DESIGN AND DEVELOPMENT OF AN ONLINE STUDENT INFORMATION SYSTEM (OSIS)

Case study: Uganda Martyrs University, Nkozi

A Post Graduate Dissertation Presented to the Faculty of Science in partial fulfillment of the requirements for the award of the degree of a Master of Science in Information Systems

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UGANDA MARTYRS UNIVERSITY

SCHOOL OF POSTGRADUATE STUDIES

Master's Dissertation

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DEDICATION

This work is dedicated to the following people; my parents for having brought me into this world and for loving me un conditionally; to my mum and my brother Agaba Appolo for their love, support and for having taught me to have faith in God and believe in me; to baby brother Oscar, sisters Innocent, Mackline, Agnes, Jane and Judith; nieces and nephews Doris, Daisy, Ewin, Felix, Brave, Faith, Tayebwa, Derick, Edwin and Isaac for their love and moral support. To my friends most especially my best friend Ms. Namanya Honest for tirelessly supporting me throughout the period I had to move to Rubaga for study and last but not the least to God my creator for everything that I am, most especially the gift of life, wisdom and strength.

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ABSTRACT

This project is about the design and development of an Online Student Information System (OSIS) for UMU. Though, UMU had been ranked highly among the Universities in Uganda providing quality education; difficulties in timely access to students' information had increasingly become problem. There were difficulties in information sharing between the registry and departments/faculties which caused delays in processing and making information quickly available to students. As a result, students faced difficulties of frequent travel to the main campus to find information which process was characterized by long queues and time wasting in addition to delays in decision making. The project was therefore aimed at enhancing student information management and access through the design and development of an OSIS to provide a flexible platform to communicate student information in real time.

To realize the above, both research and development methodologies were employed. The study followed a design –oriented research approach, which accommodated both qualitative and quantitative methods to gather and analyze the required data to justify the relevance of the new system. Interview guides, observation guide, questionnaire and document analysis were employed to collect the required data. Data analysis was done with the use of SPSS and a qualitative narrative to come up with the requirements for the new system solution. The study found out that despite UMU's heavy investment in information technologies, student information management processes were still being handled by use of stand- alone desktop office applications characterized by too much duplication, inconsistencies and inflexibility. The study also revealed that the intention to use online services is high, in particular relative to services providing information based on localization.

In response to the above, a prototype solution was designed and implemented. Several methodologies and tools were employed here after weighing their benefits vis-à-vis costs. DEMO, UML, Ms Office, and Dreamweaver embedded with HTML and PHP, notepad++, Ms Visio and MYSQL were employed through planning, analysis, design and implementation of the solution. The research used prototyping technique to come up with a product which was later tested and evaluated to ascertain that the pre-established required functionality was met.

The OSIS provides students with on-line access to student information including; their personal details, examination results, progress reports, financial statements, transcripts, courses and programs. The OSIS also provides support to the registry staff both in the main and faculties' with on-line access to a central student database system to enable them effectively input and share student information processing activities for timely delivery of information to stakeholders.

LIST OF ACRONYMS

BIS	Business Information Systems
CD-ROM	Compact Disk Read Only Memory
DBMS	Database Management System
DEMO	Dynamic Essential Modeling of Organizations
DVD	Digital Video Disk
GAT	Graduate Admission Test
GUI	Graphical User Interface
HTML	Hypertext Markup Language
HTTP	Hyper Text Transfer Protocol
HTTPS	Hyper Text Transfer Protocol Secure
ICT	Information Communications Technology
IS	Information Systems
IT	Information Technology
ITU	International Telecommunications Union
KIU	Kampala International University
MUST	Mbarara University of Science and Technology
MYSQL	My Standard Query Language
NCHE	National Council for Higher Education
OSIS	Online Student Information System
PHP	Hypertext Preprocessor
RAM	Random Access Memory
RDBMS	Relational Database Management System
SMS	Short Message Service
UCU	Uganda Christian University
UML	Unified Modeling Language
UMU	Uganda Martyrs University
VoIP	Voice over Internet Protocol
WWW	World Wide Web

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CHAPTER ONE: GENERAL INTRODUCTION

1.1 Introduction

This study was conducted to establish students' information access problems and design a viable online student information system (OSIS) for higher learning institutions to enhance student access to information. One of the key issues was the problems students face in accessing information with specific reference to Uganda Martyrs University. This research therefore reports on the study of the information access problems that students face, and the implemented system solution to address them. However, before the details of study are given, it is imperative that a brief background to Uganda's University education with respect to information access is examined.

1.2 Background to the study

Kasozi, (2003) describes Universities as "centers of higher learning where knowledge is created, preserved and disseminated". According to Kasozi, the first dent in the monopoly of higher education by its traditional suppliers was the rapid rise of many private universities owned by private entrepreneurs and philanthropists. Although only a few were founded for profit motives, the majorities depended and still depend on tuition fees for survival. Kasozi, (2003) reports that, virtually every country has witnessed the growth of these institutions and Uganda's private universities founded on the traditional campus model increased from zero in 1987 to twelve in 2001. A report by (The National Council for Higher Education, 2006:p.7) shows that there has been rapid growth of instituions of higher learning among which university institutions consisted 17.2% of tertiary institutions in Uganda. In the same report, it is indicated that there were 27 universities of which four are public (Makerere, Mbarara, Kyambogo and Gulu) and one affiliated public institution, Makerere University Business School. In Uganda, private sector

participation in higher education provision has been on the ascendancy since the commencement of privatization in the late 1980s and early 1990s. There were fifteen private universities of which: one (Islamic University in Uganda) is established by statute and has international status; two (Uganda Christian University and Uganda Martyrs University) are chartered in accordance with the UOIA, 2001; twelve (KIU, Aga Khan, Nkumba, Ndejje, Busoga, Bugema, Kabale, Kampala, Kumi, Mountains of the Moon) have provisional licences and five (Nile, Bishop Barham, Bishop Stuart, central Buganda and Luwero) are operating without provisional licences as required the law.

However, higher education is faced with a number of trends related to technology and delivery of education and services. One of the trends is the shift in student needs which requires a reaction that is service oriented with the student in the role of a customer (Howell 2003). Uganda like elsewhere has seen changes in higher education including the manifestation of enrollment, entrance of market forces, the ever increasing use of ICTs and the transformation of education into a marketable commodity all of which have greatly impacted on the delivery of higher education since the early 1990s. Kasozi, (2003) relents that market models treat education as a product and students as consumers and educational institutions are regarded as merchants with education products to sell. He forwards two major factors responsible for this; that high demand for education cannot be satisfied by traditional institutional structures and secondly, I.T is releasing higher education from the limitations of space, person-to-person pedagogy, borders and age of students. In addition, increasing student expectations for fast, economical, personal, and courteous service has placed additional pressure on Universities to continually improve the quality of services offered to students or risk losing enrollments to those better able to provide them. In response to the above pressure, higher education institutions have poured millions into

information technologies to increase the effectiveness of operations, information flow and delivery. Despite the heavy investments in information technologies, (Research and Education Network of Uganda, 2006) noted that the following, currently characterized Institutions of Higher Learning: manual management systems; slow and inefficient operations; systems that have ground to a halt and very poor customer care among others. On another note however, Woodruff, (1997) denotes that driven by more demanding customers, global competition, and slow-growth economies and industries, many organizations search for new ways to achieve and retain a competitive advantage. To achieve the above, most universities are building we-based campus information systems to bring information closer to their customers. Campus Information System for students is defined as "an interrelated group of information resources, accessible by computer through the campus institutional external and internal web environment, that a university places at the disposal of its users to enable them to consult it and/or provide a selection of significant and relevant data, in the wide context of their university life in its academic, administrative and social senses, in order to improve student's knowledge base" (Cobarsı´ et al., 2008). Student data needs to be properly managed and availed to the relevant stake holders through a flexible platform. In this project, the researcher particularly addresses students' need for quick, convenient and timely access to information. Perceived accessibility to information was put forward by (Culnan, 2007) as a unifying concept for the design and evaluation of a wide variety of information systems and services. It was against this background that the online student information system (OSIS) was planned, designed and a prototype developed to replace the disparate file-based systems that were characterized with too much duplication and paperwork, inconsistencies, long queues and difficulties in accessing timely information.

The study employed the design-oriented research approach to accomplish the project. System requirements for the OSIS were determined by use of several techniques including; Oral face-to-face interviews held with the Registry staff both in the main and faculties, Accounts and ICT staff to gather facts, their opinions and speculations regarding the systems in place as well as expectations from the new system; Questionnaires were administered to students to gather data from Full-time, part-time and distance learning students as key stake holders of the system (Kakinda, 2000); Observation of registration, processing, storage and dissemination activities and procedures, systems used, technology and software also provided a deep insight into the major business activities and infrastructure. Document analysis proviede information on the organ (Registry) that handles students, the data collection instruments and documents like registration forms, clearance forms, admision forms, sample of transcripts, mark sheets, mannuals that provided a broad coverage of all the major aspects of the student information system. Jeffrey, (2008, p.174) argues that, in the process of data collection, you must collect information about the information systems that are currently being used and how users would like to improve the current systems and organizational operations with new or replacement information systems. SDLC development methodology specifically prototyping was used to enhance faster completion of the project. DEMO was used to model the enterprise architecture while Unified Modeling Language (UML) a modern object-oriented notation and the language generally accepted as best practice in the development of IT/IS projects (Lunn, 2003) was employed to model the system. The OSIS target users are students, registry staff both in the main and faculties, lecturers, accounts staff and the Registrar on behalf of management.

1.3 Statement of the problem

Since the inception of Uganda's private universities in late 1980's, competition has become a phenomenon that has driven Universities to expand far and wide. With this tremendous

expansion, provision of equal and real time access to information becomes very important to all stakeholders, however, the rapid expansion of Uganda's universities does not seem to match the strategies that ensure equal and timely delivery of student information to all students. Research and Education Network of Uganda, (2006) noted that the following, currently characterized Institutions of Higher Learning: manual management systems; slow and inefficient operations; systems that have ground to a halt and very poor customer care among others. Watson, (2006) shows that data management systems do not reflect the complexity of the real world; lack of integration, redundancy from data stored in different systems, lack of data control, poor interfaces that make data difficult to access, and delays to requests for data characterize most information systems. Traditionally, the standalone applications used by most academic institutions have the limitation of data isolation making it difficult to access and share their data. In this project, the researcher particularly addresses students' need for quick, convenient and timely access to information. Perceived accessibility to information was put forward by (Culnan, 2007) as a unifying concept for the design and evaluation of a wide variety of information systems and services. It was against this background that the study was carried out, a system solution planned, designed and a prototype of the Online Student Information System (OSIS) developed to enhance access to student information.

1.4 Main objective

To design and implement an online student information system that provides a flexible platform to communicate important student information in real time and enhance timely decision making.

1.4.1 Specific objectives

1. To analyze the current student information system and determine user requirements for the design of a new online students' information system.
2. To review the existing literature on information systems development concepts in order to determine the best approach, methods and tools for the design of a new system.
3. To design a prototype of an online student information system that can centralize information, enhance flexibility in access and avail students' information in real time.
4. Implement the prototype based on objective 3.
5. To test and validate the prototype of the student information system to ensure its effective functionality to improve access to students' information within the education institution.

1.5 Research questions

Specifically, this study was designed to address the following research questions:

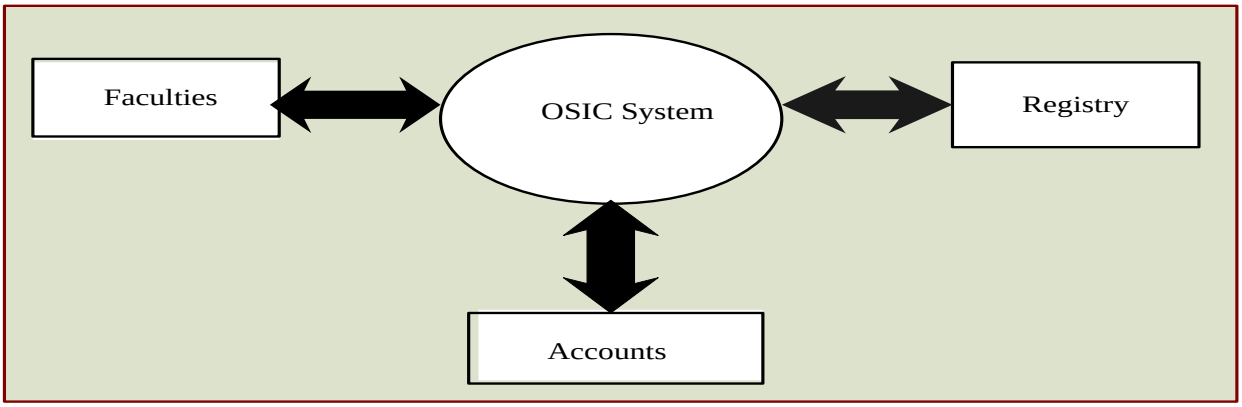
1. What business and information needs can be identified from the identified business processes?
2. How can the literature available on systems development and similar solutions aid in the design of the new student information system?
3. Why online student information system and how can it address the existing problems and enhance the students' access to student information?
4. Is it possible to design and build a prototype that will mirror and enhance research question No.1
5. What ways can be done to ensure that the implemented system performs according to the expected goals?

1.6 Scope of OSIS project

1.6.1 Geographical scope

The OSIS project geographical scope covers Uganda Martyrs University; limited to the offices of Registry (Main student services department), Accounts (Financial Statements) and Faculties (Lecturers and Administrators) as first contacts to student services.

Figure 1: Shows the Scope of OSIS System



Source: Primary data

1.6.2 Functional scope

This project was confined to the design and development of a prototype of an online student information system (OSIS) focusing on enhancing access to student information. On the supply side, the system is functionality limited to; allowing web access for remote data entry for authorized administrators enabling them to register students, programs and courses and handle student queries regarding registration, coursework and examination marks; lecturers to enter and examination marks; accounts staff to enter and manage fees payment details; and the assistant registrar to oversee transcript processing. Allows them to view, modify and update students' records including electronic results reporting. On the demand side, the system allows online view

of financial statements, results, transcripts and courses on log in. On the home page, the system provides links to any other outside databases with relevant student information.

1.6.3 Time scope

The project time frame lasted for 12 months.

1.7 Justification/ Significance

The success of a business organization depends on its ability to manage business information. Organizations are characterized by data management systems that do not reflect the complexity of the real world, lack of integration (Watson 2006), redundancy from data stored in different systems, lack of data control, poor interfaces that make data difficult to access, and delays to requests for data. Traditionally, the standalone applications used by most academic institutions have the limitation of data isolation; it is difficult to access and share their data. This often results in redundant data entry, data integrity problems, and inefficient or incomplete reporting. In such cases, a student's information can appear in multiple places but may not be identical. The OSIS will provide better services to students, faculties and administration by providing meaningful, consistent and timely information thus promote the vision of senior management to address opportunities for change. It will also promote efficiency by converting paper processes to electronic form.

To Students

Many of the constraints of time and place have disappeared as the increase in the number of different kinds of things students can do over the Internet; institutions need to give students a personalized web presence that allows them to easily access all the required information in real

time. With the OSIS, a great many users can reach this information efficiently in a common platform and view the same data simultaneously saving time and cost. In addition, the system will also enable stake holders' access to information in real time and in an interactive manner through a website thus eliminating delays in getting feedback.

The owners of the institution

The evaluation's criterion of the university activity is its competitive capacity comparing with other universities. In order, the university board to evaluate university competitive capacity; they have to get reliable information about university pedagogical and academic production and how it is evaluated outside the university. Being online, the system will increase flexibility and enhance real time access to student information by the university patrons there by promoting the institution's credibility and image.

University Management

Different service providers on campus (such as registry student-services, the library and finance services) and obviously lecturers, need to be able to exchange information in a meaningful way. The creation of an enabling platform would lower barriers to access and use of spatial data, (Rajabifard, 2009) to both administrators and the wider community within any jurisdiction, and particularly to those off campus users. If barriers are minimized, then entities would be able to pursue their core business objectives with greater efficiency and effectiveness. Information system requires the systematization of automated process and the integration of separate processes. Such a system helps the university to make decisions and increase their reliability, as it allows for accountability of students' progressiveness quantitatively allowing the evaluation of the studies process. The database will store the information about the students' personal

information, courses, received studies, and grades. From it can be derived how the student fulfils studies plans of chosen program and this accumulated information decreases expenses of work for preparing the documentation of graduation.

The fact that there is an ever increase in generation of students' data and that their utilization has been made possible by the current advances in computer technology, the findings of this study will help university leaders to appreciate the value of automation and more so the online student information system as an effective tool in the management and delivery of students' information.

Obbayi, (2011) argues that in time; the information stored within Intranets tends to get disorganized because quite a number of organizations do not formulate policies on control and storage of files and documents on the Intranet and that everything may seem okay in the beginning but as months go by, the magnitude of this common problem begins to manifest. Finding information posted by one user that is to be shared may become difficult to trace and clutter becomes the order of the day. All stake holders will have the convenience of accessing relevant student information from a single web portal. The system will enable staff to keep an update record of all students, timely reporting leading to improved service delivery and decision making.

1.8 Limitations of the study

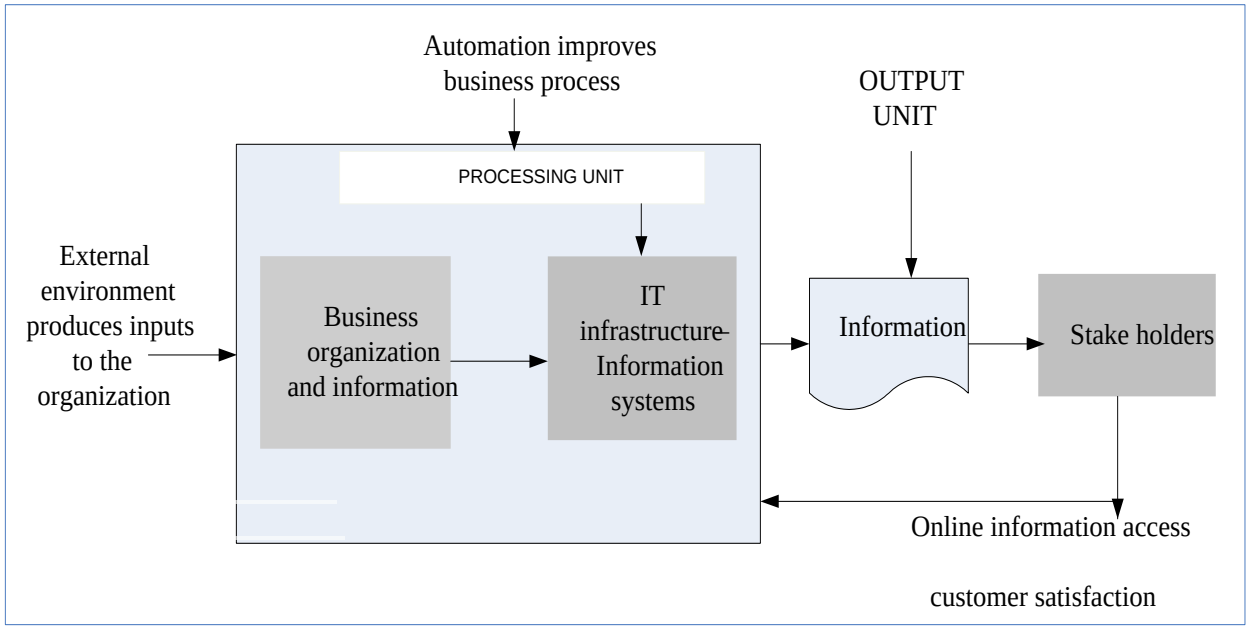
1. The researcher had no experience in software development and programming
2. Limited time with in which to accomplish the project was another challenge given that the researcher needed to learn how to use software packages like PHP and Java script to design and develop the system.

3. Financial constraints were another big challenge that is evident in the limited number of questionnaires given out since printing was very costly in addition to costs for the purchase of other required materials for the project.

1.9 Conceptual framework

The conceptual framework includes the identification of components of the system that is; business organization and information, IT and ICT as an enabler of information access, customers' need for information and online information access bringing about customer satisfaction.

Figure 2: Conceptual Frame Work for the New Information System



Source: Primary data

The figure above is the constructed framework by examining its components. The interpretation is based on the issues that are fundamental to the design and application of the OSIS. The conceptual framework considers societal values, practices and principles; particularly because the nature, characteristics and needs of the society are fundamental for the design of an OSIS.

Business organization and information

The organization receives inputs from the external environment in form of students. Data is captured on students – their personal information, payment status, and academic progress throughout their study programs.

Student information system

This is a web-based self-service environment for students and staff to easily and conveniently access student information; an administrative transaction processing environment for university staff to conduct day-to-day business; an information environment for all levels of faculty and staff to do reporting, data extraction and information analysis. This is a software application for educational establishments to manage student data. Student information systems provide capabilities for entering student test/examination results/scores, registering courses taken, building schedules, tracking student attendance and managing many other student-related data needs in a school, college or university.

Information access

The online student information management applications have to accept process data and generate reports accurately and any point of time any authorized user can get access to student information.

Stake holders

These are the persons who use the student information system to capture, process, manage and disseminate student information or the end users of that information. In this regard; the key stake

holders include; the Registrar and the registry staff from the main and faculties, the Vice chancellor, Deans of faculties, Accounts and students.

1.10 Conclusion

This chapter lays the foundation on which the rest of the chapters of this project hinge. It presents a brief introduction and background to the project, statement of the problem and main purpose to the study, its objectives, scope, significance and the conceptual framework. The next chapter presents literature review on student information systems in higher institutions of learning, data management and the value of information, web-based applications in relation to information access; approaches and methodologies to modern information systems development and shows how automated information systems relates to enhancing information access in higher learning institutions.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This section presents literature review on data management and the value of information, information infrastructure and web-based applications in relation to information access; approaches and methodologies to modern information systems development. This helped the researcher to identify the gaps in the literature and how these were to be used to solve information delivery problems that affect students. This chapter restricts its self to areas deemed necessary to this study.

2.2 Universities and student records management

Kasozi, (2003) describes Universities as "centers of higher learning where knowledge is created, preserved and disseminated". According to Ministry of Local Government (2003), data comprises raw unformatted information that is easily manipulated, updated, edited, copied and reused but lacks context and structure. Cyganski, (2001) defines information as "Knowledge communicated or received concerning some fact or circumstance; news". Student information in this context is an education record containing information directly related to a student, which means that the record is personally identifiable. Personal identifiers that relate a record to a student include student name, student ID, student address, parent/family member names, and a list of personal characteristics.

Student/education records are maintained in multiple media including handwriting, print, microfilm/fiche, computer's main memory, magnetic tape, cassette, disk or diskette and may be presented by the student, submitted on behalf of the student, or created by the University. These records are used to assist offices in their support of basic institutional objectives and to document

student progress and achievement in the educational process of the University. The majority of student education records fall into the following categories: (1) Admissions Records become part of the student's cumulative academic record once the student; is enrolled in classes; (2) cumulative academic records; (3) academic advising records (4) financial records; (5) disciplinary records; (6) medical records; and (7) Personal/Career Counseling Records. The above student data must be processed into meaningful information for decision making. However, universities are traditionally highly decentralized organizations, so corporate information resources management is a challenge (Cornford, 2000). The World Conference on Higher Education in the Twenty-first Century: Vision and action 5-9 October (1998), explains; that "the complexity and challenges universities face today are; student numbers, resource constraint, records management, improving teaching and learning; increased demand for transparency and accountability, governmental regulation and institutional autonomy." This theory asserts that, systems naturally go to more complexity and as they do so they become more volatile and must expend more energy to maintain that complexity (Carter McNamara 1999), automation is looked at as an effective tool to cope with that complexity. A-Z of information, (2010) affirms the complexity of a university that "*a University is a large and complex organization*". This is especially true with the current trend of ever increasing number of students being enrolled every year for both full-time and distance education; finding your way round the many campus systems to get the required information can seem daunting. Likewise, external pressures due to the rise of the network society pose questions about the role of universities. Traditional face-to-face and paper based campuses are now part of a more rich and complex environment where electronic networked information resources have grown in importance. Haag, (2005) gives three vital dimensions of information; time, the location and the form. The time dimension according to Haag, emphasises "(1)having access to information when

you need it or timeliness and (2) having information that describes the time period you are considering" because like any other organizational resources, information can become old and absolute. The location dimension emphasises "having access to information no matter where you are". This justifies online delivery of information; "if an organisation has an intranet and you want to access information on it while away from the office, all you need is web access and the password that will allow you through the firewall" (Haag 2005: 7). The form dimension emphasises 2 aspects; (1) having information in a form that is most usable and understandable by you – audio, text, animation, graphical and others (2) with accuracy; you need information that is free of errors. In this regard, and in line with objective (1), it is imperative that the study reviews the issue of data management in relation to the expectations of the millennium generation.

2.3 Data management and expectations of the Millenium Generation

The above mentioned three dimensions of information align perfectly with the expectations of the millennium generation; those born in 1982 and are since then in universities since 2000 is a generation characterized by convenience. They have an expectation for efficiency of service (Lowery, 2004). This efficiency includes service that is of high quality, with responses that are fast and provided when they are needed or requested (Kvavik, 2000). Howe, (2003) also note that millennial generation students expect to use technology and to have the tools necessary to streamline their educational experience. This indicates that the importance of information in all spheres of life cannot be overstressed. Among other things, it is an essential ingredient in planning, decision making and implementation, by people in general and management staffs of organizations like a University (Uwaifo, 2004). There is need for decision makers to have quick and easy access to the information of their choice because failure to to do so is tantamount to

delaying people's decision making. Watson, (2006) asserts that information is used to set goals, to determine the gap and to determine the actions in order to reach a goal. Responses from students indicate that they need easy and faster access to information to decide regularly on what objectives to be achieved, what actions to take to achieve these objectives, how and when these actions are to be taken, and the resources to be used for all these activities.

2.3.1 Problems with data management systems

The success of a business organization depends on its ability to manage business information. According to (Watson 2006), successful management of data is a critical skill for nearly every organization yet, few have gained mastery. Hence there exist a variety of problems with data management systems in firms as shown in table below:

Table 1: Problems within data management systems

Redundancy	Some data are stored in different systems
Lack of data control	Data are poorly managed
Poor interface	Data are difficult to access
Delays	There are frequently long delays to requests for data
Lack of reality	Data management systems do not reflect the complexity of the real world
Lack of data integration	Data are dispersed across different systems

Source: Richard T. Watson: Data management, 2006. P.21

The above are typical of the file based systems that characterize most institutions of higher learning in Uganda, UMU in particular. These were an early attempt to computerize the manual filing system which only works well when the number of items to be stored is small. However, a manual file system crashes when cross-referencing and processing of information in the files is carried out. For example, in a university a number of students are enrolled who have the options

of doing various courses. The university may have separate files for the personal details of students, fees paid by them, the number and details of the courses taught, the number and details of each faculty member in various departments. The effort to answer queries like; annual fees paid by the students of Computer science department this year's turnover of students as compared to last year and number of students opting for different courses from different departments. The answer to all the questions above would be cumbersome and time consuming in the file based system, which justifies the design and implementation of an automated information system that can handle complex processes and allow flexibility in access to student information.

2.4 Information systems & Information technology

The problems seen above are a clear indication that in this digital era, bringing the relevant information closer to the people who need it should be a major concern of every educational institution to stand the competition and this prompted the study to review the aspect of IT and I.S in relation to their applicability in enhancement of information delivery. An information system according to Alter, (2002), is a system that uses information technology (IT) to capture, transmit, store, retrieve, manipulate or display information in an organization(s) while information technology (I.T) refers to any computer-based tool that people use to work with information to support the information and information-processing needs of an organization (Haag, 2005:p.14). Technology is of two categories; hardware and software. Hardware consists of the physical devices that make up a computer system that is; input, output, processing, storage, telecommunications and connecting devices (Haag, 2005:p.16). Software on the other hand is a set of instructions that the hardware executes to carry out a specific task for you.

Information systems today contribute significantly towards creation and maintaining a competitive advantage (Simon, 1996; Haag, 2005:p.18) and that, an organization can use technology to achieve a competitive advantage by supporting and enabling operational excellence, major business initiatives, decision making and organizational transformation. Research shows that information systems execute organized procedures that process and/or communicate information (Lucas, 2000) and that, the use of technology in the design of effective and efficient information systems reduces on the administrative costs and improves efficiency in the decision making process. Connolly, (2005) stress that; databases have become part and parcel of organizations as tools for improved data processing, storage, information retrieval and dissemination and forwards many advantages associated with the database approach including controlled redundancy which saves space and maintains consistency of data, sharing of a database by any number of application programs or users, data independence, data integrity and security among others. Because, modern society has rising expectations concerning the accessibility of information; people now expect efficient and speedy responses to requests for information and in view of the above advantages, the project employed Mysql DBMS to manage the database.

2.4.1 Information technology infrastructure

To deliver efficiently and effectively, information systems today depend on modern I.T infrastructures. In a study by (The National Council for Higher Education, 2006) there was a modest increase in ICT accessibility in tertiary institutions in 2005 where by institutions with email addresses increased from 79 (51%) in 2004 to 97 (68%) in 2005. Similarly, those with websites increased from 34 (21.9%) in 2004 to 42 (26.8%) in 2005. However, the same report shows that the percentage of institutions with both emails and websites dropped from 42 (27.1%)

in 2004 to 41 (26.1%) in 2005. Newman, (2002) forwards the use of digital-based technology to enhance learning through the application of the computer, the internet, the web and related soft and hardware in education delivery has a number of advantages as it is known to:

- Increase both student learning and student interest in learning.
- Offer the student an opportunity to return, at the student's own convenience, to materials previously covered in an almost real-life situation.
- Change the role of the academic staff from sole information provider to a learning facilitator in methods Socrates would have approved.
- Give the student access to information that was previously impossible to get in the same time span.
- Enable the student to compare courses and notes given by various institutions before making a decision on what to take.
- Lower educational costs. Investment in digital technology is relatively low in comparison to other hardware.
- Transform distance learning from using the massive volumes of paper correspondence courses to an instant online interaction between the student and the source of information.

The above improved infrastructure provides a vital platform for the design and implementation of the online student information centre. Oh, (2003) seems to agree that the availability of ICT can provide opportunities and possibilities as well as threats and dangers to teachers and administrators. He continues that "understanding, directing, and managing information-related activities within educational institutions have become critical to the success of education programs and policies'. In the same study, he mentions that among the more specific implications of ICT for education, the following are worth noting: Integration of technologies and media makes distance in space and time increasingly relative; Long distance "on-line"

connections are possible, so that simultaneity and nearness are less and less bound by limits consequently, the experience of a limited territory in which one can act and communicate becomes less relevant; Communication relations and actions can thus be organized on the basis of the desired level of scale and scope, the desired participation and the desired information provision (Frissen, 1996). Likewise, the mode of education consequently changes because it has always been based on limitations in time and space. The technological developments thus seem to lead to deteritorialization (Frissen 1998, 37) because neither time nor space poses significant constraints and higher education cannot ignore this change. He concludes that, the activities of teaching and learning are powerfully driven by ICT and that; students increasingly rely on ICT to gather information, to complete their homework, and to communicate with others. From the management perspective, complex challenges are generated in supporting students who must cope with this more information-rich and depersonalized virtual learning environment. Omona & Ikoja, (2006) carried out a study on application of ICT in health information access and dissemination in Uganda. Their study concluded that a number of challenges must be addressed if the full benefit of the use and application of ICT to facilitate access and dissemination of information is to be realized in Uganda, and draws the attention of all the stakeholders in the health sector to the need to support and promote ICT as the most effective tool for health information access and dissemination. Their focus however, was on health information delivery and ICT applications in general. Kasozi, (2003: p.70) indicates why the internet has taken a big advantage over other means of communication. The cost of sending large documents via the internet is cheaper compared to the other methods. Emailing a document of 40 pages from Kampala to New York or Washington costs less than a dollar, faxing it about five dollars and by courier over fifty. He continues that; Internet users in Uganda grew from 2500 in 1998 to 25, 000 in 2000 and a number of universities and schools were taking advantage of this global trend by

getting connected to the Net. This indicates that massive information can be sent by internet from one institution to another very cheaply.

Table 2: Uganda Internet Usage and Population Statistics

YEAR	Users	Population	% Pen.	GDP p.c.*	Usage Source
2000	40,000	24,400,000	0.1 %	US$ 410	ITU
2006	500,000	28,574,909	1.7 %	US$ 280	ITU
2007	750,000	30,262,610	2.5 %	US$ 280	ITU
2008	2,000,000	31,367,972	6.4 %	US$ 300	ITU
2009	2,500,000	32,369,558	7.7 %	US$ 300	ITU

Note: Per Capita GDP in US dollars, source: United Nations Department of Economic and Social Affairs.

According to Balimwikungu (2011), "Uganda, like elsewhere in the developing world has registered a fast growth in ICT use among the youth". Research on Internet Usage in Uganda conducted by the Uganda Communication Commission in 2005 also indicates that the youth were the major users of the Internet in Uganda. The internet and the World Wide Web (WWW) have become the most powerful IT infrastructure. Raymond, (2005) defines Internet as a group of networks connected by routers so that any application on any host on any network can communicate with any application on any other host on any network. This is supplemented by Haag, (2005:p.106) who defines it a vast network of computers that connects millions of people all over the world. It can also be seen as a multimedia-based collection of information, services and web sites supported by the internet. On the web among the various information resources available are web sites. A web site is a specific location on the web where you visit, gather information and perhaps even order products. Research shows that schools, businesses, government agencies and many others have all connected their internal networks to the internet, making it truly a large network of networked computers. The internet especially the World Wide

Web is beginning to have an important impact on the relationships between firms and external entities and even on the organization of business process inside a firm. The internet increases the accessibility, storage and distribution of information and knowledge for organizations and is capable of dramatically lowering the transaction and agency costs facing most organizations (Laudon, 2006). Businesses are rapidly rebuilding some of their business processes based on internet technology and making this technology a key component of their IT infrastructures. The effectiveness of learning and training in many ways depends on increased demand for student's convenience, including his/her time, pace and place of learning. Pedagogical strategies that are based on total use of state-of-the-art technologies such as Internet and the World Wide Web correspond to the highest level of student's convenience. Integration brought by web-based information systems is shown by (Cyganski, 2001) while describing the importance of web-based information systems that an organization for instance; may advertise the availability of new information by simply placing a hypertext link that connects to its new document in an existing document that is known to many colleagues as a home for many such links related to this field of endeavor. It is often expected that those who have an interest in such work will make a habit of scanning this and other related home pages for new additions. In this way, the Web allows us to browse for new information rather than having to wait to be actively contacted by someone. The Web provides answers to problems associated with distributing varied types of information to largely unknown recipients. Turban, (2005) assert that web-based systems clearly have influenced how decision-making is supported and that the development of m-commerce; more and more personal devices can access information sources and users can respond to systems with information updates, collaboration efforts and decisions.

2.4.2 Web-based applications

As web applications become increasingly integrated in business strategies for all types of organizations/businesses, the need to build reliable, usable and adaptable systems grows in importance. Included in this category are complete websites, specialized functionality within websites and information processing applications that reside on the Internet or an Extranet. It should be noted that the system is seen as a support infrastructure for the user, according to Star and Ruhleder (1996), Checkland and Holwell (1998), and Srikanthan and Dalrymple (2005). It intends to provide the user with various selected sets of data to help him or her in university matters. In some cases, the system can enable contact with other people in university in order to enhance informal information exchange or knowledge sharing (Amin and Cohendet, 2004). In addition, taking as a reference the socio-technical concept of information systems, it is considered that the existence of contents and services implies the availability of certain technological elements (computer applications) but, in addition, of an adequate organizational environment. Both elements, the technical and the organizational, form the infrastructure. A large number of context-based mobile services have been developed over the last years, in a number of different domains, such as tourism (Kabassi, 2010; Yu and Chang, 2009), friend presence (Petersen et al., 2010), shopping (Hella and Krogstie, 2010). MyCampus (2005) is a Semantic web environment for context-aware mobile services aimed at enhancing everyday campus life at Carnegie Mellon University (CMU). myCampus utilizes semantic web technology to provide services to its users, by accessing and processing contextual information such as location and personal preferences. A central element of the myCampus architecture is its use of Semantic eWallets that support the automated discovery and access of contextual resources. MIT Mobile Web (2009) is providing a similar solution. This solution provides the services like News, Events, Shuttle track service, campus map, people directory, and mobile access to MIT

course management system. This solution utilizes mobile web technology to provide these services. Harvard Mobile (2010) is another solution developed by Harvard University. This solution is based on web technology and provides services like news, events, course updates, map and a directory of people.

2.5 Student information systems

A student information system (SIS) is a software application for educational institutions to manage student data and distribute information to support decision-making and control in an organization. University students need information of different kinds that are not necessarily scholarly in nature, but are, nevertheless, extremely valuable and support their learning. Such information may be available in a variety of forms and formats in different places within the institution with different access control mechanisms in place. Examples of such information may include; students' registration and performance related information that may be available with the registry; various student support services in relation to funding, health, accommodation among others that may indirectly facilitate learning. In a true managed learning environment, these information systems need to be integrated in a way that facilitates students' learning and life within the university, including accommodation, sports, financial and other supports (Meyyappan, Foo and Chowdhury, 2001,2004). Student information systems provide capabilities for entering student data and other assessment scores through an electronic grade book, tracking students' fees payment, tracking students' discipline, and managing many other student-related data needs in an institution. The National Center for Education Statistics points out that "the maintenance of extensive, accurate, historical, and current data about individual students is essential to the functioning of schools and school districts, and can promote effective educational practices at all levels of the education system" (NCES, 2000:p. 2). With the advent of internet

and technology, traditional method of school administration has given way to online platform. With this new methodology known as the student information systems**,** the teachers have found the tiresome procedure of making lesson plans, grading term papers, taking quizzes and other such things more convenient. By using the online student information management software, many teachers and administrators have been able to effectively reduce time for carrying out the normal routine processes like cross-checking the examination papers, taking daily attendance and so on. An example of such one system is the AERIES Browser Interface (ABI) which is a cross platform web-portal that allows for real-time access to student data using any modern web browser (Eagle-Software, 2011). The Aeries Student Information System is a comprehensive solution that incorporates multiple technologies to meet the diverse and ever-changing needs of schools, districts, and education agencies. The design and development of this robust, user-friendly system is rooted in over 40 years of experience in educational technology. Aeries is both flexible and scalable to meet and exceed the needs of both small and large districts. ABI is a feature included with the AERIES Student Information System package and its use benefits Teachers, Parents, School and System Administrators, as well as improves the education of students by facilitating the communication of information between school and home. Despite the importance of student information systems, research on its application in Ugandan education institutions remains minimal. The lines below are a review of the overall applicability of automated student information systems. Many scholars have put forward views and recommendations on how Management Information System (MIS) would operate and be managed especially with an integrated system. Barrett (1999, p.4) encapsulates the essence of a student information system. He defines SIS as "an integrated software package that maintains, supports, and provides inquiry, analysis, and communication tools that organize student accountability data into information to support the educational process". Consequently, Poel et

al. (1989) looks at the different forms of architectures that make up the system to be in place that allows continuation of information planning. In the process, information systems have evolved to support these efforts. Among the different types of systems is, information architecture in which information flow is required to support the business processes which leads to the development of the application architecture in which operational management has to indicate the functionality, how the information systems need to interact and who is responsible for which data. The information architect identifies and maintains the relationships between the different architectural levels and the whole structure of the information system leading to supporting the company's architecture and guard the quality of the results i.e. conciseness, completeness, consistency, accuracy, effectiveness, timeliness of the system through integration. Truijens, (1990) argues that, Integration recognizes different architectures where agreement between users and developers is received and regards it as valuable. The different kinds of systems like management information system or accounting system have different requirements which need to be thought of if the automated system is for developing a specific method to incorporate suitable specific characteristics in order to meet the same criteria regarding response-times, throughput capacity, security and robustness. These can be distinguished to provide for the differences in the required data storage for access. There has to be the infrastructure architecture where technical components like middleware (tiers) and relational databases have to exist and how they will be interrelated. Interrelatedness will bring in the development architecture that will specify the development process for software development and control, the method of how the software will be designed and created and the tools to be used for managing the software development process and documentation. The development architecture will use many methods but there will be need to come up with one method for the system with the right software development process.

2.6 Review of methodology

The Information Systems discipline and related research focuses on the development, understanding, and use of technology to meet business needs. Technology, in particular "software" is the basis for IS research, making software engineering a critical component of research in the IS domain. Perceived accessibility to information was put forward by (Culnan, 2007) as a unifying concept for the design and evaluation of a wide variety of information systems and services. Mulira (2004), in an ongoing study, looks at a service approach to information systems implementation in institutions of higher learning. The study highlights that the services-based approach to information systems implementation proposes a solution that will mitigate the socio-economic inhibitors that have led to the negligible efficiency gains in the deployment of automated information systems. Though there are various research approaches, design-oriented research approach was used for this study. The main idea behind design-oriented research is revealing of new knowledge of some sort as its main objective. In a very basic way thus, research tries to be 'true' by describing something in the way it is. Nelson, (2003) argue that al-though, the prospect of any kind of research being able to arrive at anything 'true' whatsoever of course can be and has been debated from several perspectives, it still seems fair to say that 'true' lives on as an ideal for research – something to strive for. Turning it over, if research should not strive to be true, then what should it strive for? In this respect, design-oriented research argues that this new knowledge, "*this new description of a state of affairs, is of a kind that cannot be attainable if design – the bringing forth of an artifact such as a research prototype – is not a vital part of the research process".* Qualitative data sources include observation and participant observation (fieldwork), interviews and questionnaires, documents and texts, and the researcher's impressions and reactions (Myers 2009).

2.6.1 Requirements collection

Jeffrey, (2008, p.174) argues that, in the process of data collection, you must collect information about the information systems that are currently being used and how users would like to improve the current systems and organizational operations with new or replacement information systems. To find out information about a system a number of methods are available:

Questionnaires can be used to get the opinions of lots of people with relative ease. They are cheap but limit the amount of feedback a user can give. *Interviews* on the other hand are the most useful fact finding method as they allow the researcher to deeply probe for details regarding a situation. Babbie, (2007) looks at a qualitative interview as an interaction between an interviewer and a respondent in which the interviewer has a general plan of inquiry, including the topic to be covered. The qualitative interviewer must be familiar with the questions to be asked. In this research, qualitative interviews were conducted to enable the researcher to collect data on the various aspects of the business processes that were of interest to the topic in question. Another method that can come in handy is *observation*. Bell (2005) points out that observation can be useful in discovering whether people do what they say they do, or behave in the way they claim to behave. It also depends on the way people perceive what is being said or done. Bell emphasizes that if mastered, observation technique can reveal characteristics of groups or individuals which would have been impossible to discover by other means. Further emphasis is put forward that to get the most out of the observation period, one has to be clear about the purpose of the observation and why he/she is observing that particular group or individual. If one's main interest is a process, then methods of recording the process have to be found. As methods are selected, Bell points out that some questions have to be kept in mind such as: 'what do I need to know?', 'why do I need to know it?' and 'what shall I do with this information when I have it?' Some of the processes that were observed included IT infrastructure in relation to

technologies available; how they were being used and what they were used for, kinds of data captured, how they were processed and stored, the registration process and staff. The methods above may sometimes be insufficient with-out the researcher's access to existing documents.

Examination of paperwork allows you to see what information, types and amounts, the current system handles and how much the new system must be expected to handle. Document analysis according to (May, 2001) is one of the modern techniques used in research. He however emphasizes four indispensable points that must always be considered in assessing the quality of documentary sources; authenticity, credibility, representativeness and meaning. The analysis of documents like the other research techniques required the flexibility of the researcher for instance to verify the validity and reliability of those documents. Documents reviewed included; UMU's Vision and mission statements, organization structure, programs and courses hand books, student handbooks, registration criteria, examination procedures, fees payment procedures and clearance information. Bell, (2005) says that information obtained from the documents reviewed can be particularly useful when access to the subjects of research is difficult or impossible. The information obtained from the documents reviewed can be used to supplement information obtained by other methods.

2.6.2 System analysis

The purpose of analyzing a current system is find out the requirements for any proposed system, what data needs to be handled, how it should be handled and who will be using the system. There are a number of different approaches to system analysis. Systems analysis and design methodologies display a series of process models and techniques which can be used for constructing an information system. Several methods are employed for planning and building the system with different complexities and approach. According to Ewart (1985, p.271), the

development of information systems is not only a technical process but also a political one. Achieving success with large, integrated systems that are combined with traditional systems requires the organization to analyze the existing system. Explaining the systems analysis approach, Jacquot and Finance (1990, p.391) assert that a good information system depends on the equipment, more on human technical backup, and largely on how the system is organized. They believe that it is the way in which a system is organized (structure, design and integration) that determine its success. This requires the establishment of information requirements in an effort to organize such systems. According to Ewart (1985, p.271), the major challenges of organizations (especially Education institutions) are to plan, manage, and control the development and operation of such systems. Various models of information analysis have been developed. The most common approach to analyzing systems is the 'Systems Development Life Cycle (SDLC)' which has been widely applied in the analysis of information systems. The model works on the assumption of steady uni-directional progress through the various stages, without going back or repeating them. Hoffer et al, (2008) interprets the analysis phase as one for describing the current system, identifying problems or opportunities with a general recommendation on how to fix, enhance, or replace the current system. He also recommends explanation of alternative systems and justification for chosen alternatives. When a computer-based information system is developed, systems analysis (according to the Waterfall model) would constitute the following steps:

- The development of a feasibility study, involving determining whether a project is economically, socially, technologically and organizationally feasible.
- Conducting fact-finding measures, designed to ascertain the requirements of the system's end-users. These typically span interviews, questionnaires, or visual observations of work on the existing system.

- Gauging how the end-users would operate the system (in terms of general experience in using computer hardware or software), what the system would be used for etc.

2.6.3 Enterprise architecture framework

Enterprise Architecture is a means to support business and IT alignment and is a commonly used term in the design of information systems. Rohloff, (2005) gives three basic domains of the enterprise architecture framework as; business architecture, application architecture and infrastructure architecture. The *business architecture* describes the fundamental organization and requirements of the business based on business strategy and objectives. It is composed of the four building blocks business model, organizational architecture, process architecture, and information architecture. The business model gives a high level view on the nature of the business in terms of products and services offered in the market, the value chain, business partners, market channels utilized, and the combination of resources and information for generating value add. The organizational architecture describes the organizational design of the enterprise and the principal cooperation with customers and suppliers. The process architecture classifies and describes all processes of the business and their respective value adds. The information architecture shows the logical structure of all information entities like products, business partners, logistic information etc. The *application architecture* gives an overview on all applications supporting the processes of the business with the building blocks enterprise applications, portal & information management platform and data repositories. The portal and information management platform is the universal access to all company information and knowledge. Data repositories are the physical storage of all relevant company data and provide an integrated view on product, customer and business partner, and/or financial data.

Enterprise application integration services provide the integration of applications and data across the company. Integration technology spans from message exchange, data exchange to process integration. The *infrastructure architecture*, also referred to as technology architecture, comprises the software, hardware and network infrastructure required for operations of all applications. Infrastructure building blocks are basic services, workplace services, server systems and storage, and the network. Basic services are essential applications providing a specific functional support which are independent from business processes. Examples are communication services like Email or Telco, directory or search services, and administration services like single sign on. Web Services are emerging services which transfer the concept of basic service to the internet. Workplace services provide for presentation and work with information and for productivity support at the work place. They comprise fixed and mobile devices at the client site and include basic office applications and browser. Server systems support all back end resources like applications, data repositories, integration services etc. Storage provides all memory capacity for running the applications on the server. Networks provide the communication links in the LAN and WAN, within the company, between companies and in the Internet. Security is integral part of all architecture building blocks and described in an overlaying structure.

According to (Trevor, 2003), Client-Server software architecture is a versatile, message based infrastructure that is intended to improve usability, flexibility, interoperability and scalability to centralized and real time computing solutions. Client-server architecture became the dominant structure for corporate computing in small, medium and large organizations. It combines the best concepts of centralized, robust infrastructure with decentralized capability and control. The most popular three-tier client-server architecture is the World Wide Web (Chaffee 2000) with a front-end web server serving static content, and potentially some cached dynamic content. In web

based application, front end is the content rendered by the browser either static or generated dynamically. The middle end contains dynamic content processing application server, for example, ASP.NET, PHP platform; a back-end database comprises both data sets and the database management system or RDBMS software that manages and provides access to the data.

During the business re-engineering process, it is important to be able to clearly link operational processes and organizational services to business goals and objectives. Every modeling technique, tool or method is developed with a particular purpose in mind and therefore is focused on particular aspects of a system (or object of study). For this study, DEMO and UML were used. DEMO (Dynamic Essential Modeling of Organizations) is a modeling methodology considering an organization from the Communicative Action Perspective (Dietz, 1994; Dietz, 1996; Reijswoud and Dietz, 1998). It is a cross-disciplinary theory, rooted in the language-action perspective (Dignum and Dietz, 1996), for describing and explaining the action of organizations, as well as for organizational (re)engineering (Reijswoud and Dietz, 1998). The advantage with DEMO methodology is that it consists of several model types, each expressed in a specific diagram, that collectively provide the necessary knowledge for information systems development and business process redesign. The core concept is the notion of the essential (business) transaction. It is the 'atomic' building block of 'molecular' structures called business processes. The operation of an organization is explained in terms of communicative actions between people. By means of the DEMO models it is possible to achieve a solid understanding of the types of transactions taking place in an organization, the participants involved in these transactions, the information that is needed and created during the transactions, and the relationship between the different transaction types. UML on the other hand is an industry standard modeling language with a rich graphical notation, and comprehensive set of diagrams and elements and according to

(Watson 2010), UMU is Object Management Group's (OMG's) most-used specification, because of the way it models not only application structure, behavior and architecture, but also business process and data structure. UML also provides a key foundation for OMG's Model-Driven Architecture, which unifies every step of development and integration from business modeling, through architectural and application modeling, to development, deployment, maintenance, and evolution.

2.6.4 System design

This section reviews the various design methodologies. The waterfall method of modeling an information system is a traditional approach which takes into account all the steps for developing a product. It takes into account the various steps such as planning, designing, coding and implementation. This is a quite planned approach in that once a step is completed, the product jumps into another step to get shapes accordingly unlike to other methods (Hoffer, 2002). Information engineering on the other hand focuses on an organization's information requirements and generic processes which are quite flexible for future changes. In contrast to waterfall model which involves methods that do not take care of the organization's requirements but focus on the product development which makes it closed to changes, the former lays a good amount of emphasis on the organization's data. Rapid application development (RAD) techniques reduce the time complexity of the waterfall methods by prototyping methods and other techniques. Unlike waterfall and information engineering methods it creates joint application development sessions to understand the user requirements better and decide on functionality for design and usability. In place, RAD addresses the above problems of not involving the users and makes sure that the stakeholders of the system are able to meet and discuss on all grounds including design and look and feel. However, short iteration may not add

enough functionality, leading to significant delays in final iterations; there is no up-front detailed design which could result in more redesign effort in the long run. And the product may lose its competitive edge because of insufficient core functionality and may exhibit poor overall quality.

The object oriented approach makes the process modeling quite simpler in nature by constructing the objects which represent real life features. In comparison to other process models the organization's data is given more importance with relation to its storage and security. The ability is also enhanced with the use of other object oriented features such as inheritance and polymorphism (Booch, 2003). The reusability of the data and business processes is the prime feature of object oriented methods which makes it quite strong in comparison to other methods. In waterfall, emphasis is more in modeling organizations processes, information engineering focuses on modeling organization's data whereas object oriented methods envelope both. Design-oriented research methodology was used to shape and develop the system basing on the analyses from the collected requirements (Verschuren, 2005). According to this methodology, the system is designed and developed following the steps below:

1. Set goals to be realized
2. Specification of the requirements to be fulfilled within the frame that is defined by the goals.
3. Structural specifications of the artifact to- be, i.e., the characteristics, aspects and parts that the artifact must have in order to satisfy the whole set of requirements
4. Build a prototype; (Chaffey, 2002: p.388) forwards prototyping as a popular approach to developing all kinds of business information systems (BIS). Its benefits include preventing major design or functional errors being made during the construction of the website that may be costly and time consuming to fix once the site becomes live and may also damage the brand. Such errors are identified early on and then corrected. It involves the team responsible

for the website and ideally the potential audience of the website in proactively shaping the website.

5. Implementation where the prototype is put into practice to evaluate whether it will work appropriately
6. Evaluation and testing to check whether the short and long term effects of utilization of the prototype fit the design goals and satisfy the expectations of the designer and various stake holders.

2.6.5 System development and implementation

Implementation plans sometimes over emphasize the role of technology with less importance given to the organizational structures and institutional processes that rely on both technology and information. Petrides, (2004) argues that in fact, many information system implementations in higher education fail not because of the technology, but because insufficient attention is paid to issues related to organisational culture – organisational processes and practices, information politics and patterns of information sharing and hoarding. Studies have shown that technology alone cannot be used to address discordant organisational information structures. In developing information systems, there are various methodologies available for use. Despite the advantages of the methodologies discussed above, the researcher chose prototyping for it offers an opportunity to achieve favorable user attitudes toward the design process and the information system. Furthermore, it facilitates fast response to user needs, allows clarification of user requirements and offers an opportunity for experimentation. Hoffer & George, (2008) define prototyping as an iterative process of systems development in which requirements are converted into a working system that is continually revised through close collaboration between an analyst and users. The research used this technique considering first the time factor; to complete the

product in time and because it minimizes development costs, allows the developer to receive quantifiable user feedback, facilitates system implementation since users know what to expect, and exposes the developer to future system enhancements. Chaffey, (2002: p.388) forwards prototyping as a popular approach to developing all kinds of business information systems (BIS). Its benefits include preventing major design or functional errors being made during the construction of the website that may be costly and time consuming to fix once the site becomes live and may also damage the brand. Such errors are identified early on and then corrected. It involves the team responsible for the website and ideally the potential audience of the website in proactively shaping the website. Although there are pitfalls and shortcomings, none seemed troublesome enough to outweigh the potential benefits.

2.6.6 System and data security

Gleason, (1991) asserts that access control can be handled in a very straightforward and efficient manner by assigning access privileges to all of the positions in the institution and admits that it is a desirable way to eliminate access control for large numbers of individual. He continues to argue that basing security on positions rather than on people relieves the paperwork burden and results in a more secure system.

2.7 Conclusion

From the literature reviewed, it was clear that if implemented well, an online student information system can help universities UMU in particular to effectively manage students' information, save costs, enhance information access and consequently, timely decision making. The review of related literature also revealed that though computerization had been adopted in organizations and institutions of higher learning, much emphasis has been on adopting the new technologies

without any clear strategy for managing the information created. Literature review highlights the importance of information, ICTs and ISs in organizations and explains why organizations should strive to integrate their systems. Most attempts showed a need to coordinate information wherever it exits into a system that facilitates its use. However, these studies did not focus on the design and implementation of a general purpose online student information system. Chapter three discusses the methodology the researcher used.

CHAPTER THREE: METHODOLOGY

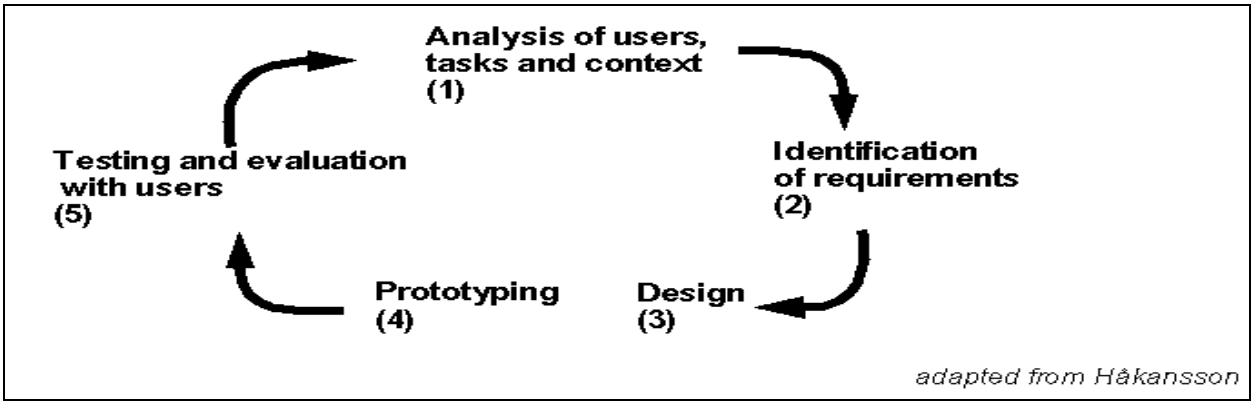
3.1 Introduction

This section focuses on the approach, methods and tools the researcher used in collection of the requirements for the new system as well as the development of the solution. It covers the area of research, research design, subjects of the study, data collection methods and research procedure, data quality controls provided for the study and tools used to analyze the collected data and present the findings.

3.2 Research approach

The research followed a design science approach that involved a combination of both qualitative and quantitative techniques including surveys to argue for the relevance of the system and evaluation of different versions of the system. This approach was deemed appropriate because it uses prototyping and evaluation at the end of each phase of the development which plays a key role so that the artifact designed should satisfy a set of preset design criteria. The researcher based the design into the real user needs and therefore the end users were fully involved in order to determine their real needs.

Figure 3: Research approach adapted from Hakansson



3.3 Study area

The study was carried out at Uganda Martyrs University, Nkozi a faith-based institution owned by the Episcopal Conference (A Council of Catholic Bishops of Uganda). Its main campus is situated at Nkozi, 82 kilometers of Kampala on the Kampala-Masaka road. The population under study included the Registry staff both in the main registry and faculties, Accounts staff, ICT staff and UMU students (Undergraduates, post graduates both fulltime, part-time and distance learners).

3.4 Research design

Research design provides an overall guidance for the collection and analysis of data of a study. The importance of research design stems from its role as a critical link between the theory and argument that informs the research and the empirical data collected (Nachmias & Nachmias 2008). A choice of research design 'reflects decisions about the priority being given to a range of dimensions of the research process (Bryman & Bell 2007, p. 40), and this of course will have considerably influence on lower-level methodological procedures such as sampling and statistical packages. It is therefore a blueprint that enables researchers to find answers to the questions being studied for any research project. Along with clear research plan it provides, constraints and ethical issues that a study will inevitably encounter must also be taken into account (Saunders *et al.* 2007). The researcher used a case study focusing on Uganda Martyrs University, Nkozi and the area of interest was the Registry's student information management and access system. Yin (2002) introduces the case study as "an empirical inquiry that investigates a contemporary phenomenon within its real life context especially when the boundaries between phenomenon and context are not clearly evident". Case studies offer in-

depth understanding of how and why certain phenomenon occur and can reveal the mechanisms by which cause-effect relationships occur.

3.4 1 Identifying the sample size

Saunders et al (2007) emphasize that collecting data from a sample which represents the entire population is a valid alternative when there are constraints on time, the budget and it is impracticable to survey the entire population for the research. It is further explained that normal distribution of the data which ensures the validity and reliability of the data, stating that the absolute size of sample as the central limit theorem occurs even when the population is not normally distributed. Here the mean values of sample size of 30 or more is usually very close to the mean values of a larger sample (Stutely's (2003); cited by Saunders et al (2007:211).) Given the student population of UMU, the researcher followed the advice of Roscoe (1975) cited by Sekaran (2003:295) and Fisher (2007) that as a rule of thumb, a minimum sample of 30 is acceptable for statistical analysis; to select the sample for the study. For this study, 80 questionnaires were sent out to 80 respondents.

3.4.2 Identifying the sampling technique

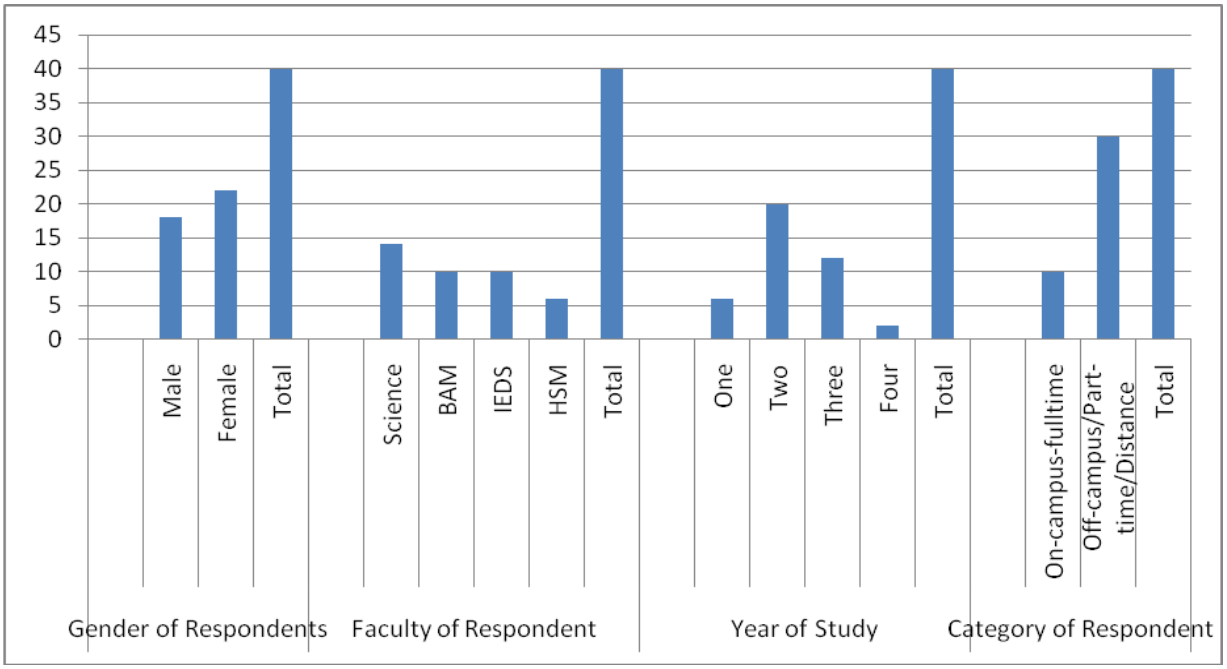
Selection of student respondents to treat with a questionnaire

To capture views from a multitude of students both part-time and distance; the study population was purposively selected from faculties that have both full time and distance learning students (Science, (BSC, IT, MSCIDE, MSCIS, HSM), BAM (Microfinance, BAM, MBA), IEDS (MA, Human Rights, Good Governance Studies) and Health Sciences Management) in order to get views from those that need the service most. Disproportionate stratified sampling was used for the selection of a sample to get representatives from both full time (10) and part time/distance

students (70) in the sample. Simple random sampling was used in each stratum to give an equal chance of males and females being included in the sample. To get a sample from the chosen faculties, convenience sampling was used to capture those willing to participate as well as different programs. The researcher selected a sample of 80 respondents to whom a questionnaire was administered. Ideally, all students were supposed to participate but from those who willingly participated, 40 questionnaires were filled and returned.

The graph below shows the number of respondents by faculty, year of study and category. The large number of off-campus respondents in the sample was intended to capture their problems, attitudes towards online services as a group that was likely to benefit more from the new system. For the same reason, data collection was scheduled purposively at the time when off-campus learners were on campus for face-to-face.

Figure 4: Graph showing the number of respondents by gender, faculty, year of study and category



Source: Primary data

Selection of staff respondents for an interview

For the staff, a sample was purposively selected from the departments that directly handle student information. From the staff population of UMU, a sample of 20, 50% (**10)** were interviewed because they were either directly involved with students' records and their management or were key users of students' information. These included; the Deputy Registrar, Assistant registrar in charge of Admissions section, Assistant Registrar in charge of Transcript division; 4 Faculty administrators (HSM, Science, IEDS, BAM), 1 Assistant Librarian, Chief Accountant and Head ICT. The intention was to deeply seek answers through use of probing questions.

3.5 Identifying data collection techniques and tools

There are a variety of research techniques and tools but the following were chosen for this study. These included; interviews, questionnaires, observation and document review.

3.5.1 Interview

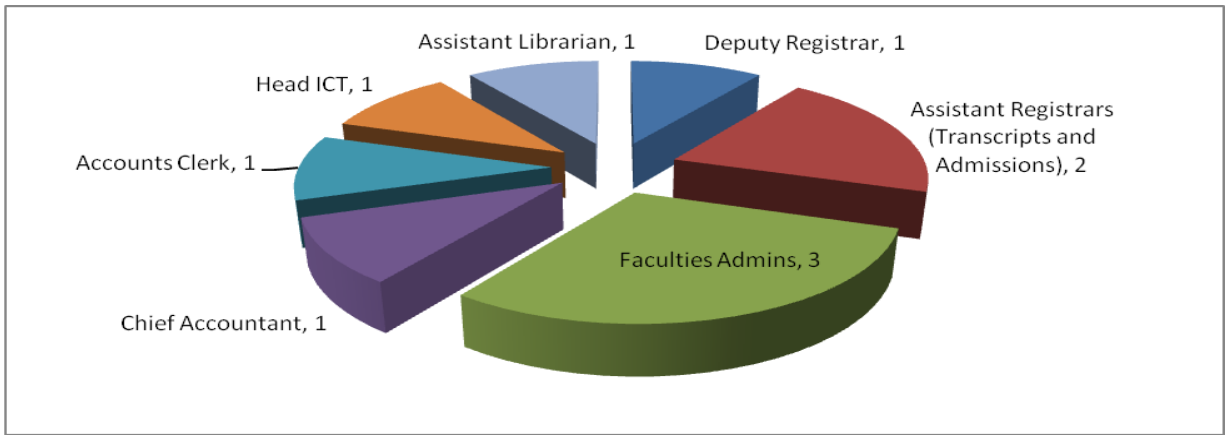
According to (Kvale, 2009), interviewing is a careful questioning and listening approach with the purpose of obtaining thoroughly tested knowledge. Saunders et al (2007) identifies that qualitative methods such as interviews and similar methods are more suitable for examining highly subjective attitudes and behavioral researches which will enable the collection of a rich and detailed set of data. Face-to-face interview technique was preferred for collecting data from the Registry, Accounts, ICT and Library staff because the researcher needed to probe for a deeper understanding of the current system according to the users' perspective in order to identify the requirements for the design of a new system since this is the dominant technique in

the field of qualitative research that gives the researcher the advantage to ask more complex questions, observe as well as listen than in other data collection technique.

Interview guide

An interview guide helped the researcher to carry out a focused interview to determine the responses of persons exposed to the system being studied. An interview guide is a set of topics and/or questions about which the interview is conducted (Kakinda, 2000). It was preferred for its ability to un-cover information on the significant aspects of the total situation and its magnitude. This study used structured questions for the reasons that the interviewer asks questions as written on the form and record answers as given; it reduces the bias; questions are ordered and the respondent is quickly engaged in the interview with interest maintained throughout. Interview guides are shown in Appendix B.

Figure 5: Pie Chart Showing Staff Respondents Interviewed



Source: Primary data

3.5.2 Questionnaires

To establish whether the online information services would be viable from the main stake holders' perspective and in the interest of time in relation to the population of UMU students, a questionnaire method was deemed appropriate in its quantitative form. This method was chosen

for its advantages over other methods when it came to handling large populations (Kakinda, 2000). The researcher used this method to gather data from Full-time, part-time and distance learning students. The response rate was 50% as 40 of 80 questionnaires were returned. A questionnaire is showed in appendix A.

3.5.3 Observation

The method was found to be the most appropriate technique for collecting information on key business processes and the technologies used. The researcher made visits to the registry offices and observed the processes through which students' data is captured, processed, stored and those that involved access to that information by students. To find out what kind of student information they produce, the business processes in view of how best they could be integrated into a one stop student information centre, the observation guide was used to focus on areas relevant for the study; Registry records management systems and accounts systems.

Observation guide

This was a list of general topic areas of the research problem that the researcher intended to observe in the process of investigation and this aided in identifying the problems that existed. It also provided first hand information about the procedures and events that occurred in the two departments under investigation and was particularly helpful in determining the various work flow processes and procedures. The observation guide is shown in Appendix C.

3.5.4 Document review

The researcher reviewed documents relating to business processes that involve students' information. Documents such as a draft of what is hoped to be passed as official mission

statement for the registry, admission forms, registration forms, examination reports, sample of transcripts, brochures, financial statement reports, etc were used to supplement information obtained by use of other methods mentioned above. Document analysis has been proven to be an extremely valuable alternative source of data especially where there is lack of access to research subjects (Bell, 2005).

3.6 Data analysis

Both qualitative and quantitative analyzes were done to determine the user requirements for the design of a solution. The key data collected was categorized, coded, summarized and displayed in tables, pie charts, and graphs; interpreted to determine the requirements for the new system. This is covered in details in Chapter Four of this report.

3.6.1 Computer programs used to analyze the data

Results from interviews were analyzed qualitatively in a narrative form. Computer software programs (SPSS and Excel) were used to analyze and record findings from the questionnaire. The questions, results from the questionnaires were entered into (SPSS Version 16) to analyze the findings. This was preferred for its ability to provide a wide variety of analysis's accurately (Fisher, 2007). Saunders et al (2007) also support this argument and emphasize the advantages of computer aided analysis such as time, inexpensiveness and accuracy.

3.7 System development methodology

To come with a solution, Systems Development Methodology was used. Hoffer & George, (2008) show that it as a standard process followed in an organization to conduct all steps necessary to analyze, design, implement and maintain information systems.

3.7.1 Prototyping

The researcher chose prototyping to get the product in time. Hoffer & George, (2008) define prototyping as an iterative process of systems development in which requirements are converted into a working system that is continually revised through close collaboration between an analyst and users. The research used this technique because it minimizes development costs, allows the developer to receive quantifiable user feedback, facilitates system implementation since users know what to expect, and exposes the developer to future system enhancements. Chaffey, (2002: p.388) forwards prototyping as a popular approach to developing all kinds of business information systems (BIS). Its benefits include preventing major design or functional errors being made during the construction of the website that may be costly and time consuming to fix once the site becomes live. Such errors are identified early on and then corrected.

3.7.2 Re-engineering

Upon verification using the data collected, it was found necessary to automate some key business processes to improve management and access to student information. Models were analyzed using object oriented analysis technique that focuses on the state of real world objects. DEMO was used to model the enterprise architecture while Unified Modeling Language (UML) a language for specifying, visualizing, constructing, and documenting the artifacts of software systems, as well as for business modeling and other non-software systems was used to come up with design models (Larman 2002). The UML has a number of models which in turn form part of the models into system functionality specification. Here the study used models available in UML including use-case diagrams, class diagrams, activity diagrams, entity-relationship diagrams, and conceptual data model.

3.7.3 Development platforms

Operating system

The study used the Windows 7 operating system because it is what is running on the computer used for the implementation of this project.

3.7.4 Programming languages

PHP (Hypertext Processor)

This was used to link the interfaces to the database; creating forms, user interfaces, sessions to store user information and other functions that are called. It was preferred because it is platform independent, compatible with HTML and helps to perform tasks that are not possible with HTML alone and for its robust support for object oriented programming and better support for MySQL through rewritten extension and error handling.

3.7.5 Database management system

MySQL – My Structured Query Language

This research employed MySQL to formulate the system database because it offers more reliability, data integrity, scalability and high level security for the stored information. It is free open source software, easy to use, fast, and accommodates large amounts of data.

3.7.6 Development software applications

Dream weaver

This research used Dream weaver because it is easy and efficient in use, has the ability to create consistent looking web pages, and is available for use on Windows operating systems.

Microsoft Office

Tools employed in the development of the new system included Ms Word and Ms Visio. They are packages that produce high quality diagrams, graphs and tables.

3.7.7 Identifying hardware

These included Windows 7 laptop; 2.0+ GHz processor, 2 GB system RAM, and 120 GB free hard drive space.

3.8 System development process

3.8.1 System planning

This phase established the need, system justification and scope specification were made, a proposal was submitted and accepted, a detailed work plan and schedule designed. The methodology, software and hardware for the project were also planned during this phase.

3.8.2 Systems analysis

At this stage, requirements were gathered and analyzed to come up with design models for the new system. Use case diagrams, Class diagrams, Activity diagram, Conceptual data model, functional and non-functional requirements were drawn. The core of the systems analysis was driven by the construction of sequence diagrams that, in turn were used to produce collaboration diagrams and class diagrams. The sequence diagrams use scenarios derived from the primary paths in the use case descriptions to determine sensible networks of objects to implement the behavior and these objects were then recorded in class diagrams. These are shown in Chapter four.

3.8.3 Systems design

The purpose of this stage was to create a technical solution that satisfies the functional requirements for the system. At this point in the system lifecycle the functionality of the system was specified, containing a complete description of the operational needs of the various entities that will use the new system. The actual design of the system was done using the requirements identified from the analysis phase. The work done here included; selection of the appropriate database software, designing the Entity Relationship Diagram (ER diagram), logical, functional and physical design of the database, designing User interfaces, report templates, system architecture, network and security model and the program design. These provided inputs for the implementation phase of the system. Architecture was also designed to provide a blue print of the OSIS system. Architecture defines the broad structure of the system to be developed. According to (Lunn, 2003) architecture involves the software tools that are used to construct the system, such as compilers, modeling tools, databases, and packages. Within the technical architecture, the software can be broken down into major components that cover items such as the user interface (computer screens), detailed processing, and storage. The architectural design involves the gross details of architecture and the fine detail of how individual components of a system are constructed. This research followed an object-oriented approach to design and used the different notations in the Unified Modeling Language to produce detailed designs.

3.8.4 Implementation

In this phase, the system design was converted into a prototype. System code was developed using object-oriented programming coding style. PHP, MySQl imbedded with sql were used to develop the system. The interface was developed and programmed using software selected and linked to the database. The prototype was tested on users to ensure that the system was working

according to the desired performance requirements specified. Other issues tested included user friendliness and privacy. Below is the project schedule.

Table 3: Project Schedule for the OSIS Development

TASK	MAIN ACTIVITIES	DELIVERABLES	PERIOD
System Planning and selection	- Identification of need - Determination of scope - Develop data collection tools	- Priorities for system and project - Architecture for data, network, hardware and IS management - Detailed work plan for project - Specification of system scope - System justification	Sept 2010 -Dec 2010
System Analysis	- Determine requirements - Determine design of system - Identify business transactions, actors and roles - Requirements and object model designs	- Description of current system (problems and opportunities) - Recommendation on how to enhance/replace current system - Justification of design chosen for system - Business Transaction list, coordination model and Business Process model - Information and IT infrastructure models - Use-case, Class, Conceptual and activity diagrams	Jan -Mar 2011
System Design	- Logical design - Physical design - Network and security design - Report writing	- Detailed specifications of system elements - Acquisition plan for new technology - Entity Relationship Diagram - User Interface diagrams	Apr – July 2011
Implementation	- Coding -Implementing interfaces -Linking interfaces to the database -Testing - Report writing	- Code and documentation - Software code -Interface (website) -Working system -Final report	Aug –Oct 2011

3.8.5 Evaluation and testing

Validity tests (internal and external) were carried out to ensure that the results are valid. The prototype developed was then tested on prospective users to ensure that it was functional. A combination of testing approaches used included functional, structural, system and unit-testing to

ensure that system program, database structure and performance requirements were working according to the specifications. The database was tested on Firefox. The security of the online transactions was improved by the use of username with a corresponding password and the incorporation of HTML with PHP scripts enhanced validity of the system. This was done to check whether the short and long term effects of utilization of the prototype fit the design goals and satisfy the expectations of the designer and various stake holders. Documentation was also an important activity that occurs throughout implementation.

3.9 Conclusion

The research methodology chapter basically explains the design of the study, methods used and the data collection instruments. It also describes the site, the participants and the sampling techniques used.

CHAPTER FOUR: DATA PRESENTATION AND ANALYSIS

4.1 Introduction

This chapter presents findings from the data collected, analyses the results and presents the requirements and specifications gathered for the design of the OSIS. Results from questionnaires were analyzed using SPSS; data from interviews, observation and documents reviewed was discussed and presented in narrative form. The requirements from the analyses were presented using DEMO and UML.

4.2 Current system

The Academic Registrar's office handles the various activities like processing of admissions, registration of students, identity and examination cards and results, preparation of transcripts and keeps a copy of the various types of students' records created as a result of those activities such as: admission records, student registration files, examination records, fees records, clearance records and disciplinary records. Currently, UMU uses both manual and computerized systems to process, store and retrieve students' data despite having (IT) equipment such as computers, printers and network connections (both LAN and Wireless) to facilitate operational processes. The computerized system is mainly in form of office packages like spreadsheets (Access and Excel) and Word processing packages (Word perfect and Ms Word). The admissions division (Main registry) has an access database that is used to capture information about each student (including bio-data, previous studies, and contacts) from the admission forms. Faculties use Excel templates for processing and storing examination results from the various course units for each program offered in the respective faculties. Word perfect is used for making student progress report containing a student's grades that have been passed by senate at the end of each semester. Report making is a tedious and time consuming task as the staff has to prepare each

student's report individually. Systems are stand-alone making it difficult to access the same data centrally. From the interviews conducted, findings indicate that records kept in the main registry may not reflect those kept by the faculties which means that for the Main Registry officer (Admissions office) despite having an access database, to respond to information requests from the various stakeholders (NCHE, Bank of Uganda, ESPCOPAL directors, management est.) has to get this information from the faculties; merge and come up with a master file which has to be replaced after every semester with new updated files which is also not regularly done. The current system is very costly in terms of materials used, duplication and time involved in physically collecting information, updating as well as information flow and access. This study therefore, sought to address the problems within UMU's students' information management system through the design and implementation of the OSIS. To achieve the above, the research focused on the analysis of the business activities, information flow, students' information needs and came up with the requirements that were used to design a solution. The assumption and belief was that the OSIS would centralize information, improve storage, retrieval and access to student information. The next lines explain how data was gathered, presented, analyzed, requirements determined and business activities modeled.

4.3 Requirements gathering

End-User requirements gathering was carried out using the traditional system development life cycle route. Interviews were conducted with key registry personnel and were geared towards understanding what the users liked or disliked about the current system. Questionnaires (Appendix A) were administered to randomly selected students from the various strata (undergraduate fulltime, postgraduate fulltime, part-time and distance learners); face-to-face oral interviews (Interview guide in Appendix B) were conducted with key users of the system

(registry staff from the main and faculties, accounts and ICT staff) in order to uncover the problems within the existing system as basis for establishing requirements for the new system. Observation (Observation guide in Appendix C) was used as a mechanism to establish the information flow, technologies and systems in use and how they are used within the overall student information system while document review was used to establish key information gathered on students and activities related to students which helped the researcher to come up with entities and their attributes in the design of OSIS database.

4.4 Data presentation and analysis of the findings

Initially, a survey was conducted by use of questionnaires to find which type of services and functionality that was perceived to be valuable for students to provide easy access and retrieval of relevant student information. The respondents were mainly technology students who were familiar with computers and internet technology. A total of **40** respondents completed the survey. After gathering the feedback from the target user group, the researcher took some design decisions for OSIS. Findings indicate that there is need for a central student information management system accessible online to provide easy access and retrieval; more personalized information customized to the individual student's needs i.e. the information services should be more user-centric. Ultimately, study came up with the requirements for the OSIS that will enhance the campus life for the student. The decision of which services to include in OSIS was largely influenced by the feedback gathered from the survey.

4.4.1 Current business processes

In line with study objective 1, the study sought to establish the key businesses through face to face interviews with key informants in order to establish the problems within the existing processes. Findings indicate the following as key business processes:

Table 4: Current Business Processes

CURRENT BUSINESS PROCESSES
• Admission process • Fees payment and financial account management process • Registration process • Examination process • Results processing • Transcript processing • Records management

Admission process

The researcher was fortunate to carry out this research at a time when the Registry staffs were processing application forms and admissions. Prospective students download forms online or collect application forms from the university offices; fill and return back to the University Registry. When Registry staffs receive filled application forms with the prospective student's personal and academic details and the following processes take place:

For undergraduates, when an application form is received, it is given a code or number, thereafter sent to an admissions board for selection. The applicants that qualify are selected following the criteria for admission specific to the faculty or institute's requirements.

For postgraduates, applications are received by the registrar's office and then sent to the school of postgraduate studies where they are coded. Those that meet the requirements are subjected to Graduate Admission Test (GAT) examination in order to be considered for admission. All students that meet admission requirements are admitted and the list of admissions processed and posted on to the university website. Letters of admission are sent through post office and/or picked at the university campus.

Fees payment status management

To check fees payment status, a student physically goes to the UMU accounts office, wait in line until he/she is worked upon. The accounts department uses Sun System to capture; process and store student payment data. However, at the moment, the payment statements are produced one by one, printed and sent out to students either by mail and/or picked from their respective faculties. This is costly for both the institution and to students especially part-time and distance learners.

Registration process

The faculty administrator on behalf of the registry handles the registration process. The process begins with a student presenting a receipt as proof of payment of registration fee and tuition or sometimes part of tuition fees. Then a student's academic papers are verified and if valid, a Reg. No. is given to each student that uniquely identifies each student's record from the rest. This is prior generated by the accountant for easy reconciliation of the student's payment account. The students use the ID No.s throughout the study program to identify them as UMU students. The student registration number is designed in such a way that for instance a student with an ID No. 2009-M132-20006 portrays;

- The year of entry into the program – Year (2009)
- The nature of the program – Maters, Bachelors, Diploma or Certificate (Maters is given **M**);
- The course code which represents the course being pursued (Information systems is given **13**);
- The center code which represents the centre in which the student is attending the program (Centre code for Rubaga is **2**)

- The Student ID which is a unique number that identifies each student (A program is set to accommodate up to 1000 students so student number **6** is given **0006**).

A file is opened for every student according to given registration numbers which are retained until the completion of the course. After registration, copies of lists of registered students are processed using Excel and a copy sent to the Registry for filing. The university keeps track of each student's names, student number, current address and phone, permanent address and phone, date of birth, gender, nationality, religion, class (Undergraduate or graduate), department and degree program (certificate, Diploma, Bachelors, Masters or Ph.D.). The registration No. helps the university track each student throughout the study program.

Examination results management

Results are submitted by lecturers to the respective faculty administrators on hard copy forms for entry. These are entered into an excel template set with formulae to accumulate totals and generate GPA. In case of any missing results, the administrator physically cross-checks the answer booklets stored in the main registry basement. The results are presented to the senate, discussed approved and signed by the Vice Chancellor to become valid results. Results sent in excel are merged into Word perfect, reports created, printed and released by the respective Faculties to students through post office (Personal letter). In case of failure to receive his/her results, a student physically comes to the Faculty Dean’s office which is costly and time consuming.

Transcript processing

Final approved results are entered into the transcript template. Difficulties arise when errors are discovered; the assistant registrar in charge of transcripts has to move to the respective faculty to cross check with what is on file. This process is long, tedious and time consuming.

Records management

Documents prepared in Microsoft Word or Excel such as letters, and reports are not appropriately filed with descriptive file titles, which make it difficult for others to locate and retrieve a file when the administrator is absent. This problem leads to disruption of work and causes delays especially if the staff responsible is on sick leave. This is in contrast with (Wallace, 1987) characteristics of a good filing system which include; compactness, accessibility, economy, simplicity, elasticity, easy location and reference, cross references, availability of clear retention policy and out guides.

File tracking problems

From the investigations carried out through face-to-face interviews, all respondents admitted that there is no centralized storage and access system for students' records. One respondent from the main registry confirmed that to keep track of a student's record throughout his/her study period requires constant consultation with the faculty administrators who keep up-to-date files. The central registry needs to keep a copy of each student's file but this has to be replaced every time new information is added in the files kept in the faculty.

Inconsistencies

To locate and retrieve a student's file is tedious and time consuming especially files for courses with many students. One administrator had this to say, "*Sometimes Faculties may update the registration lists, but you find that the central Registry office staffs are still working with the old lists, which leads to double work*".

Lack of flexibility

Another respondent said that; "establishing whether a *student has no debt with the University requires the person to personally go to the Accounts office which causes a lot of delays and inconveniences.*

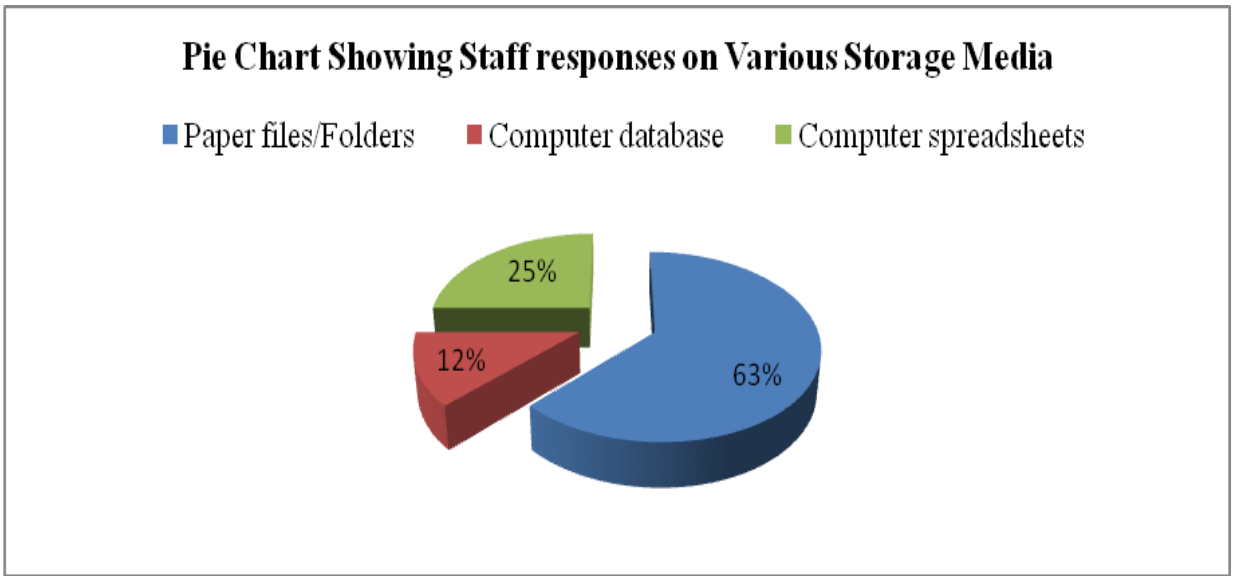
Too much duplication

One respondent lamented that *"The registry keeps duplicate copies of different documents from various departments like the library, finance office, warden's office in order to know who has/has not cleared with those offices/departments before examination cards are issued to students and admitted that this is not only tedious but also time consuming".*

Storage Space Problems

Findings from the staff interviewed on the availability of the storage space for records, 100% said that they were running out of office space for storage of hard copy files.

Figure 6: Pie Chart Showing Staff Responses on Various Storage Media used at UMU



Source: Primary data

The figure above; indicates that the common means of storing students' data was by paper files/folders (63%). This explains why problems like limited storage space, misplacement of files, a lot of duplication of documents, lack of proper coordination, inconsistencies, lack of updates, delays in report generation were cited as the most pressing problems of the current students' information management system by the staff respondents.

Though accurate and timely information are necessities for informed decision-making, a manual records management system of UMU rarely produces the information that meets this criterion. One Registry staff had this to say, *"Data is scattered in various departments and this makes the report production process a nightmare*". Responses from interviews also indicated registration, results grading plus storage and retrieval as the three most crucial functions that need to be automated. According to one Registry staff, "*a customized integrated database system linking*

the registry, Finance office, Dean of students' office and the library is needed to make it easier for staff and users to access and retrieve data without wastage of time.

4.4.2 Current organizational structure

From interviews with key informants, it was established that the registry does not have well documented working mission and objectives though; its operations are geared towards fulfilling the strategic mission and objectives of the university. From the institution's organizational structure however, the study was able to extract the reporting structure of the Registry through the roles described below.

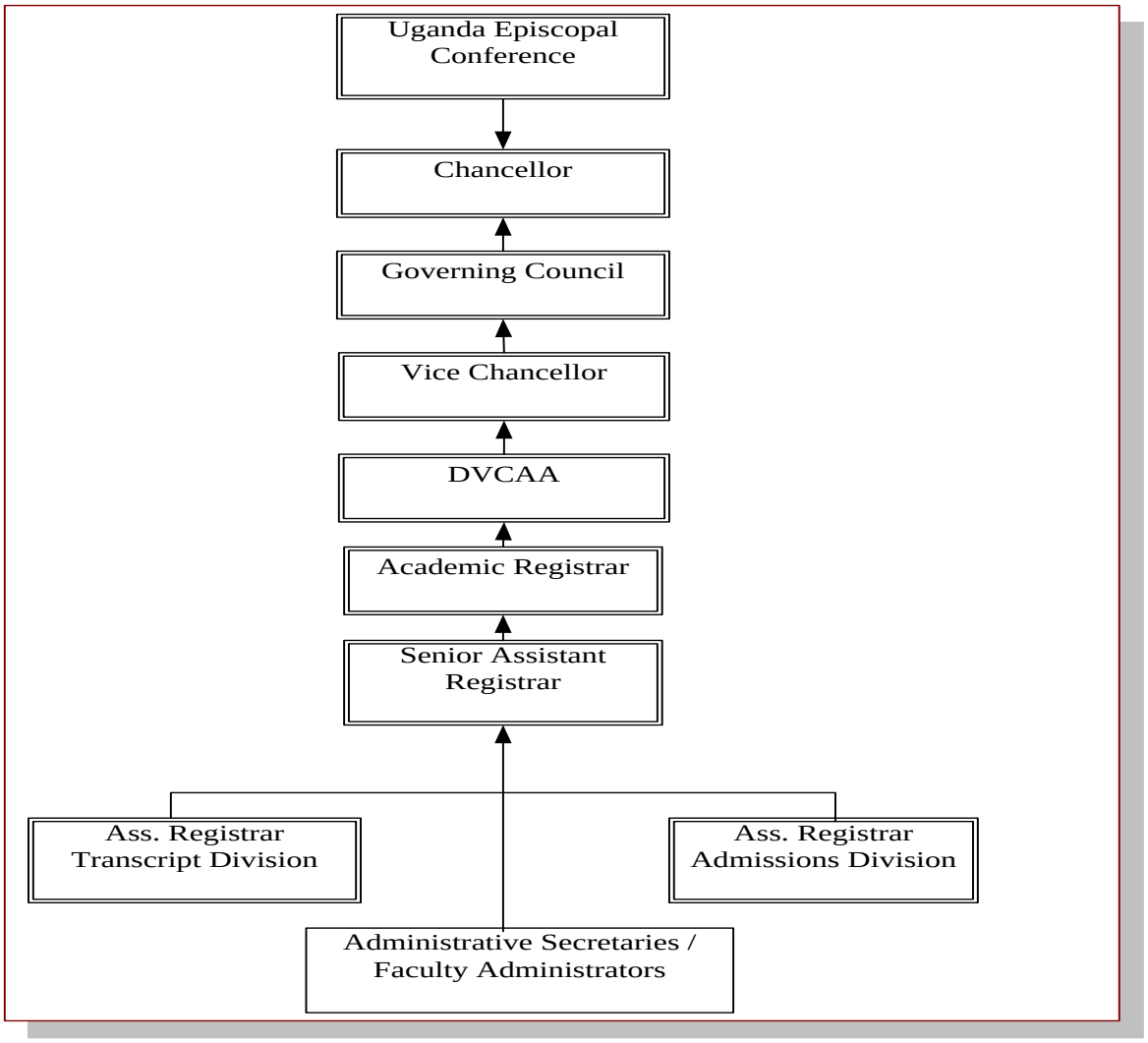
Table 5: Table Showing Current Roles

ROLE	DESCRIPTION
Uganda Episcopal Conference	These being the owners of the institution are at the top. They receive highly summarized reports on the general performance of the University/business.
Chancellor	He is the representative of the Owners of the institution and therefore reports to the Uganda Episcopal Conference.
Governing Council	This is composed of persons suggested by the Owners to provide leadership role of overseeing the running of the institution's businesses. It reports to the Chancellor. It monitors staff appointments/recruitment, finances and the general welfare of the institution.
Vice Chancellor	He is the CEO of the institution; oversees the running of the university's operations and reports to the Governing Council.

	He approves results by signing them off as valid.
DVCAA	He is responsible for overseeing all academic affairs of the university and reports to the CEO
Registrar	He is responsible for academic programs and records keeping
Senior Assistant Registrar	He makes a follow up on enrollment, records management, production of transcripts and graduation.
Assistant registrars	Assistant registrar admissions division is responsible for processing admissions and records keeping. Assistant registrar transcript division is responsible for transcript processing
Administrative secretaries/ Faculty administrators	These work at the operational level. The handle all students related activities on behalf of the registry. They handle registration Do processing of student data Handle examinations Process and enter student examination marks into grade sheet templates Process results reports/letters Disseminate results/post results to the students Handle records management activities

Source: Research findings

Figure 7: Shows the Registry's Current Reporting Structure



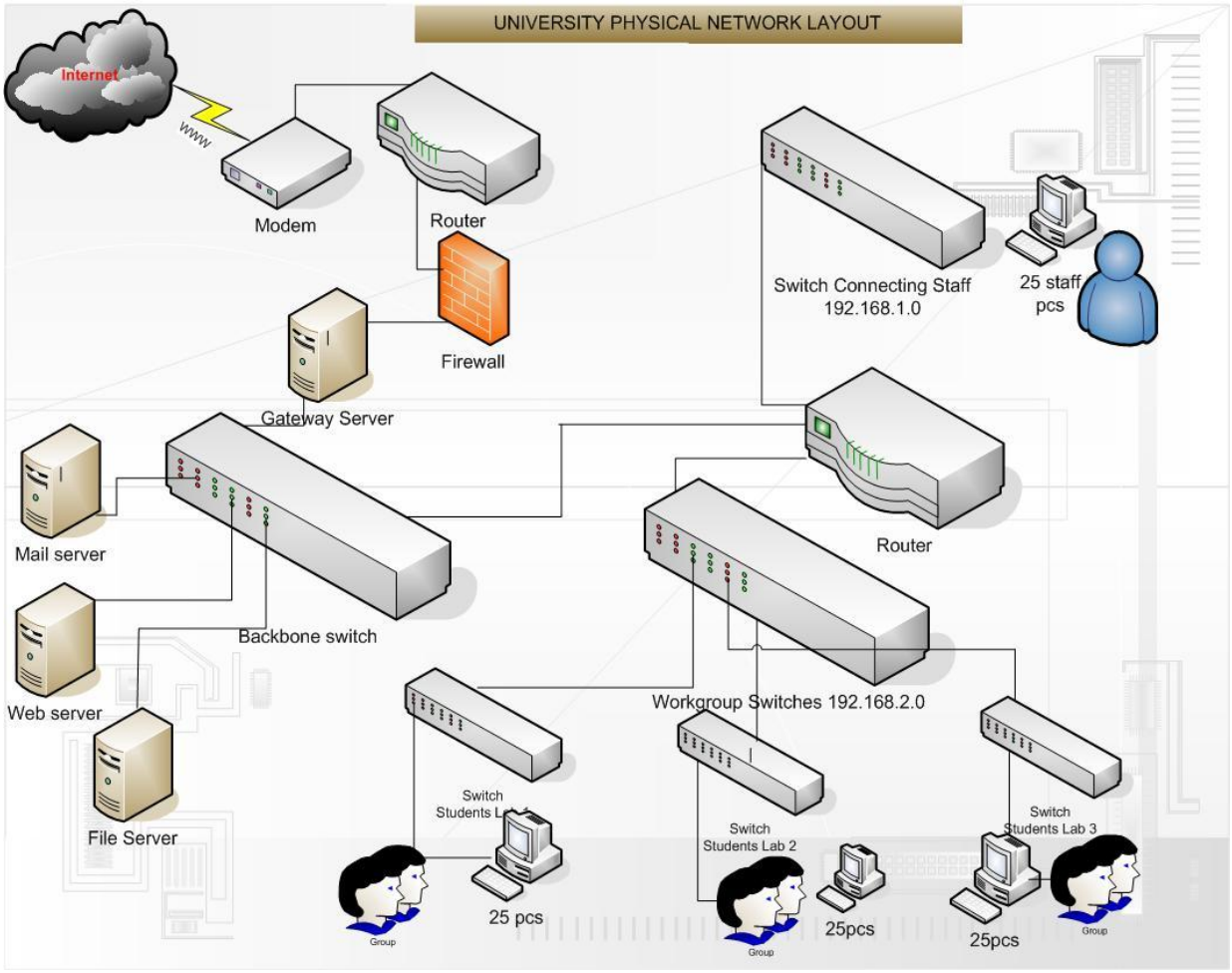
Source: Research findings

4.4.3 Current network infrastructure

There is a network infrastructure in place that supports the central server room which shelters the web, mail and file servers. All computers registered with ICT office are accessible on the network. However, the existing network does not serve current needs of the registry because there is no integrated student database that allows simultaneous sharing of data and auto generation of reports. To make work process easier, there is need to have the OSIS database

server in the server room and the database available online. Figure below shows the current network layout for UMU.

Figure 8: Current University Network Layout



Source: Research findings

After analyzing information from the supply side, it was vital to analyze the information gathered from the demand side to establish their information access problems, needs and their attitudes towards use of online platform to access information to justify the relevance of the OSIS.

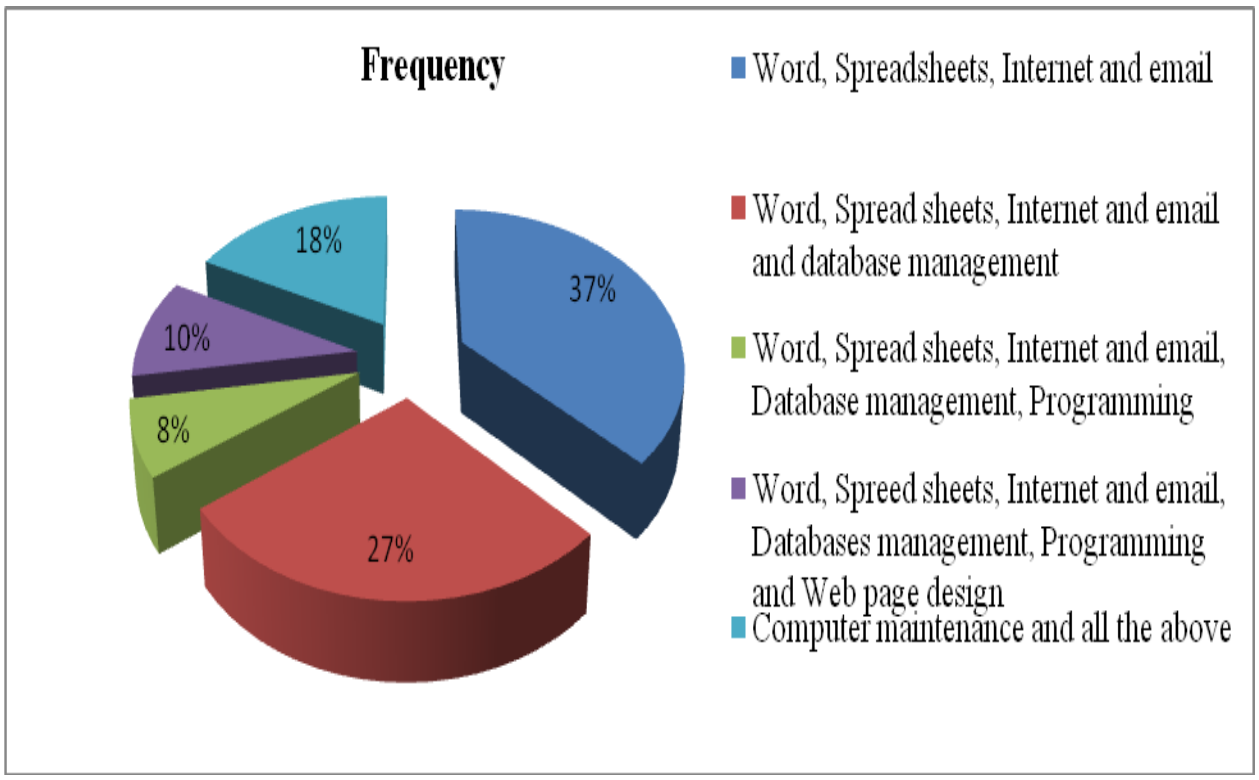
4.4.4 Findings on the current system from the student perspective

Initially, a survey was conducted to find which type of services and functionality that was perceived to be valuable for students to provide timely access to information. This was intended to establish the information that is in highest demand by students, the existing avenues through which information is delivered, the problems within and students' attitudes towards online information delivery and access. A questionnaire was created and distributed to the target group. The respondents were mainly off-campus and technology students composed the highest number purposively for their familiarity with computers and internet technology. A total of 40 respondents completed the survey. In order to establish the viability of the online student information system, the researcher asked questions regarding information access problems encountered in the current system, respondents' familiarity with computers and internet use, accessibility to computers and the internet, available channels of information access and whether there were effective, attitudes towards online information access and users' expectations if a new and improved system was to be put in place.

Findings from students' questionnaires regarding delays in accessing requested information indicate that the system is very inefficient and time wasting. (38/40=86%) respondents said they have ever been delayed because their records could not easily be located while (2/40=14%) said the reverse.

On the issue of knowledge of computers and internet use, all the 40 filled questionnaires (100%) were positive implying that if the new system is put in place, a very large number of the student population would be able to use it. On the question of computer skills, the pie chart below shows the varying skill sets in percentages.

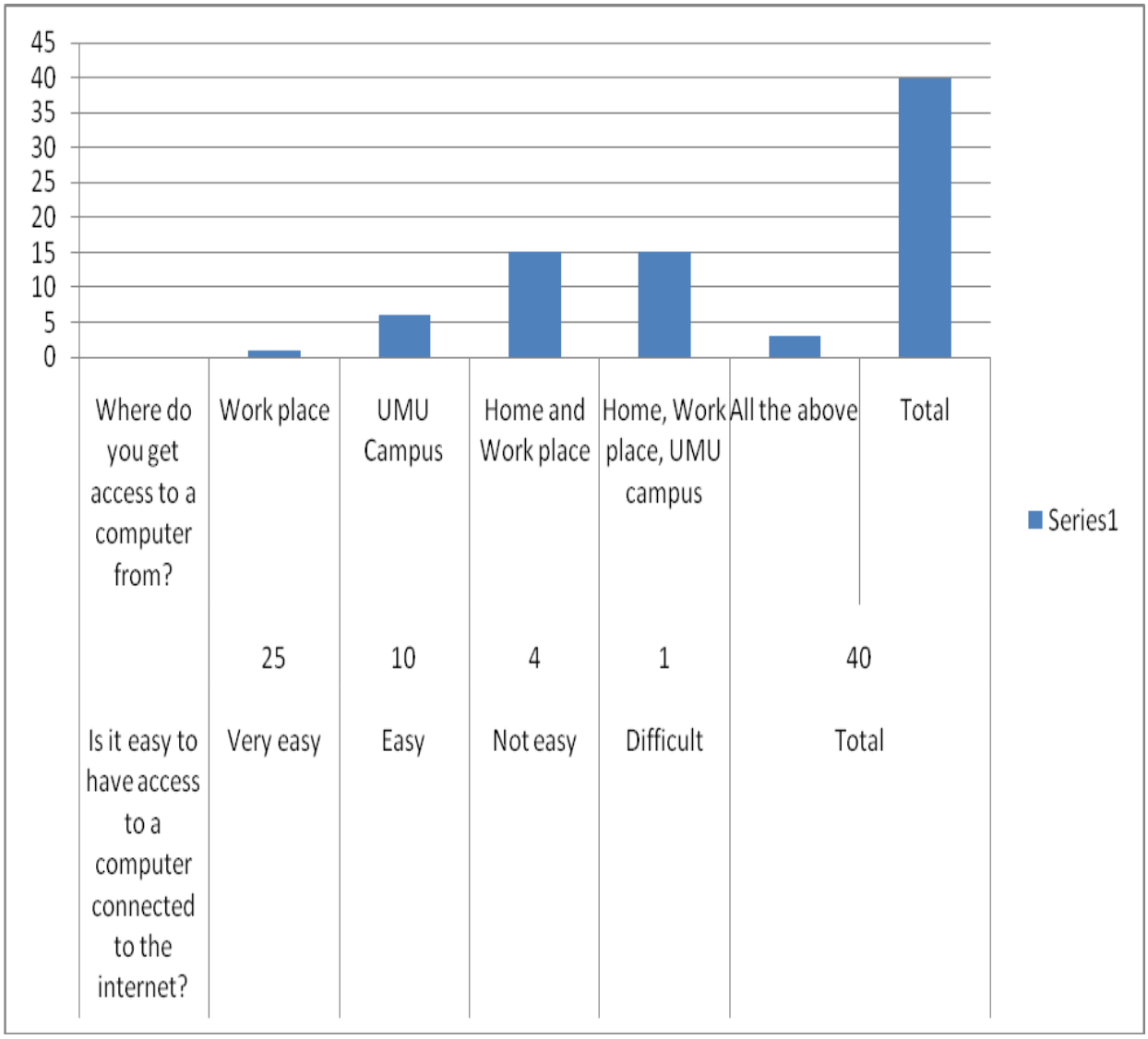
Figure 9: Pie Chart showing respondents with varying computer knowledge and skills



Source: Research findings

Since the successful utilization of the new system depends on fulltime availability of IT infrastructure and internet, the study sought to find out whether the target population had access to the internet; the issue of location and the ease with which respondents had access to the internet were evaluated. From the findings, students displayed a largely positive attitude towards the easy accessibility to computers and the use of internet. All respondents reported having access to a computer and of the 40 responses got, 15 (Home, workplace and UMU campus), 15 (Home and workplace), 6 (UMU campus), 1 (Work place) and 3 (All the above). While on the ease of access to the internet, of the 40 responses got; 25 (very easy), 10 (easy), 4 (not easy) and 1 (very difficult). The graph below summarizes the results.

Figure 10: Graph showing the number of respondents with access to Computers and Internet

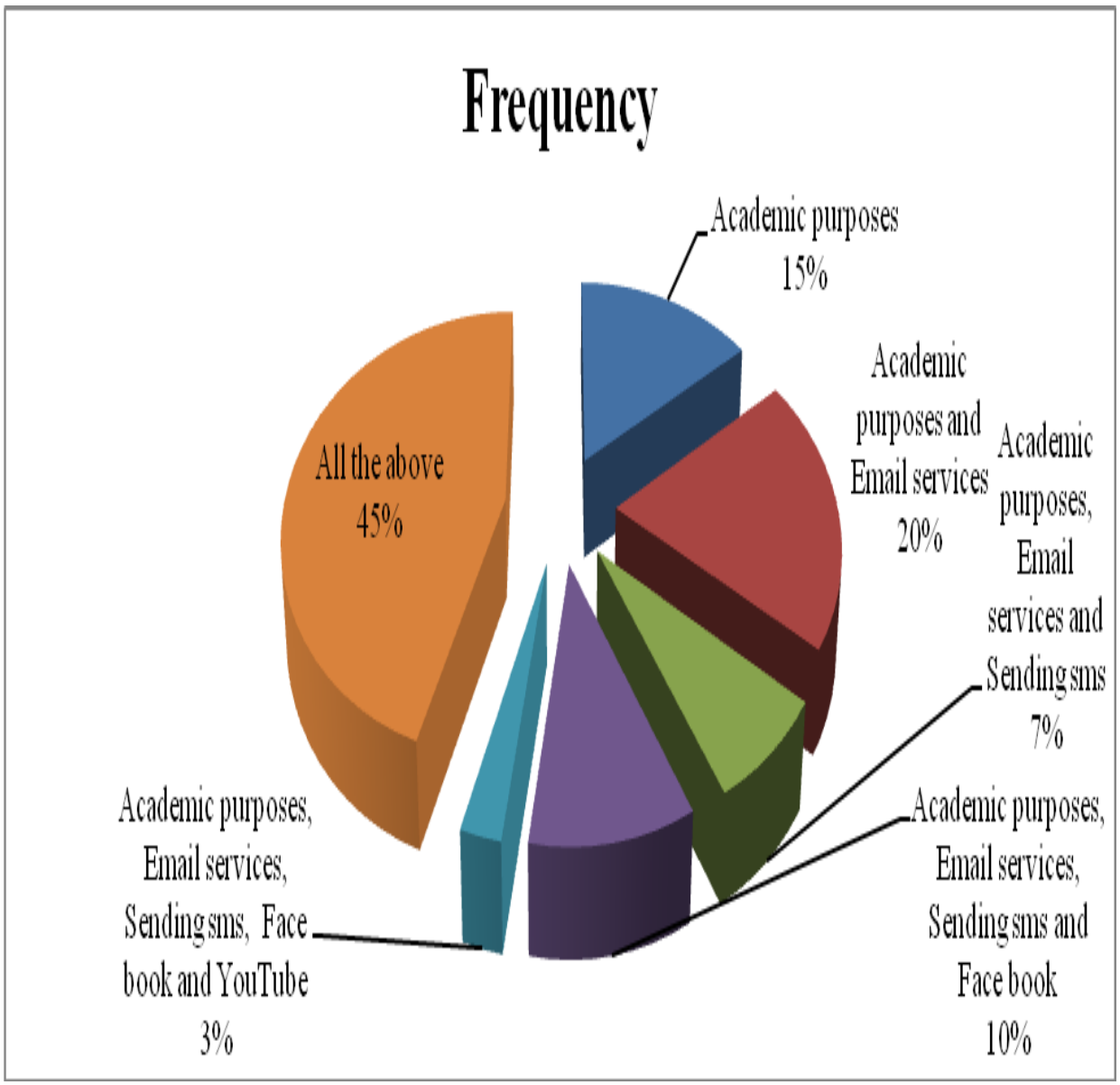


Source: Research findings

The above finding implies that many respondents have easy access to computers and the internet which is a favorable platform for the intended system solution.

To establish the stakeholders' familiarity and knowledge of software applications, a question on what the respondents mostly used networked computers for was posed and the pie chart below presents the results in percentages.

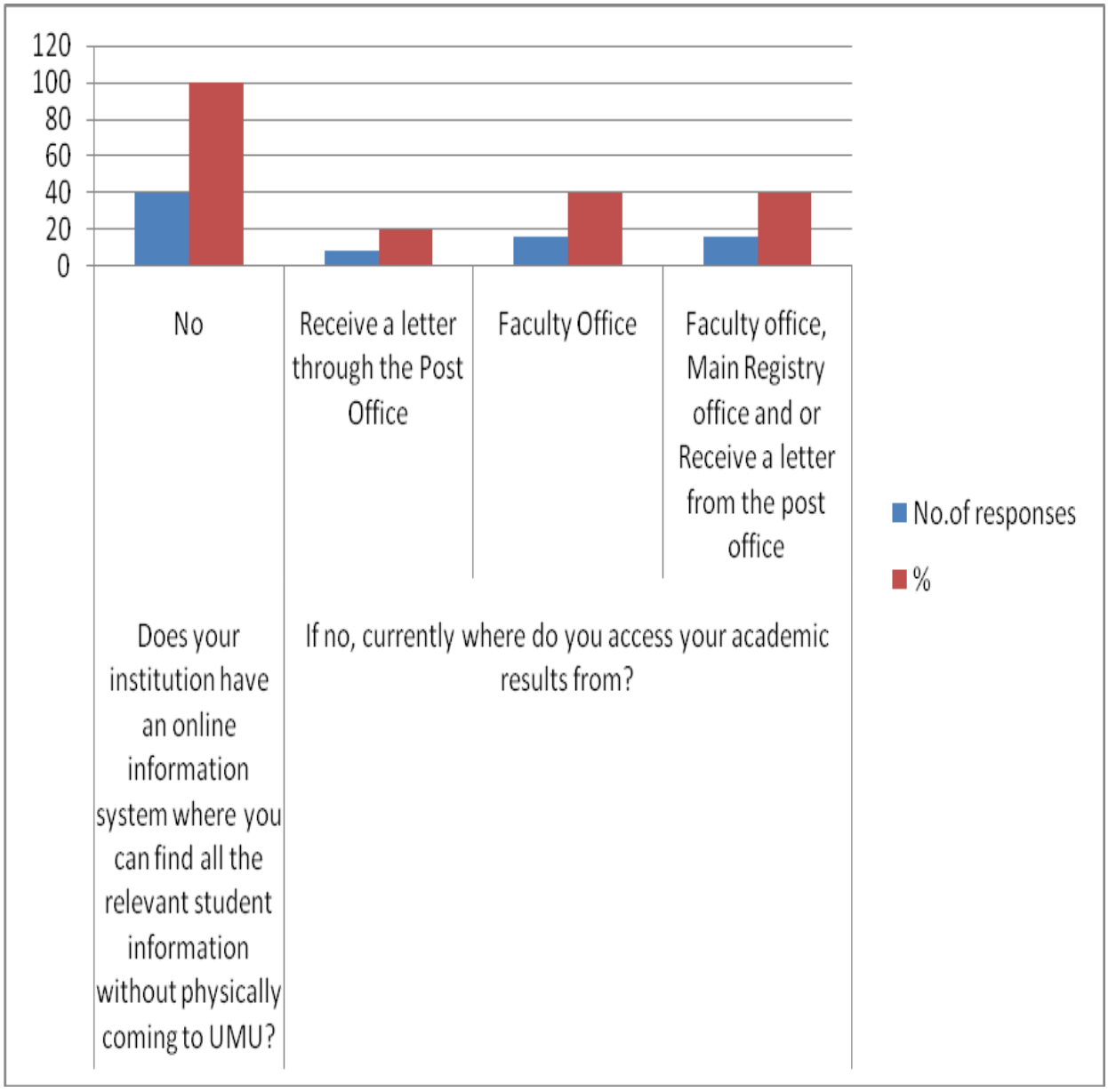
Figure 11: Pie chart showing the respondents' views on use of networked computers



Source: Research findings

To establish the existence of an online student information management system, respondents were asked whether UMU had an online information system (Student web-based interface) where you can find all the relevant student information without physically coming to UMU. Findings 40 (100%) indicate that UMU had no such system and the information access channels currently available are displayed below.

Figure 12: Respondents' confirmation of non-existence of an OCIC and access channels used

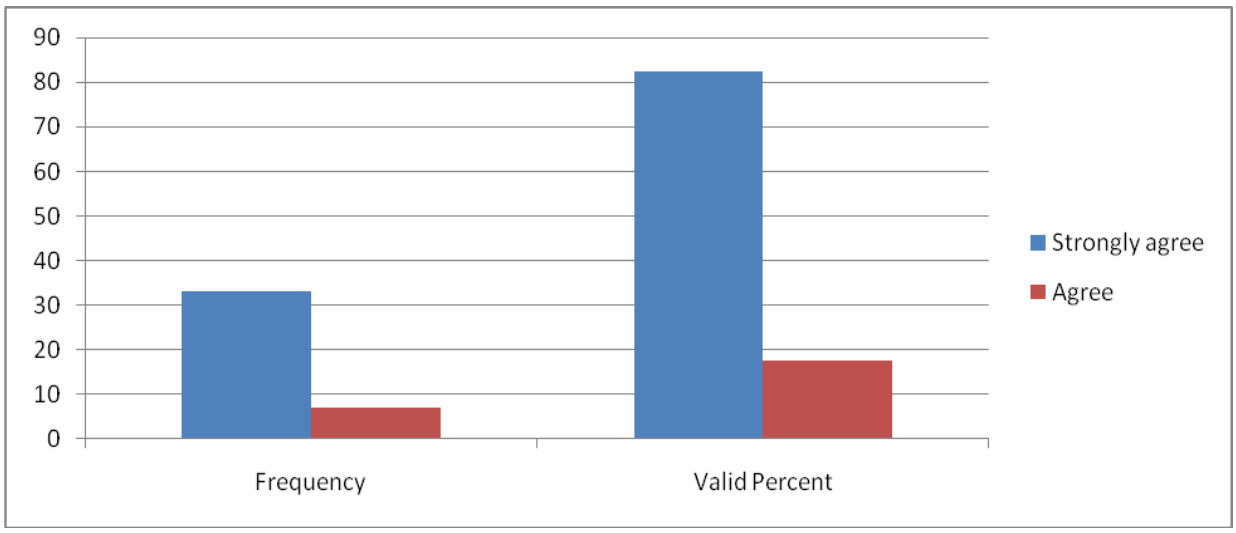


Source: Research findings

Student attitudes towards Online Information Access

To establish the respondents' ability to fully embrace online information system and services, the following statement was posed, "**I feel that the standard of my academic work would suffer without access to the internet".** Findings as graphically displayed below 40 (100%) indicate positive responses with **strongly agree** (32) and **agree** (8).

Figure 13: Graph showing Student attitudes towards Online Information Access



Source: Research findings

Table 6: Information Access Problems from Student Questionnaire

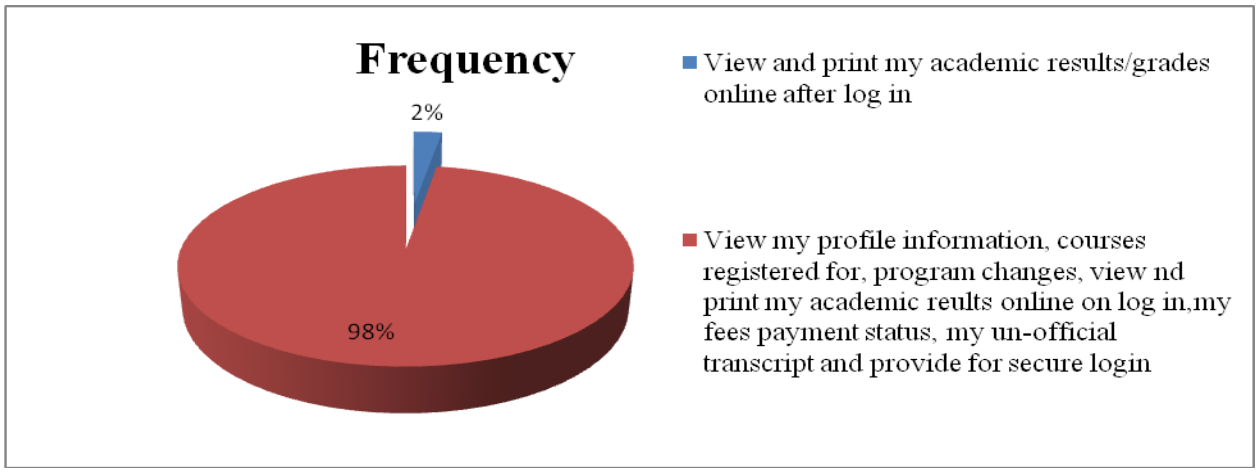
PROBLEM AREA	PROBLEM
Financial Statement	• Long queues towards examination are time consuming and frustrating • Too many errors that waste our time to follow up • Lack of flexibility due to the required physical presence to check payment status
Examinations results	• It is sometimes difficult to know when results are out • Posting results via post office takes too long • Postal system is un-reliable • A lot of errors • Inconveniences in planning study schedule resulting from delays in receiving results
Updates on fees structure changes and any other current information	• Most cases, I depend on hear say • Delays in getting updates lead to problems in planning study • Important information posted on notice boards is not flexible

Source: Research findings

Student expectations from the new system

Findings (89%) indicate that students expect the new system to have the functionality that allow a view and print of one's academic results, fees payment status, un-official transcript, courses and personal profile information. This is in line with (Chapin & Fitzgerald, 2002) that the demand for online information appears to be quite strong as supported by their findings which indicate that approximately two-thirds of respondents (64.7 percent) reported that the Internet was used as *a source* for information about prospective planning programs and that in every four respondents (25.1 percent) reported using the Internet as their *primary source* for information about graduate planning programs.

Figure 14: Student expectations/Requirements from the New System



Source: Research findings

4.5 Current system problems

From the analysis, it was established that the current system was characterized by the following problems:

1. Stand alone office packages process and store data leading to alot of duplication of the same files kept by various departments.

2. Manual system does not allow flexibility for instance, it does not facilitate the addition and deletion information but rather every time an update is needed, a new document is created which increases paper work and duplication.
3. All systems (Main registry and faculties) work in isolation i.e. no centralized database to hold student information. Large volume of information available makes it difficult to collect, organize and link documents using the manual system.
4. The system cannot automatically generate reports when required for decision making
5. Management of reports is not always done on a regular basis and statistics for these reports are hard to compile. The system in place does not automatically know special examination, retake or supplementary. This is fed in manually which is tedious and time consuming given the ever increasing student numbers each year.
6. Writing result letters for each and every student and printing each result letter is costly, tedeous and time consuming. It also leads to delays in sending results to students. In addition, as the student numbers keep increasing, it will be nearly impossible to write and print a result letter for each and every student.
7. Too much paper work has led to storage space problems
8. Difficulties in retrieving information when needed due to the numerous files created in the process of keeping updates
9. There is no proper coordination between the main registry and the faculties since each department does its functions in isolation
10. Difficulties in tracking every student's academic progress by the registrar due to disparate systems
11. Security of student records is not guaranted in the current system

12. Un reliability of the postal system due to frequent changes in student addresses leads delays in receipt and or loss of results
13. The current system is not flexible which is costly for students who have to physically come to the campus every time there is need for information
14. Sorting through the paper work proves to be more time consuming as the number of students grows.

4.6 Justification for OSIS

1. The study revealed automation of the students' information management system as an answer to current system's problems. On the question of alternative solutions to the current system's problems; 100% respondents gave automation. Reasons supporting their assertion included; increase in speed of work, time saving, space economy, reduction in duplication and errors, instant updates, simultaneous access to students' data, data sharing, data security, increased efficiency and easy reports generation which are major challenging issues of the current system.
2. Increased consistence and accuracy and reliablity of information once properly input
3. Speedy retrieval of information
4. Increased connectivity among the departments that capture, process, store and share student data hence reducing costs of time and money that would otherwise be spent on frequent calls
5. Increased ability to manipulate data once input and keep regular updates
6. Increased flexibility in access to the required information tha is not limited to location
7. Ability of the system to store large amount of data on a small physical space and expandability of computer systems
8. Cost efficiency in operations

9. Ability to ensure greater accuracy and consistency in the performance of routine tasks
10. Multiple or simultenous access to information

Benefits of using an integrated database system in managing students' data put forward by respondents included; increased speed in work processes, space savings, reduction in human errors, instantaneous updating of data, production of regular reports, simultaneous access to information, reduction in paperwork and duplication, easy retrieval and time saving which are some of the many issues pressing the current system.

After gathering the feedback from the target user group, the researcher took some design decisions for OSIS. It was found out that there is need for online access and personalized information customized to the individual student's needs. Ultimately, the researcher ended with several services that can be put online to enhance the campus life for the student. The decision of which services to include in the OSIS was largely influenced by the feedback gathered from the survey which were later translated into user requirements listed below in sub-section 4.5.

4.7 User requirements

4.5.1 Requirements gathered from interviews with staff respondents

1. A central database was proposed by key informants. This is can be located in the central registry linked to departments.
2. They preferred a system able to access the central database remotely from departments
3. Update the database by authorized users
4. Track students' results/grades and academic progress from year to another
5. Display payment status.

6. Store students' results, transcript and certificate templates that allow generation of the transcript and certificate for every student that has successfully completed the program
7. Generate reports and these should include the students' related information such admission lists, grade reports and graduation lists.
8. Should be online to allow students to view their financial statement, results and their grades from anywhere but without any option for altering.

4.5.2 Requirements gathered from student questionnaire

1. A system that enables a view of my tuition payment summary
2. A system that enables a view of my grades earned from each course taken up to the last completed semester.
3. A system that enables me to view and print non-official record of grades
4. A system that allows me to view and print my un official transcript
5. A system that can display a computed value of my current GPA
6. A system that is fast and easy to use
7. It should also be accessible via the Intranet to ease accessibility and contain an option for printing.

4.5.3 Software requirements from observation

Table 7: Requirements gathered on software used for student information management systems

Question	Current	Requirement	Conclusion
Database	- MS Access database 2003 SP3 - Available in a few individual sections	- Not centralized but rather standalone database - Getting updates from faculties is tedious	Need to be changed in favor of an integrated / centralized and versatile database system

Operating system	- Windows XP Professional Version 2002 SP3	- This is getting out of date	Move to Windows 7 and above
Application programs	- MS Office 2003	- MS Office 2003 is out of date	Move to Office 2007 and above
Security on Database	- There is free entry and exit which puts the database at risk	- None, accessible by anyone - Provide user access levels	Include strong security features in new OSIS
Updating the database	- Manual and done whenever any major changes are done	- No regular updates	Need for a system that automatically updates on mouse click
Linkage to other databases	- Stand alone databases while other sections use MS Excel sheets	- No proper communication - Not cost effective - No standardization of processes	Need to upgrade to an integrated database supported by MySql and with a web-based interface

Source: Research findings

4.8 Business process reengineering

The increasing market turbulence and the increasing need for the creation of competitive advantages force businesses to rethink the way they perform their business. This rethinking is often performed unstructured or fragmented, and they fail to consider the business as a whole. Therefore there is a need for making a diagnosis as a basis for redesigning the business. In order to perform this diagnosis and redesign in an effective and efficient manner, there is a need for structured business modeling tools.

During the business re-engineering process, it was important to be able to clearly link operational processes and organizational services to business goals and objectives. Upon verification using the data collected, it was found necessary to redefine and recommend an organizational structure

and new roles in relation to the student information system. Models were drawn for the various actors who included the Academic Registrar, Deputy Registrar, Administrators and Students who are entailed in the business processes and transactions. Analysis of such models involved stepping through a process by instantiating it with a full description of a world state. The lines below describe the proposed IT infrastructure.

4.8.1 New Organizational Structure

Proposed mission

To provide a committed, professional Registry service that is recognized as exemplary by its users, behaving in an approachable and courteous way, being well-informed in the present and aware of developments to come, seeking always to address the heart of the matter with integrity and honesty, and giving accurate information and consistent, fair advice.

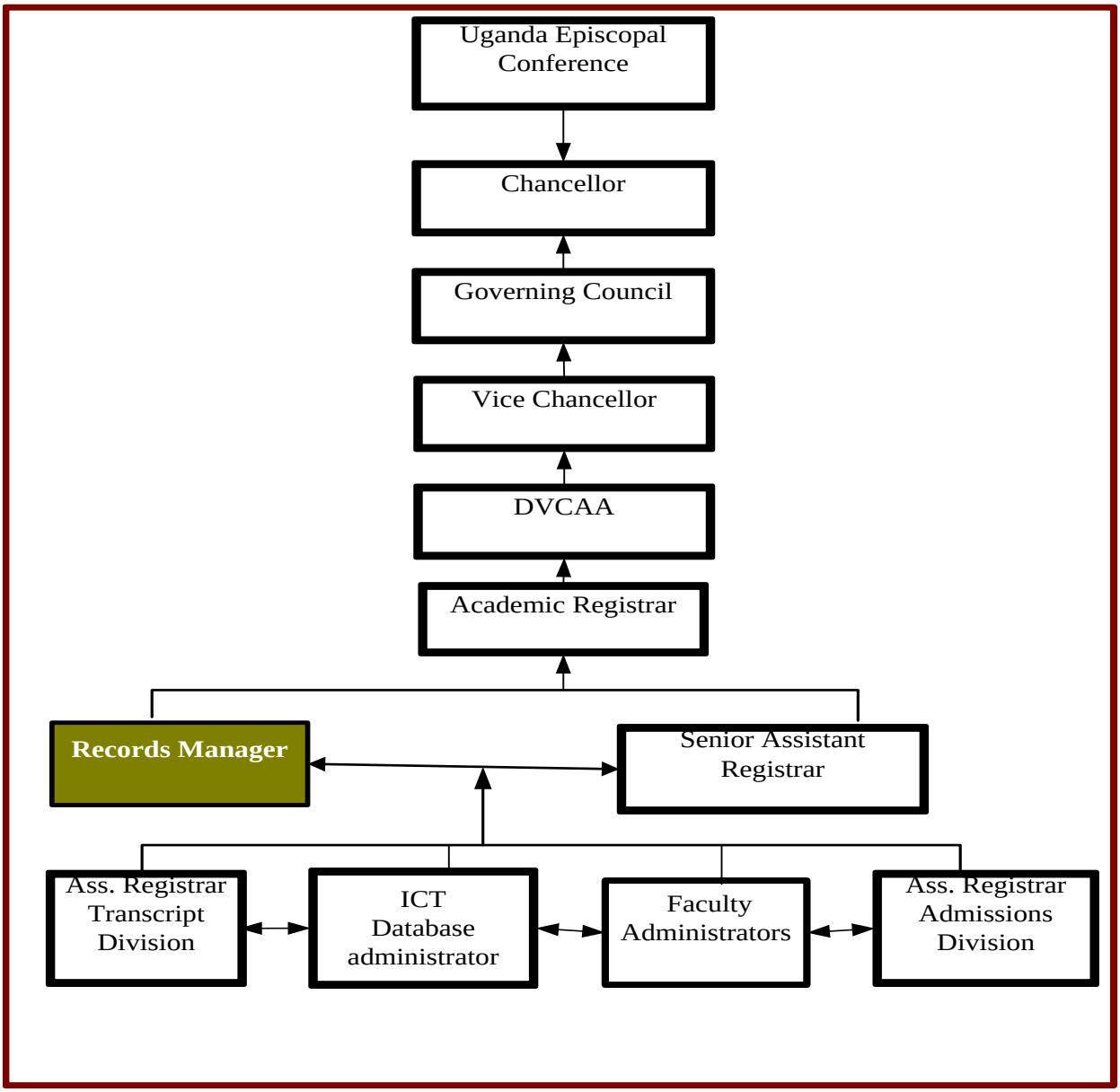
Proposed objectives

1. To administer student admissions, enrolment, record maintenance, examinations, degree ceremonies, quality assurance and enhancement activities and regulations relating to students and to teaching and learning
2. To enhance student employability through careers advice, information and guidance, access to information about employment and schemes for enhancing transferable skills
3. To develop and enhance the provision of web content to contribute to the experience and success of students and staff.
4. To provide the support students need to deal with aspects of student life that can inhibit learning and the assurance of academic standards

Proposed additional role - Records manager

- This will be responsible for the student records management system
- Work on records management policies
- Monitor the life cycle of student records from creation to disposition
- Creating and managing the institutional archive

Figure 15: New organizational Structure



Source: Research findings

4.8.2 New business processes and roles

User account creation – Systems Administrator

This process begins with the system administrator logging on to the system to create accounts for system users. On clicking add new user, the user registration form is displayed which is then populated with the necessary staff details and saved in the database. The system administrator then assigns user access privileges to users (administrators). The administrators have the privilege to create accounts for staff (Lecturers).

Program and course registration – Faculty Administrator

To register program, clicking on course structure brings an option to add a new program. If a program already exists, the system should bring a warning message. The process extends to course registration once the registered program is clicked on by displaying the course registration form. The courses to be taken for that semester are then populated into the form as appropriate and clicking the save button saves the details into the database.

Student Registration – Faculty Administrator

For a student details to be captured into the system, there must be an existing program that student must offer. The process begins with the faculty administrator capturing data. He/she must logon to system successfully. The next step is to click on manage students link which opens the input form for entering a student's details. On clicking add new student, the system brings a registration form which the administrator populates with student details as appropriate. The save button once clicked saves the input data into the database.

Examination results management - Lecturer

Once the student profile exisits in the system, the Lectuer can access the manage marks module to input marks for his/her module. Once successfully logged on to the system, the lecturer can add new marks, edit and/or delete as appropriate.

Records management – Faculty Administrator

Faculty administrator uses the system to manage examination records by viewing and updating results only for the faculty he/she is attached to including producing academic reports and grades for transcript production as appropriate.

Transcript generation - Assistant registrar

He/she generates and prints transcipts for signing by the faculty Dean and the Registrar.

Fees payment account management - Accountant

The system allows staff (Accountant) to enter student payment details so that they can be viewed online on log in. In the student account, the "view finances" link once clicked takes the student to his/her fees payment details.

Retrieval process - student

For a student to check his/her results, the system prompts him/her to login with the correct username and password. Once successfully logged on to the OSIS, a student can access without any option for changing his /her results, fees payment statement, courses registered for and profile information.

Table 8: Definition of the Registry Business Processes and the Resulting Facts

BUSINESS PROCESS	RESULTING FACTS
User registration	In this transaction new users are registered, resulting in the fact that a certain staff or student is now a member of the University by **identification number** and registration ends with giving a user name and password that guarantees access to the OSIS by user role.
Fees payment account management	Before a student qualifies to sit for examinations, he/she must have paid fees. The administrator must verify that the student has cleared fees payment resulting in the fact that **fees have been paid**.
Results processing	Results are captured from hard copy forms and entered into the system resulting into an automated **marks report.**
Results validation and approval	The administrator can not release results until they have been discussed by Senate and signed off by the Vice Chancellor resulting in **approval**.
Transcript production	The assistant registrar oversees transcript generation and printing. The student can view his/her transcript after successfully completion of his/her study and payment of all fees resulting in the fact that the **student study program has ended.**

Source: Research findings

Business transaction list

The Facts Model is the complete and precise specification of the state space of the object world. The facts diagram is used to represent the Facts Model. Analyzing the business system led to the identification of the main business transactions and their resulting facts from the business

processes; Eight (8) major transactions were identified from the business processes and these are summarized in the table below:

Table 9: Table Showing the Business Transaction List

TRANSACTION TYPE	RESULTING FACT TYPE
T1 Validating admission status	Entry E (Student S, Admission Letter L, Registrar V)
T2 Registering users	Registration R (Student S, Administrator A, Details D, Payment receipt No. J) Registered
T3 Courses management	Updating R (Course C, Course unit U, Description R, Administrator A) Course is updated
T4 Marks entry	Recording (Search StudentID I, Student S, Marks M, Lecturer L) Results record is started
T5 Results validation	Validation V (Marks M, Student S, Senate N) Validation started
T6 Results approval	Approval O (Results R, Student S, Vice Chancellor H) Results approved
T7 Managing payment accounts	Payment P (Fees amount F, StudentID I, Balance B) Payment record is started
T8 Generating transcript report	Transcript T (Results R, Student S, Grade G) Student record is completed

Determining actors and their responsibilities in the above transactions

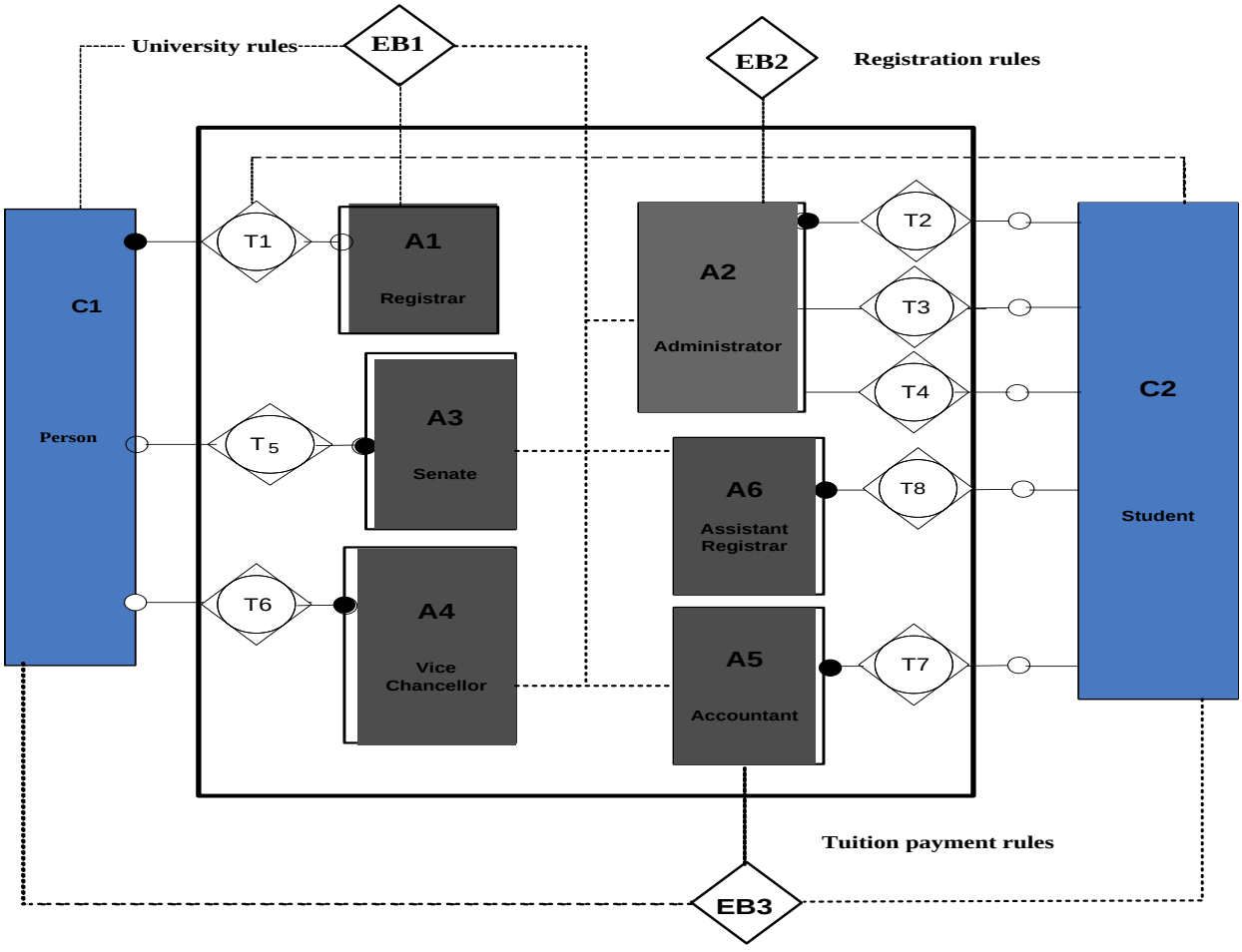
This model is a specification of the actors and the information that is needed by these actors to execute a transaction type.

1. Academic registrar **(actor A1)** has the responsibility and authority to admit qualified applicants (prospective students) in transaction **(T1).**
2. The administrator **(actor A2)** is responsible for registering admitted students in transaction **(T2)** on behalf of the registry; manage/update courses **(T3)**; computes grades **(T4).**
3. Lecturer records examination marks **(T4).**
4. Senate **(actor A3)** is responsible for discussing and passing students' results **(T5)**.
5. The Vice Chancellor **(actor A4)** validates the results by signing them off in transaction **(T6)** to confirm them as valid results before they can be disseminated to the students.

6. Accountant **(actor A5)** handles payments and produces payment statements which are received by students **(T7)**
7. Assistant registrar **(actor A5)** processes transcripts **(T8)**

From the above identified roles and responsibilities, the researcher was able to determine business processes. However, since business processes have uncertainties and are frequently only partially specified, DEMO was used to be able to specify and analyze models of business processes in the context of partial models.

Figure 16: Coordination Model of the student information system



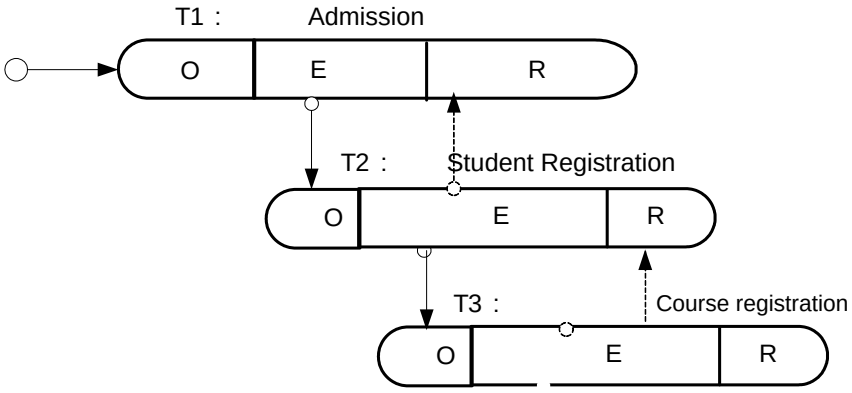
The DEMO interaction diagram provides an overview of the organization as a network of commitments. The organization is observed as a system of actors that send and receive

information, and perform calculations on this information in order to create derived information. At the *essential* level an organization is conceptualized as a system of actors that are engaged in the executions of business transactions. At the essential level organizations are considered as networks of business transactions, which are composed of interrelated communicative acts. In other words, at the essential level the organization is viewed as a social system, at the informational level as rational system, and at the documental level as a formal or material system.

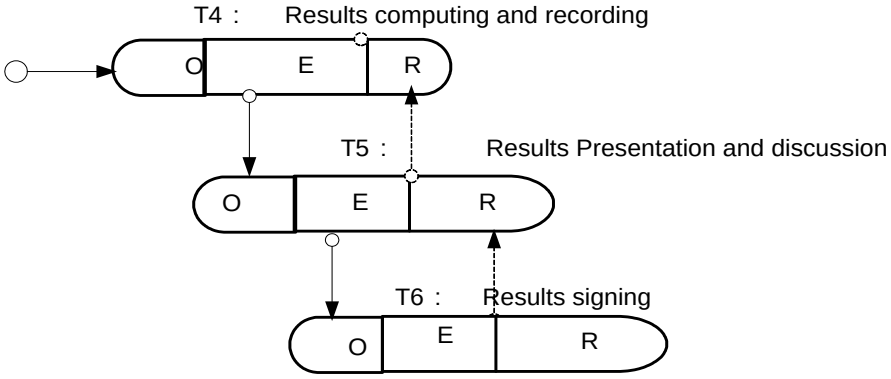
Therefore the interaction diagram does not show the relationships in time and the mutual relationships between the transaction types. The process model is used to highlight these relationships. Transaction types are represented by circles or stretched circles. The point of initiation is represented as a tiny circle. Causal relationships are presented as solid arrows while conditional relationships are presented as dotted arrows. Optional relationships are indicated with a small horizontal line on the causal relationship arrow. In DEMO a business process is defined as a chain of causal related transactions. The figure below shows the relationships between the transaction types.

Figure 17: Business process model for the student information system

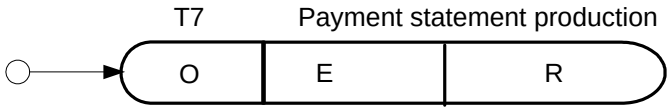
Process 1 : Registration process



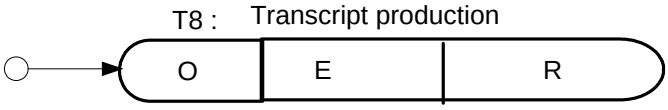
Process 2 : Results management



Process 3 : Fees payment and account management



Process 4 : Transcription processing

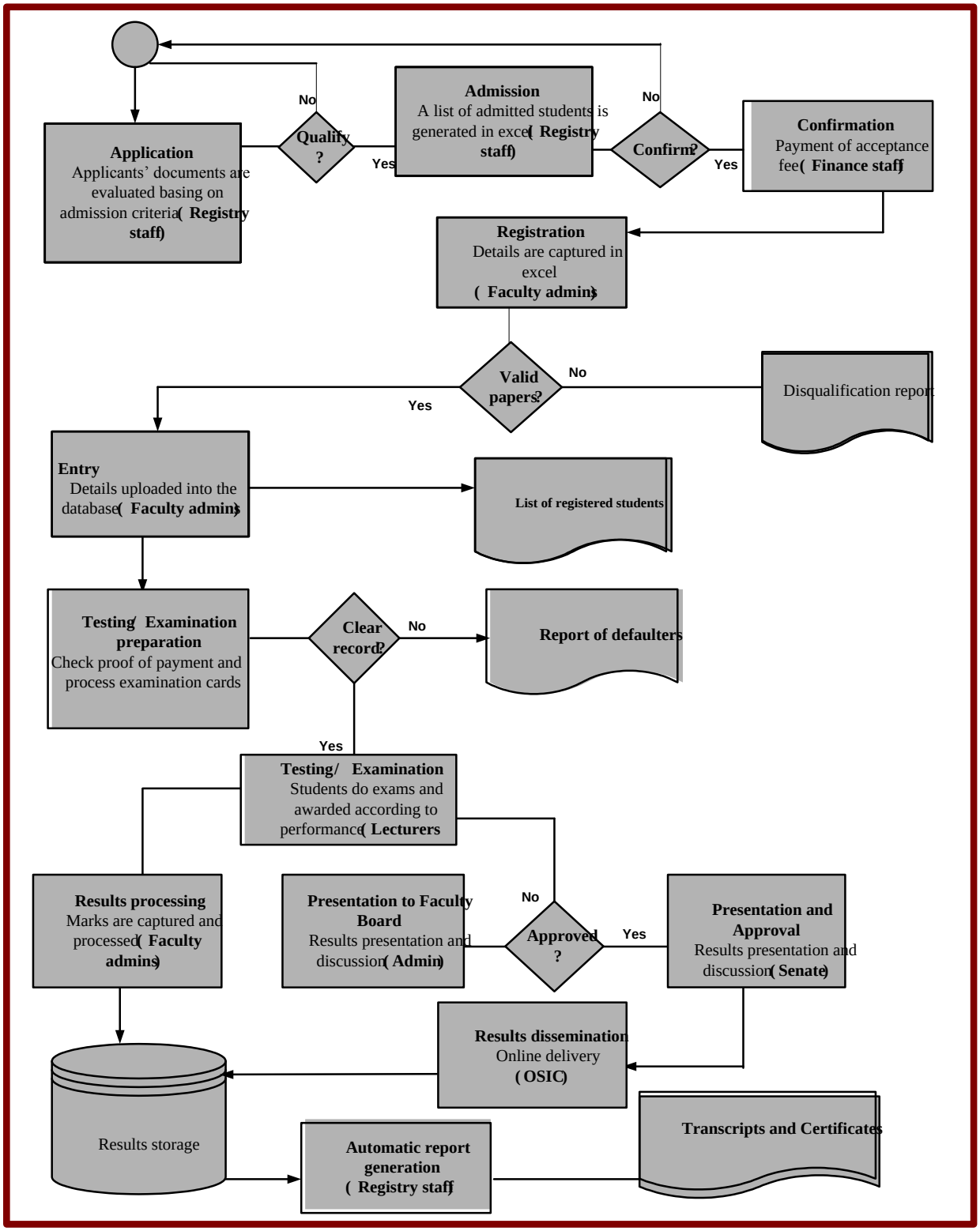


Actor restrictions

1. For a student to register, he/she must have been admitted into the program at UMU. For the registrar to admit a student, he must follow the university rules regarding admissions.
2. To register a student, the administrator must follow the university's rules regarding registration. Before registration can take place, a student must present a receipt of payment of registration and tuition fees or at least part of it. During registration, each student must present his/her original copies of past academic performance for verification. A student is given a registration number that uniquely identifies his/her record throughout the study program.
3. The lecturer must follow the university's policies and procedures regarding course work tests, examinations in computing and entry of students' marks.
4. The administrator must follow university policies and guidelines when updating and maintaining students' records.
5. Before the administrator can disseminate students' results, they must be presented to senate for discussion and validation. The results must at this point be signed off by the vice Chancellor to pass as valid results.
6. The accountant is responsible for enforcing payment of fees and availing students with their financial payment statements following the university's policies and procedures regarding fees payment.

In order to perform organizational transformation, a constructional understanding of the system and its elements is needed. A constructional understanding of a system refers to the knowledge of the working of the system. Below is the process flow diagram for the OSIS.

Figure 18: Process flow Diagram for the OSIS



Source: Research findings

Proposed new Information Technology Infrastructure

The proposed IT infrastructure is intended to ensure efficient and effective service delivery to all stake holders especially UMU students by enabling the registry staff to realize business objectives of the institution. The proposed IT infrastructure should meet the following requirements:

SERVER SIDE	SPECIFICATIONS
OS	UNIX (Linux, Windows 2000, XP and Windows 7)
PHP version:	PHP 5.2.5+
Web Server:	Apache Web Server. 2.2.6+
Database:	MySQL 5.0.45+
Monitor resolution	800x600 pixels
Processor Speed	2.0 GHz
Disk space	260GB
Bandwidth	100kbps
CDROM	
RAM	2GB and above
Machine	Uninterruptible power supply unit
CLIENT SIDE	**SPECIFICATIONS**
OS	Windows XP, Vista and Windows 7
Web Browser:	Microsoft Internet Explorer 5.5+, Netscape Navigator 6.0+ & Mozilla 1. 3 +
Antivirus	
Monitor resolution	800x600 pixels
Processor Speed	1.0 GHz
Disk space	40GB
RAM	Should not be below 250 MB
Machine	Uninterruptible power supply unit.

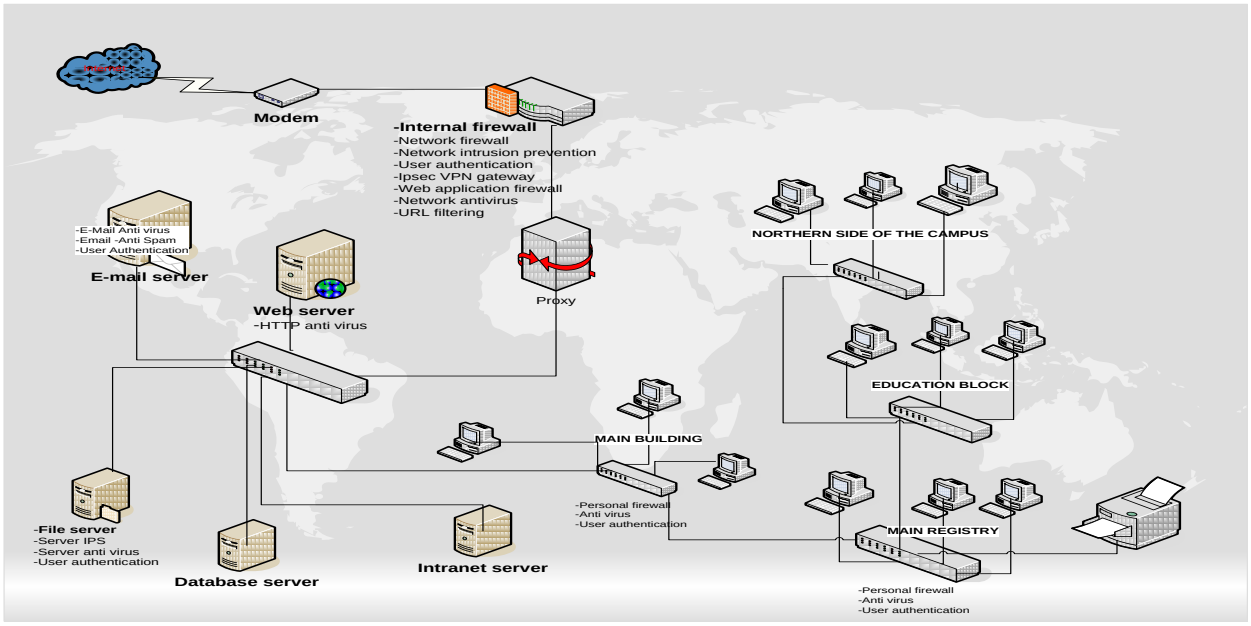
Source: Research findings

The network should have a number of security features such as;

- Encrypted user authentication by username and password to core modules that contain personalized information to reduce the risk of unauthorized access
- A firewall to minimize unauthorized access

- Provide varying access levels to maintain privacy of personalized information from exposure to the general public.

Figure 19: Show the Proposed Network and Security Model for the OSIS



Source: Research findings

4.9 System requirements Specification

From the above analysis, the researcher came up with the following system requirments for the OSIS.

4.9.1 System Functional Requirements for the OSIS

1. The system should be able to capture and store patrons' details into the MSQL database
2. The system should be able to capture and store program details into the MYSQL database
3. The system should be able to capture and store course details into the MYSQL database
4. The system should be able to handle user management so that administrator can add, edit, or delete and or update student details.

5. The system should be able to allow administrators to delete, add and update programs, courses as predetermined by the University procedures.
6. The system should allow students to view their details, grades, financial statement and an unofficial transcript online on login.
7. The system should be able to produce academic transcript, so that students can look at their grades in any specific semester of all course they have taken.

4.9.2 System Non Functional Requirements for the OSIS

Performance

The system should have a quick response time. It should be able to handle multiple/concurrent users a big number of processes accurately at a high speed. For the purpose of this research project, this would be defined as less than 4 seconds.

System reliability

System should be reliable by being available 24x7 (regularly scheduled maintenance). Electronic records are maintained so that they are accessible and retain their integrity for as long as they are needed. The system should have little or no downtime. Mandke and Geisler (2003), point out that information flow within the system and between the key participants in the system must exhibit both the attributes and dimensions of information integrity as well as satisfy the quality. Specifically, the information should display the attributes of accuracy, consistency and reliability of content and processes as well as the dimensions of usefulness, completeness, manipulability and usability.

Usability

This is considered in designing the system so users can use and navigate the system easily and effectively. This means that the system has been developed with good user interfaces that make it easy for users to interact with it.

Scalability

The system should be designed in such a way that it allows room for future expansion

4.9.3 System Security Requirements for the OSIS

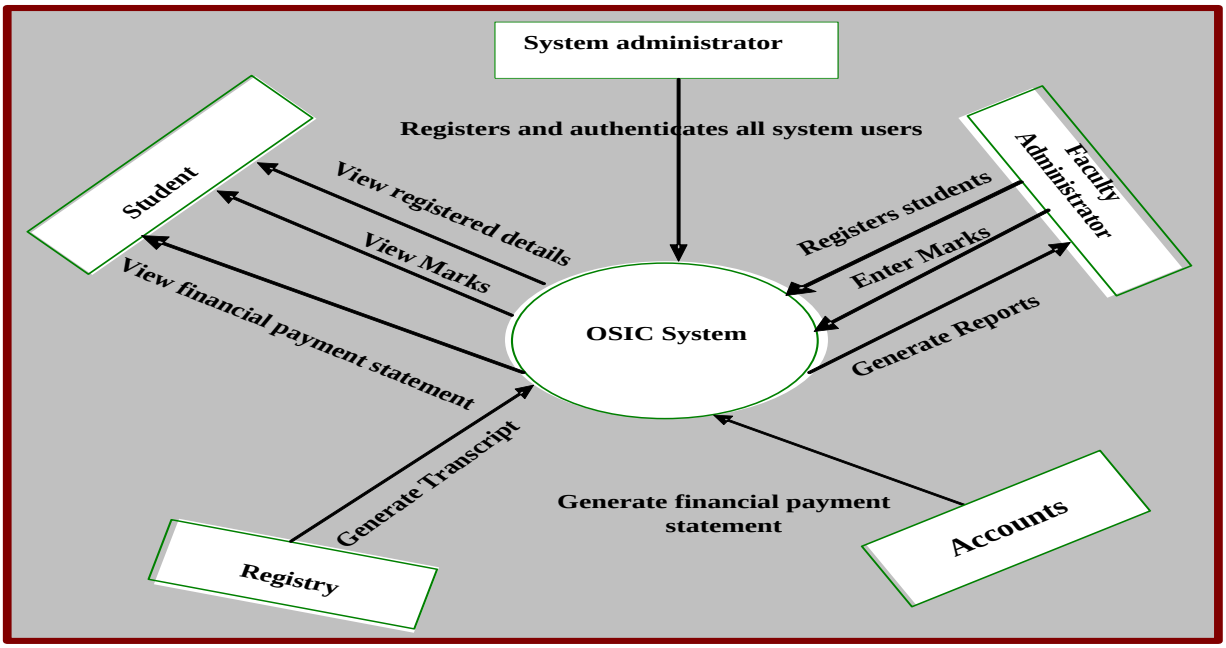
Academic records must meet a number of criteria. Some of these criteria affect how the system can be accessed as well as how key players may interact with these systems. Moore and Welson (2002), point out security requirements, transmission standards, privacy, information integrity and quality as some of the essential criteria. Essentially security falls into three main categories namely; administrative, physical and technical. The privacy criterion deals with the purpose to maintain strong protections for individual identifiable academic information/record. The OSIS should be able to satisfy the following security requirements:

1. The system must allow access only to initiators and administrators that have successfully logged into the application with a valid ID and password.
2. The system should allow varying privileges to administrators as per their ranks – Registrar (higher access level; view everything), Faculty administrators' access should be limited the records belonging to their respective Faculties.
3. The details of a specific user must be verified before user can be granted access to the core modules of the system. The system should log the user that has been assigned user name and password. The system was designed to make it impossible for anybody to logon without a valid username and password. On login, each student access must be limited to his/her

account information (personal grades, profile information, financial statement and an unofficial transcript). Data encryption should be employed to keep the user login name and password secret.

With the knowledge, the researcher was now able to contextualize the to-be system in terms of activities and the actors that will interact with the system. The figure below represents the more important external actors that will interact with the OSIS system. It pictures the system at the center, with no details of its interior structure, surrounded by all its interacting systems, environment and activities.

Figure 20: Shows the Context Diagram for the OSIS



4.10 Data modeling

This involves identification of entities that make up the system and their associated attributes.

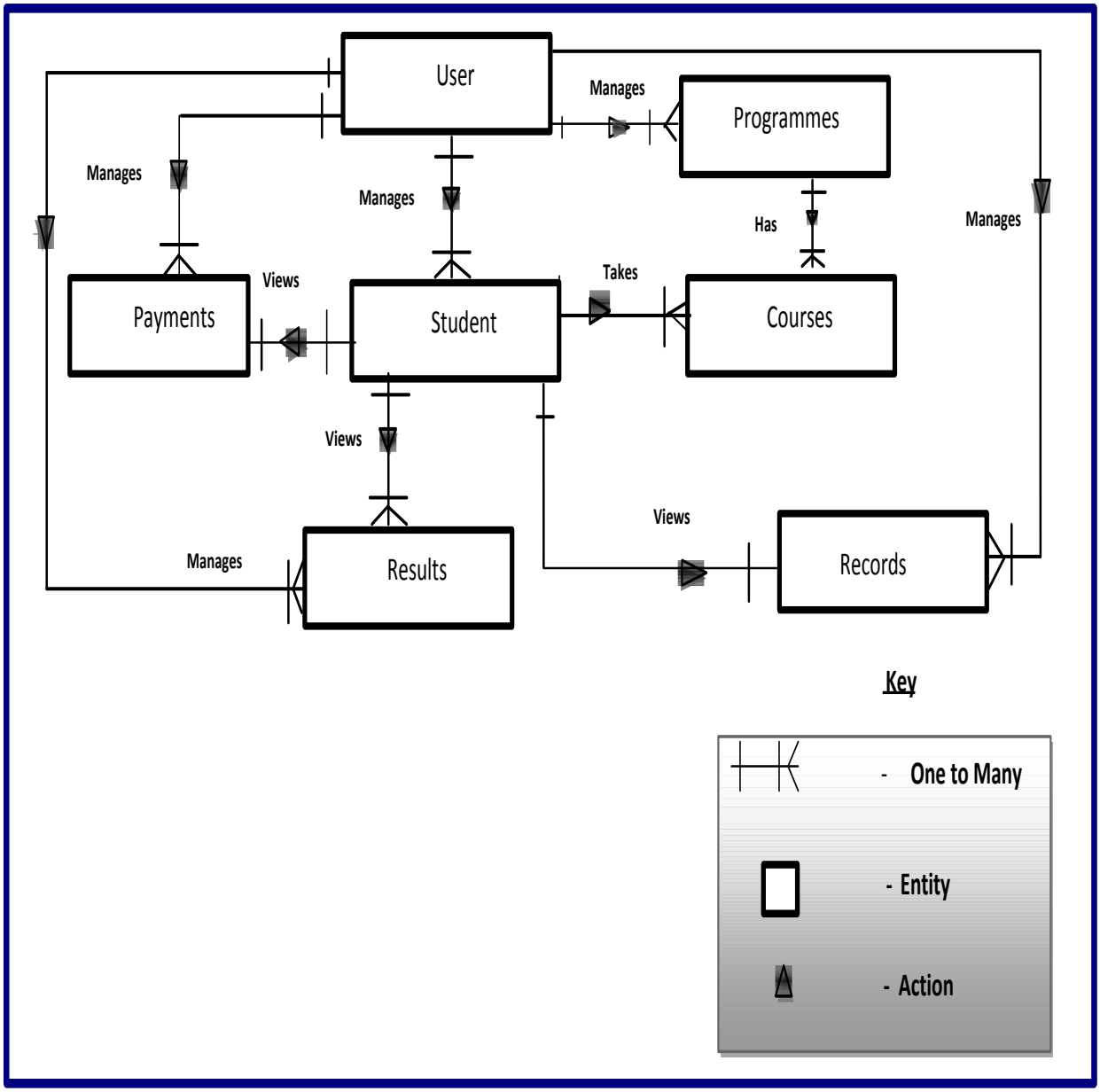
Table 10: Entities, their Descriptions and Attributes

ENTITIES	DESCRIPTION	ATTRIBUTES
Student	This is a registered student in the university.	Registration number, first name, last name, email, phone number, address, date of birth, nationality and gender.
Programme	This represents the study program the student is pursuing	Program code, faculty, program name
User	Member of staff that has rights to access the database and make manipulate and manage data	User identification number, first name, last name, email, phone number and address
Course	The course offered by the student	Course code, course name, course year, and course semester
Results	Examination results attained by a student for each course examined	Results Identifier, Course Identifier, period and marks
Payments	This represents the payment details for each individual student	Payment Identifier, item paid for, payment date and amount
Records	This represents a student record	Record Identifier, Session Identifier, Course Identifier and marks

Source: Research findings

To conceptualize the functionality of the new system at a higher abstract level, UML was used to diagrammatically visualize and specify working of the new system. Below is the conceptual data model for the OSIS.

Figure 21: Conceptual Data Model for the OSIS



Source: Research findings

4.11 System modeling

4.11.1 Use Case Scenario

Use-case scenarios were used to develop use case diagrams following a sequence of events as shown below.

Table 11: Table Showing Use Case Scenario

USE CASE SCENARIO	
Use case Scenario A: Creating User accounts	To access the core modules, the system administrator is prompted to log in before performing any tasks. Once logged in he/she can register all other users. The details recorded include staffid, First Name, Last Name, Email, user type, Username, Password and Department Id.
Scenario B: Adding programs and courses	Once the faculty administrator has successfully logged in, the system allows him/her to add a new program by clicking on the link "course structure". This is prompted by a click event on the "add new program". Once the program clicked on, the system prompts for adding a new course.
Scenario C: Adding a new student.	Once the faculty administrator has successfully logged in, he/she can add a new student by clicking on the link "manage students". This is prompted by a click event on the link "add new student". He/she can also edit and /or delete a student.
Use Case Scenario D	Once a lecturer is logged in, he/he has access to only the marks module to allow him/her add marks. This is prompted by a click event on the link "manage marks". He/she can edit and/or delete marks as appropriate.
Use case Scenario E: Checking results, payment statement and transcript	Students who want to check their results, payment statement and /or transcript, the system prompts the student to login. The student will always be authenticated by the username and password to access his/her account.
Use case Scenario F: Generating Transcripts	The system allows the Assistant Registrar to produce academic transcripts for students who have completed their course. This is prompted by a click event on the link "manage transcripts'.

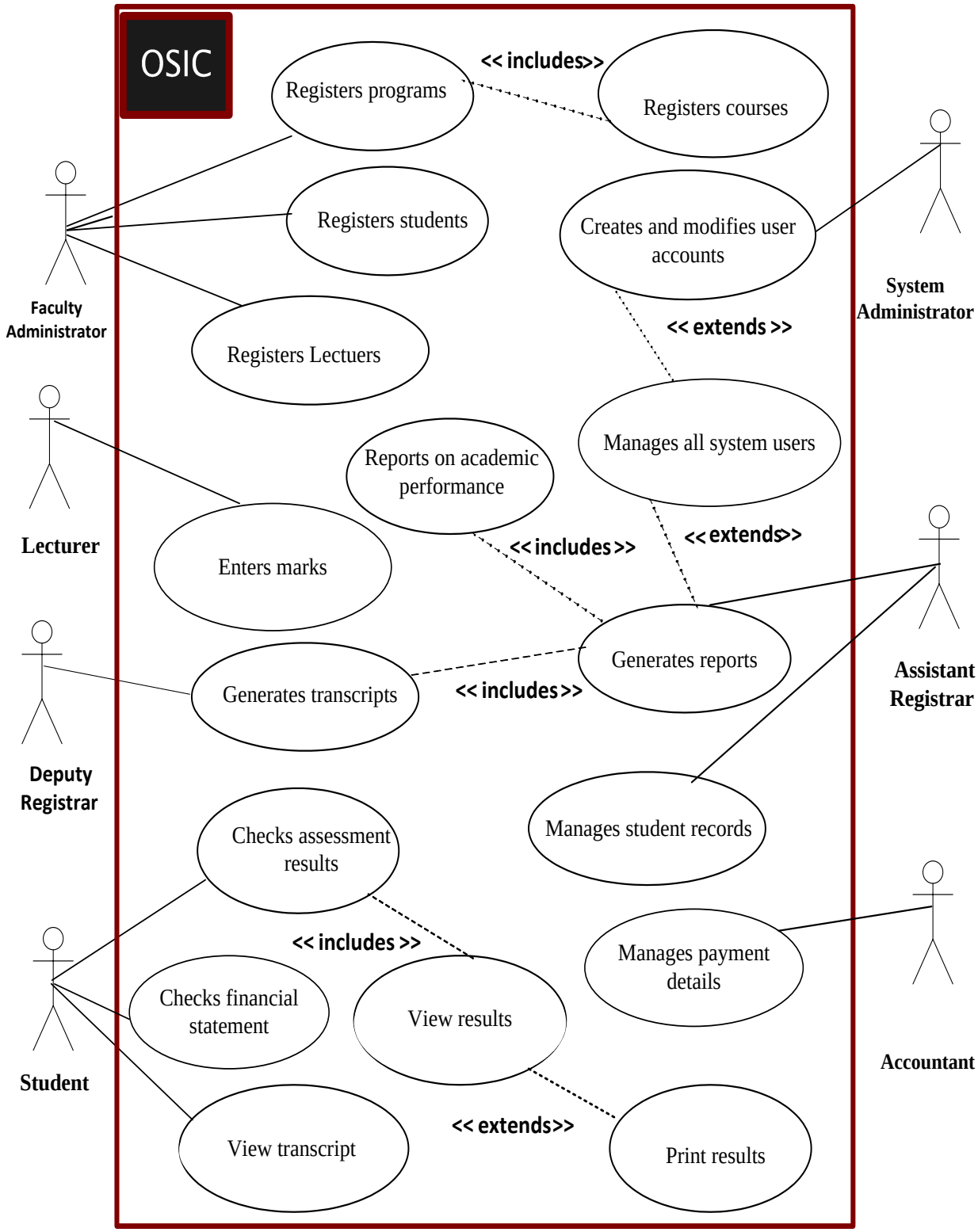
Scenario G: Viewing Reports	The system produces reports on academic progress of a student. These reports are then viewed by respective faculty administrators who may want to edit the student's marks by entering or deleting a student record; Main Registry staff to print reports or transcripts and system administrator who may add or delete a user.

Source: Research findings

4.11.2 Use Case Diagram for the OSIS

A use case diagram illustrates a unit of functionality provided by the system. The main purpose of the use-case diagram is to help development team visualize the functional requirements of a system including the relationship of actors (people who will interact with the system) to essential processes as well as the relationships among different use cases. To show a use case on a use case diagram, an oval is drawn in the middle of the diagram and the name of the use case put in the center of or below the oval. To draw an actor indicating a system user on a user case diagram, a stick person is drawn to the left or right of your diagram.

Figure 22: Use-case diagram for the OSIS



Source: Research findings

Identifying classes

The system should enable the system administrator to handle registration of users by capturing and retaining their details. The system administrator then assigns user name and password to enable the users to login. The faculty administrator must first register programmes and courses according to university policy. He/she then inputs each student details according to the registration guidelines. The system accepts each student to be registered under an already registered programme. A student must take the required number of courses. The lecturer examines students, wards marks and enters results into the system.The assistant registrar processes transcript for each student that has successfully completed his/her study program. The accounts staff receives proof of payment and enters payment details into the system and generates a payment statement. For a student to view his/her payment statement, results and or transcript; he/she must be authenticated by login.

Accepting Classes

The potential Classes were identified and accepted or rejected based on the following criteria: Retained information, needed services, multiple attributes, common attributes, common operations and essential requirements.

Potential Classes include: Registration, Program, Processing, Department, Course, Course Unit, User, Student, Payment, Results and login. Objects were accepted if they satisfied most of the following requirements: (1)Retained information - the system needs to remember data about the object; (2) Multiple attributes - objects should have many attributes; (3) Needed services - the object must have an identifiable set of operations; (4) Common attributes - a set of attributes that apply to all occurrences of the object; (5) Common operations - a set of operations that apply to

all occurrences of the object; and (6) Essential requirements - external entities that produce or consume essential information.

Table 12: Table Showing Potential Class and Class Requirements

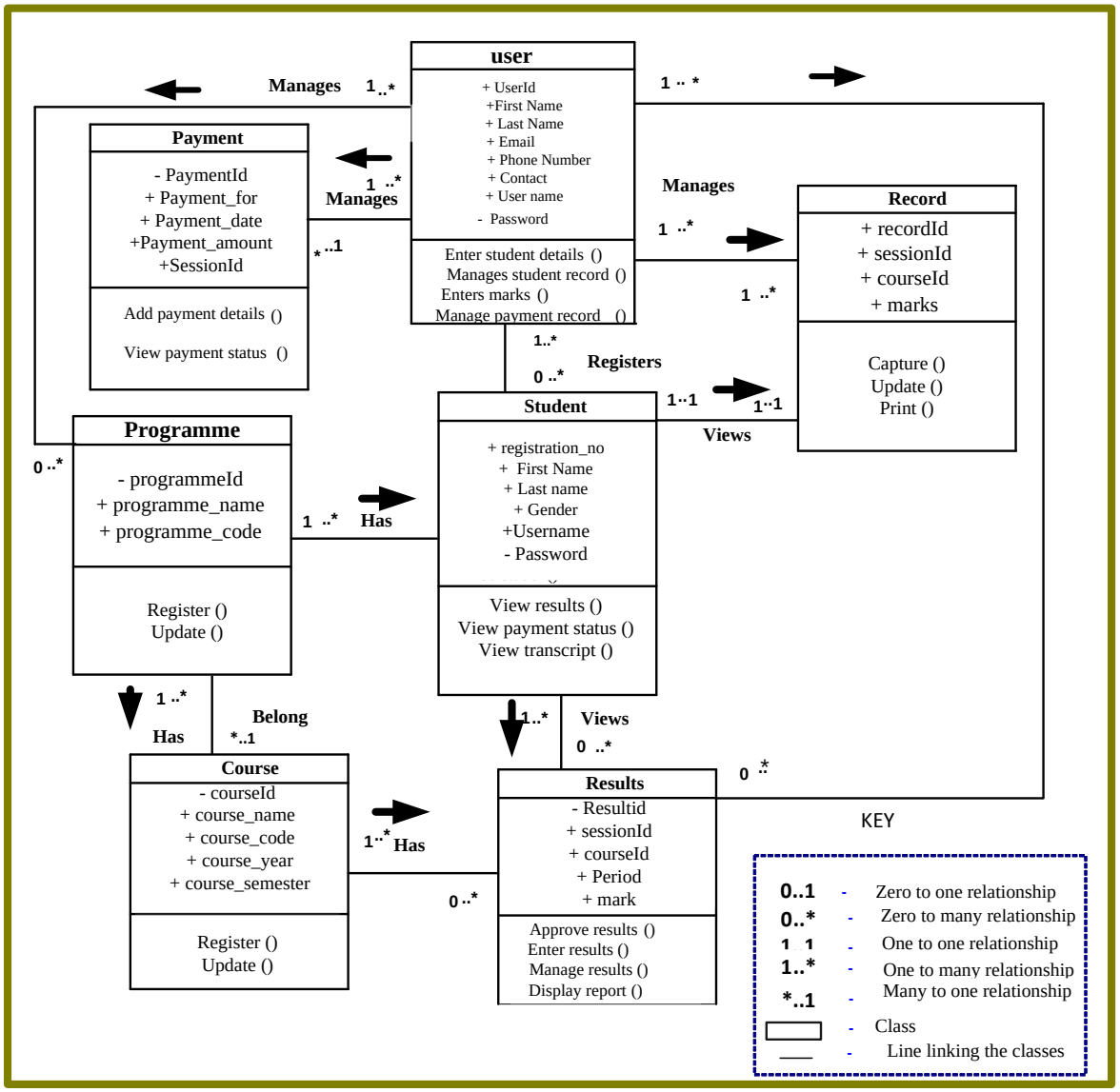
Potential Object/Class	Attributes	Class Requirements
Programme	Name, ID	Accepted: all apply
Processing	Item	Rejected: 2, 4,5,6; fail
Department	Name, ID, StaffID	Accepted: all apply
Course	Name, Code, course unit	Accepted: all apply
Student	Name, ID, Age, Gender …	Accepted: all apply
Payment	Name, ID, Date, Status	Accepted: all apply
Results	ID, Subject, Marks …	Accepted: all apply

Source: Research findings

4.11.3 Class Diagram for the OSIS

The class diagram shows how the different entities (people, things and data) relate to each other. It shows the static structure of the system. A class is depicted on the class diagram as a rectangle with three horizontal sections; the upper section shows the class' name; the middle section contains the attributes and the lower section shows the class' operations or methods. The figure below is the class diagram displaying the OSIS entities, their attributes and methods.

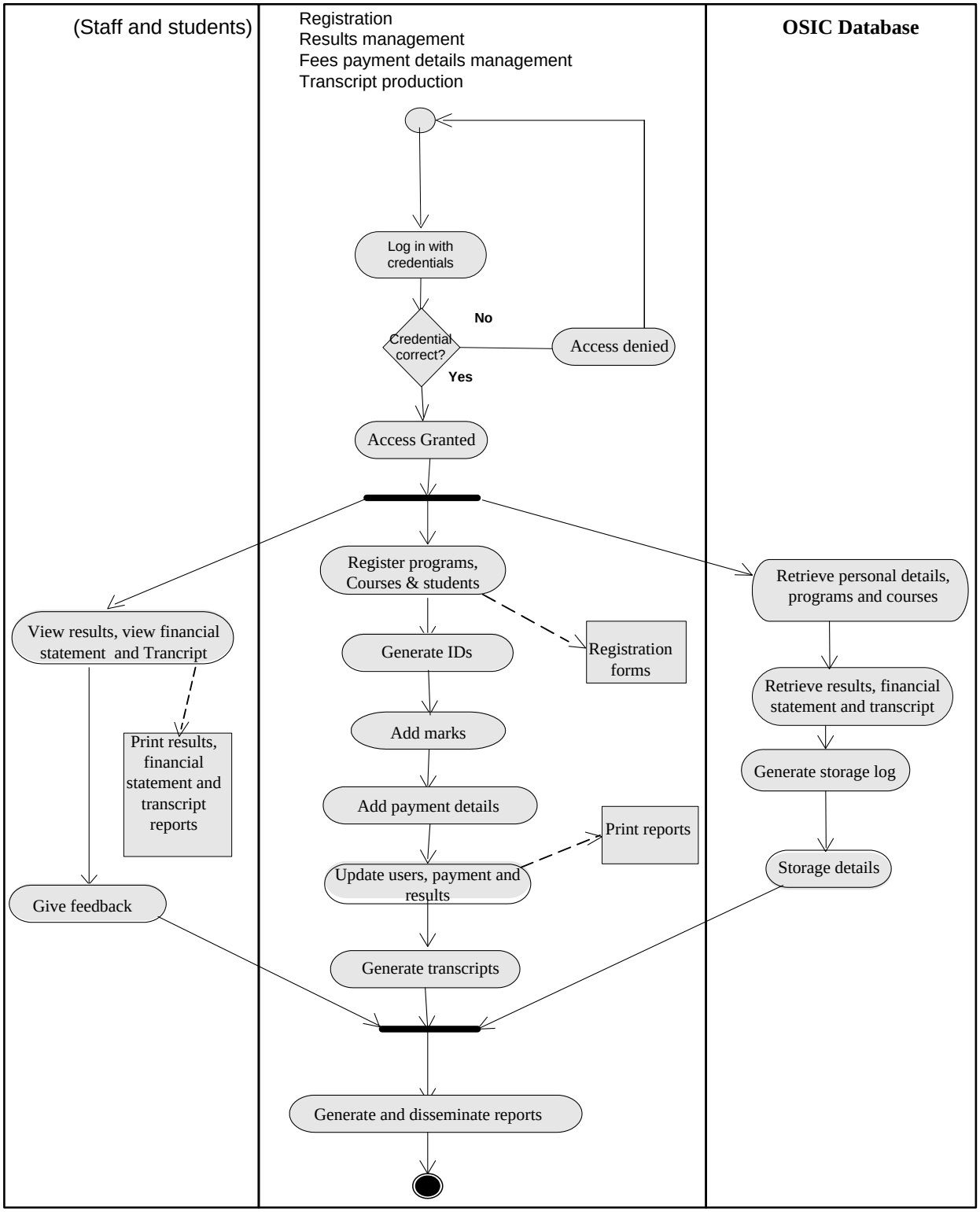
Figure 23: Class Diagram for the OSIS



4.11.4 Activity Diagram for the OSIS

After specifying classes, attribute and methods, it was vital to identify the various objects and their states in the system. The activity diagram below represents the various states of objects in the OSIS module and the models of relationships between the various action states of the objects.

Figure 24: Activity Diagram for the OSIS

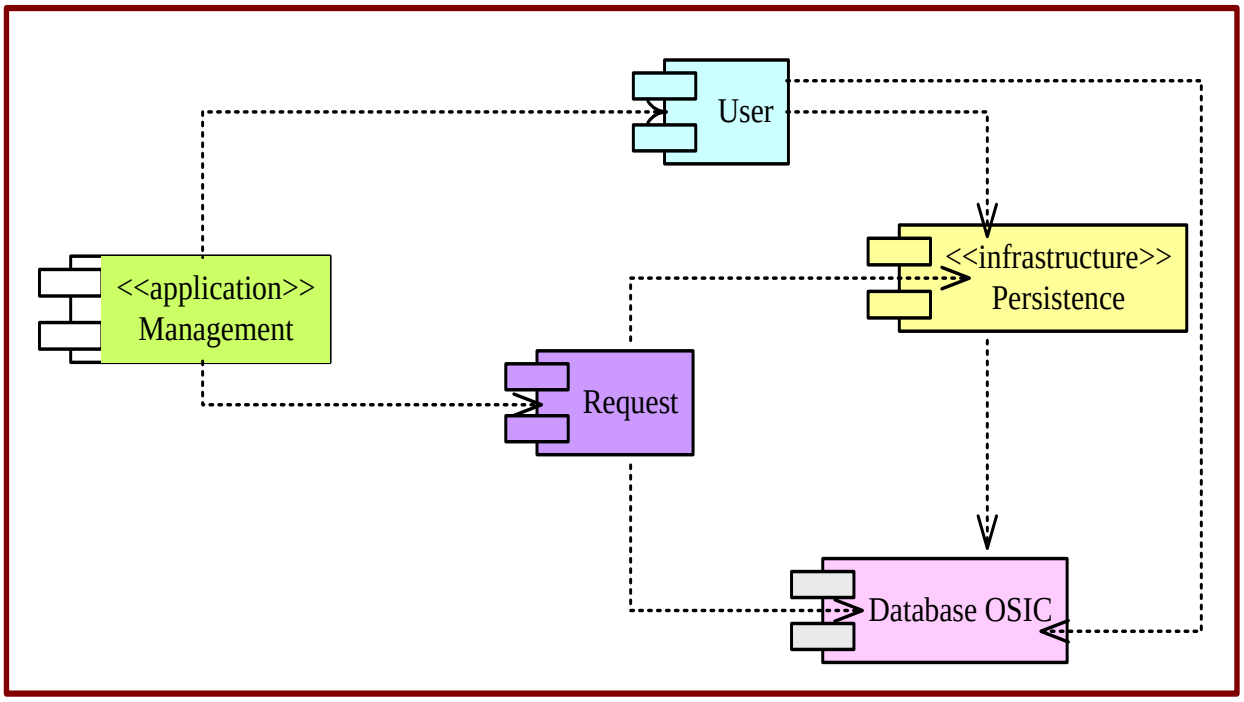


Source: Research findings

4.11.5 Component Diagram for the OSIS

This provides a physical view of the system. Its purpose is to show dependencies that the software has on the other software components like software libraries in the system. The diagram can be shown at a very high level with just the large-gain components, or it can be shown at the component package level.

Figure 25: High Level Component Diagram for the OSIS

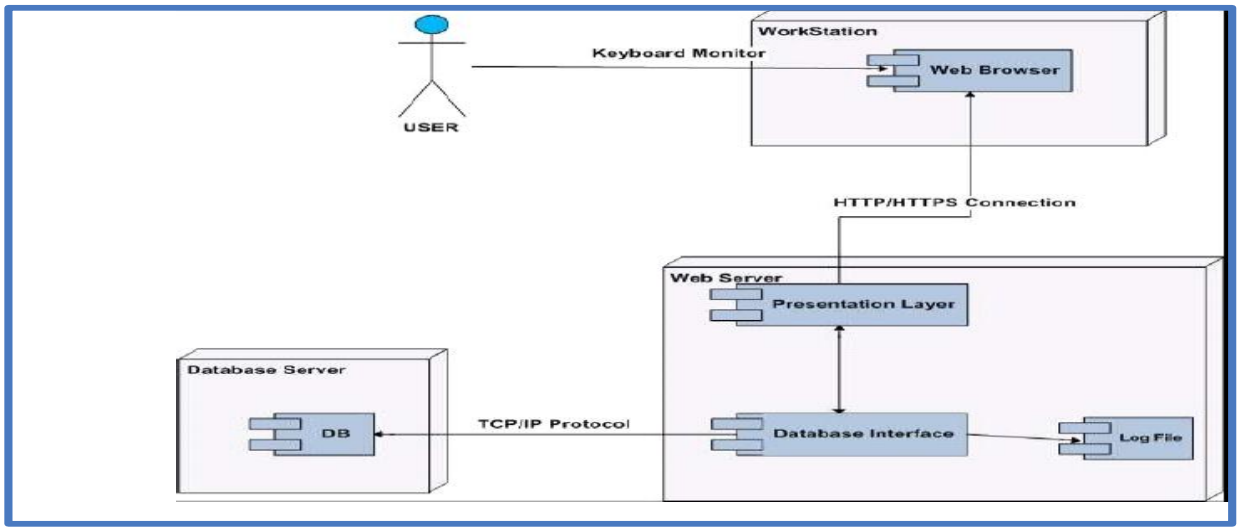


Source: Research findings

4.11.6 Diployment Diagram for the OSIS

This shows how the system will be physically deployed in the hardware environment. Its purpose is to show where the different components of the system will physically run and how they communicate with each other. Since the diagram models the physical routine, a system's producation staff will make considerable use of this diagram.

Figure 26: Deployment Diagram for the OSIS



Source: Research findings

4.12 System planning

This involved identifying the activities to be executed in chapter five of the project and their expected deliverables.

Table 13: Project Activities and Deliverables

OBJECTIVE	ACTIVITIES	DELIVERABLES
Identify functional specification for the new system	• Come up with use case diagrams • Activity diagrams • Come up with ER diagrams • Come with physical database design specification	Design models
Create a MSQL database, design an interface and link it to the	• Identify entities and their relationships and link them up • Create a database and give it a name, the tables representing entities about which information will need to be captured, stored, updated and	MYSQL database A user friendly interface through which users can interact with the

Mysql database	retrieved to meet users' needs. Save the database and its tables • Create an interface and link it to the Msql database	database
Capture data for the OSIS	• Registration of students- student information details into the database • Registration of staff that will interact with the system • Program registration • Course registration	A view of registered patrons A view of courses A view of programs A view of reports
Generate user IDs	• Assign users' unique identifiers for easy retrieval	ID NO.
Allow users access to the OSIS	• Assign access levels • Document access guidelines	Username and passwords
Manage programs and courses	• Edit programs and courses to reflect what is on ground • Delete programs and courses that no longer exit • Update programs and courses as per standards set • Display programs and courses available	A view of programs and courses update forms
Display financial statements	• Pull payment status from accounts • Post payment status to the student account	A link to a view of fees payment report
Display student results online	• Enter results as given by Lecturers • Enable the "View" results on approval by Senate	A sample view of grades/ results report
Display an unofficial transcripts	• Enter grades on final approval by Senate • Allow view and print only	An unofficial Transcript

Source: Research findings

Opportunities

- The university has IT infrastrasture in place including the internet
- Administrators are computer literate which makes orientation in the use of the new system easier
- Students are familiar with computers and online systems

Anticiptated Risks

- Limted time for project completion
- Limited skills in programming
- Inadequate finances

4.13 Conclusion

In this chapter, the data was analyzed and user/business requirements determined. The requirements of the proposed system were discussed and analyzed through Use case diagram, class diagram, component diagram, deployment diagram and activity diagram. The specification of the new system's functionality was also determined and this is tailed in the next chapter.

CHAPTER FIVE: SYSTEM DESIGN

5.1 Introduction

The study findings indicate that automation of the students' information management and access system can lead to improved data management and retrieval. IT and IS are vital components for proper management of data from different operational processes. This is the reason automation was identified by respondents as candidate alternative to improving the work processes through increased speed, easing access to students' records and faster retrieval of the same. Functions ranked highly for automation included; financial statements, results and transcripts production respectively. Basing on the user / business requirements identified in chapter four above, this section lays out system functional design specifications, database, and interface, network and security designs for the OSIS.

5.2 Functional design specification

For the student; there should be a process that allows him/her to:

1. View his/her tuition payment summary
2. View courses registered for
3. View his/her examination results earned from each course taken up to the last completed semester
4. View and print his/her non-official record of grades and transcript

For system administrator; there should be a process that allows him/her to:

5. Manage other administrators – register, add, edit, give access permissions and delete administrators

For the Registrars/administrators; the system should be able to allow:

6. Assistant registrar; Transcript division to view student grade reports across all Faculties to enable generation of transcripts
7. Each administrator attached to a particular Faculty a view of only the information on students belonging to that particular Faculty
8. Each administrator to manage course structure – register courses and update programs and courses as predetermined by the University procedures
9. Each administrator to enter his/her faculty's course work marks and final grades

5.3 Database design

5.3.1 Logical database design

Below is the logical design of the OSIS database showing the entities and their attributes defined with the primary key fully underlined and the foreign key underlined with dotted-lines.

Programmes (**programmeId**, programme_name, programme_code, **faculty**)

Courses (**courseId**, course_name, course_code, course_year, course_semester, **programmeId**)

Results (**resultid**, period, mark, **sessionId**, **courseId**)

Std_profile (**profileId**, registration_no, gender, pob, dob, yoc, country, district, image, mobile, phone number, address, **programmeId**, **sessionId**)

Users (**userId**, firstname, lastname, email, contact, address, department, loginstatus, username, password, user_type, **sessionId**)

Payments (**paymentId**, payment_for, payment_date, payment_amount, **sessionId**)

Records (**recordId**, **sessionId**, **courseId**, marks)

5.3.2 Entity relationship diagram

An entity relationship (ER) diagram is used to visualize the system and represent the user requirements. This was used to represent entities and how they relate to one another. The ER diagram also shows the relationships between the entities and attributes as shown below.

Figure 27: Identifying Entity relationships

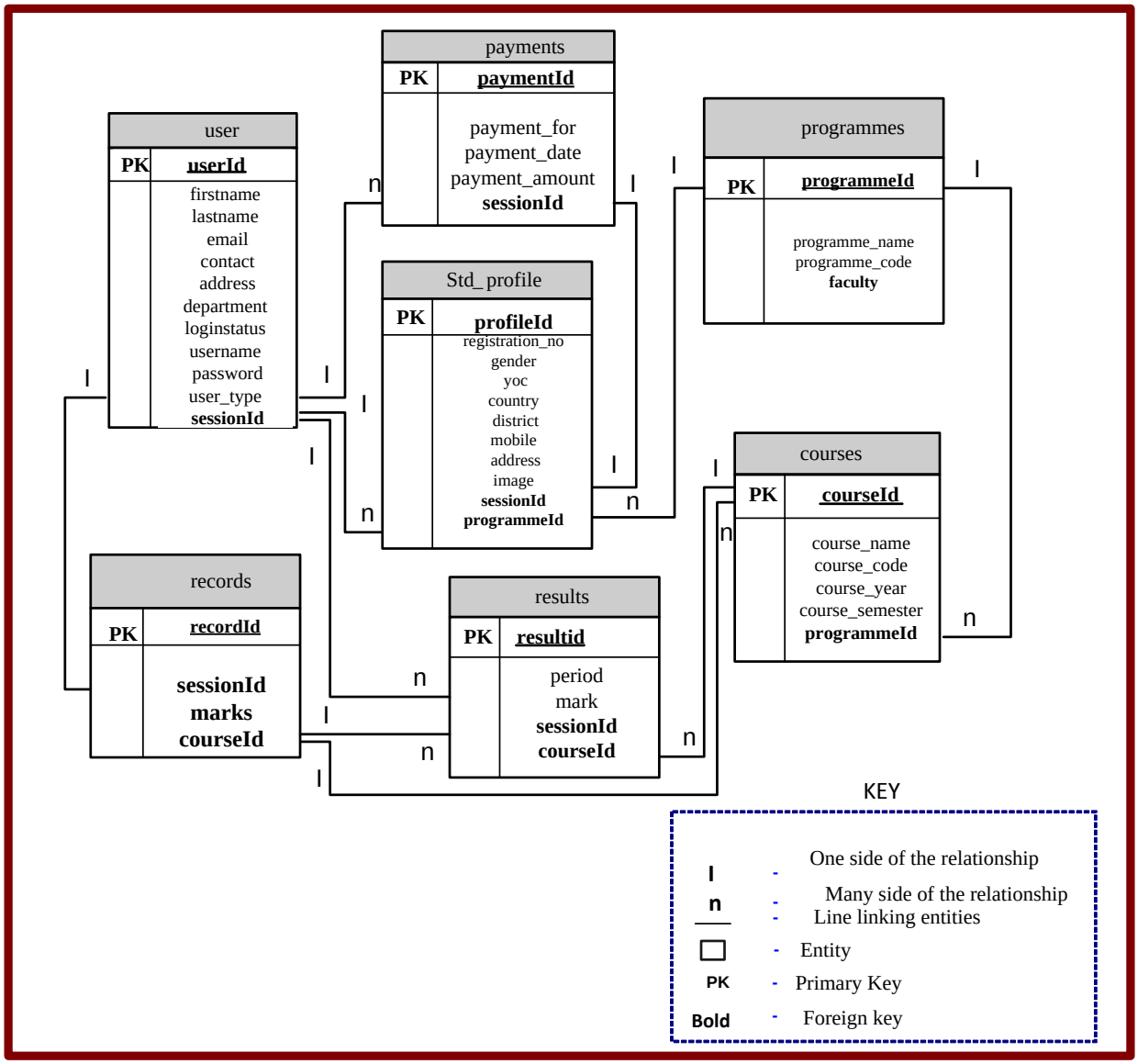
IDENTIFYING RELATIONSHIPS

- A programme has many courses
- Student *offers* a programme
- Student *takes* examination and is *awarded* grade
- A system user (Lecturer) *enters* marks
- Student *views* his/her results
- A student *checks* his/her payment status
- A system user (administrator) *produces* reports

Description of the relationships

1) Entity "student" is linked to a programme by programmeID.
2) Each programme has a name, ID, code and a faculty it belongs to. The value of the programme ID is unique for each programme.
3) Each course has a name, ID, code, year, semester and programmeId for the programme under which that course is offered. The course ID distinguishes different courses of the same progamme that are taught during the same semester/year.
4) Each payment can be described by its ID, purpose of payment, date of payment, amount and login session.
5) Each record relates to a course by courseId and then to a student through the same.
6) Each user has a user ID, first name, last name, email, contact, address, department, login status, username, password, user type, session ID.

Figure 28: Entity Relationship Diagram for the OSIS



5.3.3 Data dictionary for the OSIS

Table 14: Table showing Structure for Table payments

ATTRIBUTE	DESCRIPTION	DATA TYPE	COMMENT	CONSTRAINT
paymentId	Payment Identifier	INT(12)	**PK**	NOT NULL
payment_for	Purpose of payment	VARCHAR(100)		NOT NULL
payment_date `	Payement Date	DATETIME		NOT NULL
payment_amount	Amount of money	DOUBLE		NOT NULL
sessionId	Login Session	VARCHAR(40)	**FK**	NOT NULL

Table 15: Table showing Structure for Table programmes

ATTRIBUTE	DESCRIPTION	DATA TYPE	COMMENT	CONSTRAINT
programmeId	Programme Identifier	INT(12)	**PK**	NOT NULL
faculty	Faculty Name	VARCHAR (200)		NOT NULL
programme_name	Programme Name	VARCHAR (200)		NOT NULL
programme_code	Programme Code	VARCHAR(200)		NOT NULL

Table 16: Table showing Structure for Table courses

ATTRIBUTE	DESCRIPTION	DATA TYPE	COMMENT	CONSTRAINT
courseId	Course Identifier	INT (12)	**PK**	NOT NULL
course_name	Course Name	VARCHAR(100)		NOT NULL
course_code	Course Code	VARCHAR(100)		NOT NULL
course_year	Year of Course	INT (2)		NOT NULL
course_semester	Semester	VARCHAR (12)		NOT NULL
programmeId	Programme Identifier	INT (12)	**FK**	NOT NULL

Table 17: Table showing Structure for Table results

ATTRIBUTE	DESCRIPTION	DATA TYPE	COMMENT	CONSTRAINT
resultid	Exam Paper Code	INT (12)	**PK**	NOT NULL
sessionId	Login Session	VARCHAR (40)	**FK**	NOT NULL
courseId	Course Identifier	INT (12)	**FK**	NOT NULL
period	Period	VARCHAR (25)		NOT NULL
mark	Student marks	FLOAT		NOT NULL

Table 18: Table showing Structure for Table student_profile

ATTRIBUTE	DESCRIPTION	DATA TYPE	COMMENT	CONSTRAINT
profileId	Profile Identifier	INT(12)	**PK**	NOT NULL
registration_no	Registration Number	VARCHAR(50)		NOT NULL
gender	Gender	VARCHAR(10)		NOT NULL
pob	Place of birth	VARCHAR(25)		NOT NULL
dob	Date of birth	VARCHAR(25)		NOT NULL
yoc	Year of course	INT(2)		NOT NULL
major	Specialization	VARCHAR(25)		NOT NULL
country	Home country	VARCHAR(25)		NOT NULL
district	Home district	VARCHAR(25)		NOT NULL
town	Home town	VARCHAR(25)		NOT NULL
street	Home street	VARCHAR(25)		NOT NULL
mobile	Mobile Phone Number	VARCHAR(25)		NOT NULL
office	Work office	VARCHAR(25)		NOT NULL
apartment	Apartment	VARCHAR(25)		NOT NULL
apartment_no	Apartment number	VARCHAR(25)		NOT NULL
image	Profile photo	VARCHAR(100)		NOT NULL
programmeId	Program Identifier	INT(12)	**FK**	NOT NULL
sessionId	Session Identifier	VARCHAR(40)	**FK**	NOT NULL

Table 19: Table showing Structure for Table users

ATTRIBUTE	DESCRIPTION	DATA TYPE	COMMENT	CONSTRAINT
userId	UserId	INT(12)	**PK**	NOT NULL
firstname	First Name	VARCHAR(25)		NOT NULL
lastname	Last Name	VARCHAR(25)		NOT NULL
email	Email	VARCHAR(50)		NOT NULL
contact	Contact	VARCHAR(50)		NOT NULL
address	Physical address	VARCHAR(200)		NOT NULL
department	Department Name	VARCHAR (100)		NOT NULL
loginstatus	Login status	VARCHAR (25)		NOT NULL
username	User name	VARCHAR (25)		NOT NULL
password	Password	VARCHAR (40)		NOT NULL
sessionId	Session Identifier	VARCHAR (40)	**FK**	NOT NULL
user_type	User type	INT(1)		NOT NULL

Table 20: Table showing Structure for Table records

ATTRIBUTE	DESCRIPTION	DATA TYPE	COMMENT	CONSTRAINT
recordId	Record Identifier	INT (12)	**PK**	NOT NULL
sessionId	Session Identifier	VARCHAR (40)	**FK**	NOT NULL
courseId	Course Identifier	INT(12)	**FK**	NOT NULL
marks	Student marks	INT(12)	**FK**	NOT NULL

5.3.4 Physical database design

Physical database design translates the logical data model into a set of SQL statements that define the database for a particular database system. In other words, it is the process of producing a description of the implementation of the database on secondary storage. It describes the base relations and the storage structures and access methods used to access the data effectively, along with associated integrity constraints and security measures. To design the database for storing the desired data, MYSQL was used to create the database for the OSIS system. MYSQL is a Relational Database Management System (RDBMS) that uses Transact-SQL statements to send requests between a client and the Server and in this case the following translations occur:

- Entities become tables in MySQL.
- Attributes become columns in the MySQL database.

- Relationships between entities are modeled as foreign keys.

Below is the query that was used to build the database, tables and the data dictionary for the OSIS.

Creating the database

```
CREATE DATABASE OSIS_database
USE OSIS_database
SET SQL_MODE="NO_AUTO_VALUE_ON_ZERO";
-- Database: `osic`

Table structure for table `programmes`
CREATE TABLE `programmes` (
`programmeId` int(12) NOT NULL  auto_increment,
`faculty` varchar(200) NOT NULL,
`programme_name` varchar(200) NOT NULL,
`programme_code` varchar(200) NOT NULL,
  PRIMARY KEY  (`programmeId `)
) ENGINE=MyISAM  DEFAULT CHARSET=latin1 AUTO_INCREMENT=115 ;

Table structure for table `courses`
CREATE TABLE `courses` (
  `courseId` int(12) NOT NULL auto_increment,
  `course_name` varchar(100) NOT NULL,
  `course_code` varchar(100) NOT NULL,
  `course_year` int(2) NOT NULL,
  `course_semester` varchar(12) NOT NULL,
  `programmeId` int(12) NOT NULL,
  PRIMARY KEY  (`courseId`)
) ENGINE=MyISAM  DEFAULT CHARSET=latin1 AUTO_INCREMENT=115 ;

Table structure for table `payments`
CREATE TABLE `payments` (
  `paymentId` int(12) NOT NULL,
  `sessionId` varchar(40) NOT NULL,
```

```
  `payment_for` varchar(100) NOT NULL,
  `payment_date` datetime default '0000-00-00 00:00:00',
  `payment_amount` double NOT NULL,
  PRIMARY KEY  (`paymentId`)
) ENGINE=MyISAM  DEFAULT CHARSET=latin1 AUTO_INCREMENT=30 ;

Table structure for table `records`
CREATE TABLE `records` (
  `recordId` int(12) NOT NULL,
  `sessionId` varchar(40) NOT NULL,
  `courseId` int(12) NOT NULL,
  `marks` int(12) NOT NULL,
  PRIMARY KEY  (`recordId`)
) ENGINE=MyISAM  DEFAULT CHARSET=latin1 AUTO_INCREMENT=328 ;

Table structure for table `results`
CREATE TABLE `results` (
  `resultId` int(12) NOT NULL,
  `sessionId` varchar(40) NOT NULL,
  `courseId` int(2) NOT NULL default,
  `period` varchar(25) NOT NULL,
  `mark` float NOT NULL,
  PRIMARY KEY  (`resultId`)
) ENGINE=MyISAM  DEFAULT CHARSET=latin1 AUTO_INCREMENT=36 ;

Table structure for table `std_profile`
CREATE TABLE `std_profile` (
  `profileId` int(12) NOT NULL,
  `registration_no` varchar(50) NOT NULL,
  `gender` varchar(10) NOT NULL,
  `pob` varchar(25) NOT NULL,
  `dob` varchar(25) NOT NULL,
  `yoc` int(2) NOT NULL default '1',
  `major` varchar(25) NOT NULL,
  `country` varchar(25) NOT NULL,
```

```
  `district` varchar(25) NOT NULL,
  `town` varchar(25) NOT NULL,
  `street` varchar(25) NOT NULL,
  `mobile` varchar(25) NOT NULL,
  `office` varchar(25) NOT NULL,
  `apartment` varchar(25) NOT NULL,
  `apartment_no` varchar(25) NOT NULL,
  `image` varchar(100) NOT NULL default 'default.png',
  `programmeId` int(12) NOT NULL,
  `sessionId` varchar(40) NOT NULL,
  PRIMARY KEY  (`profileId`)
) ENGINE=InnoDB  DEFAULT CHARSET=latin1 AUTO_INCREMENT=24 ;

Table structure for table `users`
CREATE TABLE `users` (
  `userId` int(12) NOT NULL,
  `firstname` varchar(25) NOT NULL,
  `lastname` varchar(25) NOT NULL,
  `email` varchar(50) NOT NULL,
  `contact` varchar(50) NOT NULL,
  `address` varchar(200) NOT NULL,
  `department` varchar(100) NOT NULL,
  `loginstatus` varchar(25) NOT NULL,
  `username` varchar(25) NOT NULL,
  `password` varchar(40) NOT NULL,
  `sessionId` varchar(40) NOT NULL,
  `user_type` int(1) NOT NULL,
  PRIMARY KEY  (`userId`)
) ENGINE=MyISAM  DEFAULT CHARSET=latin1 AUTO_INCREMENT=45 ;
```

Connecting to the Database

The script below has the function that connects to the “osic” database.

```
<?php
        function dbconnect() {
        mysql_connect("localhost","root","") or die(mysql_error());
```

```
        mysql_select_db("osic") or die(mysql_error());
        }
        dbconnect();
?>
```

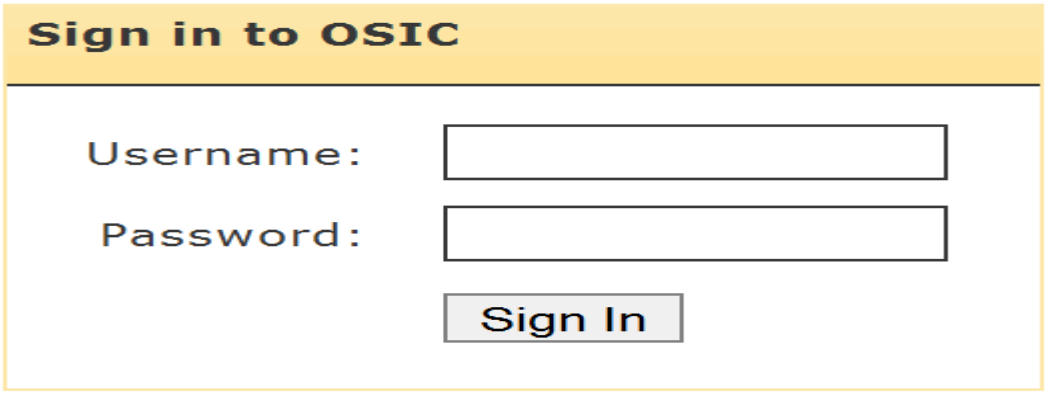
5.4 User interface design

Interface design is the design where colors, text fonts, font sizes, shapes and line thickness are strategically composed in an aesthetic manner to please the user and also set a hierarchy in the communication. This helps the user focus and attend to the information on the page sequentially. The user interfaces were developed through successive iterations of the prototyping model. The screens were designed using Microsoft Visio 2003 SP3 to come up with prototypes based on the requirements collected. Once the user interface was agreed upon, the system was developed using PHP as the web development tool, MYSQL as the RDBMS for the backend and Apache as web server.

5.4.1 Input design

Input design is a part of the overall system design. The main objective during input designing is to produce a cost-effective method of input, achieve the highest possible level of accuracy and ensure that the input is acceptable and understood by the user. All users login the same login form; however, what each user views is determined by the access rights that user has on the system. Below is a design of the login form.

Figure 29: Login Form



Login to the OSIC system is by user access level privileges which are based on user roles.

Faculty administrators

- Have access to the marks, payments and transcript modules.
- They can view payment details to inform them in the process of clearing students for examinations.
- They have no rights enter, edit and or delete payment details.
- They access the transcript module to enter final grades that have been successfully approved by Senate.

Accountant

- Only has access to the finance module to manage payment details.

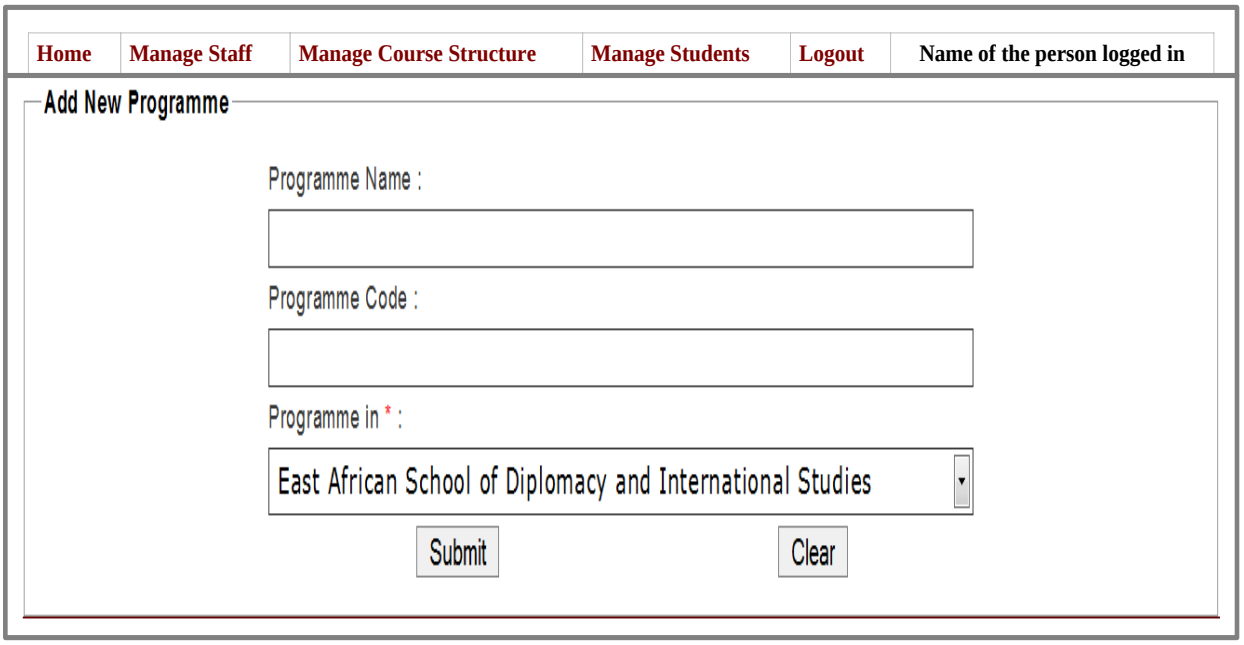
Lecturer

- Only have access to the manage marks module.

Form for adding new programme

For a course and a student to be created and/or registered there must be an existing program to which the two are to be attached. Below is a form for adding a new program:

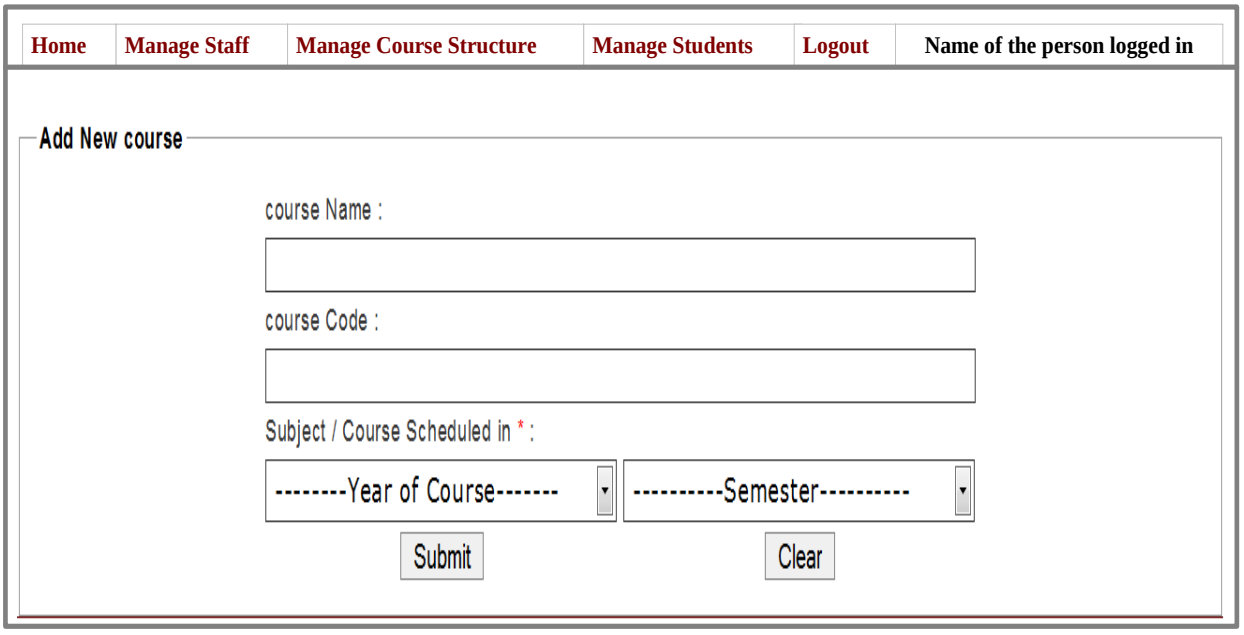
Figure 30: Program Registration Form



Source: Research findings

The designed template below will enable the programmer to implement the course registration form that allows administrators to register or input new courses into the system.

Figure 31: Form for adding new course

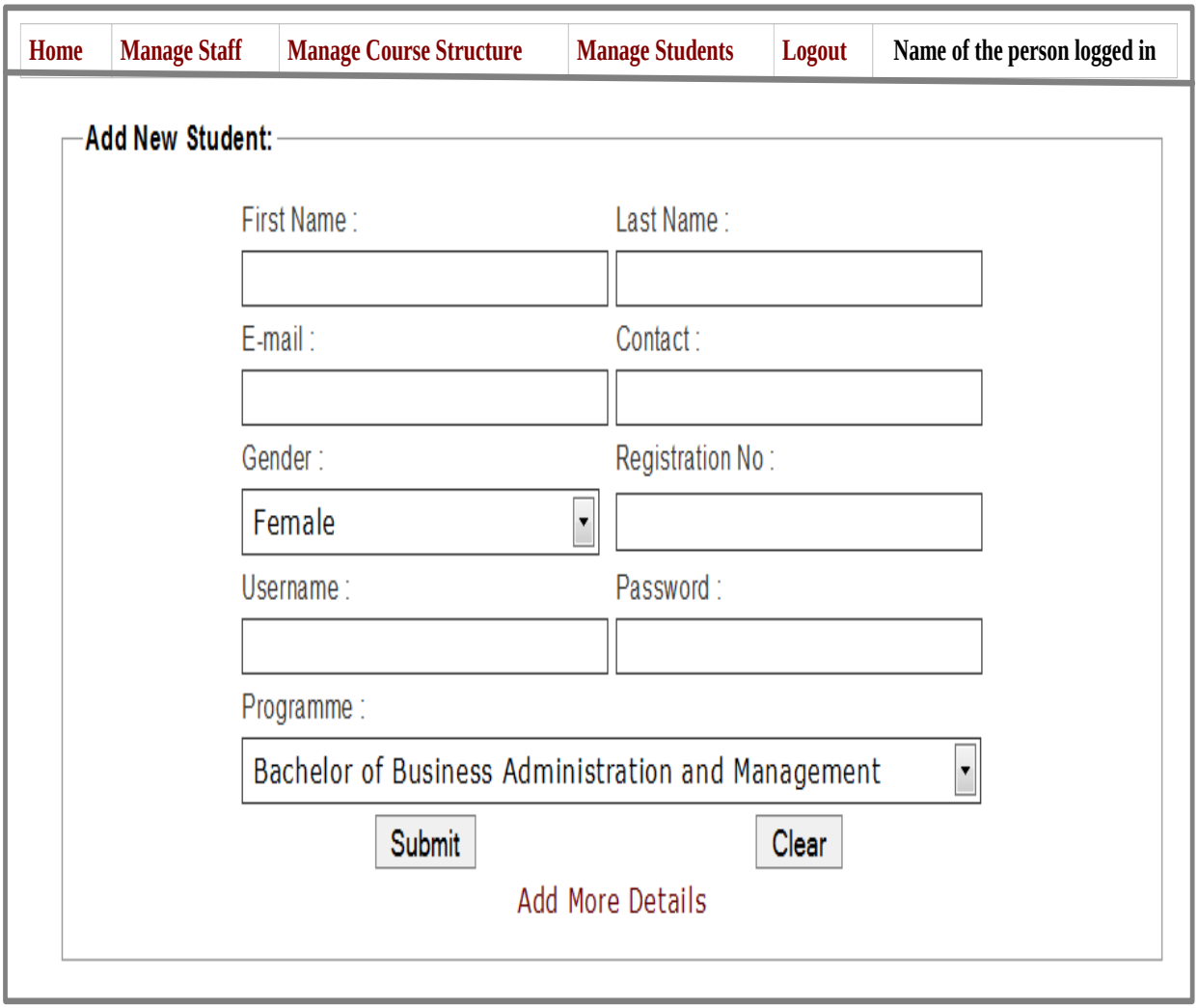


Source: Research findings

Add new student

The "add new student form" contains fields required to fill in the details of students who are pursuing the programme and its associated courses in that respective faculty. The student's details like Id, student name, date of birth, nationality, address, city, country, phone no., email and password are filled in. The "submit button" enables the system to accept the input details, the "clear" button councils the operation.

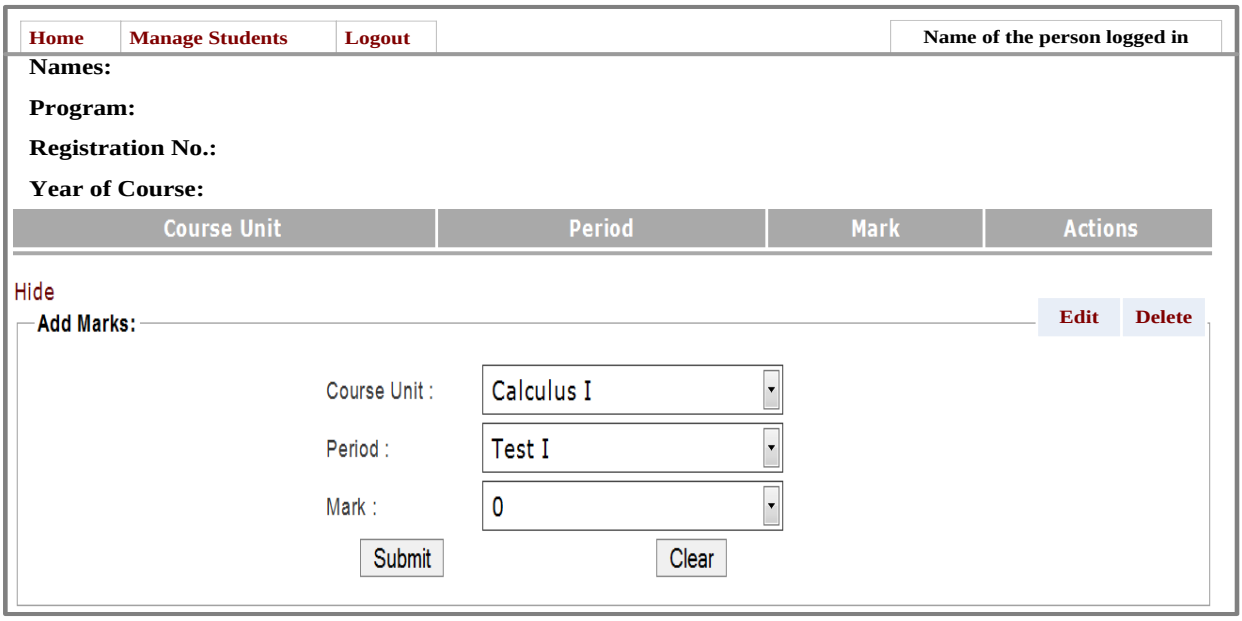
Figure 32: Student Registration Form



Source: Research findings

Add marks

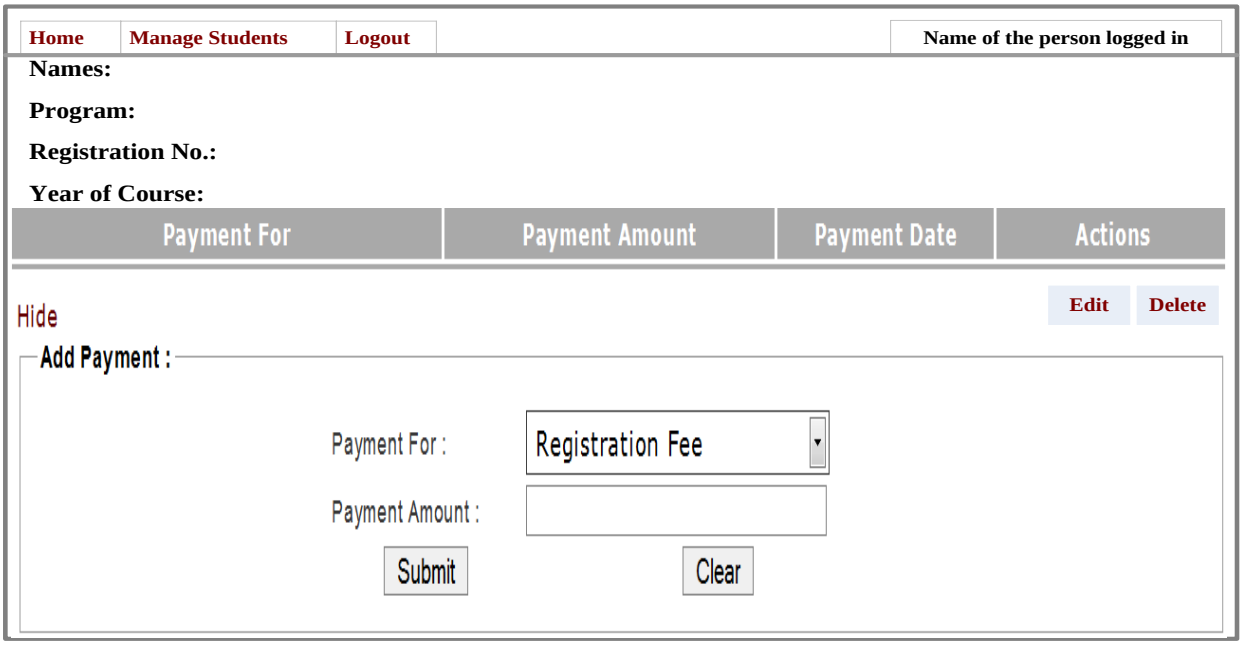
Figure 33: Form for Adding Marks



Source: Research findings

Form for adding payment details

Figure 34: Form for Adding Payment Details



Source: Research findings

5.4.2 Output design

Outputs from computer systems are required primarily to communicate the results of processing to users. The various types of output are; academic results report, payment status report and transcript report as shown in the figures that follow below.

Result Report Design

The result report template designed below will enable the programmer to implement a result report form that has key fields that display vital student academic performance progress given in form of marks scored for each subject completed.

Figure 35: Results Report Design

Home	Course Structure	View Finances	View Results	View Transcript	Logout	Name of the person logged on

Uganda Martyrs University
Name of the Faculty

Print

Unofficial Marks Report

Name:
Year of Enrolment:
Registration No:

Year 1		
COURSE UNIT	**PERIOD**	**MARK**
Year 2		
COURSE UNIT	**PERIOD**	**MARK**

Source: Research findings

Payment Report Design

The payment report will have the fields designed in the form below to capture and display student's payment details.

Figure 36: Payment Report Design

Home	Course Structure	View Finances	View Results	View Transcript	Logout	Name of the person logged on

Uganda Martyrs University
Name of the Faculty

Print

Unofficial Financial Statement

Name:
Year of Enrolment:
Registration No:

PAYMENT FOR	PAYMENT AMOUNT	PAYMENT DATE

Source: Research findings

Transcript Report Design

Figure below is a grades report template that will enable the programmer to implement a transcript report form in which the final grades will be input from the semester result report.

Figure 37: Transcript Report Design

Home	Course Structure	View Finances	View Results	View Transcript	Logout	Name of the person logged on

Uganda Martyrs University
Name of the Faculty

Print

Unofficial Academic Transcript

Name:
Year of Enrolment:
Registration No:

Year 1			
AEMESTER ONE		SEMESTER TWO	
Subject	Grades	Subject	Grades
Year 2			
SEMESTER ONE		SEMESTER TWO	
Subject	Grades	Subject	Grades
Total: 0	Out of: 1600	Average:	0%

Source: Research findings

5.5 System architecture design

5.5.1 The three-tier architecture

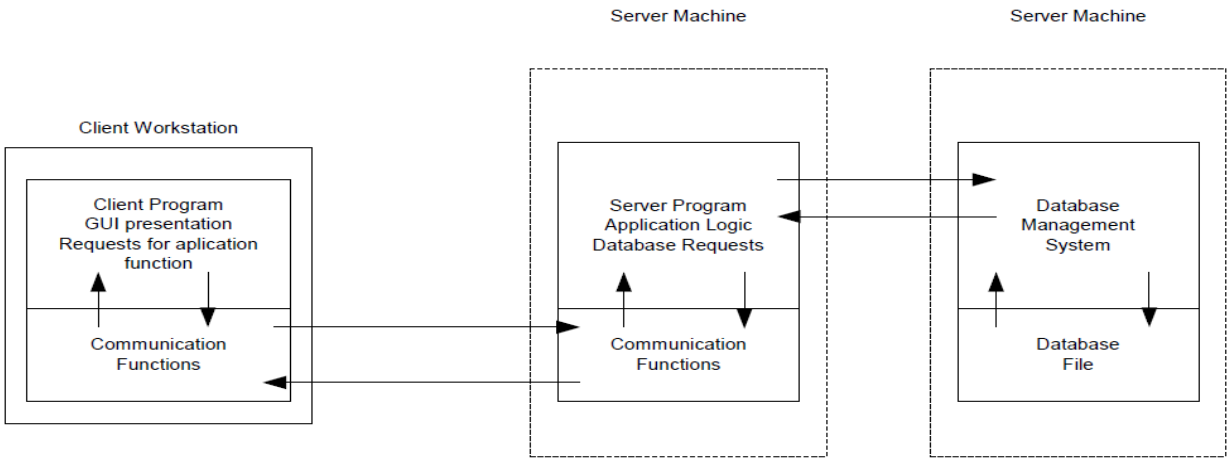
This system is a web-based Information System that uses 3-tiers architecture. Level 1 handle HTTP-request and give the response after the request is processed by web server. Level 2 handle database, directory, mail server, and SNMP (Simple Network Management Protocol) and level 3; the user interface through which users interact with the system

Front end tool

The researcher chose PHP programming language for developing the code. The motivation for choosing this language was the need for a platform independent language that could be used to create software to be embedded in various consumer electronic devices.

Back end tool

MySql is a relational database management system for maintaining the database. This research employed MySQL to formulate the system database because it offers more reliability, data integrity, scalability and high level security for the stored information. It is free open source software, easy to use, fast, and accommodates large amounts of data.



Adapted from: http://channukambalyal.tripod.com/NTierArchitecture.pdf

5.5.2 Operating system platform

Windows 7 was the platform preferred for it has a consistent appearance, command structure, easier to learn and use than the MS-DOS. Users can easily switch among different windows programs and exchange data between them. It also provides a wealth of insult routines that allow the use of menus, dialog boxes, scroll bars and other components of friendly user interface.

5.5.3 Hardware, network and security design

The new system infrastructure designed will use the following hardware and network resources to enhance flexible information flow in support of business goals and objectives. Processor – Intel Pentium IV and above, RAM – 2 GB and above, Hard Disk – 120 GB free space and above, Keyboard – 105 keys, Mouse – Any pointing device and high resolution hp printers. This will enable system users and the new system to capture, process, and store; retrieve data from any connected computers anywhere and allow sharing of network resources.

To ensure security for the OSIC, the following features were included as fundamental measures:

Restricted privileges

A user is only given those powers which are absolutely essential to do his/her work.

Use of password

Each user must have a user name and password to access the system.

Password

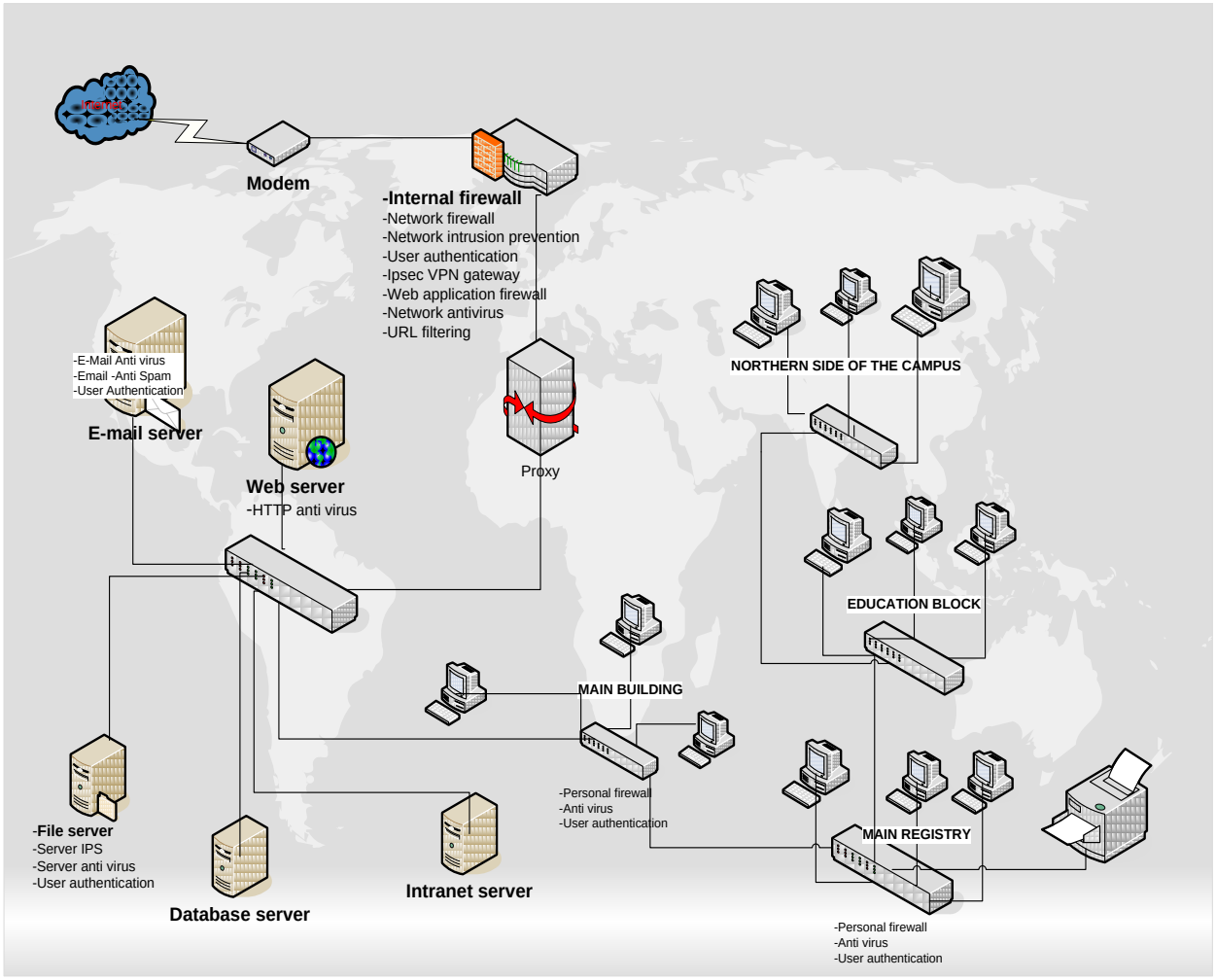
All passwords are encrypted to prohibit any attempts to copy them.

Firewall at network level

This is part o the university network infrastructure. The ICT administrator must ensure that the firewall covers the OSIC server as well to prohibit any intrusion.

The infrastructure below is designed with high security design in mind for the smooth running and operation of the OSIS system.

Figure 38: Network and Security Design



Source: Research findings

5.6 Program design

Pseudo code for accessing the osis system

This presents the instructions in a lay man's language to understand what is going on in section of a database. Shown below is the pseudo code showing the login process and the restriction to the OSIS.

Table 21: Pseudo Code for accessing the OSIS System

```
<?PHP

$LOCAL_COMPUTER =”LOCALHOST”;
$USERNAME=”ROOT”;
$PASSWORD=””;
$DB=”OSIC”;

$connection = mysql_connect($LOCAL_COMPUTER, $USERNAME, $PASSWORD, $DB) or
die('Cannot connect to the database');

If (submit is pressed){

$a=$_POST['username'];
$b = $_POST['password'];

        If($a and $b are empty){
                Redirect to login page;
                }
        Else{
                $sql="select * from osic_user where username = '$a' and password = '$b'";
                $result = mysql_query($sql,$connection) or die(mysql_error());

        $chk_rows = mysql_num_rows($result);

                        if($chk_rows >0){
                                Redirect to required page;
                                }
                                else{
                                Redirect to login page;
                        }
                }
?>
```

5.7 Conclusion

This chapter described the detailed specifications of the system elements of the OSIS, based on the functional, logical, physical, network and program designs. An ER diagram was drawn; data dictionary established from the physical design, as well as the User interface design and report templates. The designs provide inputs for the actual implementation of the OSIS project that follows in the next chapter.

CHAPTER SIX: SYSTEM IMPLEMENTATION

6.1 Introduction

Following the models designed in the previous chapters (four and five), the researcher was able to implement the actual system that the user interacts with. This chapter describes how the OSIS was deployed, tested, installed and converted into a working and reliable system and documenting work that has been implemented to provide a self help for the intended stake holders. It includes the overall implementation plan, the outputs (screenshots) of the system design, code used to produce the system and the user guide. The system was tested basing on the objectives and functionality requirements prior set and the lines below explain how the project was implemented.

6.2 Implementation plan

Table 22: Implementation Plan for the OSIS

ACTIVITY	DELIVERABLES	TOOLS
Coding	- Implement components of system design - Connect the user interfaces to the database	PHP, MySQL, Macromedia Dreamweaver 8.0 and Paint
Testing	**Implement the test plan** - Review of code for error correction - System review - Security testing, authentication	PHP, MySQL, Macromedia Dreamweaver 8.0, Ms Word
Installation plan	**Hardware installation** - Installing new hardware & upgrading others - Backup and Recovery plan **Software installation** - Installation of Dreamweaver version 8.0 - Installation of PHP version 5.2.5 and MySQL version 5.0.45 - Installation of WampServer 2.0 - Installation documentation (Procedures)	Network Servers, Installation CDs, Ms Word, PHP scripts for migration, Hard drives
Documentation Training plan	- System documentation and key features -Technical reference guide -User manual	Ms Word Powerpoint Ms Word and PDF CDs

Support plan	- Online help, email, phone	Email, phone, web services
Security plan	- Authentication and Authorization - Firewall	Login particulars
Change management plan	-New additional role -New business processes - Data migration procedures -Implementing changes	Procedures MS Word
Evaluation plan	- New features to be added to the system - Documentation of system successes and failures - Final report	MS Visio Ms Word

Source: Primary data

6.3 Coding

At this point, the physical design specifications and models designed earlier were converted into working computer code.

6.3.1 Database implementation

MYSQL DBMS was used to create the osic database. To ensure reduction in redundancy and improve data integrity, tables were normalized by use of "Primary keys" to uniquely identify each entry in the database and the "foreign key" to show the relationships by linking different tables. The implementation of the database was based on the entity relationship diagram (figure 28) created in the design phase. In order to test the integrity of the database design, attempts were made to enter erroneous data into the database to ensure that the correct data types were recognized.

6.3.2 Implementing the user interfaces

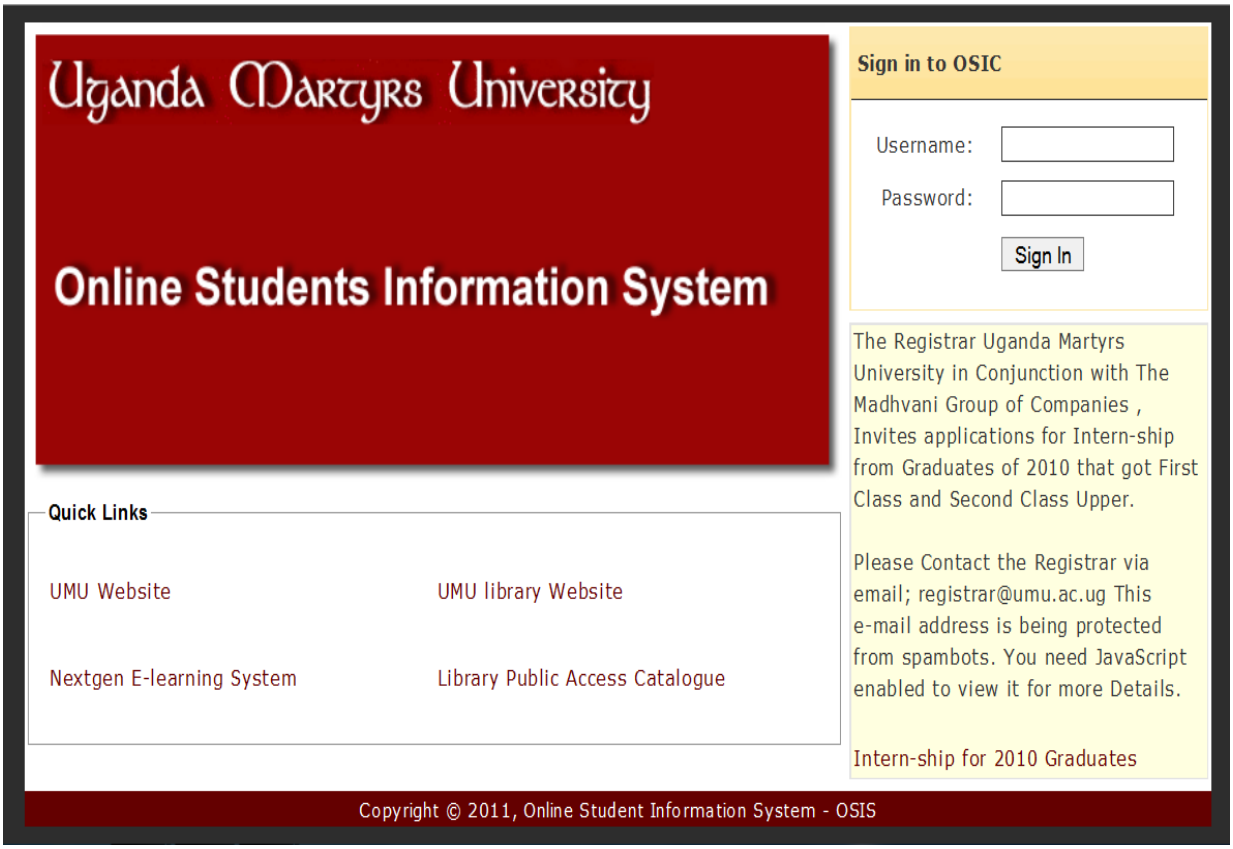
PHP was used in developing the user interface and building the logic to connect the interface to the database. Macromedia Dreamweaver version 8.0 a web page program editor was used for coding and de-bugging PHP. PHP was used to build the front end and build logic in the business

layer to connect to the backend, Cascading Style Sheets (CSS) for styling up the interfaces and making them more presentable.

index.php

This script is the home page of the OSIS. Running the index.php (http://localhost/osic/index.php) automatically starts up the home page as shown below.

Figure 39: OSIS Home Page Interface

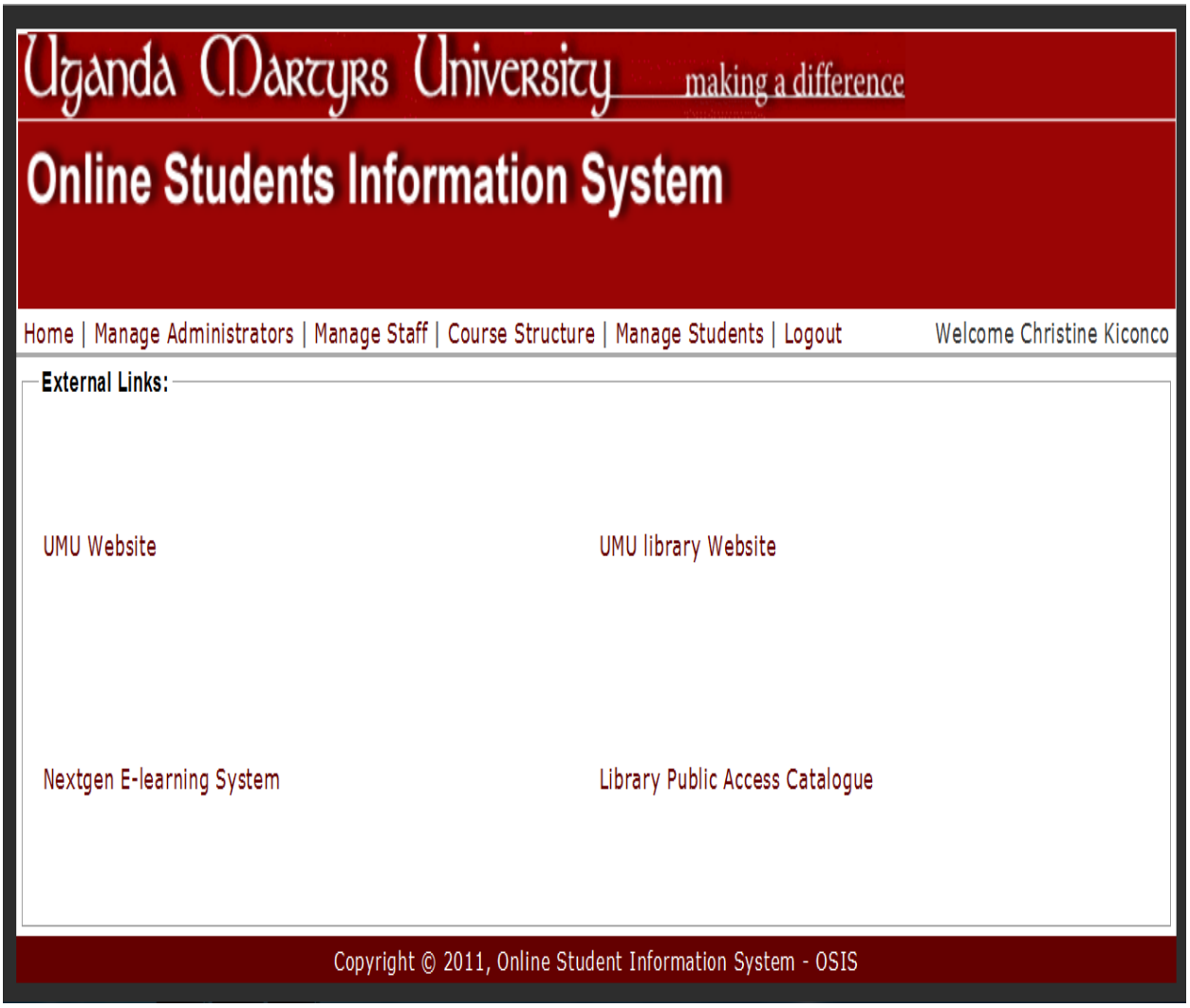


Source: Research outcome

localhost/osic/home.php

This script opens the system administrator control panel.

Figure 40: System Administrator Control Panel

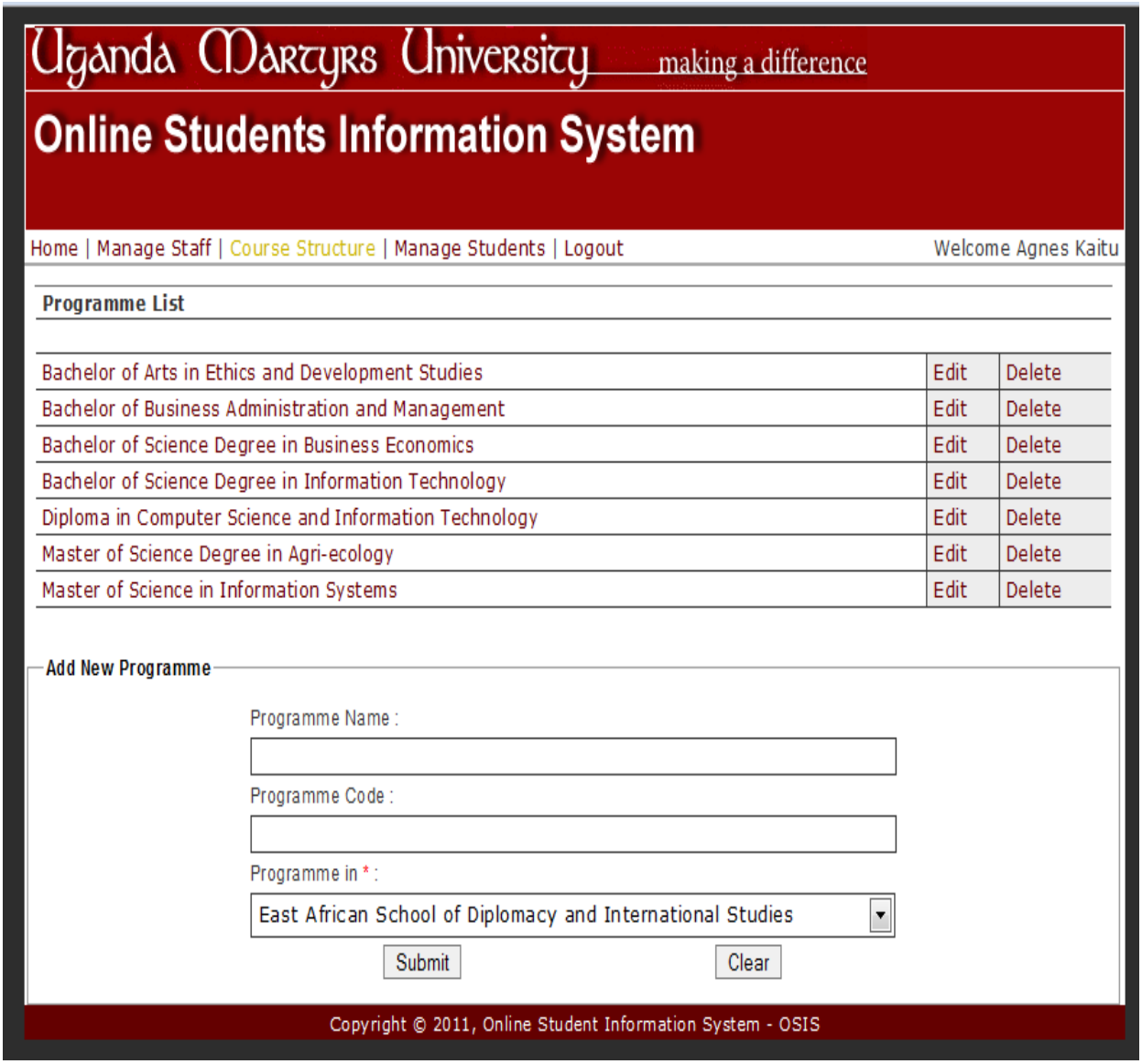


Source: Research outcome

osic/course_structure.php

This script is used to lay out the program and course structure in the system. Logically, a course cannot be registered without an existing program under which this course belongs. This script makes it possible for the administrator is able to register new programs and courses as shown in the two figures below.

Figure 41: Program Registration Interface

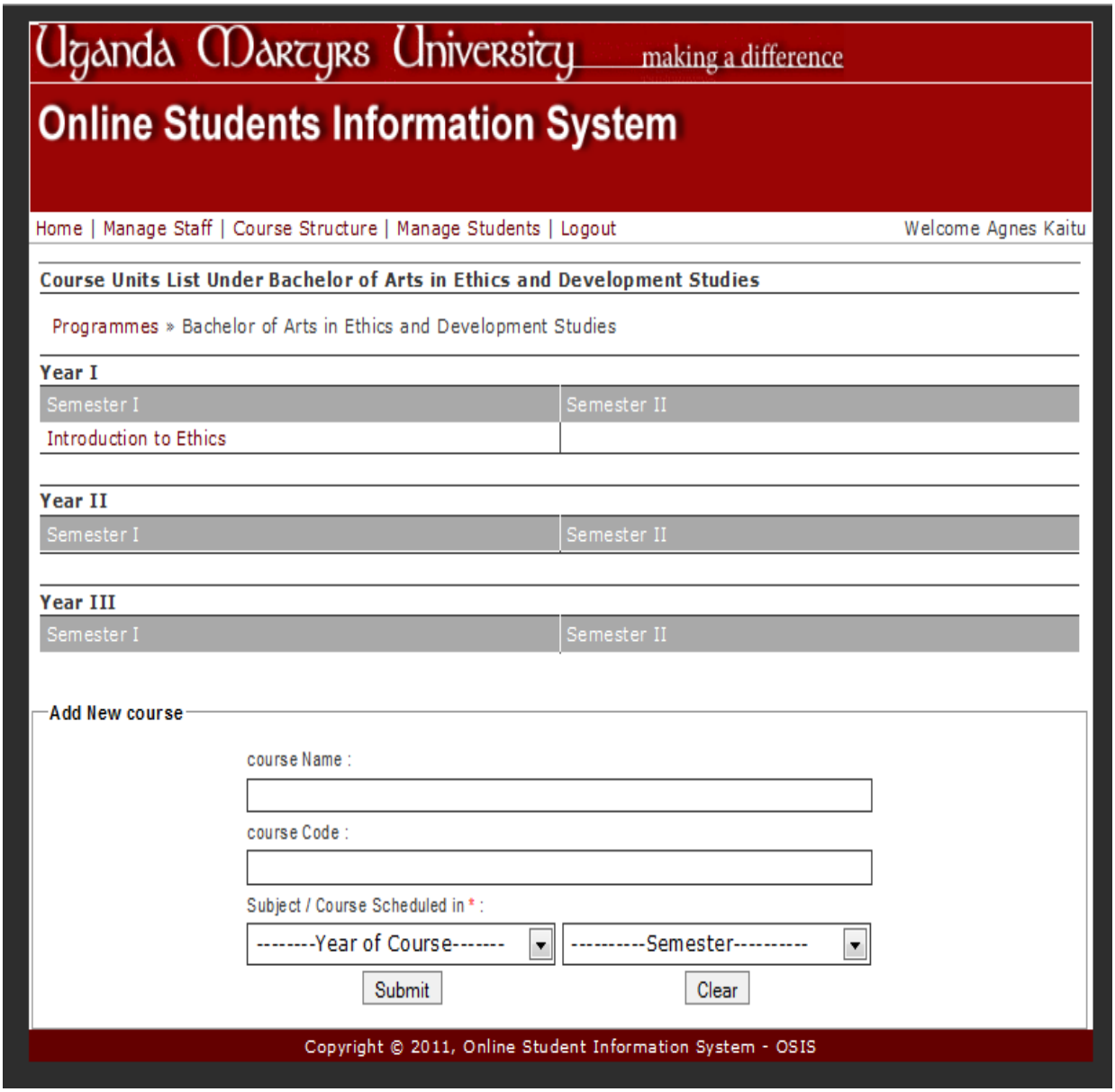


Source: Research outcome

Course registration

To add a new course, there must be an existing program under which that course is to be registered. The system allows the administrator to enter new courses as shown in the figure below.

Figure 42: Course Registration Interface

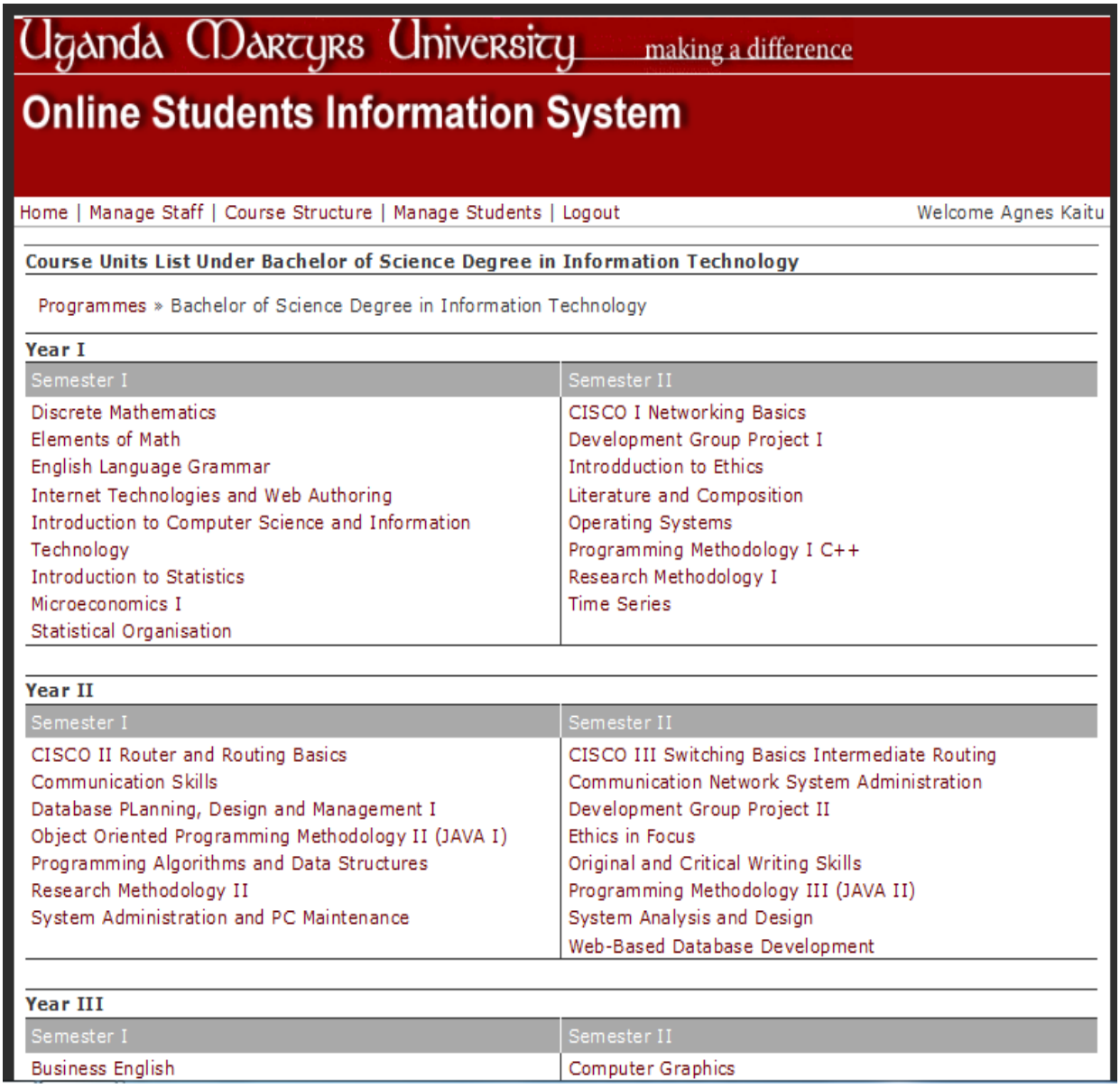


Source: Research outcome

View courses interface

Under each program are courses offered and to view them, the link "course structure" is clicked to take the user to the program list. When a user clicks on a program of his/her interest, a list of courses under that program is displayed as shown in the figure below.

Figure 43: Interface for Viewing Registered Courses Under each Program



Source: Research outcome

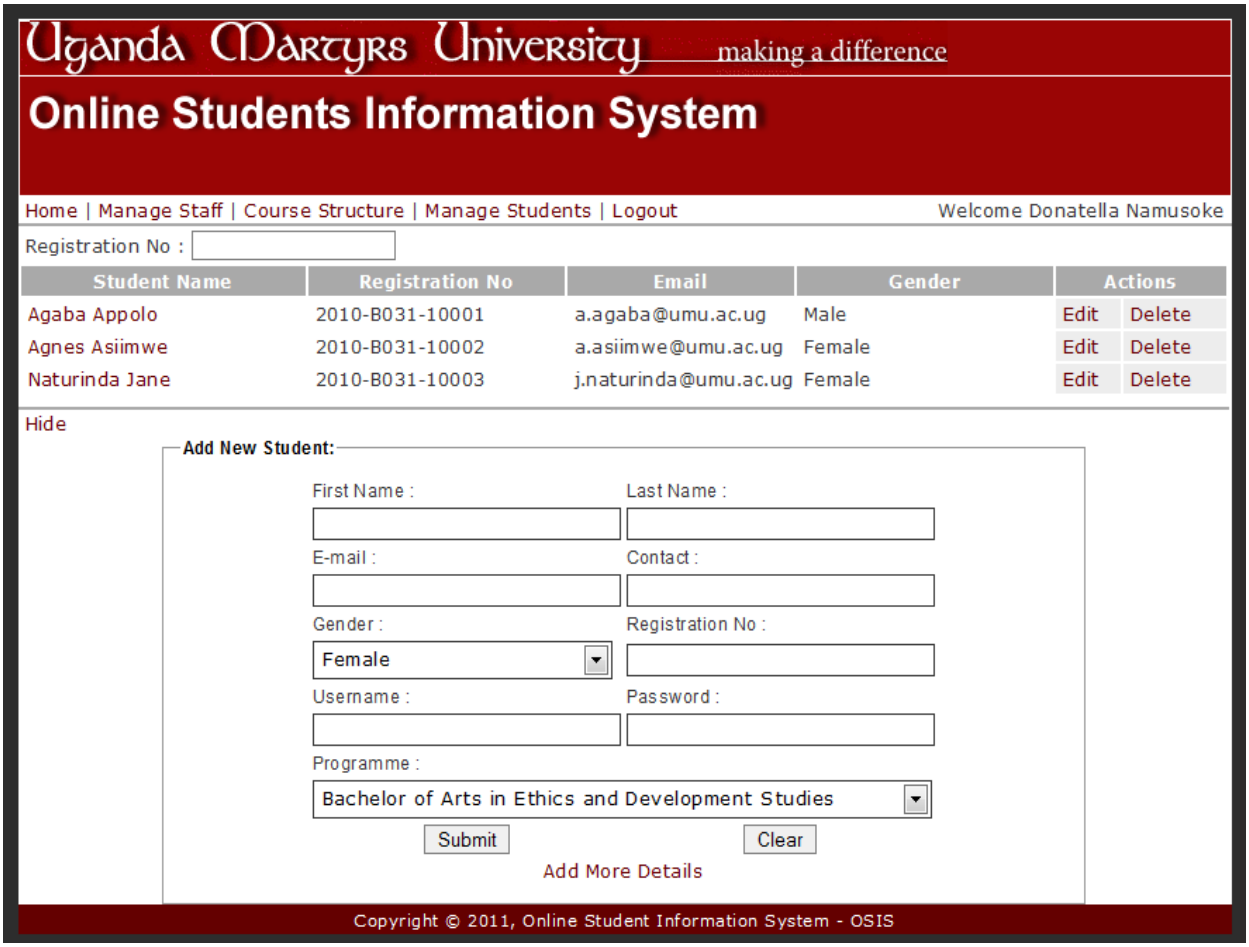
osic/manage_std.php

This script is used to structure the student module. It formats the look of the fields in which student attributes will be input and links this structure to the other functions that execute the queries to the student table in the database. Functions implemented under this include the following:

Student registration interface

The system can only allow the administrator to register/add a new student if he/she is to be attached to an existing program. This means that a student enrolls into a program that is offered at UMU and registered into the system.

Figure 44: Student Registration Interface

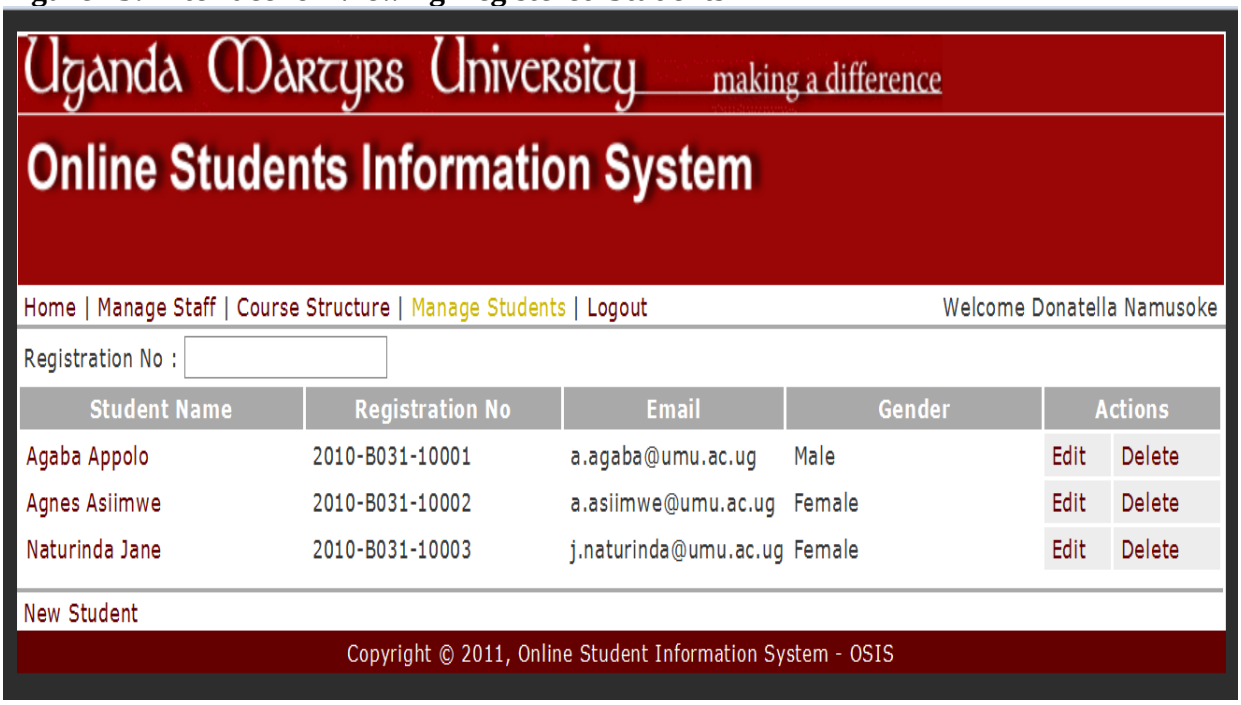


Source: Research outcome

Student registration report

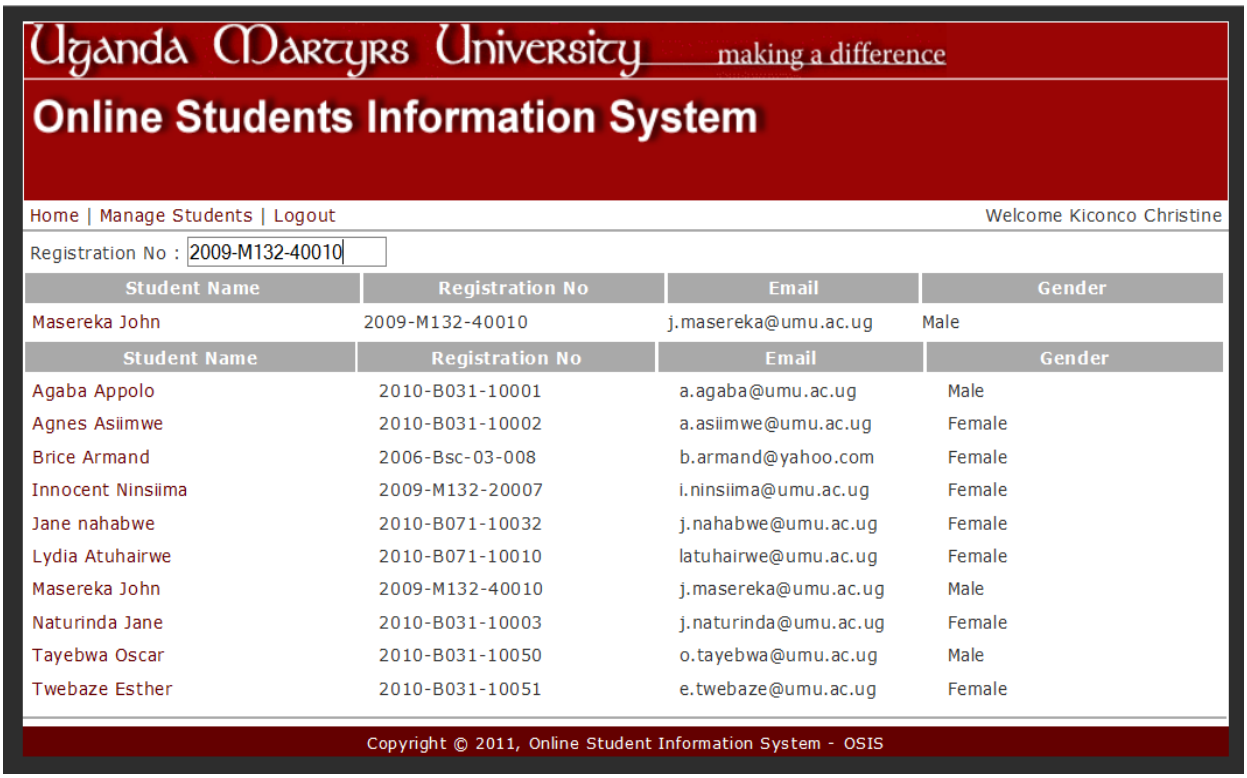
When the administrator clicks on the link "MANAGE STUDENTS", the list of registered students is displayed. An administrator can add a new student, edit a student's profile and/or delete student record as appropriate.

Figure 45: Interface for Viewing Registered Students



Source: Research outcome

Figure 46: Implementing the search functionality

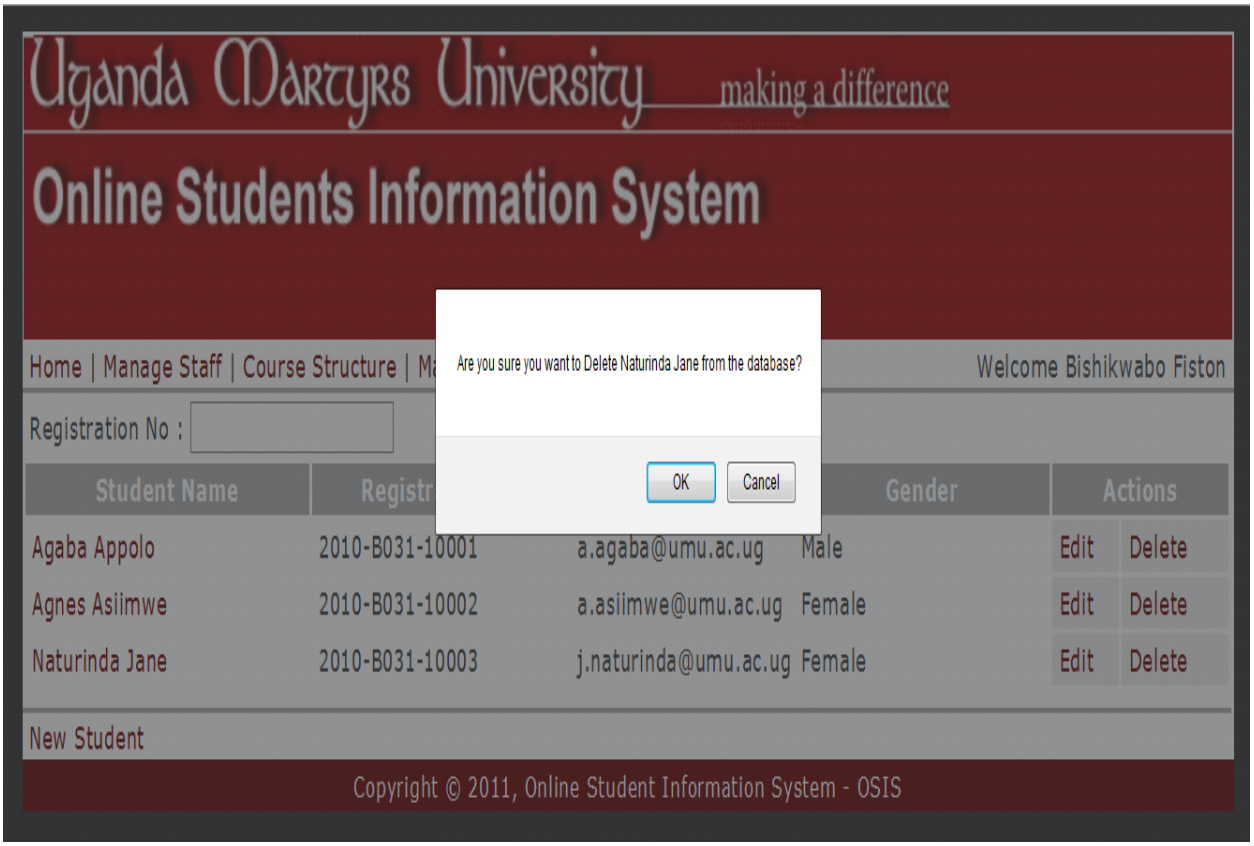


Source: Research outcome

Deleting a student profile

To delete a student, the administrator clicks the "**DELETE**" button corresponding to the student's name. This allows that particular student to be deleted from the system as shown below.

Figure 47: Deleting a student record



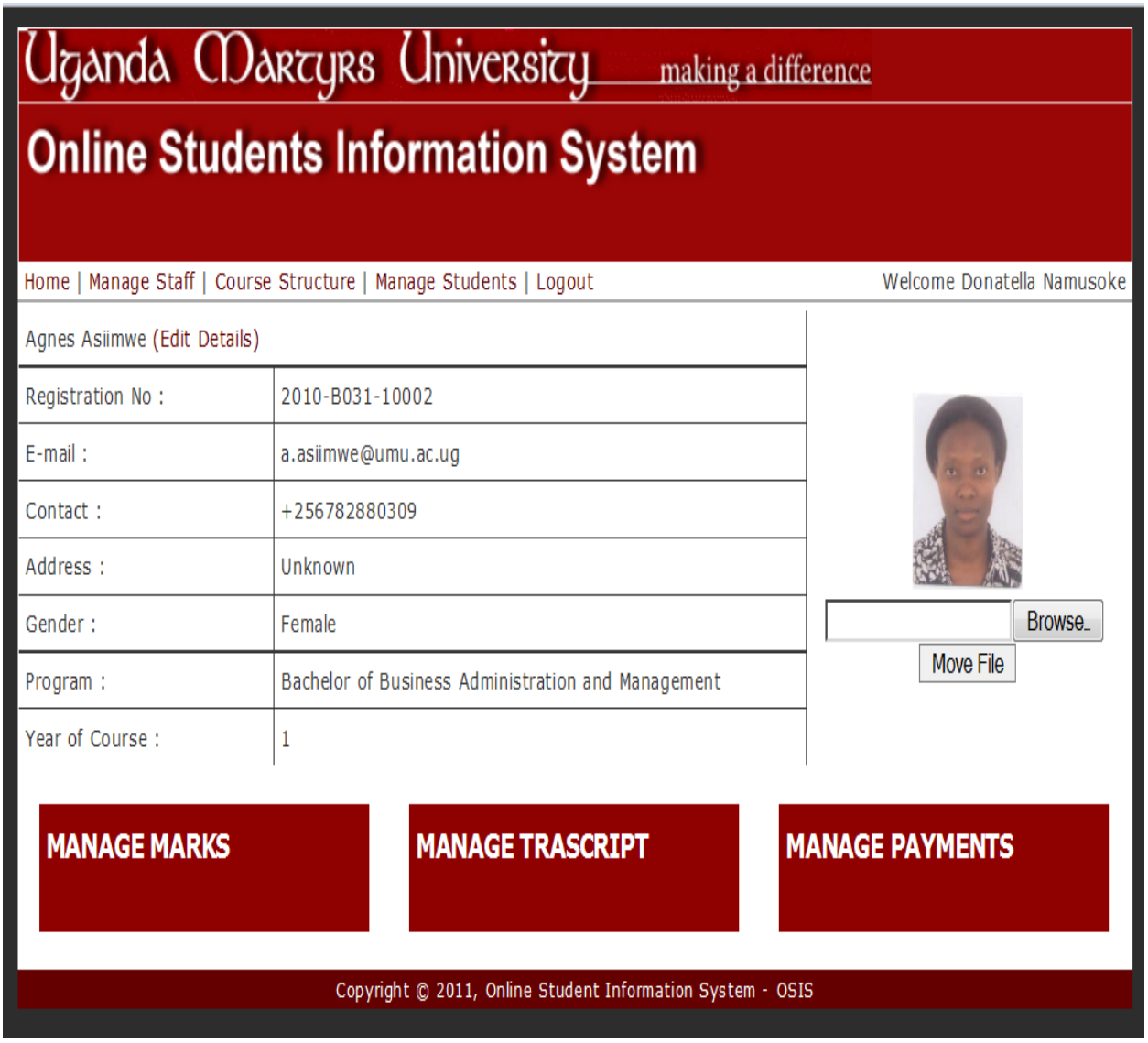
Source: Research outcome

6.3.3 Implementing the interface for managing student record

Administrator's student records management interface

This interface allows the administrator to manage student's records. He /she can manage students' results and transcript. He/she only has the privilege to view payment details for students belonging to his/her faculty to help in clearance and issuing of examination cards.

Figure 48: Administrator's Student Records Management Interface



Source: Research outcome

Lecturer's interface for managing marks

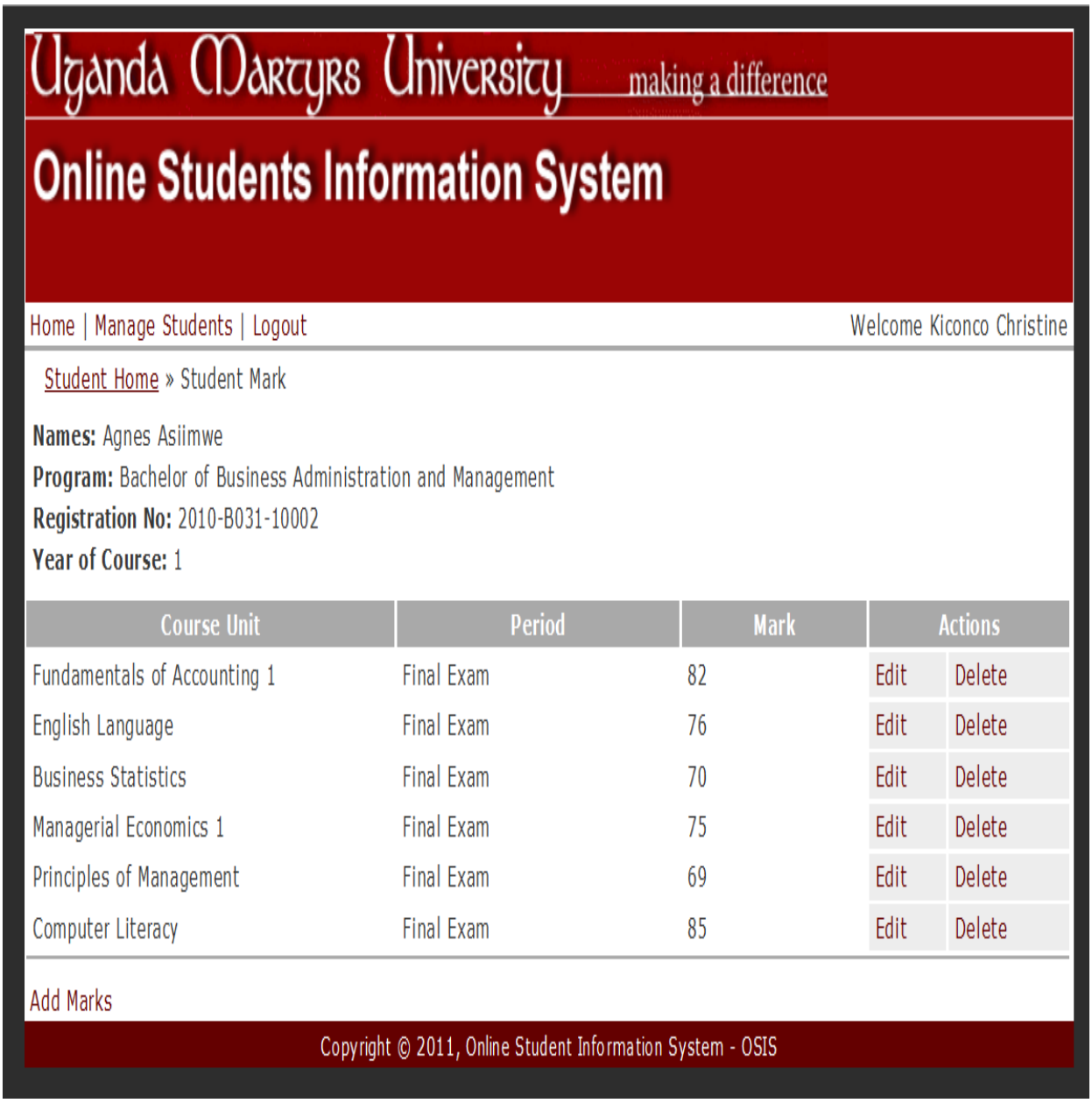
A lecturer only has access rights to the examination marks management module. He/she once successfully logged in, can enter, edit and/or delete examination marks as appropriate. However, these do not automatically go to the transcript template which is only accessible by the administrators. This is intended to maintain integrity of the students' results and grades through differing user roles in the management of student academic grades.

Figure 49: Manage Student Marks Interface

Source: Research outcome

When a lecturer clicks on "Manage marks", he/she can enter student marks into the system, view, edit and/or delete student's marks belonging to his/her department as showed in the figure below.

Figure 50: Results Management Interface

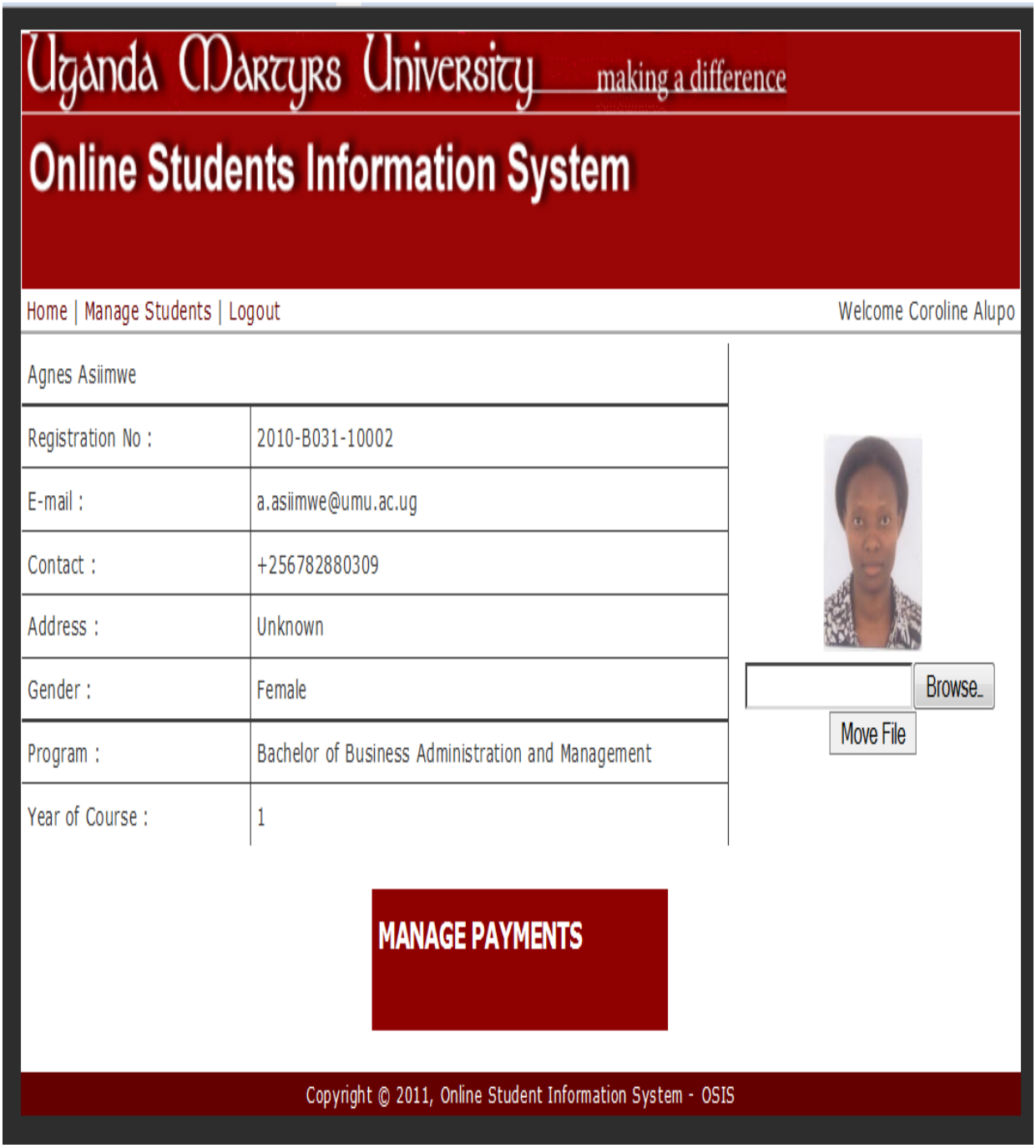


Source: Research outcome

Accountant's interface for managing payment details

The system has provision for entering payment details for various kinds of fees paid at the university including registration fee, academic (tuition), supplementary, examination, special exam and graduation fee. On clicking on "Manage payments", the accountant can enter payment details in the system, edit and/or delete as required.

Figure 51: Manage Payments Interface

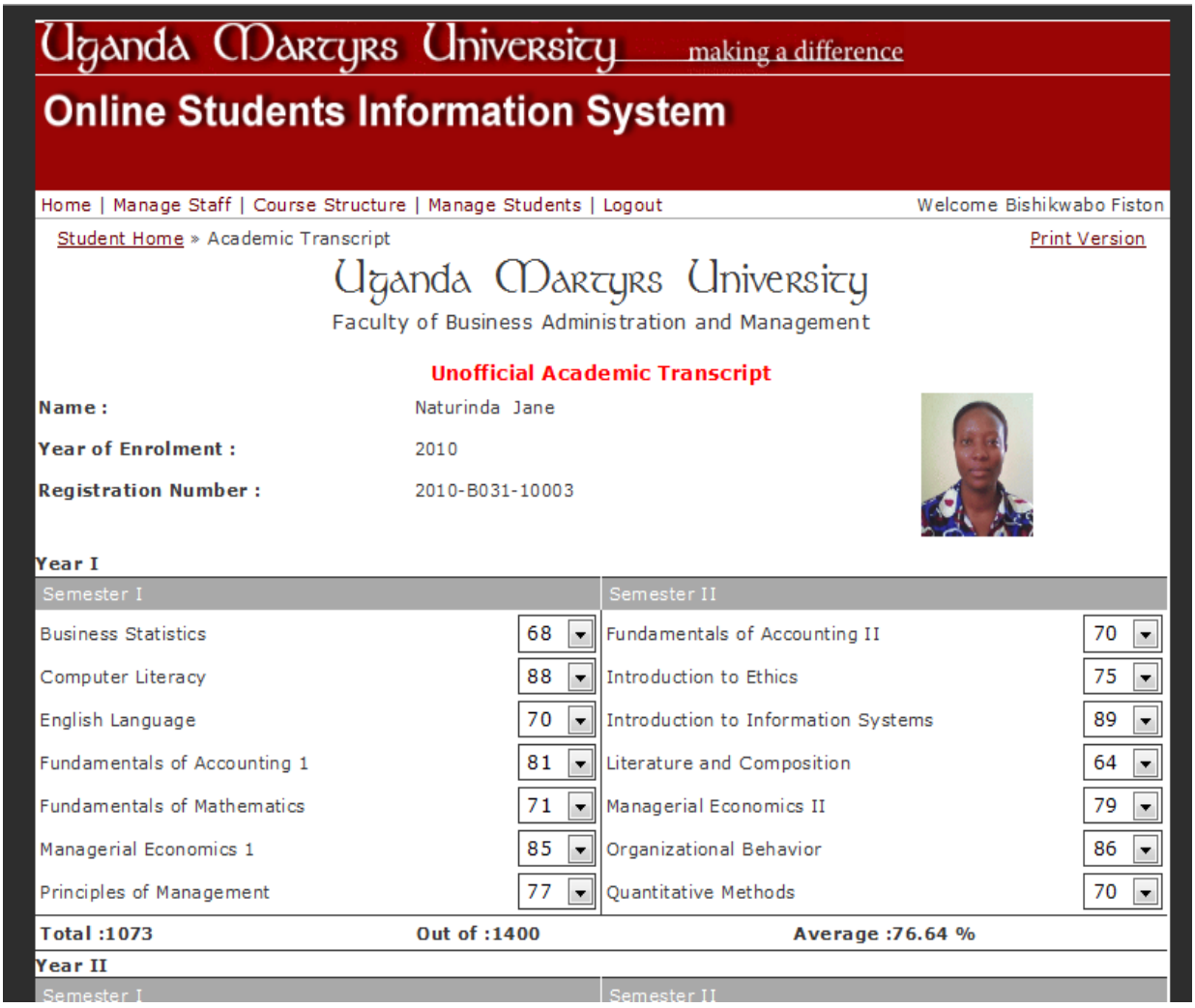


Source: Research outcome

Managing transcript

When the administrator clicks on "manage transcript", he/she can enter student final total results for each course into the transcript template for final print out as showed in the figure below.

Figure 52: Transcript Management Interface



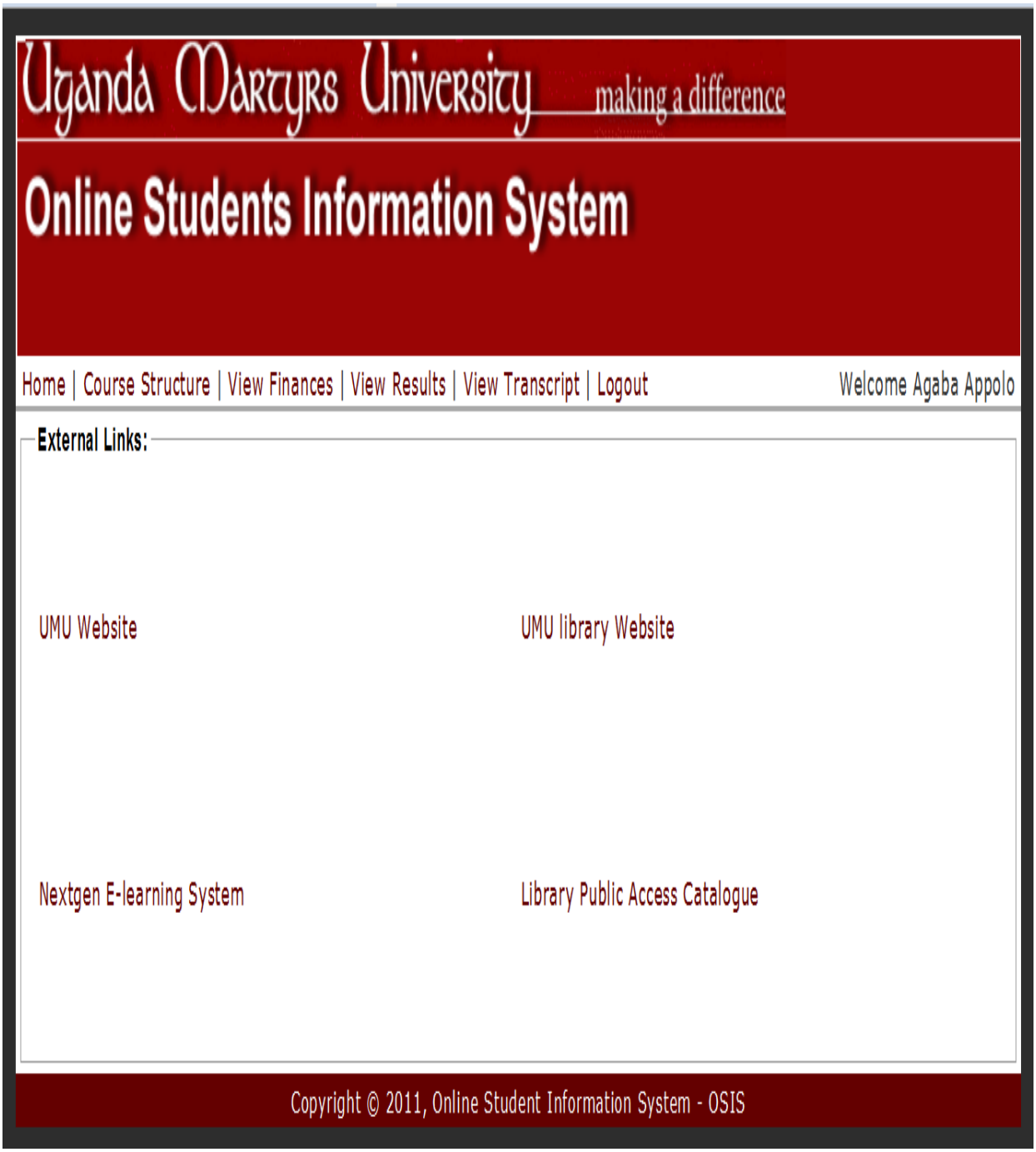
Source: Research outcome

Following the main objective of the study, the researcher's next step was to implement the interface that enables the student to interact with the system. Below is a description of the implemented student interface.

6.3.4 Implementing the student interface

Below is a student interface on login. In this module, a student can view his/her examination results, payment statement, transcript and programs and courses.

Figure 53: Student Home Page

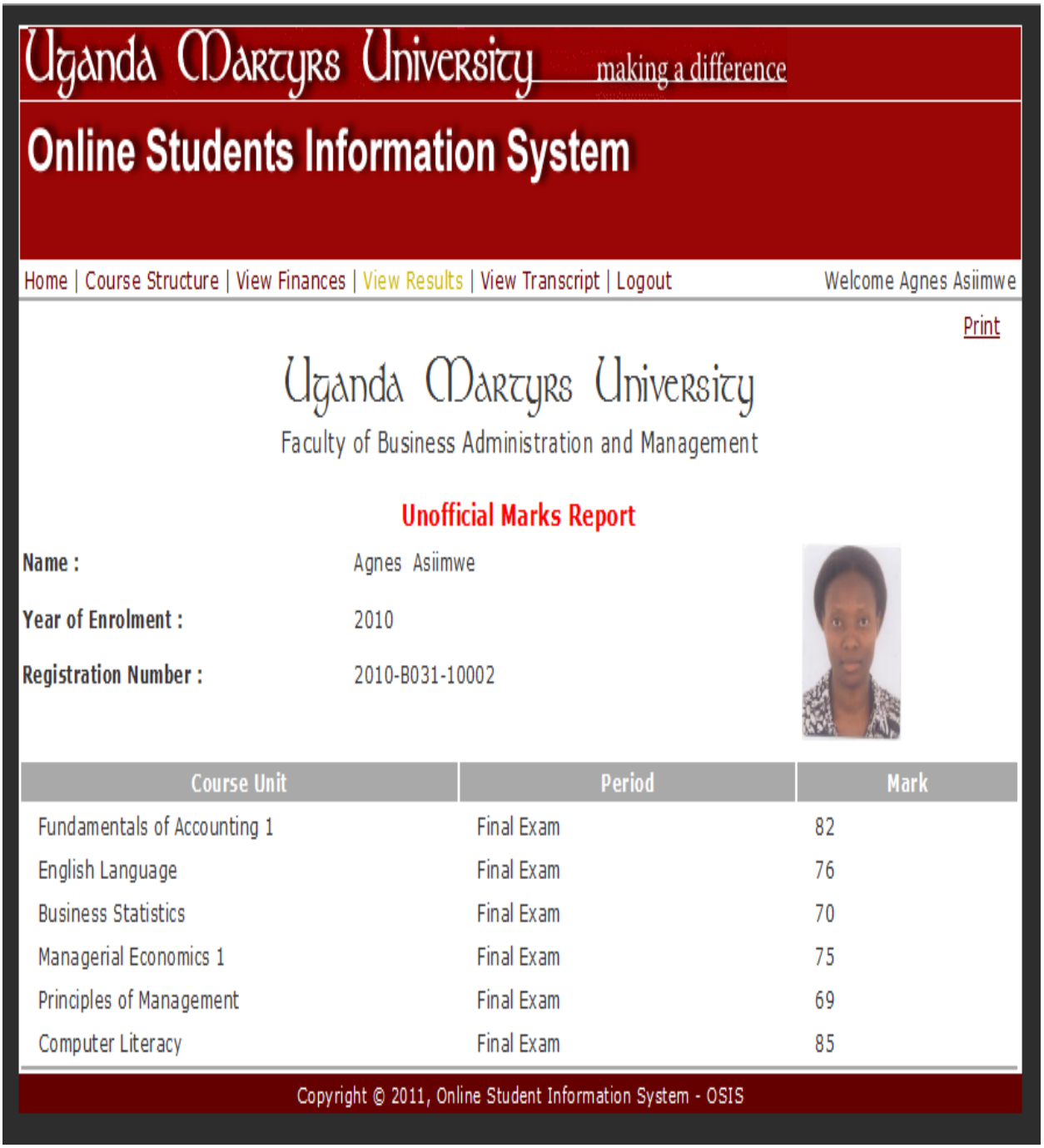


Source: Research outcome

Results report

Upon valid login, the system allows a student to access, view and/or print his/her examination results report as shown in the figure below.

Figure 54: Student Results Report



Source: Research outcome

Financial payment report

Upon valid login, when the student clicks on "View finances", the system allows him/her to view and/or print his/her financial payment statement as shown in the figure below.

Figure 55: Fees Payment Status Report

Source: Research outcome

Transcript report

At the end of academic program, a student is able to access the transcript module to view and/or print his/her unofficial transcript online without having to move to the University as shown in the figure below.

Figure 56: Transcript Report

Uganda Martyrs University making a difference

Online Students Information System

Home | Course Structure | View Finances | View Results | View Transcript | Logout Welcome Naturinda Jane

Print

Uganda Martyrs University

Faculty of Business Administration and Management

Unofficial Academic Transcript

Name : Naturinda Jane

Year of Enrolment : 2010

Registration Number : 2010-B031-10003

Year I

Semester I		Semester II	
Business Statistics	68	Fundamentals of Accounting II	70
Computer Literacy	88	Introduction to Ethics	75
English Language	70	Introduction to Information Systems	89
Fundamentals of Accounting 1	81	Literature and Composition	64
Fundamentals of Mathematics	71	Managerial Economics II	79
Managerial Economics 1	85	Organizational Behavior	86
Principles of Management	77	Quantitative Methods	70

Total :1073 **Out of :1400** **Average :76.64 %**

Year II

Source: Research outcome

After implementing the database and user interfaces; the next step was to test and validate the system to ensure that the predetermined requirement specifications were being met.

6.4 Testing

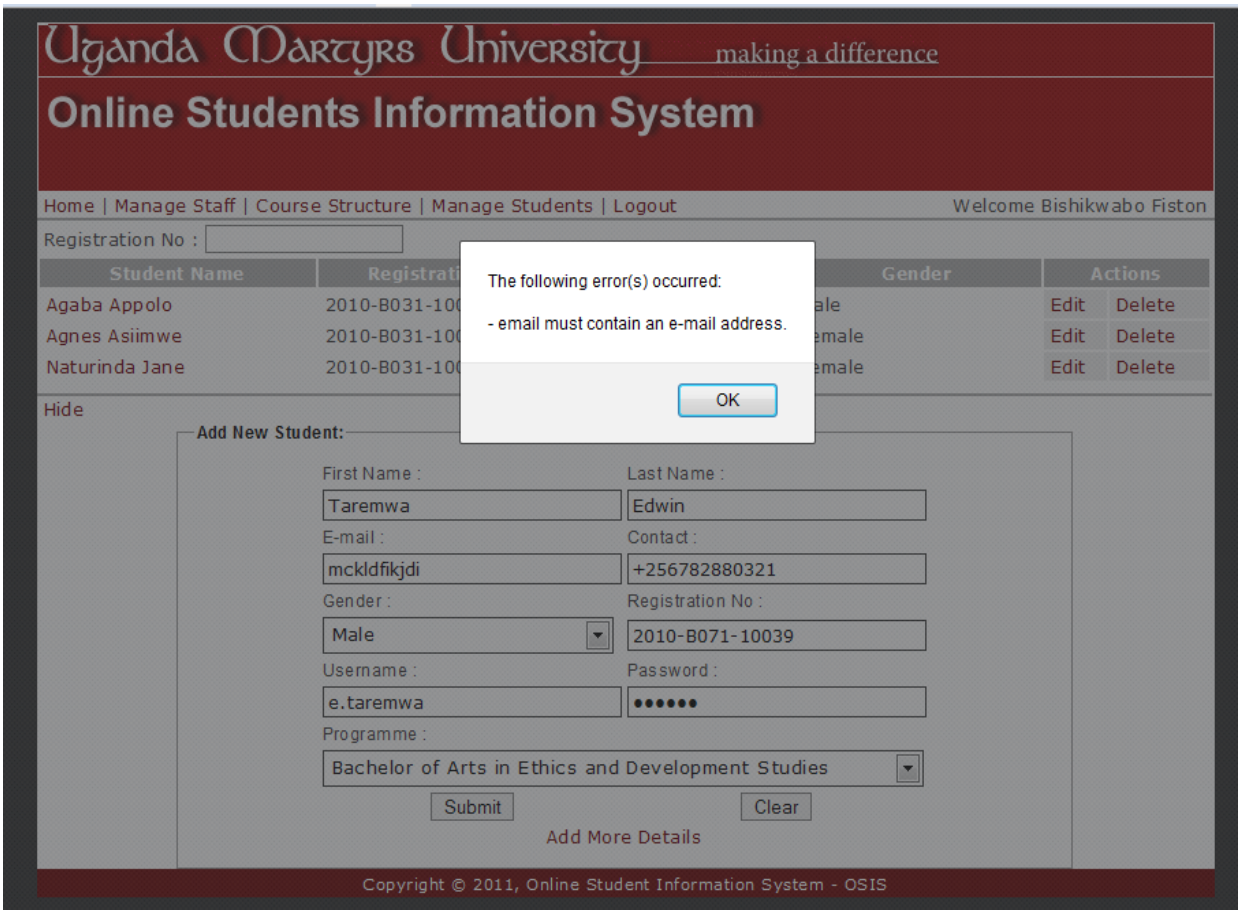
As prior specified in chapter three, this section shows how the system was tested basing on the preset functionality to ensure that the system was working according to the specifications and

that the objectives for which the project was undertaken were being met. The testing process involved testing validity of the results in relation to input data, authentication, performance and code for any errors. Below are some of the tests carried on the OSIS prototype.

6.4.1 Validation

The system was implemented to accept certain values that had been preset. Each text field is preset to accept specific values and if wrong values are input, the error message window pops-up rejecting the input values. In the figure below, the email address text field does NOT accept values missing the "@" and "." characters.

Figure 57: Validation of Input Data in the OSIS

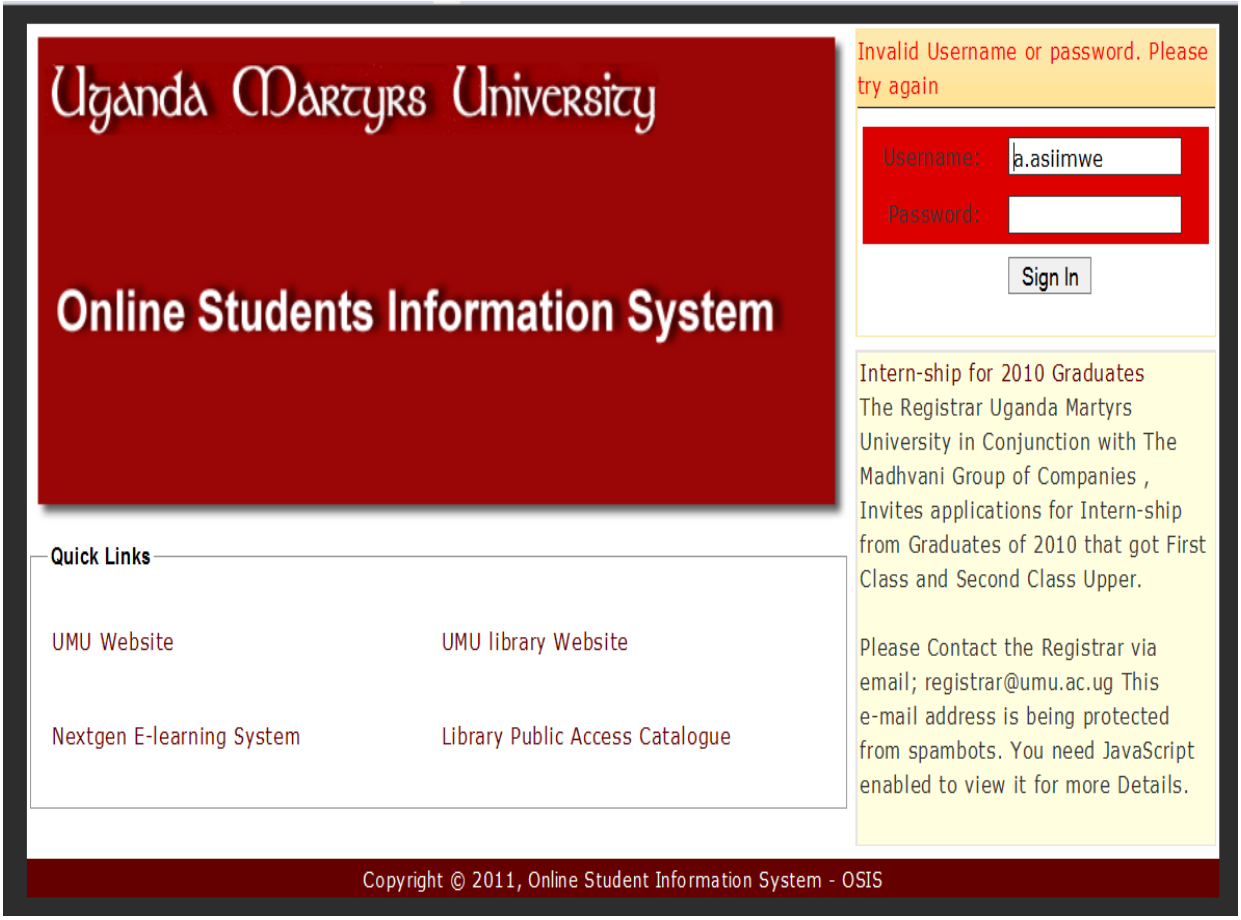


Source: Research outcome

6.4.2 Authentication

When a user logins in with wrong login in particulars, the login fails with a message “invalid username or password” and takes the user back to the login page. If the login has failed, the login box screen turns “RED” as shown in the figure below.

Figure 58: Authentication Interface



Source: Research outcome

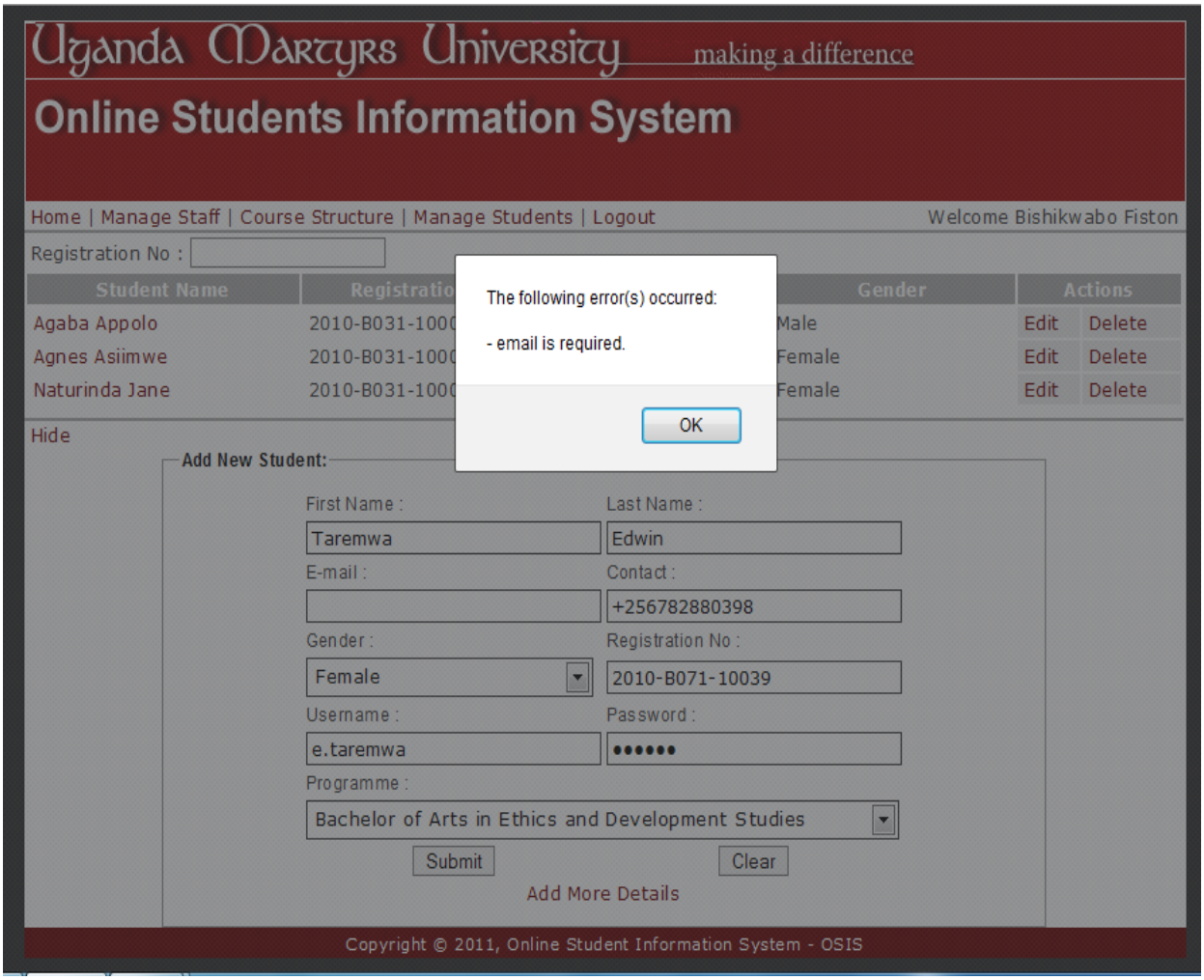
6.4.3 Unit testing

This was done to test implemented functionality against the pre-set required functionality. The bottom up testing was performed on each module to effect a print verification of the actions performed and each module was tested against the required functionality.

Completeness

Completeness was tested to verify that system produces complete results. When registering users, all the mandatory fields must be filled in; otherwise an error message window pops-up as shown in the screenshot below.

Figure 59: Incomplete Registration Test Result

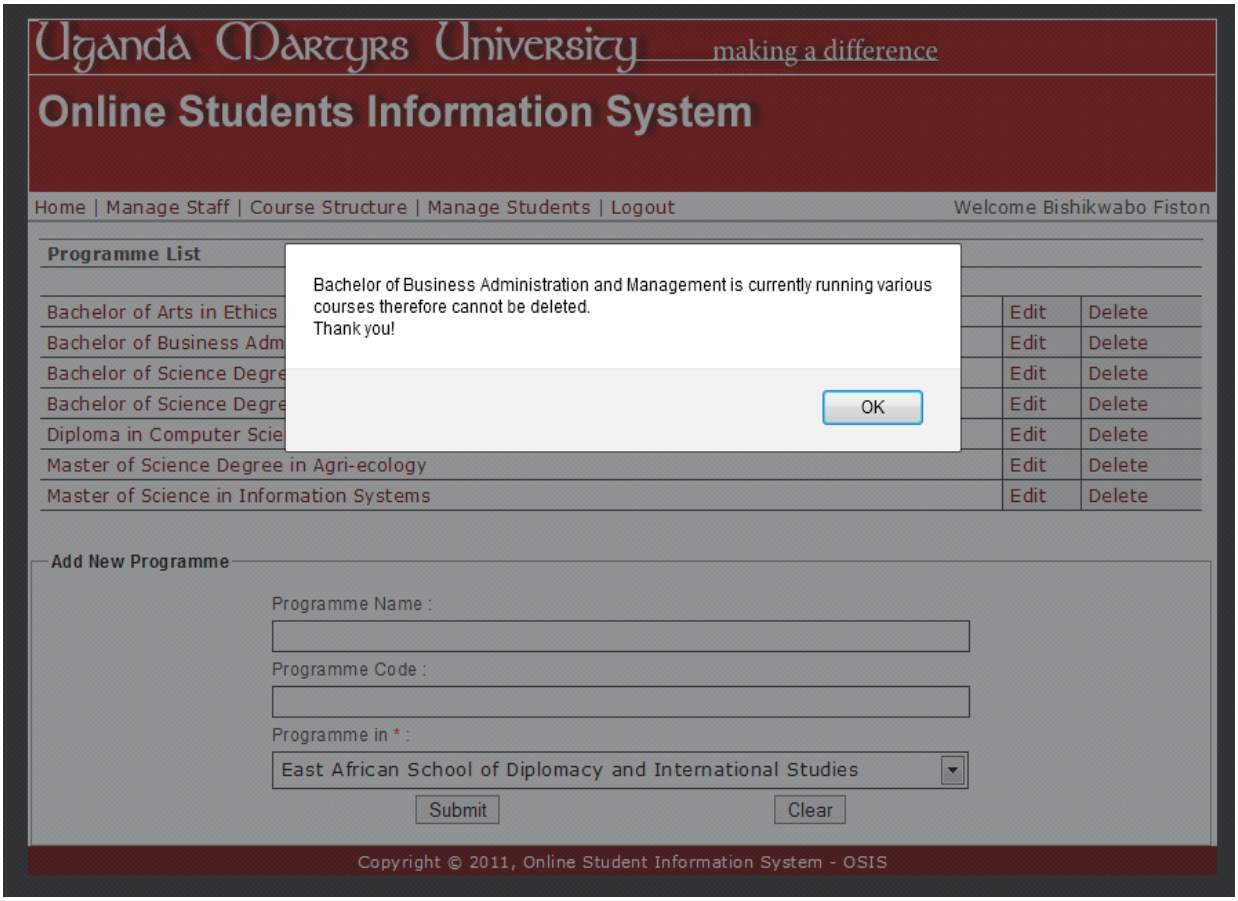


Source: Research outcome

Reliability

The system allows the administrator to delete a program **only** if it has no courses registered under it.

Figure 60: System Restrictions Testing Result



Source: Research outcome

Test results were logged in table form to see if the pre-set system functionality requirements were met basing on the access levels predetermined. The users of the system include; system administrator, faculty administrators, lecturers, accounts staff and students.

- A student only has the privilege to view and print his/her record.
- A lecturer only manages results.
- Accountant only manages payment details.
- Faculty administrator manages his/her faculty's student records. Can view and manage programs and courses, lecturers, accounts staff, student profile, results and transcript on behalf of the registry. Below is the test log.

Table 23: System Testing Log

Role	Systems administrator	Faculty admin	Lecturer	Accountant	Student
Login / Logout	YES	YES	YES	YES	YES
Add and manage users	YES	YES	NO	NO	NO
Manage programs/courses	YES	YES	NO	NO	NO
Manage student results	YES	YES	YES	NO	NO
Manage student payment	YES	NO	NO	YES	NO
View student payment details	YES	YES	NO	YES	YES
View student results	YES	YES	YES	NO	YES
Run and manage reports	YES	YES	YES	YES	NO

Source: Research findings

After the testing phase, the next step is to install the system in order to begin operations. Below is the installation process for the OSIS.

6.5 Installation planning

Hardware

Based on the design made earlier, upgrading of computers will be required, network printers, UPS units, backup utilities, high speed internet connectivity, firewall system to block unwanted programs or access, Application and database Servers need for host the OSIC database need to be installed.

Software

To have the OSIS up and running, the following software that will be needed; Windows 7 and higher as the Operating System, Mozilla Firefox version 3.5 and Microsoft Internet Explorer

version 5.5 and above as web browsers, Microsoft Office suite, MYSQL Server version 5.0.45 and higher, PHP 5.2.5 and higher, Dreamweaver 8.0 and Apache 2.0 for Windows.

Table 24: Installing wampserver

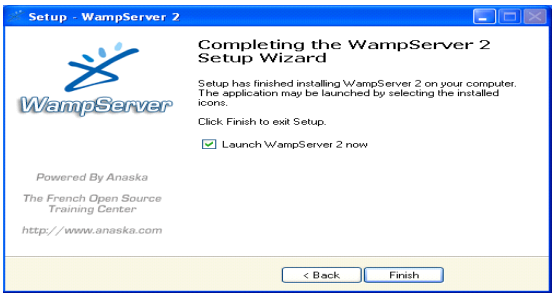
Installing wampserver
The latest version of WAMP 2.0 can be downloaded from this link http://www.wampserver.com/en/download.php. And the installation to your local computer follows these steps as listed below: 1. Locate the downloaded setup file and double-click on it. You will be prompted with an alert window warning you not to upgrade from WAMP5 1.x. Click on Yes to continue. 2. The Welcome setup window will load. Click on Next to proceed. 3. On the License Agreement screen select the radio button for I accept the agreement then click on Next. 4. The Select Destination Location screen will load. Change the default location (c:\wamp) if you desire then click on Next. 5. Then the Select Additional Tasks screen is loaded. Select the checkboxes for any icons you want installing then click on Next. 6. You will be prompted with the Ready to Install screen. Review the settings and use the Back button to go back and change any of the settings. If the settings are correct, click on Install to install WAMP 2.0 7. If you have Mozilla Firefox installed on your computer, you may be prompted with the window that prompts whether you want FireFox to be your default browser, so select the appropriate choice. 8. The PHP mail parameters screen will load. Review the default settings (SMTP: localhost, EMAIL: you@yourdomain) and change accordingly then click on Next. The default values can generally be used when installing WAMP 2.o to a local computer. 9. The final screen to load is the installation completed screen. Click on Finish to close the window and start WAMP. 

Table 25: Installing Dreamweaver Macromedia 8.0

Installing Dreamweaver Macromedia 8.0
1. Initiate the ColdFusion installer from the CD or download the free developer edition from **http://www.macromedia.com/coldfusion**. After a few moments, the installation begins.
2. Select your language, read through the information, and click Next twice to proceed through the Introduction and License agreement sections. These sections both contain important information, so don't just skip them.
3. In the Install Type screen, you are prompted to enter your serial number. If you do not have one, check the Developer Edition check box and click Next.
4. In the Install Configuration screen, leave the default at Server configuration. Click Next. The other two options are for configuring a ColdFusion server to run on top of a J2EE server.
5. Click Next again in the Sub-component Installation screen, leaving the three boxes checked.
6. Accept the default and click Next in the Choose Install Directory screen. This screen enables you to specify where the ColdFusion application files are installed.
7. In the Web Server Selection screen, choose Built-In Web Server (if you are not running a Web server), or (if you are running a Web server) choose Configure Web server connector for ColdFusion MX and verify that your server is listed in the Web Servers/Sites box. Your choice here ultimately affects the URL you use to view ColdFusion pages, which is important when configuring Dreamweaver later in the lesson.
8. Continue to finish the wizard

Running the OSIS Project

Once WAMP and Dreamweaver Macromedia 8.0 are installed on your computer, you have PHP and MYSQL. Follow the steps below to run the OSIS project:

Table 26: Running the OSIS Project

Running the OSIS Project
1. Ensure that you have wamp installed on your computer.
2. Copy the folder containing the project (osic) and paste it in the folder named www found in wamp. The wamp folder is on drive C:\ however, this may vary depending on your personal specifications preset.
3. In the folder osic is a sub-folder names sql. Open the .sql script that is in there. This file normally has

the same name as the project and for this project it is osic; the database reconstruction script. Select and copy all the information that is in that file. Open the MySQL server through the browser by typing the url: http://localhost/phpmyadmin

4. Click SQL on the menu and paste the information that was copied from the database reconstruction script, run it and the database will be created.
5. Start the browser and type the url: http://localhost/osic
6. The default access details of the system administrator are:
   Username: admin
   Password: yahoo

Source: Research outcome

6.6 Training plan

Training will be implemented after the system has been installed and the documentation is in place for the users. The training targets system administrators on how to install, configure, migrate and maintain the new system. Once the system is fully implemented and launched, system users in the registry, all departments and students will be trained on how to use the OSIS. Trainers will use PowerPoint presentations to train users on how to use the system. User manuals will be posted on the university website in pdf, also to the student email for self help. Adequate training must be given before authorized users are allowed to use the system in a production environment. The developed training plan below will aid in carrying out the training exercise.

Table 27: Training Plan

ACTIVITY	TRAINEE	ASPECT COVERED	TOOL
Training	All system users (Registry staff, faculty administrators, lecturers, accountants and students	Use of the OSIS	Projector, MS Power Point
	ICT administrator (systems)	System management	CD-ROMs, Adobe files
	ICT administrator (systems)	System installation and Trouble shooting	CD-ROMs, Hard drives

	ICT administrator (systems)	Backup and recovery	CD-ROMS, Hard drives
	Training methods		
		Online tutorials, training manuals	CD-ROMs, Online

Source: Primary data

6.7 Support plan

Support is extremely important to users as it has been proven to be a number one criterion contributing to user satisfaction. On-going support for the OSIS deployment falls under both the developer who will have to continue to provide support, maintenance and upgrades for the OSIS and ICT staff will provide on-going first line support.

6.7.1 User support

The system developer should develop unique set of documentation and training requirements. While user guides, reference manuals, and online help are of course important, enterprise implementations and rollouts are also heavily process-based. This means change management, implementation checklists, project management documentation, test scripts, and similar documentation and training are needed for the proper implementation of the project.

6.7.2 System support

The system developer can offer an on- going support to users through Help Desk facilities, documentation and on-line support facilities on system maintenance and upgrades to ensure the user benefits from the developed system. User support shall be provided in the following means; Information Centre / Help desk; email, phone or at the developers support centre.

- Automated support can be offered via internet, tools such as remote desktop connections and other web service such an automated internet help-desk are used.
- Providing recovery and backup; a network backup facility should be provided to ensure timely automatic backup mechanism.
- Disaster recovery; In case of system failure or any other system problem, a restoration can be made from the backup.
- PC maintenance; the database server may require periodic upgrades in terms of software

6.8 Security plan

Security and protection of sensitive student information is of paramount importance. This sub-section provides an overview and discussion of the security features that will be associated with the system when implemented. It should include the primary security features associated with the system hardware and software.

Constant monitoring of the OSIS (hardware, network, application, OS and security) is critical. An effective monitoring solution will predict and fix problems before they adversely affect the end users of the application. An effective monitoring system will be implemented and operated by the support team. The following items to be considered when implementing a monitoring system include:

Event reporting

User sessions and web site hits including source IP addresses;

System monitoring - CPU utilization, Disk Space utilization, Memory utilization, Simple Network Management Protocol (SNMP) capability to monitor external devices (routers, etc).

Server user login accounts should be limited to a few ICT administrators involved in the setup, configuration and/or maintenance of the OSIS application.

Employ virus protection

An anti-virus updates should be consistently installed and kept running on the OSIS server and configured to perform daily scans and full scans on weekly basis. It should be configured to automatically trigger alerts to support users in the event of virus detection.

Authentication

The application will allow only authenticated users access to the system. The system authenticates, enforces and maintains unique system wide user name and password credentials, for every user that has been granted access to the OSIS. Online access is limited to selected group of authorized users and the system will automatically log off users after a certain amount of inactivity. All user passwords in the database are encrypted and deciphered only by backend server modules and are transmitted and stored in an encrypted fashion.

User authorization

Access to the system is by user role with a set of privileges that indicate to the application whether to grant or deny particular user access to specific functionality in the application.

Encryption

The system will be supported by the Secure Socket Layer (SSL) certificate using strong 128-bit Key encryption on the Application Server to enhance encrypted transmission of any data being exchanged between the server running the OSIS and the client system/ internet browser. Without

SSL, sensitive data such as passwords and client information will be transmitted as clear text and would thus not be protected from hack attacks.

Audit trail

The system will track and log all critical interactions with the user including capturing the identity of the user, the user's action, and the timestamp of the action. Sample user interactions include; updates to user profiles, results, payment details and transcript report by each user.

6.9 Maintenance and change management plan

The maintenance activity involves making changes to the existing system modules and documenting to support its operational effectiveness. Here UMU ICT support and maintenance personnel will be critical in successfully implementing the OSIS. Types of maintenance anticipated will include:

- Corrective maintenance to fix any errors that might emerge with regular use of the system
- Perfective maintenance to consistently improve system's performance
- Adaptive maintenance to add new capabilities and enhancements like enhancing security
- Preventive maintenance to reduce the possibility of future system failure

The OSIS implementation will cause changes in which the business activities are carried out. It will require redefining job responsibilities, and restructuring the organization; for instance, the lecturer's role on OSIS is to enter and managing students' results which has been the role handled by faculty administrators hence reducing on their heavy workloads. The goal should be to improve the efficiency and effectiveness in student information delivery. Change management will involve establishing baseline versions of products, services, and procedures and ensuring all changes are approved, documented, and disseminated. Change controls should address all

aspects of an organization's technology environment including software programs, hardware and software configurations, operational standards and procedures. UMU ICT team should establish change controls that address major, routine and emergency software modifications.

6.10 Documentation

System documentation provides detailed information about a system's design specifications, its internal workings and its functionality.

Figure 61: System Documentation

USER GUIDE

PHP files

The PHP files are all located in the default folder C:\wamp\www\ while the OSIC program files are located in the C:\wamp\www\osic. Sample code of the various files is in Appendix E.

Functions/templates.php

The class "templates" contains the scripts that define different sections of the main structure of the OSIC template. These are functions that are called in all the files that display outputs to the user including the following:

function html_open_body();

function html_open_right();

function html_close_right();

function html_close_body();

The database

The database is found in the project folder – osic; Sub-folder – sql

Click on wamp on the desktop;

Then click on the web browser icon on your desktop;

In the address bar, type; localhost

The wamp server opens. On the heading "projects"; click on osic. This should open the home page.

The interface

Administrator module

ADMIN – Login is case sensitive:

Username: admin

Password: yahoo

Student interface

Sample login for one student;

Username: latuhairwe

Password: 123456

Source: Research outcome

6.12 Evaluation of the OSIS project

Hevner, (2004) quotes (Silver et al. 1995) that information systems are implemented within an organization for the purpose of improving the effectiveness and efficiency of that organization. Capabilities of the information system and characteristics of the organization, its work systems, its people, and its development and implementation methodologies together determine the extent to which that purpose is achieved. For the same reason the major goal of evaluating this project was to determine the extent to which the researcher has been successful in implementing the project objectives; while on the other hand checking for any limitations and/or failures in order to determine where there is a need for improvement. Two strategies used included; outcome evaluation that was used to investigate whether the project caused demonstrable effects on specifically defined target outcomes and; implementation evaluation which was used to determine whether the system performs according to preset standards. The table below summarizes the successes and failures of the OSIS project at the point of implementation.

Table 28: Evaluation Results of the OSIS Project

FEATURE	REQUIREMENT	RESULTS	CONCLUSION
Functionality	Should allow the administrator to register new programs and courses	The system allows the administrator to register new programs and courses	Working
	Should capture and store users' details (students, staff)	Captures and stores users' details (students, staff)	Working
	Should allow authorized users to input data, edit, delete and update as appropriate	The system allows authorized users to input data, edit, delete and update as appropriate	Working
	Should produce reports (Registration, Results, Payment statement and Transcript)	The system produces reports (Registration, Results, Payment statement and Transcript)	Working
Security	System administrator should view everything	System administrator views all modules in OSIS	Working
	Accountant should view finance module only	An accountant views only the finance module	Working
	Lecturer should view marks management module only	A lecturer views only the manage marks module	Working
	Faculty administrator should view faculty data only	Faculty administrator	Needs rework
User access	Users access to the system should be by user role	The faculty administrator views everything contradicting the preset requirement	User privileges functionality needs improvement
Usability and friendliness	The system should have a friendly interface and easy to navigate through	The system has user friendly interface that a user can easily navigate through without any difficulties	Very friendly
Performance	The system should quick response time and able handle multiple users a big number of processes accurately at a high speed	The system was tested on a few users	Needs to be put online to be evaluated on a large number of simultaneous users
Reliability	The system should display information accurately and consistently	The system displays accurate output basing on the preset and implemented functionality requirements.	Working

6.11 Conclusion

The software has been tested and implemented. The OSIS is web-based, making it quick to roll-out, easy to support. It will give UMU students, staff, faculty and administrators real-time access to the information they need anytime and anywhere. It includes a number of built in reports, and you have complete control over your data so that users can generate the reports they need when they need them. This modern data structure promotes efficiency, normalization, and reliable storage and brings information together to provide an easy way for UMU to make information and services available 24x7, without the hassle of setup and integration between existing systems. The OSIS uses the familiar point-and-click interface of today's Web browser to bring your data to your desktop anywhere, anytime. Finally, all OSIS functions are designed to be multiuser, allowing users to simultaneously work independently of each other. Modules are completely integrated to unify your data, eliminate the need for multiple systems, and automate your administrative tasks.

CHAPTER SEVEN: CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

This project was aimed at enhancing student information access through the Design and Development of an online student information system (OSIS) for UMU. This set off with the evaluation of the current systems; establishment of user and or business requirements that aided in specifying the functional and non functional requirements that were used to design models from which the prototype for a new solution was implemented. This chapter lays down the researcher's conclusions after the implementation of the solution, recommendations and hints on future plans regarding the OSIS.

7.2 Report summary

This sub-section presents a summary of the study that was carried out at Uganda Martyrs University, Nkozi as part of the requirements for the award of a Degree of the Master of Science in Information Systems. It presents the aim of the study, objectives, and how these were achieved, the challenges and successes as shown below.

The study aimed at enhancing student information access through the design and development of OSIS. To achieve this, the study set out with objectives to evaluate the existing student information systems in view of business processes and technologies to establish weaknesses in relation to the institution's goals; review methodologies to come up with the best approach and methods for executing the project; design a prototype solution and implement the solution (Chapter one). The study reviewed literature on related works to determine the gap (Chapter two) and established student information access problems on the demand side, evaluated the business processes on the supply side through use of data collection techniques and tools (explained in

chapter three). Findings revealed that students constantly faced conveniences of long queues during registration and examination periods that were frustratingly time consuming, un-reliability of the postal system as a chief means of delivery of their examination result reports in regards to delays and the problem of having no central place online where one could conveniently find the required information. On the staffs' side, problems established included; long queues leading to overcrowding of their offices by students with queries (results and payment status reports among others), heavy work load due to the systems being manual and stand alone that every time a file is required one has to move physically to another building and or office to access the required file, errors due to inconsistencies from the various files created that cannot be automatically updated among others. In response, the OSIS development and implementation was planned, user and system requirements determined (Chapter four); models designed (Chapter five) and the OSIS solution implemented in (Chapter six) basing on the project objectives and requirements prior determined. Chapter seven clearly shows that the OSIS project was successful in implementing the objectives as stated in the previous chapters of this report. The use of OSIS reduces overcrowding in accounts office, registry and faculty offices, duplication, and inconsistencies, enhances flexibility and ensures real time access to student information. It also facilitates quick generation of students' reports hence improved decision making.

7.3 Challenges

It is however worth noting that several challenges were encountered in the process of executing the OSIS project among which the most pressing included;

- System coding given that the researcher had to learn the programming languages used.

- Secondly, the researcher had underestimated the complexity of the OSIS project wherein each department did things somewhat differently and used varying terminology.
- These coupled with time constraints meant that the scope of the system functionality preplanned had to be reduced to complete the project in the timeframe.

7.4 Successes

Despite delays in implementation of the OSIS, student services personnel remain excited about the benefits to come. They cite the move to a student focus as long overdue. Individuals involved with the admissions, records and transcripts expressed enthusiasm that students can view their files online. With students able to do business with the university when convenient for them, registry personnel expect the students to be delighted with the new system.

Administrators see convenience as the greatest student benefit. Although the system requires marketing to the non-traditional student who may not be comfortable with computer technology, these students will benefit most from the convenience of a system that allows online transactions.

Even while recognizing the need for careful communication, training and marketing for the new system, the researcher envisions students taking ownership of their education. With online access to grades, payment statements, course and program updates among others; students gain both control and responsibility for their education.

Often, student services and instructional activities operate as separate entities. By providing a common platform for communication and interaction, faculties can utilize the system to access student learning profiles to customize student learning or to refer students to support programs.

Staff and faculty members envision using the system to more effectively interact with and serve students.

7.5 Recommendations

This research project will greatly improve staff operations and enhance student access to the information. However, this research also un-covered new areas that need further study. The researcher therefore recommends the need for further development of the OSIS in the areas shown below.

7.5.1 Online course registration

The online registration module was out of scope of this system. However, the researcher recommends that this module be incorporated in the future version of the OSIS. As it stands, in order to officially register for classes at UMU, each student must fill out a course registration form manually, bring it to the Faculty office or at times Auditorium, stand in line (often for twenty to thirty minutes), and finally have the form officially approved and stamped. In order to change anything about one's current course such as changing the course option, or showing official permission from a lecturer, the student must go through the same tedious process. This is not only costly in terms of resources and time, it is inconvenient and tedious.

7.5.2 Online scheduling

Online scheduling was also out of scope of this project due to the limited time in which the project was planned to be accomplished. Timetabling is a major administrative activity in any academic institution where a number of subjects taught by the corresponding lecturers are allocated into a number of available classrooms and a number of timeslots subject to constraints.

The lectures are activities and lecturers and classes are resources. These resources are not available at certain time periods. A lecture can be given in period only if the corresponding class and lecturer are available in it. Online scheduling eases the work of assigning periods to classes such that lessons are effectively spread across the teaching cycle as much as possible and; the fact that some classes need 'double periods' (preferably 2 consecutive periods) especially for core subjects without clashes. Online scheduling makes it easier to update the schedule and have the changes effected and made conveniently accessible by all stakeholders where ever they are. The time tabling problem is said to be feasible if and only if it satisfies the following constraints: Every lecturer and every class must be present in the timetable in a predefined number of periods; there cannot be more than one teacher in the same class at the same period; and no lecturer can be assigned to more than one class at the same time; The researcher therefore recommends that this vital module be incorporated in the next version of the OSIS.

7.5.3 Short Message Service (SMS)

The sms module should be incorporated in the future version of the OSIS to deliver information updates to distance learners that either hardly have access to computers and the internet and/or have no computer skills to use the online system so that they are able to benefit from the services offered by the OSIS.

7.5.4 Other recommendations

Ensure access to internet and networks, increased bandwidth, connection stability and those technologies that permit better online traffic and provide privacy protection filters for content accessed by students are vital as well as putting in place a reliable local network structure that is safe and accessible.

UMU management needs to realize that going IT and managing information systems is an on-going transformation process that requires close examination of what is available, what is required, and what might be required in future. The cost-benefit analysis principle needs to be applied when deciding the kind of information management system to implement. The study acknowledged that automation has been discussed by management but no sensitization has been done and most stake holders were adamant to change. Motivation and support for the automation project is lacking.

7.6 Future plan for the OSIS

Due to the limited time in which this project was to be accomplished, the researcher was un-able to have an adequate number of trial results by the users. The researcher plans three months trial period of the OSIS by the stakeholders to gain more acceptance and if it is positively received, then fully launch the system once the necessary infrastructure is in place.

7.7 Conclusion

As universities increasingly expand their coverage through part-time and distance learning, the desire to ensure customer satisfaction will become even stronger and more pervasive. Viewing students as customers provides a competitive advantage for higher education and enhances a university's ability to attract, retain and effectively serve its customers. This web based online student information system was developed mainly to support students' information needs. The system manages several processes such as grades/results, payment statements, academic transcripts, user management, course registration and reporting. The development and implementation of OSIS project in UMU was examined as were the benefits realized by

implementing it. These include a student-centric focus, improved customer data and process management, better services to students, faculty, staff, prospective students and administration among many other interested parties; provides meaningful, consistent and timely data and information to end users, increased efficiency by converting paper processes to electronic form, enhancement of senior management's vision to address opportunities for change, increased student loyalty, retention and satisfaction with the University's programs and services. Finally, through the OSIS, links to other vital student resources and services are provided to enable students to access a variety of vital resources such as access to the library's portal, Nextgen e-learning system and the university website.

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APPENDICES

DATA COLLECTION INSTRUMENTS

UGANDA MARTYRS UNIVERSITY

FACULTY OF SCIENCE

APPENDIX A: QUESTIONNAIRE

TOPIC: DESIGN AND DEVELOPMENT OF AN ONLINE STUDENT INFORMATION SYSTEM: UGANDA MARTYRS UNIVERSITY, NKOZI

Dear Respondent,

As part of my MSCIS program, I am carrying out a study by use of a questionnaire and you have been randomly selected to participate. I therefore request you to spare some time and honestly answer the questions asked in this questionnaire. The answers will be used to provide the requirements for the design and development of a prototype of AN ONLINE STUDENT INFORMATION SYSTEM for UMU. The information provided will be treated with utmost confidentiality.

1. SECTION A: BACKGROUND INFORMATION

i) Gender: [1] Male [2] Female
ii) Faculty/Department …….....Year of study.....
iii) Student category [1] On-campus/Full-time [2] Off-campus/part-time and/or distance

2. SECTION B: COMPUTER SKILLS

a) Do you know how to use a computer to search for information? [] Yes [] No
b) What computer skills do you have?
[1] Word-processing and Spreadsheets
[2] Word processing, Spreadsheets, Internet and email
[3] Word processing, Spreadsheets, Internet and email and Database management
[4] Word processing, Spreadsheets, Internet and email, Database management and Programming
[5] Word processing, Spreadsheets, Internet and email, Database management, Programming and Web page design
[6] Computer repair and maintenance and all the above

c) When you are using a computer to do your work, how often do you ask for assistance when you have challenges?
[1] Always [2] Sometimes [3] Rarely [4] Never

SECTION C: INFORMATION ACCESS AND RETRIEVAL

3. Where do you have access to a computer from?
[1]Home
[2] Work place
[3] Uganda UMU Campus
[4] Hostel

[5] Hostel and UMU Campus
[6] Home and work place
[7] All the above

4. How easy is it to have access to a computer connected to the internet?
[1] Very easy [2] Easy [3] Not easy [4] Difficult [5] Very difficult

5 When you access a networked computer, what do you mostly use it for? Tick as applicable
[1] Academic purposes
[2] Academic purposes and E-mail services
[3] Academic purposes, E-mail services and Sending sms
[4] Academic purposes E-mail services, Sending sms and Face book
[5] Academic purposes E-mail services, Sending sms, Face book and you tube
[6] All the above

SECTION D: ATTITUDES TOWARDS ONLINE INFORMATION ACCESS

6. Please, rate your feelings or opinions to the following statements:
a) I feel that the standard of my academic work would suffer without access to the Internet

[1] Strongly agree [2] Agree [3] I don't agree [4] I don't know [5] I don't use it

b**) Given the opportunity to choose between ONLINE ACCESS to my academic results/grades, fees payment statements, program changes and physically coming to UMU to access the same, I would choose online access than physically coming to UMU.**
[1] Strongly agree
[2] Agree
[3] Disagree
[4] Strongly disagree
Please indicate the reasons for your choice
……
……
……

SECTION E: PROBLEMS FACED WITH INFORMATION ACCESS

1. **i) Does your institution have a online information system (Student web-based interface) where you can find all the relevant student information without physically coming to UMU?**

[1] Yes
[2] No
ii) If no, currently where do you access your academic results from?

[1] Main Registry office
[2] Receive a letter through the post office
[3] Faculty office
[4] Electronic email
[5] Faculty office, Main Registry office and / or receive a letter through the post office

8.i) Do you sometimes get inconvenienced in planning your study schedule because your academic results (coursework, exams) are delayed?
[1] Yes
[2] No

ii) If yes, what do you think are the causes of such delays?

[1] Processing is done manually
[2] Posting results via the post office takes long

[3] No online student information management system to post student's results for timely access
[4] 2 and 3
[5] All the above

9. i) Where do you access your financial statement?

[1] Receive a letter through the post office
[2] Electronic email
[3] On the University Notice board
[4] Physically check with the Accounts office
[5] 1, 3, and 4
[6] 1 and 4

ii) If there are changes in fees structure, how do you get that information?

[1] Go to UMU to check with the Finance office
[2] Posted on the intraweb
[3] Receive email containing the updates
[4] Posted on the University Website
[5] Notice board
[6] Hear say
[7] 5 and 6

iii) Do you sometimes get inconvenienced towards examination time because your fees payment status is unclear?
[1] Yes
[2] No

iv) What problems do you face when trying to access your fees payment statement?

[1] Time consuming due to long queues especially towards examinations
[2] Staffs are not customer friendly at times
[3] Too many errors
[4] Uncooperative staff to facilitate easy access
[5] Not flexible; have to go to accounts office every time I need an update of my fees payment status
[6] 1, 2, 3 and 5
[7] 1, 3 and 5
[8] 1 and 4

v) In your opinion, what would be the best way to avail access to your fees payment statement?
[1] Online via student information portal on log in
[2] Receive a letter through the post office
[3] Electronic email
[4] Physically check with the Accounts office
[5] 1 and 3

10. Are you satisfied with the way/medium through which access to student information is availed?
[1] Yes
[2] No

11. i) If a new online student information system is put in place, what would be your expectations from it?

[1] View my profile information

[2] View courses I registered for
[3] View program changes online
[4] View and print my academic results/grades online after log in
[5] View and print my fees payment status information online after log in
[6] View my un-official transcript online after log in
[7] Provide for username and password to protect my account information with the university
[8] All the above

ii) Any other expectations?
.....
.....
.....

THANK YOU

APPENDIX B: INTERVIEW GUIDE

Questions will be formulated and written down prior to the process of obtaining data. These are guidelines during the interviewing of the Registry, Accounts, and ICT staff of Uganda Martyrs University.

REGISTRY STAFF / FACULTY ADMINISTRATORS

ADMISSIONS DIVISION

General information

- Gender: Male ☐ Female ☐
- Faculty/Department …….....…..
- Job role .....
- Period of time you have worked in that job role.....

Business processes

1. Please briefly describe functions of this Division

……
……
……

2. Are you involved in the capturing , processing and management of information on students?[] Yes [] No

3. What kind of information do you capture about a student?

……
……

4. How do you go about processing this information?

……
……

5. What tools do you use to process student information at the time of admission?

……
……

6. What equipment/media do you use to store student information?

……
……

7. Does the Registry have centralized data storage and access system that keeps all relevant students' information? [] Yes [] No
8. If no, please describe the system currently in place?

……
……

9. Is the system currently in place capable of aiding you to keep track of a student throughout his/her study period? [] Yes [] No

If no, how do you keep track of students who have dropped out?

……
……

10. Is the system in place accessible outside your office building and does it allow you to flexibly access student records and work anywhere outside your office? [] Yes [] No
11. What challenges do you encounter with the current system when managing student information?

……
……

12. Do you have any suggestions on how the system can be improved to meet your job needs?

……
……

TRANSCRIPT DIVISION

General information

- Gender: Male ☐ Female ☐
- Faculty/Department …….....…..
- Job role .....
- Period of time you have worked in that job role.....

Business processes

- What activities do you perform in your job role?

……
……

- Does the Registry have centralized data storage and access system that keeps all relevant students' information? Yes [] No []

If no, how does your division keep track of a student's academic record throughout his/her study life at UMU?

……
……

- Do you encounter any challenges in getting/retrieving and availing students' academic progress report when urgently requested for? | Yes | No |

If yes, what difficulties do you encounter?

……
……

- What challenges do you face in the process of preparing transcripts?

……
……

If you have any suggestions on the best way forward, could you please explain them?

……
……

FACULTIES - RESULTS DIVISION

General information

- Gender: Male ☐ Female ☐
- Faculty/Department …….....…..
- Job role .....
- Period of time you have worked in that job role.....
- What activities do you carry out in your job role?

  ……
  ……

Business processes

A. Data capture activities

Please describe the kinds of student information you capture and currently hold in your department?

……
……..……..

- When is it necessary to capture information about students (Joining University, Beginning of semester, examination time)?
- Who are the key users of the information you capture and manage in your faculty/department?

……
……

B. Processing and storage activities

- Do you manage examinations records? Yes [] No []

If yes, what forms of processing do you undertake on examination results?

……
……

- Do you have a database (web-based) system that allows you the flexibility to process students' results outside your office premises and be able to access the same data anywhere you are?
  Yes [] No []
- If no, please describe the system you use to store and manage students' results (Grades, course work, tests).

  ……
  ……

C. Dissemination activities

- Do you have an online student information system? Yes [] No []

If no, please describe how you ensure that results/progressive reports are made available to all your students.

……
……

- What challenges do you face using the system you have in place to disseminate students' results?

  .....
  .....
- Have you ever received any complaints from students regarding failure to access their results on time? Yes [] No []

If yes, what in your opinion do think could have been the causes of such delays?

……
……..……..

- If AN ONLINE STUDENT INFORMATION SYSTEM was to be put in place, what is the most crucial services you would wish to be automated first?
  ……
  ……
- What alternative solutions do you suggest to simplify the processes and make information available easily?

……
……

ACCOUNTS STAFF

General information

- Gender: Male ☐ Female ☐
- Faculty/Department …….....…..
- Job role .....
- Period of time you have worked in that job role.....

Business processes

1. What students' data do you capture, process and keep?
   ……
   ……

2. Where do you get that data from?

……

3. Please describe the process you go through when capturing, processing, storing and retrieval of student financial data?
   ……
   ……
4. Do you have any difficulties in processing and storing students' financial details? Yes [] No []
   If yes, what are they?
   .....
   .....
5. Do you encounter any difficulties in retrieval of students' financial data? Yes [] No []
   If yes, please explain
   .....
   .....
6. Does your system allow students to view their financial statements online? Yes [] No []
   If no, how do update them on their payment status?
   .....
   .....
7. Does this institution have a web based student service information system? Yes [] No []
   If no, where do you post information regarding changes in fees structure, payment modes and any other relevant updates?
   .....
   .....
8. In your opinion, do you think the medium you are currently using to update students regarding their financial stand with the university is efficient? Yes [] No []

If no, what alternative solutions do you suggest to simplify the processes and make financial information available easily to students easily?

.....
.....

ICT STAFF

General information

- Gender: Male ☐ Female ☐
- Faculty/Department …….....…..
- Job role .....
- Period of time you have worked in that job role.....

Business processes

1. Describe the computing resources used by students in your institution and indicate the types of software available.

……..
……

2. Please describe the IT infrastructure of your institution

……
……

Please describe the systems available for capturing, processing, storing and disseminating information to students?

……
……..

3. How do you ensure that student information in this institution is kept secure?

……
……

4. What challenges do you encounter in ensuring security of student information?

……
……

5. What are your plans for the future regarding systems security, data protection and privacy of the institution's data and information?

……
……

6. Please give any suggestions on how student information access can be improved.

……
……

THANK YOU

APPENDIX C: OBSERVATION GUIDE

AREA UNDER STUDY	OBSERVATION
Main business processes in the students' information system	Registration, examinations, results, financial statements processing, reports
Platforms through which information is made available to the stakeholders	Information retrieval/access
IT infrastructure	Computers, Printers, Scanners, Internet connectivity, Security and staff
Software used	Operating systems, Application software and utilities software

APPENDIX D: DOCUMENT ANALYSIS

1) Review the Academic Registry's mission, vision and objectives
2) Review the details/fields on the application forms for both undergraduate and post graduate students
3) Review the details/fields on the registration forms for both undergraduate and post graduate students
4) Review the recommendations by previous researchers on student records management systems at UMU
5) Review the documentation/reports on the existing systems and technologies at UMU.

APPENDIX F: SAMPLE SYTEM CODE

The home page: index.php

```
<?php include("functions/templates.php");
                $about = new template();
                $about->header();
                $about->html_open_body();
                $about->content();
                $about->html_open_right();
                $about->login();
                $about->newsscroller();
                $about->html_close_right();
                $about->html_close_body();
?>
```

System files: functions.php

```
<?php
function dbconnect() {
        @mysql_connect("localhost","root","") or die(mysql_error());
        @mysql_select_db("osic") or die(mysql_error());
}
function checklogin() {
        if (!isset($_SESSION["login"]) || !is_array($_SESSION["login"])) {
                @header("Location: index.php?noset");
                        exit ();
                        }
}
function mysql_prep( $value ) {
        $magic_quotes_active = get_magic_quotes_gpc();
        $new_enough_php = function_exists( "mysql_real_escape_string" ); // i.e. PHP >= v4.3.0
        if( $new_enough_php ) { // PHP v4.3.0 or higher
                // undo any magic quote effects so mysql_real_escape_string can do the work
                if( $magic_quotes_active ) { $value = stripslashes( $value ); }
                $value = mysql_real_escape_string( $value );
        } else { // before PHP v4.3.0
                // if magic quotes aren't already on then add slashes manually
                if( !$magic_quotes_active ) { $value = addslashes( $value ); }
                // if magic quotes are active, then the slashes already exist
        }
        return $value;
}
class actions {
        function call_links() {
                include ('admin_links.php');
        }
        function h_links() {
                echo $this->call_links();
        }
}
?>
```