

**Zimbabwe School Examinations Council Online
Mark Capturing and Grading System**



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Mark Capturing and Grading System**



By

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ABSTRACT

The first chapter gives a summary of the ZIMSEC as an organisation, when it was formed and its relevant operations. The objectives that led to the research are also crafted in this chapter together with the justification for the study. Different types of feasibility were carried out to ascertain whether it was viable to continue with the system development and an analysis was done for all types of risks that might be encountered. The analysis phase focused on fact finding and different methodologies such as observations and interviews were used to gather information about how the current system was operating and what the users expected. Data flow diagrams for the current system showing how data flowed between different entities were also crafted and functional and non-functional requirements were discussed. After gathering facts about the old system and its weaknesses, the design for the new system was laid out that is physically and logically. Different output and input forms for the system were drafted to make the user have a clear picture on how the new system and its interfaces will be displayed. The implementation as the final phase illustrated different testing strategies conducted before the system was deployed to users. Training sessions timetable was drafted and various types of maintenance discussed together with the recommendations for maintenance and to stakeholders of the system training was carried out at ZIMSEC and the internal employees were given hands on experience with the system. Maintenance schedules were put in place after user training. Recommendations were also documented for further or future developments and this then will give an opportunity and ideas to the organisation in the future to improve the system

DECLARATION

I, **NANCY V MHUTE** hereby declare that I am the sole author of this dissertation. I authorise the **Midlands State University** to lend this dissertation to other institutions or individuals for the purpose of scholarly research.

Signature:..... Date:

APPROVAL

This dissertation entitled “Zimbabwe School Examinations Council, Online Mark Capturing and Grading System” by **Nancy Mhute** meets the regulations governing the award of the degree of **BSc Honours Information Systems** by Midlands State University, and is approved for its contribution to knowledge and literary presentation.

Supervisor’s Signature:

Date:

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I would also like to thank the Zimbabwe School Examinations Council and all staff members at the Information Systems Department for their moral and financial support. Special thanks goes to the Acting Assistant Director Information services, Mrs C Chinonzo I cannot imagine where I would be without your support.

DEDICATION

To my husband Zenzo for your continuous support and patience throughout the course of this research. Your devotion has made me sail through I couldn't have made it without you. To my family, your support from the very beginning is realised in these pages.

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LIST OF ACRONYMS

| | |
|-------------|--|
| NPV..... | Net Present Value |
| ROI | Return On Investment |
| ZIMSEC..... | Zimbabwe School Examinations Council |
| NARC..... | National Academic Recognition Centre |
| EAD..... | The Examinations Administration Department |
| SQL | Structured Query Language |
| ECZ..... | Examination Council of Zambia |
| HEXCO..... | Higher Education Examinations Council |
| OMR..... | Optical Mark Reader |
| DRS..... | Data Resolution Services |
| UML..... | Unified Modelling Language |

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CHAPTER 1: INTRODUCTION

1.1 Introduction

The need to get the candidate's examination mark into the database efficiently and effectively drove this research to focus on the study of the mark capturing and grading system at Zimbabwe School Examinations Council ZIMSEC. The examination system commences at the registration stage where candidates writing their examinations register and they get their entry details. In Zimbabwe, ZIMSEC is the main body offering examinations in the country with Cambridge taking a lead in the few established private schools in the country. It has become unaffordable to many due to the foreign currency crisis. ZIMSEC offers two examinations sessions June and November and the results obtained cannot be combined into one certificate. The mark capturing and grading system aims at getting the correct candidate mark into the database and grading it efficiently so that students obtain their true results without any alterations hence the purpose of this study.

1.2 Background of the study

Cambridge Assessment is Europe's leading assessment agency liable for the administration of a huge number of examinations in its home town and internationally. The assessment board also conducts examinations at selected centers in African countries. After the marking of candidate's scripts, the examiners capture the marks onto a temporary text file created and this can be a spreadsheet or a word document. The marks are first captured here to create room for checks and balances then they are loaded into the main database for grading. The text file contains the candidate's name, surname candidate number and the marks obtained in the examinations.

In Zambia there is the Examinations Administration Department which carries out the examination administration tasks for the Council. These cover examination centres registration, and candidate registration. Examinations are set, question papers moderated and lastly examination material are printed and dispatched. The finishing processes include marking of scripts, mark capturing, release of results to centres and issuing certificates. Before 2009 the Council used OMR- mark sheets to capture candidate examination marks and these were scanned before data was loaded by IT department. A new system was then introduced in the year 2009 at grade twelve and the system did the mark capturing process electronically. The system is running under the pilot changeover method (pindula.inc, 2015).

At the Zimbabwe School Examinations Council, candidate's marks are shaded on a mark sheet by examiners at the marking venues after the marking process and these marks are later scanned by examination administration officers into the database at ZIMSEC head office. This procedure has several challenges as it is cumbersome and time consuming. After marking a considerable number of scripts, the examiners then enter the candidates' mark on the mark sheet by shading the figures which correspond to the mark obtained. The marks are loaded into the marks database by scanning using the Optical mark reader scanners supplied by Data Resolution Services (zimsec.inc, 2010).

1.2.1 Background of the Organisation

This ascertains the history and nature of a well-defined organisation with reference to its current literature (libguides.inc, 2016). ZIMSEC is a parastatal which operates under the ministry of Primary and Secondary Education. Its responsibility is to administer primary and secondary examinations in schools and the syllabuses were assessed by the National Academic Recognition Centre (NARC) in the United Kingdom. The syllabuses were rated and found to be equivalent to the General Certificate of Education Standard offered in countries like the United Kingdom, Australia, New Zealand, United States of America and the other English-speaking countries. Qualifications offered by the council are recognised internationally (zimsec.inc, 2010). During the year 1983, a decision was made by the cabinet concerning localisation of advanced and ordinary Level examinations. Markers were trained and the first batch received training during the year 1984. November 1990 saw the first localised Ordinary level examination being written. The Zimbabwe School Examinations Council Act, was passed by parliament in 1994 and ZIMSEC operates under this act.

1.2.2 ORGANISATIONAL STRUCTURE

According to Borrington (2013), an organisational structure defines how tasks such as duty allocation, coordination and supervision, are directed towards an organisation's individual aims. The main goal is to arrange staff and jobs to ensure efficiency in meeting organizational goals and objectives. Also known as an organogram, the chart demonstrates relations between people in an organisation and these might include managers to sub-workers directors to managing director's chief executive officer to various departments. Organisational charts have multiple uses and can be demonstrated in various ways. They can be used for planning purposes by top level management, or as a personal directory.

According to Meyer (2017), organisational structures are found in various types which include functional top-down, divisional structure, matrix and flat organizational chart.

1.2.2.1 Functional Top-down hierarchy

Mintzberg (2012) defines the top- down hierarchy as a traditional business structure which illustrates the executive or top management first, senior management, middle management up to the last or lowest level. This structure accommodates partitioning into traditional departments which can be Information Technology, Marketing, Finance and Human resources and it is centered on a person's practical role within the organisation. Employees who possess identical skill-sets and specialisation are grouped together in the functional top down hierarchy. The functional structure has an advantage that individuals are devoted to a single function, roles are defined which limits misunderstandings. The only shortfall it has is the difficulty in facilitating effective communication between different departments

1.2.2.2 Divisional Organisational Chart

Defining from the name, this type of organisational chart mirrors a company structured along a product line or a specific geography. This set up is ideal for an organisation with one division which is adequately independent from another.

Greater flexibility is given to a huge organisation with several sections or divisions. It permits each division to operate on its own therefore making decisions will be quicker rather than having all agendas approved at very top levels. The problem or shortfall brought by this structure is that when focus is put on divisions, employees working in the same function in different divisions may not communicate together effectively to meet organisational goals (Gould ,2014).

1.2.2.3 Matrix Organisational Structure

The matrix structure groups employees into teams based on different criteria which may be by projects or product led, by a project or product manager reporting to a functional manager. The structure helps in facilitating improved, more open communication and generates a flexible, work environment. Resources are transferred where they are needed without any difficulty (Bourgeois and Bourgeois,2013). However, owing to the complexity of this structure, some employees may be confused as to who they report to. Dual authority which comes with the structure may bring misunderstandings amid employees and managers

1.2.2.4 Flat Organisational Chart

Often engaged by smaller businesses, this structure illustrates limited or no levels of management amongst executives and all other personnel. Every employee has a better decision making ability. The shortfall with the structure is that employees do not get individual attention from a supervisor or manager and this makes them feel less confident about their performance. There might also be lack of one –on one mentoring and guidance on employees as they would generally receive if they reported to a manager with lesser direct reports (Mintzberg, 2012).

ZIMSEC embraced the functional top down approach where the senior level management consisting of the directorate is at the top, pursued by middle managers, low level management up to the general hand. Employees with similar skill sets are grouped together and traditional departments like Finance, Information Technology, Human resources exist within the organisation. Figure 1.1 illustrates ZIMSEC Organisational structure.

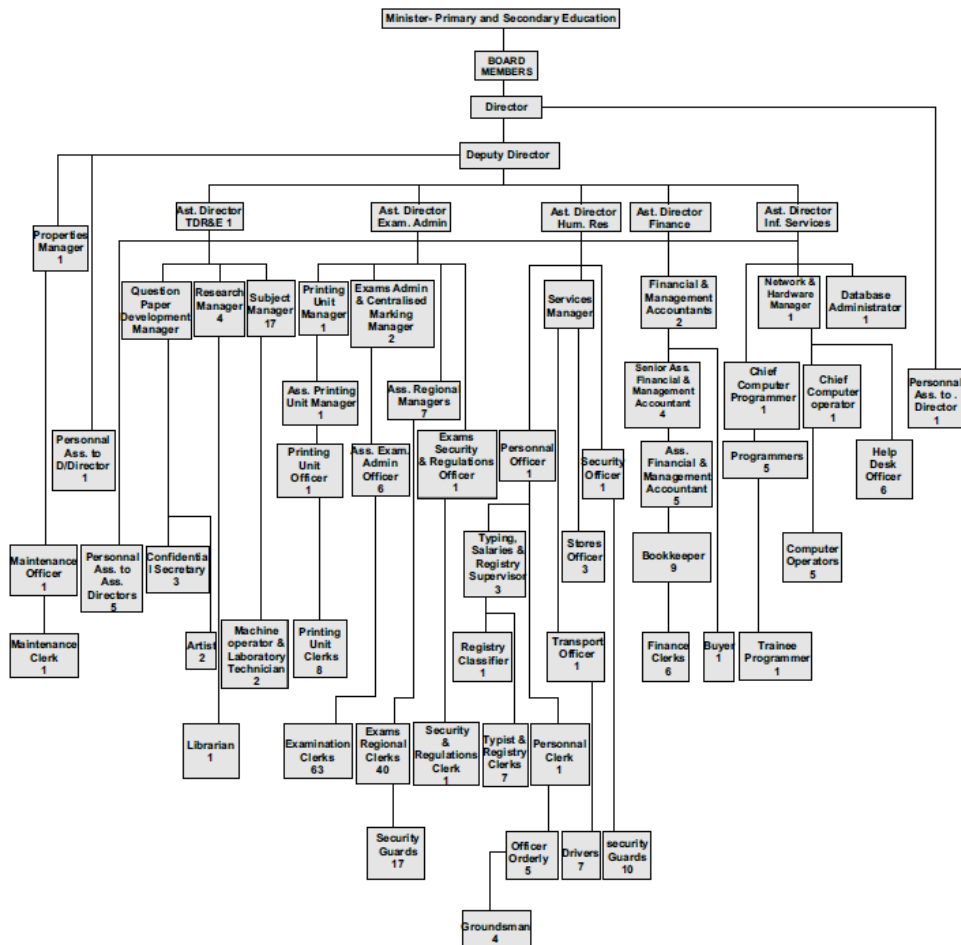


Figure 1.1 Organisational Structure

1.2.3 Vision

According to Bart (2012), a vision statement is an organisation’s long term plan which indicates what the company intends to become in the near future. Initiatives that transform the organisation are guided

by setting a clear road map for the company's growth. Vision statements hardly go through revisions during the era of a business and they are formally written and referenced in company documents.

A good vision statement should be easy to reminisce and repeat. It has to be very clear and be able to outline a major goal, limits, focused, describing where the organisation is heading rather its existing state. The vision statement should be able to absorb market or technology changes, challenging not easily met and discarded, general enough to embrace an organisation's interests and long term endeavours, inspiring and motivating to workers

1.2.3.1 The vision of the Zimbabwe School Examination Council:

To be the center of excellence within the sub-region and beyond in Quality Assessment in Education.

1.2.4 Mission Statement.

According to Abrahams (1995), this outlines what the organisation is, why it exists, and the rationale for its existence. It describes an organisation's key purpose and responds to the question why does your business exist. A mission statement defines the organisation's purpose both for the internal and external stakeholders. Mission statements differ from organisation to organisation but they depict an organisation's present potentials, customer focus, roles and business framework.

1.2.4.1 The Mission Statement for ZIMSEC

The Quality assessment of candidate's learning performance and awarding of nationally and internationally recognised certificates at different levels of the school education system, while optimally utilising the human and material resources available to ZIMSEC.

1.2.5 Core Values

Organisational values refer to the essential morals or doctrine which the business organisation will stick to in any given conditions. They reveal an organisation's ambitions for proper workplace behaviour and assist in building an optimistic culture within an organisation. They motivate the employee's best efforts and also restrain their actions.

Dubois, Jolibort and Muhlbacher (2007) define these as the traits or qualities that demonstrate an organisation's highest priorities, culture and essential driving forces. They are the core of what an

organisation and its employees stand for in the world. They are important as they attract and retain the best and most contributing employees

1.2.5.1 Core Values for ZIMSEC

Commitment

Professionalism

Integrity and Honesty

Innovation

Accountability

Security and Confidentiality

1.2.6 SIGNIFICANCE

ZIMSEC aims at offering an exceptional, ambitious, educational valuation and competitive awarding systems. The council strives to exceed expectations continuously by using the available capacity to the maximum. Quality assessment is done to warrant the quality of manpower for national development. Potential talents are identified and abilities and skills for upcoming leaders of industry, commerce and government feeds institutions of higher learning and the employment sector. Standards for levels of academic expertise of Zimbabwean nationals for use locally and internationally are set by the Council.

1.3 PROBLEM DEFINITION

Problem definition aims at bringing out the difference between the existing state and the desired state in detail (Bennatan, 1995).

During the marking exercise, ZIMSEC contracts school teachers who would have trained to mark particular subjects which they teach at their relevant schools to mark the examination scripts at selected marking venues through- out the regions or provinces in Zimbabwe. These teachers apply to mark in response to a particular advert which ZIMSEC would have put and they get invitations for training. After the training process the successful ones will be shortlisted and advised and they have now become examiners, implying that they have become contract workers for the council. These examiners manually mark candidate examination scripts following a particular marking scheme they would have agreed upon during the co-ordination process.

These marks are first written on the candidate script and after marking a handful at a particular center the examiners are given marks sheets with a list of candidates' names where they shade in pencil the candidate mark at the relevant space provided. The candidate mark is shaded to the corresponding candidate name. The shading method proves to be ineffective witnessed by the number of errors that are produced during shading. As they shade the mark sheets it is easy for instance to shade 21 instead of 12 or vice versa. Some spaces are even left blank without a mark and this might even distort every other candidate that comes underneath as they might all get wrong marks because of this omission. This can even go unnoticed and candidates get wrong marks at the end of the day and when results are given to candidates they come to ZIMSEC for re-marks in their numbers. The marks on the mark sheet are then scanned into the system so that they get into the database for grading. This scanning process is quite tiresome as it calls for scanning mark sheets for every candidate and subject at a given school. There is also an issue of too much form handling as these marks come from the relevant marking venues in their numbers they are offloaded at the ZIMSEC head office for scanning by officials in the relevant section or department. When the marks are in the database they are deemed correct and no other processes take place to make sure that a particular candidate obtained their actual mark on the script the marks in the database and those on the script are never checked for consistency which is a very big loophole in the examination process. A few cases where examiners suspect malpractice are noted.

1.4 Aim of the Research

Designing a computerised mark capturing database system that will permit examiners to directly punch candidates' marks into the system after marking is the main aim of this research. This will eliminate the shading and scanning process. The first examiner will capture the marks then exchange with another examiner in the same team who will now act as a checker (examiner) and punches in the same marks again. An error message will be displayed where there is inconsistency (that is where the first mark entered by the first examiner does not match the one entered by the checker.) After all marks have been captured into the system and before the marks are graded the system will also analyse the candidates' examination marks to deduce different patterns in the data (data mining) which may help to investigate cases of malpractice or fraudulent activities done during the examination. The data mining process may also deduce patterns which will help reveal subjects which can form a perfect combination at advanced level. The system will bring an efficient way of getting marks into the database without having to load scanned marks into the database overnight. Marks on the mark sheets are the raw data which is later

transformed into meaningful information after the process of grading where candidate obtain grades in relation to the mark attained. These marks do not need to be compromised by passing through different hands where they can be easily tempered with or altered hence this research aims at countering all loopholes in this current system.

1.5 Objectives of the study

According to Niven and Larmote (2006), objectives represent specific results that a system aims to attain within a certain period of time making use of available resources. Objectives must be specific, straight to the point and easy to evaluate. Objectives of the project must be specified to guarantee that the system runs smoothly, efficiently and also assist future users of the system. The set objectives of the system are,

- To develop a computerised examination mark capturing and grading system for Zimbabwe School Examinations Council.
- To enhance consistency, accuracy and security of candidates' examination marks since a second part is available (examiner) to verify if the correct mark for a particular candidate has been captured by repeating the capturing process.
- To punch candidates' examination marks directly into the marks database from marking venues.
- To record abnormalities or differences in the captured marks (inconsistency)
- To view pass statistics for the examination with the help of visual aids.
- To deduce different patterns from the gathered marks in the database which might help in investigating cases of malpractice or fraudulent activities
- To deduce combination of subjects that most students fail or pass the reasons behind or implications may then be further investigated.

1.6 Instruments and Methods

To counter problems currently faced by the existing system, the proposed system will be developed using different data gathering or fact finding techniques.

1.6.1 Instruments

According to Dubois (2013), MySQL is a simple natural language and robust relational database which gives entry to facts and enables the transformation of information into data.

PHP – Hypertext Preprocessor which is a broadly used open source, general scripting language well suited for web development and can be embedded into HTML (Ullman,2008).

Notepad ++ is a free source code editor supporting various programming languages

xampp with PHP version 7.2 or better

MYSQL

SSL Certificate (Secure Socket Layer)

Semantic antivirus package

1.6.2 Methods

A research is carried out by choosing from a different selection of strategies and tools to gather data and making analysis (Kumar,2014). Following are the methods used for data gathering

Interviews- Questions will be asked by the interviewer and the respondent giving answers instantly. The discussion or conversation will be conducted face to face.

Questionnaires - Series of questions will be designed on paper and respondents will fill in the spaces provided. The responses will be analysed later.

1.7 Justification and Rationale

The online marks capturing and fraud, malpractice detection system which will eliminate the cumbersome processes involved in manual mark shading on the mark sheets provided to the examiners by the council after the marking of examination scripts. The need to acquire the mark sheet forms acquired from the Data Resolution Services (DRS) in the United States of America will be eliminated, removing costs to the organization. The computerised system will also analyse different patterns in the marks obtained by candidates and the gathered information will help in gathering statistics of pass rates by gender, subject and this will be represented by visual aids such as graphs. Furthermore, an examiner will be available in the system to verify the mark captured by the marker in the first instance by repeating the capturing process.

Subject managers at ZIMSEC will also use this system to make decisions based on the different patterns deduced from different marks from different subjects. New subject combinations may be proposed. The time taken to load marks into the database will be lesser meaning all manual processes will be removed. Every candidate registered to write the ZIMSEC examination will get a fair result. The release of examination results will be done within set deadlines since cumbersome processes would have been removed. The vision and mission statements of ZIMSEC will be strengthened as they highlight on quality assessment of candidates and awarding of nationally and internationally recognized certificates. The marks capturing process if articulated well, assurance is given that all remaining processes will follow suit until completion.

1.8 Summary

To summarise on this chapter, the problem has been defined and the objectives of the study given. It is now of paramount importance to move on to the next chapter where the methods stated will be used to gather user requirements and an analysis will be conducted to ascertain whether they are achievable. All the resources needed will be gathered, and this research will be accomplished effectively so that the online marks capturing system will meet organisational goals as well as user requirements.

CHAPTER 2: PLANNING PHASE

2.1 Introduction

Langer (2008) defines system planning as a stage where a decision about what entities and attributes can build up the system has to be made. The relevant overheads, duration and benefits are to be taken into account in order to come up with a meaningful project plan. Some features of the old system like capturing the mark from the script will be adopted but in a different and more improved way from shading of mark sheets. A work plan will be implemented at this stage and work will be executed as scheduled.

2.2 Business value

When assessing the business value that a proposed system brings to an organisation, operational and technical efficiency of this system should be considered. Maximum benefits have to be realised after exploiting all the system capabilities. Inputs should be generated into meaningful information useful for managing operations and making decisions (Walker, 2004). The online marks capturing system will bring efficiency in the mark capturing process from marking venues. The following indicate the business values this system will bring to the Examinations Council:

(i) The system will minimize the rate of errors

A checker will verify the candidate marks captured by the examiner at the marking center before it loads onto the database for grading. This will improve on accuracy.

(ii) Real time processing of candidates marks

Marks are captured during the marking process straight into the database and as soon as verification is complete, the marks are ready for grading. The scanning process eliminated would normally take two to three weeks before marks are loaded into the database.

(iii) Cost effectiveness

The process of acquiring mark sheets to shed candidate marks is eliminated. The mark sheets are obtained from a company in the United Kingdom (Data Resolution Services) which is enjoying monopoly as the sheets are a special type of paper, which can go through the scanners, and they are pricey. The cost of transporting these papers from marking venues all over the provinces in the country

to the Head Office for scanning is also eliminated. Staff from the Results section at the Head Office would also be paid to work overtime scanning these marks sheets so this cost will be removed as well.

(iv) Early release of examination results.

Of late, the Council has been facing great competition from the international examining body Cambridge in the release of examination results and stakeholders expressed so much concern on the late release of results by ZIMSEC compared to Cambridge, which led to most parents preferring the schools that offered the Cambridge examinations. The system will put the Council at a competitive advantage since the marks are loaded straight from the marking centers and the grading and all processes that follow will be tackled in a timely manner leading to an early announcement of results. The core business of the council, to examine and certificate will then be accomplished efficiently.

(v) Flexibility

The system allows the checker to verify and correct if the mark entered by the examiner does not tally with what is on the answer script. The system will be able to detect inconsistencies in the captured mark and give an error message so that the mark can be amended.

(vi) Security

Too much form handling of the marks sheets being transported from the marking centers after shading by examiners to ZIMSEC for scanning by the officials imposes a lot of security risks on the mark sheets as the marks they contain may be easily altered and this would be rarely caught. This whole process being eliminated means the risk is reduced and the electronic capturing of the marks proves to be a secure system.

2.3 Feasibility Study

This is a primary investigation that aids in decision making for the senior level of management. After a thorough investigation has been made, it can be ascertained whether the system is doable or not. An existing system may be improved, a new one may be developed, evaluations and estimates for further development are generated. Feasibility study ascertains whether an appropriate resolution to the problem found during study of the system can be found (Dubois et al., 2007). According to Harvard (2013), this study defines exactly how a project can be developed successfully considering technical, economic,

social and operational aspects that affect the development of the project. It helps to determine the possible positive and negative effects of the research before a project before financing it.

This study focuses on the ZIMSEC marks capturing and grading system and a thorough research will be made to ascertain the feasibility of the project before embarking on it. The important details required to determine the feasibility of the study were all gathered and evaluated. Threats, opportunities, tangible and non-tangible benefits, just to mention a few were discussed. The different aspects of feasibility on online mark capturing and grading will be discussed in the sections to follow.

2.3.1 Technical Feasibility

This studies how the existing resources within the business organisation can be applied technically in order to obtain the anticipated results of the online marks capturing system. Smith and Mckeen (2003) define technical feasibility as an evaluation of the existing hardware, software and how meet the requirements of the system .The study evaluates the degree to which the system can be designed, developed and implemented , technical risks involved and attempts to study whether development of the system is achievable (Dennis, Wixom, and Roth 2012.)The new system has to be compatible with the current technology within the business organisation and the new technology and applications that comes with it need to be incorporated into the existing environment s they may heavily depend on data from the current systems, generate data provide other applications and may make use of the organisation's communication infrastructure. Technical feasibility should determine the availability of the necessary technology, whether the technology can accommodate the requirements of the new system, if there are any extra requirements to be added to the current technology and whether management recognise and accept the technology.

Table 2.1 gives a detailed description of the hardware resources required for the new system.

Table 2.1 Hardware resources

| Resources | Quantity | Specifications | Status | Concluding Remarks |
|--------------------------------------|-----------|--|-------------------|---|
| Desktops | 500 | 500GB hard drive Core i2 processors 4GB RAM. HP, or any other brand that meets the specifications | Unavailable | Use is only seasonal (during marking period only) therefore hiring is the best alternative. |
| Server machine | 1 | | Readily available | No need to purchase the compatible server machine is readily available. |
| Hard drives (external) | 2 | One terabyte | Unavailable | These have to be bought for backing up mark and grade details |
| Routers, Switches, and Access points | 1 of each | | Readily available | The readily available devices can be put into use. |

Furthermore, software resources are required for the system development and these are illustrated in table 2.2.

Table 2.2 Software resources

| Software | Specifications | Status |
|---------------------------------------|--|---|
| Xampp with PHP | Version 7.2 or greater | The software is readily available |
| SSL certificate (Secure Socket Layer) | DigiCert SHA2 Extended validation server | Needs to be acquired important for the encryption of candidate's marks. |
| Antivirus package | System endpoint, semantic | Readily available but necessary updates to be installed timeously |

2.3.1.1 Human Resources

To determine if enough personnel with the ability to build and use the new system efficiently, human resources was categorised under technical expertise. The analysis was carried out to find out the following:

- If adequate human resource is available currently for the new system development?
- Does the human resource have the essential skills needed for the development of the new system?
- Any training required to improve the performance of the personnel.

The online marks capturing system for ZIMSEC would require training of the ZIMSEC head office and regional staff who will also train the leadership at marking venues. The leadership will in turn impart the knowledge to their various groups or teams in their respective subject specialties. Table 2.3 shows a detailed analysis of technical expertise.

Table 2.3 Technical Expertise Analysis

| Stakeholder | Status | Council's View | Remarks |
|---------------------|--|---|---|
| Computer Operators | relevant ZIMSEC personnel possess knowledge of computers | Any additional costs on training are paid for by the organisation. | Employees may get extra training on new features of the system |
| Internal Developers | The developers expressed knowledge on common programming languages | The internal developers to receive the necessary training. | Developers need more training on PHP . |
| Examiners | they examiners are computer literate. | Thorough training for the examiners is needed to avoid human error. | Leadership must receive proper training which is necessary so that there will be able to train their teams. |

A good consideration was given to the available hardware and software resources and it was realised that most of the needed resources were readily available thereby rendering the project technically feasible.

2.3.1.2 Overview of Technical feasibility

After making a thorough analysis of the technical feasibility study, the development of the system proved to be technically feasible since hardware, software requirements could be met by the organisation, and technical staff was readily available within the organization.

2.3.2 Economic Feasibility

Economic feasibility establishes the viability of the project economically thus it compares the costs of developing the project against the benefits that will be derived from it. The costs should not outweigh the benefits for the project to be considered feasible economically (Cohn, 2014). To determine whether the project is feasible economically the Return On Investment (ROI) and payback period were computed.

2.3.2.1 Costs

Costs can be defined as the cash outflows, overheads or expenses encountered in the course of the system development and operation of a system (Goldsmith 1991). Financial estimation of effort, resources, time, utilities used in the construction and deployment of the new system (businessdictionary.inc, 2015). The financial department needed a deeper understanding of the costs involved in the system construction and deployment so as to ascertain if the budget could be met.

2.3.2.1.1 Development cost

According to Rockevans (1987), development costs are encountered from the commencement of the project up to the final stage where it is implemented. The ZIMSEC online marks capturing system had some costs associated with its development and these are illustrated in Table 2.4

Table 2.4 Development Costs

| Item | Quantity | Estimated hiring costs/unit/day (USD) | Total estimated cost (USD) |
|-------------|-----------------|--|-----------------------------------|
| Desktops | 500 | \$20 for 10 days | \$100 000 |

An organisation cannot escape operational costs as they are and they are experienced or encountered on a daily basis (Pettinger, 2014). Table 2.5 summarises the projected operational expenditure for the two years (2019 and 2020).

Table 2.5 Operational Costs

| Narration | 2019 (USD) | 2020 (USD) |
|-------------------------|-------------------|-------------------|
| Maintenance of hardware | \$2000 | \$1500 |
| Maintenance of software | \$1000 | \$800 |
| Computer consumables | - | \$1500 |
| Internet service | \$1000 | \$800 |
| Examiner's training | \$1000 | \$500 |
| Total | \$5000 | \$5100 |

2.3.2.2 Benefits

Ness (2016) defines benefits as positive returns gained from the introduction of a new system. They can be classified into tangible and non-tangible benefits.

2.3.2.2.1 Tangible benefits

Tangible benefits are a form of remuneration expressed in financial terms (Ness, 2016) A decline in those costs which were being met in the current system is what can be termed as tangible benefits and this decline comes with the introduction of the new system.

Table 2.6 outlines estimated tangible benefits for e ZIMSEC online marks capturing system for the two consecutive years 2019 and 2020.

Table 2.6 Tangible Benefits

| Description | 2019 Benefits(USD) | 2020 Benefits (USD) |
|--------------------------------------|--------------------|---------------------|
| Decline in stationery cost | \$75000 | \$85500 |
| Decline in labour cost | \$25000 | \$27000 |
| Estimated decline in other expenses. | \$15200 | \$20000 |
| Total | \$115200 | \$132500 |

2.3.2.2.2 Non-Tangible Benefits

These are of non-monetary value and are difficult to measure. Non-tangible benefits have an important effect on the efficiency, business relations and revenue of the company (tutorialspoint.inc, 2015).

Following are the non-tangible benefits that comes with the introduction of the mark capturing system.

- Enhanced handling of candidate's marks since they only pass through the examiners hands.
- Reduced risk of errors (i.e. the chances of giving a candidate the wrong marks are slimmer.)
- Marks quickly get into the database and processed on time leading to an early release of examination results
- Eliminates the time consuming process of shading marks sheets. Examiners will be motivated to work even harder so that they finish marking early and attend other calling duties from their schools
- Improved organisation reputation

- Assurance of data integrity and security and confidentiality

2.3.2.3 Cost Benefit Analysis

Marshall (2016) defines cost benefit analysis as practice of comparing a process of adding up all financial benefits and weigh them with the costs incurred in order to determine the economic viability of the project or research. The result of this analysis determines whether the project is worth undertaking. Table 2.7 shows the projected costs versus benefits.

Table 2.7 Cost Benefit Analysis

| Description | 2019 (USD) | 2020 (USD) |
|---------------------------|-----------------------|-----------------------|
| Estimated benefits | | |
| Tangible - benefits | \$115 200 | \$132 500 |
| Total | \$115 200 | \$132 500 |
| Estimated - costs | | |
| Development costs | \$100 000 | - |
| Operational costs | \$5 000 | \$5 100 |
| Total | (\$105 000) | (\$5 100) |
| Profit /(Loss) | \$10 200 | \$127 400 |

table 2.7 illustrates that ZIMSEC obtained a lower margin of 10 200 in 2019, and in 2020 it had risen to \$127 400. Basing from the outcome from table 2.7 it was then concluded that proved that the project was achievable economically and the finance department was in agreement. The Return On Investment (ROI) and payback period were also calculated basing on the cost benefit analysis.

2.3.2.3.1 Return On Investment (ROI)

This compares the profits obtained to the investment made (Ness, 2016) The formula for its calculation is as follows;

$$\text{ROI} = (\text{average annual profit}/\text{total investment}) * 100$$

$$\text{average annual profit} = \text{net profit} / \text{number of years}$$

$$\text{Total Investment} = \text{development cost} + \text{operational costs for 2019}$$

$$10\,200 + 127\,400/2 = 68\,800 \text{ average annual profit}$$

$$100\,000 + 5\,000 = 105\,000 \text{ total investment}$$

$$68\,800/105\,000 * 100$$

$$= \underline{\underline{65.3\%}}$$

A return on the funds initially invested of 65.3% is expected within the two years, which is favourable as the project's benefits outweigh the costs.

According to Langer (2008), ROI should never be used as the only evaluation for a project's worthiness. Another technique was then used to justify the worthiness of the project

2.3.2.3.2 Pay-back Period

Harvard (2013), defines pay-back period as the duration taken to breakeven or realise positive outcome from the project, usually calculated in years. A determination as to when the initial investment would start reaping positive results was then made.

$$\text{pay-back} = (100\,000/115\,200) * 12$$

$$= 11.5$$

$$= \underline{\underline{10.4 \text{ months}}}$$

This was considered favourable as the project pays back within the first year.

2.3.2.3 Overview of Economic Feasibility

After calculations on return on investment and payback period were done and favourable results were obtained, the project proved to be economically feasible.

2.3.3 Social Feasibility

This study defines the effect that the proposed system has on the organisation's social culture. According to Horine (2012), this study evaluates the bearing that the project has on the lives of interested parties (stakeholders) both inside and outside the organisation and their response to system. The stakeholders of Online marks capturing system include management, ZIMSEC officers, examiners, candidates.

2.3.3.1 Examiners

The examiners were optimistic that the new system will relieve them of some time consuming processes, which gives them, time to focus on social issues pertaining to work at the making centers. The processes include queuing for mark sheets as well as shading them. However, some expressed mixed feelings on computer literacy but assurance was given that they were going to receive the necessary training before the use the system.

2.3.3.2 ZIMSEC Officials

The new system also has an important effect on the motivation of employees. The scanning process has been eliminated for ZIMSEC officials in the results section giving them ample time to focus more on examination issues like missing marks and retrieval of scripts. The production of computerized reports makes workload lighter for them. Generation of automated reports also relieves the workers from the cumbersome process of writing reports. The employees welcomed the proposed system.

2.3.3.3 Management

At the Examination council management were also positive that the introduction of the online marks capturing system will see an early release of Ordinary and Advanced level results. Marks will be captured into the database without any hustles of transporting mark sheets for scanning. However great concern on security issues was expressed. Decision making at the top level would be based on accurate information as reports are generated automatically as the data is processed in the system.

2.3.3.4 Students

School candidates were confident with the system and the fact their results would be released earlier than before with the introduction of this system made them so excited and eager to see it in operation.

Management, officers, examiners and candidates accepted the system, however some officials from the council expressed fear and discomfort as the technology was taking away of one their responsibilities and giving it to the contracted examiners. The overtime incentive they were getting when scanning marks sheets will also be eliminated.

2.3.3.5 Overview of Social Feasibility

A conclusion was reached that the project was feasible socially as a greater number of stakeholders accepted the system

2.3.4 Operational Feasibility

According to Borrington (2013), this study assesses the effect that the system has on daily or routine operations of the organisation. It ascertains whether the system being proposed will bring with it a solution to the defined shortfalls of the current system. To be operationally feasible, the system has to bear a positive influence to the current business procedures, working environment and meet the objectives in terms of duration or time scale, deadlines for deployment and organisational principles. The new system should fulfill user requirements gathered in the requirements analysis and has to be in full operation after development.

The relevant stakeholders got informed about the slight modifications and alterations that might affect their routine operations due system deployment. While some had reservations, most accepted change. A request was made for constant practice on the system operations as users get familiar with it. The users have to perceive the system easy to learn, use and comprehend. The scheduled period for the system development is convenient since there are oncoming June examinations with a small candidature and they can be used as a test case for the new mark capturing application running in parallel with the shading of mark sheets. The existing business process like scanning of mark sheets will be eliminated and officers can engage themselves in other processes. Risk of poor security when transferring mark sheets will be eliminated as well as paperwork.

The system will operate efficiently after development for the two sessions of examinations that is June and November every year and it will surely satisfy all stakeholders needs.

2.3.5 Overview of the Feasibility Study

The concluding remarks on the feasibility study denote the project is feasible in all aspects of feasibility studied during the research and the risks assessment has to be done to determine the types of risks expected.

2.4 Risk analysis

Hopkin (2010) defines risk analysis as the practice of investigating and detecting possible matters that could adversely impact vital project initiatives to assist the organisation in mitigating those risks. It can also be defined as the process of assessing the likelihood of an adverse event occurring during the development of the project. The goal is to identify each important adverse event or source of uncertainty and estimate its impact on the outcome of the project. The investigation strives to respond to the following;

- What might possibly take place?
- What are the chances of it happening?
- What might be the results of the risk?
- What action can be taken to alleviate the risk?

The different types of risks will be assessed in table 2.8

2.4.1 Resource Risk

This type of risk mainly arises from personnel related issues and mainly caused by shortage of resources. The resources might be funds, timescale available and also availability of experts. Employees and finances constitute resource base and if the employees are lack skills and ineffective to tackle the operations a possible risk is imminent. From a human resource point of view, a project must begin with sufficient people and must not be understaffed to ensure a well-planned human resource base. Adequate funds should be available so that all crucial activities will be carried out in time and management should always be in agreement whenever making decisions so that all the relevant resources are available for the project's development.

2.4.2 Operational Risk

Heldman (2005) alludes that operational risk emanates from unsuccessful measures, schemes and strategies. Employee errors and omissions, software or IT systems failure, loss of key people in the project, are all operational risks examples. This type of risk can have a negative impact on user satisfaction, status of the organisation and increases instability during system development.

Applications and procedures need to be accurate so that the risk is mitigated or avoided. This type of risk can be managed by ascertaining the extent to which the developer is willing to take the risk in order to meet system objectives which can be accomplished by balancing the costs of improving the old system against the expected benefits (Cost benefit analysis).

2.4.3 Schedule Risk

This denotes the potential for a project or task to take longer than planned. The probability that the project fails to meet the deadline or fails to finish within the set timeline defines schedule risk. This type of risk is common in most projects as it is quite difficult to estimate the period that the project is going to take before its deployment. The initial stages of the project are characterised by little or no information, developers have to rely on personal experience, knowledge and understanding. More information becomes available as the project evolves through the life cycle. As a project progresses through the systems life cycle, more information becomes available thereby delaying the progress of the project. A project may fail to meet its expected requirements if it takes longer development time than expected.

A Gantt chart is tool that is used for this type of analysis as it gives a detailed summary of the outlined tasks against their expected duration period. This helps to indicate the status of each activity in relation to where it should be.

2.4.4 Technical Risk

Chittister and Haimes (2001) define technical risk as a measure of the likelihood and degree of negative effects associated with the development of the project .Technology failures affect the development of the system and may lead to losses within the organisation where a technology project goes over budget and fails to meet goals or objectives set out or security incident resulting in theft of customer data, which renders the council legal liability, reputational damage and compliance issues. Inefficient code during

system design will result in error-prone or unmaintainable code and model, untestable or untraceable requirements

Table 2.8 summarises the risk analysis of ZIMSEC online marks capturing system.

Table 2.8 Technical Risk Analysis

| Category | Rate of Occurrence | Impact | Measures |
|---|--------------------|--|--|
| Hacking of marks | Low | Distortion of candidate's marks and loss of credibility. | The SSL encrypts marks and decrypted in the database |
| Lack of system experts | low | System failure | Intensive training for internal developers |
| Lack of desktops for capturing marks | Low | Delay in capturing marks | Desktops will be hired from reputable organisations |
| Unclear requirements | Low | The development of a system with wrong functionality | A well-documented requirements specifications document to be available |
| Insufficient testing | Low | System flaws after deployment | There should be enough time for testing and debugging |
| Implementing parallel changeover strategy | Average | Extra costs generated | The changeover will be done for the June session only |

Table 2.9 Operational Risk Analysis

| Category | Rate of Occurrence | Impact | Measures |
|---------------------------|---------------------------|--------------------------------|---|
| User resistance | Minimum | System Rejection. | The system should be user friendly and cater for all requirements |
| Slow budget approval | Minimum | The project is delayed | Reservations made for unexpected expenses |
| Errors in capturing marks | Very low | Distortion of candidates marks | Examiner will capture marks for the second time for verification purposes |

Table 2.10 Resource Risk Analysis

| Category | Rate of Occurrence | Impact | Measures |
|---------------------|---------------------------|----------------------|--|
| Resource Deficiency | Minimum | Missing the deadline | Required resources to be acquired in time. |

Table 2.11 Schedule Risk Analysis

| Category | Rate of Occurrence | Impact | Measures |
|--------------------|---------------------------|--------------------|--------------------------------------|
| Unclear objectives | Low | Inefficient system | Clarity on objectives at every stage |

2.5 Stakeholder Analysis

According to Schemeer (2000), the analysis involves systematic assessment and examination of interested parties to the project development so that priority is given to their needs as they become actively involved in the system construction. The interested parties will be ranked according to their significance in the system development and the influential ones are key players in the project's development. The stakeholders must be clearly defined as well as their needs. The participation and support from the stakeholders in the development of the project is vital and guarantees a successful completion. It is of paramount importance to be able to identify the stakeholders and their classification can be;

- Active members of the project
- Sections or divisions in the organisation
- External participants

The following steps are carried out during stakeholder analysis;

- Identify all stakeholders (interested parties)
- Document stakeholders' needs
- Assess and analyse their impact
- Manage their expectations
- Take necessary actions
- Repeat all stages

Carrying out the stakeholder analysis brings along benefits to the development of the project, which can be;

- Requirements of all interested parties with influence on the development of the project recognised.
- All risks considered before implementation.
- Important players for circulating information during implementation phase are identified.
- Groups that should participate in different stages of the project are alerted and encouraged.
- Individuals expected to participate are informed well in time.
- Communication planning and stakeholder management strategy during project planning phase to be initiated.
- Techniques to handle negativity amongst stakeholders formulated well in time.

Stakeholders' needs should be managed as they are vital for continuity and effective completion of the development. They should feel free to express their thoughts and give contributions whenever necessary so that they feel actively involved in this development. The online examination marks capturing system for the Zimbabwe School Examinations Council, has Internal and external stakeholders identified as follows

2.5.1 External

Examiners, Markers

2.5.2 Internal

ZIMSEC IT personnel, ZIMSEC Results section personnel, ZIMSEC management.

Table 2.9 illustrates the stakeholders involved in the project their interests, risks, how the interests are addressed and the reaction of the stakeholders

2.9 Stakeholder Analysis

| Stakeholders | Requirements | Risks | Solution | Response |
|---------------------------|---|--|---|--|
| Examiners | A user friendly system that captures marks without any difficulty. | Lack of computer appreciation | The application should be easy to comprehend and work with. | More than 80% are confident in their computer literacy and optimistic that they will be able to work without any difficulty. |
| Checkers | Inconsistencies should be detected as they punch marks after the examiners. | | Much emphasis will be put on this as the checker punches the final mark to be graded. | The checkers also welcomed and accepted the system as a convenient way of getting candidates marks into the database. |
| ZIMSEC management | The system should be error free and efficient. It should be able to capture and grade marks correctly. Accuracy is a prerequisite when dealing with marks | Some may not be convinced that the system works accurately | Development of the system that meets management expectations. | Anxious to see the effectiveness on mark capturing. |
| Results section personnel | The accurate mark for every candidate in the database | Capturing of different marks | The system will detect any abnormalities | Mixed feelings as some felt the system had replaced their major tasks during the marking exercise. |
| ZIMSEC IT personnel | An accurate and efficient system which is going to | System failure due to lack of cooperation | The system will be developed within the time scope and | They welcomed the system as it brings assurance of quality and |

| | | | | |
|--|----------------------------------|--|---|------------------------------------|
| | improve processes at the council | | validation measures will be incorporated to reduce errors | error free marks into the database |
|--|----------------------------------|--|---|------------------------------------|

2.6 Work plan

Leonard (2018) describes a work plan as a vital instrument that assists developers to allocate responsibilities, control operations, record various components and timelines. A work plan is specific to needs of an organisation but normally does not extend to more than a year. Team members work together to achieve a common purpose or goal as they stand guided by the work plan and they focus is mainly on the working according to plan. It illustrates the timetable of how the project will advance from the proposal to the maintenance stage, specifying the timescale a certain activity is expected to take. The work plan is normally illustrated in the form of a Gantt which is a simple communication tool with the users. The following steps can be used to create a work plan

- Understand the importance and duration of the project
- Partake detailed research
- Questions asked should be meaningful to development
- Generate the outline or schedule
- Communicate with team members
- Write a complete plan
- Gantt chart
- Publish the
- Prepare to keep planning

The work plan illustrates the activities, time scale and the expected outcome.

Table 2.10 Work plan

| Stage | Description | Time scale | Expected outcome |
|----------------------------|--|------------|--|
| Proposal | Problem identification and objective creation | 3 months | Proposal draft, problems identified , objectives and justification of the proposed |
| Planning | Work on feasibility study, analysis of risk and identify business values | 2 months | Risk analysis report and feasibility report |
| Analysis | Existing system analysis, establishment of data collection methods and outline of functional and non-functional requirements | 2 months | System analysis report |
| Design | Come up with the structure of the system physically and logically graphical user interfaces and the database | 3 months | Proposed system design |
| Implementation | Deploying the system to users and training them | 2 months | New system deployment |
| Maintenance and evaluation | System maintenance and assessment | Continuous | evaluation report |

2.6.1 Gantt chart

A Gantt chart gives a summary of all activities in a project in their respective order against the timeline given to each activity. These are an important tool in project planning as they help identify who will be responsible for each task, the duration period of each task, and the difficulties that might be faced. The timeline given should be achievable the right people are allocated to each activity. A Gantt chart illustrates all practical features of a project such as the time taken before deployment, tasks with high

priority and the path with the minimum time a project can take to complete (Clark, Polakov and Trabold, 2018). The advantage of using a Gantt chart throughout project planning is that project team and sponsors are always informed of progress, schedule changes and their implications and the tasks that have been completed successfully.

Table 2.11 illustrates the Gantt chart for the online marks capturing system for ZIMSEC with all the project activities displayed in their order against timescale.

Table 2.11 Gantt Chart

Time in (Months)

| ACTIVITY | MAY | JUNE | JULY | AUG | SEPT | OCT | NOV | DEC | JAN | FEB | MAR | APR | MAY | JUNE | JULY |
|----------------------------|-----|------|------|-----|------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| PROPOSAL | | | | | | | | | | | | | | | |
| PLANNING | | | | | | | | | | | | | | | |
| ANALYSIS | | | | | | | | | | | | | | | |
| DESIGN | | | | | | | | | | | | | | | |
| IMPLEMENTATION | | | | | | | | | | | | | | | |
| MAINTENANCE AND EVALUATION | | | | | | | | | | | | | | | |
| DOCUMENTATION | | | | | | | | | | | | | | | |

Maintenance, evaluation and documentation are continuous activities throughout the system's lifespan.

2.7 Summary

This chapter looked at the feasibility study, analysis of risk, stakeholder analysis, and work plan for the project. A consensus was reached that the project was doable basing from the results obtained from the different analysis done. The following chapter emphasises on analysing how the old system operated, its shortfalls and different fact finding methodologies used will be discussed as well as alternatives whether to outsource, develop in house or enhance the system that is currently in operation

CHAPTER 3: ANALYSIS PHASE

3.1 Introduction

The analysis phase defines the user requirements for a new or improved system. These user expectations must be achievable, significant and comprehensive. This stage is vital and calls for continuous user involvement and consultations as the system development progresses. This will curb future conflicts and uncertainty as their contributions will be taken note of and applied. More emphasis should be put on user needs and the goal must be to ensure the system fulfills gathered user needs or requirements (Langer,2008). The phase demands combination of hardware, software and human resource aspects like engineering expertise and interpersonal abilities. Gathering requirements is the main task done under this phase. Following are the stages followed when gathering requirements from interested parties

- Collect, analyse, and validate information.
- Identify needs and prototype for the system.
- Weigh the alternatives and arrange user requirements in order of priority.
- Study the user needs that helps improve the system
- Prepare a Software Requirements Specification document (SRS).

3.2 Information gathering methodologies

Masters (2010) defines them as techniques applied to gather the information requirements of an organisation and the information is used to compute the SRS document that users can comprehend well.

The document meets the following requirements

- Be complete, clear, and understandable
- State effective, well planned, information requirements.
- Resolve potential disagreements amongst users and the analyst.
- Incorporate visual aids to make understanding easier.

According to Kendall and Kendall (2006), Information must be collected from the users to determine the system requirements. The information gathered will facilitate a well-defined, exact and thorough picture of how data and business operations integrate. Several methods can be used to gather information and these will be discussed in the following sections.

3.2.1 Interviews

An interview can be seen as a dialogue between interested parties on a particular topic of interest in order to gather information (Clark et al., 2018). The person asking questions to gather information should possess interpersonal skills so as to gather as much important information as needed for the purpose of the research. The questions asked should be relevant, brief and straight to the point without any victimisation throughout the process. The parties involved in this activity should be good listeners and the interviewer should allow freedom to express views and thoughts. Proper language which matches the social background, principles and values of the interviewee must be used to gather information and different responses are gathered depending on the information being collected. Interviews can be in different methods, structured and unstructured, (Polak and Green, 2015)

a) Structured Interview

A standard formulated manner is used to conduct the interview and the scheduled questions are followed sequentially without any deviations therefore investigations beyond the schedule are not accommodated even when necessary (Gubrium and Holstein, 2001).

(i) Strengths

- The interviews were easy to conduct since a template was used
- Less time than anticipated was taken
- A huge sample was interviewed therefore the results are generalised to a large population

(ii) Limitations

- The interview guideline limited the flexibility of questions asked.
- The gathered data was of high quantity rather than quality.

(b) Unstructured Interview

According to Yousuf and Asger (2015), unstructured interviews are not formal and might not follow any schedule. They are less rigid compared to the structured ones and questions may be addressed in any sequence.

(i) Strengths

- Questions were changed to fit user responses which was more flexible.

- The questions were open ended and made it easy to collect data of high quality and quantity. The respondents were allowed freely express their opinions on important issues.
- Face to face conversation, with the interviewees enabled the interviewee to build confidence as first-hand information was being gathered in a direct manner.
- Interviewees got the opportunity to seek clarity on ambiguous questions instantly.
- Immediate responses obtained from interviews assisted in quick decision making.

(ii) Limitations

- The interview consumed much time for the workers who had to leave their duties for the interview; certain operations were disturbed at the council. Much time was also needed to analyse the collected information.
- Establishment of a good relationship with the interviewee and knowing when to probe was a bit difficult task for the interviewer.
- Some stakeholders felt that the interviewing method of collecting information was too direct as they preferred anonymity in some instances, they also went on to express that the questions were asked in a subjective manner to the interviewer's advantage.
- Other interested parties could not make it due to circumstances beyond their control, so some important information might have been missed.

iii) Key Findings

Unstructured Interviews were conducted at the examination council and following were the findings; Examinations administration personnel from the relevant sections were interviewed and important points were noted down. The most common complaint was on the cumbersome work involved in the shading system. Personnel from the Information Services Department were interviewed as they were the ones with a deeper understanding when it comes to technical operations and they expressed that an improvement to the existing system was long overdue. Management at the council also got the chance to express their views on how the old system operated and were a bit hesitant on costs of introducing a new or improved system. Outside the Council the ZIMSEC contract workers, the examiners were interviewed as they were the main users of the shading system. They also expressed that shading was time consuming and involved a lot of errors with it. All stakeholders involved were able to comprehend their views on both the current and proposed system. The interview schedule was drafted by the human

resources officers and teams or groups were interviewed independently basing on their time slots. A few representatives from each group then assembled in the last interview and were asked their observations and anticipations as well as drafting how their procedures would work together to achieve one common goal

3.2.2 Questionnaires

According to Sharmila and Umarani (2011), a questionnaire is an established set of questions written and distributed to a huge audience for the purpose of gathering information on a particular topic of interest or research. Many responses are obtained from questionnaires and if designed well this technique can also gather quality information and saves cost and time. Questionnaires can be open ended or closed ended where the closed ended type provide the respondent with possible answers to select from denoting a limitation. The open ended type is the exact opposite where respondents articulate responses on their own (Kendall and Kendall,2006). At the examination council the questionnaires were distributed to examinations clerks, management, subject managers, examiners and school candidates and three quarters were successfully attended to. The strengths and weaknesses of engaging questionnaires to gather information are discussed.

(i) Strengths

- A good response ratio was obtained from the circulated questionnaires.
- The respondents attended to the questionnaires at their own spare time without any hustles.
- Examiners, students and ZIMSEC officials are not co- located so the questionnaires proved effective in carrying a survey for dispersed people.
- Questionnaires made it easy to quantify different perspectives alluded to.
- The distributed questionnaires were anonymous there by responses were given with no fear of victimisation.

(ii) Limitations

- Since questionnaires contain anonymity, perspectives of a certain group of people could not be established.
- Incomplete data was collected on a few questionnaires.
- Reactions and sentiments of people could not be understood using questionnaires.

iii) Key Findings

Most respondents indicated unhappiness with the current system and were eagerly waiting for the new system to be put in operation. Important business processes like the release of results was taking too much time thereby inefficiency of the system. The new system would empower them with the modern technology and enhance their skills. The ordinary level students expressed great concern on late collection of results as this made their first term for lower six very short and were eager to collect the results earlier for advanced level placement.

3.2.3 Observations

Somerville (2011) describes observation as a method of gathering information by noticing and observing the people, events, and objects. Generally, observation includes taking note of people as they partake their routine work and also understand how the current system stakeholders perform their daily activities as well as understanding how the existing system itself functions as the users interact with it. According to Yousuf and Asger(2015), an observation can be carried out passively without interruptions or actively with the user being interrupted for clarity on certain operations, the analyst should have knowledge of observation domain.

(i) Strengths

- First -hand information was collected instantly without being window dressed.
- Observations proved to be a direct method of collecting or gathering information and no hustles were encountered by the researcher.
- Complexity of certain system features which end-users failed explain clearly were noted.
- Observations produced more accurate and reliable information.

(ii) Limitations

- The “Hawthorne effect”, which is when the presence of an observer changes the behavior of those being observed was felt during observations.
- Observations showed that the workers were not comfortable working whilst being watched as they were afraid of making errors.
- Since the environment was artificial responses during interaction were somehow not realistic as they reacted differently from how they normally would.

iii) Key Findings

A few selected examiners were observed while shading mark sheets which were later scanned by ZIMSEC officials as an illustration since the June examinations have not yet been written. The observation was active and interactions were done while observing. Mark sheets which are dirty creased due to packaging could not run through the scanners as they were rejected by the optical mark reader. These had to be captured manually into the system which is not secure as these marks may be lost also requires extra time to be captured.

3.3 Analysis of the existing system

According to Dennis (2009), analysis of the existing system gives a better idea of what problems are being encountered in the system in operation and these should be addressed in the proposed system. The analysis was properly done to ensure that the parts of the system being upgraded or enhanced were the rightful ones and this was going to help address the current problems. It was also important to revisit the objectives of the new system mentioned earlier to see if they are addressing the shortfalls of the current operations.

While analysing the existing system the systems developer should

- Be involved in the operations of the system at site so as to be acknowledged as one interested party of the development.
- Take note the of the important workers besides the supervisors, these add value towards the operations of the system.
- Spend some time with the users of the system so as to have a deeper appreciation of how the system works.
- Outline the boundaries of the system and its main purpose.
- Collect and study all the documents generated by the system. The documents could be printed or handwritten.
- Draft the procedures, methods and guidelines used in operating the system.
- Take note of the measures and security being applied during operation.

- Make a list of the outputs (statements, reports) containing information. Get the contents of the reports approved by the head of the department.
- Analyse the requirements of the information and reports from the utility point of view.
- Draft accost benefit analysis.

3.3.1 Description of current system

The existing system at ZIMSEC for capturing candidate marks is a manual shading system which is complemented by scanning the marks into the marks database done at a later stage after shading. The examiners shade the candidate mark from the script onto a mark sheet manually. The mark is shaded using a pencil, and the corresponding digit for the mark obtained is also written on this sheet for verification purposes. The mark sheets are handed over to ZIMSEC officials after completion and later on transported to ZIMSEC. At the examinations council, the marks are then scanned in batches into the candidates' database for grading. The scanning machines has an optical mark reader which is capable of reading the shaded marks and not the written one so verification is done manually before scanning to see if the shaded figure corresponds with the digit written as a figure. The scanning system's purpose is to load the candidate marks onto the marks database for grading. The examinations administration department officials from the Senior and Junior results sections are the users of this system as they engage in shifts to scan these mark sheets.

3.3.1.1 Inputs of the current system.

Unprocessed data is entered into the system and processed to become output (Tomsho, 2016). Inputs required for the online marks capturing system are;

- Candidate_name
- Candidate_Surname
- Sex
- Candidate_number
- Centre_number
- Subjects
- Level_of_examination
- Session

- Year_of_examination
- Status
- Mark_obtained

3.3.1.2 Processes

Shepard (2002) describes processes as actions liable for transforming input to output and for the current system they include;

- Arrange candidate scripts according to candidate number order.
- Shade the candidate mark to the corresponding candidate name on a mark sheet.
- Scan the mark sheets into the marks database.
- Grade the marks and produce results.

3.3.1.3 Output

Output refers to the results of the processed data (Rosenblatt, 2014). It is the outcome from certain operations and in the framework of systems theory, outputs from one part of a process may act as inputs to another part of the process. Output can be reports or printed statistics. The output for the online marks capturing system are

- Marks distribution lists.
- Missing marks reports.

3.4 Process analysis

This explains the method by which something is done (Dennis et al., 2015). Using an activity diagram the operations of the current system were drafted.

Activity Diagram for current system

Dennis et al. (2015) define an activity diagram as a diagram which describes the flow of data from one activity to another and these activities represent the processes of the system. Figure 3.1 illustrates the activity diagram for the existing system.

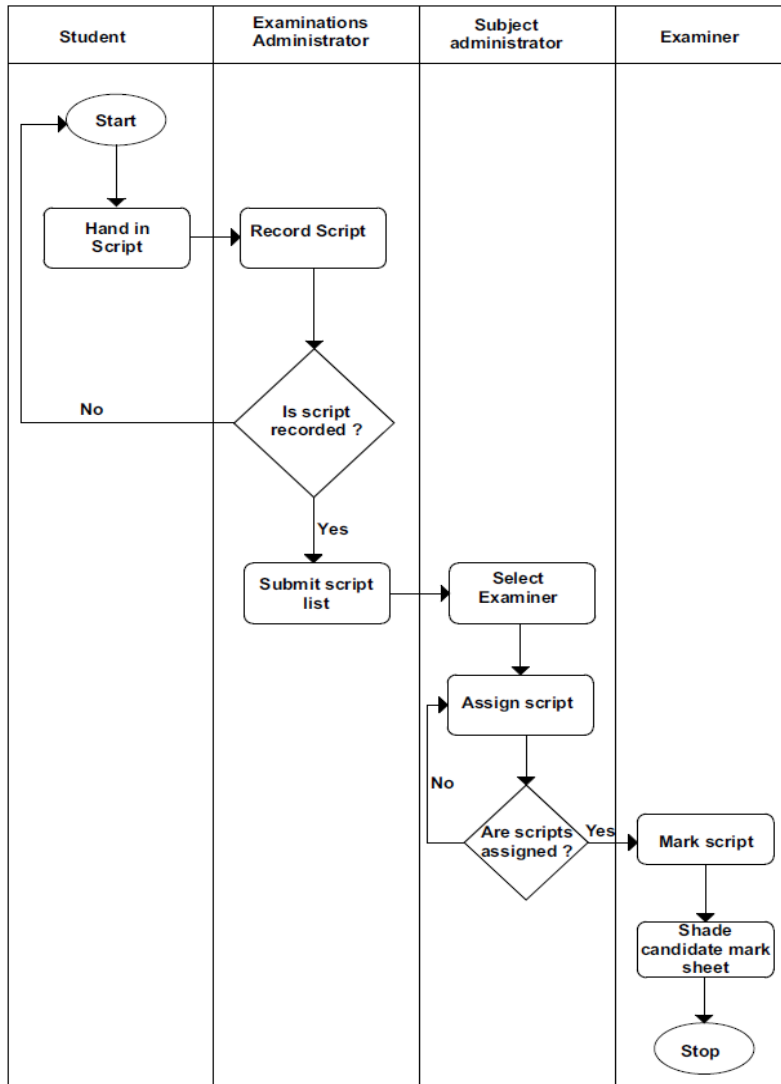
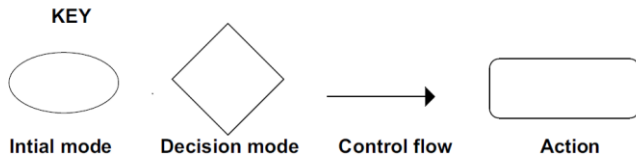


Figure 3.1 Activity Diagram



3.5 Data Analysis

According to Shamo and Resnik (2003), this is the process of scrutinising, refining, altering and modeling data with main objective of gathering valuable information, and assisting indecision-making. The analysis of data can be classified into two categories which are qualitative and quantitative data analysis (Dudovskiy,2013)

During qualitative research there is the identification of common patterns found in the responses obtained from the different fact gathering techniques used. These are analysed and evaluated critically to achieve goals of the research or study. Quantitative research focuses on interpretation of figures and numbers and seeks to find basis behind the development of key findings

Statistical and logical techniques are applied systematically to define and demonstrate, summarise, assess, and evaluate data. Both the qualitative and quantitative approaches were used to collect data for the online marks capturing and grading system. The data was reviewed and evaluated to get complete conclusion on the operations of the current system. The context diagram and data flow diagram were used for the analysis.

3.5.1 Context Diagram

Also known as the level 0 dataflow diagram, a context diagram seeks to describe the scope of the system in a more detailed manner (Kendall and Kendall, 2014). It illustrates the scope between the system and its existing environment, displaying the key entities working together in the existing system. The main business process is illustrated just as a single processes with data flowing to and from the relevant entities. Figure 3.2 illustrates the context dataflow diagram for the existing scanning system

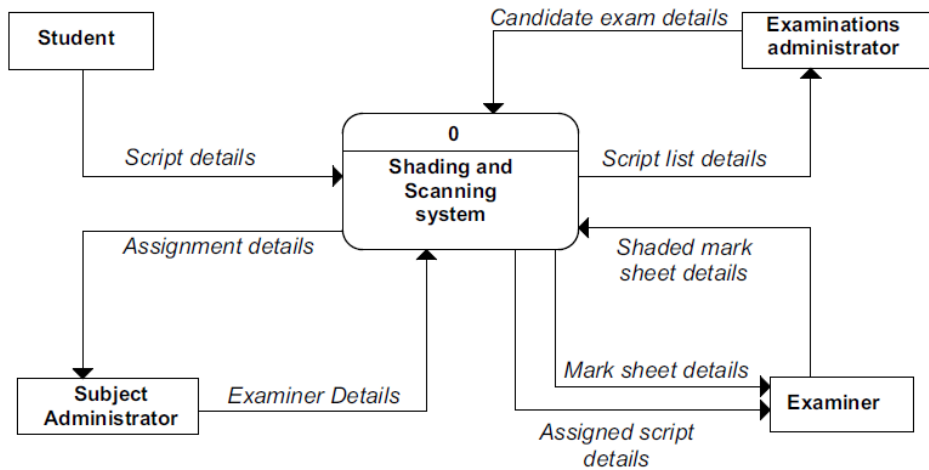
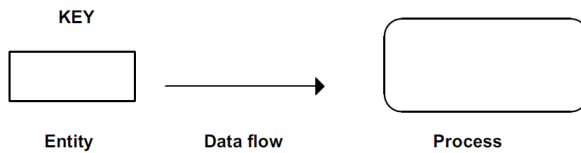


Figure 3.2 Context Diagram for the current system



3.5.2 Data flow Diagram

This diagram illustrates the how data flows in between significant entities in a system. It summarises processes, alterations made, the data that is produced and where it goes as output and the storage mechanism is defined (Dennis et al., 2009). It has a graphical format which makes it easy to learn understand thus a good tool for communication between users and developers.

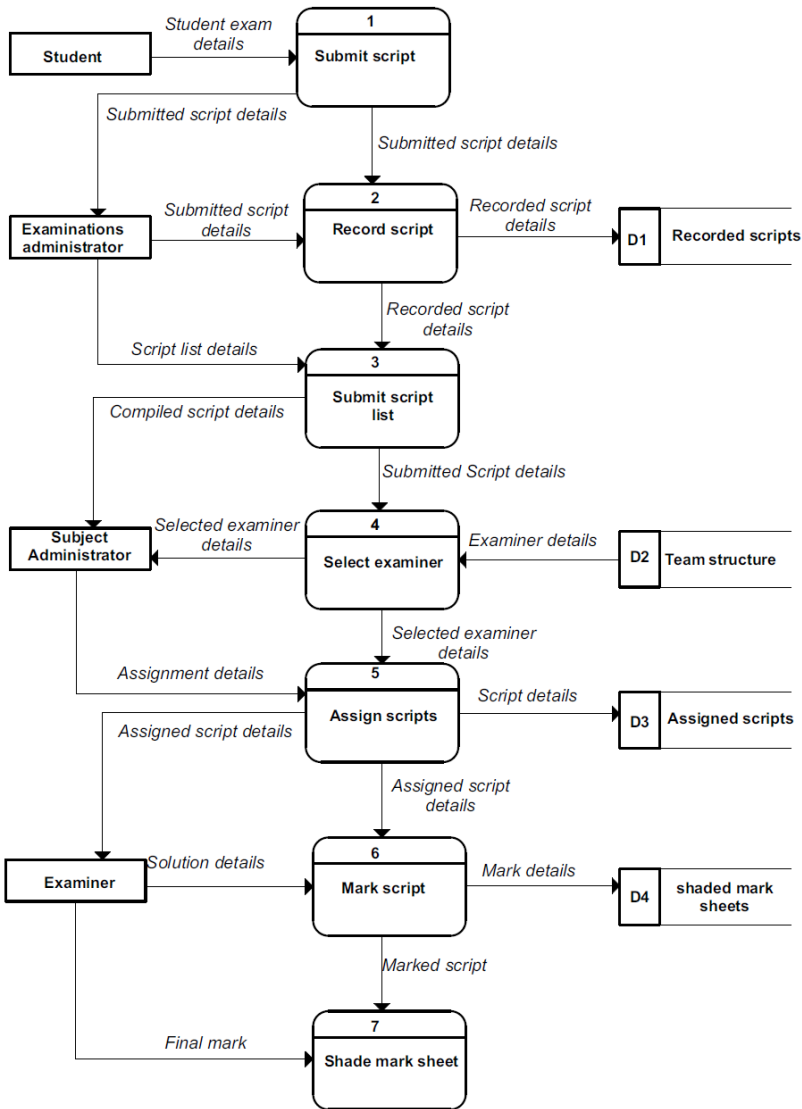
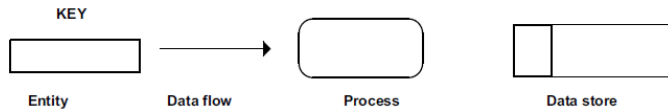


Figure 3.3 Dataflow Diagram of the Current System



3.6 Weaknesses of current system

According to Roebuck (2011), a systems weakness can be revealed by the shortcomings associated with its use. It is a deficiency in an organisation's internal controls which can result in a higher risk that might lead to an organisation's downfall. The shortfalls of the current system were gathered using the different gathering techniques and these are;

- Marks are shaded manually on mark sheets, which increase the chances of human error
- The mark sheets are acquired using foreign currency from the only monopoly Data Resolution Services (DRS) company based in the United Kingdom. They are costly and they are also the sole supplier of scanning machines which can only support their type of paper.
- During the present economic hardships, the Organization is facing difficulty in acquiring the foreign currency needed to purchase the scanner sheets from the Reserve Bank of Zimbabwe and this will turn affect the marks capturing process in the forthcoming exams.
- Too much paperwork, form handling and transportation involved might lead to some mark sheets missing and also dirty or creased sheets which cannot be read by the scanner machines.
- Once the mark sheets get to ZIMSEC there is no effective communication with the markers which can leave many mishaps unsorted.
- The sheets which cannot be read by scanner machines are handed over to exams clerk to manually punch the marks which means the marks are passing through too many hands and security on the mark sheets might be an issue.
- The whole process of shading mark sheets for candidates is time consuming, does not guarantee efficiency and leads to delay in grading and publishing of results.

- The vision of the organization to be competent with other examination bodies is not achieved by the current system since other bodies like Cambridge release results way earlier than ZIMSEC.
- The mark sheets require storage space and are not good for the environment.
- The scanning machines have well depreciated and require regular maintenance. they are functioning below expected standards.
- Data may be lost at any time due to lack of security controls.

3.7 Evaluate Alternatives

Dennis et al. (2009) this calls for the assessment and weighing and determining the need for a new system. Various alternatives of implementing the system will be assessed and the best which helps in achieving goals is chosen for the organisation.

For the online mark capturing and grading system, the developer studied each alternative in detail. The available alternatives were outsourcing, enhancement of the current system and in house development. These were discussed briefly outlining their feasibility operationally and economically

3.7.1 Outsourcing

Outsourcing is when an organisation engages a reliable and well established third party to assist in its business processes. Once contracted the service provider becomes accountable for the operations and maintenance of the system (Baltzan and Phillips, 2015). The team members outlined the advantages and disadvantages associated with outsourcing the new system

a) Advantages

- Much of the work is done externally giving the organisation an opportunity to focus on other pressing issues
- Outsourcing reduces operational expenses for the organisation.
- Software of high quality may be obtained from a reputable third party

b) Disadvantages

- The software cannot be modified in case of new requirements.
- Outsourcing might be costly.

3.7.1.1 Reason why outsourcing was not chosen.

This alternative was not chosen because it would not involve active participation of users at the council and there would be risk of resistance to change. There is readily available equipment at the council for the development of the system and the online marks capturing and grading system is an essential process which would require great confidentiality so outsourcing would not be ideal for security reasons as well.

3.7.2 Improvement

Improving a system will allow a business to have more control, consistency, efficiency, effectiveness and sustainability (Cassidy and Guggenberger, 2000) When the improved system follows a well-tested set of steps, errors and delays are reduced, there is less duplication of work, and users and clients in this case the candidates are more satisfied. The system in existence will be modified to suit user needs.

a) Advantages

- When an improvement is done within the organisation, the system becomes easy to use, maintain and will take less time to complete.
- The alternative is cheaper as it is done within the organisation and does not require much training.
- Improvement of the current system will bring confidence that the system is now performing better than before and security is guaranteed since it is done internally.

b) Disadvantages

- An improvement might not completely address the problems of the current system.
- An improvement might bring about changes in routine operations which might not be favourable to users.

3.7.2.1 Reason why improving the current system was not chosen

An improvement to the current system was not chosen as it had a probability of not addressing or solving all problems being encountered currently and there were chances of resistance to change as improvement would mean change in daily operations for council employees.

3.7.3 In-house Development

This alternative takes place onsite and is ideal for organisations with enough resources and favourable infrastructure to develop software on their own. It gives access to knowledgeable support because the

development is carried out by the in house team (McCarthy, 2005). ZIMSEC will use internal Information Services employees to develop a system tailor made for the organisational needs.

a) Advantages

- In-house development would not compromise on security of confidential information about candidate's marks.
- Much commitment noted from employees as they become active participants of the system development.
- Complete ownership will grant the development team the right to modify and upgrade any time.

b) Disadvantages

- Much time might be consumed while developing the system.
- The organisation will be liable for all risk that might be encountered.
- Data might be lost if the system does not perform as expected.
- The council will not have the opportunity to experience new ideas concerning technology which might be brought by external people.

c) Choice of alternative.

After the assessment of all these alternatives, in-house development was considered the best alternative because of the following reasons;

- There will not be any need to hire external personal thereby cutting on costs.
- Confidentiality of information about candidate marks and grades guaranteed.
- No extra costs incurred on unnecessary features needed to suit the specific needs of the organisation.
- Mark sheets procurement and scanning process are also eliminated.

3.8 Requirements Analysis

This involves evaluating user needs to confirm that the system performs according to their expectations. It describes how the system is going to behave as well as its limitations. Requirements analysis intends to counter current system deficiencies (Dennis et al.,2009) and it is categorised into functional and non functional requirements.

3.8.1 Functional Requirements

According to Haralambos and Holborn (1995), this documentation defines how the system performs and

responds to specific inputs to the system and to any particular scenario. They define what is expected from the system and the activities that the system performs. Table 3.1 illustrates the functional requirements for the online marks capturing and grading system.

Table 3.1 Functional Requirements Table

| | |
|-----|---|
| FR1 | The Administrator will create user types into the system add subject components and components details. They will manage venue administration, reset user passwords, and activate users |
| FR2 | The Administrator will populate the database with provincial administrators, subjects, paper details, schools or centres, candidates, grades and grade boundaries. |
| FR3 | Markers and examiners will be flagged into the system indicating who will be marker and who will be examiner and team structures will be created in the system. |
| FR4 | The centre administrator administers several subjects. They manage the examiner selection and activation to capture marks for a particular their subjects. |
| FR5 | The system will allow the Administrator to enter parameters for grading or grade boundaries and the system will grade marks. |
| FR6 | The administrator will be allowed to view marks and also errors or abnormalities captured across several subject components. |
| FR8 | Centre administrators will view the abnormalities in captured marks and be able to see the responsible person for the error. |
| FR9 | The centre administrator can rectify the error by entering the correct mark taken from the script. |

| | |
|------|--|
| FR10 | The markers or examiners will be authorised to capture candidate marks for particular subjects. They search for a centre and capture marks according to the scripts. |
| FR11 | The system notifies the marker of every effective capture. |
| FR12 | The examiner will capture candidate marks for the second time without viewing what the marker has captured for verification purposes. |
| FR13 | The system will give an alert of any inconsistencies or abnormalities in the marks captured by both the marker and the examiner in the centre administrator's platform |

3.8.1.1 Use case diagram

Use case diagram is a summary of the user details and how they relate with the system. It is a graphical representation of the associations among numerous elements of a system (Miloudi and Ettouhami, 2018). Figure 3.3 illustrates use case diagram for the system

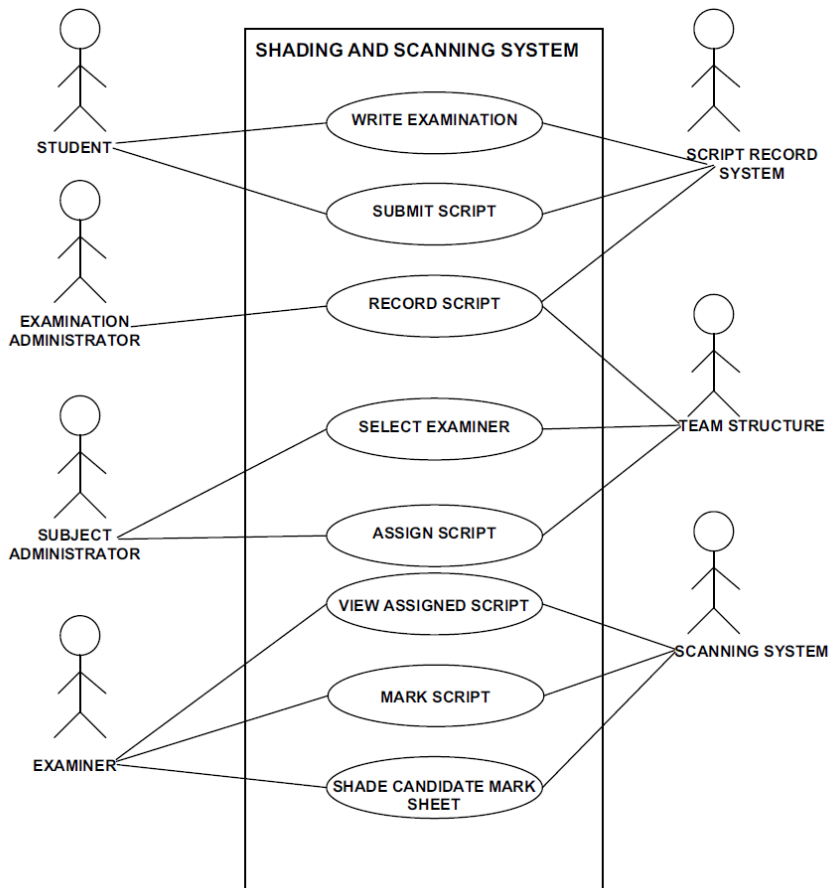
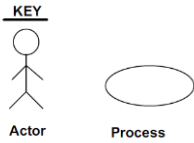


Figure 3.3 Use Case Diagram



3.8.2 Non-functional requirements.

These describe how the software performs as well as the quality issues related with the system. Non-functional requirements do not really consider how the system performs but rather stipulates the measures used to evaluate the system operations (Haralambos and Holborn, 2009). The Non Functional Requirements defined for the online marks capturing system are indicated in table 3.2.

Table 3.2: Non-Functional Requirements Table

| | |
|-------|--|
| NFR1 | System users will login with some unique type of credentials (emails and passwords) |
| NFR2 | The system will be accessed by those with valid emails created by the administrator . |
| NFR3 | For security reasons ,users will be asked to change the default password and put their own password when they log in for the first time. |
| NFR4 | The system will accept one antivirus. |
| NFR5 | Operating system(s) and programming language(s) used shall follow industry standards, be obtainable and broadly used. |
| NFR6 | The user interfaces will be easy to learn and understand and meaningful error messages or prompts will be displayed to assist the user in rectification. |
| NFR7 | The system must discontinue more execution and catch any errors as soon as they occur |
| NFR7 | The system will be operating online (web application) |
| NFR8 | The administrator will have unlimited access to all features of the system. The system administrator shall not have anything to do with capturing of marks , editing or verification but only offer assistance where system is not performing as expected. |
| NFR9 | Complete documentation for all the operations and user maintenance of the system shall be provided. |
| NFR10 | The software application and program will be documented and drafted in a familiar language. Software shall be written in a style that is legible using practices that brings about slight misunderstandings. |

3. 9 Summary

A detailed analysis for the system in operation has been made by means of the numerous fact finding methods. A data flow diagram and context dataflow diagram displays how the data flows in the system from an entity, procedure to data stores. System alternatives have been assessed and developing an in-house system has been chosen as the best alternative basing on cost and efficiency. The next chapter will focus on the proposed system design showing the flow of data between entities and the architecture of the database.

CHAPTER 4: DESIGN PHASE

4.1 Introduction

This phase outlines the structural design, physical design, logical design, and database design of the new system. The logical information obtained from the earlier stage of detailed analysis is converted into the actual logical prototype demonstrating how different processes interact. The software requirements specification document (SRS) is the reference for the product to be developed since it states complete expectations of the users. Functional requirements gathered in the previous chapter will help to project the processes and procedures the system is expected to perform during its lifetime. The system interfaces must be easy to comprehend and will be designed by the non-functional requirements.

4.2 System Design

System design activities include the high level architectural, database, interface and detailed designs. According to Stair and Reynolds (2012), system design is a stage a determination is made on the proposed systems' operations and how it is going to achieve user needs. It seeks to investigate the user requirements in order to give an explanation of the core structure that functions as its foundation. During the phase of system design, many serious strategic decisions are made to accomplish the vital functional and quality requirements of a system. The proposed system should aim at addressing the practical needs of users in an effective, and consistent manner and it will possess the following features.

Efficiency - Required processes by the users should be completed at minimal time. The proposed system should provide anticipated outcome in the stipulated time period. Data should be recovered efficiently if any loss transpires within the system.

Reliability – The application should be well designed in order to produce the expected result. It should be effective enough to partake all the tasks for which it was designed for.

Security – Access should be restricted to unauthorised users to avoid loss of private information. There is need to safeguard data, processes and procedures must be established to handle breach in security.

User Friendly - The user interface must simple to study and understand. System operators must be through the application without much consultation.

Maintainability – The proposed system should be maintainable and adapt to any changes that might occur throughout its lifecycle.

4.2.1. Description of the current system

ZIMSEC mark capturing system has been necessitated by the limitations of the existing shading system currently running at the examination council. The mark capturing application will enable the online capturing of candidate mark details, grading and storing in the marks database. The system will allow marks to be captured twice by both the examiner and the marker as a way of maintaining consistency in the mark captured and the system will report any abnormalities. The system will display visual aids which will show the pass rates per subject, per gender and per province which will be used for analysis and statistics.

4.2.2 Context diagram of the proposed system

The context diagrams demonstrate the way different entities interact within the system, exchanging information, processing and sending to storage (Shelly and Rosenblatt ,2010). The relationship between various entities and the key process which is marks capturing and grading will be illustrated. The context diagram for the proposed ZIMSEC mark capturing and grading system illustrates interactions between the capturing process and marker, examiner and center. The Context diagram is shown on figure 4.1.

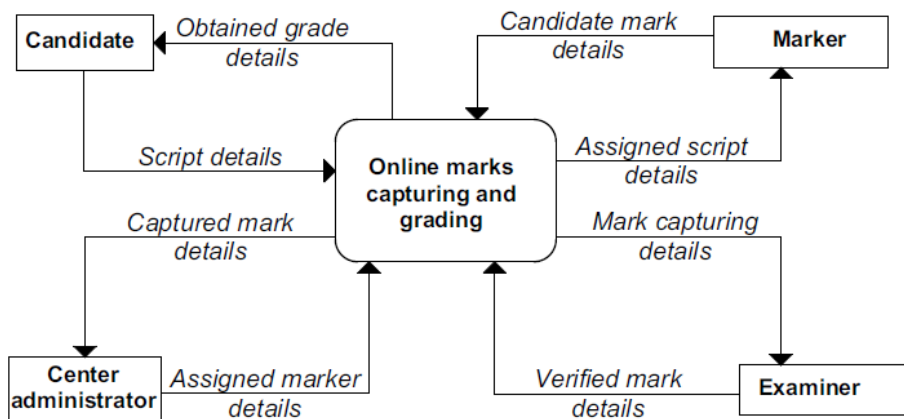
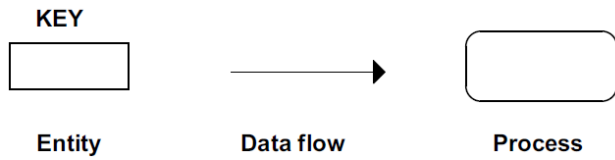


Figure 4.1 Context Data Flow diagram



4.2.3 Data flow diagram of the proposed system

The diagram is more detailed as it reveals the different entities and their relevant processes which they operate in the system and the storage location of the processed data (Shelly and Rosenblatt, 2010). Data flow diagrams demonstrate the linked operations of practical requirements of the system. The processes are outlined in sequential order from the first to the last. This dataflow diagram for the new system is illustrated by the diagram in figure 4.2

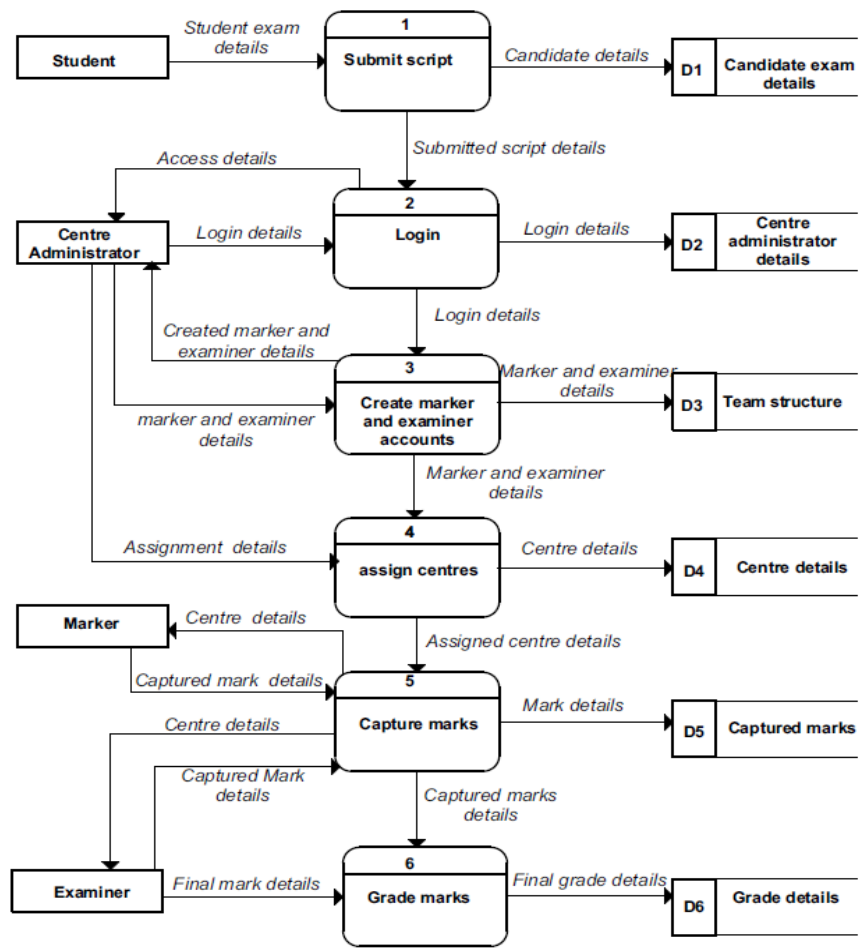
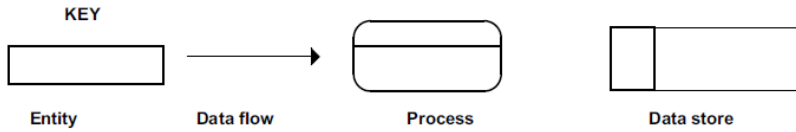


Figure 4.2 Data Flow Diagram



4.3 Architectural Design

The architectural design splits a system into different modules and the interactions between these modules the rationale being to align the representations of the system requirements thus functional or non-functional (Somerville, 2008). This design defines the logical and physical components of the system in general. To understand the architecture under discussion there is need to view these components graphically as shown in figure 4.3

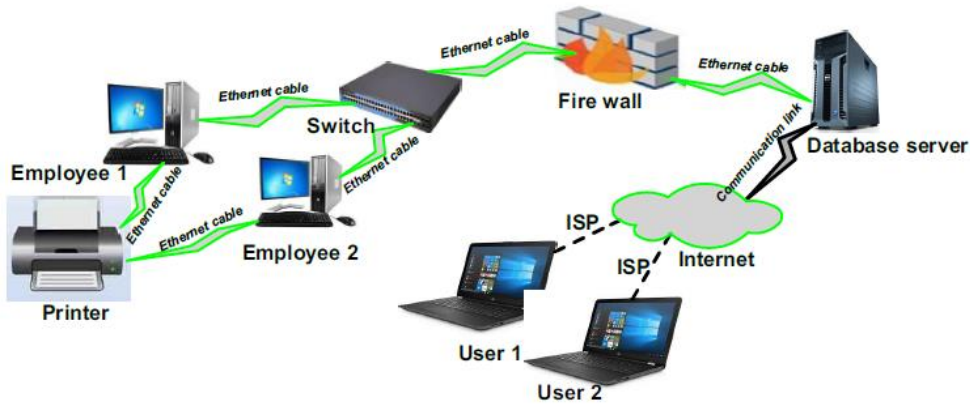


Figure 4.3 Architectural design Source: Somerville (2004)

User 1 and 2 – this is a user machine such as a laptop or desktop used mainly by an appointed Centre Administrator to create examiner and markers accounts.

Internet – Users will be allowed to capture and verify marks online using the internet.

Database Server - The SQL server will store the final captured marks and grades. It will provide access to authorised users to peruse the data for different purposes respectively. The server will be hosted at the ZIMSEC headquarters in Harare.

Ethernet Cable – These provide internet connection as they link the switch with the user machines.

Firewall –This is a software used to block intruders from accessing the network and the marks and grades in the database.

Switch – The switch will host connections of markers and examiners to the database server.

Employee 1 and 2 – These are client machines which access the database from ZIMSEC head office.

4.4 Physical Design

According to Coronel and Crockett (2008), the design mainly focuses on the hardware required for the proposed system's operations and how this hardware is inter linked. An appointed centre administrator will access the system and create accounts for examiners and markers who will work with the system from their relevant marking venues using their desktop to capture candidate marks into database. This is illustrated in figure 4.4

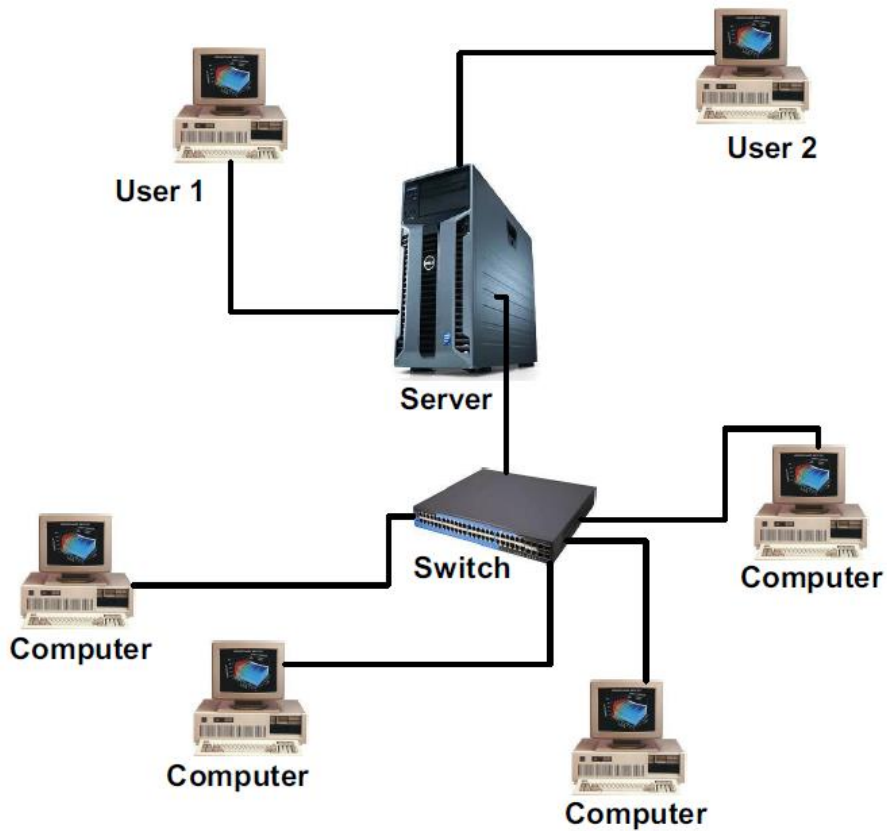


Figure 4.4 Physical Design Source: Coronel and Crockett (2008)

4.5 Database Design

A database stores processed or unprocessed data for organisational use. It makes it easy to retrieve or manipulate information whenever there is need and certain constraints are applied so that there is integrity, consistency and minimal redundancy in the data (Somerville, 2008). The system's database is going to be designed following the ANSI SPARC architecture with three levels as shown in figure 4.5

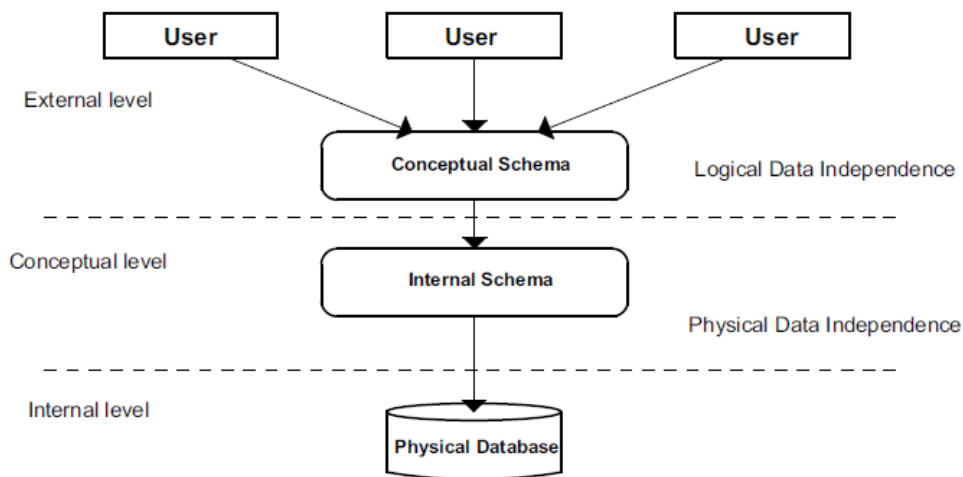


Figure 4.5 Database Design Source: Somerville (2004)

4.5.1 The External View

Each user obtains a tailor made or customised view of the database and it is also referred to as the view level. An index is used to access data that is relevant only to a particular user (Somerville, 2008). In the case of the online marks capturing, the marker marks and captures the candidate mark on the script and the examiner captures the mark for the second time without any of them having access or viewing what the other has captured.

4.5.2 Conceptual Level

The conceptual level shows the relationship that exist between entities in a database in the case of the mark capturing system, the relationship between the exam centre admin and the examiner is shown. Constraints on data, security and integrity are represented. This level illustrates the global view of the database thus it displays the entities, attributes and the relationship that exist for instance the relationship between a marker and an examiner in the mark capturing system. The level provides a community view of the database, hiding implementation details from the users (Coronel and Crocket, 2008).

4.5.3 Internal Level

The level defines the actual physical structure of storage of the database thus the physical view which shows the distribution of memory for data as well as catalogues. It provides easy access to stored data as it clearly describes how the data is stored and pre- arranged. Somerville (2008) describes the internal level as the most technical level of the three levels.

4.5.4 Logical Design

According to Denis (2015), logical design holds related data in an organised format of rows and columns illustrating the description of functional requirement of an information system in the process. The Zimbabwe School Examinations Council will have access to the tables shown in the following tables.

Table 4.1 Login Table

| Field | Type | Descriptions |
|--------------|-------------|-------------------------------|
| Name | varchar | administrator's first name |
| surname | varchar | administrator's last name |
| Email | varchar | administrator's email address |
| Password | varchar | administrator's password |

Table 4.2 Student Table

| Field | Type | Descriptions |
|-----------------|-------------|---------------------------------|
| student_name | varchar | student firstname |
| student_surname | varchar | student surname |
| national_id | varchar | student national identity |
| cand_number | varchar | examination Candidate number |
| Gender | char | gender |
| centre_id | varchar | centre number |
| created_at | date | date centre was created |
| updated_at | date | last date of update |

Table 4.3 Subject Table

| Field | Type | Descriptions |
|--------------|-------------|-------------------------------|
| subject_name | varchar | name of subject |
| subject_code | varchar | code of subject |
| created_at | Date | date subject was created |
| updated_at | Date | date subject was last updated |
| Id | varchar | subject Identity |

Table 4.4 Paper table

| Field | Type | Descriptions |
|--------------|-------------|------------------------|
| paper_name | varchar | name of paper |
| Description | varchar | structure of paper |
| total marks | Int | marks for the paper |
| subject_id | varchar | subject identification |

Table 4.5 Exam Centre Table

| Field | Type | Descriptions |
|---------------|-------------|------------------------------|
| Centre_name | varchar | name of exam centre |
| area_name | varchar | area where centre is located |
| centre_number | varchar | number for the centre |
| user_id | varchar | centre identification number |
| created_at | date | date centre was created |
| updated_at | date | date centre was last updated |

Table 4.6 Marks Table

| Field | Type | Descriptions |
|----------------|-------------|----------------------------|
| paper_id | varchar | paper Identity |
| student_id | varchar | student Identity |
| marker_marks | Integer | marks captured by marker |
| examiner_marks | Integer | marks captured by examiner |
| Percentage | varchar | mark percentage |
| Marker | varchar | marker name |
| Examiner | varchar | examiner Name |
| Status | varchar | |
| created_at | date | date mark was captured |
| updated_at | date | date mark was last updated |

Table 4.7 Grades Table

| Field | Type | Descriptions |
|--------------|-------------|-----------------------------|
| Min | integer | minimum mark obtainable |
| Max | integer | maximum mark obtainable |
| grade_name | char | name of grade |
| created_at | date | date grade was created |
| updated_at | date | last date grade was updated |

4.5.5 Enhanced Entity Relationship Diagram

Database architectural design includes with it entity relationship diagrams. The method shows a graphical representation of entities, their respective attributes and the relationship that exist amongst them (Kendall and Kendall, 2005). The entity relationship diagrams convey the super type and sub type relationship that exists. The super type possessing subtype entities with a unique attribute. The enhanced entity relationship diagram can be of overlap or disjoint type. The disjoint type denoted by a (d) is where entities are strictly confined to their area or field and an overlap denoted by an (o) displays an entity which can carry more than one task. In the case of the mark capturing system the disjoint type exists because a marker cannot be examiner an examiner cannot be a marker and this is also true for the centre administrator. They all possess unique attributes making them a subtype. The enhanced entity relationship diagram is shown in figure 4.6

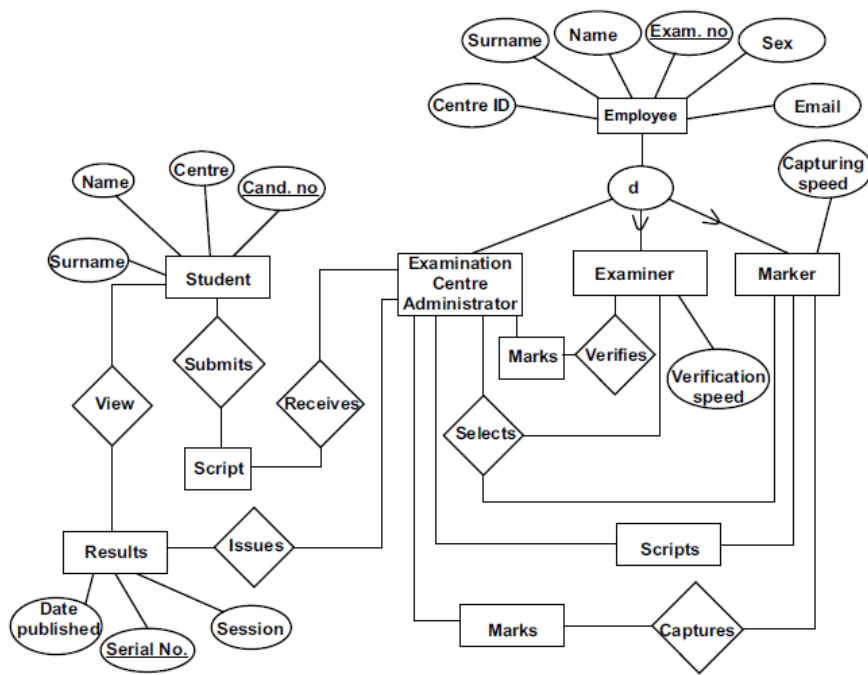
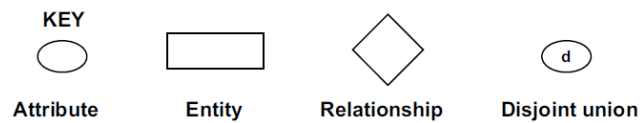


Figure 4.6 Enhanced Entity Relationship Diagram



4.6 Program design

A program can be defined as set of regular of commands that tells a computer what to do (Dennis, 2012). Program design includes program units, classes, and tasks of a system that users interact. In context of the Zimbabwe School Examinations Council, the program design for the new system will comprise all

procedures involved from the examination stage, submits the script until the mark they obtain is graded by the system. Users desire systems that are not difficult to use and understand therefore a user –friendly interface was implemented to cater for good communication between the mark capturing application and its relevant users. The use of package and sequence diagrams will help illustrate the program design for the mark capturing and grading system.

4.6.1 Package Diagram

A package diagram interconnects software modules or units of a system logically and these modules are denoted in classes to form packages (Somerville, 2008). Figure 4.7 illustrates the package diagram for the capturing and grading system.

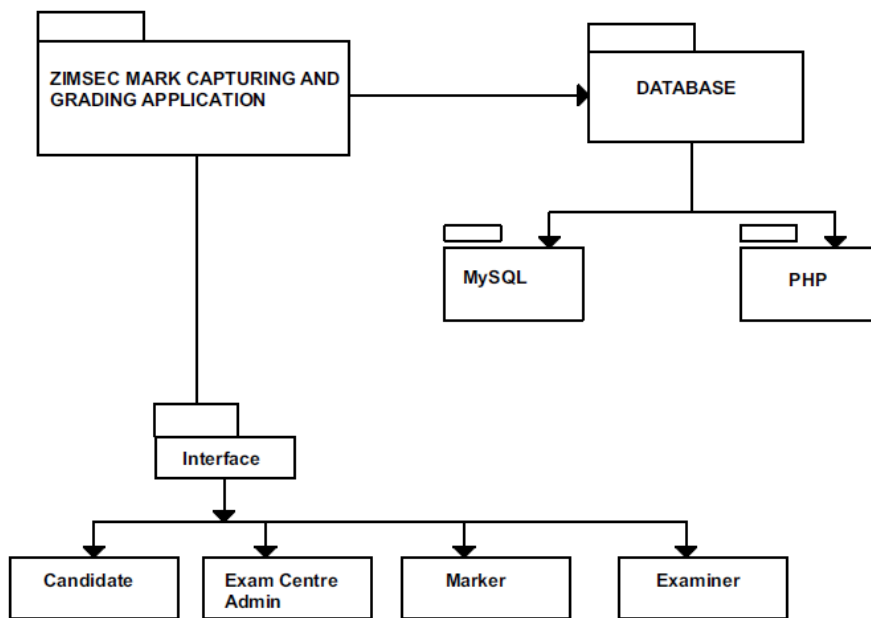
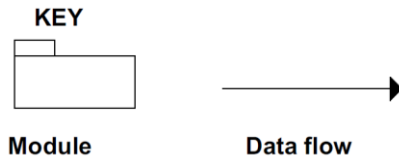


Figure4.7 Package Diagram



4.6.2 Class Diagram

A class diagram signifies the relationship between objects. In object oriented programming, a class is denoted as a collection of interrelated objects meaning these objects which are related combine to form a class. The objects in a class have their own attributes and behaviour (method) (Somerville,2001). The Employee acts as the superclass or parent class with examiner, marker and centre administrator as subclasses or child classes. The examiner, marker and centre administrator are the objects of the class employee as illustrated in figure 4.8.

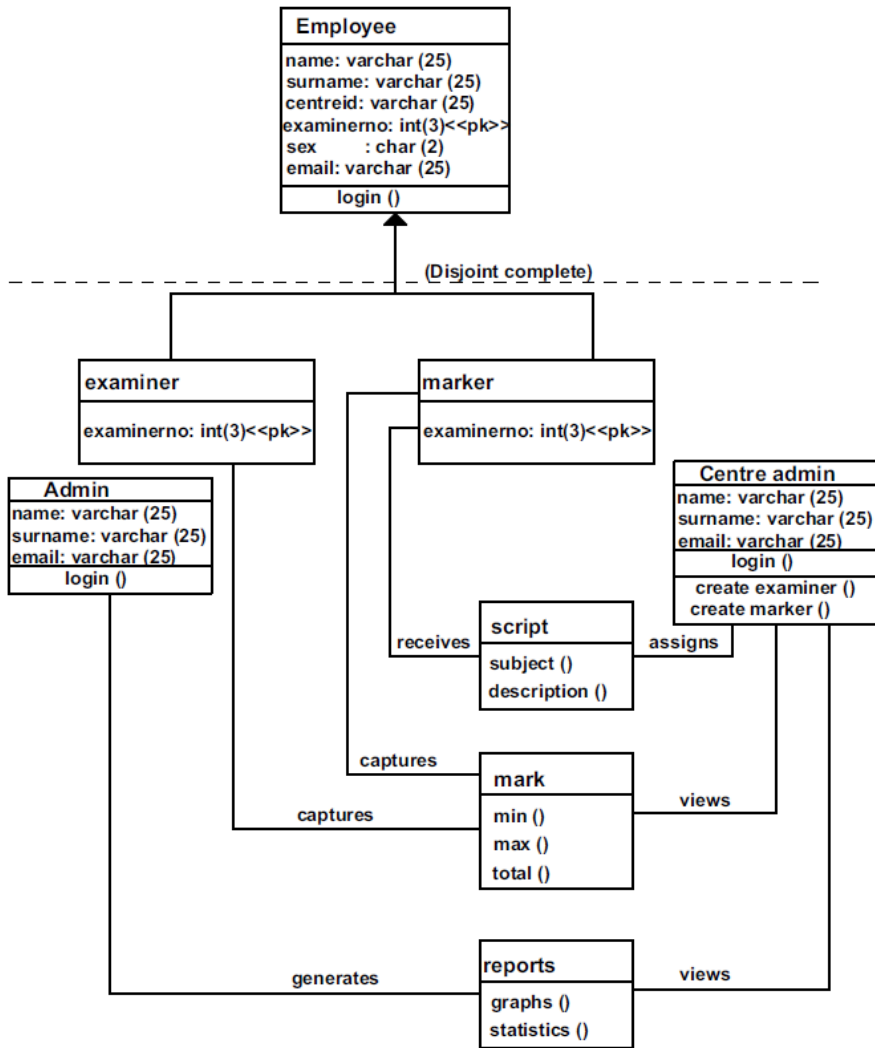


Figure 4.8 Class Diagram

KEY

| |
|------------|
| Class name |
| Attributes |
| Processes |

4.6.3 Sequence Diagram

A sequence diagram displays how objects communicate with each other in a defined sequence which brings an understanding of the operations of the system from beginning to end. The methods used by these objects are displayed as the data which flows from one entity to another. A comprehensive depiction of the complete system can be drawn to show the logic behind the system design. A sequence diagram for the new system is shown in figure 4.9.

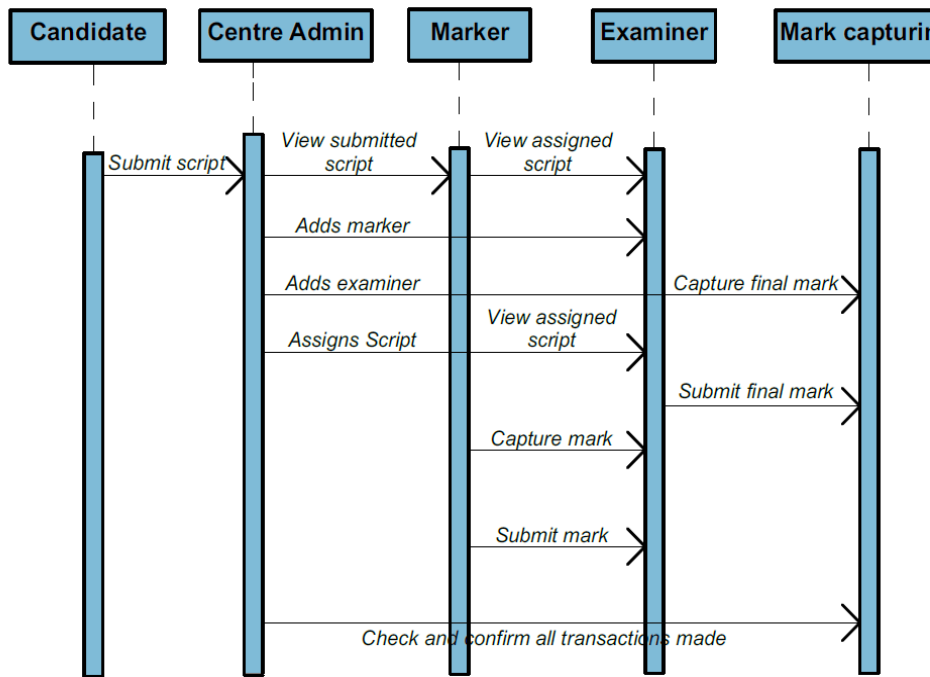


Figure 4.9 Sequence diagram

4.7 Interface design

Denis (2012) says that an interface design includes forms, reports and displays on the screen and they provide users with an opportunity to interact with the system. The interface design for the mark capture system was designed in a friendly and self-explanatory such that users can interact or communicate with the system with less or no supervision at all. The design of interfaces has a great impact on system acceptance within the organisation.

4.7.1 Menu design

A menu is a list of options provided to the user so that they interact with the system efficiently. System users are permitted to navigate around it so as to select the preferred option (Dennis, 2012). It supports users in performing numerous actions through navigating the functions offered by the system.

4.7.1.1 Main menu

The main menu contains sub –menus to assist all system users in selecting the desired option. The users will access the main menu after they log into the system and dashboard has been included which allows quick viewing of system functionalities. Figure 4.10 represents the main menus .

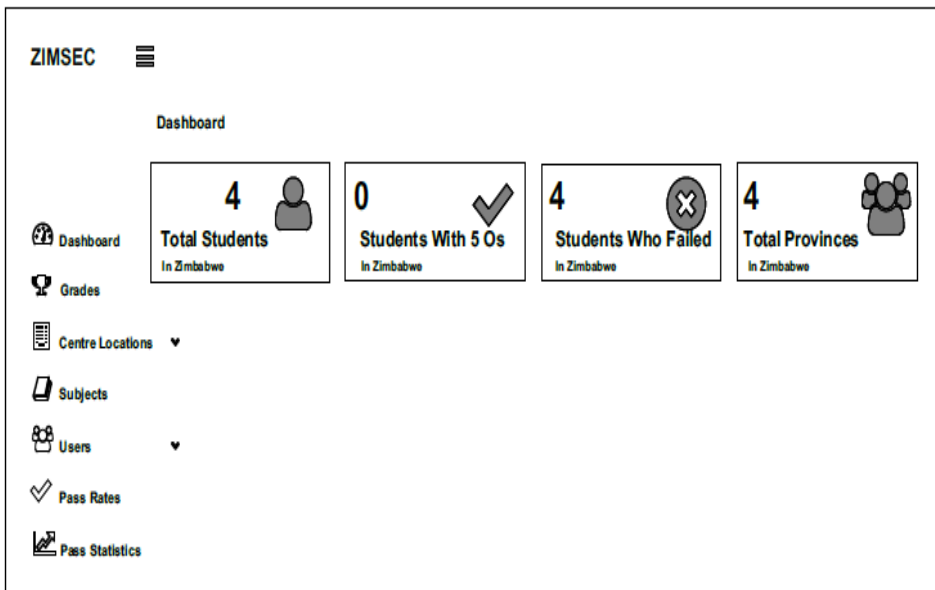


Figure 4.10 Main Menu

4.7.1.2 Sub-menus

Submenus give users additional options to execute the processes of the system and they differ according to the role of the respective user in the system. The administrator sub menu gives the options to add users, subjects, provinces and districts and has more options than any other menu.

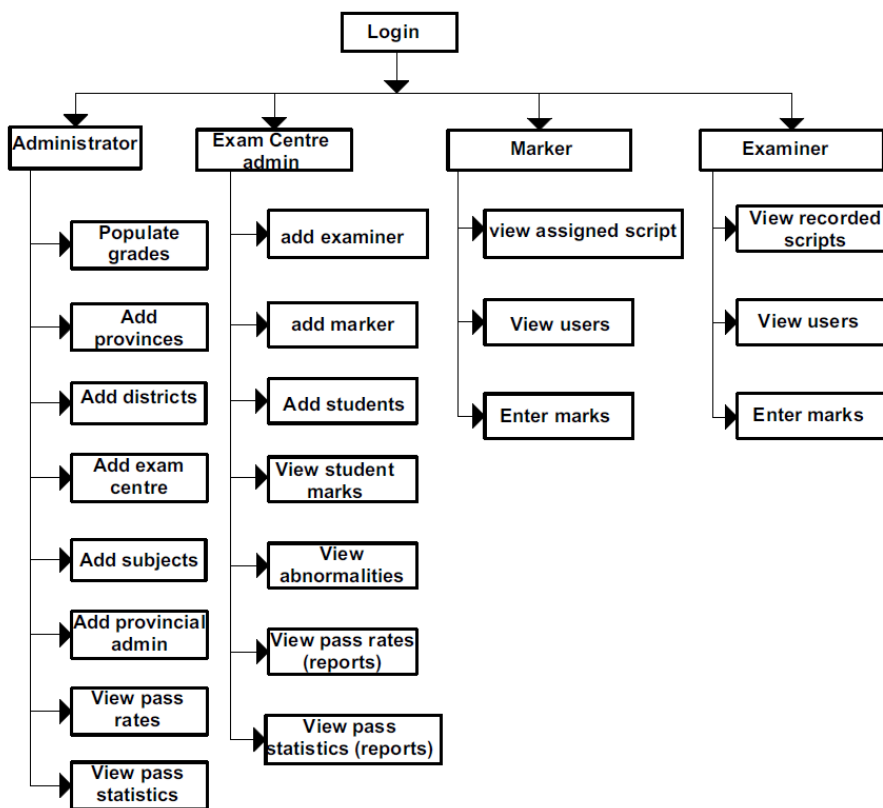



Figure 4.11 Sub menus

4.8 Input design

Input design is the design that allows users to enter some information into the system (Shelly and Rosenblatt, 2012). The data is processed and transformed to output. Data validation and verification is made so that accuracy is guaranteed and also that the system will only accept correct data types within the relevant data fields. Figure 4.12 demonstrates log in platform where an email address and password are required in order to gain entry or access.


Login Form

**ZIMBABWE SCHOOL
EXAMINATION
COUNCIL**

Figure 4.12 Login

Figure 4.13 shows the Provincial administrator creating an account for the district administrator by providing their credentials as follows

Add new User

First name * Surname * Email Address *

Select District

▼

District Admin

| Name | Surname | Email. | District |
|------|---------|--------|----------|
|------|---------|--------|----------|

Figure 4.13 Create new user.

4.8.1 Output design

Hofferand and Morden (2011) define output as the result of data processed the system to become more meaningful and be used for different purposes like decision making. ZIMSEC mark capturing application displays output to users through dashboard which is a modern and convenient way of representing out to users

The Administrator is able to view output from the system dashboard which displays the output from the whole system. Figure 4.14 illustrates the output dashboard

ZIMSEC

Dashboard

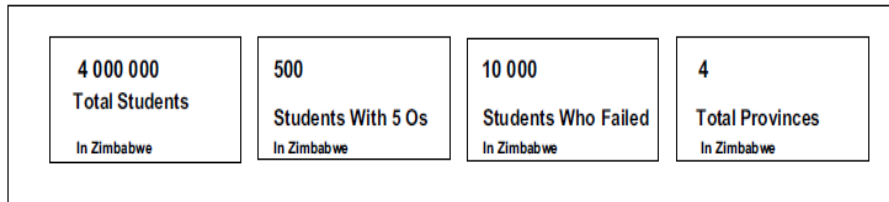


Figure 4.14 Feedback

The system also displays the grade boundaries which operate as guidelines for grading marks. Figure 4.15 illustrates the grade boundaries.

Dashboard

| Grade Symbols | Min Mark | Max Mark |
|---------------|----------|----------|
| A | 80 | 100 |
| B | 60 | 79 |
| C | 50 | 59 |
| D | 40 | 49 |
| E | 30 | 39 |
| U | 0 | 29 |

Figure 4.15 Grade Boundaries

The marks being captured by the marker from the script to the relevant candidate represented by the centre number and candidate number.

Recording English language Marks

| Subject | Candidate Number | Enter Marks | |
|----------------------|------------------|---------------------------------|-------------------------------------|
| English language-One | ZIM-4 2019-1661F | <input type="text" value="20"/> | <input type="button" value="Save"/> |
| English language-One | ZIM-4 2019-8040 | <input type="text" value="45"/> | <input type="button" value="Save"/> |
| English language-One | ZIM-4 2019-47VM | <input type="text" value="78"/> | <input type="button" value="Save"/> |
| English language-One | ZIM-4 2019-4604 | <input type="text" value="63"/> | <input type="button" value="Save"/> |

Figure 4.16 Captured marks.

4.9 Pseudo Code

A Pseudo code describes the operations of a system in english like statements that follow a specific order of execution in detail (Somerville, 2008).

Login

Administrator log in

Accept email and password

If records match, *then*

direct admin to home page

else display login failed message

Adding new user

Accept name, surname and email

Register user

else user creation failed message

Adding grades

Accept grade name

Accept max-marks and min-marks

Register grade

Else display grade registration failed message

Adding centre locations

Accept province name

Register province

Accept district name

Select province

Register district

Accept exam centre name and location name

Select district

Register exam centre

Else display registration failed

Adding Subjects

Accept subject name

Register subject

Else display error adding subject

Capturing marks

Accept center number

Accept candidate number

If records match

Accept mark

Else display

mark capture failed

Verification of marks

Accept centre number

Accept candidate number

If records match

Accept mark

Verify mark

If marks match

Accept final mark

Else display different marks error message.

4.10 Security Design

The design phase will not be concluded without taking a look at issues concerning security surrounding the proposed online mark capturing system for the school examination council. A security threat is any act that can be performed on a system with the intention of harming its routine operations (Zacker, 2000). In this process confidential information maybe lost and it deforms the reputation of the organisation. The system was designed with security measures put in place to safe guard against unauthorised access which might make the system vulnerable to any threats.

4.10.1 Physical Security

The physical assets of an organisation such as desktops, servers and switches need to be protected against harmful acts such as burglary, vandalism, and natural disasters like fire (Hughes and Cottrell, 2009) Physical security for the system will be implemented by use of strong burglar bars and locks, fire extinguishers, Closed Circuit Television (CCTV) and engaging a disaster recovery site.

4.10.2 Network security

This kind of security safeguards the network from intruders such as hackers who might enter the network with harmful intentions (Kendall and Kendall, 2005). The capturing system will be online therefore there is need to protect the data that moves inside the network. A proxy server which helps bring the internet in the organisation using its public IP address will be used together with a firewall which filters traffic that enters the network. A ZIMSEC domain server will deal with updates of antivirus to avoid harmful bugs from entering the system.

4.10.3 Operational security

These are the threats that can damage operations of the system during its working or operational life. The vulnerabilities may be internal (inside the organisation) or external (outside the organisation) (Pierce, 1992). When users are operating a system, they may expose sensitive information and there is a threat that intruders may attack the system. During the operation of the system, security will be granted through the use of email and passwords and the data being processed will be in an encrypted format.

4.10.4 Summary

A more practical approach was used in the design phase to provide a comprehensive view of the system. Tools such as dataflow diagrams, tables, entity relationship diagrams were used to illustrate processes and entities within the system. The input / output forms, menus were illustrated to portray a clear image of the new system features and operations. At this juncture, a conclusion can be that the system can now be implemented successful so as to carry the operations it was designed for. Implementation of ZIMSEC's new system will be covered in chapter five which is the next and last chapter in this research.

CHAPTER 5: IMPLEMENTATION PHASE

5.1 Introduction

After the design of the system is complete, it is then deployed so that users can now attempt to interact with the system. The system will be given or handed over to the users only after it has gone through the different types of testing that will be discussed in this chapter. The system will be tested against its objectives mentioned in the first chapter to ascertain whether it is performing as expected by the users and validation and verification testing procedures will be used. Different methods of implementing the system, known as changeover strategies will be discussed and the most appropriate method will be chosen.

5.2 Coding

Coding refers to the process or procedure which encompasses transformation of basic text into grammar that a secure channel or a medium can transmit (Reynolds, 2013) a code can be written in different languages interpreted by the compiler and for the development of the capturing application, Pre-processor Hyper text programming language was used.

5.3 Testing

System testing is done for the purposes of validation and verification so that system objectives are achieved. System testing is done with reference to the mentioned objectives of the system to ensure that they are being met as specified. Testing cleans the system of any errors or bugs making it efficient and accurate as it fulfils its desired goals. The verification and validation procedures are carried out in order to ensure that the user specifications are being met by the system (Dustin, 2002). The testing operation follows a series of stages as shown in figure 5.1

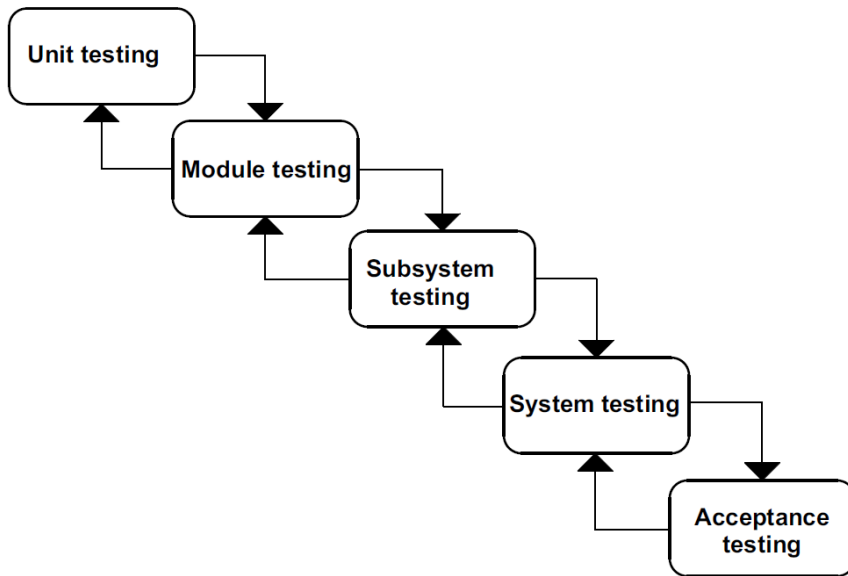


Figure 5.1 Testing Process Source: Somerville (2012)

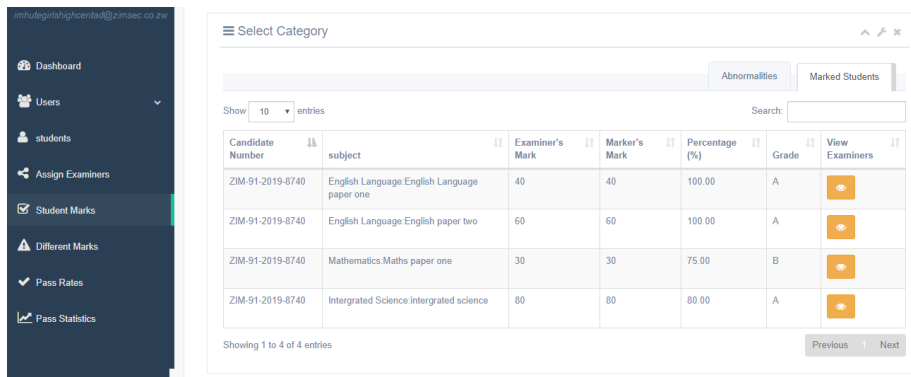
5.3.1 Unit Testing

This indicates the smallest testable part representing an application for instance functions, classes, procedures and interfaces (Whitten ,2013). These separate components of source code are verified to ascertain whether they are appropriate for use. The unit testing is basically carried out by software engineers to get an assurance the program accomplishes its and requirements and that individual parts are working correctly. Any function or procedure should return proper values when a set of inputs are given and failures should be handled gracefully during the course of execution when an invalid input is given. The system passed unit testing successfully as the marks capturing data was added into MySQL database. Various other units were tested for errors and input was obtained from past dummy records used in the manual system in the past. Approaches to unit testing are the black box and the white box testing.

5.3.1.1 Black Box Testing

This focusses more on functioning and meeting objectives rather than testing for the operations of the application (Hudges and Cotterell, 2009). The software is tested without knowledge of how the code is organised and it proves to be a valuable test as it reveals concealed bugs or errors in the code snippet and it ensures a thorough test on the implementation of the system.

The system was testing here for the functionality of capturing and grading marks as shown in figure 5.2



| Candidate Number | subject | Examiner's Mark | Marker's Mark | Percentage (%) | Grade | View Examiners |
|------------------|---|-----------------|---------------|----------------|-------|----------------|
| ZIM-91-2019-8740 | English Language:English Language paper one | 40 | 40 | 100.00 | A | |
| ZIM-91-2019-8740 | English Language:English paper two | 60 | 60 | 100.00 | A | |
| ZIM-91-2019-8740 | Mathematics:Maths paper one | 30 | 30 | 75.00 | B | |
| ZIM-91-2019-8740 | Intergrated Science:intergrated science | 80 | 80 | 80.00 | A | |

Figure 5.2 Black box testing

5.3.1.2 White box testing

White box testing is performed by the programmer because it requires a deeper understanding of the core logic of the application's code. It is an exceptional type of testing done especially when the code is too complicated (Whitten, 2013). It is concerned with the innermost operations of the component of the module.

5.3.2 Module testing

The test determines the ability of the software modules to work collectively or in combination with one another. The different set of modules should be able to work together after the integration of their functionalities to accomplish a common purpose (Jawadekar, 2004).the test continues stage by stage until all modules have been combined and function as required. In figure 5.3 the capturing and the verification modules were combined together to test their functionality

| Candidate Number | subject | Examiner's Mark | Marker's Mark | Actual Mark | View Examiners |
|------------------|---|-----------------|---------------|----------------------|----------------|
| ZM-91-2019-8740 | Mathematics:Maths paper one | 30 | 28 | <input type="text"/> | Save |
| ZM-91-2019-8740 | Mathematics:Maths paper two | 45 | 60 | <input type="text"/> | Save |
| ZM-91-2019-8740 | Intergrated Science:Intergrated science | 80 | 56 | <input type="text"/> | Save |
| ZM-91-2019-8740 | Accounting:Accounting | 58 | 45 | <input type="text"/> | Save |
| ZM-91-2019-8740 | Commerce:Commerce | 58 | 79 | <input type="text"/> | Save |
| ZM-91-2019-7671 | English Language:English Language paper one | 35 | 25 | <input type="text"/> | Save |
| ZM-91-2019-7671 | English Language:English paper two | 30 | 60 | <input type="text"/> | Save |

Figure 5.3 Module testing examiners mark is compare to the marker's mark for verification purposes.

5.3.3 Subsystem testing

A subsystem is formed when one or more modules are connected together. The testing done at the subsystem level assesses how modules work together as they are added (Kendall and Kendall ,2015). The modules are combined together to form a subsystem and the test is then executed to identify concealed errors occurring in combined system modules.

5.3.4 System testing

The application is tested as whole to evaluate the execution of the combined sub-systems (Limaye ,2009). The system has to comply with the stated requirements and errors caused by merging of modules will also be tested and identified. The effectiveness of the developed system will be compared with the existing system and any errors occurring while the system is functioning are identified. In the mark capturing system, the capturing module, grading and verification module were combined together to evaluate how they work together as illustrated in Figure 5.4 and 5.5

| Candidate Number | subject | Examiner's Mark | Marker's Mark | Actual Mark | | View Examiners |
|------------------|---|-----------------|---------------|----------------------|------|----------------|
| ZIM-91-2019-8740 | Mathematics Maths paper one | 30 | 28 | <input type="text"/> | Save | |
| ZIM-91-2019-8740 | Mathematics Maths paper two | 45 | 60 | <input type="text"/> | Save | |
| ZIM-91-2019-8740 | Intergrated Science Intergrated science | 80 | 56 | <input type="text"/> | Save | |
| ZIM-91-2019-8740 | Accounting/Accounting | 58 | 45 | <input type="text"/> | Save | |
| ZIM-91-2019-8740 | Commerce Commerce | 58 | 79 | <input type="text"/> | Save | |
| ZIM-91-2019-7671 | English Language English Language paper one | 35 | 25 | <input type="text"/> | Save | |
| ZIM-91-2019-7671 | English Language English paper two | 30 | 60 | <input type="text"/> | Save | |

Figure 5.4 Capturing and verification modules combined

Graded candidates after verification

| Candidate Number | subject | Examiner's Mark | Marker's Mark | Percentage (%) | Grade | View Examiners |
|------------------|---|-----------------|---------------|----------------|-------|----------------|
| ZIM-91-2019-8740 | English Language English Language paper one | 40 | 40 | 100.00 | A | |
| ZIM-91-2019-8740 | English Language English paper two | 60 | 60 | 100.00 | A | |
| ZIM-91-2019-8740 | Mathematics Maths paper one | 30 | 30 | 75.00 | B | |
| ZIM-91-2019-8740 | Intergrated Science Intergrated science | 80 | 80 | 80.00 | A | |

Figure 5.5 the final mark has been graded

5.3.5 Acceptance testing

Acceptance of a system is done by its users hence the term acceptance testing. There should be complete picture that the users have confirmed that the system meets their requirements and they have approved of it (Rosenblatt, 2011). Acceptance testing is computed in two stages;

5.3.5.1 Alpha Testing

This test is done to discover and fix bugs that could not be discovered in tests done in the early stages (Rosenblatt, 2011). Before the application was given to external examiners it was tested in a lab situation by the district and centre administrators who work at the examination council. Minor changes took place at after this test and these included spelling mistakes and broken links which were rectified.

5.3.5.2 Beta Testing

Beta testing is the last testing conducted before the software is deployed to users for commercial use (Fine, 2002). Contributions and feedback about the system is sent back to the developers so that they make their final changes to the system before it is deployed for use. The resultant system is error free and efficient after this since it is tested under routine practical operations of the business. Beta testing added value to the software development as it gave the real users such as examiners and centre administrators a chance to deliver their inputs into the system so as to test the functions, and operations of the online marks capturing system. Center administrators managed to create profiles for markers and examiners who are going to capture and verify marks into the system respectively.

5.3.6 Testing strategies

Test strategies were implemented on the mark capturing and grading system for validation and verification purposes.

5.3.6.1 Validation

Somerville (2012) defines validation testing as a testing procedure carried out to determine whether the system is accepting the right input in terms of data type predefined during coding. An example would be entering integers where the data type declared for that variable requires string type. The system should not accept such input in this case to guarantee that the validation is accurate. Validation attempts to answer the following questions,

- Does the software fulfil its intended use?
- Is the organisation building the right product?
- Can the system be properly implemented?
- Are the documents in line with the development process?

a) Test Cases

These are tests that determine system capabilities. Output from the system should be of high quality as anticipated. Test cases were conducted with both dummy and real data. The administrator at the back-end entered user details while creating provincial administrators. A pop up message will be displayed where fields are left null and no processing will take place before the fields are populated with the required data.

The administrator is prompted to provide the system with user credentials during account creation. The process cannot be completed if any fields are left null as indicated by the pop up error message.

The image shows a web application interface for user creation. The top section is titled 'Add New User' and contains three input fields: 'First Name' (containing 'Zenzo'), 'Surname *' (containing 'Mhute'), and 'Email Address *' (which is empty and has a red border). Below the 'Email Address *' field is a red error message: 'Please enter the email address of the user'. There is also a 'Select Province' dropdown menu with 'SELECT HERE' selected. A blue 'Save' button is located at the bottom right of the form.

The bottom section is titled 'ProvincialAdmin' and shows a table with one entry. The table has columns for Name, Surname, Email, and Province. The entry is for 'Adiola' with surname 'mhute' and email 'adymharprovad@zimsec.co.zw' in the 'HARARE' province. Above the table, there is a 'Show 10 entries' dropdown and a search box.

| Name | Surname | Email | Province |
|--------|---------|----------------------------|----------|
| Adiola | mhute | adymharprovad@zimsec.co.zw | HARARE |

Figure 5.2 User Creation



Figure 5.3 Login validation

Creating user account

The system administrator creates Provincial administrators in the system. Figure 5.4 illustrates an error message displayed due to the input of wrong credentials into the system

An invalid error message for an email address is shown

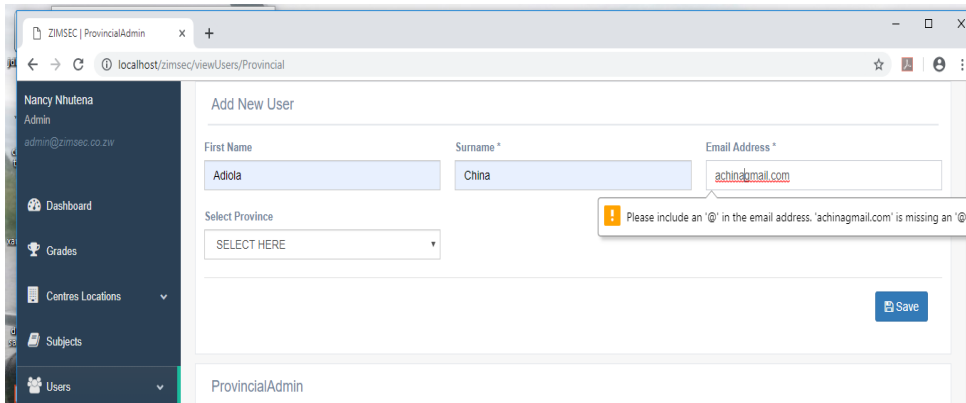


Figure 5.4 Creating user account

When the grade boundary entered is invalid a message will show

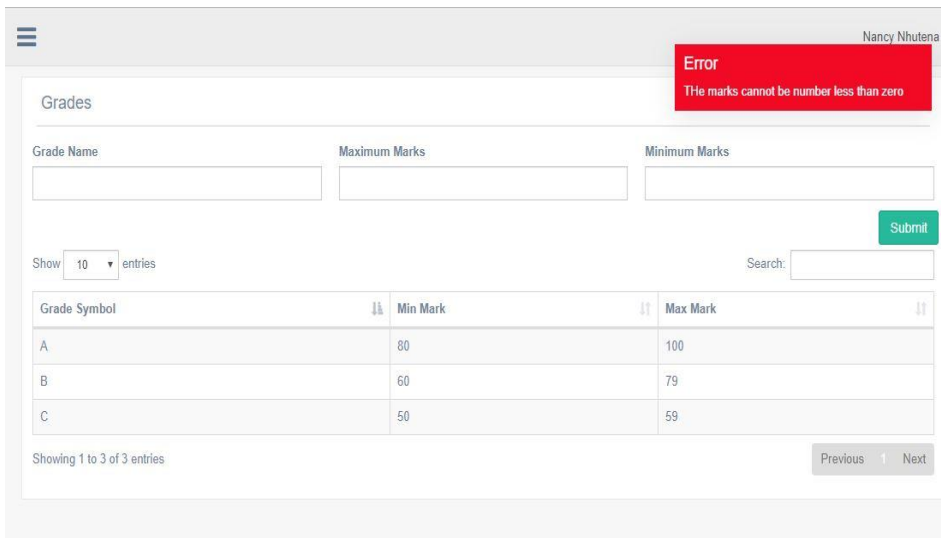


Figure 5.5 Invalid grade boundary

b) Security Testing

This type of testing is done to ensure that the system will not allow unauthorised access at any given point in time (Grady, 1997).The mark capturing system will allow access to the system by provision of a valid email and password generated by the system and sent straight to the users account. Each user will only access their relevant portal and it will be displayed on the menu.

User access levels

Users only access information which is relevant to them. The marker and the examiner perform similar tasks of capturing the same mark but each of them cannot see or view what the other has captured. They both see what is only relevant to them.

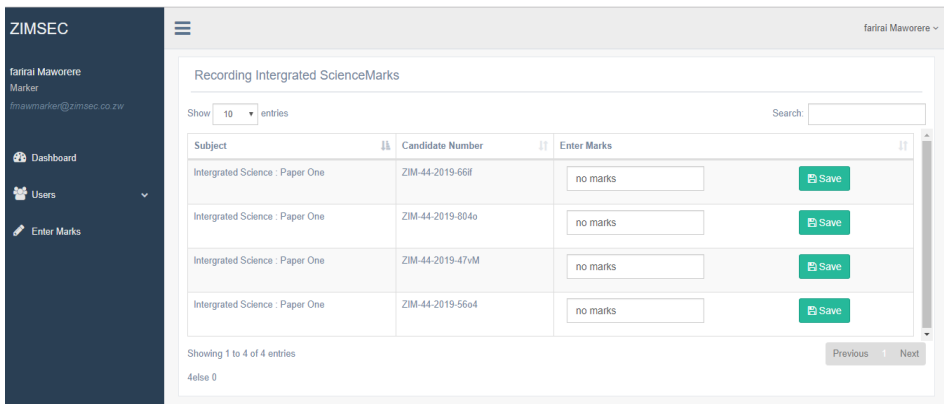


Figure 5.6 Marker platform

The examiners platform will allow verification of marks only without seeing what the marker has captured first.

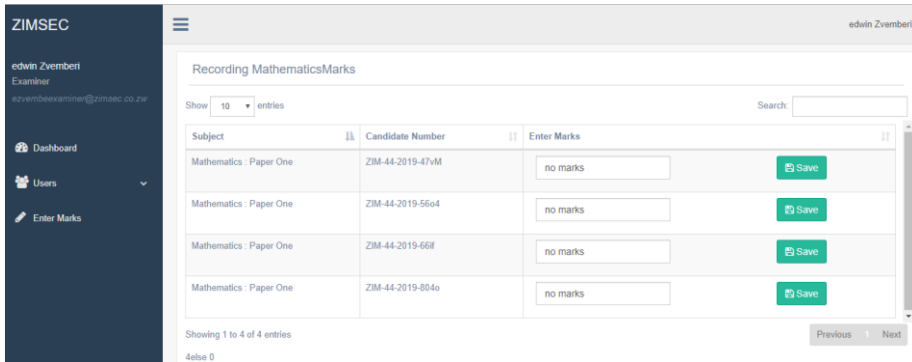


Figure 5.7 Examiner platform

Data integrity

Accurate data must be provided to the system for processing. The Administrator populates the database with most of the functions. The system first checks for null values and these are not accepted so an error message will display asking for input into the particular field before processing anything. The next step will be to check data type and when entering grades, a grade symbol cannot be repeated. The grade symbols should be within the range of the predefined symbols A, B, C, D, E, U. The system will not accept negative digits on mark boundaries and these are all shown in the figures to follow.

The system will not accept null values in any field as shown in Figure 5.8

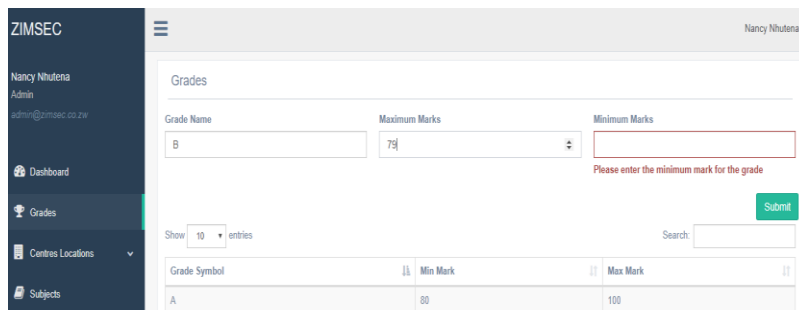


Figure 5.8 Null values

The subject name has been validated to accept string data type only.

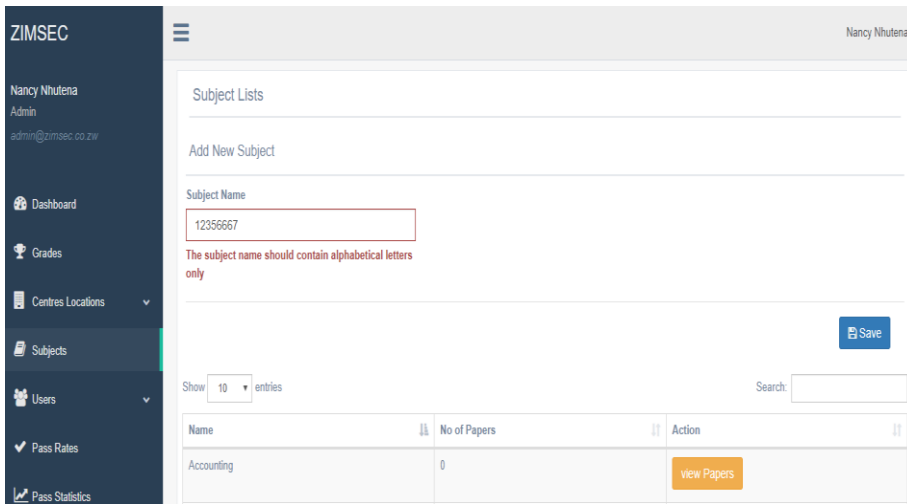


Figure 5.9 Incorrect data type

When creating grade boundaries, the system will not allow duplication of grades

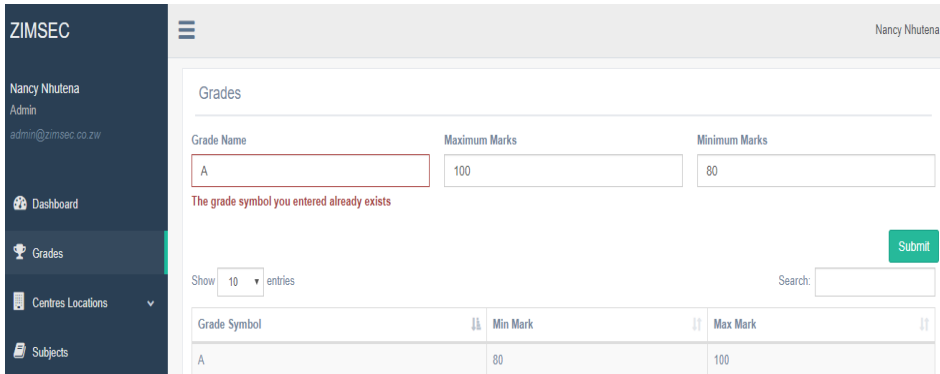


Figure 5.10 Symbol repetition

Marks were validated not to process negative figures

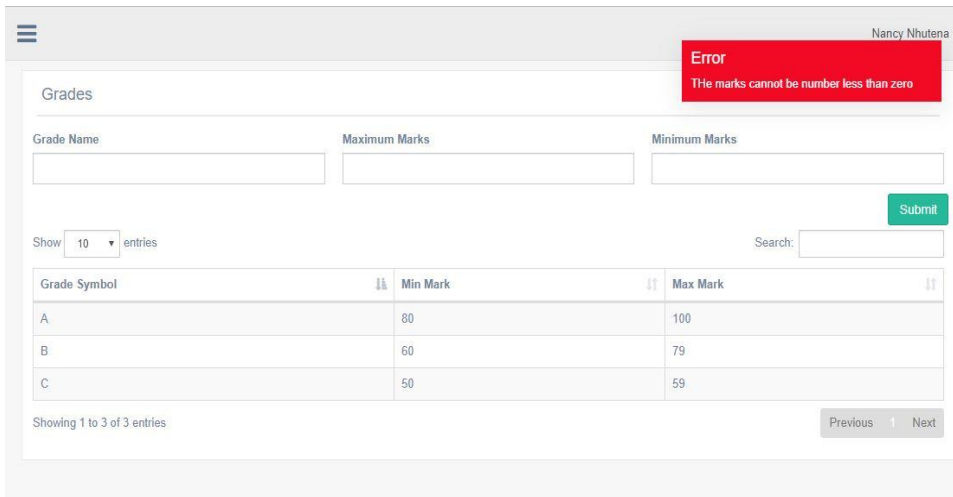


Figure 5.11 Negative digit for a mark

Accepted grade boundaries are those defined in the system parameters

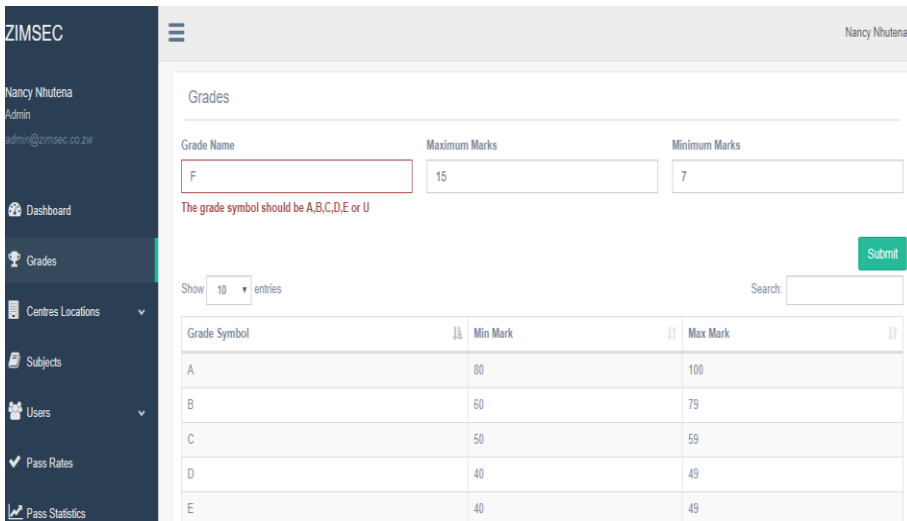


Figure 5.12 Invalid grade symbol

5.3.6.2 Verification

Verification confirms whether the correct product is being developed (Dennis, 2001). The software is assessed to check if it is functioning as expected and producing the desired. Software is checked for any bugs and if found they are instantly debugged before being deployed to users. The user requirements and design specifications must be fulfilled.

5.3.6.2.1 System versus Objectives

System objective 1

Computerised mark capturing –The platform is used by the marker to capture candidates' marks.

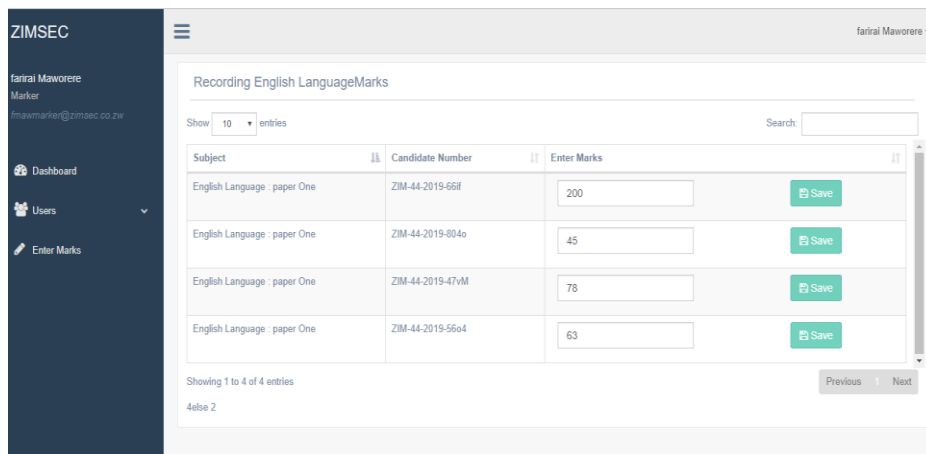


Figure 5. 13 System Objective 1

System objective 2

To verify captured candidate marks – The examiner also captures the same marks using their own platform for verification purposes

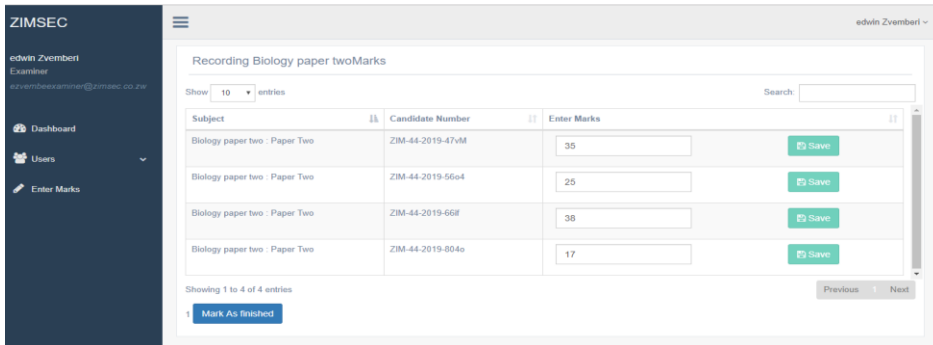


Figure 5.14 System Objective 2

System objective 3

Punch marks direct into the database –The final marks are stored in the database

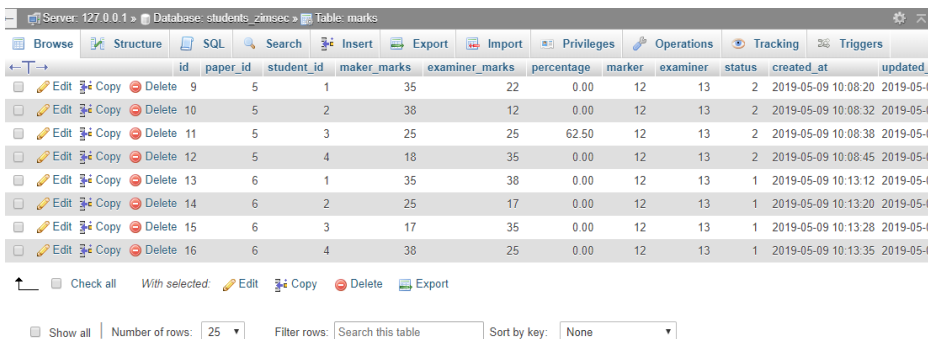


Figure 5.15 System Objective 3

System objective 4

To record irregularities or abnormalities in captured marks where the marks captured by the marker and those by the examiner do not match.

tadwa Masanga
Exam Centre
tmasgr@highcoentad@zimsec.co.zw

Dashboard

Users

students

Assign Examiners

Student Marks

Different Marks

Pass Rates

Abnormalities Table

Select Category

Abnormalities | Marked Students

| Candidate Number | subject | Examiner's Mark | Marker's Mark | Actual Mark | | View Examiners |
|------------------|-----------------------------|-----------------|---------------|----------------------|------|----------------|
| ZIM-44-2019-668f | Biology paper two Paper One | 35 | 22 | <input type="text"/> | Save | |
| ZIM-44-2019-804o | Biology paper two Paper One | 38 | 12 | <input type="text"/> | Save | |
| ZIM-44-2019-56o4 | Biology paper two Paper One | 18 | 35 | <input type="text"/> | Save | |

Figure 5.16 System Objective 4 Abnormalities

System objective 5

To view pass statistics for the examination with the help of visual aids

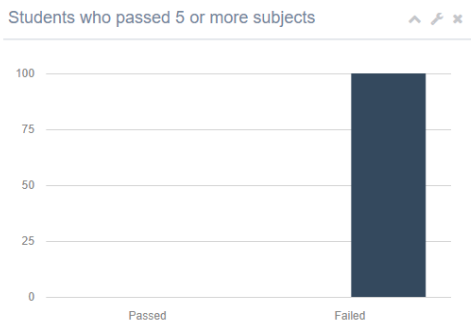


Figure 5.17 System Objective 5 Pass statistics

System objective 6

To deduce combination of subjects that most students fail or pass the reasons behind or implications may then be further investigated.

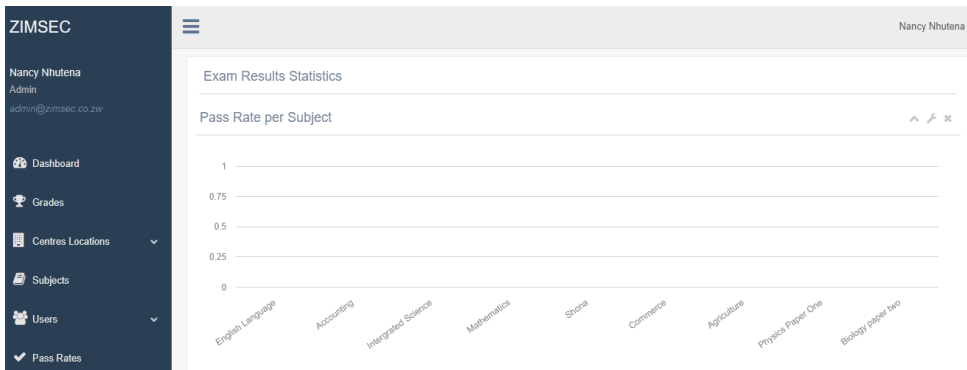


Figure 5. 18 System Objective 6 Pass rate per subject

5.4 Installation

According to Shelly and Rosenblatt (2010), installation is when developed system is put in place for use by the authorised users. An installation procedure will be followed and once installed, the system is ready to perform its intended use. Users are trained on how to use the system, files are converted and system changeover strategies implemented.

a) Installation procedure

- Install xampp with php 7.2 or greater
- Copy system files into folder names htdocs
- Start Xampservices : Apache and Mysql
- Open Browser and type the following URL:Localhost/phpMyadmin
- Once on the phpMyAdmin Page Click on create new Database
- Type in the database name: students_zimsec, and select create(GO)
- Select the database and then select the tab Import
- Click on file upload, and navigate to the system files and select file students_zimsec.mysql
- Click GO
- Open new browser tab and type the following URL: localhost/zimsec

5.4.1 User training

The users need to be well acquainted with the developed system so that they can work without any hiccups. Training will be done in sessions at the examination council and all stakeholders will have a hands on experience with the system. Through training management will have an appreciation of the reports generated by the system and they will be able to analyse and evaluate them. The training presentation will be conducted on PowerPoint using a projector.

Commented [m1]:

5.4.1.1 Training Plan

Training was conducted in three sessions.

First session

The first session is highlighted below;

Table 5.1 session 1

| | |
|--------------------------|--|
| Date | 13/05/2019 |
| Venue | ZIMSEC Head Office |
| Selected trainees | ZIMSEC internal personnel |
| Scope | Showing the functionalities of the application and how to troubleshoot |
| Objective | To provide knowledge to the system users so that they will be able to support the system during marking at the designated venues . |

Table 5.2 session 2

| | |
|--------------------------|---|
| Date | 14/05/2019 |
| Venue | ZIMSEC Head Office |
| Selected trainees | Top management |
| Training scope | Illustrating how the system generates reports and statistics of captured marks. |
| Objective | To be able to read and evaluate reports generated by the system which will improve the decision making process. |

Table 5.3 session 3

| | |
|--------------------------|--|
| Date | 15/05/2019 |
| Venue | Prince Edward High School |
| Selected Trainees | ZIMSEC external examiners and markers |
| Training scope | How to log into the system and change their password for security reasons as well as how their relevant platforms for capturing and verifying marks operate respectively |
| Objective | To make their examiners and markers have a hands on experience on how to capture marks into the database accurately and efficiently. |

5.4.1.2 Training Requirements

Software specifications

Recommended programs for Pcs.

- *Windows 7 or Windows 8*
- *Language format should be set to English Zimbabwe*
- *Currency settings should be set to US\$*

- **Hardware specifications**
- Recommended hardware
- **At least 30Gighard drive / C drive free space**
- **A CD/DVD Writer(ROM)**
- **At least 1Gig RAM**
- **Printer**
- **Screen resolution should be 1024*768 pixels minimum**
- **Screen Monitor should be 15" (inches) minimum**
- **One Anti-Virus required.**

5.4.1.3 The Online marks capturing Process

The mark capturing and grading system operations are demonstrated in figure 5.19

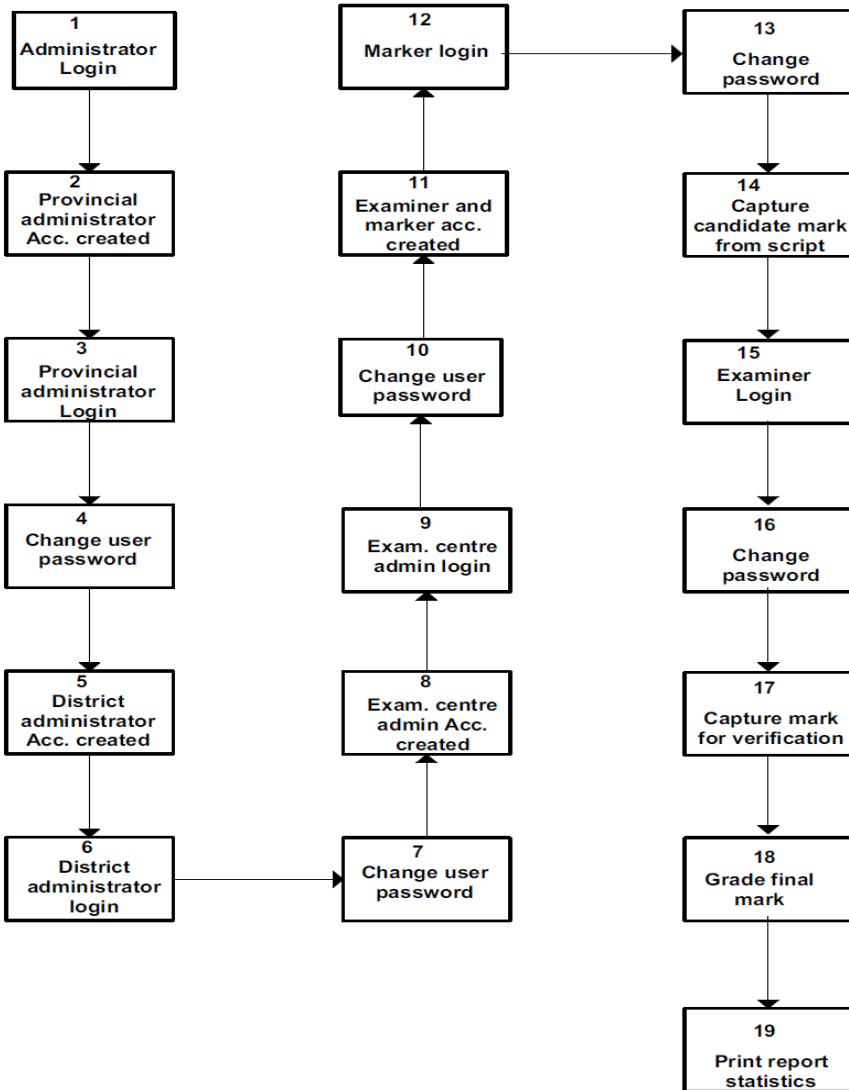


Figure 5.19 Marks capturing process

5.4.2 Data migration

Data migration occurs when data is relocated from the current to the new system (Selah, 2009) The loading of data into the new system will be done manually and processes conducted automatically. The threat related with the movement of data was curbed for by putting some security measures in place.

5.4.3 Changeover strategies

Shelly and Rosenblatt (2011), define system changeover as methods used to implement the system The changeover process can be accomplished in different ways which are direct changeover, parallel changeover, pilot changeover and phased changeover.

5.4.3.1 The Direct changeover

This type of changeover calls for the instant change from the existing to the new system. This can be done after working hours so that daily operations of the business will not be interrupted. In this technique the old system is shut down as soon as the new system starts to operate. The shading of marks on a mark sheet will be done away with instantly and marks will be captured direct into the system if this method is chosen

(i) Advantages

- This is the fastest changeover strategy of all.
- It reduces replication of work thereby efficient.
- Minimal costs will be encountered for the operation of one system.

(ii) Disadvantages

- The technique is risky in case of system failure.

5.4.3.1.1 Direct changeover assessment

The direct changeover method would not be ideal for the online mark capturing and grading system The data about candidate's marks is essential for the release of examination results to candidates so the risk of using this approach should be avoided because if the system fails the data will be lost.

5.4.3.3 Pilot Changeover

During pilot changeover only a small unit of the application will replace the system at a time. One section or department is tested and if successful the pilot version will be stretched to the next section or department. The old system will be in full operation while the pilot versions are implemented (Whitten, 2003).

(i) Advantages

- Minimal costs encountered.
- The risk of failure is low since the system is added in units.

(ii) Disadvantages

- It consumes too much time.

5.4.3.3.1 Pilot changeover Assessment

This method is less risky although it has its own limitations. Using this strategy, the developed system will only be installed in one section of an organisation at a time for example the finance section. Departments which work concurrently sharing the same data will not be able to operate. This will not be a commended strategy as dependent departments like IT and examinations administration need to work together towards one goal.

5.4.3.4 Phased changeover

Phased changeover makes use of modules of the system (Duffy, 2011). The system is implemented one module at a time. A good example using the online mark capturing will be to implement the capturing module then after its succession the grading module follows.

(i) Advantages

- In case of system failure only one particular module will be affected.
- Errors encountered when modules are implemented at the same time will be avoided.

(ii) Disadvantages

- The process takes time if the modules are many
- The budget for training might be exceeded thereby costly.

5.4.3.4.1 Assessment of the Phased changeover

The online mark capturing system will not be implemented using the phased changeover since it has to be tested for the oncoming June examinations all the modules need to integrate at once.

5.4.3.2 Parallel changeover

This changeover method permits the two systems to run in parallel until there is satisfaction that the new system is performing as expected by all users (Gibson and Hughes 2001).

(i) Advantages

- The method has very low risk since users can always go back to the old system in case the new system fails to deliver
- There is room to always refer back to the old system in case of misunderstandings.

(ii) Disadvantages

- It is costly to run two systems at the same time.
- Concentrating on two systems at the same time can be cumbersome and time consuming.

5.4.3.2.1 Assessment of the Parallel changeover (Recommended).

It might appear costly to run two systems at the same time but in the final end this method is the ideal as it removes the risk of data loss. Candidate marks will still be found on the shaded mark sheets in case of system failure the marks can still be scanned and candidate will obtain their results. This is the most appropriate method of them all and the mark capturing system will be implemented using this strategy.

5.5 Maintenance

Maintenance refers to the upkeep of the system to ensure it continues to run as expected in order to meet the goals and objectives of an organisation. Regular monitoring is required so that the system remains error free and efficient (Valacich, 2012). There are different types of maintenance to be discussed in the sections to follow.

5.5.1 Corrective maintenance

Corrective maintenance is conducted after the system is implemented and the users pick out the errors they encounter. Errors are debugged as they occur and thus a corrective measure is taken to ensure an accurate and efficient system (Valacich, 2012).

5.5.1.1 Recommendations

This is highly recommended so as to reduce bugs that might harm the operations of the system.

5.5.2 Adaptive maintenance

Adaptive maintenance is the process of examining whether the system has adapted to the operational environment. The system must be able to operate as intended so that it meets all the stated user requirements (Shelly and Rosenblatt, 2011). This strategy is a very important adaptation to the operational environment that guarantees the success of the system. Changes to the system must be done if the system is not able to cope with the environment so that it adapts. Adaptive maintenance is done to ensure that the system is free from errors or bugs that might affect its performance.

5.5.2.1 Recommendations

Improvements to the system were recommended in anticipation of future changes if they arise the system should adapt well to these changes.

5.5.3 Preventive maintenance

This is a safety technique taken to prevent a harmful attack or event before it takes place. Software patches are installed into the system to avoid future inconveniences. The patches must be always up to date to ensure effective operations of the business. In short preventive maintenance is pro-active in nature and most difficult since it is hard to predict future errors.

5.5.3.1 Recommendations

It is always good to prevent than to cure therefore it is highly recommended that this method of maintenance be applied.

5.5.4 Perfective Maintenance

This calls for a complete change in the system so that it becomes more accurate and effective in its operations. The request comes from the management and key system users. More time is needed to test on functionality under this type of maintenance. According to Somerville (2007), during perfective maintenance some additional functions that might have been omitted during program development are made.

5.5.4.1 Recommendations

Perfective maintenance may be costly to the organisation since a new system has to be built. It is therefore recommended to conduct all the other types of maintenance so that the system remain performing as required to avoid users and management calling for a complete change.

5.5.5 Recommendations for maintenance

Constant and effective maintenance has to be conducted on the online mark capturing and grading system so that it delivers good service to its users. During the operations of the system errors must be identified and debugged instantly and all types of maintenance mentioned should be greatly considered as they all work differently to bring out a perfect system which satisfies its intended purpose.

5.6 Recommendations for future development

Future developers need to consider the following:

- There is need for continuous improvement on the mark capturing system to continuously adapt to the ever changing trends in technology therefore resources need to be distributed generously for the development of the system.
- ZIMSEC online mark capturing and grading system be integrated with the oracle system which captures all candidate details at registration there by making it easy to work with candidates' databases.
- The management at ZIMSEC must take into consideration suggestions and views from low level employees as these are the users of systems on a day to day basis and through experience they can give a lot of feedback which might be very important to the organisation.
- There is also need for effective communication between top level management and low level employees to ensure efficient running of the systems in the organisation.

- It is recommended that security policies be put into place and passwords should be changed on a monthly basis to ensure effective security of the system.
- The ICT team should link or incorporate the system with other systems within the organisation. This will enable the organisation to handle or manage all the systems easily.

5.6.1 Recommendations to stakeholders

- It is highly recommended that users stick to the fundamentals that they learnt throughout the training exercise. The system administrator should be consulted in case any problems might arise. Passwords are a confidential item and should never be compromised.
- The user manual for the system will be provided, please make full use of it and get help as and when needed
- The external examiners and markers are recommended to have an appreciation of the system as it lightens their workload and shortens the marking period. They are highly recommended to be accurate when capturing marks as the system will not give them an opportunity to capture marks twice.
- The capturing and verification of marks is a confidential process which is supposed to be known only by authorized personnel therefore passwords should remain confidential.

5.7 Conclusion

To conclude this research, the new system has managed to pass all the stages from the introduction to the implementation stage without any difficulty. Development of the system was centered on objectives and user requirements specified in the project proposal. Budgetary constraints were encountered along the way but innovation, resilience and management support ensured continuation of the project. Different fact finding techniques were used to gather data from interested parties and the data was analysed and combined together to come up with a detailed study and make informed decisions. The illustration on how the data is going to be moving from one entity to another in the system was depicted by means of context and dataflow diagrams in the design phase as well as the architecture of the system. The logical design for the mark capturing was demonstrated in chapter four showing the different types of forms the systems has. The system was successfully implemented according to stakeholder requirements in the last chapter and various testing techniques were conducted with errors being

corrected where necessary to make the system accurate, efficient and serve the purpose it was designed for. In order to keep the system running, recommendations for maintenance were made and it was gathered that all types of maintenance be considered as each of them had a different purpose but work with one goal that is to develop a perfect system which fulfilled the requirements of its users.

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APPENDICES

Appendix A: User Manual

A user manual is a document which assists users on how to use the system without any difficulties. It consists of steps and procedures that direct users on how to navigate from one system module to another throughout the system. It gives users direction and helps in case where the system reacts in an unusual manner. The user manual for the ZIMSEC online marks capturing and grading system has been written to assist the users to navigate and use the different functionalities of the modules

a) Mandatory Requirements:

All users of the Online marks capturing and grading system will have to undergo a training exercise to familiarise with the functions of the system since the changes they make in the system will be permanent. User accounts are created by the systems administrator with email addresses as user names and the default password is changed at first login.

b) Getting Started

ZIMSEC mark capturing and grading system is an online application which facilitates the capturing of candidate marks into the marks database accessed from the different marking venues. The system administrator creates an account for the provincial administrator and populates the database with subject and paper details, grade boundaries used for grading and the provinces, districts and the relevant exam centres. The provincial administrator creates accounts for the district administrators from their relevant provinces and these district administrators create accounts for exam centre administrators for their districts. The exam centre administrator is the one who creates accounts for the and markers and examiners who capture and verify marks respectively. The exam centre administrator will be able to view irregularities or errors in captured marks by going to the different marks tab. Pass statistics by gender, per subject, and students with more than five subjects will be illustrated by means of visual aids (graphs).

c) Login

There are two text fields labelled **email** and **password** where the user is required to type in and then click the button labelled **login** for the user to gain access into the system. The login platform gives access only to those with privileges, those with accounts that have been created and exist in the database.

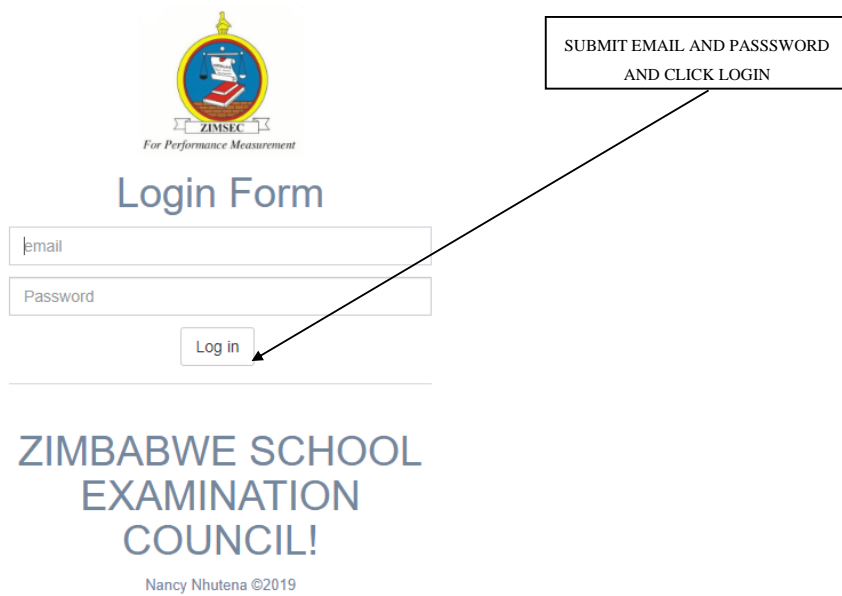


Figure A1: ZIMSEC Login form

When the correct details have been submitted, users and the admin are granted access into the system with full access to services provided by the system limited within given parameters. Once wrong credentials are submitted, an error message will pop up as shown on.

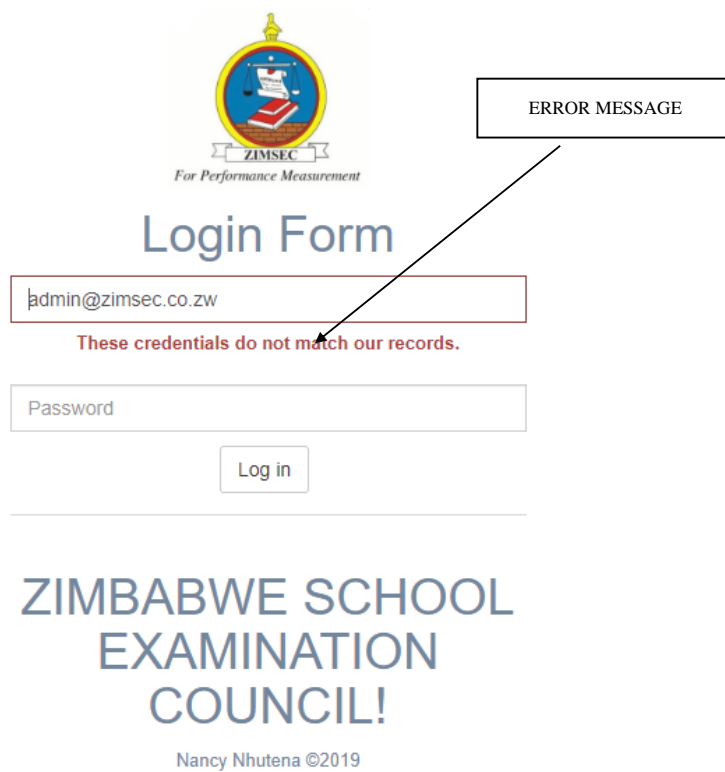


Figure A2: Login failed

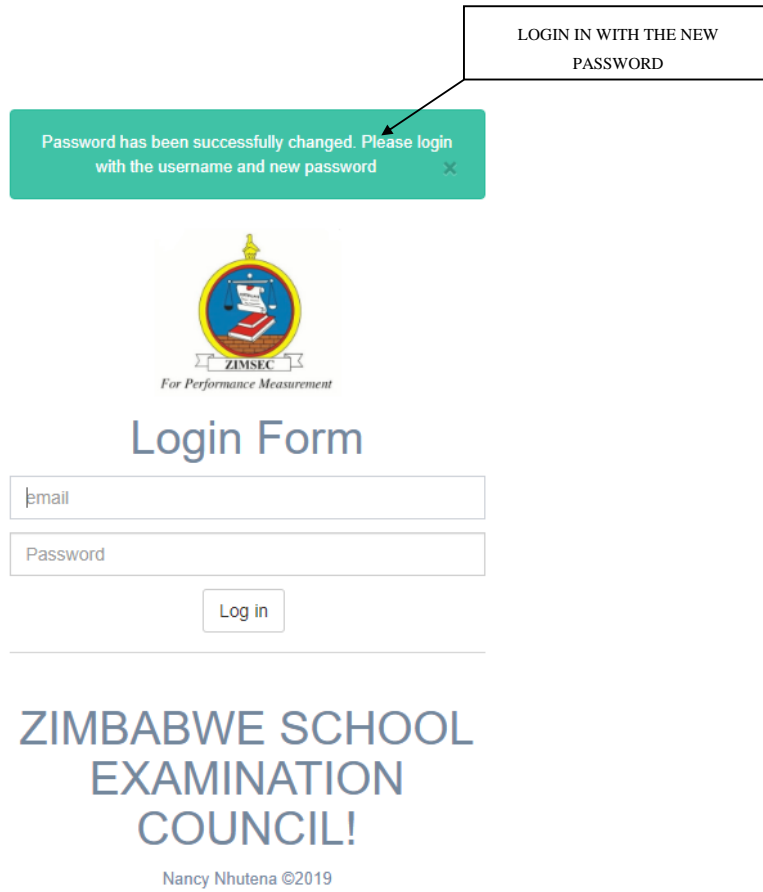
Changing password

At first login every user is prompted to change the default password generated by the system for security reasons.

The screenshot shows a web form titled "Change Password" for the Zimbabwe School Examination Council. The form contains two input fields: "Password" and "password Confirm". Below these fields is a button labeled "Change". A callout box with a black border and white background points to the "Change" button, containing the text "CHANGE THE DEFAULT PASSWORD". At the bottom of the form, the text "ZIMBABWE SCHOOL EXAMINATION COUNCIL!" is displayed in large blue letters, followed by "Nancy Nhutena ©2019" in smaller black text.

Figure A3: Change Password

When the password has been changed and confirmed successfully the user is asked to enter the new password to access their relevant profiles.



The image shows a web interface for the Zimbabwe School Examination Council (ZIMSEC). At the top, a green notification box contains the text: "Password has been successfully changed. Please login with the username and new password" followed by a close icon (X). A callout box with a black border and white background points to the notification with the text: "LOGIN IN WITH THE NEW PASSWORD". Below the notification is the ZIMSEC logo, which features a circular emblem with a book and a scale, surrounded by the text "ZIMSEC" and "For Performance Measurement". Underneath the logo is the heading "Login Form". The form consists of two input fields: "email" and "Password". Below these fields is a "Log in" button. At the bottom of the page, the text "ZIMBABWE SCHOOL EXAMINATION COUNCIL!" is displayed in large, bold, blue letters, with "Nancy Nhutena ©2019" written in smaller text below it.

Figure A4: Enter new Password

After a successful login the system administrator will be directed to their relevant platform with the dashboard displaying output.

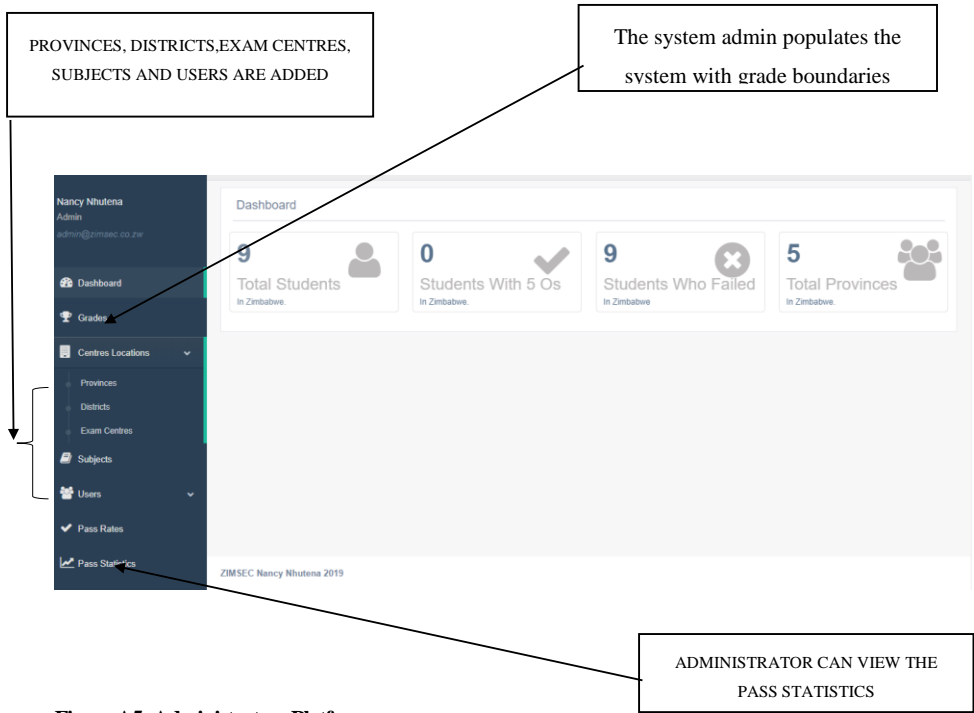


Figure A5: Administrators Platform

The exam centre admin is responsible adding and assigning tasks to the markers and the examiners respectively.

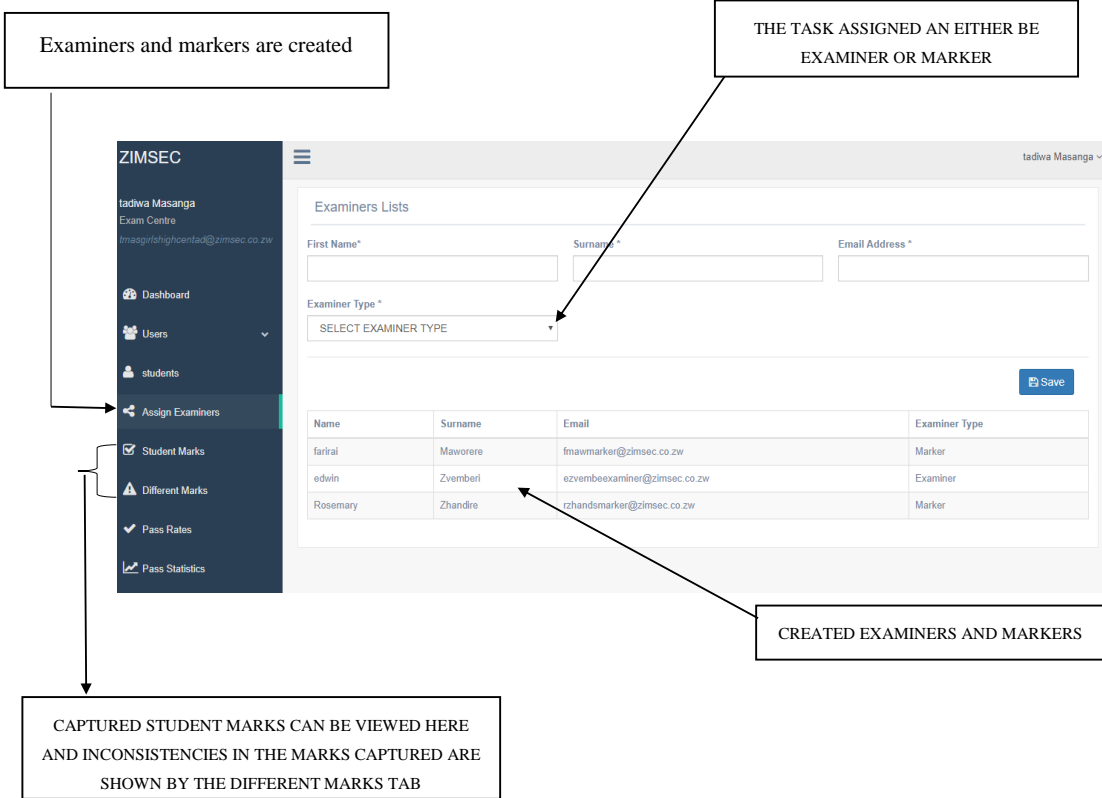


Figure A6: Exam centre administrator

The assigned examiner is the first to capture candidates' marks into the system.

The screenshot shows the ZIMSEC marking interface. A sidebar on the left contains the user's name 'fariral Mawore', role 'Marker', and email 'fmaawmarker@zimsec.co.zw'. Below this are menu items for 'Dashboard', 'Users', and 'Enter Marks'. The main content area is titled 'Recording English LanguageMarks' and features a table with columns for 'Subject', 'Candidate Number', and 'Enter Marks'. Each row includes a 'Save' button. Callout boxes with arrows point to specific elements: 'ACCESS LEVEL DEFINED' points to the user's role; 'THE CENTRE NUMBER AND CANDIDATE NUMBER FOR THE CANDIDATE' points to the 'Candidate Number' column; 'THE SUBJECT AND COMPONENT' points to the 'Subject' column; and 'CAPTURED MARKS' points to the numerical values entered in the 'Enter Marks' column.

| Subject | Candidate Number | Enter Marks |
|------------------------------|------------------|-------------|
| English Language : paper One | ZIM-44-2019-66f | 200 |
| English Language : paper One | ZIM-44-2019-804o | 45 |
| English Language : paper One | ZIM-44-2019-47vM | 78 |
| English Language : paper One | ZIM-44-2019-56o4 | 63 |

Figure A7: Marker capturing marks

The examiner verifies the marks by punching in for the second time using their relevant profiles and they cannot view what the examiner has captured first

The screenshot displays the 'Recording English Language Marks' interface. It features a table with the following data:

| Subject | Candidate Number | Enter Marks |
|------------------------------|------------------|-------------|
| English Language : paper One | ZIM-44-2019-47VM | no marks |
| English Language : paper One | ZIM-44-2019-56o4 | no marks |
| English Language : paper One | ZIM-44-2019-66If | no marks |
| English Language : paper One | ZIM-44-2019-804o | no marks |

An arrow points from a text box to the 'no marks' input field in the third row.

THE EXAMINER WILL ENTER MARKS IN THE FILEDSPROVIDED

Figure A8: Marker capturing marks

The dash board for the examiner will show the number of scripts they have captured and this applies for the marker too.

The screenshot displays the 'Dashboard' interface. It features a large number '8' with a checkmark icon, indicating 'Total Recorded Scripts'. Below the number, it says 'Recorded By : edwin Zvemberi'.

Figure A9: Scripts Recorded by the marker.

The center administrator will be able to view output from the dashboard after the capturing and verification process. The specified output shown is for their relative centres

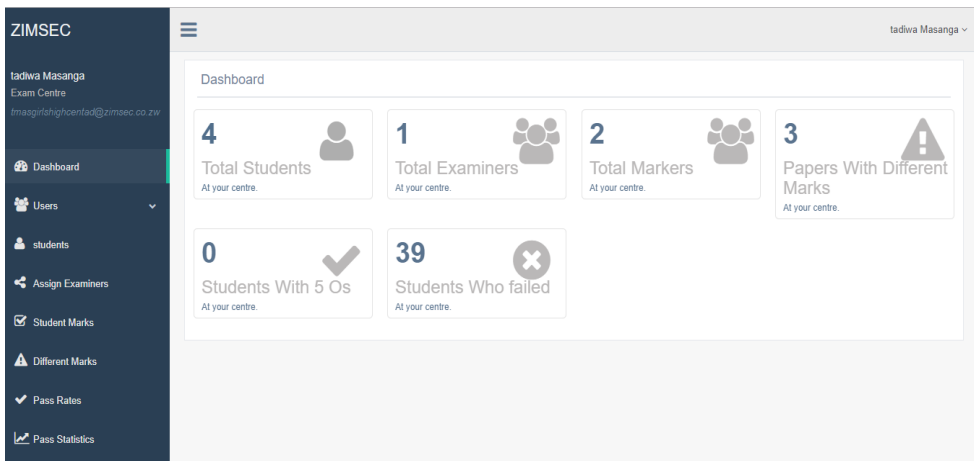


Figure A10: Centre administrator viewing output

The successfully captured marks will be graded

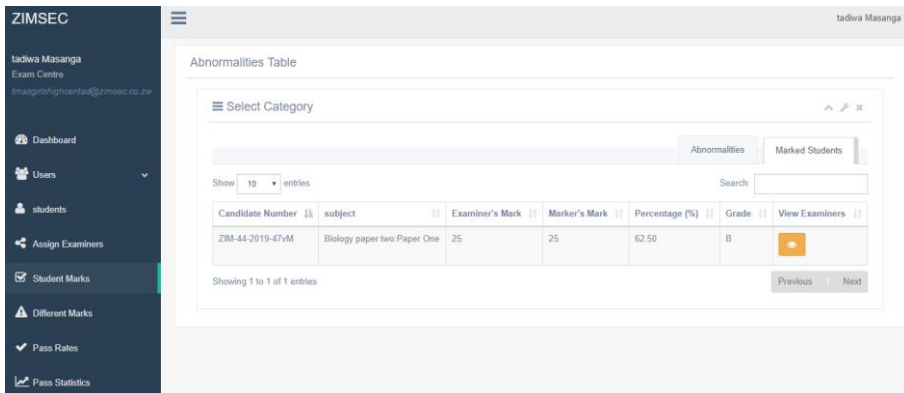


Figure A11: Graded marks

The centre administrator will be able to view marks captured differently by both the marker and the examiner.

ACCESS LEVEL DEFINED

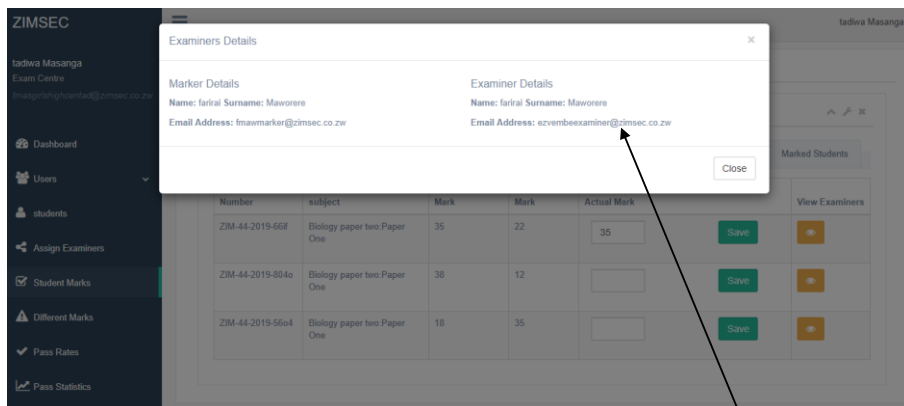
THE EXAMINERS WHO CAPTURED DIFFERENT MARKS CAN BE VIEWED

| Candidate Number | subject | Examiner's Mark | Marker's Mark | Actual Mark | | View examiners |
|------------------|-----------------------------|-----------------|---------------|----------------------|--|--|
| ZIM-44-2019-66f | Biology paper two Paper One | 35 | 22 | <input type="text"/> | Save | View |
| ZIM-44-2019-004o | Biology paper two Paper One | 38 | 12 | <input type="text"/> | Save | View |
| ZIM-44-2019-56o4 | Biology paper two Paper One | 18 | 35 | <input type="text"/> | Save | View |

DIFFERENT MARKS FOR THE SAME CANDIDATE

Figure A12: Abnormalities.

The marker and examiner who mad errors in capturing marks can be viewed using the view examiners tab



The details of the examiners responsible for the abnormalities

Figure A13: View the marker and examiner with abnormalities

OUTPUT

The system displays pass rates by means of visual aids

ALL USERS WILL LOG OUT USING THIS TAB

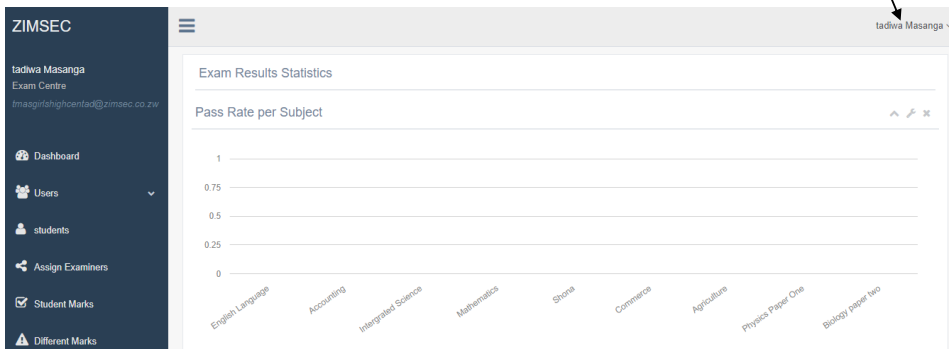


Figure A14: Pass Rate per subject

Output

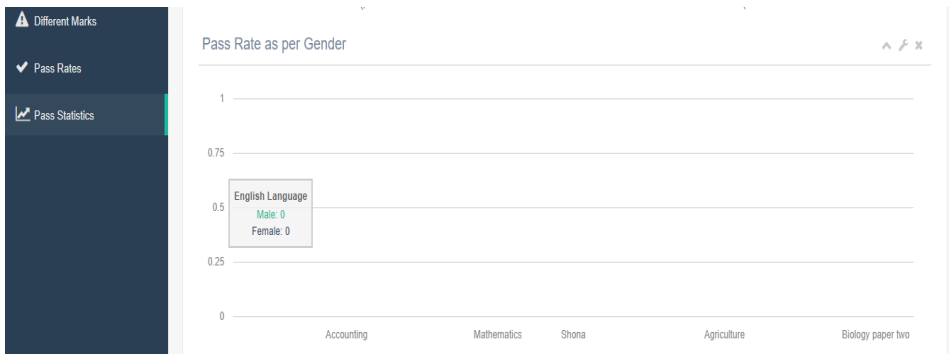


Figure A15: Pass Rate per Gender

Output

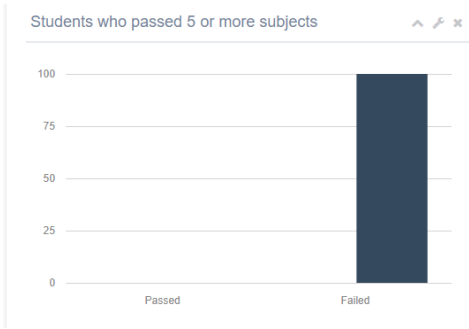


Figure A16: Students who passed five or more subjects.

OTHER USERS

The Provincial Administrator is created by the system administrator and adds the District administrator for their relevant province.

PROVINCIAL ADMINISTRATORS PROFILE (ACCESS LEVEL)

DISTRICT ADMINISTRATORS ACCOUNTS BEING CREATED

The screenshot shows a web application interface. On the left is a dark sidebar with a user profile for "Zenzo Tirwanhu" and a menu with "Users" selected. The main content area has a "Add New User" form with fields for "First Name", "Surname", "Email Address", and a "Select District" dropdown. Below the form is a table titled "DistrictAdmin" with columns for Name, Surname, Email, and District. Three rows of data are visible, with the third row highlighted. A "Save" button is located at the bottom right of the form.

| Name | Surname | Email | District |
|-----------|-----------|------------------------------|---------------------|
| Amanda | Mutandazo | ammanicdistrad@zimsec.co.zw | NYANGA |
| Ethan | Mukuchira | emukuhardistrad@zimsec.co.zw | HARARE METROPOLITAN |
| Ishewashe | Maworere | immanicdistrad@zimsec.co.zw | NYANGA |

CREATED DISTRICT ADMINISTRATORS

Figure A17: District administrator creation

The District administrator uses their profile to create exam centre administrator for their relevant district.

DISTRICT ADMINISTRATORS PROFILE (ACCESS LEVEL)

EXAM CENTRE ADMINISTRATORS ACCOUNTS

THE EXAM CENTRE ADMINISTRATORS CREATED

| Name | Surname | Email | Exam Centre | Area | Action |
|---------|---------|------------------------------------|------------------------|--------|--------|
| tadwa | Masanga | tmasgirlshighcentad@zimsec.co.zw | Girls High School | Harare | |
| shingai | Mapira | smapihartzelcentadmin@aimsec.co.zw | Hartzell High School | Mutare | |
| Tendai | Mapira | tmapichigwedercentad@zimsec.co.zw | Chigwedere High School | Hwedza | |

Figure A18: Exam centre administrator creation

Appendix B: Interview Checklist

Midlands State
Established 2000 University



Midlands State University
Faculty of Science and Technology
Department of Computer Science and Information Systems
P O Box 9055
Gweru

My name is Nancy Mhute; a final year student in the above mentioned institution carrying out a research project entitled “Online mark capturing and grading system” as part of the requirements of the degree.

You have been identified as a key subset of my population of the study. Your comments and responses will be treated with utmost confidentiality and used for academic purposes only and no names will be published.

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

Examinations Administration staff

Q1 What do you think about the scanning and shading system?

Q2 May you outline all the tasks that you perform?

Q3 Do you have any form of feedback that you give to examiners after scanning?

Q4 Is your feedback to management about progress in processing marks timely delivered? If NO, give reasons for delay.

Q5 Does the current system operations give you enough control to effectively and efficiently perform your duties?

Q6When working with the system which areas do you find time consuming and cumbersome?

Q7How do the external examiners view the system?

Q8If answer to Q5 is NO then why could it be so?

Q9Is the current system delivering as per your expectations?

Q10How do you feel about computerising the capturing process?

Q11 Have you recently faced difficulties in accepting or adopting any new technology that was brought into the organisation? If so, please state when and the type of the technology?

Q12Any recommendations or suggestions to the development of the new system?

Appendix C: Questionnaire

This questionnaire seeks your responses for the purpose of gathering information pertaining ZIMSEC scanning and shading system. The information gathered is confidential and shall not be used for any other purposes other than study or research.

Please feel free to give your response to the questionnaire.

(NB. Do not write your name or any personal identification particulars on the questionnaire. The questionnaire consists of 5 questions)

- Answer all the questions
- Give accurate details on all answers and be open to express your views.
- Return the questionnaire to the I.T. Manager (Mrs Mukarati) by 15 March 2019

******Tick where appropriate and fill in where spaces are provided. ******

Put a tick in the appropriate box for your answer.

1. Are you satisfied with the current system?

Yes
No

2. Are you facing security problems with the current system?

Yes
No

If your answer is Yes state, the problems and recommendations.

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

3. How do you rate the current system?

Good
Average
Poor

Explain your response.....

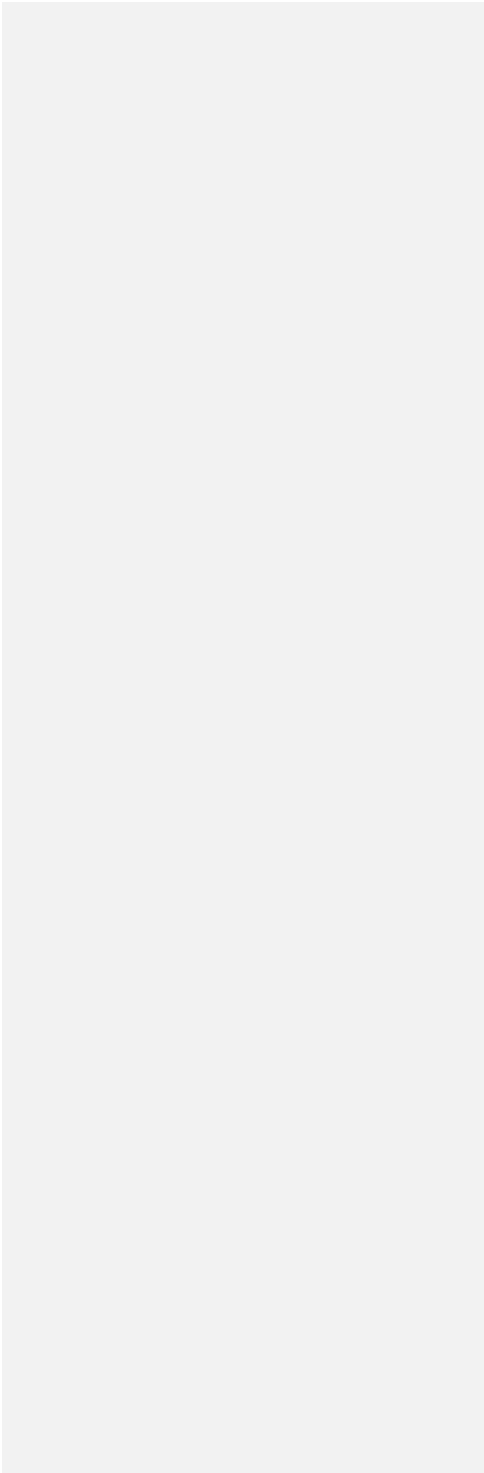
.....
.....
.....

4.How long does it take to get the mark sheets ready for scanning after shading?

.....

5.What effect do you think the introduction of a computerised system will have on the current processing of candidates' marks?

.....
.....



Appendix D: Observation Score Sheet

Midlands State
Established 2000 University



Midlands State University
Faculty of Science and Technology
Department of Computer Science and Information Systems
P O Box 9055
Gweru

NAME OF THE OBSERVER

DATE OF OBSERVATION

TIME OF OBSERVATION

PLACE OF OBSERVATION.....

OBJECT BEING OBSERVED

OBSERVATION.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

CONCLUDING REMARKS

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

Appendix E: Snippet of Code

Adding grade boundaries

```
public static function getGrade($mark,$student,$type){
    $finalGrade = "";
    if($type == "grades"){
        foreach (Grade::all() as $grade){
            if($mark >= $grade->min and $mark <= $grade->max){
                $finalGrade = $grade->grade_name;
            }
        }
        return $finalGrade;
    }
}
```

```
if($type == "passRates"){
    //note that $mark is the subject id
    $getMarks = DB::table('marks')
    ->select('examiner_marks')
    ->join('papers','marks.paper_id','=', 'papers.id')
    ->where('papers.subject_id',$mark)
    ->where('marks.student_id',$student)
    ->sum('examiner_marks');
```

```

$expectedTotalMarks = Paper::where('subject_id',$mark)->sum('total_marks');
//calculating percentage pass

$passPercentage = ($getMarks/$expectedTotalMarks)*100;
foreach (Grade::all() as $grade){
    if($passPercentage > $grade->min and $passPercentage <= $grade->max){
        $finalGrade = $grade->grade_name;
    }
}

if(count(studentGrade::where('student_id',$student)->where('subject_id',$mark)->get()) == 0){
    $grade = New studentGrade();
    $grade->student_id = $student;
    $grade->subject_id = $mark;
    $grade->grade = $finalGrade;
    $grade->save();
}

return $finalGrade;

```

Capturing marks

```

public static function getStudentMarks($id,$paper_id,$type){

```

```

if(Auth::user()->hasRole('Marker')){
    $checkMarks = Mark::where('student_id',$id)->where('paper_id',$paper_id)->get();
    if(count($checkMarks) == 1){

        $checkMarks = Mark::where('student_id',$id)->where('paper_id',$paper_id)->first();

        return $checkMarks->maker_marks;
    }else{
        $checkMarks = "no marks";
        return $checkMarks;
    }
}

if(Auth::user()->hasRole('Examiner')){
    $checkMarks = Mark::where('student_id',$id)->where('paper_id',$paper_id)-
>where('status','>=',1)->get();
    if(count($checkMarks) == 1){

        $checkMarks = Mark::where('student_id',$id)->where('paper_id',$paper_id)-
>where('status','>=',1)->first();
        if($checkMarks->examiner_marks == -1){
            $checkMarks = "no marks";
            return $checkMarks;
        }else{
            return $checkMarks->examiner_marks;
        }
    }
}

```



```

    }

    }else

    $checkMarks = "no marks";

    return $checkMarks;

    }

```

Verification of marks captured by marker and examiner

```

public static function compare($id){

if(Auth::user()->hasRole('Examiner')){

    $yardStick = DB::table('students')

        ->join('examiner_placements','students.centre_id','=', 'examiner_placements.exam_centre_id')

        ->where('examiner_placements.user_id',Auth::id())

        ->get();

    $markedStudents = DB::table('marks')

        ->join('examiner_placements','marks.examiner','=', 'examiner_placements.user_id')

        ->join('papers','marks.paper_id','=', 'papers.id')

        ->where('papers.id',$id)

        ->where('examiner_placements.user_id',Auth::id())

        ->get();

    }else{

    $yardStick = DB::table('students')

        ->join('examiner_placements','students.centre_id','=', 'examiner_placements.exam_centre_id')

        ->where('examiner_placements.user_id',Auth::id())

```

```

->get();
$markedStudents = DB::table('marks')
->join('examiner_placements','marks.marker','=', 'examiner_placements.user_id')
->join('papers','marks.paper_id','=', 'papers.id')
->where('papers.id',$id)
->where('examiner_placements.user_id',Auth::id())
->get();
}

if(count($yardStick) == count($markedStudents)){
    $results = 1;
    return $results;
}else{
    $results = 0;
    return count($yardStick).else '.count($markedStudents);
}
}

public static function getGrade($mark,$student,$stype){
    $finalGrade = "";
    if($stype == "grades"){
        foreach (Grade::all() as $grade){
            if($mark >= $grade->min and $mark <= $grade->max){
                $finalGrade = $grade->grade_name;
            }
        }
    }
}

```

```
}  
return $finalGrade;  
}
```

```
if($type == "passRates"){  
    //note that $mark is the subject id  
    $getMarks = DB::table('marks')  
    ->select('examiner_marks')  
    ->join('papers','marks.paper_id','=', 'papers.id')  
    ->where('papers.subject_id',$mark)  
    ->where('marks.student_id',$student)  
    ->sum('examiner_marks');  
  
    $expectedTotalMarks = Paper::where('subject_id',$mark)->sum('total_marks');  
    //calculating percentage pass  
  
    $passPercentage = ($getMarks/$expectedTotalMarks)*100;  
    foreach (Grade::all() as $grade){  
        if($passPercentage > $grade->min and $passPercentage <= $grade->max){  
            $finalGrade = $grade->grade_name;  
        }  
    }  
}
```

```
if(count(studentGrade::where('student_id',$student)->where('subject_id',$mark)->get()) == 0){  
    $grade = New studentGrade();  
    $grade->student_id = $student;  
    $grade->subject_id = $mark;  
    $grade->grade = $finalGrade;  
    $grade->save();  
}  
  
return $finalGrade;
```