Challenges in Implementing Enterprise Resource Planning (ERP) system in Large Organizations: Similarities and Differences Between Corporate and University Environment

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ABSTRACT

Enterprise resource planning (ERP) system has been one of the most popular business management systems, providing benefits of real-time capabilities and seamless communication for business in large organizations. However, not all ERP implementations have been successful. Since ERP implementation affects entire organizations such as process, people, and culture, there are a number of challenges that companies may encounter in implementing ERP systems.

Recently, some universities have begun replacing their legacy systems with ERP systems to improve management and administration. This thesis focuses on challenges of ERP implementation between corporate and university environment. I review previous studies that determine Critical Successful Factors (CSFs) and risk factors to implement ERP in both environments. Particularly, case studies in this thesis emphasize the organizational dynamics involved in ERP implementation by using CSFs and three phases of framework by Miles and Huberman (1994): antecedent condition, implementation process, and outcomes. This study uses findings from the case studies to assess ERP readiness and CSFs' fulfillment. The results from this study contribute to contextual understanding of distinctive challenges in ERP implementation between corporate and university environment.

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1. Introduction

1.1. ERP in Business

Enterprise Resource Planning (ERP) is a software solution that integrates business functions and data into a single system to be shared within a company. While ERP originated from manufacturing and production planning systems used in the manufacturing industry, ERP expanded its scope in the 1990's to other "back-office" functions such as human resources, finance and production planning (Swartz & Orgill, 2001; Nieuwenhuyse, Boeck, Lambrecht, & Vandaele, 2011). Moreover, in recent years ERP has incorporated other business extensions such as supply chain management and customer relationship management to become more competitive (See Figure 1-1 below).

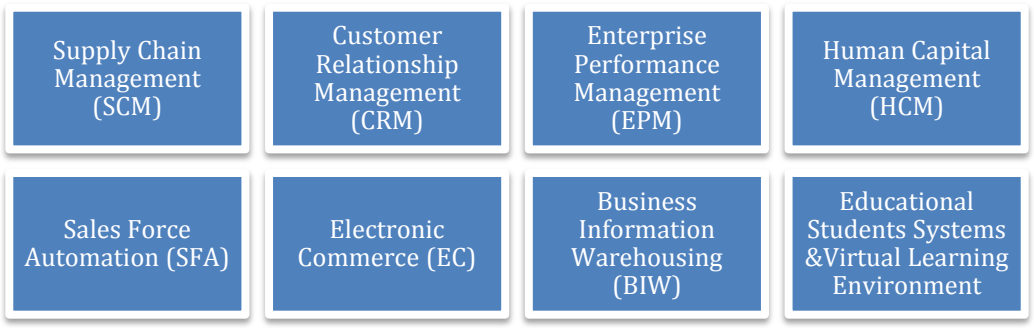

Figure 1-1. ERP Extension (Abbas, 2011)

The major goal of ERP is to increase operating efficiency by improving business processes and decreasing costs (Nah, Lau, & Kuang 2001; Beheshti 2006). ERP allows different departments with diverse needs to communicate with each other by sharing the same information in a single system. ERP thus increases cooperation and interaction between all business units in an organization on this basis (Harrison, 2004).

Also, ERP standardizes processes and data within an organization with best practices. The company also streamlines data flow between different parts of a business by creating a one-transaction system (Lieber, 1995). As Hitt, Wu, and Zhou (2002) stated, "the standardized and integrated ERP software environment provides a degree of interoperability that was difficult and expensive to achieve with stand-alone, custom-built systems." Standardization and integration of processes and data allows a company to centralize administrative activities, improves ability to deploy new information system functionality, and reduces information system maintenance costs (Siau, 2004).

As a result of its benefits, ERP has become the backbone of business intelligence for organizations by giving managers an integrated view of business processes (Parr & Shanks, 2000; Nash, 2000). ERP is designed to adapt to new business demands easily. The continuous technological advancement and the increasing complexity of ERP require companies to regularly upgrade their systems. Most ERP vendors provide an opportunity to update procedures and align with perceived best practices to meet changing business needs more quickly (Harrison, 2004).

A significant number of organizations have adopted ERP over the last two decades, and the revenue of the

ERP market has grown from $17.2 billion in 1998 (O'Leary, 2000) to $39.7 billion in 2011 (Dover, 2012).

1.2. Challenges of ERP implementation in Business

In spite of ERP's significant growth from the late 1990s to the present day, there are a number of challenges that companies may encounter when implementing ERP.

Dillard and Yuthas (2006) stated that most multinational firms are using ERP and that more small and midsize companies have begun to adopt ERP. Despite ERP's promises to benefit companies and a substantial capital investment, not all ERP implementations have successful outcomes. ERP implementations commonly have delayed an estimated schedule and overrun an initial budget (Ehie & Madsen, 2005; Helo, Anussornnitisarn & Phusavat, 2008).

Furthermore, the literature indicates that ERP implementations have sometimes failed to achieve the organization's targets and desired outcomes. Much of the research reported that the failure of ERP implementations was not caused by the ERP software itself, but rather by a high degree of complexity from the massive changes ERP causes in organizations (Scott & Vessey, 2000; Helo *et al.*, 2008; Maditinos, Chatzoudes & Tsairidis, 2012).

These failures can be explained by the fact that ERP implementation forced companies to follow the principle of 'best practices' in most successful organizations and form appropriate reference models. (Zornada & Velkavrh, 2005) According to Helo *et al.*, (2008), "Unlike other information systems, the major problems of ERP implementation are not technologically related issues such as technological complexity, compatibility, standardization, etc. but mostly [about] organization and human related issues like resistance to change, organizational culture, incompatible business processes, project mismanagement, top management commitment, etc.". Huang, Chang, Li and Lin (2004) presented the top ten risk factors causing ERP implementation failure (See Table 1-1 below).

Priority	Name
1	Lack of senior manager commitment
2	Ineffective communications with users
3	Insufficient training of end-users
4	Failure to get user support
5	Lack of effective project management methodology
6	Attempts to build bridges to legacy applications
7	Conflicts between user departments
8	Composition of project team members
9	Failure to redesign business process
10	Misunderstanding of change requirements

Table 1-1. Top ten risk factors of ERP risk (Huang *et al.*, 2004)

These risk factors illustrate various organizational considerations: organization fit, skill mix, project management and control, software system design, user involvement and training, and technology planning.

Since ERP implementation inevitably causes organizational changes, it requires the engagement of senior management from across the organization who is able to resolve conflicts. Without the commitment of senior management, ERP implementation has a high risk of failure.

In other words, due to changes in business processes across an organization, there can be resistance to adopting the ERP system. ERP connects and integrates all business functions within the organization. Therefore, it is critical that management staff be committed, and particularly that they equip employees who are using business functions influenced by ERP with clear channels of communication. Lack of end-user training increases risks by creating confusion and inaccuracy, thereby decreasing user satisfaction and the credibility of the system.

Excellent project management is also needed for successful ERP implementation. Project teams should have clear guidelines to execute ERP implementation from their project objectives and work plan to their resource allocation plan. Without good project management, ERP implementation projects that are large in scale and must take place over longer time periods may end in failure.

Furthermore, the composition of team members plays a crucial role in ERP implementation. ERP integrates diverse business functions across an organization into one single system, necessitating a complex and integrated software package. If a project team does not clearly understand the changes in its organizational structure, strategies, and processes from ERP implementation, it will not be in a position to benefit from ERP's competitive advantage. In order to best implement ERP, project team members should be selected with a balance between members with business experience within the organization and external experts with specialties in ERP.

From the perspective of project management, the iron triangle can illustrate how important it is to balance the three corners of the triangle – scope, schedule and cost. (Lamers, 2002)

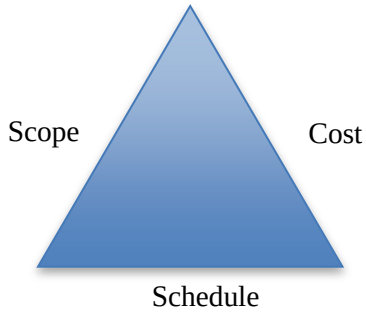

Figure 1-2. The iron triangle of project management (Lamers, 2002)

However, in ERP implementations, both schedule and cost tend to be underestimated, while scope is overestimated (Aiken, 2002). ERP changes the entire organizational environment by reengineering the entire business process; thus, after implementation, it is not easy to revise previous processes. Therefore, ERP implementations need accurate estimation, preparation with a holistic view, and systematic management of the entire implementation process.

1.3. ERP in Higher Education Institutions (HEIs)

Despite the challenges of implementing ERP systems, organizations in the corporate sector, which likely operate in more financially competitive environments than those in the non-profit sector, have experienced numerous benefits from ERP systems during the last two decades. These successes have encouraged higher education institutions (HEIs) to adopt ERP systems with the same goals that promoted corporate sector adoption (Fisher, 2006) such as increasing operational efficiency and decreasing costs.

HEIs have made significant investments in ERP implementation to improve institutional business processes (Mehlinger, 2006). According to Abugabah and Sanzogni (2010), HEIs spent more than $5 billions in ERP investment during the last few years. Recently, ERP vendors have expanded their product scope to include new products in response to relatively new market needs. Examples of such products include student lifecycle management software from ORACLE and SAP.

In spite of these additions, the implementation of ERP systems in HEIs has been described as challenging. (Rabaa'i, Bandara & Gable, 2009) One study found that in 60 to 80 percent of higher education contexts, ERP implementation failed to meet expected outcomes and results of implementation were found unsatisfactory (Mehlinger, 2006). ERP was initially designed for corporate organizations. Although ERP provides numerous customization options, these options may increase the risk of failure by increasing the scope of work and cost of implementation, as well as delaying implementation schedules.

Also, Pollock and Cornford (2004) described that ERP implementations create tension and affect the identity of universities raising new organizational issues based on the perceived uniqueness of specific universities, an issue that will be discussed later. Feemster (2000) described the difficulties experienced with an ERP system implementation in a U.S. college as "merging a system of decades– old databases and re-educating campus employees" and causing "enormous cost and pain".

HEIs have considered ERP adoption as a method of achieving greater integration of their management systems to better manage increasingly complex operations (Frantz, 2002). From decreasing government funding to increasing expectation by stakeholders, universities are currently under pressure to deliver higher quality educational services for lower costs. For these reasons, ERP systems can be very appealing to HEIs as a potential route to meeting these standards.

1.4. Research motivation

This thesis is motivated by the increasing adoption rate of ERP systems in HEIs. Even though there have been numerous studies about the challenges and critical success factors for ERP implementation in the corporate sector during the last two decades, HEIs have been reported not getting last-mover advantages from lessons learned in the corporate sector.

This study investigates why ERP implementation failures continue to occur within universities[1] using a case study of ERP implementations in Massachusetts Institute of Technology (MIT). It compares this case to another case from the corporate sector to figure out similarities and differences of challenges in ERP

[1] Higher education institutions cover a wide range of institutions- universities, colleges, academies, and institute of technology. (Wikipedia) This study focuses on universities.

implementation between the corporate sector and HEIs, and attempts to describe key similarities and differences of challenges in ERP implementation between the corporate sector and HEIs.

1.5. Thesis Structure

The study is structured as follows. First, a brief literature review introduces the university setting, the adoption of ERP systems in HEIs, and benefits and challenges of ERP implementation in HEIs. This section also gives ERP implementation process and critical success factors (CSFs) in ERP implementation. Next, the study conducts two in-depth case studies – one from a university and another from corporate sector – by following a framework of ERP implementation processes according to Miles and Huberman (1994)'s matrix with antecedent conditions, the implementation process, and outcomes.

The cases emphasize different areas in which challenges are most commonly reported, including the decision of ERP implementation, ERP selection, ERP implementation procedures, Consultants relationship, and ERP system evaluation. In subsequent discussion, Assessment of ERP readiness and CSFs fulfillment using the findings from the case studies offer a rich contextual understanding of comparative challenges in ERP implementations between these two sectors. Finally, a conclusion section summarizes key findings and makes recommendations for further research and action.

2. Literature review

2.1. University context

A university's most valuable assets are faculty, students, and staff. Each has distinctive interests within the same organization. For faculty, a university is a place to teach, conduct research, and write. For students, it is a place to learn, live, and entertain. For staff, it may share many features with corporate work, including management structure, hours, and HR practices. (Duderstadt, Atkins & Van, 2002) Pollock and Cornford (2004) stated that university is "thought of as a band of scholars coming together in pursuit and dissemination of knowledge, governed by a more or less collegiate model of organization, based around a complex structure of committees and with a high degree of individual and departmental autonomy".

In this sense, a university has been regarded as a "unique" organization that is different from an organization in the corporate sector in the literature for several decades (Lockwood & Davies, 1985; Balderston, 1995; Pollock & Cornford, 2004). Studies indicate that we must think of universities as more than non-profit organizations.

According to Lockwood and Davies (1985), universities have a certain combination of unique characteristics: complexity of purpose, limited measurability of outputs, both autonomy and dependency with regard to wider society, and diffuse structures of authority and internal fragmentation. This particular combination makes universities "unique", while general corporations have one or more of these components (Pollock & Cornford, 2004).

"Colleges and universities are organized along the lines of academic and professional disciplines, grouped into larger units such as a college of arts and sciences or a school of engineering, as well as into smaller subunits such as a department of history or an institute of biotechnology research (Duderstadt *et al*., 2002, p93)." The parallel structure divided into highly specialized academic units in universities makes decision-making processes different from those of corporations, which have formal and hierarchical communication structure.

On the other hand, there are some fundamental similarities between universities and corporations, and chief among these is that both universities and corporations are facing the common challenges of survival in competitive environment: increasing needs to improve efficiency and performance in administrative services (Allen & Fifield, 1999).

Enrollment in degree-granting institutions such as universities in the U.S. increased by 11 percent between 1990 and 2000. Between 2000 and 2010, enrollment in degree-granting institutions in the U.S. increased 37 percent, from 15.3 million to 21.0 million. During the same period, the number of full-time students rose 45 percent. [2]

While the number of students in universities has been increasing, rising expectations on the part of stakeholders (particularly students and the government), quality and performance requirements, and more competitive federal and local research funding have encouraged universities to strive for administrative excellence and to provide the best opportunities for students to attain competitive advantages (Allen &

[2] U.S. Department of Education, National Center for Education Statistics. (2012). *Digest of Education Statistics, 2011* (NCES 2012-001), Chapter 3. http://nces.ed.gov/fastfacts/display.asp?id=98

Kern, 2001; Fisher, 2006; Okunoye, Frolick & Crable, 2006). As a result, in spite of their uniqueness, universities have been forced to adopt certain of the corporate sector best practices for efficiency and productivity in business.

In addition to the competitive environment, rapid advances in information technology have reshaped university administrative practices (Duderstadt *et al*., 2002). For example, research and scholarship depend upon information technology such as virtual laboratories and digital libraries. Also, new technology has affected teaching, "freeing the classroom from the constraints of space and time and enriching the learning of our students through access to original source materials" (Duderstadt *et al.*, 2002).

Considering the significant influence of information technology in universities, it is not surprising that many have adopted ERP systems for development and reengineering of administrative systems as a route to improved performance (King, 2002; Abugabah & Sanzogni, 2010).

2.2. ERP benefits in university

ERP use in HEIs integrates administrative functions that have been supported by separate legacy systems[3] in the past (Zornada & Velkavrh, 2005). Separate legacy systems were "disparate" and have led to "duplicate resources and services" (Allen & Kern, 2001). ERP enables HEIs to consolidate disparate data and legacy systems and adopt best-of-breed processes and modern technology.

As different departments across an institution share an integrated database, end users can access data in real time. Best-of-breed information technology such as web technologies, mobile phones, and on-line services offer additional benefits not only to the administration within an institution, but also to people who constantly interact with the institution – faculty, students, and staff (Murphy, 2004; Zornada & Velkavrh, 2005).

According to King (2002), the main advantages of ERP in HEIs are (1) improved information access for planning and managing the institution, (2) improved services for the faculty, students and staff, (3) lower business risks, and (4) increased income and decreased expenses due to improved efficiency. Sabau, Munten, Bologa, Bologa and Surcel (2009) provide ERP benefits for universities in terms of business and technical point of views (see Figure 2-1 below).

[3] A legacy system refers to an old method, technology, computer system, or application program. It may still be in use instead newer or upgraded versions for certain role. (Wikipedia, 2013)

Business benefits

- campus wide integration on a common system;
- improve internal communications;
- reduce or eliminate manual processes;
- enhance strategic decision making and planning capabilities;
- establish a self-service environment for employees;
- improve self-service environment for students and faculty;
- enable higher availability of administrative systems;
- support sophisticated data analyses for use in decision-making;
- integrated workflow, industry best practices, and reduced dependence on paper;

Technical benefits

- reduce or eliminate the need for backup or shadow systems;
- platform for re-engineering business practices and continued process improvements;
- develop and maintain consistent data definitions;
- provide accessible, user-friendly administrative and student support services;
- increase data integrity, validity and reliability;
- assure system wide security and protection of confidential information;
- create a more seamless integration between technology and education delivery by providing a single platform based on new technologies;
- access to data in real time.

Figure 2-1. ERP benefits in Universities (Sabau *et al.*, 2009)

2.3. The ERP implementation process

In order to better understand the process of ERP adoptions, a number of researchers have developed conceptual ERP life cycle frameworks or process models. Ehie and Madsen (2005) suggested a five-stage ERP implementation process using various reviews of the previous literature: project preparation, business blueprint, realization, final preparation, "Go-Live" and support (See Figure 2-2 below).

Project preparation refers to a comprehensive planning phase that forms a project team with leadership roles, sets budget targets, and defines the project objectives and plan. In the business blueprint phase, the current business process is analyzed in detail in order to select an appropriate ERP system. A project team then is trained on functionality and configuration of the selected ERP system. An understanding of the selected ERP system allows a project team to gain insight to reengineering its business processes.

In the realization phase, a project team concentrates on implementing an ERP system including modification, development of interfaces, and data conversion. At the same time, each process design is tested on a conference room pilot[4]. In the final preparation phase, the entire process is fully integrated and tested throughout the organization with full data and various scenarios. End users are trained in this phase as well. Finally, in the "go-live" and support phase, the ERP system is constantly stabilized and may have extensions for competitive advantage.

[4] A conference room pilot refers to a software acceptance testing to validate a software application to meet business requirements and expectations for end-users of the software. (Wikipedia, 2013)

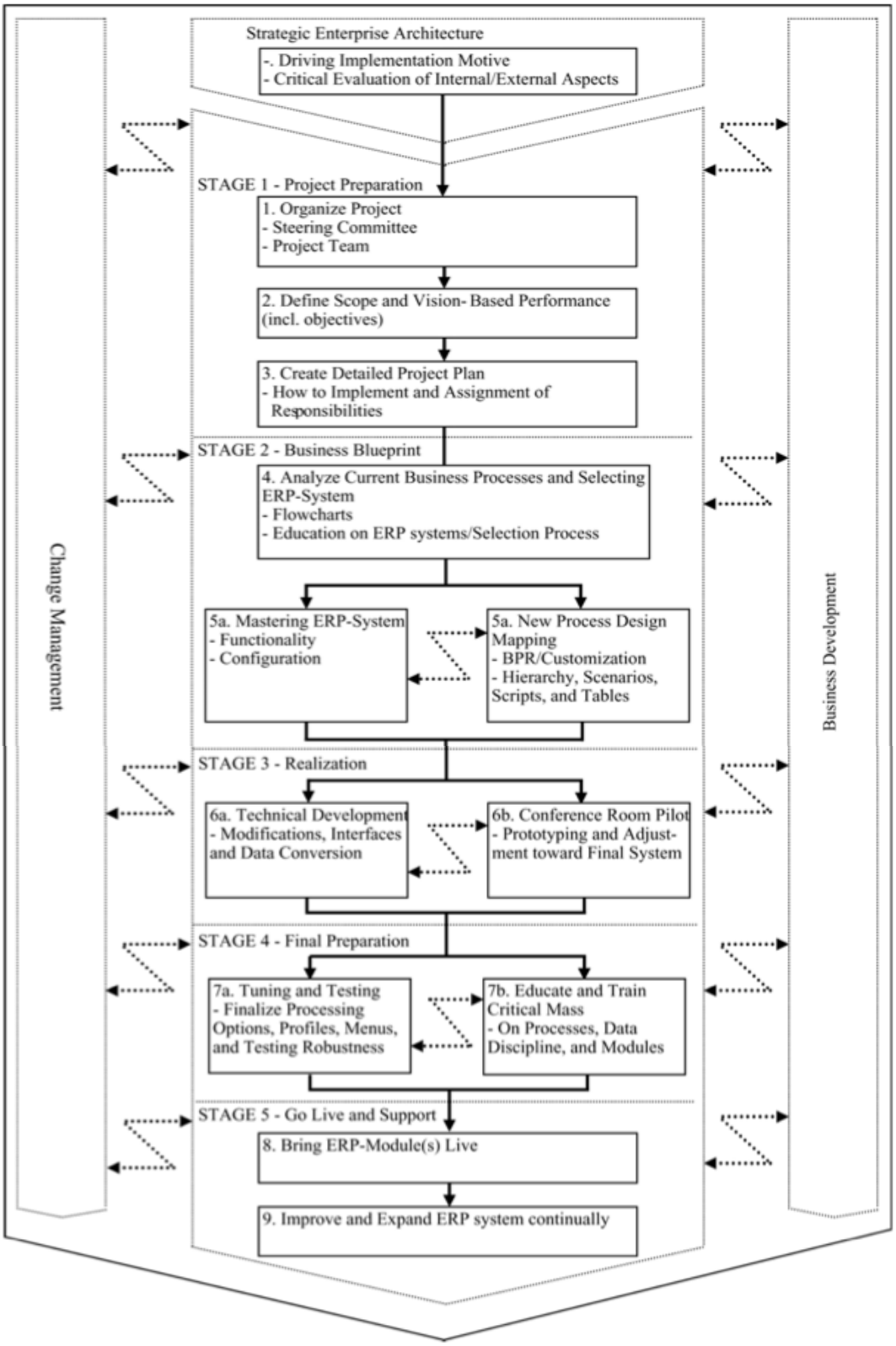

Figure 2-2. Five stage of ERP implementation process (Ehie & Madsen, 2005)

2.4. Challenges of ERP implementation in University

Heiskanen, Newman and Similä, (2000) suggest that ERP software, which incorporates best practices from the corporate business industry, is not appropriate for universities, since universities have unique structures and decision-making processes.

Organizational culture heavily affects ERP implementation. Tsichritzis (1999) indicates that today's universities have been forced to admit that "education is a business and students are the customers". ERP implementation encourages universities take a more business-like approach to education, resulting in cultural changes including "the use of managerial language and techniques" (Allen, Kern & Havenhand, 2002). There can be resistance to ERP implementation at universities because it involves not merely the adoption of a new information system, but a holistic change in organizational culture.

While there are diverse forms of management hierarchy from university to university, Birnbaum & Edelson (1989) describes that there exist two sources of authorities within a university: administrative authority and academic authority. ERP implementation is believed to reinforce administrative authority as a model of governance. For academics, this may lead to fear that use of a new system that results in increased transparency of their transactions would result in a loss of control. On the other hand, administrative staff may fear for their job security when redundant processes are eliminated work functions are automated across a university (Allen *et al.*, 2002).

Moreover, Pollock and Cornford (2005) argue that ERP, as a "generic type of solution" from the corporate industry, could be a high-risk strategy for universities. Despite HEI's needs for unique business functions, ERP solutions limit their choices and encourage adopting a "generic solution". Since there have been few discussions and considerations regarding the challenges that universities might face from generic ERP system adoption, there is little assurance that the process will be successful.

Also, as ERP systems are "large integrated packaged solutions" with dynamic complexity, it may cause difficulties with implementation for management and IT staff in universities, even those who might have comprehensive understanding of their own organizations (Pollock & Cornford, 2005). This is because universities have expanded a range of systems many of which have sometimes competing functions whenever they had particular needs (Pollock & Cornford, 2005). In the worst case, universities do not always have management or IT staff who are well-versed in organizational functions.

Standardization and integration, both of which are key features of ERP systems, limit flexibility in university systems. This loss of flexibility may lead staff to create 'workarounds' in which workers attempt to carry on their previous processes. This response to new ERP systems may ultimately increase staff workloads and create a data gaps between the system and reality.

2.5. Critical Success Factors for ERP implementation

Rabaa'i (2009) researched previous studies identifying critical success factors (CSFs) for ERP implementation. This research presents the top 12 most frequently cited CSFs from previous studies: Top management commitment and support, change management, project management, business process re-engineering and system customization, training, ERP team composition, visioning and planning, consultant selection and relationship, communication plan, ERP system selection, ERP systems integration, and post-implementation evaluation measures.

Top management commitment and support

Successful ERP implementation depends on management to prepare for challenges that might be faced (Motwani, Mirchandani, Madan & Gunasekaran, 2002), as well as senior management who are involved in overall strategy of the company and are not familiar with technical aspects (Yusuf, Gunasekaran & Abthorpe, 2004). Also, top management commitment and support leads to overall organizational commitment across an organization. It results in the successful ERP implementation (Umble & Umble, 2002).

Change management

Ehie and Madsen (2005) stated that ERP implementation involves more than changing software or hardware systems. Ideally, by reengineering business processes, ERP implementation can help an organization to benefit from higher levels of efficiency and improved performance. Therefore, ERP implementation may cause changes that lead to resistance among employees (Glover, Prawitt & Romney, 1999). Consequently, balancing conflicts between staff and technology and effectively managing employees in the change process are key elements for the successful ERP implementation (Ash & Burn, 2003).

Project management

Effective project management is critical for the successful ERP implementation (Umble, Haft & Umble, 2003; Nah & Delgado, 2006). Bingi, Sharma, and Godla (1999) found that "a lack of proper understanding of the project needs and the inability to provide leadership and guidance to the project" are the main factors when ERP implementation fails. Thus, effective project management should define clear project objectives, develop a work and resource plan, and carefully track the project's progress.

Business Process Re-engineering and system's customization

There are two approaches to implementing ERP systems in an organization: reengineering business processes and ERP customization (Shehab, Sharp, Supramaniam & Spedding, 2004). Business process reengineering creates deep changes in organizational processes in order to fit them to ERP functions. On the other hand, when an organization wishes to maintain its existing processes using an ERP system, it can customize ERP functions. However, many researches indicate that ERP customization should be avoided or minimized in order to achieve the full of benefits offered by ERP systems (Shanks, Parr, Hu, Corbitt, Thanasankit & Seddon, 2000; Light, 2001; Bajwa, Garcia & Mooney, 2004).

Training

End user training has been recognized a critical factor for ERP implementation (Bajwa *et al*., 2004). Due to the complexity of the integrated ERP system, end user training is essential for a robust understanding of how the system works and how to use it. Consequently, appropriate end user education and training will maximize ERP benefits and increase user satisfaction.

ERP team composition

Since ERP covers diverse functional areas across an organization, ERP team composition is also important for the successful ERP implementation; an ERP project team should consist of representatives from all functional units related to ERP.

Consultant selection and relationship

ERP consultants play a critical role in ERP implementation. Consultants can be essential knowledge resources for ERP's hardware, software, and personnel. They also can help staff, have responsibility for project management, and audit the project. On the other hand, in order to be successful system maintenance after post-implementation, knowledge transfer from consultants is crucial for the organization.

Communication plan

Strong communication within the entire organization during the implementation process increases success for ERP implementation. It allows the organization's stakeholders to understand the goal and the expected benefits of the project as well as to share the progress of the project. An "open information policy" protects the various communication failures for the project. (Al-Mashari, Al-Mudimigh, and Zairi, 2003)

While the critical success factors can lead to success of ERP implementation, they do not guarantee it. Al-Mashari, Al-Mudimigh, and Zairi (2003) state that the delivery of the critical success factors is one major condition to lead to benefits from ERP implementation, and they suggests that IT projects can be considered successful as according to the following terms:

- Correspondence success, which occurs when there is a match between IT systems and the specific planned objectives.
- Process success, which occurs when IT project is completed within time and budget.
- Interaction success, which occurs when users attitudes towards IT are positive.
- Expectation success, which occurs when IT systems match users expectations.

In addition, the taxonomy represented in Figure 2-2 (Al-Mashari *et al.*, 2003) illustrates the interplay between core business strategy aspects in the ERP implementation and explains how the role of IT and associated systems can play in supporting the effective deployment.

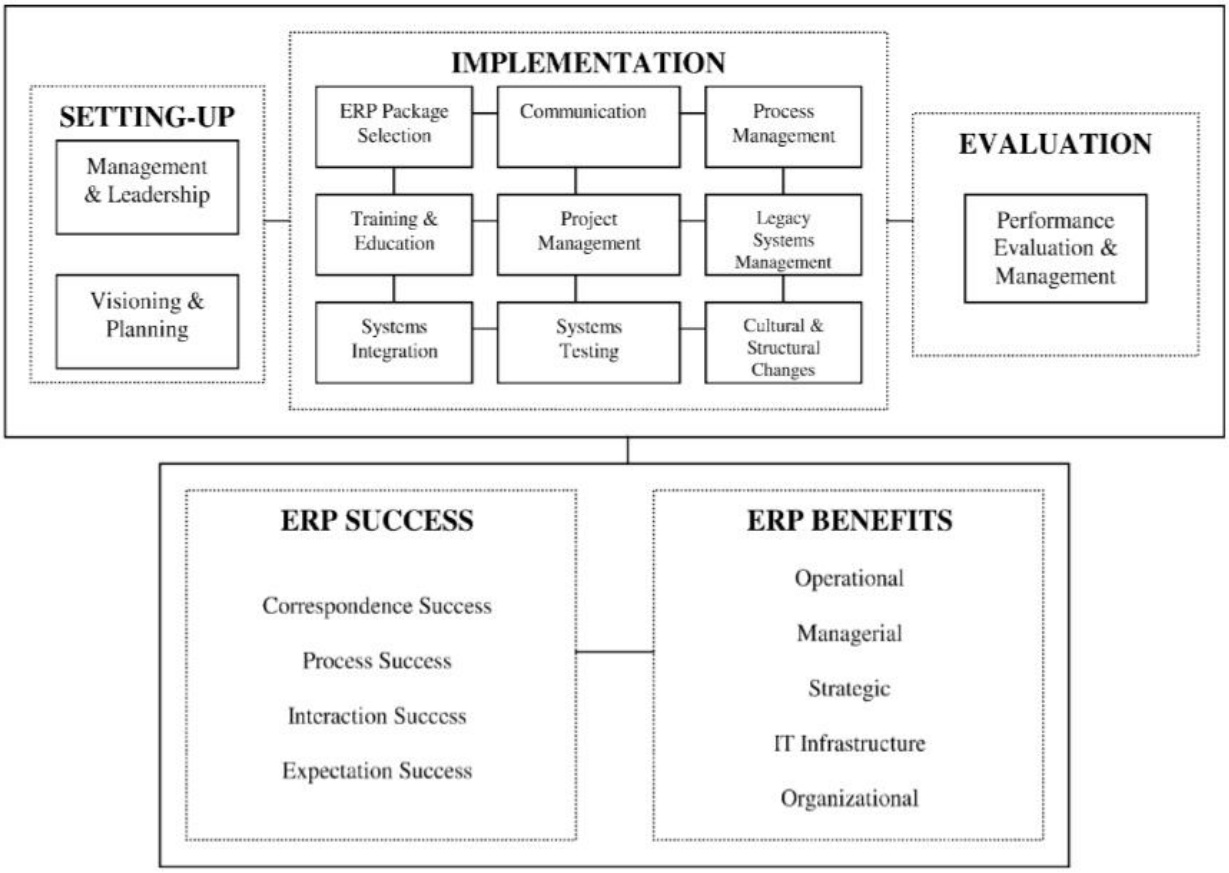

Figure 2-3. Taxonomy for ERP critical factors (Al-Mashari *et al.*, 2003)

3. Case Study of MIT ERP Implementation

3.1. Antecedent Condition

At the beginning of 1990's, the Massachusetts Institute of Technology (MIT) in Cambridge, Massachusetts, which had 10,000 students and faculty and staff totaling 8,000, faced pressures from outside of MIT as well as a significant operating budget problem. Federal research spending and growth in U.S. research spending had decreased, and increasing MIT's tuition fee would lead to enrollment barriers for too many students. These problems may cause to increase operating gap, resulting in difficulties to attract and support MIT's major stakeholders – students, faculty, staff, alumni, sponsors, and employers (See below Figure 3-1 and Figure 3-2).

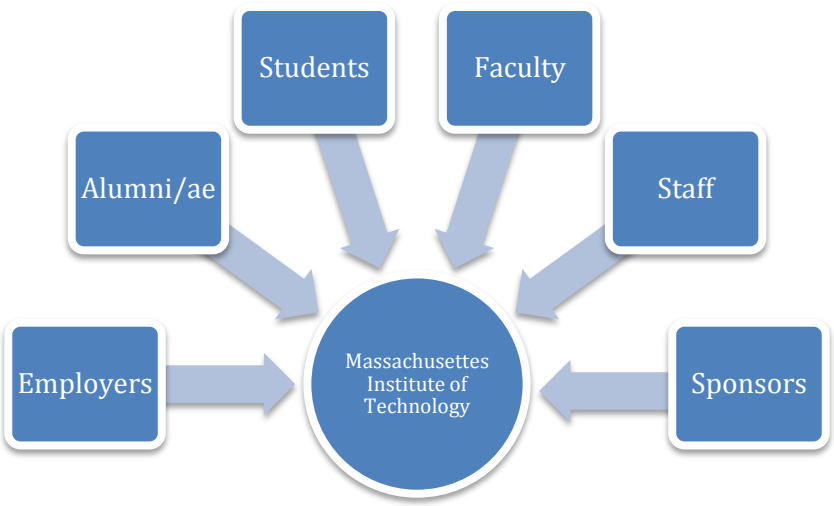

Figure 3-1. Stakeholders on MIT

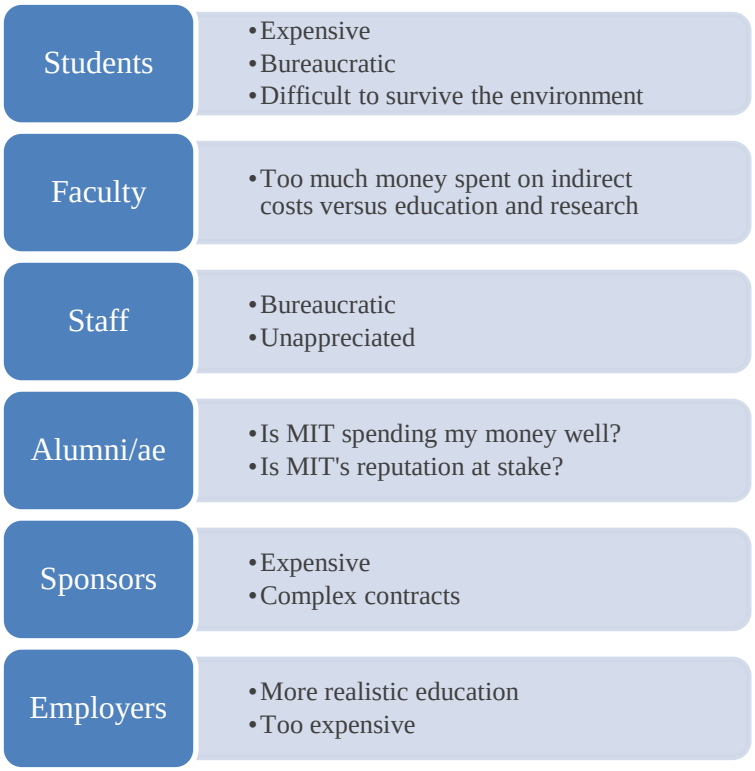

Figure 3-2. Stakeholder challenges on MIT to change

MIT's administrative processes were too complex, leading to errors, requiring repeated work, and wasting effort. In 1992, in order to reduce the operating gap, MIT introduced a project, known by 1994 as the "Reengineering MIT" initiative, aimed to improve the work environment and MIT's competitive position for research awards, and provide leadership in streamlining university administration. The scope of the reengineering efforts included facilities operations, management reporting, buy-pay process, student services, and research proposals.

Reengineering of management reporting

Of these goals, management reporting describes the process of delivering management information across the institute. Management information at MIT consisted of the information needed to manage the projects, programs, and operations of MIT. At that time, the central accounting office (CAO) in MIT had full control in the entire institute's operation and provided a monthly summary statement and detail transaction reports to departments, labs, and centers (DLCs) once a month from the central financial systems.

However, DLCs needed to maintain independent systems some of which "shadow" the functionality of the central systems to get critical management information for their own purposes, because the current central financial systems and processes were not sufficiently flexible to accommodate many DLCs' needs.

These disparate systems required manual reentry, reconciliations, and repeated work. Data could not easily be transformed into meaningful information and was not directly accessible by DLCs. This difficulty resulted in use of information that was no longer timely or relevant. Moreover, the lack of non-financial measures across the institute could not make any synergy by using the current central financial

systems; these measures would align MIT's vision and strategy, assess performance, and facilitate decision-making.

Therefore, reengineering for management reporting aimed to integrate processes and systems to deliver real-time financial and non-financial information across the institute, reduce administrative activities connected with the procurement process, streamline MIT's planning and budgeting processes, and bring about the adoption of a set of non-financial performance measures. Another goal was to make information available online, both centrally and within the institute's DLCs, to any user with appropriate account authorization.

In other words, MIT hoped to replace its current financial systems and processes with integrated real-time financial information system. MIT then faced two options: either develop a single, integrated system or adopt a system from a vendor. Given the complexity of an integrated online financial system and its development cost, MIT decided to adopt an ERP system from a vendor which provided pre-packaged standard business functions and processes based on corporate industry best practices.

3.2. Implementation Process

MIT began the implementation of SAP in the early spring of 1995. The initial focus, named Release 1, was on replacing MIT's legacy central financial systems with SAP. A second phase of implementation, Release 2, would extend to DLCs throughout MIT and implement the processes there (see Figure 3-3 below).

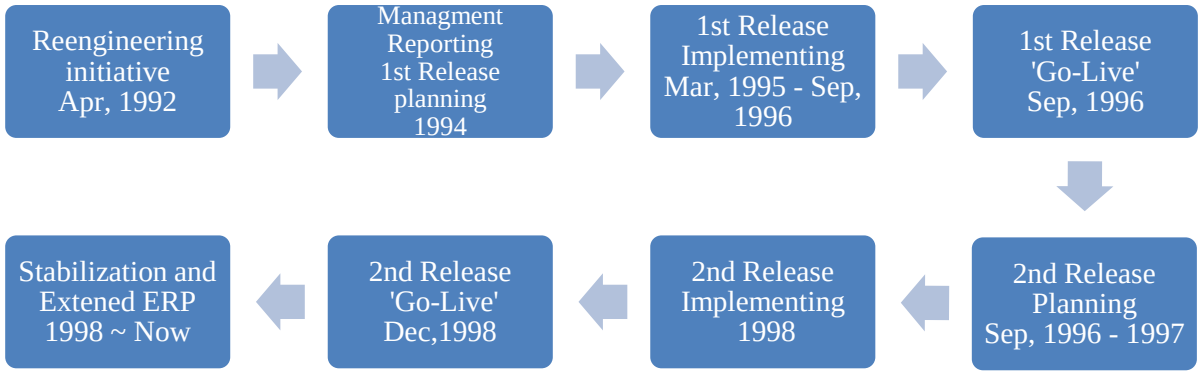

Figure 3-3. MIT ERP Project Key Milestone

(1) Release 1 (Mar. 1995 – Sep. 1996)

ERP Selection

MIT formed a team that consisted of consultants from the Index consulting firm and staff from administration and IT department in MIT in order to evaluate ERP systems from various vendors and select one well fitted to MIT's needs. This evaluation is summarized in Figure 3-4 below.

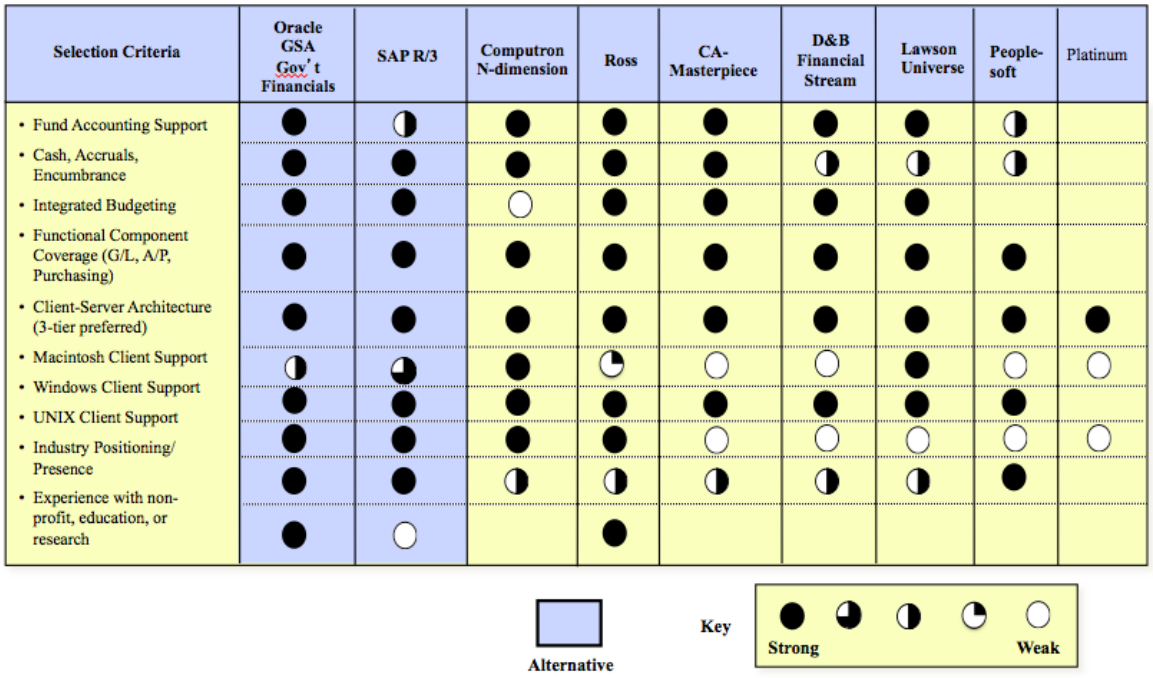

Figure 3-4. Vendor evaluation for the ERP system (MIT, 1997)

MIT eventually decided that two vendors – Oracle and SAP – were best suited to the current needs. Oracle had a bigger market share and higher awareness in the business community and was more stable, whereas SAP was more advanced and used innovative new approaches in its software. In the end, MIT decided to select SAP R/3. The chief information officer of MIT noted that "SAP R/3 was an up-to-date product over time, and we had an opportunity to have influence on SAP which had tried to get into higher education institutions, while Oracle had not." (James D. Bruce, April 12, 2013).

The SAP R/3 ERP system provides flexible, integrated client/server and mainframe-based business applications software that was compatible with most popular hardware, software, and database platforms at the time. In 1990's, more than 4,300 companies in 41 countries used SAP software to manage complex financial, manufacturing, sales, and human resources requirements. When MIT decided to implement the ERP system, SAP had just started to move into the higher education market in North America: the first university that implemented ERP was University of Toronto, the second was Central Michigan University, and the third was MIT. MIT's decision to use the system would have significant marketing benefits for SAP in the higher education ERP market. This influenced the price negotiation with SAP, allowing MIT to acquire SAP licenses and software at a reduced rate.

MIT chose SAP R/3 to replace six legacy systems – accounts payable and receivable, budgeting, purchasing, general ledger, and fixed assets accounting – which were the core functions of its financial operations. However, there were significant gaps between MIT's requirements and SAP's existing software. For example, SAP's access control and security were not sufficiently strong to meet MIT's needs. Moreover, the accounting module was not complete, and certain benefits and overhead charge processes were not aligned with government requirements for universities.

"MIT required an integrated system not only capable of providing superior management reporting and financial systems, but one that could be modified to meet the unique requirements of the higher education market," said Klaus P. Besier, chief executive officer and president of SAP America. "We are pleased to add such a prestigious university to our client list and are committed to working with MIT to meet the needs of the higher education community." (Bruce, 1995)

Project Team

For Release 1, MIT formed the SAP implementation project team (See Figure 3-5 below). It consisted of project management team, buy / pay process team, management reporting, account payable (A/P) and account receivable (A/R), database (DB) and SAP admin, and development team under the Senior Vice President with steering committee. Under project management team, each process unit such as buy / pay process team was composed of staff from related MIT departments and consultants from the Index consulting firm.

For implementing redesigned business processes to support the general accounting, purchasing, fixed assets accounting (property), account payable, and account receivable functions of the institute, MIT implemented the following SAP modules: FI (Financials), CO (Controlling), MM (Materials Management), FM (Fund Management), SD (Sales and Distribution). These work processes were taken over by the central offices.

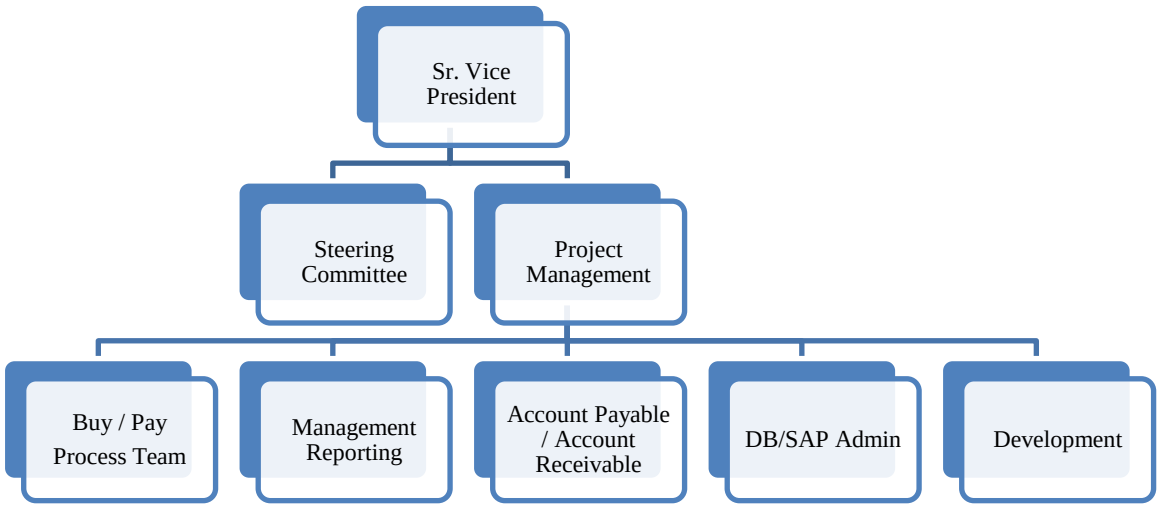

Figure 3-5. MIT SAP Project Team Organizational Chart

Lack of experience for leadership

As the initiative for reengineering MIT's legacy system came from the leadership level at first, the reengineering project leadership was committed to its success. President of MIT stated that reengineering MIT was and is his idea, that it must succeed, and that there was no Plan B if it does not (MIT, 1997).

However, leaders who did not have direct experience in reengineering data system designs and implementing new systems or working with related reengineered processes can cause delays and setback. At the time of ERP implementation, MIT did not have any leader who already had experience with ERP systems or large-scale of projects. This often caused delays in decision-making and the project at large.

Customization for unique requirements

As MIT learned from evaluation of vendor products, MIT processes were not well matched to SAP R/3 in many areas, due to unique processes at MIT and within the DLCs. For example, most of DLCs had their own processes and policies, which they managed autonomously. This meant it was hard to forge a compromise among all DLCs wherein they agreed to use a single standardized process for a specific type of work. Moreover, MIT allowed so many exceptions to central administrative rules that it could not point to overarching processes that were in place. Also, the fundamental challenge for MIT was the lack of understanding of business functions of SAP. Moreover, the university used the legacy system and operating processes for at least two decades. Although the ERP system required a change of perspective and new training for staff, MIT wanted to retain familiarity in the system as much as it could. Although SAP implementation stemmed from a desire to reengineer the university's management reporting system, project managers decided it was necessary to significantly customize the software to fit unique needs at the general.

Consultant relationship

Given the unique requirements, the consultants in the project team agreed to customize SAP R/3 to fit to MIT's purposes mostly without argument. The consultants did not have any SAP implementation experience in higher education institutions before and emphasized their commitment to keep to the initial project launch deadline, especially the go-live schedule related to MIT's new fiscal calendar. Since all data entered to the ERP system are influenced and stored in related modules across the system automatically, data migration to fill in certain period after the fiscal year becomes more difficult. Moreover, this can be explained from the consultant's point of view that the more customization in the system the client has, the less responsibility for trouble-shooting they have.

Learning Curve

Also, during ERP implementation, MIT staff was required to learn new language and terminology used by the ERP system. For example, in accounting, MIT used the term "account" for categorizing the costs and revenues associated with a particular project or activity at MIT, but "cost objects" in SAP R/3. Moreover, to classify types of revenue, expense and balance sheet transactions, MIT had used "object codes" but SAP R/3 used "G/L accounts". Furthermore, an integrated ERP system required staff to study related processes that were not their own work areas.

(2) Release 2 (Jan. 1998 – Dec. 1998)

After Release 1, the Release 2 implementation phase began to extend the new system to DLCs across the institute. Release 2 had five stages for roll-out: concept workshop, analysis, build, operational training, and roll-out itself. To gain a clear idea of what needs the DLCs had and how the ERP system could support these needs, the Sloan School of Business took the pilot project of Release 2.

For several months, the project team carefully reviewed the requirements from Sloan School. The project team learned that as the ERP system already configured and customized functions that the central office needed, the Release 1 ERP system limited DLCs' options to those used by the central office, and thus required huge amount of additional management effort or customization in the ERP system. For instance, the Sloan School of Business had approximately between 500 and 1000 cost objects in the legacy system. However, it became to make between 4,000 and 5,000 cost objects in the ERP system, since the ERP system provided very high-level cost object and did not have additional objects to clarify information in the department point of view (Donna Behner, April 23, 2013).

The project team learned from the pilot project that it was too expensive to implement the requirements for each DLC. As a result, other DLCs did not put any effort into reengineering their processes, and chose to keep using their shadow systems for supporting their specific needs, just as they did before.

(3) Post-implementation (1999 – Now)

For both Release 1 and Release 2 MIT equipped the real-time integrated ERP system for core financial functions. In addition to financial functions, MIT had diverse administrative functions common among higher education institutions such as human resource (HR) management, student information management, and others. MIT limited the scope to only financial functions among these diverse administrative functions of higher education institutions such as human resource (HR) management, student management (MIT, 1997).

Until 1995, SAP did not have any specific modules to fit in higher education institutions. For example, in university setting, certain benefits in HR process had to be distributed according to a 9-month academic calendar. This feature could not be applied in SAP's standard processes. As a result, the scope of the ERP system implementation did not include HR, payroll, travel, student management, and other functions. This "segmented" implementation created disconnection between employees; not all stakeholders had SAP accounts, so it was necessary to continue allowing paper-driven process in some cases, and as a result MIT faced the issue of increased system interfaces and data redundancies.

When quickly adopting new technologies and methodologies such as SAPWEB, self-service options, and the "portal" concept, MIT further developed and extended additional modules in the ERP system, such as purchasing and travel in 1998, benefits in 2001, HR in 2003, payroll in 2004, and EHS (Environment, Health, and Safety Training) in 2006. More specifically, in 1998, MIT developed its own travel system in the ERP system without adopting any standard functions of SAP. However, as a result, in 2009, MIT bought a travel expense management solution from a third party for higher education institutions and improved a travel process with advanced practices (See Figure 3-6 below).

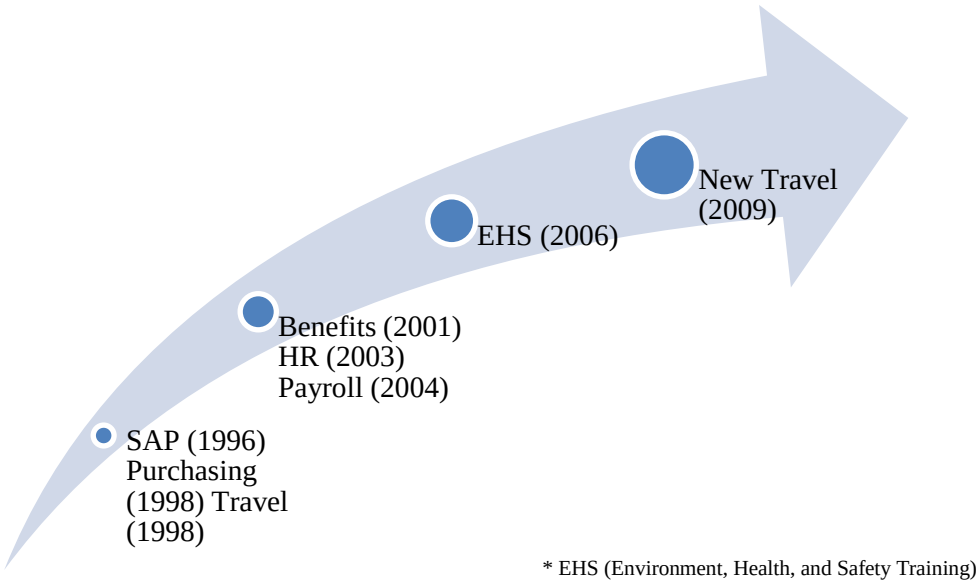

Figure 3-6. MIT ERP System Extension (Kevin Lyons, April 3, 2013)

When expanding additional modules in the ERP system, MIT benefited from consolidation and formal management of common data. However, many of the special capabilities that MIT had to write for itself were created in the standard version of SAP. The current system architecture, which has a high rate of customization, requires much effort and spending to maintain and inhibits the possibility of outsourcing the operations (See Figure 3-7 and Figure 3-8 below).

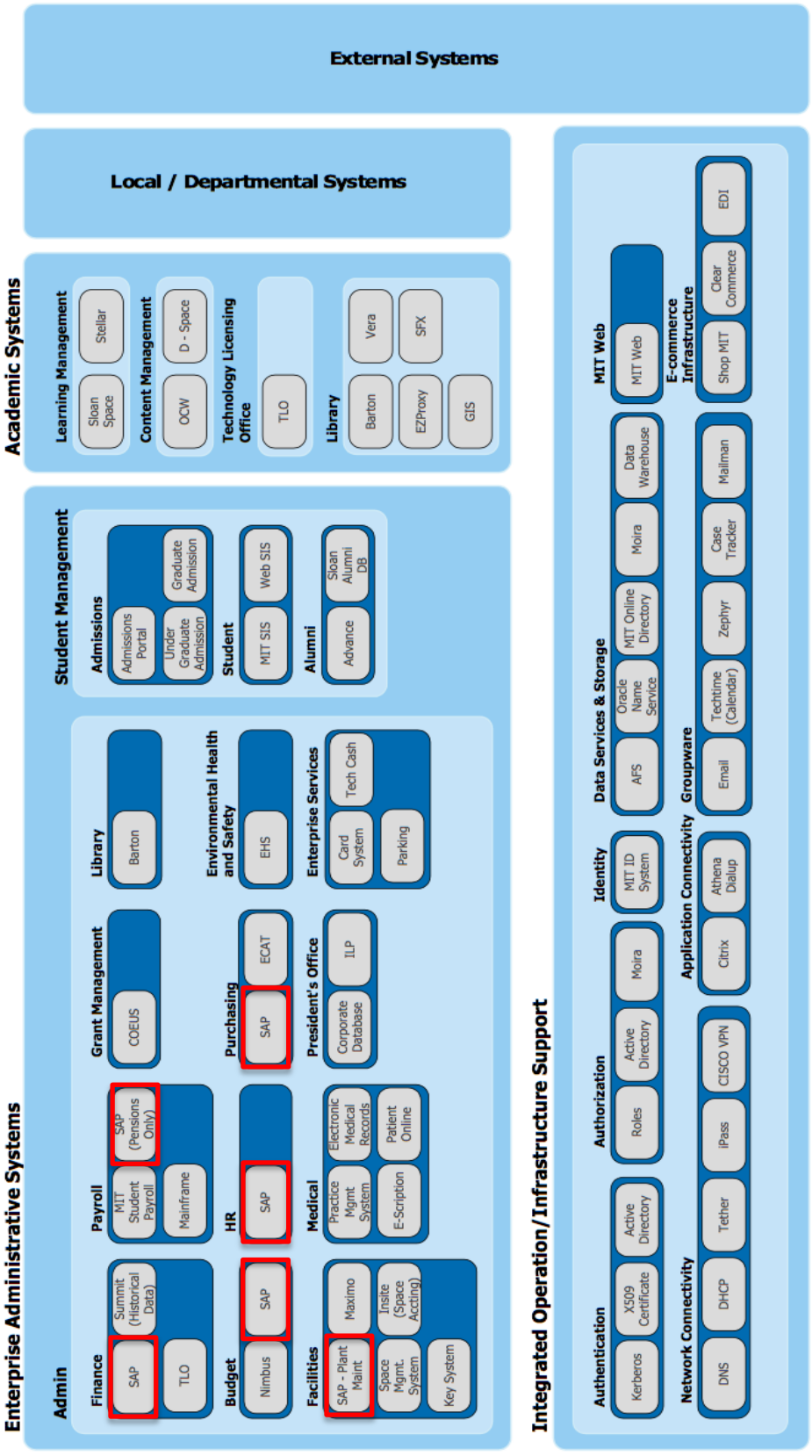

Figure 3-6. Enterprise System Architecture of MIT (MIT, 2004)

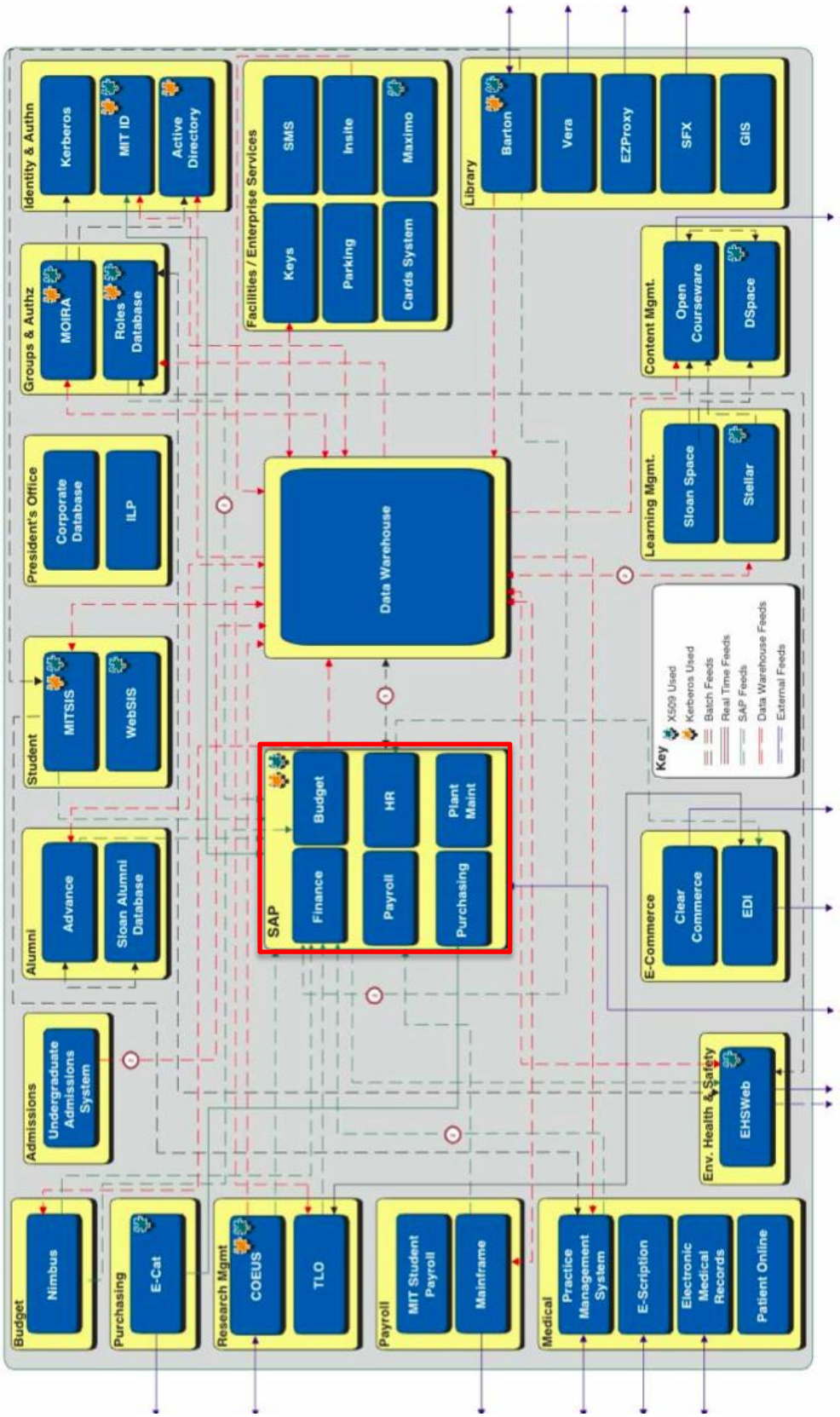

Figure 3-7. Enterprise System Interfaces of MIT (MIT, 2004)

3.3. Project outcome

The Real-time integrated information system

First of all, MIT had effectively equipped itself with a real-time information sharing system. Any person who had an SAP account could access the ERP system and find real-time data when desired, without the need to wait for monthly summary reports. Moreover, the ERP system integrated disparate legacy systems to a single system, giving higher level management quick access to changes and the ability to respond quickly. By reengineering processes, it eliminated process redundancies and increased efficiency to support services. Last, ERP implementation allowed MIT to retain cross-functional data seamlessly since the ERP system launch, as MIT built data warehouse (DW) concurrently during ERP implementation.

Delayed "Go-Live"

Initially, SAP implementation began in March 1995 was supposed to launch on July 1, 1996. However, the use of the SAP system as MIT's financial system went live on September 3, 1996 – two months delay from the original deadline. Since January 1996, MIT had prepared to finish development, integration tests, user documentation, and the stabilization plan, but the work required to transform MIT's business processes and to implement them using the new framework took more time than expected. This stemmed as much from the complexity of MIT's business processes as from the time required to learn and implement the comprehensive, integrated SAP R/3 ERP system.

Unexpected increased workload

Compared to the legacy systems, the number of data input screens for a particular process in the ERP system increased. For example, it took longer to process invoices in the ERP system. According to a memo from Ken Le Vie of the project team on November 20, 1996, "the accounts payable department currently has 31 people posting invoices in SAP. Eight full time operators, 15 temporary employees, 3 supervisors, 2 SAP team members and an average of 3 additional people from the central accounting office (CAO) are putting in an average of 40 to 48 hours each per week, while 13 full time operators each working 35 hour week were needed to stay current posting invoices on the old VAPS system." There was not much difference in the number of invoices paid between the month of October 1995 and October 1996, with totals of 30,451 and 30,555 respectively (Le Vie, 1996).

This was primarily due to data conversion to the ERP system, and data entry and data cleaning were still in progress even after the go-live date. In addition, the ERP system required a higher skill level to handle processes and extended learning curve. Posting invoices was no longer a matter of data entry. Analysis of purchase orders and an increase in the decisions that need to be made contributed required a full week of formal training and an extended ongoing informal training period of approximately 2 months. This is compared to only 2 full days required in the old VAPS system.

One of the aims for reengineering of MIT's processes was to decrease operating gap by reducing the number of administrative staff. However, the number of staff in the accounting department changed from 16 in 1995 to 30 in 1998, two years after the ERP system's initial launch. Ken Le Vie of the project team recalled that since the ERP system was more complex than the legacy systems and was difficult to learn, this increased errors by users, and, once made, errors took far more time to resolve (Ken Le Vie, April 9, 2013).

In addition, MIT made substantial changes to customize the ERP system for use in higher education. According to the document (MIT, 2009), because of this customization, it is now very difficult for MIT to make further changes to the ERP system and to stay current with new versions of the software distributed by the vendor. Apart from customization, the ERP system much less flexible than the legacy systems and required numerous ad-hoc processes or workarounds. These contributed to management cost increase and the need for more administrative and IT staff and resources.

Limited benefits for DLCs

For the phase of release 2, each DLC's engagement was the most important element of reengineering existing processes and adopting SAP's best practices. However, some of the ERP system's functions were impossible to apply to the DLCs. Also, getting a common voice from the DLCs was laborious task. Although the Release 2 roll-out used phased implementation methods, these did not result in improved implementation with lessons learned from previous phases.

4. Case Study of the global engineering company, ENGCO

4.1. Antecedent Condition

ENGCO is a global engineering company that provides engineering, procurement and construction (EPC) services for heavy plants worldwide. Since an EPC business is run on a made-to-order production basis, success is closely tied to project managers' ability to manage each order efficiently and effectively.

In 2003, when the EPC domestic market was in a period of economic stagnation, ENGCO had unfavorable financial conditions. Approximately 90 percent of ENGCO's revenue came from domestic businesses with $2 billion in revenue and a total of 1,500 employees.

New CEO and ERP initiative

When the new CEO was appointed to ENGCO, also during 2003, he saw immense opportunities from oversea markets and set a goal to be one of the global top 10 leading EPC companies by 2015. However, the new CEO realized one of the biggest impediments was the current IT capability. Before the company's goals could be achieved, the current IT system would need to be improved.

By 2000, ENGCO had committed two years to process innovation by implementing the legacy system 'SPEED' to support general business functions such as sales, finance, cost control, treasury, and related processes. However, it designed for only support of domestic businesses, and there were not any standard process to manage oversea projects. For example, for management planning, corporate business administration team gathered a sheet of excel data with a project manager's general estimations in high-level categories for oversea projects.

The new CEO had experienced successful ERP implementation project previously. He believed that integration of an ERP system would support global business appropriately through use of standardized processes and best practices. He believed that an ERP implementation was urgent and necessary step for the future business of ENGCO.

The new CEO drove the ERP implementation project, believing it to be a first step in transforming ENGCO into a global leader in the ECP business. Within six months, the ERP project was expected to increase the number of overseas projects in ENGCO's business portfolio and enhance business capacity for overseas projects rapidly. The new CEO brought the chief information officer (CIO) to ENGCO in 2003, as the company's first corporate CIO. CIO, who reported directly to the CEO, assembled an IT planning team that had comprehensive IT planning experience and collaborated with an information services team, both outsourced from ICTCO. (See Figure 4-1 below)

ENGCO, one subsidiary of a successful conglomerate, outsourced all IT services from ICTCO, another subsidiary of the conglomerate, including IT infrastructure, network, management and delivery of business systems, and employees. The retention rate of the IT department was extremely high: the average length of staff's service was 6.5 years. Approximately 90 percent of employees in the IT department had started their careers from ENGCO's IT department. (For 90 percent of employees in the IT department, their ENGCO position was also their first position.) High retention rates in the IT department allowed for sincere relationship with ENGCO, and IT employees were experts familiar with ENGCO's business.

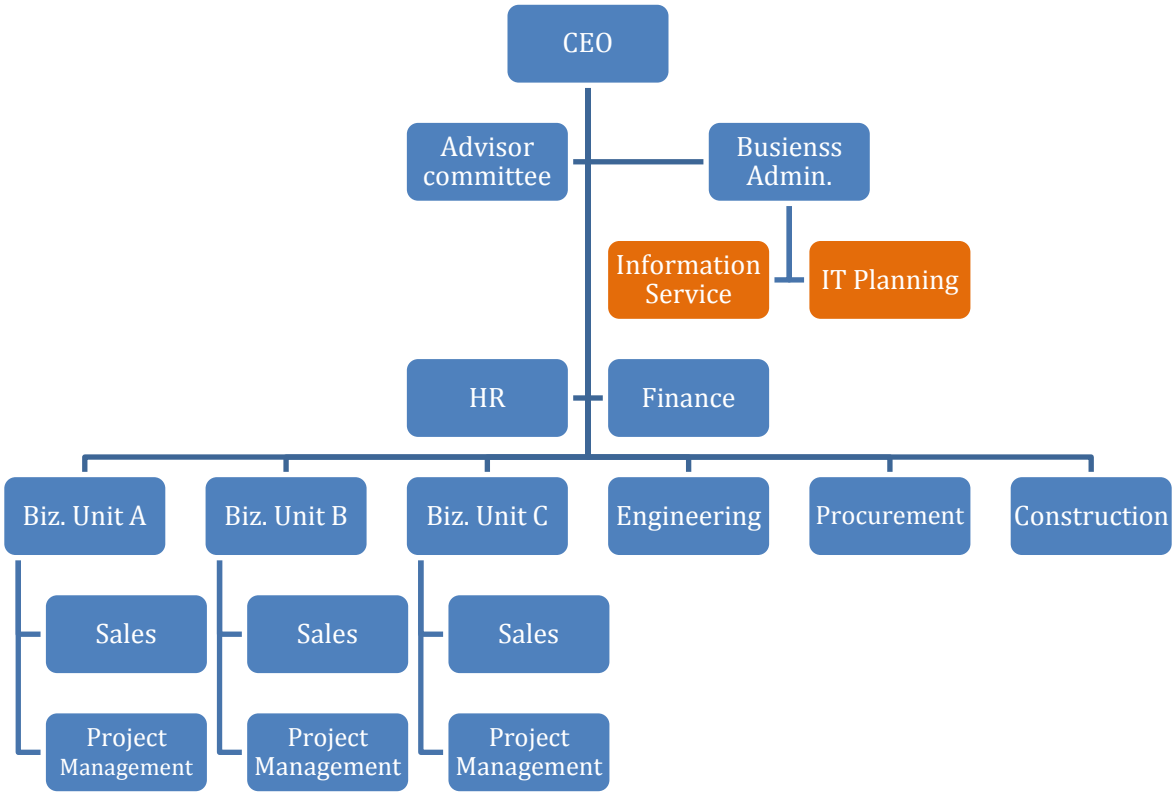

Figure 4-1. ENGCO Organizational Chart, 2003

4.2. Implementation Process

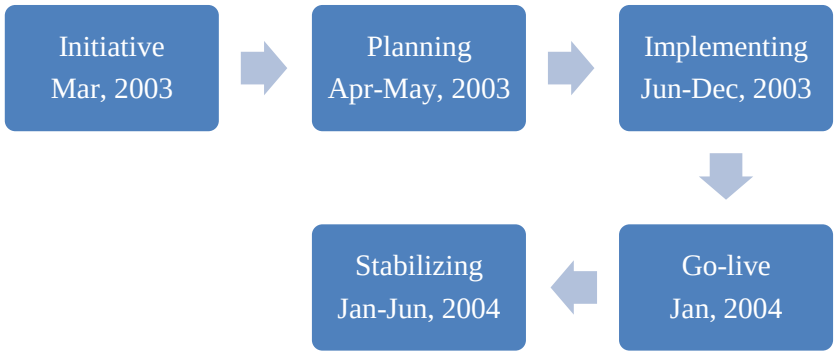

Figure 4-2. ENGCO ERP Project Key Milestone

ERP selection

During the ERP selection process, ENGCO reviewed cases of other subsidiaries that used the ERP system. When ERP consultants from ICTCO joined the T/F team, they emphasized that the SAP ERP system would offer huge benefits for "earned value management (EVM)" for ENGCO. The purpose of EVM is to

measure project performance and progress by objective perspectives in terms of scope, cost, and schedule. For instance, SAP provides core processes for schedule management using the project system (PS) module while providing functions for controlling and forecasting costs using cost controlling (CO) module. Finally, ENGCO decided to select 'SAP' as an ERP vendor.

Project Task Force Team

With top management commitment, ENGCO formed an ERP project task force team (T/F team) that consisted of selected employees (mostly manager level) from each business department and ERP consultants hired from ICTCO. Before initiating the ERP implementation project, T/F team defined the scope of the project for two months.

Also, employees in IT department who were in charge of the legacy systems related to ERP processes were dispatched to T/F team. The IT department employees were expected to analyze business processes required when adopting the new ERP system and write system specifications in collaboration with the ERP consultants (see Figure 4-3 below).

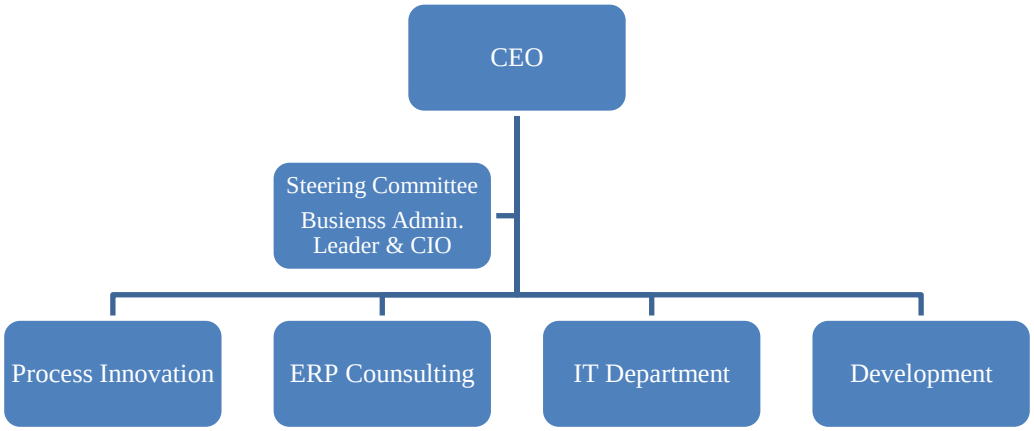

Figure 4-3. ENGCO ERP Project T/F Team Organizational Chart

Lack of capabilities of T/F Team

Employees in the IT and business departments who were selected for the ERP T/F team had no prior experience with ERP systems, and needed to learn the selected system. To meet this need, the ERP consulting team provided both a training course regarding basic system configurations and major features of modules for the T/F team, and ABAP (Advanced Business Application Programming) programming training for employees in the IT department for two weeks.

Although ERP consultants from ICTCO had diverse and successful ERP system experience with various clients including other co-subsidiaries, government organizations, and other corporate clients, they did not have experience in the made-to-order production industry at that time.

Process Standardization

ENGCO adopted six ERP modules from SAP – Sales and Distribution (SD), Material Management (MM), Financial (FI), Cost Controlling (CO), Project System (PS), and Treasury (TR). As the legacy system 'SPEED' already had process reengineering, the T/F team decided to change the tool from 'SPEED' to SAP without further process reengineering. On the other hand, with top management commitment, the T/F team also believed that ENGCO had to adapt SAP's processes as much as it could, because SAP had best practices and globalized standards. However, since SAP modules were mostly based on the needs of the manufacturing industry, ENGCO had to customize SAP functions to fit in its business processes (see Table 4-1).

Module	SAP Standard Usage (%)
SD	30%
MM	10%
FI	100%
PS	30%
CO	70%
TR	70%

Table 4-1. SAP Standard Usage by Modules in ENGCO (%)

Implementation Challenges

In its legacy system, ENGCO was using a method known as the "Work Breakdown Structure" or (WBS), which broke down projects according to their cost structure. However, in SAP, WBS was used for both costing and scheduling. In the ERP context, WBS is a standard form used to communicate across modules. ENGCO's WBS could not carry schedule data, and it had used other software for project schedule management. If ENGCO wanted to use the schedule function of WBS, it would need to change the WBS system.

In addition, material codes for EPC business production are completely different from those used in the manufacturing business. Since the EPC business is based on made-to-order production, each ENGCO plant had its own specification and material codes, whereas the manufacturing business produces the same product during the product's life cycle so does not require different codes. In SAP, material codes are classified as master data and standardized by a rule of the manufacturing business, meaning that ENGCO's existing materials codes were very different form the SAP ERP system's codes. ENGCO's material code was hardly fit to SAP's standard material master. However, the ERP consultants insisted that SAP would enable ENGCO to handle material codes effectively as master data.

During ERP implementation, the T/F team was concerned about the SAP Project System (PS) module's scheduling function and the use of the SAP Material Management (MM) module's material code as master data for three months out of total six months implementation period. Finally, ENGCO decided not to change its standard WBS and not to use a schedule function for projects.

User training

ERP implementation for ENGCO was supposed to be completed in six months. Within this tight schedule, ENGCO did not have enough time to train users on the new system during the implementation period. Once the ERP implementation was complete, ENGCO made detailed online manuals for the new system and distributed them using an easy-to-access employee intranet system. At the same time, ENGCO began offering ERP system user training sessions for employees. Since ongoing projects were diffused throughout the country as well as overseas, the system training team from T/F Team traveled to main project sites and regional bases. User training was completed six months after the initial launch.

4.3. Process Outcome

Efficient project management

In the new ERP system, ENGCO defined seven standard WBS structure groups regarding to contract types of projects. Although WBS elements in ENGCO were based on cost breakdown structure, it made ENGCO communicate from sales and distribution (SD) and material management (MM) to cost controlling (CO) with the same structure. In addition, project managers could control and plan budgets, costs, and profits for their project with detailed WBS elements in a single system. This system capability allowed project managers to monitor a project's cost progress in detail without any delay, resulting in improved risk management and increased accuracy of estimates. Business unit managers and business administration could find a comprehensive profit and loss report based on automatically collected data from ongoing projects in their business unit or the entire company by using standard WBS in a real time. This ability helped the company to make decision on business effectively and efficiently. Moreover, overseas sites could access to new ERP system and input data without any limitation by using global standards.

Faster and integrated business administration process

The new ERP system shortened the monthly closing process from one month to five days. The corporate business administration team could forecast overall businesses in detail and more accurately. In order to prepare for increasing overseas project, profit and loss of foreign exchange management were necessary components of the management system. The detailed data entries from overseas projects gave ENGCO the ability to deal with foreign exchange and offered benefits to ENGCO when forecasting its overseas businesses outcomes.

Improved communication

In the new ERP system, an electronic approval system was also implemented. Most transactions requiring approval in the legacy systems processed data input and approval processes separately. For an approval, it designed to hand in a piece of paper to decision makers and took a huge amount of time to finish an approval process, which usually had a range of from two to ten people to approve. However, the ERP system solved this inefficiency by standardizing all formats for approval documents automatically created with data from SAP and setting a decision-making hierarchy for each process needing an approval in an electronic approval system. Decision-makers could get a request for an approval via the intranet system they used for most of the working day. This resulted in decreased amounts of time between request and approval, and eliminated inconsistency related to documents or human error and variation.

Since "go-live" of the ERP system in 2004, ENGCO has grown up average 30 percent every year. Manager of ENGCO recalled "If the company had not put an ERP system in place, it could not have supported such fast growth in its business".

Learning curve

However, the new ERP system was completely unfamiliar for employees at ENGCO. There were a variety of factors that made the system challenging for first-time users at ENGCO. First, ENGCO users, who were already accustomed to interactive web pages, were not satisfied with SAP's static client screens. Also, as part of its global business strategy, ENGCO implemented SAP in English, even though English was not a native language for most employees of ENGCO, employees should learn new business terms from SAP's standard processes for communication through the new system.

In the new ERP system, the moment a single transaction occurred, it would go into effect immediately across all modules, processes, and data within the system. As a result, all changes related to existing transactions required the use of provided standard transactions for change or cancel. Further, as all transactions in the new system were stored with timestamps and log data, users now had the ability to track transactions. Historically, when ENGCO's legacy system users made certain mistakes or needed to change of their transactions for some reason, they could request to change or delete their transactions via IT staff who they knew very well.

Increased workload for IT staff

During ERP implementation, IT staff who were involved in the ERP project had to continue to run the legacy system while writing specifications for new system, delivering to outsourcing developers, and managing the quality of outcomes. It was difficult for IT staff to handle the workload associated with managing both systems at once. For stabilization, IT staff continued fixing all errors system users found and dealt with system users' complains about system's complexity or inconvenience on a rolling basis.

Another challenge was that the planned project period was too short to conduct thorough system test s in various cases. Since most of the existing IT staff did not have experience with ERP and the ERP system was a software package, if they had encountered challenges using the new system, they sometimes had to request help from vendors or ERP consultants, which took additional time and delayed client service provision.

Needs for management reporting

The corporate business administrative team (BusAdmin) expected the new ERP system to reduce their reporting workload significantly through the use of integrated real-time data. However, the ERP system generated static reports, and ERP's standard format reports were usually not well matched to BusAdmin's needs. Moreover, it took more time to develop new reports in ERP than in the legacy system. Since the reports usually needed data from across modules, the development of those reports required collaboration with others managing the different modules, analysis of the format and types of data, and analysis of effects on related systems.

BusAdmin decided to adopt an additional reporting tool (OLAP, or online analytic processing) for their needs. It designed to use SAP data, but it had different database to increase reporting speed by using ETL (extract, transform, and load) transactions (see Figure 4-4 below). Business analysis for the reporting

system took three months after “go-live” of the ERP system, and then the IT staff developed 300 reports over another three month period. IT began the go-live process in July 2004.

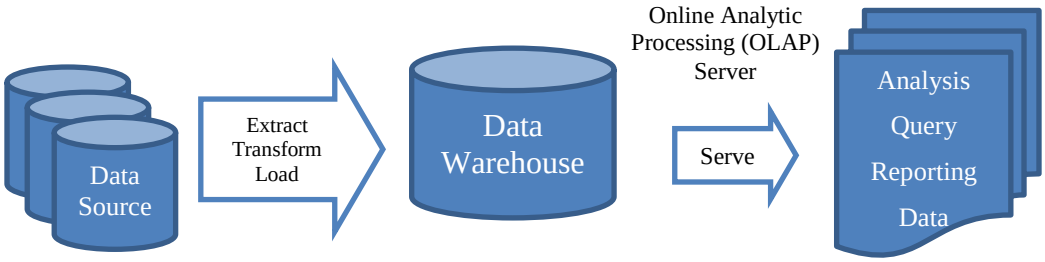

Figure 4-4. Decision support system architecture using OLAP (Chaudhuri, Dayal & Ganti, 2001)

5. Discussion

ERP Readiness

According to Gartner (2011), a readiness assessment is an activity used to determine the degree of readiness of an organization to execute a major project or initiative, and to help identify specific areas to focus on in the preparation process. Three level ratings – Ready, Limited, and Weak — are used, and an interpretation of readiness is made on the basis of these ratings (see Table 5-1 below). The rating system should be used very early in the planning phase of the project – before the ERP selection in ERP implementation. Originally, the purpose of the ratings for ERP readiness is to help identify specific areas for the ERP project team to focus on as they prepared to select and implement the ERP system best for them.

Rating	Interpretation
Ready	The system is ready to move forward and is as prepared as can be reasonably expected at this point in the project.
Limited	The system is at a limited or partial level of readiness. A minor to moderate level of effort will likely be required to contain related risks as the project progresses.
Weak	The system is not ready and substantial effort will be required to contain related risks as the project progresses.

Table 5-1. Readiness Assessment Rating Framework (Gartner, 2011)

Hanafizadeh and Ravasan (2011) proposed the framework of ERP Readiness Assessment with McKinsey 7S model (see Table 5-2 below). The framework indicates that ERP readiness can be assessed by according to 7 dimensions: structure, strategy, systems, skills, style / culture, staff, and shared values / superordinate goals. The framework also explains each dimension's definition and factors to consider for assessment.

Dimension	Definition	Factors
Structure	Basis of specialization and coordination influenced primarily by strategy, size, and diversity of organization	• Formalization • Size • CIO Position • Centralization • Specialization
Strategy	Actions a company plans in response to changes in its external environment	• Vision and mission • Goals and objectives • Strategic IT plans
Systems	Formal and informal procedures that support the strategy and structure	• IT infrastructure • Business processes • Data
Skills	The distinctive competences-what the company does best	• Management's skills • IT staff's skills • Users' skills
Style/Culture	Consisting of two components as below: • Organizational culture: the dominant values, beliefs, and norms which develop over time and become relatively enduring features of organizational life • Management style: more a matter of what managers do than what they say; how do company managers spend their time; what are they focusing on	• Top management support • Communication • Organizational culture
Staff	The people/human resource management processes used to develop management processes, and ways of introducing young recruits to the company	• HR management • Training and education • Project team
Shared values	Guiding concepts, fundamental ideas around which a business in built must be simple, usually stated at abstract level, have great meaning inside the organization even though outsiders may not see or understand them	• Shared beliefs • Company-wide commitment • Project champion

Table 5–2. The proposed framework of ERP Readiness Assessment (Hanafizadeh & Ravasan, 2011)

In this study, ERP readiness assessments are used to compares the initial stages between ERP implementation of two cases, MIT and ENGCO. Based on interview results of from case studies, the cases are evaluated by using a readiness assessment rating framework of Gartner and the framework of Hanafizadeh and Ravasan (2011). The rating outcomes may be varied by interviewer (see Table 5-3 below).

Dimension	MIT (1995)		ENGCO (2003)	
Structure	• Highly collegial organizational structure • Disparate autonomy to DLCs • Out-dated operating model and processes • Diverse stakeholders' relationship	Weak	• New CIO experienced in successful ERP implementation • 3,000 Employees, Estimated 100 ERP users • IT Planning and IT Dept. strong coordination	Ready
Strategy	• Clear objectivity for reengineering MIT from deficit pressure • Strategic and concrete plans for reengineering across the institute	Ready	• Clear vision for Global EPC leading company • Eager to increase capabilities for global business and increase both quantity and quality	Ready
Systems	• Weak IT infrastructure • Old and inefficient legacy systems • Redundancy of data and processes from disparate systems • Lack of data accessibility	Weak	• Running a legacy system 'SPEED' focusing on domestic project support • Existing non-systematic processes • Weak IT infrastructure	Weak
Skills	• Lack of knowledge of ERP for management, administration, and IT staff • Lack of expertise who have profound knowledge about processes across the institute	Weak	• Lack of experience of ERP for Users and IT staff • IT staff's high level understanding of business • Users' high dependency on IT staff' support	Weak
Style / Culture	• Strong top management commitment • Highly collegial and autonomic environment • Lack of experience a large scale project • Business silos	Limited	• Strong top management commitment for IT and ERP • Strong project management authorization • Hierarchical and centralized decision making culture	Ready

Staff	• Lack of experience in a large scale project in MIT • Business silos / lack of communication between departments	Limited	• IT Planning / IT Dept. coordination • External expertise support from subsidiary IT company • Under weak financial status, lack of resources for ERP implementation	Limited
Shared values	• President's direct statement to commit in the reengineering project	Ready	• New CEO's strong commitment to lead the growth • High expectations for new CEO and CIO	Ready

Table 5–3. ERP Readiness Comparison, MIT and ENGCO

In this ERP readiness assessment, MIT had 2 Ready, 2 Limited, and 3 Weak ratings, while ENGCO had 4 Ready, 1 Limited, and 2 Weak ratings. Both organizations had good strategy and shared values for driving ERP implementation but had weak systems and skills. While MIT had an organizational structure and culture that limited ability to implement the ERP system, ENGCO had more appropriate organizational structure for implementation.

Critical Success Factors (CSFs) fulfillment

As it earlier introduced CSFs (Rabaa'i, 2009), this study employs them to compare CSFs fulfillment between MIT and ENGCO.

Top management commitment and support

Both MIT and ENGCO as large organizations began ERP implementation by top management initiatives. While MIT had pressures on operating cost gap and competitive environment from outside, ENGCO had to grab an opportunity to extend its business globally from inside initiative. Although the motivations for ERP implementation of MIT and ENGCO were different, their strong top management commitment to the project was a key success factor to deliver the project. Initiative from top management was the most effective way to share goals and objectives of the project to the entire organization, and led to employees' buy-in to the project and increased productivity.

Change management

The case studies show how much ERP system implementation can impact an organization. After Release 1 that replaced the central financial systems to the ERP system, MIT conducted five rollout stages – concept workshop, analysis, build, operational training, and rollout for Release 2 to extend the ERP system to DLCs. Since MIT consists of autonomous DLCs and has a diffuse structure, MIT emphasized to get commitment from DLCs. By convening the concept workshop, MIT collected attention from key departmental personnel and decision makers and delivered detailed training of SAP concepts and process

redesign concepts. It was a great help to get a sense of generic solutions and models for possible use for DLCs in advance to implement new system. At the same time, MIT also had a pilot project and used phased rollout for "go-live", and thus DLCs could prepare the new big wave in advance.

On the other hand, ENGCO's centralized organizational structure and hierarchical decision-making structure enabled ENGCO to response changes quickly. However, since ENGCO had a quite short time period (originally scheduled for six months) for the ERP project, it did not have enough time to prepare for changes. As ENGCO started to train staff about how to use ERP after "go-live", the complex ERP system gave staff a long learning curve and thus increased possibility to make errors in the system. Consequently, it heavily increased workload to IT staff to support requests and stabilize the ERP system.

Business process reengineering and system's customization

An ERP that incorporates standard business processes in package software does not fit all business environments. Heiskanen *et al*. (2000) suggest that industry best practice standards in ERP are inappropriate for universities, because of their uniqueness, which includes "impossible-to-model" structures and decision-making processes. MIT also realized that there were significant gaps between MIT's and SAP's respective "worldviews". Unable to use the standard processes providing by the ERP system, MIT substantially customized the system, and DLCs decided to keep their "shadow systems". It allows some DLCs to have paper-driven process as workarounds for exceptions or urgent issues.

Moreover, ENGCO also had quite different business model (made-to-order production) from manufacturing industry. It made ENGCO adopt ERP functions difficult and customize a lot of processes to fit its requirements – especially, sales and material management. However, in order to prepare global business, ENGCO reengineered its processes from domestic point of view in the legacy systems to global standards in the ERP system. It enabled ENGCO to support global business efficiently by using the ERP system.

Communication plan

In order to integrate legacy systems and processes across the organization, however, it was necessary to make timely decisions based on deep knowledge about processes in the organization as well as the functions of ERP systems. In terms of decision-making processes, while these are more likely to be hierarchical and centralized in the corporate sector, in collegial university setting it is hard to formalize centrally based on each separate office or center's strong autonomy.

For example, because each department of ENGCO had its own role and responsibility and the project team members represented for their department, it was relatively easy to make consensus on the standard process. Also, since there existed a formal hierarchy in decision-making processes, decisions were generally made in a short time during the project. This was demonstrated by ENGCO's standardized and automated decision-making processes through the ERP system. As it transformed all related forms to electric standard forms with data extracted from SAP, ENGCO also defined all standard forms' approval scenarios and implemented these in the ERP system.

However, in the university setting with increased flexibility and autonomy, it was difficult to make decisions within the project team because of diverse cases and a number of exceptions that could not be condensed into a single process. For example, MIT spent three months coming to an agreement on only how purchase orders would be handled. (Williamson, 1997)

Consultant relationship

Both MIT and ENGCO implemented ERP at the very early stage in their respective industries. In the case of ENGCO, the lack of experience and practice in the industry caused a lack of qualified consultants at the company. Hence, inexperienced consultants were one of the causes of the project delay and rework of certain processes later. On the other hand, the consultants at MIT tended to allow customization requests from MIT to fit its unique requirements. This could be explained that consultants would like to have less responsibility for trouble shooting in the future. Consequently, this led both MIT and ENGCO to substantially customize the ERP systems, thus increased the project time and maintenance cost, and even made future upgrades to new versions from the vendor difficult.

ERP systems integration

Both cases show similar benefits from ERP implementation in terms of system integration. By integrating their disparate legacy systems across the organization, MIT and ENGCO increased data visibility and accessibility from one single ERP system. The ERP systems enabled more efficient operations in both organizations.

Table 5-4 shows a summary of ERP CSFs fulfillment comparison with three level ratings – Strong, Limited, and Weak.

CSFs	MIT		ENGCO	
Top management commitment and support	• Top management initiative for ERP implementation • Effective vision sharing for reengineering	Strong	• Top management initiative for ERP implementation • Clear project goal and objectives	Strong
Change Management	• Involvement from departments, labs, and centers • Concept workshop and user training for understanding ERP	Strong	• Tight project schedule • Limited user training before "go-live"	Weak
Business process reengineering and System's customization	• Significant gaps between MIT and SAP's worldview • Substantial amount of customization • Keep using "shadow systems"	Weak	• Effort to adopt global standards from ERP • Substantial amount of customization due to specific requirements for made-to-order production	Limited
Communication Plan	• Lack of formal channel to	Limited	• A formal hierarchy in decision-making	Strong

	communicate across departments, labs, and centers		process	
Consultant Relationship	• Lack of qualified consultants	Weak	• Lack of experience and practice in the industry	Weak
ERP Systems Integration	• Real-time data integration • Easy accessibility • Data visibility	Strong	• Real-time data integration • Faster and integrated business administration process • Management reporting	Strong

Table 5-4. Summary of ERP CSFs fulfillment comparison, MIT and ENGCO

Comparison between the literature and case findings

While universities have substantially invested in ERP implementation, little research has been carried out about ERP implementation in university environment (Nielsen, 2002). In this section, focusing on the university environment, findings in MIT case study compare to what previous studies indicate.

According to Abbas (2011), the major benefits of ERP implementation are improved productivity and reduced cost. Particularly, the central repository that stores data can give universities to easy and up-to date access to users. This study's case also shows the main benefit is real-time integrated data and easy access. Also, he indicated that "One of the common goal of all the educational institutions is a paper free environment and these ERP systems need to be able to facilitate this change". By implementing ERP system, MIT converted many paper processes to ERP system processes. Although some processes still allow a paper work for handling exceptions, this resulted in decreasing manual work.

Fisher (2006) examined staff perceptions of ERP implementation in three Australian universities. One aspect of an implementation of an ERP system was that it could be perceived of power redistribution in an organization. He described that power redistribution could occur resistance of change such as the development of shadow systems. MIT's case shows this fact that DLCs keep maintaining shadow systems to complement their specific requirements the ERP system cannot meet. Moreover, Fisher (2006) indicated that the delayed timeframe for ERP implementation in universities made more positive perceptions for the adoption of new technology. This contrasts that corporate sector emphasizes on keeping specific timeframes for successful implementation (Livingstone, White, Nelson & Tabak, 2002). The delayed timeframe can be perceived to give more time for additional training and help staff to relieve pressure from using new system. Ken Le Vie, a project member in MIT SAP implementation also recalled that the delay "go-live" date made most of people relieved. "We probably did not know how challenging SAP is going to be, but we certainly knew it meant to increase our effort (to use the ERP system) (Ken Le Vie, April 9, 2013)."

Moreover, Abbas (2011) presented that “the structures of the universities are very rigid and resistant to change, so the focus is on the change of processes not technology”. In this sense, the role of top management is critical to plan and monitor across an organization during ERP implementation. For successful ERP implementation, all the users should be informed and involved about the implementation process and progress (Abbas, 2011). The effective and efficient communication increases the possibility of success of ERP implementation.

6. Conclusion

Based on the case studies' findings, several conclusions were formulated and are presented below.

First, both corporate sector organizations and universities are seeking the benefits of ERP systems as identified in the literature, including much easier access to reliable information by integrating disparate legacy systems and reengineered business processes. However, the company in the corporate sector reengineered their business processes more easily than universities. This can be explained that compared to the corporate sector, universities tend to have little urgency given the time value of money. Moreover, revenues of universities tend to be directly related to its academic reputation rather than an efficient administration. Therefore, universities rarely change their operating models, which may raise risks on their operations, and even adopt new technology less quickly than the corporate sector normally does. On the other hand, in a rapidly changing business environment, competitors continuously threaten companies in the corporate sector. The companies stand to lose their competitive advantage or lag behind when they move later than their competitors.

Based on the literature review, top management support was one of the most frequently cited critical success factors during ERP implementation (Al-Sehali, 2000). This conclusion was also supported in both the case studies in this study. Even though both organizations changed their original plan for "go-live" schedule during implementation, implementation would have caused delay or overrun cost even more without strong top management support.

Organizational structure and culture also highly affected ERP implementation. Although both organizations presented overall dissatisfaction with more complex ERP systems than expected, the ENGCO's stakeholders were satisfied with the decision to adopt an ERP system to support their organization's rapid growth. A hierarchical and formal decision-making process in the corporate sector helped the ENGCO to use standardized processes and to successfully reengineer processes more than at MIT which was collegial and had autonomy environment. In this sense, change management and consultant relationship should play more significant roles to implement ERP in university setting (Derrian Jones and Bob Mayville, May 7, 2013). Universities should prepare detailed communication plan to share the goals, expectations and limitations of the ERP project throughout organizations. At the same time, consultants who have a deep understanding of the unique environment should conduct various roles in the project with an appropriate leadership – as an auditor, project manager, and knowledge resources from diverse experience.

Overall, both organizations felt they did not achieve their expected return on ERP system investment. Full ERP system implementation was much more costly than expected, and the systems also required significant secondary resources and ongoing maintenance efforts.

Through the two case studies presented, this study provides and confirms distinctive challenges in ERP system implementation for the corporate sector and universities. Especially, universities chosen by this study – MIT (the main case study), University of California, San Francisco, and University of Wisconsin-Madison are classified as research universities conducting very high research activities in the Carnegie Classification of Institutions of Higher Education.[5] Other universities classified as teaching universities may give us different challenges in ERP implementation. Further research could shift the focus onto what

[5] http://en.wikipedia.org/wiki/List_of_research_universities_in_the_United_States

different challenges universities may have in terms of their characteristics, and how to increase the benefits of ERP systems in spite of noted challenges.

Appendix A. Interview Questions

The interviews, which were the main source of the case studies, were conducted primarily with the stakeholders – Demand side (End users) and Supply side (The project team and IT staff) – involved in the two case studies, as well as other people in their organization who have had experiences implementing ERP in universities.

The Questionnaire is as follows:

Organization

1. What was the goal of the ERP implementation?
2. Has the ERP system led to a higher need for change of the organization and processes?
3. What was IT Capability of the organization?
4. What was the decision making process?
5. Were there any changes in the decision making process by implementing an ERP system?

Process

6. What was the project period and costs? Estimated vs. Actual (if possible to share)
7. Were there any changes in the original scope, costs and schedule? How did you handle those changes?
8. How long did it take to stabilize the ERP system after handover?
9. How much did your business processes fit to the ERP package?
10. How were employees work processes changed with the ERP implementation?

Evaluation

11. Did the ERP system show immediate benefits upon start-up?
12. Did you get expected benefits and advantages from the ERP system?
13. Has the ERP system led to greater innovation?
14. What factors were key to implementing the ERP successfully?

Communication

16. How was the communication changed between employees?
17. What were stakeholders' responses after an ERP implementation? (Positive, Neutral, Negative)

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