Enterprise systems: An emerging technology for Papua New Guinea universities

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Abstract

The rapid expansion of information and communication technology is enabling organisations to change the way they are conducting their business activities. Many organisations are using enterprise systems to integrate their business processes from multiple functional areas of operation using a single database to make them more efficient. They are utilising this technology to provide processes immediate access to real-time data to make better informed decisions in their planning. Public and private sector organisations, not-for-profit organisations and educational institutions such as universities, could adopt enterprise systems to achieve operational efficiency. To understand how these systems work, this paper discusses some concepts of enterprise systems and a simplified theoretical example in a university setting to illustrate the functioning of an enterprise system and how such a system could benefit Papua New Guinea universities.

Key words: admission, business function, business process, efficiency, enrolment, enterprise system, enterprise view of system, functional area of operation, functional business model, information system, enterprise view of information system, process business model, traditional view of systems.

Introduction

The constantly changing business environment and rapid advancement of information and communication technology (ICT) are changing the way organisations are carrying out their business activities. Many organisations are now using what are known as enterprise systems (to be described in this paper) to integrate and improve their business processes. They are utilising these systems to allow processes to access a centralised data repository to effectively manage data and provide real-time (up-to-date) information and thereby support well-informed decision making for planning.

Educational institutions such as universities could adopt these enterprise systems to merge their institution-wide data and processes so that information could be shared among these them conveniently, which in turn increases operational efficiency. To understand how enterprise systems work, this paper aims to discuss some related concepts such as functional areas of operation and business processes. It also seeks to explain the traditional arrangement of information systems (IS) and the problems associated with this type of arrangement. Further, it seeks to discuss the functioning of enterprise systems and the potential benefits which could be gained from their use. Finally, it will use a simplified theoretical example in a university setting to further elaborate

on functionality and how they could benefit universities in Papua New Guinea (PNG).

Definition of enterprise systems

Enterprise systems could be defined as "core software programs used by companies to integrate and coordinate information in every area of the business" (Monk & Wagner, 2013, p. 1). Such a system could also be defined as an enterprise solution that "supports and automates business processes and manages business data" (Gulla, 2004, p. 1). Again, it could be defined as "a suite of integrated software modules and a common central database" (Laudon & Laudon, 2014, p. 369). It is used to "help organisations manage company-wide business processes, using a common database and shared management reporting tools" (Monk & Wagner, 2013, p. 1). Enterprise systems are also known as enterprise resource planning (ERP) systems (Gulla, 2004; Laudon & Laudon, 2013, 2014). In this paper, discussions surrounding ERP systems also apply to enterprise systems.

The above definitions are valid and could be combined to define a working definition for this paper, which is stated as 'a suite of integrated software modules used to integrate and manage organisation-wide business processes that share a common central database and management reporting tools". As depicted (Figure 1), having a single database would enable sharing of information between processes and functional areas rather than having multiple databases within which it is difficult to maintain consistency across processes. The single database would then be accessed by integrated set of specialised software modules developed to automate, coordinate and support the processes. It is now necessary to discuss functional areas of operations in organisations.

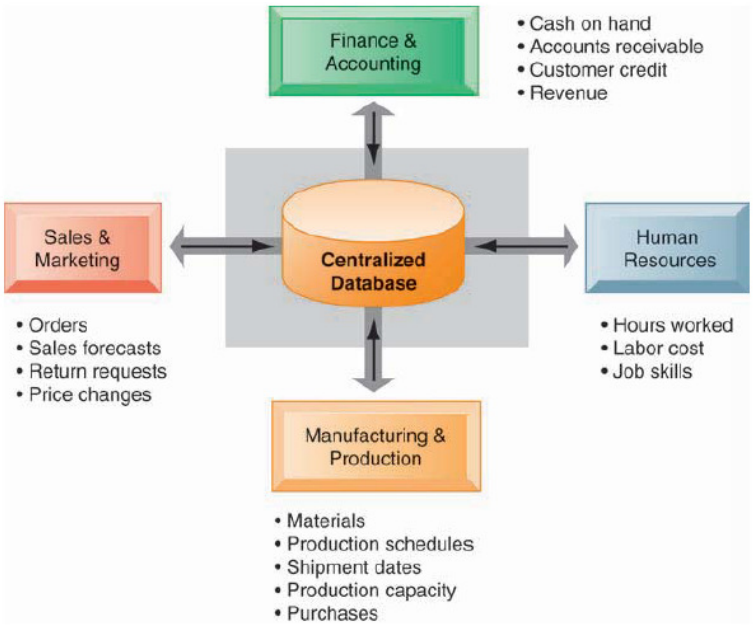

Figure 1: Enterprise systems comprise a set of integrated software modules and a central database that enables information to be shared by many different business processes and functional areas throughout the organisation. Adopted from Laudon and Laudon (2014, p. 370)

Functional areas of operations

Organisations have broad categories of functional areas of operation such as marketing and sales, supply chain management, human resource management, and accounting and finance (Monk & Wagner, 2013). These areas may have different names in different organisations depending the nature and structure of that organisation. Some may call them departments while others divisions or sections. Each area comprises specific business functions and processes. For example, a human resources department may include functions and processes for staff recruitment, induction and training. Accounting and finance may comprise accounts receivable, accounts payable and payroll. This leads now to the discussion of business processes.

Business processes view

As noted above, organisations usually have several functional areas each with its own set of data and processes. A business process may be defined as "a collection of activities (functions) that takes one or more kinds of input and creates an output, such as a report or forecast, which is of value to the customer" (Monk & Wagner, 2013, p. 1). It could be a discrete process within an individual functional area or an organisation-wide process that incorporates processes from multiple areas. With the latter, the activities performed in

multiple areas could be part of the same organisation-wide process. As shown (Figure 1) marketing and sales department which is responsible for advertising and selling of products could be linked to the manufacturing department, which is responsible for manufacturing the products. Because of such connectedness in functional areas, managers in many organisations are now shifting their attention from functions of an area to processes of the organisation (Monk & Wagner, 2013). This allows one area to interact with another through sharing of common information to complete its activities. As illustrated (Figure 2) accounting and finance may need to share information with other functional areas to accomplish its tasks correctly. It is now necessary to discuss traditional arrangement of information systems.

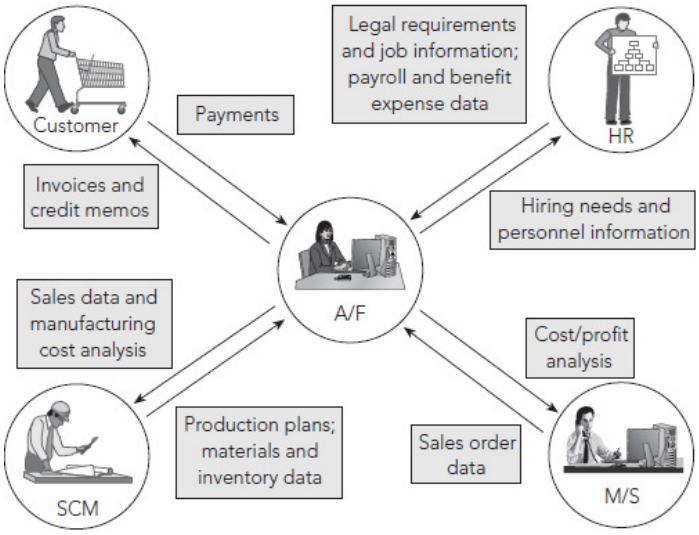

Figure 2: The accounting and finance functional area exchanges data with customers, and human resources, marketing and sales, and supply chain management functional areas. Adopted from Monk and Wagner (2013, p. 12)

Traditional view of systems

Large organisations usually have a traditional arrangement of information systems, where they have different systems, supporting only the activities, functions and business processes of individual functional areas (Laudon & Laudon, 2002; Monk & Wagner, 2013). With this arrangement, each area has its own system, resulting in organisations having many separate databases. They do not communicate with each other and the transfer of information between areas is normally done manually making it difficult for managers to assemble the data required to see a complete view of the organisation's performance.

Organisations with a traditional arrangement employ a functional business model, where activities and transfer of information flows vertically within processes of individual areas (Monk & Wagner, 2013). Systems of individual areas with disconnected databases function in isolation (Figure 3) (Laudon & Laudon, 2002). Accounting, for example, may have its own system while the human resources department has its own, supporting their own processes. This arrangement makes it problematic for lower organisational levels to exchange information effectively. Exchange of information normally takes place at top management level, which may know very little about the operations of individual areas.

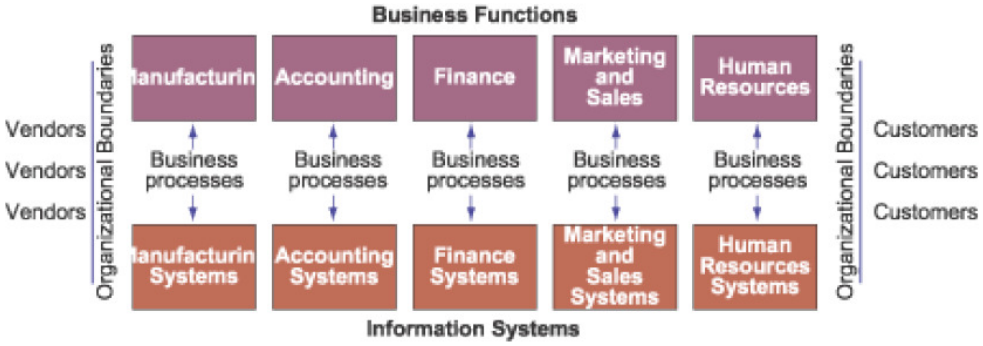

Figure 3: Traditional view of systems, where in most organisations, separate systems built over a long period of time support discrete business processes and discrete business functions, do not communicate with each other. The oorganisation's systems rarely include vendors and customers. Adopted from Laudon and Laudon (2002, p. 87)

The disconnected systems may function well within their own functional areas. However, to operate successfully in a competitive business environment with rapidly changing technology, organisations may need to integrate their areas so that processes in these areas could work together through sharing of information across the organisation. This leads now to the need to discuss some of the problems associated with traditional arrangement.

Problems with traditional systems

Having different types of systems which are not integrated may potentially result in many problems. There could, for example, be duplication of data, where the same data would be captured and updated by multiple systems (Monk & Wagner, 2013). Human data entry errors could occur when data is entered multiple times. Incorrectly entered data and updates can result in data inconsistencies. As a result, processes from multiple areas would be reading inconsistent versions of data from their own databases.

There would also be duplication of effort such as in having to update the same data in multiple places which would mean redundant effort from staff. There could be redundancy in staffing, adding to the operational cost of the

organisation. Communication can be delayed and flow of information hindered (Gulla, 2004). When data required from another area is not transferred promptly, work activities could be delayed. These problems would have a negative impact on the performance of the organisation. It is now necessary to discuss the functioning of enterprise systems, which could be implemented to deal with these problems.

Enterprise view of systems

Organisations are now implementing enterprise systems to respond to the problems previously discussed and operate efficiently in a changing and competitive business environment. Those doing so employ a process business model, which view the business as a set of processes comprising functions from multiple functional areas (Monk & Wagner, 2013). As shown (Figure 4), core discrete processes from functional areas are integrated into organisation-wide business processes (Laudon & Laudon, 2002), which allow them to share information in real time.

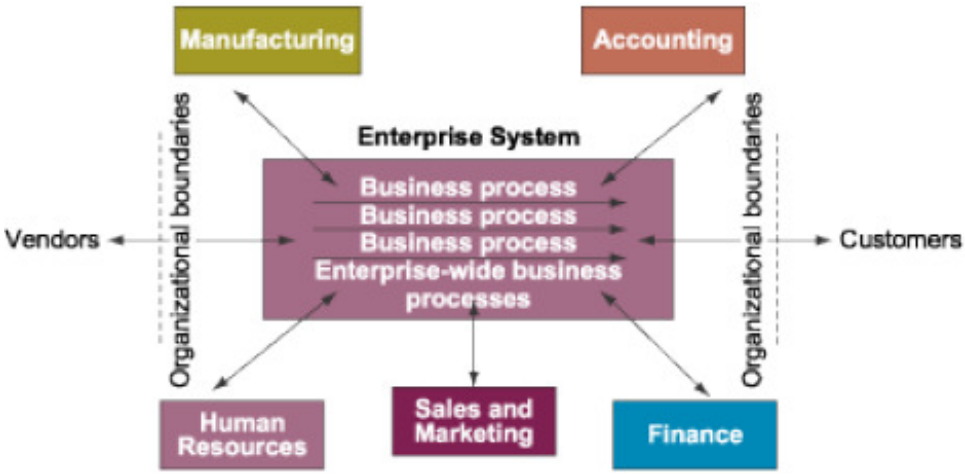

Figure 4: Enterprise systems can integrate the core business processes of an entire organisation into a single enterprise-wide system that allows information to flow seamlessly throughout the organisation. These systems may include transactions with customers and vendors. Adopted from Laudon and Laudon (2002, p. 87)

The core processes of an organisation could be automated into a suite of integrated software modules that allows information to flow seamlessly throughout the organisation, across organisational levels and areas (Laudon & Laudon, 2002, 2013, 2014; Monk & Wagner, 2013). The automated processes are linked together using a single database (Figure 5), which means that the different areas can now access the same database. Data entered by one process is immediately made available to all other processes. For example, employee

details entered by a HR process can be accessed immediately by accounting and finance processes. This improves the operations of business activities and flow of communication across the organisation. It also allows lower organisational levels to exchange information seamlessly without the need for top management to handle the exchange. Greater operational efficiency and other benefits could be gained as will be discussed in the next section.

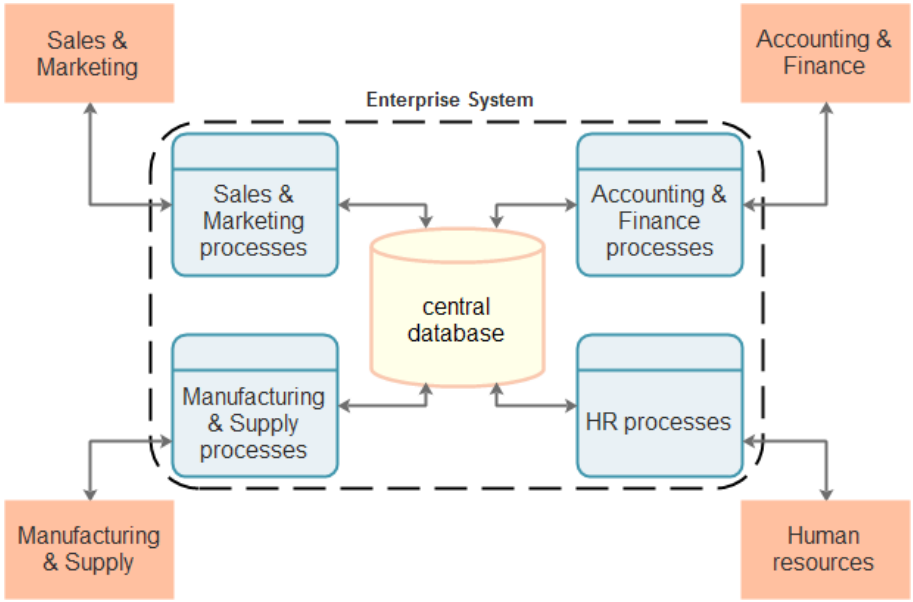

Figure 5: Enterprise systems can integrate business processes of individual functional areas into organisation-wide business processes which are automated and supported using a suite of integrated software modules.

The enterprise view of system model removes individual areas having their own systems. Enterprise systems allow different areas in an organisation to be integrated and allow them to access the same organisation-wide database (Figure 6), eliminating redundant data communication delays (Laudon & Laudon, 2013, 2014; Monk & Wagner, 2013). Enterprise systems evolved as a result of rapid expansion in technology, a view of integrating separate business processes and area systems in order to respond positively to competitive business environment. As noted, enterprise systems implement processes, such as "filling an order or scheduling a shipment, in order to integrate information across the organisation and eliminating complex, expensive links between computer systems in different areas of the business. Information that was previously fragmented in different systems can now flow seamlessly throughout the organisation so that it can be shared by processes in different functional areas" (Laudon & Laudon, 2002, p. 87)

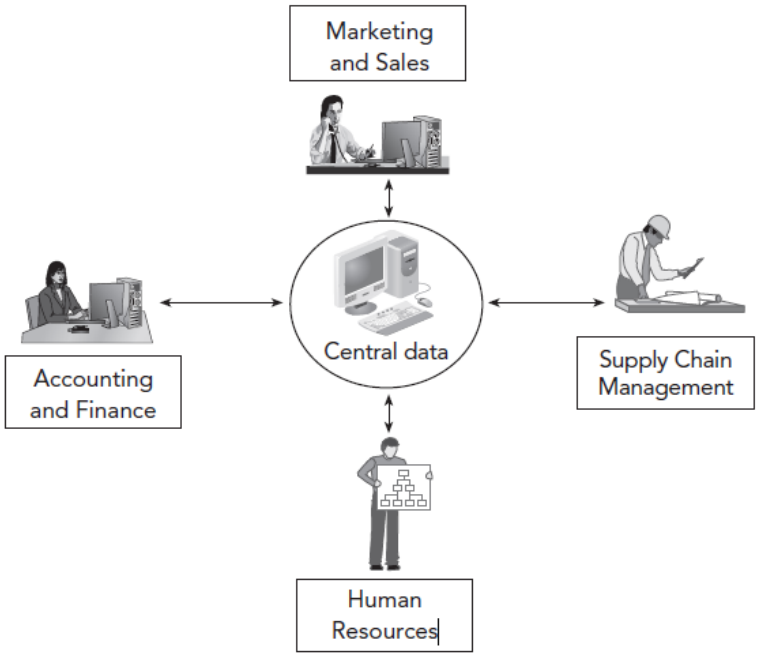

Figure 6: Enterprise system allows different functional areas in an organisation to be integrated and allow them to access the same organisation-wide database, eliminating redundant data communication lags. Adopted from Monk & Wagner (2013, p. 29)

Benefits of enterprise systems

Whilst there are various challenges facing development of enterprise systems, there are also many benefits to be gained from their successful implementation and use. Organisations are using enterprise systems achieve integration both internally and with other organisations such as suppliers and customers (Gulla, 2004; Laudon & Laudon, 2013, 2014). Using such systems, they are able to respond promptly to suppliers and customers, deal with events affecting the organisation quickly and see how they are performing at any given point in time.

As stated above, enterprise systems have the potential to enable processes from several functional areas to be integrated. This allows functional areas to access the same organisation-wide database making information sharing among processes easier. It also eliminates duplication of data, data inconsistencies, update anomalies and unnecessary redundancy of human effort.

Enterprise systems allow business processes to share information seamlessly, removing communication delays and enhancing information flows. They eliminate multiple entries of the same data in different areas. Data could be entered once into the system, and become available in real-time, accurate and

up-to-date to all processes throughout the organisation (Rabaa'i, Bandara, & Gable, 2010). This could avoid errors from occurring during data entry when users interact with the system. Reporting would be made easier and decisions made quicker because up-to-date information readily made accessible to management. Enterprise systems help managers to think in terms of organisational goals rather than focusing on goals specific to individual areas. They see the organisation as set of interconnected areas, where the function of one area affects or depends on another, which allow people from different areas to work together more effectively to achieve these goals.

With enterprise systems, it would no longer be necessary to update and repair many separate systems as there would now be one system to maintain. The need to enter and update the same data in multiple places would be removed. Management would be able to monitor and control operations more effectively (Monk & Wagner, 2013). "For example, without enterprise systems, getting an answer to 'How are we doing?' requires getting data from each business unit and then analysing that data for a comprehensive, integrated picture" (p. 36). Since enterprise systems have all the data in one single database, they can enable managers and decision makers pay more attention on improving the operations of the organisation so that the organisation can respond easily to changing business requirements.

Enterprise systems have the potential to reduce overall operational costs, thereby, generating savings (Peter & Shang, 2016). The system can help an organisation produce goods and services more quickly and a greater volume of sales could be generated. "Smoothly running enterprise systems could save an organisation's personnel, suppliers, distributors, and customers much frustration – a benefit that is real, but difficult to quantify". Providing real time information allows "organisations to improve external customer communications, which can improve customer relationships and increase sales" (Monk & Wagner, 2013, p. 39). Productivity, profitability and quality would be improved as well (Prenhall, 2016).

Enterprise systems in Papua New Guinea

Companies in PNG such as the Ok Tedi Mining Ltd are implementing enterprise systems to consolidate all areas (OTML, 2014). "As part of continuous improvement, OTML is implementing SAP as its Enterprise Resource Planning (ERP) System, replacing a number of old information technology systems and moving to a modern, integrated system" (p. 6). Telikom PNG is also implementing one to make management reporting and decision making in real time (Y. Mike, personal communication, February 8, 2016). Implementing enterprise systems could also benefit PNG universities. This leads now to the discussion of possible adoption of this type of system in PNG universities.

Enterprise systems in PNG universities

Universities have various functional areas including student administration, academic (comprising faculties and departments), research, human resources and finance, which all depend on each other to function properly (DWU, 2016a). Specific activities in the academic division (Figure 6) may need data related to enrolment from student administration. Thus, student details entered from student administration could be needed by academic staff to produce a class list and keep track of class attendance, record and report assessment results. For example, student administration shares information with students, academic and human resources areas for processes such as enrolment to be carried out smoothly.

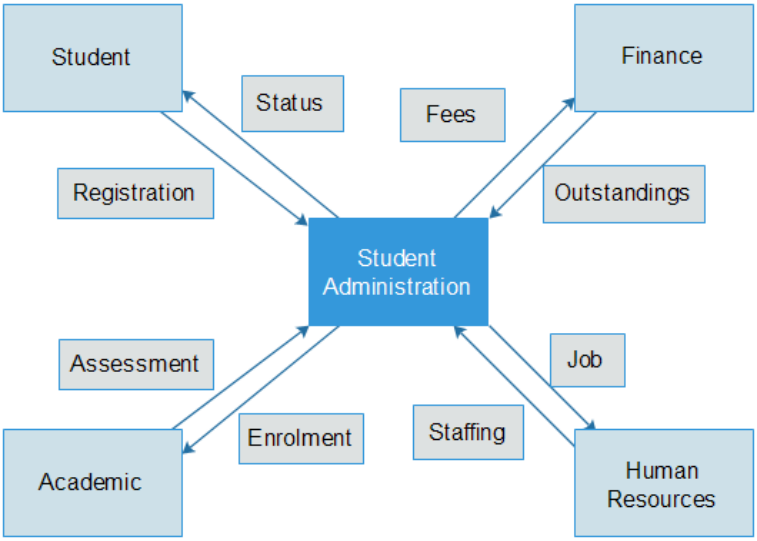

Figure 7: The student administration functional area exchanges information with students, academic division and human resources functional areas. For example, student administration needs to share information with other areas for the student enrolment process to be carried out smoothly.

Many universities, such as the Queensland University of Technology, have adopted enterprise systems to manage their data, improve their processes and reduce overall costs with the goal of achieving greater efficiency (Rabaa'i et al., 2010). It can be beneficial for PNG universities to adopt this kind of system to effectively coordinate their university-wide data and processes to achieve similar kinds of efficiency. Implementing an enterprise system to integrate and coordinate all the processes and information could provide management reporting tools for decision making and forecasting for top management. Top management would able to see an overall picture of the how university is performing and make forward planning effectively. It might also be necessary to use these systems to provide services to students, staff and other clients,

quicker and less expensively, which could all contribute towards becoming a great university.

Divine Word University (DWU) is implementing this type of system – the University 10 Student Information Management System – at the time of this writing (DWU, 2016b), which can have the potential to improve the university's processes such as student registration and enrolment. This undertaking is expected to assist in resolving problems such as duplication of data, data inconsistencies, update problems, redundancies and communication lags. Students would use the system to register online, reducing laborious efforts required from staff and students. Other existing systems within the university such as the learning management system could be integrated with this system (Figure 7), so that data and processes related to teaching and learning processes could be better coordinated and information disseminated effectively to all users concerned. Information provided to students in a transcript, for example, would normally be linked to units being taught and assessed during a particular semester. Course and assessment results can be shared between the learning management system and the student information management system so that students are able to view their transcripts conveniently. It now remains to further elaborate on how an enterprise system would function and be of benefit to PNG universities.

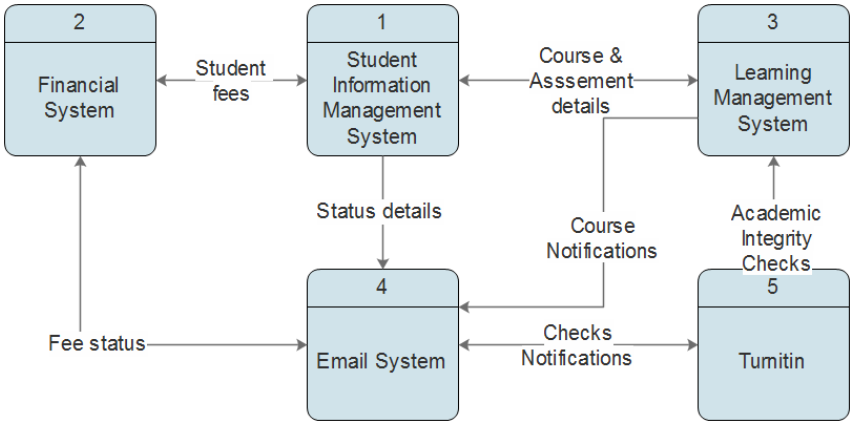

Figure 8: The student information management system could be integrated with the learning management system to exchange course and assessment information and financial system to exchange information about student fees so that students know the status of their fees.

Discussion

This section will now discuss a simplified example to further explain how an enterprise system works and how it could benefit PNG universities. As noted (Figure 9), an enterprise system could be designed to integrate processes from student administration, academic, research, finance and human resource areas

using a single shared database. Existing systems from these areas could also be redesigned into or replaced by the enterprise system.

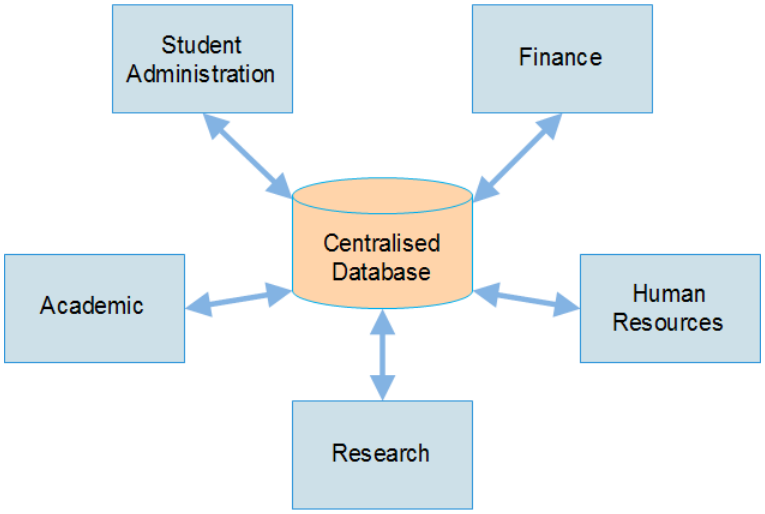

Figure 9: University enterprise systems showing the integration of some of the functional areas and processes of a university using a centralised database, enabling data to be shared by many different business processes and functional areas throughout the university.

University processes such as admission, enrolment, dormitory allocation and assessment reporting could be enhanced by such a system. Specialised software modules (subsystems) could be developed to automate these processes, which would be integrated using a single university-wide database. The enrolment subsystem could be used by students to perform tasks such as enrolling in course offerings in a given semester, un-enrolling from course offerings they have already enrolled in, viewing their profiles and assessment records, and printing their unofficial transcripts. The profile could contain information about students and the courses they have enrolled in that particular semester.

The admission subsystem could be used by the student administration staff to perform tasks such as adding student details and producing list of students who are eligible for government scholarship. The dormitory allocation subsystem could be used to perform tasks such as allocating students to dormitories and verifying students living in a particular dormitory.

The assessment subsystem could be used by the academic division, especially teaching staff, to record and report on assessment details including student marks and grades. It could also be used by student administration, mainly the registrar, to produce transcripts and generate lists of students eligible for government scholarships.

In order for the system to function correctly, it will need to keep track of data about certain aspects of the university including staff, students, courses, course offerings, enrolment and dormitories. Staff details will include identification number, name, gender, address, contact number, email and password. Student details will include identification number, name, gender, address, contact number, email and password. Course details will include code, name, description, prerequisites and credit points. Each course usually has multiple offerings, which refer to when that course is offered. IS303 Web Application Development (course) is offered in semester 1 of 2015, semester 1 of 2016 (offerings). Enrolment details may include marks and grades scored by a student in the courses she or he has studied. As per the policy of the university, students would normally be allowed to enrol in a certain number of courses per semester. Dormitory details could include the name of dormitories, number of floors and rooms, and students living in particular dormitories.

As mentioned, a university database could be developed to manage this information, which could be shared by functional areas and processes within the university. Figure 10 shows a typical university-wide registration and enrolment processes that involves various functional areas and sharing of a common database. Data entered in one area becomes available to other areas. Likewise, an output from one area becomes an input into another area in order for the latter to function accurately. When students are admitted into the university, their details would be entered into the system by student administration staff. Students would be provided with their credentials. Student would then access the system to enrol in schedules courses.

When students register in a program or enrol in particular course offerings, the course enrolment information is captured in the centralised database and the information shared among student administration, academic and finance areas. Academic staff can used that information to produce a class list. The diagram below only depicts part of a university enterprise system, showing the different functional areas and individual processes involved the university-wide enrolment process. Processes from other areas can be integrated into this model when designing an enterprise system. This leads now to the conclusion of this paper.

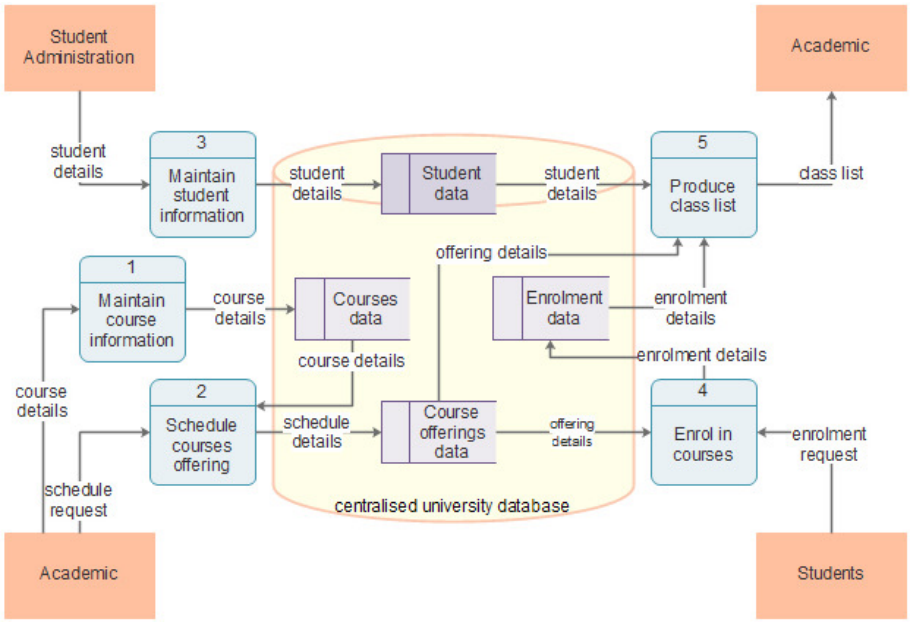

Figure 10: Simplified enterprise system model that illustrates the integration of individual processes from functional areas into university-wide enrolment process using a single shared database. Input from one area immediately becomes available to others. When students enrol in the scheduled course offerings, the enrolment information is used to produce class lists by academic staff.

Conclusion

This paper has some concepts such as functional areas of operation and businesses. It has discussed traditional arrangement of information systems and the problems inherent in this kind of arrangement. It has shown that with this type of arrangement, functional areas have their own information systems, making it difficult for lower organisational levels to exchange information effectively. Moreover, it has discussed an enterprise view of information systems, how it functions and the potential benefits to be gained from its implementation and use. It has shown how enterprise systems can integrate the key business processes of an entire organisation into a single suited of software modules that allows information to flow seamlessly throughout the organisation. Finally, it has shown that it would be beneficial for universities in PNG to adopt enterprise systems to effectively manage their university-wide data and processes to achieve organisational efficiency. It has used a simplified theoretical model in a university setting to further elaborate on how these systems work and how it could benefit PNG universities, by integrating individual processes from functional areas into university-wide processes using a single database.

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Glossary

Business function	Activities specific to a functional area of operation such as recruitment and selection in the HR
Business process	Collection of activities that takes one or more kinds of input and creates an output, such as a report or forecast, which is of value to the customer
Database	Collection of related data about things such as students
Enterprise system	A suite of integrated software modules used to integrate and manage organisation-wide business processes that share a common central database and management reporting tools
Enterprise view of systems	An arrangement where an organisation has one system that integrates business processes from multiple functional areas of operation using a single database.
Functional areas of operation	Broad categories of business activities including marketing and sales (MS), supply chain management (SCM), accounting and finance (AF) and human resources (HR)
Information system	People, procedures, software, and computers that store, organise, analyse, and deliver information
Traditional view of systems	Arrangement of information systems, where organisations have different systems, supporting only the activities, functions and business processes of individual functional areas.

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Martin Daniel is a lecturer in the Department of Information Systems at Divine Word University (DWU) and currently the university administrator for Moodle e-learning system. He holds a Master's Degree of Information Technology from the Queensland University of Technology in Australia and specialises in software information systems architecture. His research interests include researching issues related to implementation and use of e-services in Papua New Guinea. His current PhD research involves exploring the adoption of e-government initiatives in PNG. mdaniel@dwu.ac.pg and mdmartindaniel@gmail.com