CHAPTER II

LITERATURE

2.1. Understanding the System.

According to O'brien J. A, Marakas G. (2008), "a system is a set of interrelated components with, a clearly defined boundary, working together to achieve a common set of objectives by accepting inputs and producing outputs in an organized transformation process". A system is basically made up of components that interact with each other to achieve a common purpose.

2.1.1. Basic Functions of a System.

The basic functions of a system include Input (capturing and assembling elements that enter the system to be processed), processing (transformation process that converts input into output), and Output (transferring transformed elements to their ultimate destination).

2.1.2. System Characteristics.

From the above definition of a system, a system has the basic characteristics such as it is made up of components, it has a defined boundary, a system carries out input, process and output, and a system has a goal or target.

1. System Components.

A system is made up of a number of components, which in one way or another a related to each other, that work together to achieve a common goal. The components of a system can either be single parts or subsystems of the main system.

2. System Restrictions.

When we say the components of a system are bound or defined by a boundary, this means that a system is restricted to fulfilling a specific purpose. Each component of the system works inclined to these restrictions to achieve the systems goals.

3. External environment of system.

The external environment of a system refers to the environment beyond the system's limits or restriction. Because a system is defined for a specific purpose, it must maintain its environment within its limits. It is important that the external environment be retained and controlled, to prevent it fom interfering with the viability of the system.

4. System Liaison.

Since a system can be made up of two or more subsystems, it needs a medium to combine each of these subsystems together. This is medium is known as the system liaison. The system liaison provides a link which enables resource flow from one subsystem to another. Thus the liasion creates a channel by which output from one subsystem becomes input for another subsystem.The liaison integrates one system with another forming the main system.

5. System Input.

The system input refers to raw or unprocessed data that enters into the system. This raw data is then processed, manipulated and transformed into useful data.

6. System Output.

The system output is the data that has been processed and classified as useful output. As explained above, output from one subsystem, can be input for another subsystem.

7. System Processing.

The processing section of a system works to manipulate any data entered into the system, and transform them into output.

8. System Target.

As defined above, all components of a system work together, and are restricted to achieve a specific purpose. The system's target or goals guide how the system works. The system target influences the type of inputs put into the system, how these inputs are processed and what type of outputs come out of the system.

2.1.3. Classification of Systems.

Systems are built for specific puposes, thus each system has a different purpose. Because of this, systems can be classified into several categories. Some examples of system categories include physical or abstract systems, open and closed systems, and man-made information system. These system categories are further explained below:

1. **Physical Systems.**

   Physical systems are tangible entities that we can feel and touch. These may be static or dynamic in nature. For example, take a computer center. Desks and chairs are the static parts, which assist in the working of the center. Static parts don't change. The dynamic systems are constantly

changing. Computer systems are dynamic system. Programs, data, and applications can change according to the user's needs.

2. **Abstract Systems**

Abstract systems are conceptual. These are not physical entities. They may be formulas, representation or models of a real system.

3. **Open and Closed Systems**

Open systems are systems that interact with their environment. Practically most of the systems are open systems. An open system has many interfaces with its environment. It can also adapt to changing environmental conditions. It can receive inputs from, and delivers output to the outside of system. An information system is an example of this category. Closed systems:Systems that don't interact with their environment. Closed systems exist in concept only.

4. **Man Made Information Systems.**

The main purpose of information systems is to manage data for a particular organization. Maintaining files, producing information and reports are few functions. An information system produces customized information depending upon the needs of the organization. These are usually formal, informal, and computer based.

2.2. Understanding Information

According to O'Brien J. A., Makaras G. (2008) "information is data that has been converted into meaningful and useful context for end users". From the above

explanation of the system, the basic functions of a system include input, processing, and output. Thus Information is the processed output that comes out from the system.

2.2.1. The basic Concept of Information

All processed information have different values or qualities for different purposes. Following are some of the qualities of information.

1. **Accurate**

   Accurate information refers to information that is true, verifiable, and not deceptive. Accurate information is based on empirical data and can be validated by comparing sources or checking for internal consistency.

2. **Current**

   This means the information is applicable to the present time. Keeping information current requires a process of eliminating the old and adding the new. Information should be reviewed and updated at least annually to be current.

3. **Relevant**

   Relevant information applies to the interests of the individuals who use it for the decisions they are facing. Relevant information is created to suit the needs of the person using it. Local information is usually more valuable than national and international information.

4. **Specific**

   For information to be specific, it must contain concrete facts. General observations are often interesting and can provide a background for further

analysis, but specific facts are essential to realistic planning and decision making.

5. **Understandable**

People using information must be able to comprehend it before they can use it. Data must be analyzed and converted into words. The content of the message should avoid ambiguities and be informative to the intended audiences.

6. **Comprehensive**

The information should include all the important categories within its scope of coverage. In CIS that includes the full range of occupational opportunities, their related educational programs of study and training, and the schools that offer them as the core. Related to that is information about money for school, looking for work, employers and industries, working for yourself, and so on.

7. **Un-biased**

This characteristic is about the motivation or purpose for which the information is being produced and delivered. It is unbiased when the individual or organization delivering the information has no vested interest in the decisions or plans of the people who are receiving the information.

8. **Comparable**

The information presented should be of uniform collection, analysis, content, and format so that you can compare and contrast the various occupations, programs of study, and schools.

2.3. Understanding Information Systems

According to O'Brien J.A, Makaras G. (2008), an information system is "an organized combination of people, hardware and software, communication networks, data resources, and policies and procedures, that stores, retrieves, transforms, and disseminates information in an organization." Referring back to the definition of a system, an information system consists of components that work together to ensure that relevant data is collected (input) and then processed (processing) to produce useful information (output) which is then disseminated throughout the organization to help achieve the organization's goals.

2.3.1. Components of an Information System

Like other systems, information systems are made up of components that work together to achieve the system's main purpose. As stated by O'Brien J.A, Makaras G. (2008) in their book introduction to information systems, the components of an information system are as follows:

1. **People Resources**

   These are the system end users and the information systems specialists who use the information system. People resources are the components that operate the information system.

2. **Software resources**

   These are the programs and procedures that run the information system. Software resources give instructions as to how the information system should operate.

3. **Hardware resources**

   These are the machines and media that run the information systems. Hardware resources are the components that carry out the procedures and functions of the information system.

4. **Network Resources**

   These are the communication media and network supports that enables the flow of information and data resources throughout the information system. The network resources act as the transport system of the information system.

5. **Data Resources**

   These are the data and knowledge bases that represent the information system's data supplies. Relevant data is stored in databases, and retrieved whenever needed to be used by other components of the information system.

2.4. Research Case

The main case of this study is the development of the academic information system of the university of Papua New Guinea, therefore the following sections will explain concepts related to the case.

2.4.1. Academic Information System

An academic information system is an information system that manages the information resources and procedures of an educational institution. A basic academic system consists of 5 sections:

1. **Admission**

   This section manages the information and procedures related to student admission, such as student application, student recruitment, etc.

2. **Finance**

   This section manages information and procedures related to finance, such as payment of tuition fees, management of student financial records, etc.

3. **Academics**

   This section is concerned with the academic procedures of the institution such as student enrollment, student learning, student grading, etc.

4. **Alumni**

   This section involves the management of former or graduated students' information. It aims at maintaining connection with students after they graduate from the institution.

The academic information system of UPNG, as discussed in this study, will basically consist of 4 of the 5 sections explained above: Admission, Finance, Academics, and Alumni. These sections are further explained in the following paragraphs.

2.4.1.1. Student Admission

Student admission involves the admission of students into the university. Student admission involves processes such as application, screening of applications, and acceptance and recruitment of new students. At the University of Papua New Guinea, there are 2 types of student admission procedures, admission of school leavers, and admission of non-school leavers. Admission of school leavers involves the process of recruiting new students from secondary schools around the country after year 12. At the end of year 12, students fill out a school leaver form (SLF), making 3 preference choices of the universities and study programs they wish to study. After the grade 12

national examinations, the universities send out recruitment teams to select grade 12 applicants, according to their performance in the exams and SLF choices. Non-school leaver admission involves admission through application. Interested individuals who want to study at the university fill out an application form and then submit it with the necessary supporting documents. These applications are then screened by the university's selection committee, and if accepted, the applicants are then notified of their acceptance.

2.4.1.2 Finance

The Finance section of the academic information system is concerned with the financial procedures of the university. These procedures include payment of tuition and other university fees, and the management of student financial records. The finance section also includes other sponsorship or student financial support schemes that the university provides for the students. For the payment of tuition and university fees, the academic information system of UPNG will adapt an online payment system. An online payment system is a system where the payment transaction is done electronically, via the internet and computer networks. To make a payment, the student must log on to the academic information system, fill out the payment details, and make the payment. On submitting the payment form, the system will electronically transfer money form the student's account to the university's account, and the student's transaction information will be recorded.

2.4.1.3 Academics

The Academics section of the academic information system is concerned with the academic procedures of the university. This includes student enrollment, student

learning and student grading. Student enrollment is the process of registering for courses that you will take up in a particular semester. Student enrollment often occurs in the first week of the semester. Student learning is the general learning process at the university. This involves taking lectures, tutorials and other classes at the university, and doing assignments and tests to monitor your general progress in a particular course. Student grading is the process of awarding students according to their academic performance in a certain course. After doing the given assignments and tests, these assignments are marked and students are graded according to their results. Grades at UPNG are in the form of Higher Distinction (HD) with a value of 5, Distinction (D) with a value of 4, Credit (C) with a value of 3, Upper Pass (UP) with a value of 2, Pass (P) with a value of 1, Consolidate Pass (CP) and Fail (F). After each course has been graded, an overall grade point average (GPA) score is calculated out of a total GPA score of 5.00. After grading the student, a student transcript is then created to show the student's results. A transcript is an official record or report of the student's academic performance.

2.4.1.5 Student Grading Formula

In the proposed UPNG academic information system, the system calculates the grades according to the following formula:

1. If the student's marks for a course are between 85 and 100, the student is given a Higher Distinction (HD).
2. If the student's marks for a course are between 75 and 84, the student is given a Distinction (D).

3. If the student's marks for a course are between 65 and 74, the student is given a Credit (C).

4. If the student's marks for a course are between 55 and 64, the student is given a Pass (P).

5. If the student's marks for a course are between 40 and 54, the student is given a Consolidate (CP).

6. If the student's marks for a course are below 40, the student is given a Fail (F).

The system then calculates the total GPA by adding the grade values for each course and dividing it by the total number of subjects taken.

The formula for giving the total score for each course is as follows.

1. For each test, assignment, mid-exam and final-exam, the student is given a grade out of 100.

2. The total scores for the assessment pieces are then added up, i.e. assignment score + test score + mid-exam score + final-exam score.

3. Since each assessment piece is out of 100, the maximum total score that can be acquired would be 400 (i.e. 100 x 4 assessment pieces).

4. The student's total score for the particular course is then divided by 400 and then multiplied by 100 to get a total score out of 100.

2.4.1.5 Alumni

The alumni section of the academic information system involves the management of information belonging to graduated or former students. This section

mainly aims at maintaining the connection between the students and the university after they graduate from the university. Procedures involved in this section include management of graduated students' information, maintaining an alumni association or network to keep students connected with their former associates, and developing statistical reports on the number of students passing out from the university each year.

2.5. Understanding Database

According to Jeffrey A. Hoffer, V. Ramesh, Heikki Topi (2011:10), a database is an organized collection of logically related data. A database may be of any size and complexity. Databases are used to store, manipulate, and retrieve data in nearly every type of organization, including business, health care, education, government, and libraries.

2.6. Software Support

Below is a description of each software:

2.6.1. PHP (Hypertext Preprocessor)

PHP is an open source scripting language used to create dynamic web pages that run on a server. PHP is a server side scripting language, especially suited for web development and can be embedded into the HTML and dynamic web pages. What distinguishes PHP from something like client-side JavaScript is that the code is executed on the server, generating HTML, which is then sent to the client. The client would receive the results of running that script, but would not know what the underlying code was.

There are three main areas where PHP scripts are used:

1. **Server-side scripting.**

   This is the most traditional and main target field for PHP. You need three things to make this work. The PHP parser (CGI or server module), a web server and a web browser. You need to run the web server, with a connected PHP installation. You can access the PHP program output with a web browser, viewing the PHP page through the server.

2. **Command line scripting.**

   You can make a PHP script to run it without any server or browser. You only need the PHP parser to use it this way. This type of usage is ideal for scripts regularly executed using cron (on *nix or Linux) or Task Scheduler (on Windows).

3. **Writing desktop applications.**

   PHP is probably not the very best language to create a desktop application with a graphical user interface, but if you know PHP very well, and would like to use some advanced PHP features in your client-side applications you can also use PHP-GTK to write such programs.

PHP can be used on all major operating systems, including Linux, many Unix variants (including HP-UX, Solaris and OpenBSD), Microsoft Windows, Mac OS X, RISC OS, and probably others. PHP has also support for most of the web servers today. This includes Apache, IIS, and many others.

One of the most significant features in PHP is its support for a wide range of databases. Writing a database-enabled web page is incredibly simple using one of the database specific extensions (e.g., for mysql), or using an abstraction layer like PDO, or connect to any database supporting the Open Database Connection standard via the ODBC extension.

2.6.2. MySQL

MySQL is an open source database management system. A database is a structured collection of data. It may be anything from a simple shopping list to a picture gallery or the vast amounts of information in a corporate network. To add, access, and process data stored in a computer database, you need a database management system such as MySQL Server. Since computers are very good at handling large amounts of data, database management systems play a central role in computing, as standalone utilities, or as parts of other applications.

My SQL databases are relational meaning, they store data in separate tables rather than putting all the data in one big storeroom. The database structures are organized into physical files optimized for speed. The logical model, with objects such as databases, tables, views, rows, and columns, offers a flexible programming environment. You set up rules governing the relationships between different data fields, such as one-to-one, one-to-many, unique, required or optional, and “pointers” between different tables. The database enforces these rules, so that with a well-designed database, your application never sees inconsistent, duplicate, orphan, out-of-date, or missing data.

The MySQL Database Software is a client/server system that consists of a multi-threaded SQL server that supports different backends, several different client programs and libraries, administrative tools, and a wide range of application programming interfaces (APIs).

2.7. Network Configuration

A computer network is a collection of computers, servers, mainframes, network devices, peripherals, or other devices connected to one another, allowing for data to be shared and used. A computer network. The most basic of a computer network, which consists of just two connected computers, can expand and become usable when additional computers join and add their resources to those being shared. The first computer (the computer being used by you) on a network is referred to as your local computer. It is more likely to be used as a location where you do work, a workstation, than as a storage or controlling location, a server. A server computer is the computer that controls all the computers and devices on the network, and is also the storage computer.

Before computers on a network can be connected together, it is important that a network plan be drafted. A network plan is a formally created product that shows all the network's components and the planned connections between them. The network plan helps manage the information gathered, stored, and shared between the users on the computer network.

2.7.1. Network Classification

Networks are normally classified according to the geographical boundaries the network spans. Two basic geographical designations for networks are the local area

network (LAN) and wide area network (WAN). A third designation is the metropolitan area network (MAN). These are further described as follows:

1. **LAN**

   A local area network (LAN) is a network contained within a relatively small area, such as a classroom, school, or single building. A LAN has the lowest cost and least overall capability of the three geographic classifications. Despite their decreased capability, their closeness and resultant low costs typically result in the use of the fastest technology on a LAN. On a single LAN, computers and servers may be connected by cables or wirelessly. Wireless access to a wired network is made possible by wireless access points (WAPs).

2. **MAN**

   When the network spans the distance of a typical metropolitan city, it can be referred to as a metropolitan area network (MAN). Much of the same technology, such as the fast networking components and communications equipment used in LANs, can be used in MANs, but more are required, so this classification is not quite as technologically advanced as are LANs.

3. **WAN**

   When the network spans a larger area, it is classified as a wide area network (WAN). Because of the extensive distances over which WANs communicate, they use long-distance telecommunications networks for their connections, which increases the costs of the network. The Internet is an example of a WAN. Transoceanic cabling or satellite uplinks may be used to connect this type of global network.

Another method used to classify networks focuses on the roles the networked computers play in the network's operation, and more specifically on which computer controls that operation. There are two basic types of role classifications for networks peer-to-peer networks and server-based networks. This is described as follows:

1. **Peer-to-peer networks**

   A peer is considered an equal. All computers on a peer-to-peer network can be considered equals. This means, no one computer is in charge of the network's operation. Each computer controls its own information and is capable of functioning as either a client or a server depending on which is needed at the time.

2. **Server-based networks**

   Unlike peer-to-peer networks that operate without central control and are difficult to secure, a server-based network offers centralized control and is designed for secured operations. While there are still both clients and servers on a server-based network, a dedicated server controls the network. A dedicated server is one that, for all practical purposes, operates solely as a server.

2.7.2. Network Topology

Network Topology refers to layout of a network and how different nodes in a network are connected to each other and how they communicate. Topologies are either physical (The physical layout of devices on a network) or logical (the way that the signals act on the network media, or the way that the data passes through the network from one device to the next).

The types of physical topology is described as follows:

1. **Linear Bus topology**

   A linear bus topology consists of a main run of cable with a terminator at each end. All nodes (file server, workstations, and peripherals) are connected to the linear cable.

2. **Star topology**

   A star topology is designed with each node (file server, workstations, and peripherals) connected directly to a central network hub, switch, or concentrator. Data on a star network passes through the hub, switch, or concentrator before continuing to its destination. The hub, switch, or concentrator manages and controls all functions of the network.

3. **Tree topology**

   A tree topology combines characteristics of linear bus and star topologies. It consists of groups of star-configured workstations connected to a linear bus backbone cable. Tree topologies allow for the expansion of an existing network, and enable schools to configure a network to meet their needs.

2.8 Client-Server System

A Client-Server system is one in which the server performs some kind of service that is used by many clients. The clients take the lead in the communication, such as they send a request to the server, and the server responds to that request. The basic Client-Server architecture has 2 tiers (Client and Server). Client/server model is a concept for describing communications between computing processes that are classified as service consumers (clients) and service providers (servers).

2.8.1. Features of Client-Server Model

The basic features of a Client/Server model are as follows:

1. Clients and servers are functional modules with well defined interfaces (i.e., they hide internal information). The functions performed by a client and a server can be implemented by a set of software modules, hardware components, or a combination thereof. Clients and servers may run on dedicated machines.

2. Each client/server relationship is established between two functional modules when one module (client) initiates a service request and the other (server) chooses to respond to the service request. For a given service request, clients and servers do not reverse roles (i.e., a client stays a client and a server stays a server). However, a server for SR R1 may become a client for SR R2 when it issues requests to another server.

3. Information exchange between clients and servers is strictly through messages (i.e., no information is exchanged through global variables). The service request and additional information is placed into a message that is sent to the server. The server's response is similarly another message that is sent back to the client. This is an extremely crucial feature of Client/Server model.

2.8.2 Characteristics of client-server system

A client-server system has two main characteristics: cooperative processing and flexible end-user applications. These are explained as follows:

1. **Cooperative Processing**

An effective client-server system, intended to be powerful and user friendly, must avoid complexity. The concept of cooperative processing does that. When an end user needs an operation that his or her workstation cannot handle, the user just needs to issue a command to the system without knowing where the needed server is or how to access it. The system software works like a agent, contacting various servers and assigning them different jobs. The system software then assembles the results obtained from different servers and forwards the integrated findings to the workstation used by the requesting user. The workstation in this example acts as a client being helped by several servers with the coordination of an agent.

2. **Flexible end-user applications**

One major reason PCs are popular is that individual users can select their own application software. Users are not forced to employ software they do not want. Also, they can install new application software without having to go through a time-consuming approval and development process required in a centralized system. A client-server system preserves most of these attributes.