tested individually to confirm functionality. Each implemented module is tested with respect to their desired functionality and behaviour and other requirements.

5.3.3.3 Security testing

Database security testing

Database is secured by the use of username and password. The database administrator should enter correct credentials to access the contents of the database.

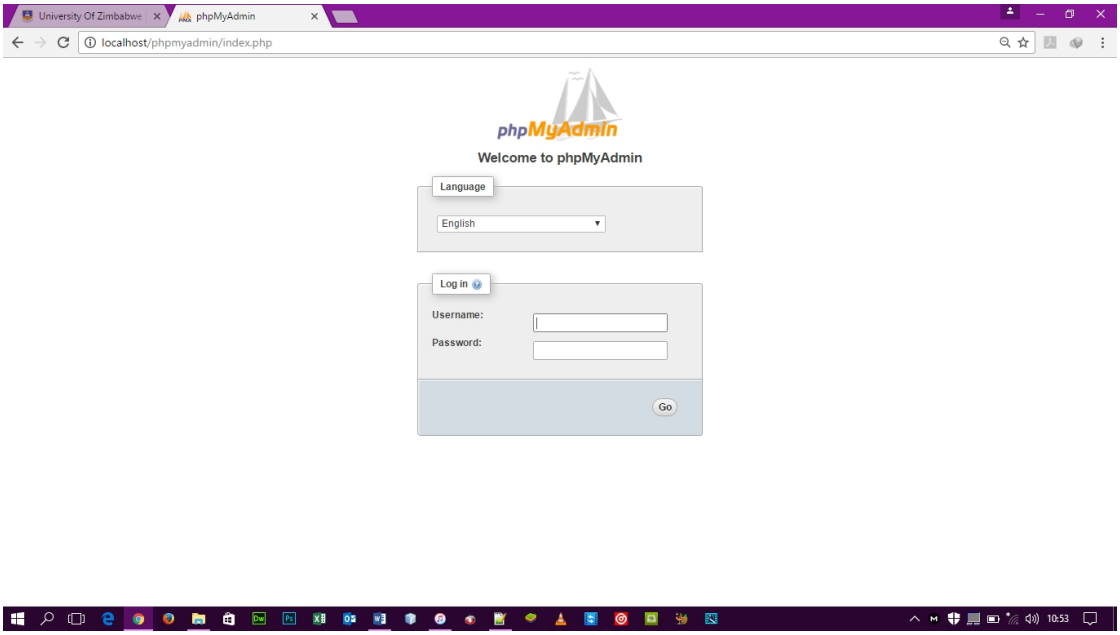


Figure 5.2: Database security

User security testing

As mentioned in chapter 4.9 that the system will decide who is going to access the system through the use of a unique identifier in this case which is a username. Permission: defining which users are permitted to have access to which objects. Controlling right of access; this encompasses the right to write, read, execute, delete, and append. The screenshot below shows the different access levels of the users

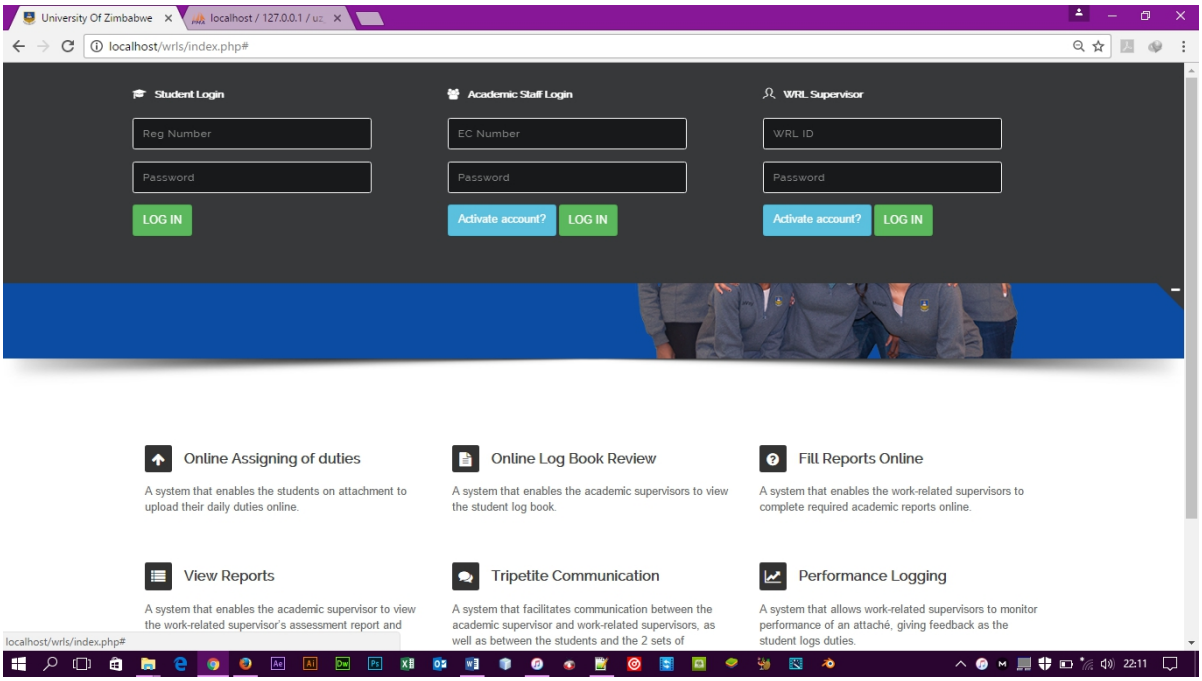


Figure 5.3: User security testing

Login testing

If a user input a wrong username or wrong password, the system will regard the user as an unauthorised user, an attempt to proceed will give the following error:

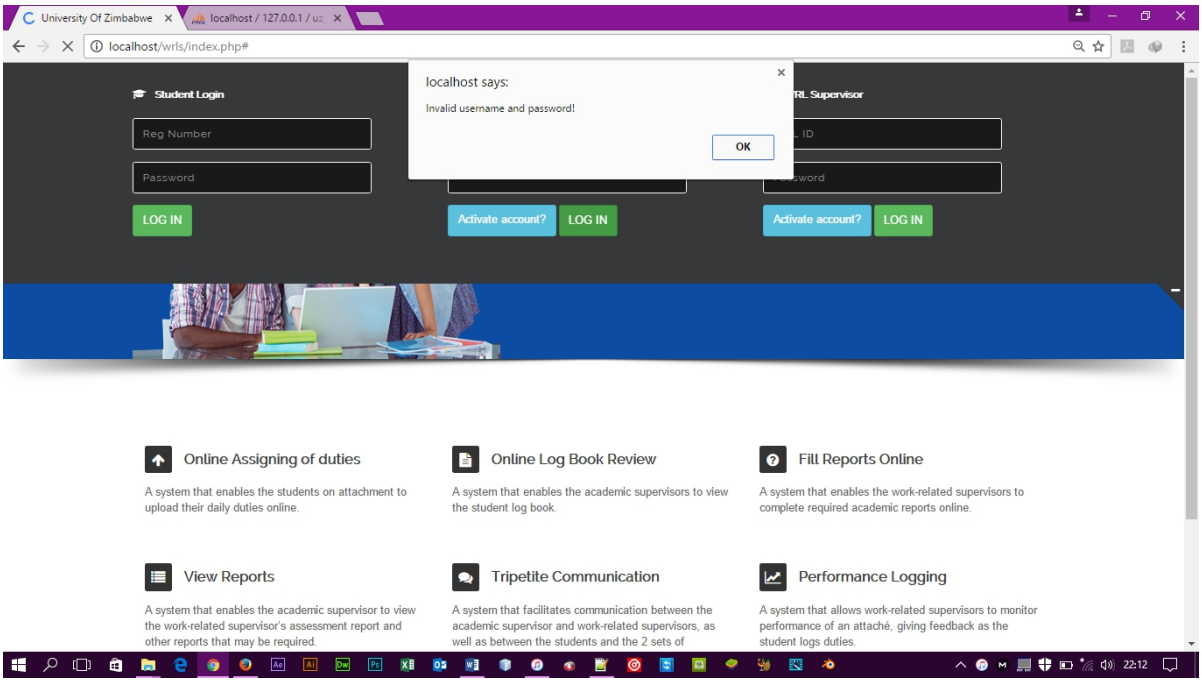


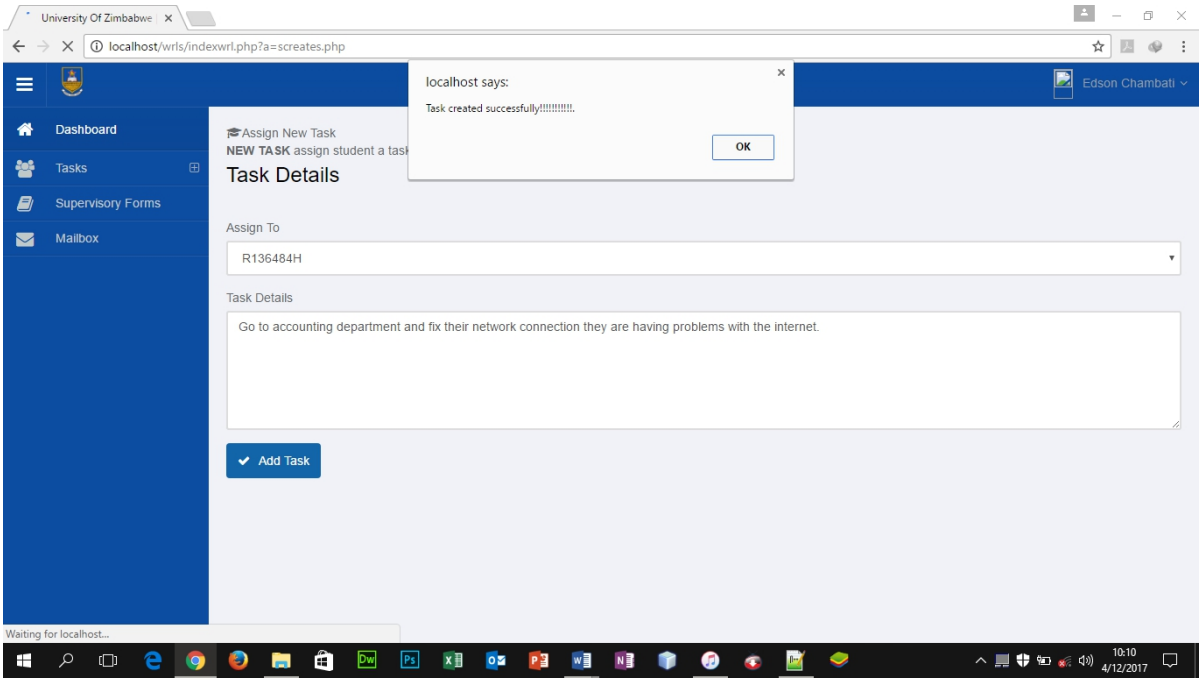
Figure 5.4: Login testing.

5.3.4 System vs Objectives

The system was successfully tested against the objectives to see if the objectives were fulfilled. Each objective was tested and screenshots were taken to clearly illustrate the tests.

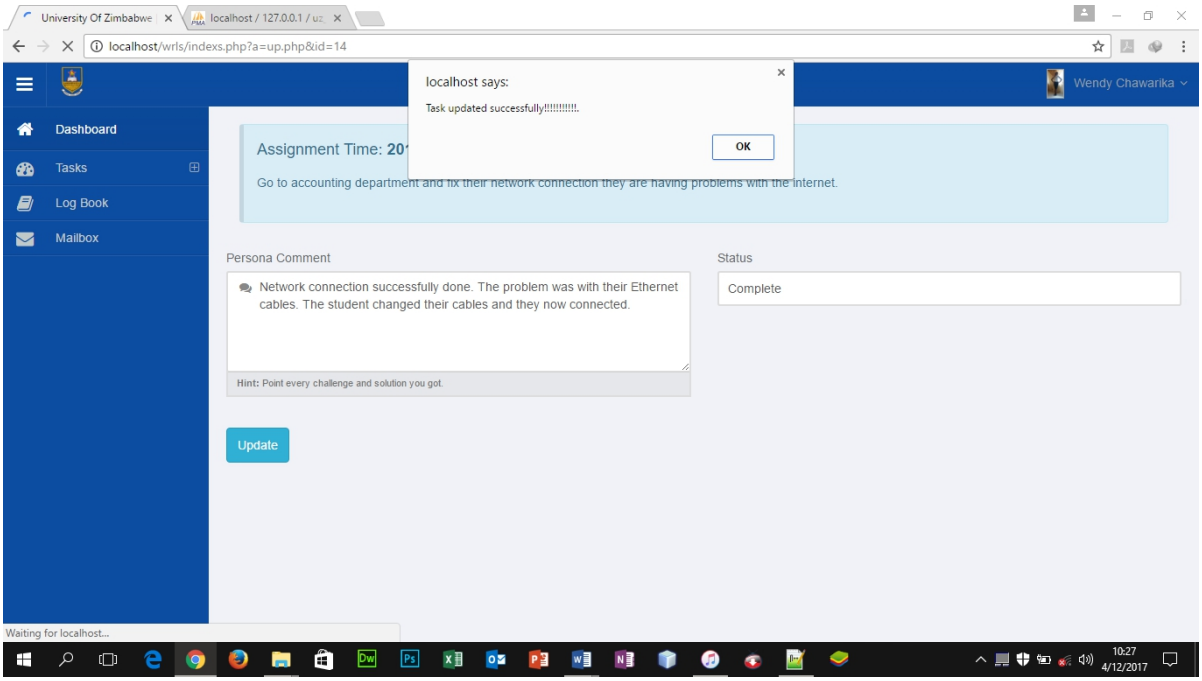
a) To develop a system that enable work-related supervisors to assign tasks to attachés online.

- The screenshot below shows the message that will pop up if a task has been successfully assigned to a chosen student/attaché.



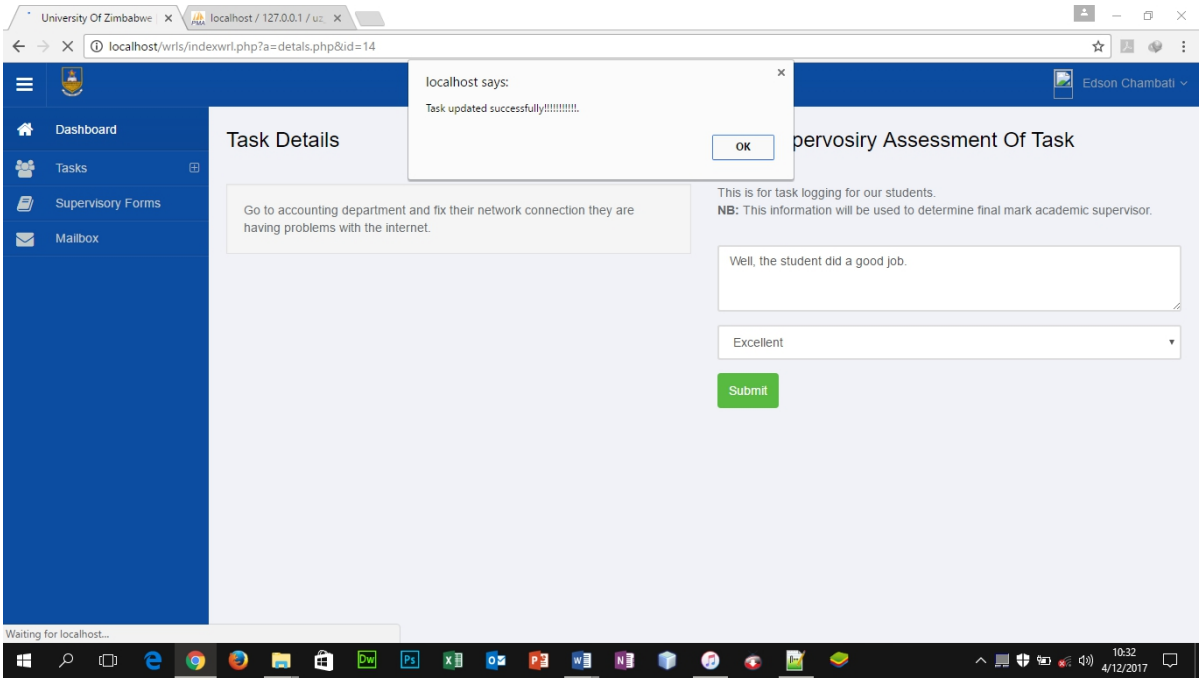
b) To develop a system that enables the students on attachment to upload their daily duties online.

- After a successful assignment of the task the student will receive the task

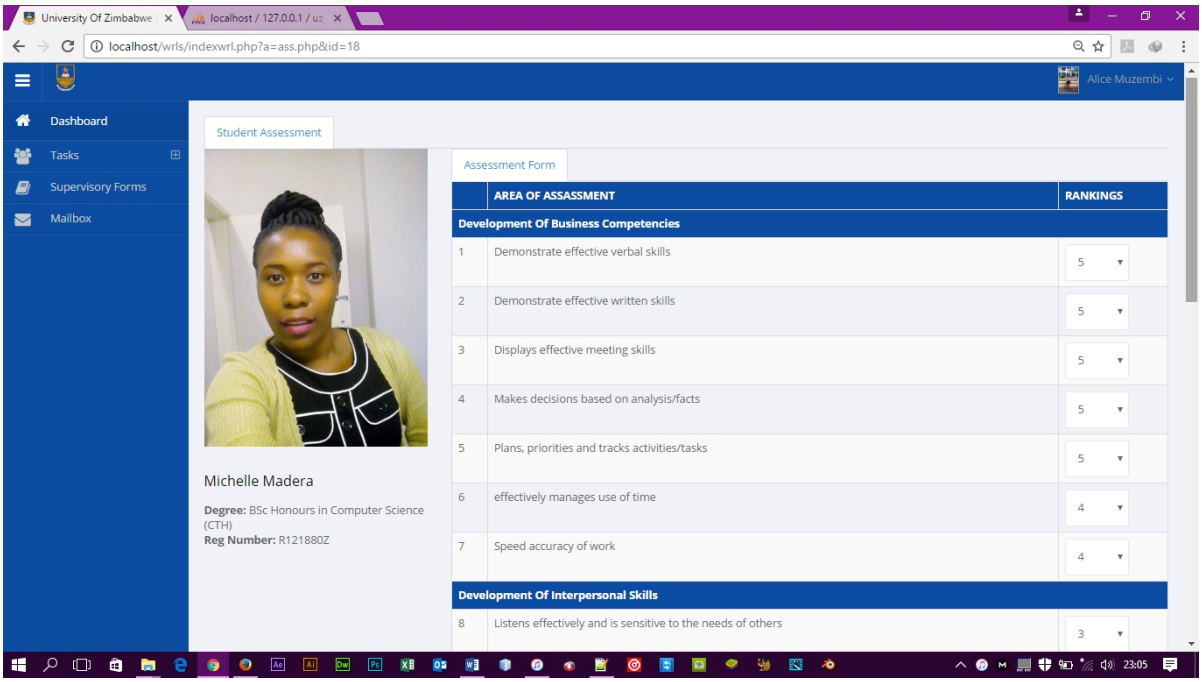


c) To develop a system that allows work-related supervisors to monitor performance of an attaché, giving feedback as the student logs duties.

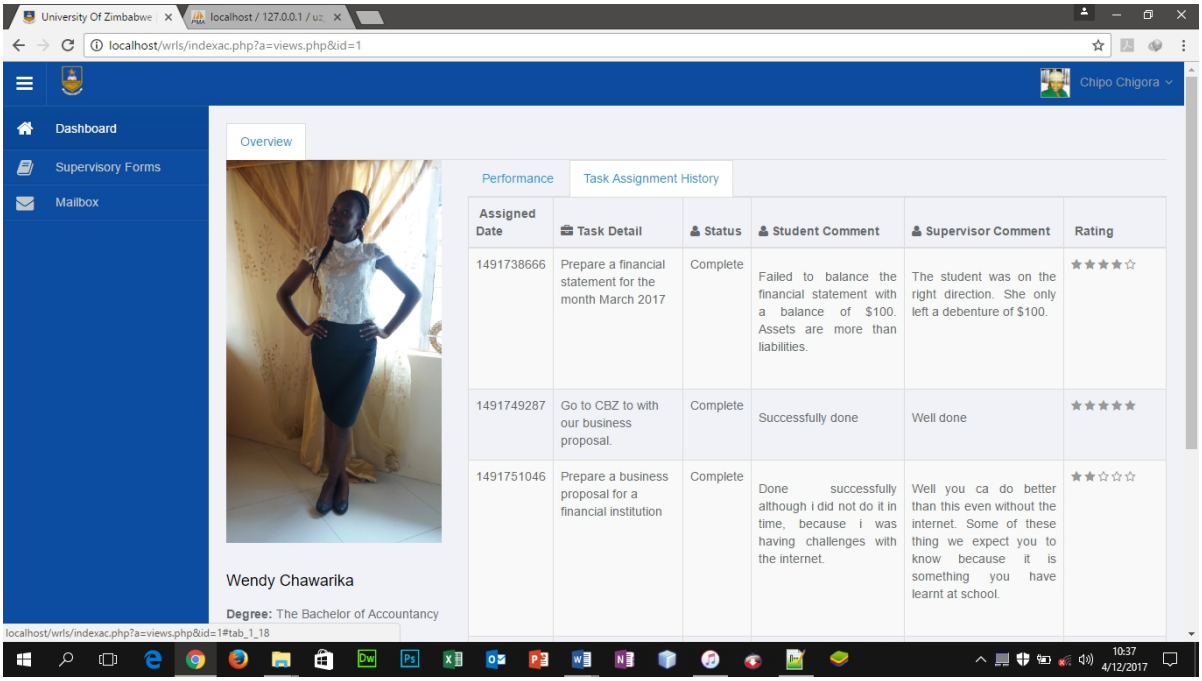
- After the student has completed the task the work supervisor will give a comment to the logged task and give feedback to the student as shown on the screenshot below.



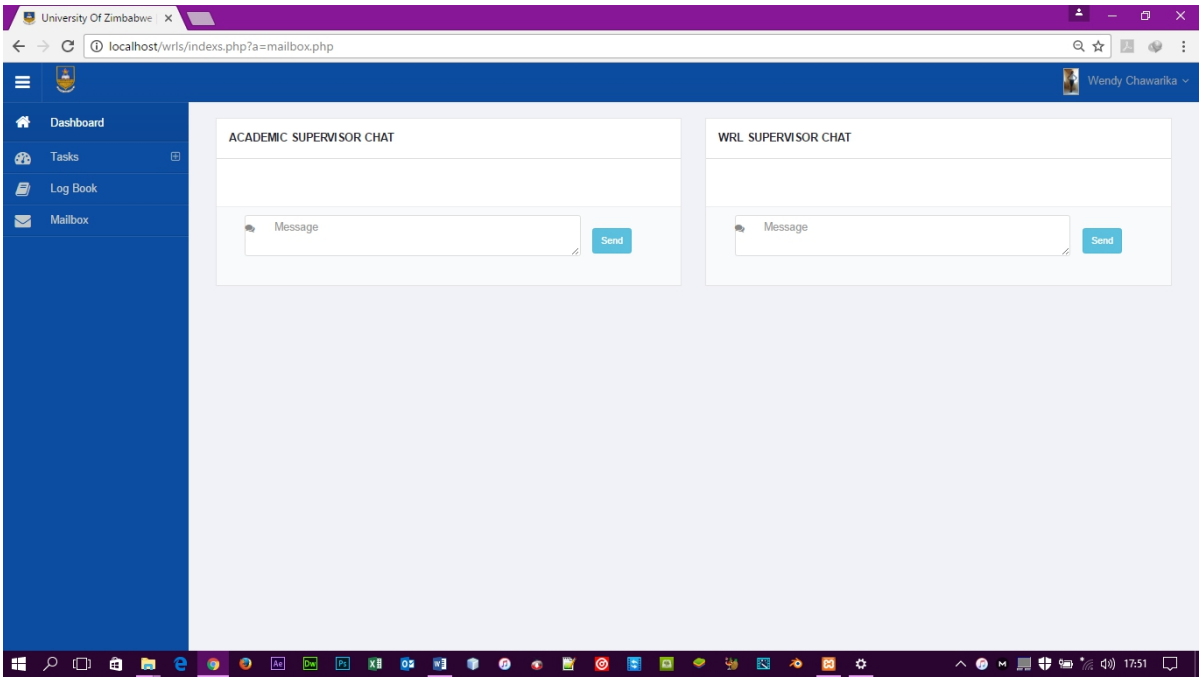
d) To develop a system that enables the work-related supervisors to complete required academic reports online.



e) To develop a system that enables the academic supervisors to view the student log books.



f) To develop a system that facilitates communication between the academic supervisor and work-related supervisors, as well as between the students and the 2 sets of supervisors.



5.4 Installation

Chemuturi (2013) revealed that installation involves deploying all the machines including servers, workstations and networking equipment and then installing the software on the respective machines. This also involved user training and all methods which are going to be used to position the system in system servers. Installation also involves the process of inserting the system onto a web server where the users will use it from (ibid). The installation was done in the UZ servers.

- The XAMPP Server with MYSQL database server was installed.
- Autocreation of a root folder in XAMPP called www.
- Type the URL www.localhost/wrlss.
- Users will be redirected to the homepage where they can find the login button for them to login using their usernames and passwords

5.4.1 Data migration

Data migration is used to describe the process of interpreting data from one format to another. Dufrasne et al (2015) mentioned that data migration is needed when an organization chooses to use a new computerized systems or DBMS that is not compatible with the existing system.

Normally, data migration is performed by a set of personalized programs or scripts that automatically convey the data.

5.4.2 System changeover strategies

As the name propose, system changeover is the process of changing the traditional system to a new system. Rosenblatt (2013) revealed that, system changeover is the process of putting the new system online and retiring the traditional system. Normally, there are four system conversion methods namely direct cutover, parallel conversion, phased changeover and pilot cutover. Their description, advantages, disadvantages and the effects of using each of these methods at UZ to replace the current system with the new online system are as follows-:

5.4.2.1 Direct cutover

The entire UZ will immediately stop using the old system at one time and start to use the new one. The institution stops using the old system one day, start using the new system on the next day. This is a dangerous method to use. Direct changeover is a cheap method among all four but comprises high risk of data loss. With the direct changeover approach, it will be impossible for the institution to return to the old system.

Figure 5.5: Direct cutover

Direct conversion encompasses more dangers of total system failure and if there is a system failure in the institution then it will not be easy to store students' information and as a result this will lead to improper storage of data. Since this approach saves money, it may be a possible choice because of it is cheap among all four methods.

5.4.2.2 Parallel conversion

The introduction of the new system will be done while the traditional one is still in use. Both systems will run simultaneously and the results are compared. Once there is sureness that the new system works fine, the traditional one will be replaced.

Figure 5.6: Parallel conversion

Parallel changeover has very low chance of risks in the case that the new system does not work correctly, the institution can easily switch back to the traditional system as a backup option, but this changeover technic is expensive. Both system will be processing the same data. Users must work in both system and this will lead to amplified workload and delays in processing. Since it is expensive, it would not be an appropriate method for UZ although it is the safest method due to its advantage of having back up.

5.4.2.3 Pilot conversion

Part of UZ, for example, department of Computer Science will be using the new system while the rest of the University remains with the traditional one. This restricts difficulties to the pilot department so support resources can be centred on it. In spite of this, there can be interface problems where institutional units share data. The Computer Science department that will be using the new system first will be called the pilot site. The traditional system will still be operating for the entire institution including the department of Computer Science. After the system proves effective at the department of Computer Science, it is then employed in another department, usually using direct cutover method up until the system is implemented to the entire university. Pilot cutover is mixture of parallel operation and direct changeover approaches.

Figure 5.7: Pilot conversion

The Computer Science department assures the performance of the new system and the risk of system failure will be reduced. This is also relatively cheaper than the parallel conversion as only at one department both system works for a limited period of time.

This is a relatively cheap and a safer method as it is a mixture of both direct changeover and parallel changeover. This will save money and also keep their data safe with smooth working.

5.4.2.4 Phased conversion

Only a part of the new system is implemented whereas the entire traditional system will still be in use. This restricts problems to the new module so support resources can be centred on it. In spite of this, phased conversion technique is impossible since the system modules are sharing data. The risk of errors or failures is restricted to the employed module only and also phased changeover is relatively cheaper than the full parallel operation. In some situations, phased changeover can be more expensive than a pilot method where the system contains huge number of isolated phases.

Figure 5.8: Phased conversion

The web-based supervision system involves modules like, registration, assignment of tasks by work supervisors, logging in of performed tasks by students, work supervisor's comment/feedback and student assessment by work related supervisor. Because of the connection of so many phases and since they share data, it would be problematical and expensive to employ phased changeover method.

5.4.2.5 Recommendation

From the discussion above about all four possible methods, it is very clear that direct cutover and parallel conversion method alone is not appropriate for the installation of Industrial Attachment Web-based Supervision system due to disadvantages like high level of risks and high costs but the mixture of these two methods namely pilot and phased approaches is more productive.

Nevertheless, phased conversion is not most appropriate method, since there are a lot of phases concerned in the information system and it is also expensive. So, in conclusion pilot conversion is the most suggested method for UZ because this technique is cheaper and a safest technique

among all four approaches. Any department can install the new system and after the system shows to be fruitful, it will then be implemented by the entire University usually using direct changeover. The risk of system failure will be low and the system will be implemented under the budget. If the system fails to perform effectively or as intended, the entire University will not be affected and the pilot site will simply switch back to the old system.

5.4.3 User training

The new Industrial attachment web-based supervision system has four users namely the student the work-supervisor, academic supervisor and administrator. Two different user training were done as students were trained separately from the supervisors. Two different levels of training that were being used are:

- **Module level:** Every user was intended to be well equipped with technical expertise on how each and every module of the system works.
- **System level:** This was concerned with only a few individuals that have full access and control to all the system modules, so that they are well versed with the system functions and the add, update and delete operations.

Additionally, the system documentation was provided to aid in better understanding of the system.

5.5 Maintenance

Wireman (2010), mentioned that maintenance is a process of adjusting a software system or module after delivery to rectify faults, perfect performance or other features, or fit to a different environment. Maintenance focuses on fixing errors found after the software has been delivered and adjusting the software to changing requirements, changing environments. There are four types of maintenance which are comprehensively explained below.

5.5.1 Corrective maintenance

According to Gulati and Smith (2009), corrective maintenance is all about repairing of faults or defects found in day-today system functions. A fault can result due to errors in software design, logic and coding. Design errors arise when modifications made to the software are not correct, not complete, wrongly communicated, or the alteration request is misinterpreted. Logical errors

result from invalid tests and conclusions, inappropriate implementation of design stipulations, defective logic flow, or partial test of data. The need for corrective maintenance is usually initiated by bug reports drawn by the users. Corrective maintenance usually is an unscheduled amendment performed to temporarily keep the system operational, since it is done when the bugs arises.

5.5.2 Adaptive maintenance

Wireman (2010), highlighted that adaptive maintenance is the execution of modifications in a portion of the system, which has been affected by an alteration that arisen in some other portion of the system. Adaptive maintenance comprises of adjusting the software to variations in the environment such as the hardware or the operating system. This usually can be done when the students are on vacation or semester break to avoid delays in system process.

5.5.3 Perfective maintenance

Tripathy and Naik (2014) hypothesized that perfective maintenance largely focuses on implementing new or altered user requirements. Perfective maintenance encompasses making functional improvements to the system in addition to the actions to boost the system's performance and functionality even when the alterations have not been proposed by errors. This include improving both the function and efficiency of the code and modifying the functionalities of the system as per the users' changing requirements. This can be done on public holydays or bigger holidays such as Christmas to reduce interruption with users.

5.5.4 Preventive maintenance

Conferring to Braude and Bernstein (2016), preventive maintenance encompasses executing activities to avoid the manifestation of errors. It tends to lessen the software difficulty thereby refining program understandability and increasing software maintainability. It includes documentation updating, code optimization, and code reformation. Documentation updating comprises adjusting the documents affected by the alterations in order to match to the current state of the system. Code optimization comprises altering the programs for quicker execution or efficient use of storage space. This can be done every time when the system has been modified to keep up with any system updates.

5.5.5 Software backup

Nelson (2011) emphasized that data is the most vital part of computer systems. An operating system can be reinstalled and so can applications, but it may not be easy or it may be impossible to reinvent the original data.

Therefore, it is crucial that back up of vital information is frequently done and to have a plan for recovering from a system failure. A hacker or virus could crash a computer's operating system or data may be corrupted or deleted by a hardware problem. Computers can be lost, stolen, or destroyed in a fire or other disaster.

Crucial work data should be backed up on an even basis. This means copying files over to a protected system that can be accessed when those files are needed.

5.6 Recommendations for future/further development

The system is subject to evaluation and updates and it can be advanced to have capacity for the "WHAT IF ANALYSIS" that improves the management to come up with an uncompromised choice for future University information sharing and how it is organized within the University. Below are the recommendations for the system.

- The server should be continuously up and the internet should not be interrupted. Also, there is need for frequent database backup like every week.
- The system can be combined with the institution website to permit access from researchers and improve search engine optimization, hence adding value to it.
- In future, shifting to Java is strongly suggested as a programming language that is robust and more secure for web applications.
- More functions can also be added in future such as the use of SMS notification when a new task has been assigned to the student or to notify the work-related supervisor when the task has been completed. The same SMS notification feature may also be used to notify the academic supervisor when the assessment of the student is scheduled. Even the whole system can be migrated to an android and iOS application.
- The system can also be perfected to accommodate cases like if the student changed the company, the deferment of a student on attachment or if the student dies.

5.7 Conclusion

The functionality of the system and how it interacts with the user was clearly illustrated. The systems functionality was tested against the requirements provided. It demonstrated the appearance of the system with the use of screenshots and described the sample code used to produce the functionality and the appearance. All possible changeover strategies have been given and all maintenance approaches to improve the system in future, to adapt to new technology changes and functions.

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Appendices

Appendix A: User manual

Introduction

The user manual is created to simplify the navigation or use of the system by users, so it was prepared to provide guidance to the user in the absence of the helpdesk on how to operate the system. This manual has been designed to assist you getting started with this amazing new era of technology. The goal being that, users will find this user manual helpful in operating the system.

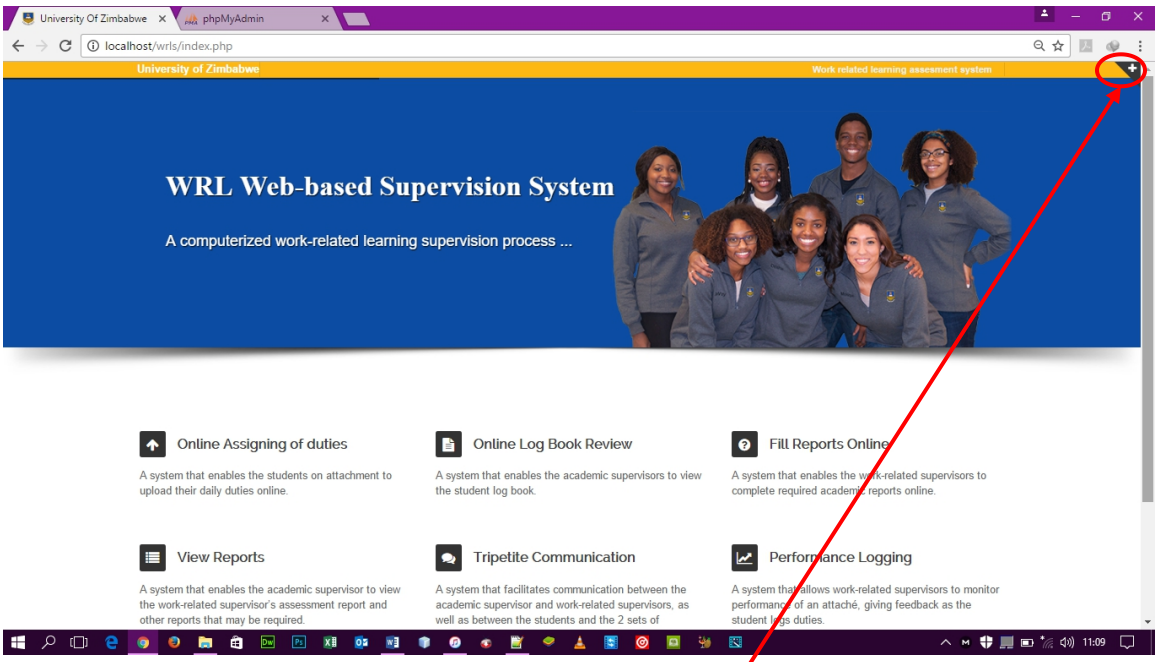
About the system

The system was constructed using HTML5, JavaScript and PHP as the programming language and MySQL being the system database from (XAMPP Server) although importing to other database engines is possible. The system comprises of the following modules;

- Student module.
- Work Supervisor module.
- Academic Supervisor module
- System administrator module

Getting started

The University of Zimbabwe Industrial Attachment Web-based Supervision system is accessed by entering the website: www.localhost/uz_wrls on any web browser. The login page will be shown as below.

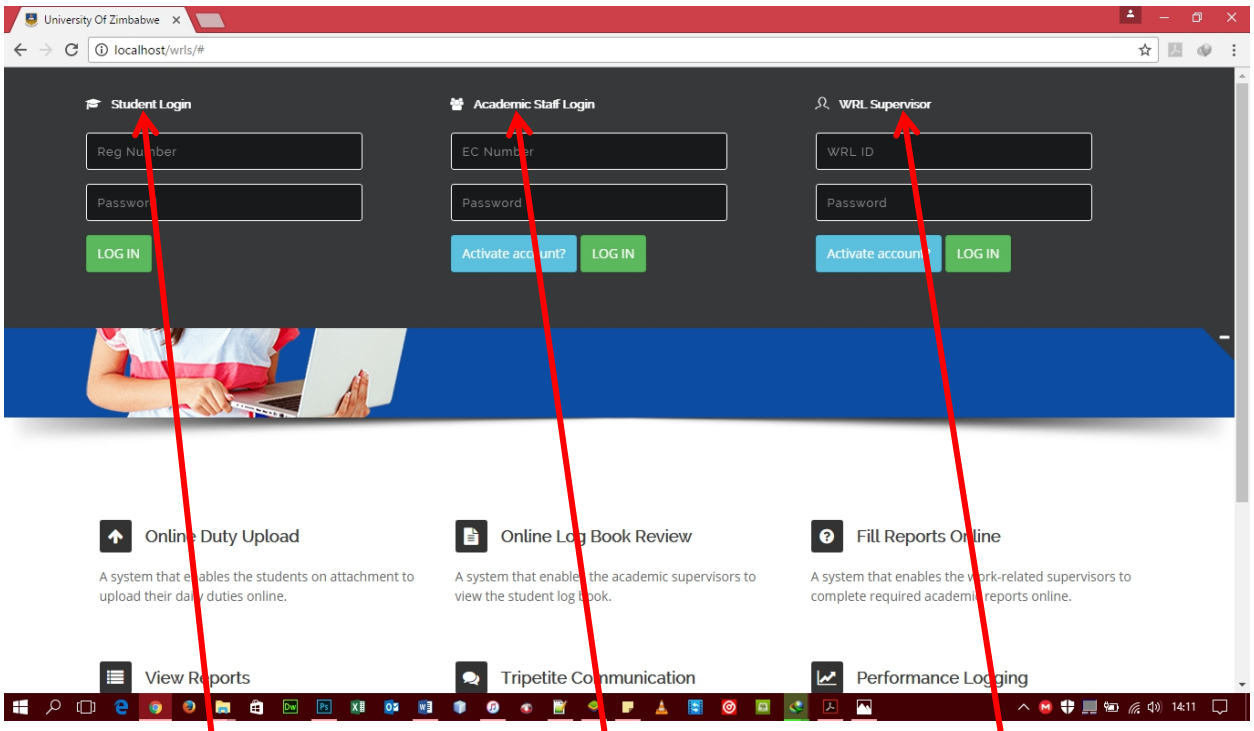


Upon clicking this white plus (+) button a login page will drop.

Figure A1: Getting started

User Login

The system comprises of four users who are the student, work supervisor, academic supervisor and the system administrator. This is the entry point for users to have access to the system. The system comes with username and password in order for a user to get entry into the system. The user must enter valid details to login successfully.



This is where students can enter their login credentials, that is reg number and password

This is the entry point for academic supervisors that is where they can login. Also, system administrator can login here.

This is where work supervisors can enter their login credentials

Figure A2: User login

Administrator homepage

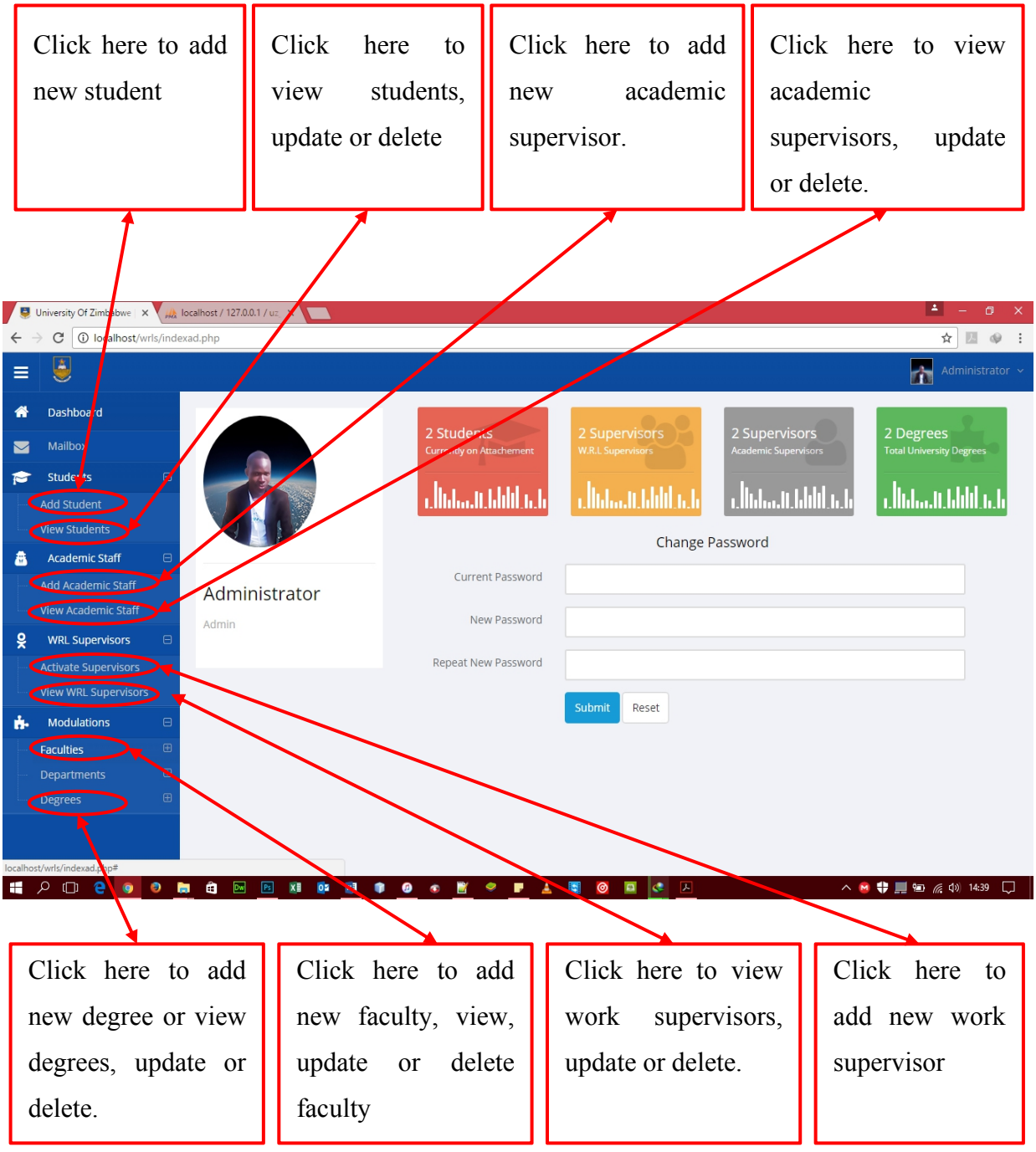


Figure A3: Administrator homepage

Student homepage

After a successful login, students will be redirected to the following homepage where they can navigate to different commands as shown below.

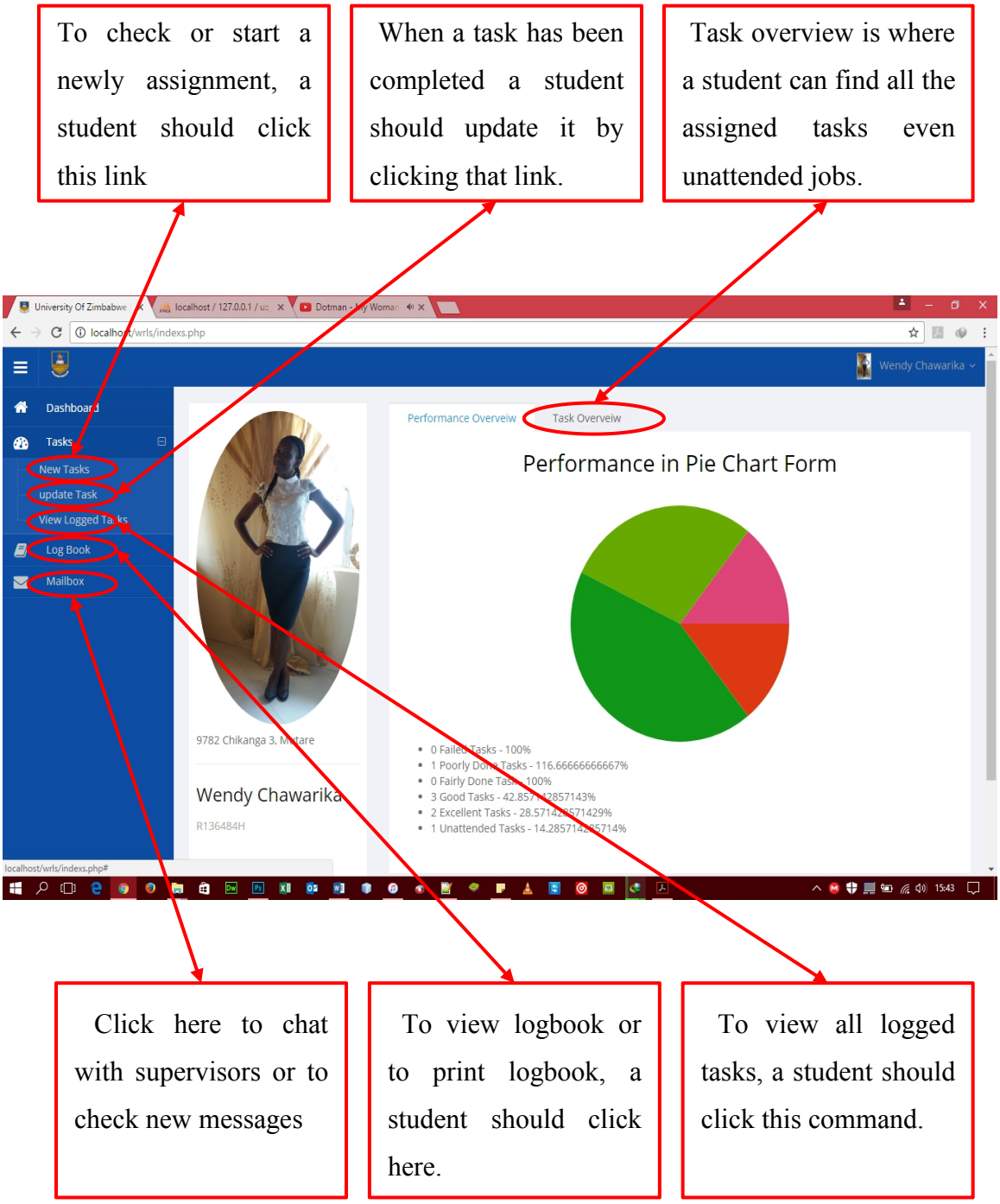


Figure A4: Student homepage

Starting a new task (Students only)

This is what a student should do when a new task has been successfully assigned by a work supervisor.

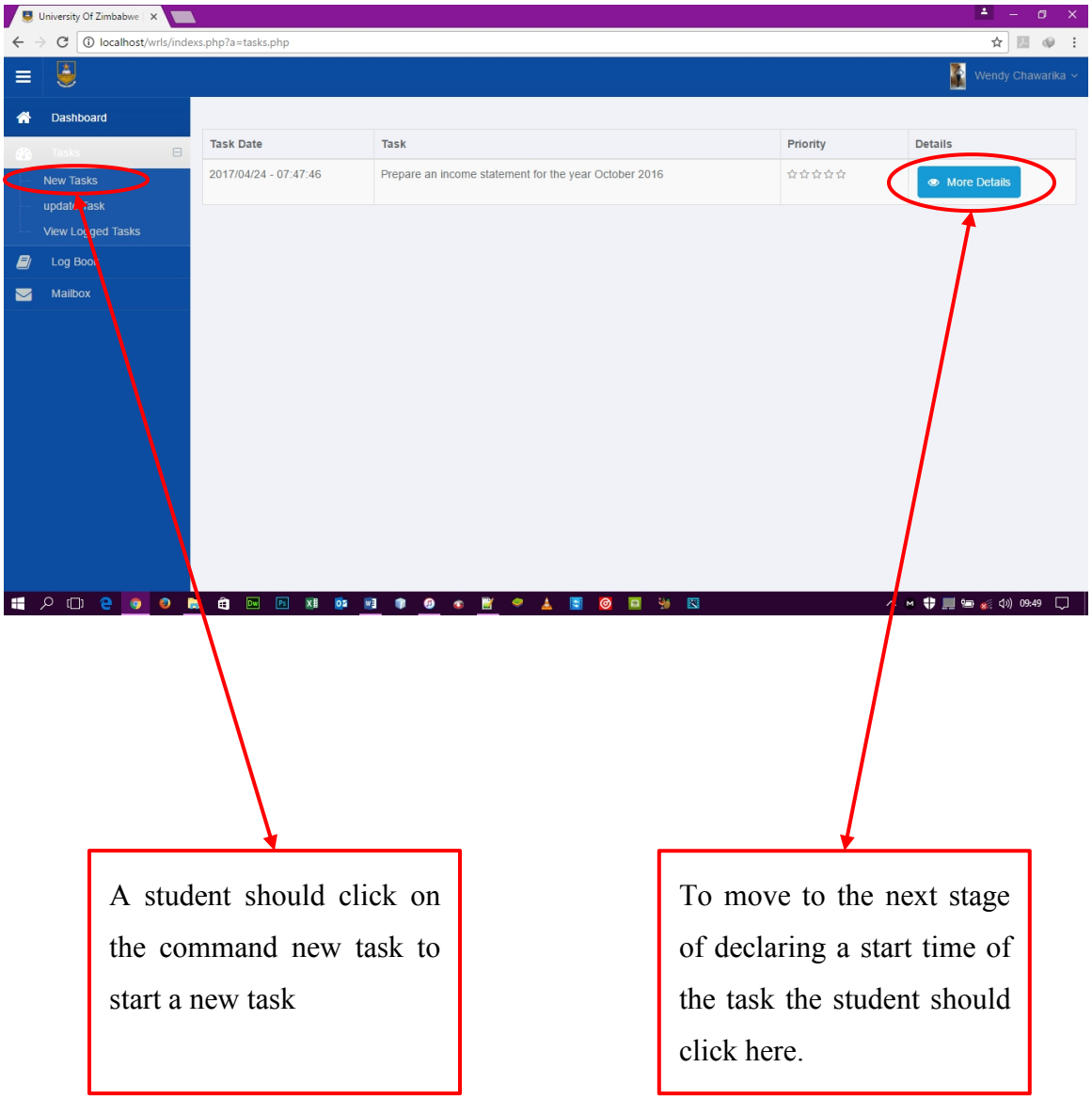


Figure A5: Starting a new task (Students only)

To declare a new task, start time (Students only)

This is what the page will look like after a student have clicked the more details button.

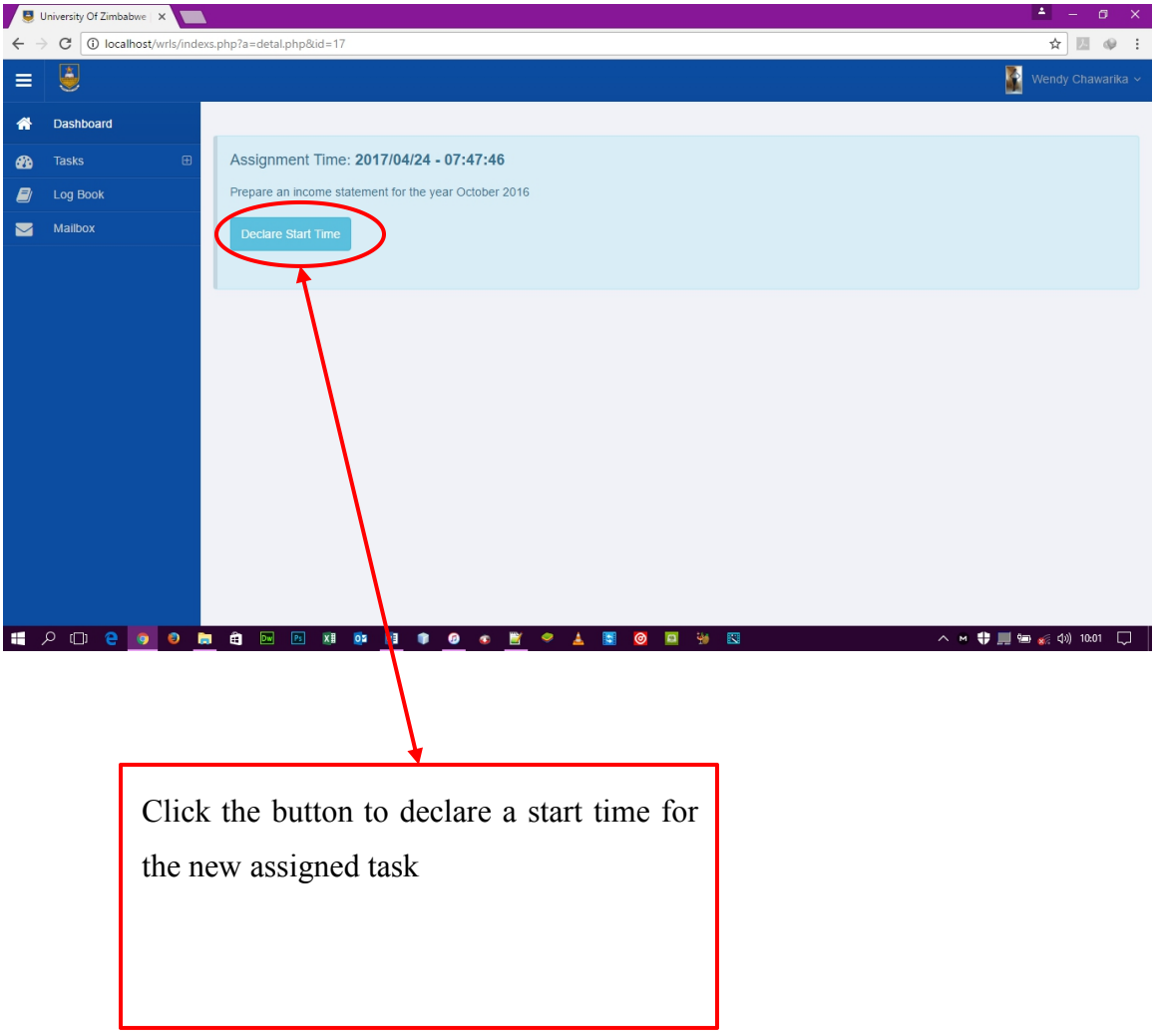


Figure A6: To declare a new task, start time (Students only)

Updating a task (Students only)

When the task has been completed this is what a student should do.

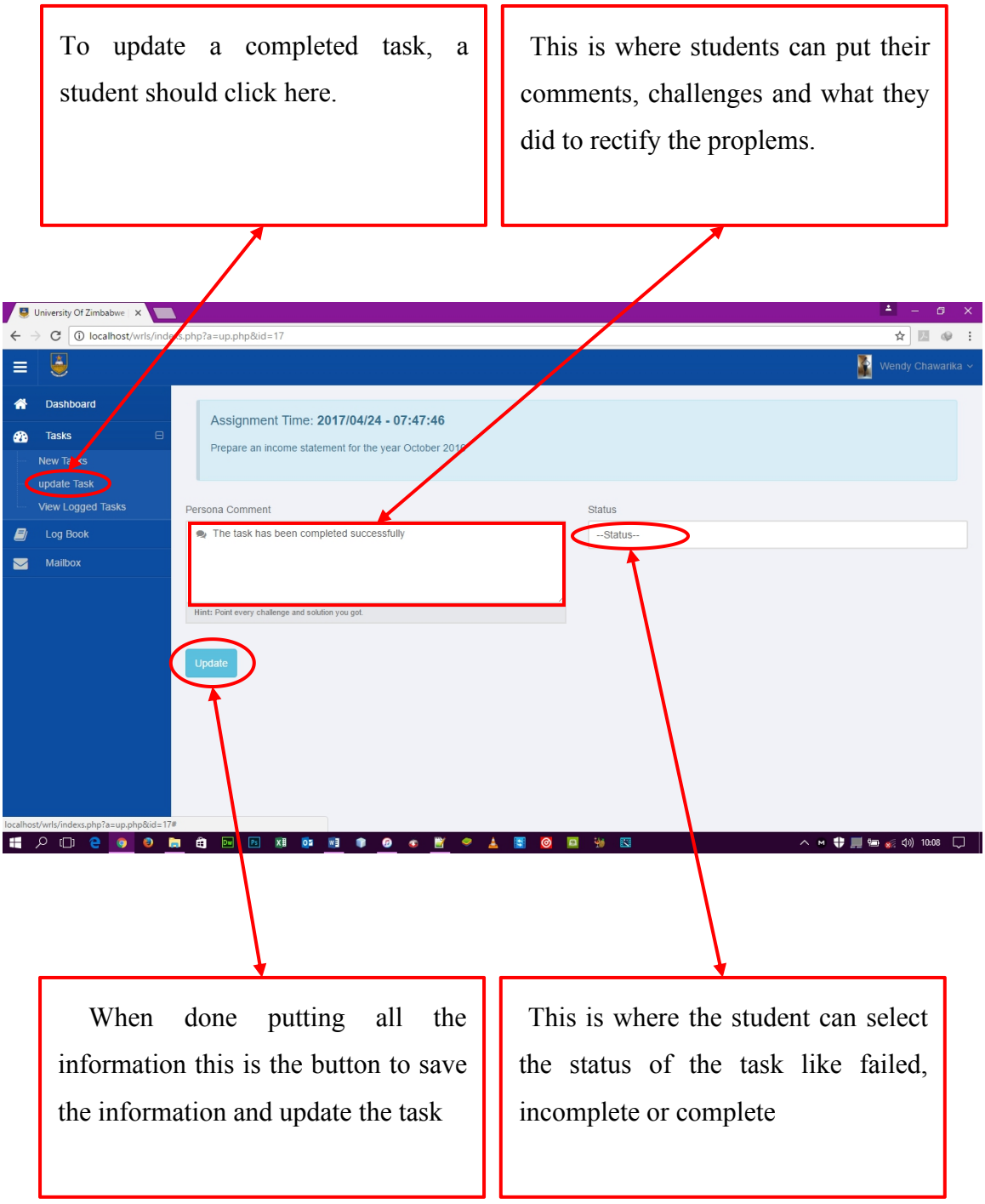


Figure A7: Updating a task (Students only)

Work supervisor's homepage.

After successfully login, a work supervisor will be redirected to this page where he/she can navigate to different functions.

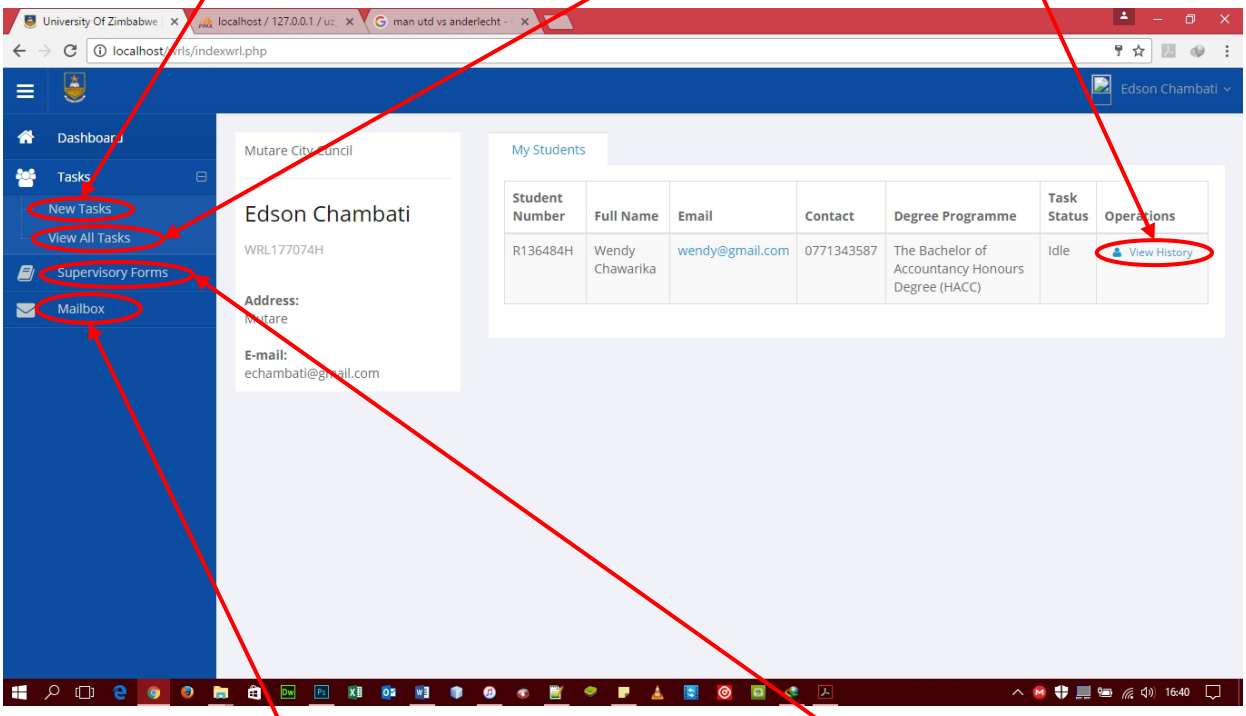


Figure A8: Work supervisor's homepage.

Assigning of a task (Work supervisors only)

Here is how a work-related supervisor can create and assign a task to a student, show on the screenshot below.

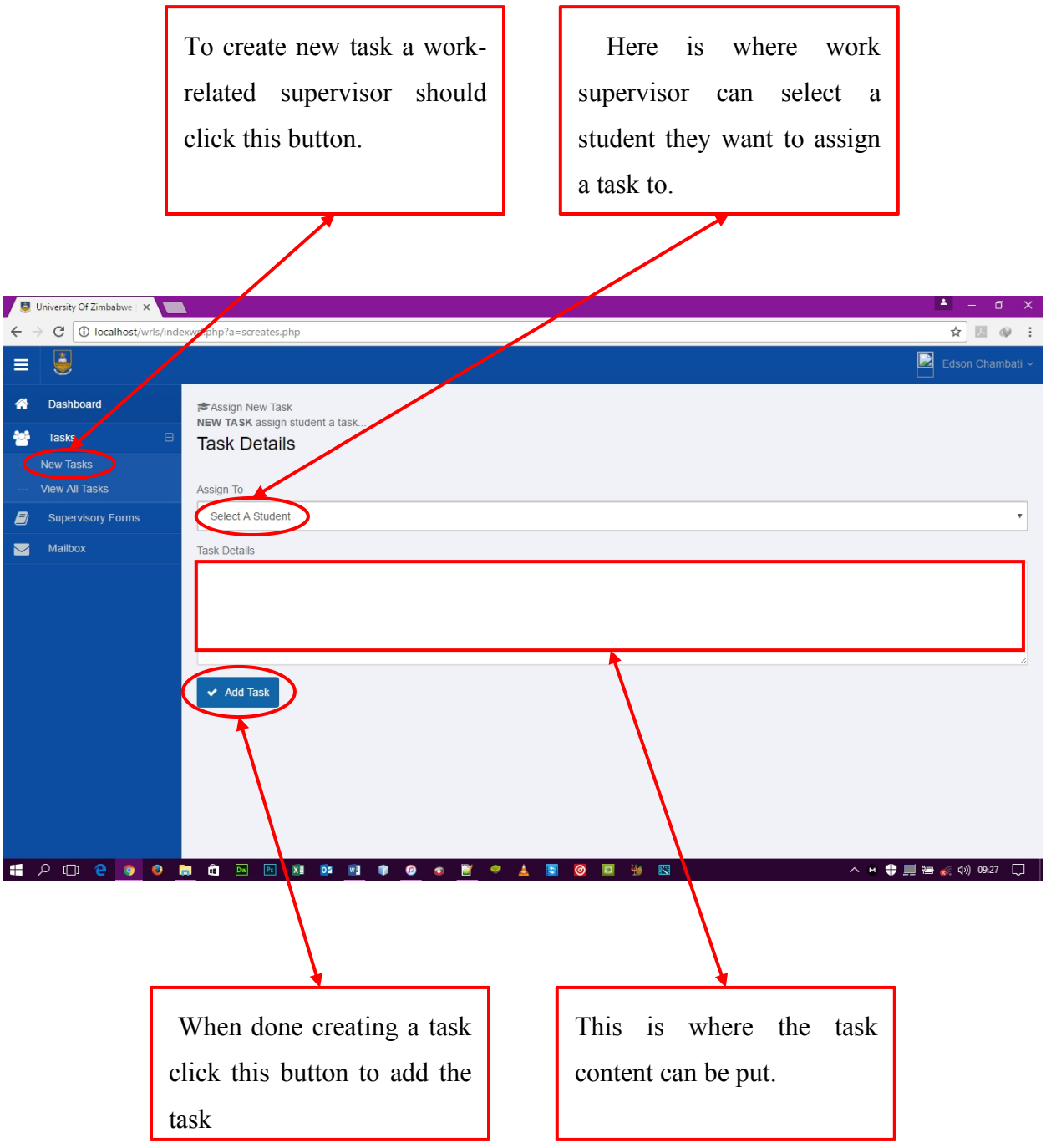


Figure A9: Assigning of a task (Work supervisors only)

How to comment completed tasks (Work supervisors only)

When the student has completed the assigned task, it is now a work-related supervisor's duty to put a comment and rank the performance of the student. Upon clicking the view all tasks the following page will appear.

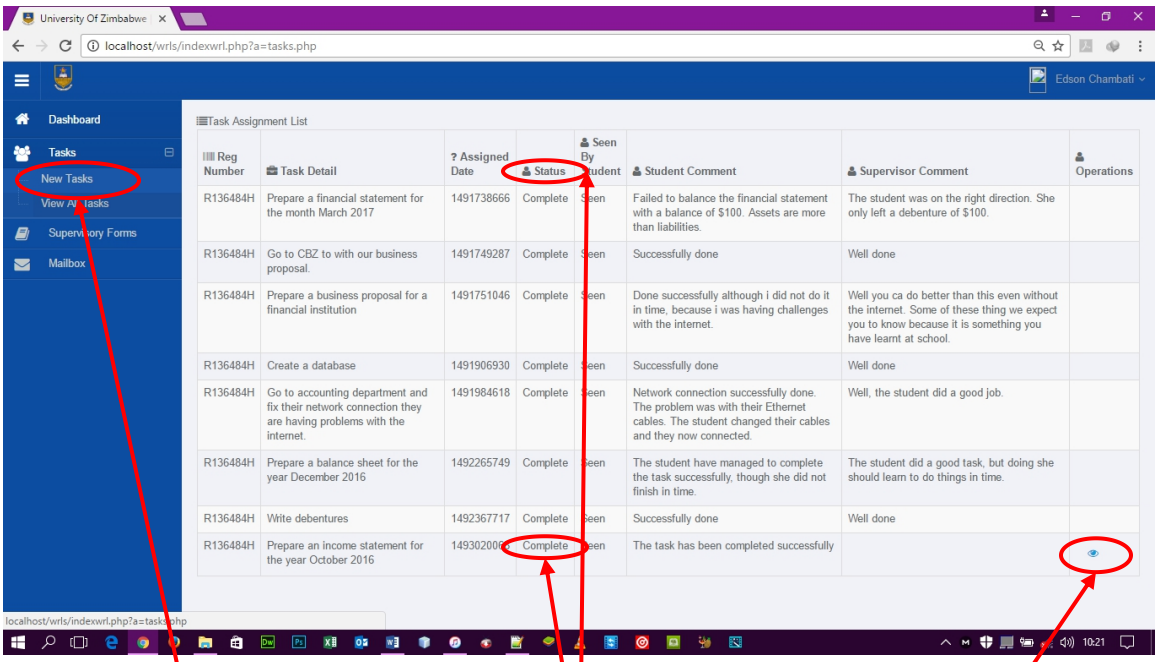
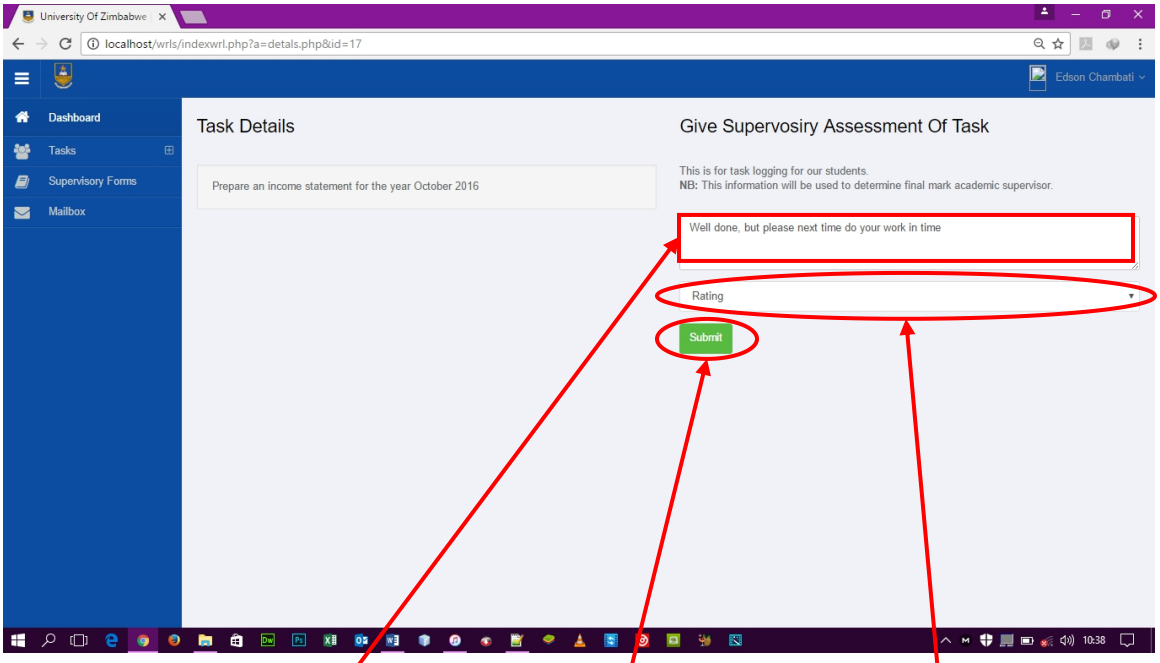


Figure A10: How to comment completed tasks (Work supervisors only)

Putting a comment (Work supervisors only)

Upon clicking an operation icon that looks like an eye the following page will appear.



This is where a work supervisor should put a comment.	When done commenting, this is the button to save.	This is where a supervisor can select a rating command from the predefined commands which are failed, poorly done, fairly done, good and

Figure A11: Putting a comment (Work supervisors only)

Academic supervisor's homepage

After successfully login, an academic supervisor will be redirected to the below page where he/she can navigate through to different functions.

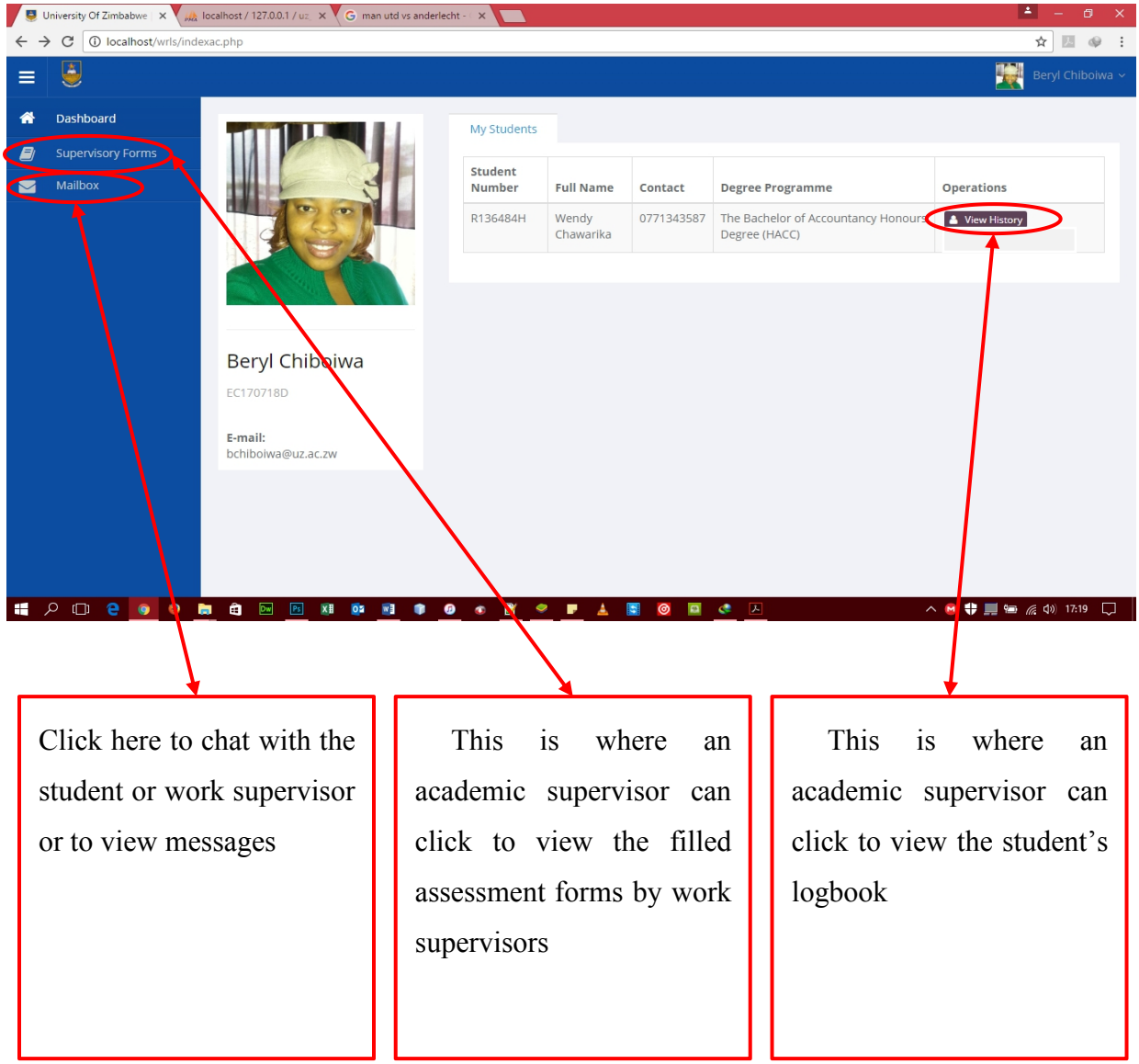
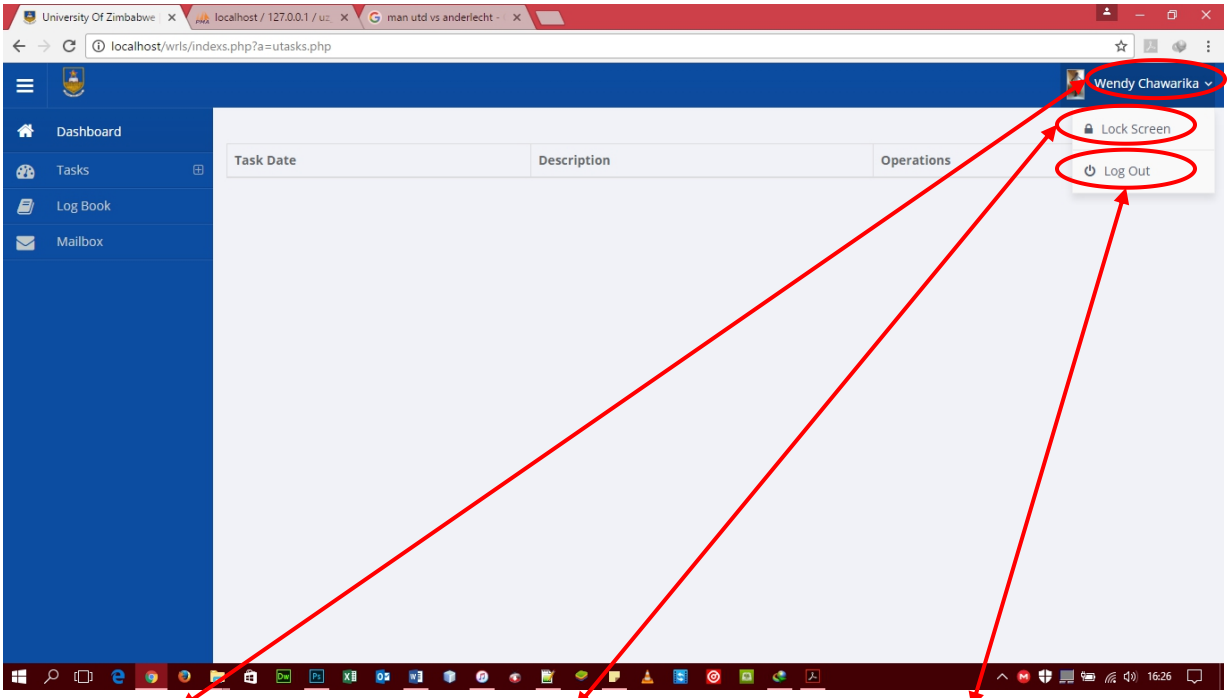


Figure A12: Academic supervisor's homepage

Logout

When the user has completed what he/she been doing on the system it is always recommended to logout. This screenshot shows where a user can find the logout button.



The logout button is on the top-right of every page, where the is user's name. Upon clicking the button a drop down will

This will appear after clicking the username, and a user can just click this button to lock the account and no one can login back without going to the login

This is where a user can click to safely logout from the system.

Figure A13: Logout

Appendix B1: Letter of consent to conduct research

03 October 2016

Dear Participant

My name is Abraham Mahoko and I am a student at Midlands State University. I am developing a system called University of Zimbabwe Industrial Attachment Web-based Supervision System for my final project. This is a platform where industrial attachment activities can be logged online. Students on attachment will be registered on the platform for them to be able to upload their log books and work-related supervisors will be able to view the log books as well as assessing the performance of the students. Also, academic supervisor will be able to view and or print the student logbooks as well as assessment forms from work-related supervisors.

I am inviting you to participate in this research study by completing the attached surveys. The following questionnaire will require approximately 72 hours completing. There is no compensation for responding nor is there any known risk. In order to ensure that all information will remain confidential, please do not put your personal details including your name. If you choose to participate in this project, please answer all questions as honestly as possible and return the completed questionnaires promptly. Participation is strictly voluntary and you may refuse to participate at any time.

Thank you for taking the time to assist me in my educational endeavours. The information from this study will be used for academic purposes only

Sincerely,

Abraham Mahoko

+263 77 442 6014

Appendix B2: Questionnaire

(Please answer the following questions by checking one box.)

1. How likely is it that you would recommend this institution to continue using this manual system?

Not at all likely Extremely likely

1	2	3	4	5	6	7	8	9	10
☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

2. Overall, how satisfied or dissatisfied are you with the current system of industrial attachment assessment?

- ☐ Very satisfied
- ☐ Somewhat satisfied
- ☐ Neither satisfied nor dissatisfied
- ☐ Somewhat dissatisfied
- ☐ Very dissatisfied

3. Which of the following words would you use to describe the current system? (**Select all apply).**

- ☐ Reliable
- ☐ Useful
- ☐ Effective
- ☐ Impractical
- ☐ Ineffective

4. How well does this system meet your requirements?

- ☐ Extremely well
- ☐ Very well
- ☐ Somewhat well
- ☐ Not so well

5. How would you rate the quality of the system?

- ☐ Excellent
- ☐ Above average
- ☐ Average
- ☐ Below average
- ☐

Poor

(Please answer the following questions in the space provided)

6. List 5 challenges you are having with the current system, if there is any.
   i. _____
   ii. _____
   iii. _____
   iv. _____
   v. _____
7. Do you think a web assessment system is ideal for the institution like UZ?
   ☐ Yes ☐ No

   Comment: _____
   _____
   _____

8. If the system is to be improved, what might be your suggestions and or requirements?
   _____
   _____
   _____

9. If the system is to be changed completely, what might be your suggestions and or requirements?
   _____
   _____
   _____
   _____

10. Do you have any other comments or concerns?
    _____
    _____
    _____

Appendix C: Interview checklist

The following is an extract of the questions that were asked during the interviews conducted during data gathering activity.

Lecturers

1. Can you give your view on the way Industrial attachment is currently being done?
2. Briefly explain how your current industrial learning assessment system works?
3. How long have you been using the current system?
4. Does the current system meet your organizational needs?
5. Are there any weaknesses that you can highlight on the current system?
6. Do you have any suggestions you think can help to improve the current system?
7. Do you feel comfortable to change the system completely to a computerized one, or do you want to improve the manual system?
8. Do you think all staff members are going to accept the change of the manual system to a computerized system?

Students

1. Have you ever thought of computerizing every system that is being used at the University of Zimbabwe? Tell us your opinion.
2. Do you think its proper to have an online industrial attachment supervision system, why?
3. How do you take the idea of computerization as a way of migrating from the current problems?
4. Have you ever talked with your colleagues about problems that are being brought by the current manual system?

Appendix D: Focus groups checklist

The following is an extract of the questions that were asked during the focus groups conducted in the process of data gathering activity.

Lecturers

1. Can you give your view on the way Industrial attachment is currently being done?
2. Have you ever experienced any inconveniencing problems with the current manual system?
3. Do you have any suggestions on how we can solve the problems being experienced?
4. Do you enjoy working with the current manual system and if so what are its strengths?
5. Do you think computerization is an option and why do you think so?
6. Are you computer literate? To what level?
7. What tasks do you think the computer system will do that challenge human effort?
8. What tasks do you think are best kept manual?

Students

1. Have you ever thought of computerizing every system that is being used at the University of Zimbabwe? Tell us your opinion.
2. Do you think its proper to have an online industrial attachment supervision system, why?
3. How do you take the idea of computerization as a way of migrating from the current problems?
4. Have you ever talked with your colleagues about problems that are being brought by the current manual system?

Appendix E: Snippet of code

```
<? php
error_reporting(0);
include "config.php";
session_start();
if(isset($_POST['stlogin'])) {
        $username = $_POST["reg"];
        $password = $_POST["spassword"];
        $result ="";
    $query = "SELECT * from student where reg='$username' AND password = '$password'";
        $result = mysqli_query($dbc, $query);
        $row = mysqli_num_rows($result);
        $rows=mysqli_fetch_array($result);
        $access=$rows['level'];
        $id=$rows['id'];
        $state=$rows['state'];
        $assigned=$rows['assigned'];
        $zita =$rows['name']." ".$rows['surname'];
        $localIP = gethostbyname(trim(exec("hostname")));
        $os = $_SERVER['HTTP_USER_AGENT'];
        $numbers="0987654321";
```

```
$length= 8;
If (!$result)     {
                    die ( "\n\ncould'nt send the query because".mysqli_error());
                    exit;
                }
            else     {
if($row==1 )          {
                $_SESSION['avatar']="../".$rows['script'];
                    $_SESSION['username'] = $username;
                    $_SESSION['level']=$rows['level'];
                    $_SESSION['userid']=$rows['id'];
                    $_SESSION['usertype']="student";
                    $_SESSION['name']=$rows['name']." ".$rows['surname'];
                    $sessionid ="h";
                    for($p=0; $p < $length; $p++){
                    $sessionid .= $numbers[mt_rand( 0 , strlen($numbers))];
                        }
                    $_SESSION['sessionid']=$sessionid;
mysqli_query($dbc, "INSERT INTO `user_log`( `username`, `login_date`, `session_id`, `machine_ip`, `OS`)
                    VALUES ('$username',NOW(),'$sessionid','$localIP','$os')")
or die (mysqli_error($dbc));
                if($assigned==0){
```

```
        echo "<SCRIPT LANGUAGE='JavaScript'>window.alert('Login Successful. Welcome: ".$zita." Please Activate your account.');window.location='activate.php?id=".$id."';</SCRIPT>";
                                        exit;
                                }
                                elseif($assigned==1){
echo "<SCRIPT LANGUAGE='JavaScript'>window.alert('Login Successful. Welcome: ".$zita." Please Activate your account.');window.location='inprocess.php?id=".$id."';</SCRIPT>";
                                        exit;
                                }
                                else {
echo "<SCRIPT LANGUAGE='JavaScript'>window.alert('Login Successful. Welcome: ".$zita."');window.location='indexs.php';</SCRIPT>";
                                        exit;
                                }
                        }
if($row!=1) {
        echo "<script type='text/javascript'>alert('Invalid username and password!');</script> ";
                                        echo "<script> window.location='index.php';</script>";
                                        exit;
                                }
                        }
                }
if(isset($_POST['slogin'])){
```

```
$username = $_POST["username"];
$password = $_POST["password"];
$result ="";
$query = "SELECT * from users where ecnum='$username' AND password = '$password'";
$result = mysqli_query($dbc, $query);
$row = mysqli_num_rows($result);
$rows=mysqli_fetch_array($result);
$access=$rows['access'];
$state=$rows['state'];
$zita =$rows['name']." ".$rows['surname'];
$localIP = gethostbyname(trim(exec("hostname")));
$os = $_SERVER['HTTP_USER_AGENT'];
$numbers="0987654321";
$length= 8;
if(!$result)    {
die( "\n\ncould'nt send the query because".mysqli_error());
exit;
}
else    {
if($row==1 && $access== '0'){
$_SESSION['avatar']="../".$rows['script'];
$_SESSION['username'] = $username;
```

```
                    $_SESSION['user_type']=$rows['access'];
                    $_SESSION['usertype']="admin";
                    $_SESSION['userid']=$rows['id'];
                    $_SESSION['name']=$rows['name']." ".$rows['surname'];
                    $sessionid ="h";
                    for($p=0; $p < $length; $p++){
                    $sessionid .= $numbers[mt_rand( 0 , strlen($numbers))];
                        }
                    $_SESSION['sessionid']=$sessionid;
mysqli_query($dbc, "INSERT INTO `user_log`( `username`, `login_date`, `session_id`, `machine_ip`, `OS`)
                    VALUES ('$username',NOW(),'$sessionid','$localIP','$os')")
or die (mysqli_error($dbc));
echo "<SCRIPT LANGUAGE='JavaScript'>window.location='indexad.php';window.alert('Login Successful.  Welcome: ".$zita."');</SCRIPT>";
                    exit;
                }
if($row==1 && $access== '1' && $state=='1'){
                    $_SESSION['avatar']="../".$rows['script'];
                    $_SESSION['username'] = $username;
                    $_SESSION['user_type']=$rows['access'];
                    $_SESSION['usertype']="chairperson";
                    $_SESSION['userid']=$rows['id'];
```

```
                                        $_SESSION['name']=$rows['name']." ".$rows['surname'];
                                        $sessionid ="h";
                                        for($p=0; $p < $length; $p++){
                                        $sessionid .= $numbers[mt_rand( 0 , strlen($numbers))];
                                                }
                                        $_SESSION['sessionid']=$sessionid;
mysqli_query($dbc, "INSERT INTO `user_log`( `username`, `login_date`, `session_id`, `machine_ip`, `OS`)
                                        VALUES ('$username',NOW(),'$sessionid','$localIP','$os')")
or die (mysqli_error($dbc));
        echo "<SCRIPT LANGUAGE='JavaScript'>window.alert('Login Successful. Welcome: ".$zita."');window.location='indexac.php';</SCRIPT>";
                                        exit;
                                }
if($row!=1)     {
        echo "<script type='text/javascript'>alert('Invalid username and password!');</script> ";
                                        echo "<script> window.location='index.php';</script>";
                                        exit;
                                }
                        }
}
if(isset($_POST['wrllogin'])){
                $username = $_POST["wrlreg"];
```

```
$password = $_POST["wrlpassword"];
$result ="";
$query = "SELECT * from wrl_supervisors where wrl_id='$username' AND password = '$password' and activated='1'";
$result = mysqli_query($dbc, $query);
$row = mysqli_num_rows($result);
$rows=mysqli_fetch_array($result);
$id=$rows['id'];
$zita =$rows['name']." ".$rows['surname'];
$localIP = gethostbyname(trim(exec("hostname")));
$os = $_SERVER['HTTP_USER_AGENT'];
$numbers="0987654321";
$length= 8;
if(!$result){
    die( "\n\ncould'nt send the query because".mysqli_error());
        exit;
    }
    else{
if($row==1 ){
        $_SESSION['username'] = $username;
        $_SESSION['level']='7';
        $_SESSION['userid']=$rows['id'];
        $_SESSION['usertype']="wrl";
```

```
                                    $_SESSION['name']=$rows['name']." ".$rows['surname'];
                                    $sessionid ="";
                                    for($p=0; $p < $length; $p++){
                                    $sessionid .= $numbers[mt_rand( 0 , strlen($numbers))];
                                        }
                                    $_SESSION['sessionid']=$sessionid;
                                    mysqli_query($dbc, "INSERT INTO
`user_log`( `username`, `login_date`, `session_id`, `machine_ip`, `OS`)
                                    VALUES ('$username',NOW(),'$sessionid','$localIP','$os')")
or die (mysqli_error($dbc));
echo "<SCRIPT LANGUAGE = 'JavaScript' > window.location = 'indexwrl.php'; window.alert
('Login Successful.  Welcome: ".$zita."');</SCRIPT>";
                                    exit;
                                }
if($row!=1){
echo "<SCRIPT LANGUAGE='JavaScript'>window.location='index.php';window.alert('Invalid
username and password!');</SCRIPT>";
                                    exit;
                                }
                            }
        }
?>
```