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Business Process-Oriented Information Support for a Higher Education Enterprise

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Abstract

As a result of the changing and turbulent market environment in which higher education enterprises (HEEs) are currently operating, HEEs around the globe are moving away from more traditional collegial styles towards corporate managerial styles, in particular, process-orientation, to stay competitive. The organisational implications for HEEs as they move into “process” mode is discussed, and the requirements for information support in this new environment are evaluated. This paper overviews the major elements in higher education from process-oriented perspective, presents a model for a process-oriented HEE and discusses the implications for information support in this environment. Finally, the paper illustrates the notion of process-oriented information support using Monash University, Australia as a case study.

Keywords

Business process-oriented, higher education, information support, enterprise resource planning, value-focused thinking

1. Introduction

Worldwide, higher education enterprises (HEEs) are under increasing pressure to operate as commercial entities as a result of diminishing government funding, escalating costs, increasing student numbers, growing demand for accountability and quality, and increasing competition, both nationally and globally (Alstete 1995; Hafner 1998; and Williams 1993). As international education is now Australia's third largest service export industry, generating export earnings of approximately \$3.7 billion each year, and comprising mainly students from Asian region, Australian HEEs are encouraged by the Commonwealth government to adopt business-based strategies to facilitate greater international education (Long 2002; Marginson 2002; and Nelson 2002).

Australia has 37 public universities, two private and four self-accrediting specialist colleges (Long 2002). The sources of revenue for Australian HEEs include Commonwealth operating grants, Higher Education Contribution Scheme (HECS) and Postgraduate Education Loans Scheme (introduced in 2002) payments, domestic and overseas fee-paying students, research contracts and consultancies, investment income and other business type activities. Over the period 1996-2000, revenue from Commonwealth grants and HECS decreased by 10 per cent

while fees and charges increased by 38 per cent (with revenue from overseas students increasing more than 75 per cent) and other income increased by 8 per cent. Further, Nelson (2002) reports that Commonwealth payments will continue to decrease from 69 per cent in 1996 to a projected 61 per cent in 2004, therefore, fees and charges, particularly those from overseas students will be central to maintaining core funding in Australian HEEs.

With regards to Australian HEEs expenditure, salaries and related costs account for a major portion of total expenditure. However, they accounted for less than 59 per cent of operating expenses in 2000 compared to 62 per cent in 1996 (Nelson 2002). Australian HEEs are now investing more in development of sophisticated systems for measuring costs associated with their activities, marketing and recruitment, offshore operations, asset management and quality assurance (Marginson 2002 and Nelson 2002). There is a need for better management of Australian HEEs finances and activities especially when operating profit over the period 1996-2000 declined by approximately 32 per cent (Nelson 2002).

HEEs encounter similar problems to commercial enterprises such as human and material resources planning and constraints, cost controlling and fierce competition (Lockwood 1985 p. 29). As a result of this, HEEs are moving away from collegial styles towards managerial styles characterised by high staff student ratios; introduction of stringent financial planning and spending; centralisation of power structures; increased focus on efficiency and effectiveness of individuals' and departments' research and teaching standards; and above all introduction of information support (IS) to gain a competitive edge (Allen, Kern & Mattison 2002). IS is a crucial component in HEEs as IS is often seen as a cornerstone or key enabler for the managerial style (Davenport & Short 1990; Hammer 1990; Malhotra 1998; Melin & Goldkuhl 1999; and Penrod & Dolence 1992).

To meet the numerous challenges faced by commercial enterprises, there is a well-documented trend among organisations around the globe to focus on value-added processes and to replace their functional silos with process-complete departments to increase competitive advantage (Armistead 1996; Childe, Maull & Bennett 1994; Dye 2002; Garvin 1995; Ghoshal & Bartlett 1995; Lee & Dale 1998; Majchrzak & Wang 1996; Stanton & Hammer 1999; Stewart 1992; and Womack & Jones 1996). This is often referred to as a shift from *functional* to *process-oriented enterprise*.

In view of this, it is important to understand the concept of process-orientation in the context of higher education (HE). The concept of a *process* has been defined by many researchers (Armistead & Machin 1997; Childe et al 1994; Davenport & Short 1990; Green & Rosemann 2000; Hammer 1990; Malhotra 1998; and McCormick & Johnson (2001). For the purpose of this discussion, we understand *process* to be *a specific ordering of work activities across time and place, with a beginning, an end, and clearly identified objectives, inputs, and outputs* (Davenport & Short 1990).

There are a number of advantages of process-orientation in HEEs, including:

- Identify key processes for *improvement and/or redesign*. This leads to the elimination of non-value adding practices and increased customer satisfaction (Baba, Kamibeppu & Shimada 2001; Howard & Rudolph 1993; Mandviwalla & Hovav 1998; Muse & Burkhalter 1998; and Oakland & Porter 1995).
- *Process modeling* enables process understanding and can be used to develop a reference model for the enterprise (Sedera, Rosemann & Gable 2001; Sedera, Rosemann & Sedera 2001; and Stewart & Rosemann 2001).
- Identify potential candidates for *process automation* (Sharp & McDermott 2001).

- Understanding of cost allocation through identification of activities and activity drivers in each process when applying *activity-based costing* (Cropper & Cook 2000; DEST 2000; Ellis-Newman, Izan & Robinson 1996; Ellis-Newman & Robinson 1996; Goddard & Ooi 1998; Robb, Shanahan & Lord 1997; and Rodney, Borden & Thomas 1999).
- Strategic control through use of *balanced scorecard* and *simulation* (Scheer, Abolhassan, Jost and Kirchmer 2002).

Nevertheless, adoption of any business management concepts is far from a straightforward activity due to resistance to change from people within the organisation. HEE is a highly complex organisation with multi-level bureaucracies (Allen & Fifield 1999 and Taylor 1995). Change in HEE is further complicated by a management style, which tend towards administrative rather than proactive leadership and a tradition of academic freedom in which individual academics operate autonomously (Allen & Fifield 1999 and Thorney 1995). This does not satisfy the communication and teamwork requirements of a process-oriented environment (Garvin 1995 and Stanton & Hammer 1999). Change management (discussed by: Allen & Fifield 1999; House & Watson 1995; Rich & Scott 1997; and Slee 1995) is an important aspect in process-orientation however it falls beyond the scope of this paper.

The above argument is not a verdict on the ability of HEE's culture to adopt a process-oriented model. It is naïve to assume that process-orientation concept that comes naturally from manufacturing area can be directly applied to a HEE, but it is even more naïve to expect that due to the traditional "collegial" orientation of a HEE, modern trends in productivity improvement will somehow by-pass the HEE. In other words, whether one likes it or not, elements of process-orientation constitute a natural part of a modern HEE and thus should be thoroughly investigated.

For instance, consider the following scenario when a student is enrolling into a new course. Firstly, the student needs to visit faculty office to obtain an enrolment pack, which includes a course enrolment form. Secondly, the student needs to seek course advice from course advisor of school. If the student is eligible to apply for credit transfer, s/he needs to obtain an application for credit transfer from faculty office and returns to the course advisor for approval. Thirdly, the student returns to faculty office to submit the completed course enrolment form and credit transfer form (if applicable). Finally, the student proceeds to central administration to submit the original completed course enrolment form, enrolment questionnaire and HECS or PELS form to complete the enrolment process and receives a student identification card.

This example clearly illustrates the presence of an "enrolment process" in the sense defined earlier in this section. It would be both dangerous and counterproductive to treat this process from a "functional unit" perspective.

The objective of this paper is two-fold:

- To investigate the notion of a process-oriented HEE; and
- To consider the implications for information support in this environment

This paper is organised as follows: Section 2 provides a survey of the higher education area from process-oriented perspective; Section 3 formulates the model of a process-oriented HEE based on analysis presented in Section 2; Section 4 facilitates a discussion of the implications for IS and overviews current IS trends in HEEs; Section 5 provides an illustration of a model of a process-oriented HEE using Monash University (Australia) as a case study. Finally, a brief summary and conclusions are presented in Section 6.

2. Elements of a Process-oriented HE Enterprise

Based on surveys of the current trends in HE (Beekhuyzen, Goodwin & Nielsen 2002; Howard & Rudolph 1993; and Oakland & Porter 1995), many HEEs are moving into “process” mode. The major elements that are important in this new environment are depicted in an entity-relationship (ER) diagram in Figure 1. A “many-to-many” relationship exists between each entity in this diagram. Each of these entities is discussed in this section, and the focus is process and how other elements support the processes.

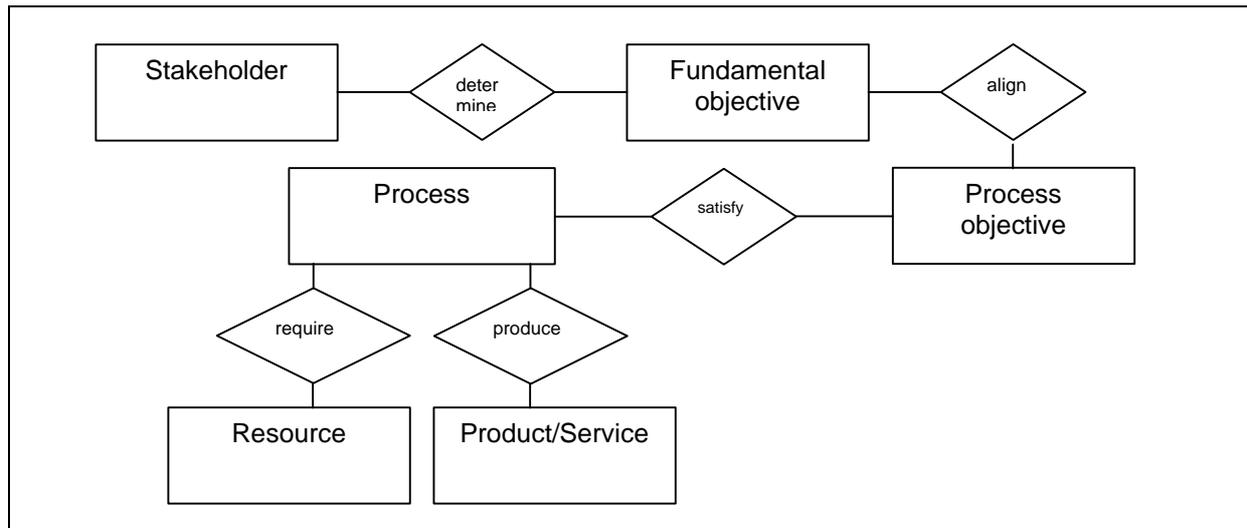


Figure 1. ER diagram of a process-oriented HEE

Stakeholders and Objectives: In Australia, Commonwealth government is responsible for setting HE policy, however, universities have a high degree of autonomy. Universities governing boards are accountable to relevant government bodies for the functioning of universities. Hence, stakeholders in HEEs definitely include *government bodies* and *governing boards*. Other stakeholders identified by researchers include for example, *students*, *academics*, *administrative and support staff*, *industry* and *society* (Dahlgard & Ostergaard 2000; Dahlgard, Kristensen & Kanji 1995; Hewitt & Clayton 1999; Kanji, Tambi & Wallace 1999; and Standard Australia 2000). It is important to note that there is considerable difficulty in identifying a unique role for a given group of people. For example, students are sometimes seen as stakeholders because of their participation in learning (Dahlgard & Ostergaard 2000; Dahlgard, Kristensen & Kanji 1995; Hewitt & Clayton 1999; Kanji, Tambi & Wallace 1999; and Standard Australia 2000) while graduates are considered products of the education process (Bailey, Chow & Haddad 1999 and Choi 1993).

Resources and Products/services: Resources are generally used as process inputs. In a HEE context, resources include *academics*, *administrative and support staff*, *teaching materials*, *technology support*, and *teaching locations* (Dahlgard & Ostergaard 2000). Products and services, on the other hand, are outputs from a process. For example, products of HE are teaching materials and research outcomes, while services of HE can be teaching. For the purpose of this discussion it is not necessary to distinguish between products and services. Outputs include *degrees*, *teaching materials*, *research outcomes*, *knowledge*, *intellectual property* and *community service* (Dahlgard et al 1995; Ghosh & Rodgers 1999; Harvey

1995; and Tribus 1998). Products and services delivered by a process can also be a resource consumed by another process, for instance, teaching materials are the results from *teaching preparation process* and they can be used as the resources for *teaching process*.

Identifying key processes and functions in HEEs: Below we discuss a number of alternative approaches for identifying processes within a HEE.

Sison and Pablo (2000) analysed the seemingly infinite set of tasks performed in any university using the *value chain* approach proposed by Porter (1985) by suggesting some processes and activities supporting these processes. The value adding processes identified are educational design, educational delivery, assessment, research and development, and outreach activities while activities supporting these processes include recruitment, admission, enrolment, academic service and alumni support.

Coopers & Lybrand and JISC (2001) suggested two methods for deriving a logical analysis of processes in a university, namely *functional approach* and *life cycle approach*. The *functional approach* starts with a top-down analysis of functions with the highest-level division of university's activities and then breaks each of these successively. The four highest-level divisions identified are *institutional strategy*, *teaching and learning*, *research and consultancy*, and *management of resources*. For *institutional strategy*, the functions performed include strategic plans and policies, market and competitor intelligence, and organisation and management structure. Similarly, the functions carried out in *teaching and learning* consist of teaching/learning strategy and plans, design course/module, prepare resources, deliver and assess courses/modules, and conduct performance review. As for *research and consultancy*, functions executed are research and consultancy strategy, bid for research/consultancy projects, and undertake research/consultancy. Finally, the functions within *management of resources* include staff, finance, assets, information, and student services.

The *life cycle approach*, on the other hand, identifies processes undertaken by a university and follows each from start to end of its lifecycle (C&L and JISC 2001). For instance, *institutional planning lifecycle* starts with institutional strategy development, then resource forecasting and planning, infrastructure planning, then annual plan development, resource management, and finally performance monitoring. *Academic year lifecycle* involves module/course planning, library planning, timetabling, academic staff allocation and management, module/course delivery, and external quality assessment. According to C&L and JISC (2001), the *undergraduate student lifecycle* begins with publicity, then student applications, selection, accommodation, registration, teaching and learning, examination and assessment, careers and advice, and ends with alumni. *Research lifecycle* involves application, sponsorship, funding application, funding management, research, assessment, publication, and acceptance/review.

Howard and Rudolph (1993) adopted total quality management (TQM) approach to an American university. This approach resulted in the identification of 12 critical processes within a HEE, namely, processes that involve admissions, curriculum development, teaching, international development, research, service delivery, community relations, information services, long-range planning, workforce hiring and development, facilities development, and funding development.

An alternative way of grouping processes was presented by Oakland and Porter (1995) based on a UK university. According to them, there are 7 key processes: teaching and staff development, strategic planning, research and dissemination, corporate development, external networks information and promotion, facilities development, and finance.

While there is no universal agreed set of HEE processes, process description proposed by SAP (2003) and referred to as *SAP solution map* for higher education has been widely accepted within the HE industry (Beekhuyzen et al 2002). In the rest of this paper we will use *SAP solution map* for higher education to illustrate a process-orientated model of a HEE and its information requirements. The solution map identifies nine major processes, namely: organisation management, university marketing, student management, studies management, grants management, records management, human resource management, material and services support, and business support.

Organisation management process involves strategic planning, budgeting, both financial and managerial accounting, and revenue management. The main objective of this process is to reduce operating costs through reduced administration and improved business process.

University marketing process aims to increase revenue through efficient campaign planning and management, developing new markets and gaining market share, and to improve customer service by improving product/service quality. This process involves all marketing activities and services required to recruit prospective students, and alumni services.

Student management process encompasses recruitment, admission, registration, student record management, student receivables, student portal, and services like financial aids, sponsorship, housing, and library services. This process intends to help universities to increase revenue by developing service offerings and efficient campaign planning and management, to reduce operating costs by reducing administration and improving business processes, to improve customer service by providing better service level and 24x7 customer self-service, and improving quality and accuracy of records, and to manage fixed assets by improving accounting processes.

Studies management process includes academic program development, class and examination planning, resources management and scheduling, academic advising and career placement, learning architecture, and media services. This process seeks to improve customer service through improved forecast accuracy and product/services quality, and providing 24x7 customer self-service. In addition, it aims to lower university's working capital through better capital utilisation, and also, to increase revenue through improved customer retention and loyalty, and development of new markets.

Grants management process consists of planning and grants application, research and grants management, financial accounting and reimbursement for sponsored programs, reporting to sponsors, and closeout. *Records management process* provides record and workflow definition, workflow execution and monitoring, records lifecycle management and information retrieval. Both of these processes in SAP's view aim to reduce operating costs by reducing administration and improving business processes.

Human resource management process seeks to reduce operating costs by improving recruiting, hiring and human resources processes. It consists of organisation and position management, recruitment, personnel administration, time management, personnel development and training, compensation and benefit administration, and payroll accounting.

Material and support process involves management of inventory, facility, and procurement, reimbursable services, and goods and services sales and distribution. The main objective of this process is to reduce operating costs by improving procurement processes, lowering logistic costs, reducing administration, and improving the management of asset and maintenance.

Business support process includes property management, cash management and treasury, real-estate management, and travel management. This process has three main objectives. The

first objective is to lower working capital by minimising borrowings, and improving cash management and capital utilisation. Secondly, to reduce operating costs by reducing both administration and travel expenses, improving asset and maintenance management, and improving business processes. The final objective is to manage fixed assets by centralising multi-location asset tracking.

Aligning Processes Objectives with HEE Objectives: It is interesting to note that when comparing objectives of processes mentioned previously and those of a HEE (see Figure 2), it is not obvious how these processes objectives fit into the fundamental objectives of a HEE. According to Keeney's *value-focused thinking methodology* (Clemen & Reilly 2001 and Keeney 1994), *fundamental objectives* are specific objectives that an organisation or person wants to achieve while *mean objectives* are objectives that help accomplish fundamental objectives. Therefore, process objectives can be aligned with fundamental objectives of a HEE using Keeney's *value-focused thinking* as depicted in Figure 2.

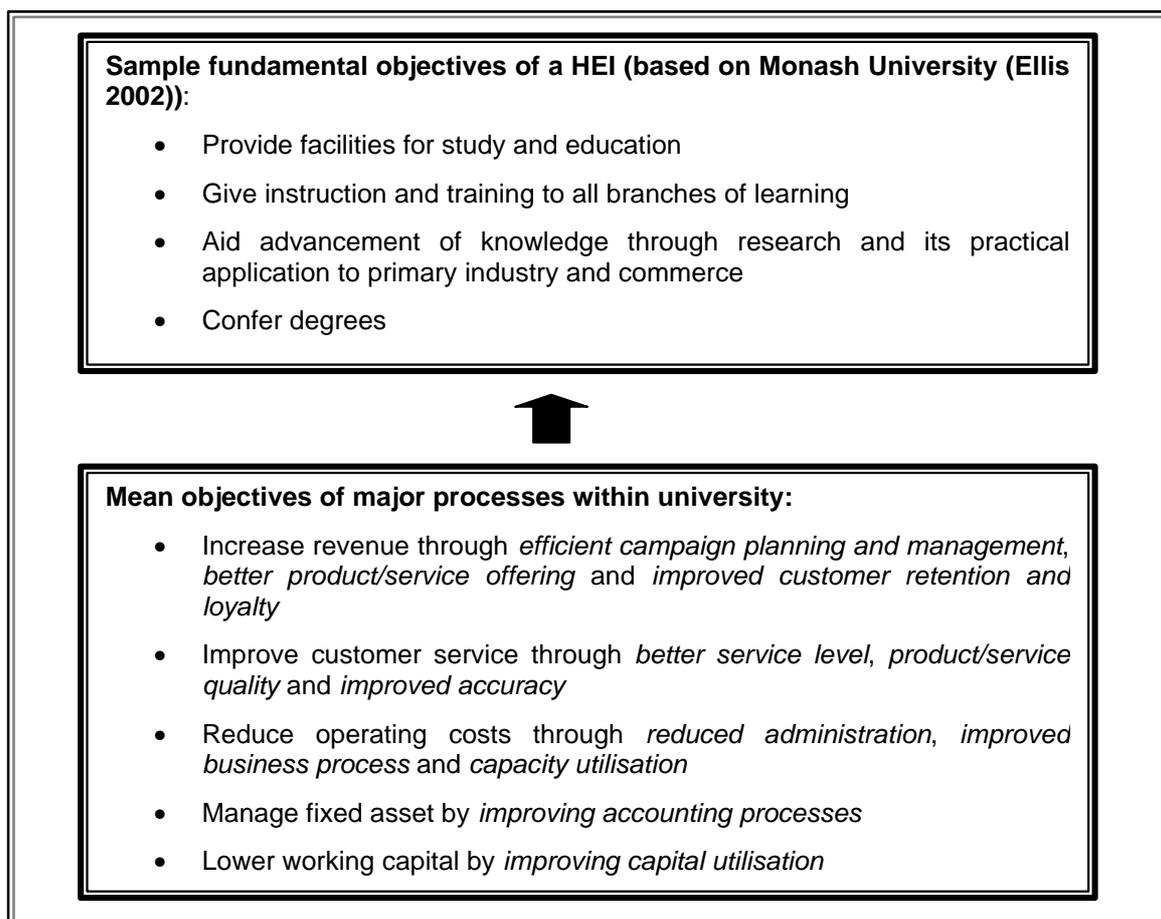


Figure 2. Fundamental and mean objectives of a process-oriented HE enterprise

In the next section a model of a process-oriented HEE is presented.

3. Model of a Process-oriented HE Enterprise

A model that summarises all the major elements of a process-oriented HEE is presented in Figure 3. This model is based on the key elements discussed in Section 2 and depicted by the ER diagram in Figure 1. In this model, stakeholders (for example, government bodies, governing boards, students, academics, administrative and support staff, industry and community) determine the fundamental objectives of a HEE.

Process-oriented HEE is centered on a number of processes that cut across functional boundaries as represented by the organisational structure of a university. The main functional boundaries identified include *student administration, marketing, finance, human resources, research, and teaching*.

Based on the discussion of processes in the previous section, nine major processes are identified and used for our analysis:

- **Organisation management:** includes university managerial activities, for example, strategic planning, budgeting, financial accounting, and managerial accounting.
- **University marketing:** contains marketing activities and services required to recruit prospective students as well as alumni services.
- **Student management:** encompasses student activities like recruitment, admission, registration, student record management, student accounts, student portal, and library services.
- **Studies management:** covers academic program development, teaching resources, planning and scheduling of teaching and related activities, and learning architecture.
- **Grants management:** handles grants and research activities, from planning, application, reporting, to closeout of grants.
- **Records management:** includes record and workflow definition, workflow execution and monitoring, records lifecycle management, and information retrieval.
- **Human resource management (HRM):** covers activities related to personnel, for example, recruitment, time management, personnel administration, and payroll accounting.
- **Material and services support:** includes management of inventory, procurement, and facility.
- **Business support:** encompasses property management, treasury, real-estate and travel management.

As presented in the model in Figure 3, a “many-to-many” relationship exists between fundamental and mean objectives, and between mean objectives and individual processes. For example, “*improve customer service*” might help achieve both “*provide facilities for study*” and “*give instruction*” objectives while the objective, “*provide facilities for study*” is achievable through both “*increase revenue*” and “*improve customer service*”. Similarly, the objectives of “*studies management*” process might include both “*reduce operating cost*” and “*increase revenue*” while both “*HRM*” and “*business support*” processes have the objective of “*reducing operating costs*”.

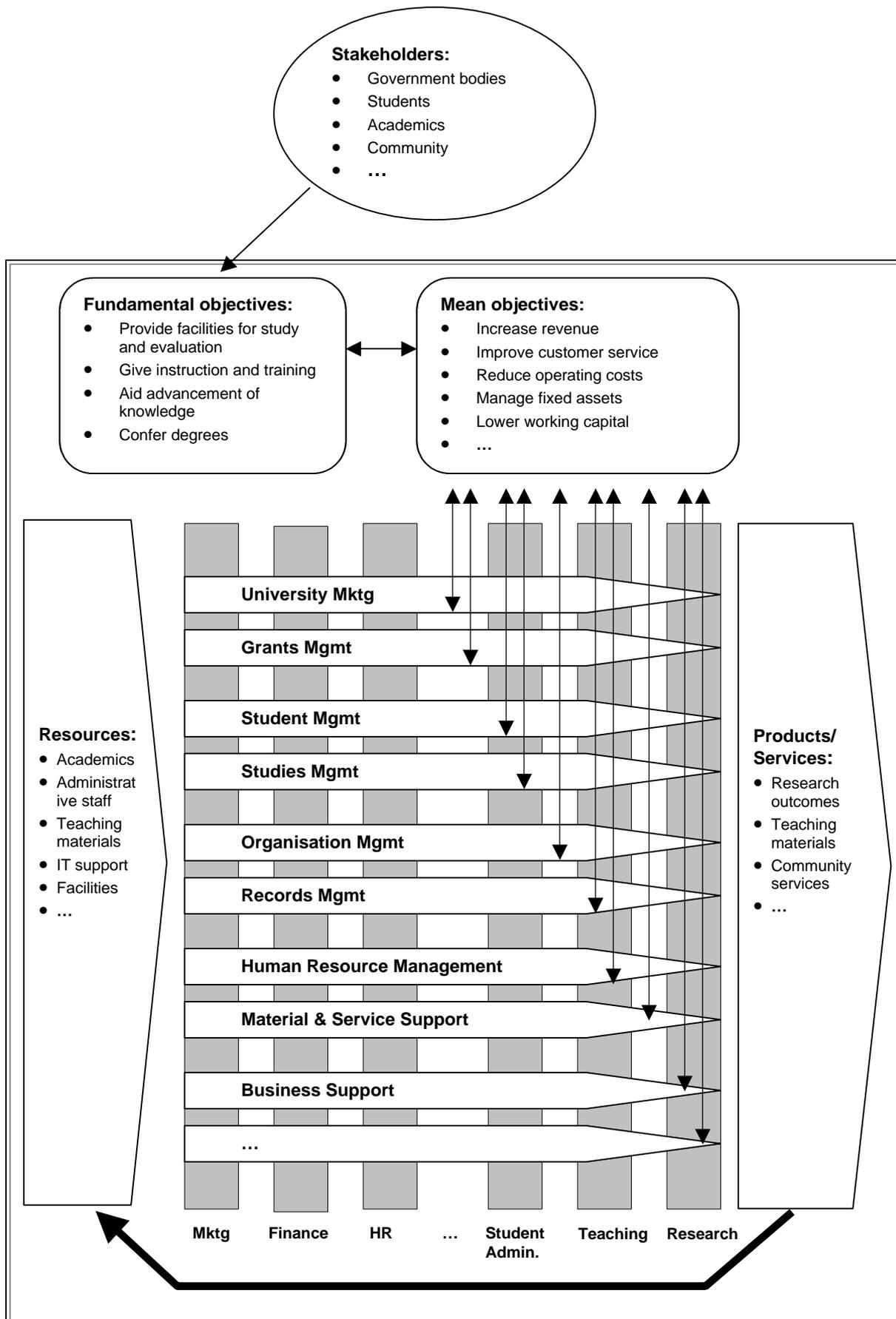


Figure 3. A model of a process-oriented HEE

Further, in this model “resources” may include *academics, administrative and support staff, teaching materials* and *IT resources* while “products/services” may consist of *degrees, teaching materials, research outcomes* and *community service*. However, products/services from a particular process can also be used as a resource to the next process, as indicated by the arrow flowing from products/services into resources.

The “...” is included in this model to enable extra elements to be added as required to reflect the dynamic nature of this industry.

This model enables the realisation of the advantages of process-orientation approach such as identification of key processes for *improvement and/or redesign, process modeling*, recognition of potential process candidates for *workflow automation*, better understanding of and more accurate cost allocation through identification of activities and activity drivers in each process when applying *activity-based costing* and enhancing strategic control through the use of *balanced scorecard* and *simulation* discussed in Section 1.

4. Implications for Information Support

Based on the model of a process-oriented HEE as depicted in Figure 3, it can be seen that such an enterprise requires enterprise wide management and planning. In order to support this environment, an *enterprise wide IS* solution is essential. A solution that links the entire enterprise exists in the form of *enterprise resource planning (ERP)* packages. Klaus, Rosemann and Gable (2000) defined ERP as a “*comprehensive packaged software solutions seek to integrate the complete range of a business’s processes and functions in order to present a holistic view of the business from a single information and IT architecture*”.

Currently, there are a number of major integrated software vendors in the industry, namely SAP AG, PeopleSoft, JD Edwards, Baan and Oracle. As well as providing standard solution to standard business processes such as accounting and logistics, some of these vendors also provide industry-specific solutions, such as *solution for higher education* provided by SAP. Due to the fact that ERP solutions are typically designed with process-orientation in mind, adoption of an ERP solution should therefore enable a higher degree of process-orientation within a HEE.

Based on the survey carried out by Beekhuyzen et al (2002), ERP adoptions by Australian universities are as high as 87%. This reflects the intense pressure experienced by Australian universities to perform as commercial enterprises. Further, 36% of those who adopted ERP implemented all three modules (Student Administration (SA), Human Resources (HR) and Financials (FI)) from a single ERP-vendor while the remaining 51% employed modules from different ERP-vendors. The percentage of universities in each state who implemented *at least one* module of ERP is reported as: 88% in Victoria, 88% in New South Wales, 90% in Queensland, 66% in Australian Capital Territory, 100% in South Australia, 100% in Northern Territory, 80% in Western Australia, and none in Tasmania.

These findings are capable of creating some controversy that reflects limited understanding of the concept of ERP. On the surface these findings may imply that 87% of HEEs exercise process-oriented IS. While, according to the survey, the breakdown of ERP use suggests that even adopting a single module of ERP software is classified by Beekhuyzen et al (2002) as an “ERP adoption” that in turn wrongly implies process-orientation.

In order to adopt a process-oriented model two classes of issues need to be resolved: conceptual issues related to the actual notion of an “ERP solution” for a HEE; and technical and social issues related to ERP adoption and implementation in a HEE environment. The technical and social issues are well documented in the literature (Beekhuyzen et al 2002; Sturdevant 1999; Swartz & Orgill 2001; and Wagner & Scott 2001). Major technical and social problems reported include ERP’s central operating platform being incompatible with university’s historically decentralised and independent structure, module implemented unable to meet universities’ core competencies and over-customisation of the ERP system to fit existing business practice (Beekhuyzen et al 2002; Sturdevant 1999; Swartz & Orgill 2001; and Wagner & Scott 2001).

As far as the conceptual issues are concerned, one of the major questions posed is “Can the use of a given stand-alone module of an ERP system in a HEE be classified as an ERP solution that enables process-orientation?”

In order to illustrate this issue, consider three scenarios depicted in Figure 4.

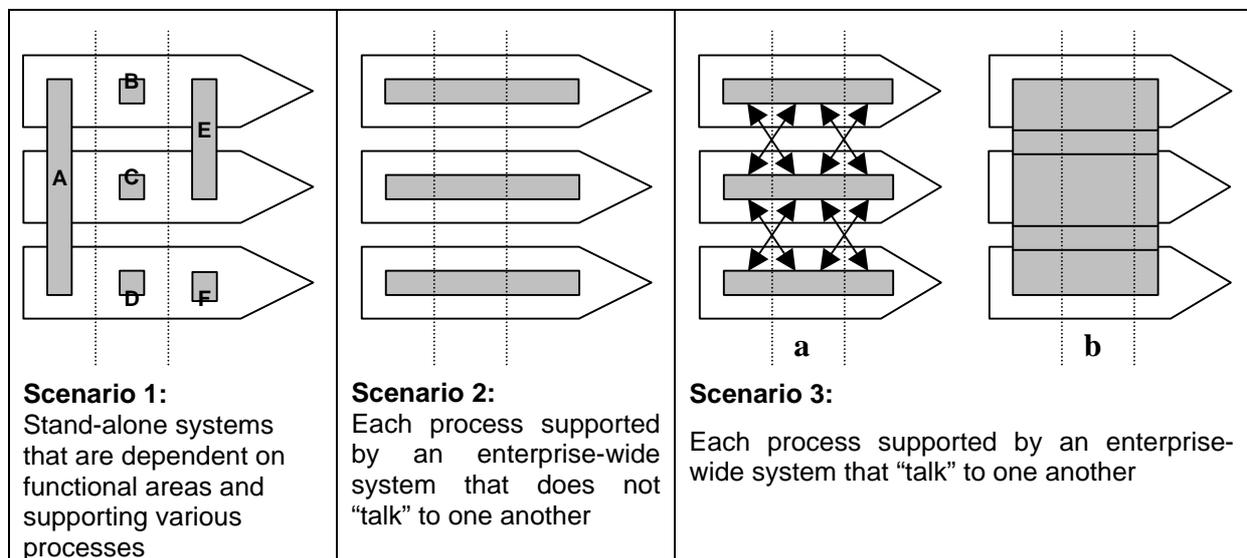


Figure 4. Common types of IS in HEEs

In the first scenario, there are a number of stand-alone systems that can support one or more processes and are dependent on functional areas. For example, software A supports all three processes in functional area 1, while each of the three processes in functional area 2 is supported by software B, C and D respectively. In functional area 3, software E supports two of the three processes while the other process is supported by software F. This situation is highly disjoint as far as IS is concerned as there can be cases with zero interfaces between different software systems, not only within processes framework but also within functional areas.

In contrast, each of the processes in the second scenario is supported by individual software system solution that cuts across functional boundaries but the inter-processes communications between these software systems are limited.

Scenario 3a is similar to the second scenario but the individual software solutions supporting each process communicate well with each other. In Scenario 3b, all the processes in the organisation are fully supported by a single enterprise software system with no communication problem.

The use of the term “ERP” in the survey performed by Beekhuyzen et al (2002) is in reality very close to the disjoint situations of Scenario 1 and Scenario 2. Therefore as far as process-orientation in HE is concerned most HEEs belong to Scenario 1, Scenario 2, or a combination of both these scenarios. Needless to say, as far as process support capabilities are concerned, the most adequate IS solution is the one presented either in Scenario 3a or Scenario 3b.

In the next section, the process support capabilities of an IS solution adopted by Monash University, Australia is examined in order to demonstrate how currently existing information systems support a process-oriented model.

5. Case Study: Monash University

Monash University is a global university with eight campuses, six located in and around Melbourne, Victoria, one in Malaysia and one in South Africa. Monash has a total number of 43,934 students studying in its campuses in 2000. According to Monash (2003), Monash is committed to the highest quality in teaching, learning, research and a wide range of professional and community activities. It is richly diverse and multicultural, serving Australians and international students from well over 100 countries. International student enrolments rose from 9% of Monash student population to 21% by 2000.

Information technology is a major enabling factor of the university’s core functions. The major software solution systems currently existing in Monash are:

- **SAP**
 - o Financials: consists of controlling, funds managements, asset management and financial accounting modules. Modules handle accounting at Monash; financial processes like purchasing and procurement, accounts payable, accounts receivables, internal transactions, and central processing; budgeting; cost management and controlling; running of reports on financial information; and assets management.
 - o Human Resources: manages and administers activities related to personnel like recruitment, payroll accounting, and personnel records.
- **Callista**: an integrated student administrative system that handles majority of business functions associated with student administration. It includes information on admissions, assessments, course structure and planning, enrolments, graduations, progressions, and research.
- **Oracle Discoverer**: a decision support or business intelligence tool that simplifies data extraction from Callista.
- **Voyager Library System**: web-based system that facilities online databases, and catalogues of other libraries searching.
- **myMonash.Portal**: a one-stop personalised web page for each student and staff member. It provides a gateway to all relevant web-based academic, administrative, social, and support resources.
- **ask.monash**: a web-based help system, which enables a searchable collection of frequently asked questions, submission of questions online and personalised area for monitoring the progress of questions submitted. This system is currently being trialed by Monash University.

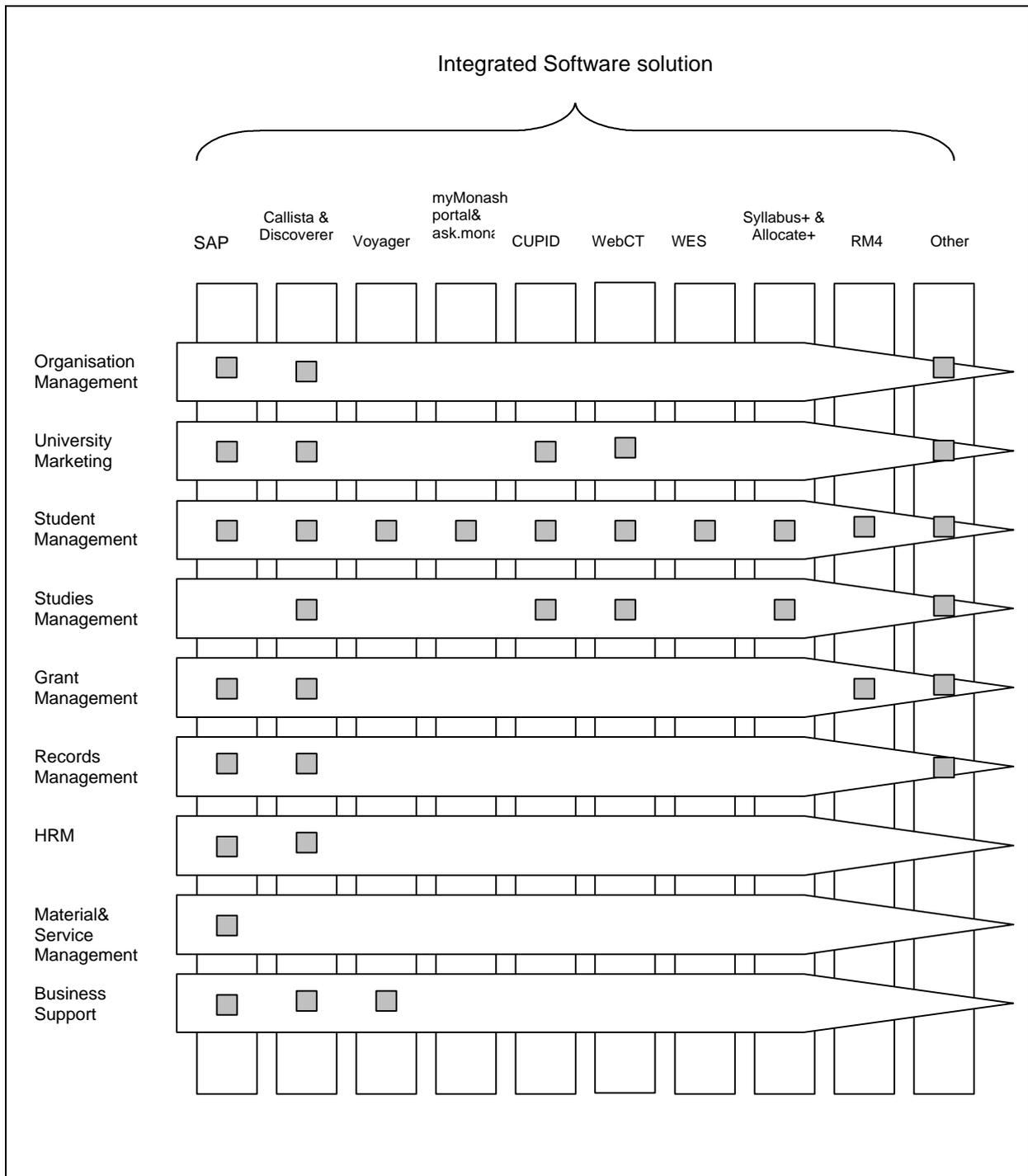


Figure 5. Summary of software solutions currently used at Monash University

- **Course and unit publication and information database (CUPID):** enables online enquiry and reporting of course, unit and other publication data through provision of online versions of undergraduate, postgraduate and off-campus distributed learning handbooks, and consolidation of data used in Monash publications preparation.
- **WebCT:** a learning management system adopted for the delivery of online learning material.

- **Syllabus Plus:** an online university-wide timetabling system.
- **Allocate Plus:** an online computer system used by students to allocate themselves into lectures and tutorials (this is available for university-wide use however, not all faculties are taking advantage of this system).
- **Web Enrolment System (WES):** a web-based access to administrative system that allow students to enroll online.
- **ResearchMaster4 (RM4):** only the publication module is installed for collection of research publications.
- Other support systems or methods used by individual faculties and schools/departments.

Having identified the major software solutions, let us analyse how the nine processes identified in Section 2 are supported by these software solutions. A graphical illustration is presented in Figure 5. Based on the investigation at Monash, it is found that both the *organisation management* and *records management processes* are supported by two main software packages, namely SAP and Callista. Analyses requiring information from both software packages cannot be performed automatically because of the technical lack of communication between them. To facilitate the information flow, information has to be extracted manually and downloaded into spreadsheets.

The *university marketing process* is sustained by a number of solutions, namely SAP, Callista, CUPID, WebCT and other standalone software. Callista supplies certain subject information to both CUPID and WebCT. However, there is no direct transfer of information between SAP and Callista as these packages do not “communicate” with one another.

As for the *student management process*, this process utilises all of the different software packages available at Monash. In addition, the Victorian Tertiary Admission Centre (VTAC) database is linked via transfer of file to Callista’s Admission module. A rollover from Admission to Enrolment module occurs when university confirms offers made by VTAC. Again, there is minimal communication between SAP and other packages while Callista provides most of the information regarding student details such as enrolment status; and subject details like subject names, lecturer in charge and subject points to most other packages.

The *studies management process* is supported by the following packages: Callista, Discoverer, CUPID, WebCT, Syllabus+ and Allocate+ while the *grants management process* is supported predominately by SAP, Callista, RM4 and other standalone software. Both SAP and Callista support the *HRM process* while *material and service management process* is supported by SAP. Lastly, the *business support process* is maintained by both software namely, SAP and Callista. Once again, analysis requiring information from both Callista and SAP cannot be done automatically due to the lack of communication between them.

As can be observed, the current situation at Monash University can be classified as a combination of both Scenarios 1 and 2, with no explicit interface between the individual systems involved. Thus, it can be concluded that there is some degree of process-orientation in IS but there is definitely much scope for further process-orientation and process enablement in Monash’s IS structure.

6. Summary and Conclusions

It is inevitable that higher education institutions around the globe are adopting some form of corporate management styles, in particular process-orientation, to gain a leading edge in today's ever-changing and competitive environment. In order for HEEs to realise full benefit from process-orientation, it is important to study the implications for HEEs and the required information support in this new environment. Subsequent to a thorough survey of current trends in HE, this paper presents a model of process-oriented HEE. In this model, stakeholders determine the fundamental objectives of a HEE and these objectives are aligned with the global objectives of government policies for higher education. This enterprise is centered on nine major processes (*organisation management; university marketing; student management; studies management; grants management; records management; HRM; material and services support; and business support*) that cut across functional boundaries of a HEE. Each individual process has its own objectives that help to accomplish the fundamental objectives of a HEE. Further each process requires resources to produce products/services.

Information support is a key enabler in process-orientation. As far as process support capabilities in HEE are concerned, the most adequate solution is when all processes in HEEs are being supported by either a single enterprise-wide system from one vendor or different process-based systems from different vendors that communicate with one another. However the findings from an analysis of the adequacy of IS currently in place at Monash University, a relatively well-advanced university, indicated that there is definitely much scope for further IS to enable a process-oriented HEE.

There are certainly advantages of presenting HEEs in a process-oriented framework. As such HEEs will benefit from a research into integration of different enterprise-wide systems supporting each process to facilitate seamless exchange of information. Further, research into the use of a methodological framework such as ARIS to synthesise architecture for an integrated HEE process-oriented information system that bring together required elements of organisational data, process and knowledge modeling to address HE needs will also be beneficial.

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