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Identifying Critical Success Factors of ERP Systems at the Higher Education Sector

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In response to a range of contextual drivers, the worldwide adoption of ERP Systems in Higher Education Institutions (HEIs) has increased substantially over the past decade. Though the difficulties and high failure rate in implementing ERP systems at university environments have been cited in the literature, research on critical success factors (CSFs) for ERP implementations in this context is rare and fragmented. This paper is part of a larger research effort that aims to contribute to understanding the phenomenon of ERP implementations and evaluations in HEIs in the Australasian region; it identifies, previously reported, critical success factors (CSFs) in relation to ERP system implementations and discusses the importance of these factors.

Key words: *Critical success factors, CSFs, ERP implementation success, ERP systems, Higher Education.*

1. INTRODUCTION

A growing number of Higher Education Institutions¹ (HEIs) worldwide have implemented or are exploring Enterprise Resource Planning (ERP) systems. The environmental impetuses for Universities worldwide (McCredie and Updegrave, 1999) and in Australia (Beekhuyzen *et al*, 2002) have been many (Cruse *et al*, 2000; Brown, 2002). For example; continuing decline in per-student government funding and support, globalisation and global competition, continuing growth in student numbers, changes in the nature of academic work, increasing competition between institutions, government pressure to improve operational efficiency, and generally diverse and shifting expectations of stakeholders. These substantial and continuing shifts in the sector, demand more efficient management processes (Allan and Kern, 2001; Pollock and Cornford, 2004) and improved administrative operations (Allen and Kern, 2001). ERP vendors have responded with products better tailored to this relatively new market and many universities, similar to large corporations, have increasingly replaced their legacy administrative systems² with ERP solutions (Allen and Kern, 2001; Beekhuyzen *et al*, 2002).

The similarity and differences between HEIs and business corporations have been discussed in the literature for several decades (e.g. Lockwood, 1985; Balderston, 1995; Pollock and Cornford, 2004). According to Pollock and Cornford, (2004), it is tempting to see the HEIs as unique organisations that are different from other organisations. This uniqueness can be based on a combination of different characteristics, which, according to Lockwood (1985), could include, complexity of purpose, limited measurability of outputs, both autonomy and dependency from wider society, diffuse structure and authority, and internal fragmentation. Thus, universities are 'different' from other organisations (Pollock and Cornford, 2004), warranting specific research attention. Though research on ERP systems in the higher education environment is emerging (e.g. Cornford and Pollock, 2001; Cruse *et al*, 2000; Pollock and Cornford, 2004), there has been little specific attention to causes and measures of ERP success or failure in the HEI sector. Concern with this inattention is being increasingly voiced in Australia (CAUDIT, 2001) and abroad (Orgill and Swartz, 2000).

¹ The HEIs are more than universities. HEIs include: universities, colleges and TAFEs. However, the emphasis in this study is on universities.

² Legacy systems, in this study context, are defined as applications (often standalone) that have been built using a prior era's technology and been in the organisation for many years. These systems are often 'due' for retirement, but still exist within the organisation encapsulating the existing business processes, organisation structure, culture, and information technology (adopted from Aiken 1995; Tayntor, 2005; Holland and Light, 1999).

The difficulties and high failure rate in implementing ERP systems at university environments have been cited in the literature (e.g. Lawnham 2001; Madden 2002; Parth and Gumz, 2003; Gilbert, 20004), but research on critical success factors (CSFs) for ERP implementations in this context is rare and fragmented. This research is an effort to fill this gap. The study proceeds from a central interest in the rapid growth of the ERP market in HEIs, the increasing pervasiveness of ERP in the sector and the lack of scholarly publications discussing ERP implementations in the HEIs. The present paper is part of a larger research effort that aims to contribute to understanding the phenomenon of ERP implementations and evaluations in HEIs in the Australasian region; it identifies, previously reported, critical success factors (CSFs) in relation to ERP system implementations and discusses the importance of these factors. The main research question of this study is: *“What are the key critical factors for ERP implementation success in a university environment?”*

The paper is structured as follows. First, a brief literature review introducing ERP systems and the adoption of ERP systems in the HEIs. Next, the research method is presented, followed by an introductory overview of the case site under investigation. Subsequently, the findings are presented. Finally, the conclusions and the implications for further research are outlined.

2. LITERATURE REVIEW

2.1 ERP Systems

ERP systems went through different development cycle since its introduction back in the 1970s until it established itself as a backbone of most major organisations, across different sectors, in the world. The term ERP was coined to describe an emerging category of hardware and software solutions that expanded upon and extended the scope of traditional manufacturing resource planning (MRP) systems (Al-Mashari, 2003; Arif, *et al.* 2004). Whereas the focus of MRP is on manufacturing processes, ERP systems look at a much broader integration of information or data management functions within the organisation. An ERP system is an attempt to create an integrated tool that manages different functions within an organisation. Various definitions and descriptions of ERP systems can be found in the literature. A comprehensive definition adopted from Klaus, Rosemann, and Gable (2000: 141), is used in this study, where ERP systems are perceived as *“comprehensive packaged software solutions seek to integrate the complete range of a business's processes and functions in order to present a holistic view of the business from a single information and IT architecture”*. They can link different areas of an organisation, such as manufacturing, order management, financial systems, human resources, suppliers and customers, into a tightly integrated system with shared data and visibility (Chen, 2001).

The reliance and dependence on ERP systems have grown substantially since the early 1990s, and the purchase and implementation of ERP systems continues to be one of the fastest growing segments of the information technology (IT) sector (Lou and Strong, 2004). According to Luo and Strong (2004:322), *“The reason behind this phenomenal growth is the promise that ERP systems can provide an integrated business computing solution and improve a company's ability to compete in the marketplace”*. During the mid to late 1990s, emphasis was placed on ERP systems to address the real and perceived problems of Year 2000 (Y2K) (Kvavik and Katz, 2002). According to the Arif, *et al.*, (2004), Swartz (2000), and Sawyer and Southwick (2002), current purposes, emphases, and reasons for ERP purchases and implementation projects are much more concrete now than ever before. Although many reasons exist for the growth in ERP systems, the core emphasis on ERP implementation focuses primarily on processes of re-engineering, business process analysis, best practice analysis, and utilization of transaction processing systems (e.g. Kock, 2002; Kvavik and Katz, 2002; Holsapple and Sena, 2003; Al-Mashari, 2003; Arif *et al.*, 2004; Esteves and Pastor, 2004; Gattiker and Goodhue, 2005).

ERP systems hold the promise of improving business processes and decreasing costs (Nah *et al.* 2001; Beheshti 2006), as these systems facilitate communication and coordination, centralise administrative activities, improve ability to deploy new information system functionality, and reduce information system maintenance costs (Siau, 2004). A successfully implemented ERP system can be the backbone of business intelligence for an organisation, by giving managers an integrated view of the business processes (Parr and Shanks, 2000; Nash 2000). A successful ERP system can be the backbone of business intelligence for an organisation because it can give managers an integrated view of the processes involved within it (Parr and Shanks, 2000; Nash 2000). ERP systems can link different areas of an organisation, such as manufacturing, order management, financial systems, human resources, suppliers and customers, into a tight integrated system with shared data and visibility (Chen, 2001). For instance, ERP systems provide seamless integration of processes across functional areas with improved workflow, standardisation of various business practices and access to real-time up-to-date data (Mebert *et al.*, 2003; Ehie and Madsen, 2005).

Despite the significant benefits that are associated with the implementation of an ERP system, there are many drawbacks recognised in the implementation process. Shehab *et al.*, (2004) stated that the implementation of an ERP system is painful and the customisation is costly and time consuming. This is because the business process reengineering (BPR) and the customisation of the software to fit the business needs can become serious and costly problems allied with the implementation, as there might be a difference between the functionality offered by the software and that required by the organisation.

However, the implementation process of an ERP system is not an easy task (Grabski and Leech, 2007); it is a process of great difficulty and complexity. There are a number of problems or difficulties associated with the implementation of ERP systems – it can be time consuming, take many years to complete, and it can be a real challenge for an organisation (Davenport, 1998; Adam and O'Doherty, 2000; Yusuf *et al.* 2004). ERP system requires significant investment in consulting to overcome difficult software implementation (Nah *et al.* 2001). Also, the budget and the duration of the implementation project of ERP systems can exceed preliminary estimates, and the planned scale of the implementation can be limited (Soja, 2006). Although ERP systems are complex and difficult to implement, a structured, managed, controlled, and disciplined approach can facilitate the implementation (Umble *et al.*, 2003).

The failure rates of ERP projects are comparatively high, and in extremes cases can lead to the bankruptcy of an organisation (Davenport, 1998; Beheshti, 2006). Nevertheless, many organisations are implementing ERP systems, and the global expenditure to implement ERP systems is relatively high. The ERP system industry has experienced rapid growth in the late 1990s, it was estimated that US\$10 billion was spent on purchasing ERP systems in 1997 (Volkoff *et al.* 1999), and the International Data Corporation (IDC) (cited in Katerattanakul *et al.* 2006) has estimated that the market for ERP will increase to US\$36.1 billion in 2008.

2.2 ERP Systems in the Higher Education Sector

Several factors have contributed to rapid changes in HEIs worldwide. In response to pressures from government policies, and to various social and economic factors (Anderson *et al.*, 1999), universities have turned to Information Technology (IT) as a core facilitator of new strategic directions. For example, the Australian Vice Chancellor's Committee (AVCC) created the Core Australian Specification for Management and Administrative Computing (CASMAC) steering committee in 1991 (AVCC, 1996). CASMAC followed the universities of UK initiative MAC (Management and Administrative Computing) (Vitale, 2000), which was introduced in the late 1980's, when universities in the UK agreed that they were not really in the business of software development, and decided to take a common approach to finding systems solutions that can be shared. CASMAC was created to develop a set of common management and administration systems across the Australian University Network (Vitale, 2000).

The main aim of ERP system implementations in HEIs has been to integrate different administrative functions into a more systematic and cost effective approach to gain a strategic advantage. The integration of administrative functions in the higher education sector spans the integration of student administration, human resource management, facilities management, and financial systems that have in the past been supported by separate legacy systems (Zornada and Velkavrh, 2005). These were "*disparate and lead to duplication of resources and services*" (Allen and Kern, 2001: 150). ERP systems were adopted to resolve this. The main advantages of ERP for HEIs are (1) improved information access for planning and managing the institution, (2) improved services for the faculty, students and employees, (3) lower business risks, and (4) increased income and decreased expenses due to improved efficiency (King 2002).

Mahrer (1999) investigated the antecedents and impact of a successful ERP system implementation in a Swiss university, and concludes that strong communication and coherence between the departments in the university was the main success factor. Oliver and Romm (2000) studied why universities wanted to adopt ERP systems. This study however was limited, as it reported findings only from secondary data collected through Web sites of ERP projects at universities in the United States and Australia. Chang *et al.*, (2000) acknowledged the importance of knowledge management in ERP implementations in the Australian public sector (including HEIs), and concluded that knowledge management had to be taken into account to successfully implement ERP systems. McConachie (2001) found that university staff wanted a new system but were afraid of the complexity of an ERP system. Other researchers (e.g. Brown, 2002; Madden, 2002) have reported on factors that limited the successful implementations of ERP system projects in the higher education sector.

The implementation of ERP systems in HEIs has been described as a challenging undertaking. For instance, expenses and risks involved are high, whereas the return on investments is medium to long-term (Ferrel, 2003). Feemster (2000: 25) described the difficulties experienced with an

ERP system implementation in a US college as “merging a system of decades-old databases and re-educating campus employees” and causing “enormous cost and pain”. Pollock and Cornford (2004: 32) argue that ERP systems are accompanied by “tensions in whichever setting they are implemented”, and that ERP systems are “refashioning the identity of universities” with the implementation of these systems in the higher education sector raising new organisational issues. For example, these systems were initially designed for corporate organisations, with little initial effort to make them fit universities (Beekhuzen *et al.*, 2001). The packaged and modular nature of these systems is also problematic for universities, as they must adjust their business processes to fit the system, or customise the system to fit the organisation’s business processes (Von Hellens *et al.*, 2005). The academic culture in four UK universities, for example, made it particularly hard to implement ERP systems (Allen and Kern 2001).

While Pollock and Cornford (2004) suggested that Universities share similarities with manufacturing organisations, they recognised that Universities have specific and unique administrative needs. Traditional ERP systems address basic business administrative functions such as HR (Human Resource), Finance, Operations & Logistics and Sales & Marketing applications. Yet, the higher education sector requires unique systems for: Student Administration, Course/Unit Administration, Facilities (Timetabling) requirements, and other applications, not part of traditional ERP.

Research in Australian higher education has reported combinations of problems with ERP implementations that appear unique to universities (Nielsen, 2005; Von Hellens *et al.*, 2005). Such problems have not been isolated, with Australian newspapers reporting what might be broadly characterised as ERP project failures (Lawnham 2001; Madden 2002) at the University of New South Wales (UNSW), Adelaide University, and Royal Melbourne Institute of Technology (RMIT). Dramatic, unsuccessful university implementations have too been reported in the United States (Parth and Gumz, 2003). For example, Cleveland State University (1998) considered legal action against the ERP vendor, when their new system could handle only half their transaction volume. They regardless continued with the implementation despite rising costs, the final cost of \$15M exceeding initial forecast by \$10.8M. ERP implementation costs for Ohio State University rose from an initial estimate of \$53M to \$85M. The University of Minnesota had a similar experience, when projected costs of \$38M finally reached \$60m.

Although ERP implementation in HEIs is often described as difficult, expensive and risky; belief in the solution, and its adoption across the sector, has continued globally (Von Hellens *et al.*, 2005). For instance, the chief information officer at George Washington University believes that integrated information solutions give higher education institutions competitive advantages, and adds that: “...institutions, which are unlikely to switch to integrated information solutions, will find it difficult to retain their market share of students. Students will, sooner or later demand services, offered by other institutions...” (Murphy, 2004). Vitale (2000) suggested the importance of administrative computing to the smooth, economical operation of a tertiary institution cannot be denied. In 2002, 86% of Australian universities were implementing or intended to implement at least one module of an ERP system (Beekhuyzen *et al.*, 2002). At that time, 38% of Australian universities had adopted ERP solutions from a single vendor, 48% had adopted a ‘best-of-breed’ approach entailing a range of modules from several vendors, and 14% had not implemented any type of enterprise modules (Beekhuyzen *et al.*, 2002).

In summary, due to the relatively unique context and needs of HEIs, the challenges and risks of ERP implementation in the higher education sector are many, and demanding of unique and separate research attention.

3. RESEARCH METHODOLOGY

The difficulties and high failure rate in implementing ERP systems at university environments calls for a better understanding of its critical success factors. Through an extensive literature review, the researcher found a large number of articles that provide answers to the question: “*What are the key critical factors for ERP implementation success*”. These articles were identified through a computer search of many of the more outstanding MIS journals including, but not limited to, those outlined in below:

- MIS Quarterly.
- Information & Management.
- Decision Sciences.
- Journal of Management Information Systems.
- Journal of the AIS.
- Communications of the ACM.
- European Journal of Operational Research.
- Business Process Management Journal.

A number of databases, in addition to the proceeding journals, were also searched, including: Emerald, Proquest Computing, Proquest European Business, these databases include hundreds of journals that are categorised as belonging to the business/IS field. Articles were selected from the search results that had used the search terms and conditions outlined in Table I. Keywords selected for this search were, in fact, chosen from the keywords supplied by the author of some of the relevant articles identified in a previous literature review. Also, as would be expected, the searches were limited to only those journals that were scholarly or peer-reviewed. The actual selection of the article for inclusion in the literature review was dependent upon the researcher's decision after reading the article abstract and title. If it was determined that the article could possibly contain information that would be indicative of ERP implementation success factors, then the article was selected for further review, otherwise the article was excluded.

Searched: Abstract and Title	
Journal searches	Database searches
Critical success factors ERP implementation	Critical success factors "AND" enterprise systems
ERP implementation success	Critical success factors "AND" ERP
ERP	Enterprise systems "AND" implementation
ERP success	Enterprise planning "AND" implementation
ERP implementation success	ERP implementation "AND" success
Enterprise resource planning	Enterprise planning "AND" success
Enterprise resource planning success	ERP
Critical success factors enterprise systems	ERP success
Success factors enterprise systems	ERP adoption

TABLE 1: Search terms- Journals and Databases

4. ERP SYSTEMS CRITICAL SUCCESS FACTORS (CSFs)

Digman (1990: 247) defined critical success factors (CSFs) as "*The areas where things must go right for the business to flourish*". Okland (1995: 325) defined them as: "*What the organisation must accomplish to achieve the mission by examination and categorisation of the impacts*". Verville and Bernadas (2005) claimed that one single critical factor by itself will not ensure the success of an ERP acquisition process because it is a mixture of several critical factors that will result in the desired outcomes. In an ERP context, we define CSFs as *a set of activities that need special considerations continual attention for planning for and implementing of an ERP system*.

There are many factors, identified in the literature, which influence and guide ERP implementations and which have a direct impact on implementation outcomes. However, researchers have very often focused on only specific aspects of the implementation process or specific CSFs. Resultantly, there is little research documented that encompasses all significant CSF considerations. While some investigators had set out to prepare a taxonomy of CSFs (e.g. Al-Mashari *et al.*, 2003; Kalling, 2003; Siriginidi, 2000b; Umble *et al.*, 2003), based on literature reviews, on the one hand, others had presented CSFs according to stages of implementation (e.g. Chen (2001) attempted to identify CSFs according to planning stages, and similarly, Nah *et al.* (2001) and Somers and Nelson (2001) presented CSFs by stage of implementation), on the other hand, others had been more focused on a specific area of the implementation, or had attempted to categorise CSFs according to planning frameworks (e.g. Trimmer *et al.* (2002) offered a list of generic CSFs based on a literature review, but then expanded this with a list of CSFs specific to health care, compiled through their own case studies).

For instance, research by Davison (2002) involved a case study on a Hong Kong University to learn more about culture as a factor that affects success; Abdinnour-Helm *et al.* (2003) recognised the importance of employee attitude to ERP implementation success. Other researchers, considered other perspectives: Tarafdar and Roy (2003) interviewed executives about the issue of organizational acceptance; Robey *et al.* (2002) used case study to address the issue of knowledge barriers. Dong (2001) focused on the influence of top management support; Gullidge and Sommer (2002) studied business process management as a CSF.

Parr *et al.* (1999) highlighted ten factors necessary for successful ERP systems implementation based on interviews with 10 experts who had participated in a total of 42 ERP implementation projects. The factors were divided into four groups - management, personnel, software, and project. The three most important factors identified were management support of the project team and the implementation process, a project team that has the appropriate balance of business and technical skills, and a commitment to change by all stakeholders. Moreover, Holland and Light (1999) provided a CSF framework consisting of twelve factors, which were divided into strategic and technical factors to illustrate the framework on two ERP implementation projects. By contrast,

Esteves and Pastor (2000) provided a more comprehensive ERP implementation critical success factors model by analysing and dividing the strategic and technical factors from technological and organisational perspectives.

Shanks *et al.* (2000) identified eleven critical success factors for ERP projects, drawn from two case studies on China and Australia. The factors were top management support, external expertise, balanced project team, data accuracy, clear goals, project management, change management, education and training, presence of a champion, minimal customisation, and using the best people full-time. However, only top management support and the formations of a balanced project team were common to both firms throughout the implementation stage. Nah *et al.* (2001) reviewed ten articles written between 1998 and 2000 to classify the key critical factors for a successful ERP implementation. Eleven critical factors were identified, such as ERP teamwork and composition, change management program and culture, top management support, business plan and vision, business process reengineering (BPR) and minimum customisation, effective communications, project management, software development, testing and troubleshooting, monitoring and evaluating performance, project champion, and appropriate business and IT legacy systems. However, the authors didn't specify which methods (case studies, empirical research or other methods) were used to determine the factors listed above.

Al-Mashari *et al.* (2003) provided a comprehensive taxonomy of ERP critical factors. The authors identified twelve factors and divided them into three groups linked to the stages of an ERP implementation - setting-up, deployment, and evaluation. The factors identified were management and leadership, visioning and planning, ERP package selection, communication process management, training and education, project management, legacy systems management, system integration, system testing, cultural and structural changes, and performance evaluation and management. However, the taxonomy's emphasis is that a clear vision and business director is fundamental for the success of ERP system implementation because the most essential element of successes and the pre-requisite for successful and effective ERP implementation is leadership and commitment. Brown and Vessey (2003) found five success factors for ERP implementations by reviewing three successful ERP implementation case studies. The success factors related to top management's engagement with the project - not just mere involvement, project leaders are veterans, change management goes hand-in-hand with project planning, satisficing mindset prevails, and team members were decision makers. Also, Umble *et al.* (2003) established a number of critical success factors based on previous studies and further applied the factors in an ERP implementation case study. The factors were clear understanding of strategic goals, commitment by top management, excellent project management, organisational change management, a great implementation team, data accuracy, extensive education and training, focused performance measures, and multi-sites issues. Somers and Nelson (2004) analysed critical success factors from 86 organisations that were completing or had completed the implementation of ERP systems- the authors identified and ranked 22 CSFs. The top five were top management support, project team competence, project champion, inter-departmental cooperation, and clear goals and expectations.

Verville and Bernadas (2005) presented ten critical success factors for successful ERP acquisition outcomes by using three case studies. The factors were divided into two dimensions, which related to the acquisition as a process and to people within the process. The factors were: a planned and structured process, rigorous process, definition of all requirements, establishment of selection and evaluation criteria, accurate information, clear and unambiguous authority, careful selection of the acquisition team members, partnership approach, user participation, and user buy-in. Finally, Nah and Delgado (2006) reviewed the literature to provide a comprehensive list of critical success factors related to ERP implementations and upgrade. Based on the work by Markus and Tanis (2000), Nah and Delgado organised these factors into seven main categories: (1) Business plan and vision; (2) Change management; (3) Communication; (4) ERP team composition, skills, and compensation; (5) Project management; (6) Top management support and championship; and (7) System analysis, selection, and technical implementation.

Table 2 highlights the frequency analysis of the 12 CSFs that were chosen for this study, including: Top management commitment and support, Change management, Project management, Business process re-engineering (BPR) and system's customisation, Training, ERP team composition, Visioning and planning, Consultant selection and relationship, Communication plan, ERP system selection, ERP systems integration and Post-implementation evaluation.

Critical Success Factor (CSF)	Number of instances cited in the literature
Top management commitment and support	28
Change management	28
Project management	24
BRR and system's customisation	21
Training	20
ERP team composition	17
Visioning and planning	15
Consultant selection and relationship	14
Communication plan	13
ERP system selection	13
ERP systems integration	11
Post-implementation evaluation	10

Table 2: Frequency analysis of the 12 CSFs that were chosen for this study³.

4.1 Top Management Commitment and Support

One of the most cited critical success factors in an ERP implementation is top management support and commitment. Davenport (1998: 130) has posited that *"if the development of an enterprise system is not carefully controlled by management, management may soon find itself under the control of the system"*. Additionally, Sarker and Lee (2003) empirically proved that strong and committed leadership at the top management level is essential to the success of an ERP implementation. Top management commitment and support referred to the need for management to anticipate any glitches that might be encountered (Motwani *et al.*, 2002) and the need for senior management who would be involved in the strategic planning, but who are also technically orientated (Yusuf *et al.*, 2004). Al-Mashari *et al.* (2003) stated that top management support and commitment should not stop at the initiation and facilitation stage, but should extend to the full implementation of the ERP system.

The implementation of an ERP system must be viewed as a high priority project by top management (Shanks *et al.* 2000), as the system will change how the organisation does its business. Glaser (1999) claimed that senior management must demonstrate their commitment by showing strong leadership, limiting the initial scope of the project, and working towards achieving an early success. Top management commitment to the project is necessary to ensure the success of the system, otherwise the project is most likely to fail or fail to deliver the full range of benefits forecasted (Gargeya and Brady, 2005; Beheshti, 2006). In addition, Bingi *et al.* (1999) posited that an overall organisational commitment could be obtained if top managements conveyed their commitment across all organisational levels. The resulting organisational commitment, which should be well defined and visible, will, in turn, ensure the successful implementation of the ERP project (Umble and Umble, 2002).

4.2 Change Management

Change management is the other most widely cited critical success factor. According to Nah *et al.*, (2001), the change management concept refers to the need for the implementation team to formally prepare a change management program, and be conscious of the need to consider the implications of such projects (Bingi *et al.*, 1999). It was estimated that 50% of the organisations that implemented an ERP system failed to achieve the intended benefits because managers undervalued the efforts needed to successfully manage the changes that took place (Pawlowski and Boudreau, 1999).

It would be impossible to successfully transform an organisation by implementing an ERP system without adequate consideration for an approach that supports change (Al-Mashari and Zairi, 2000). Thus, change management strategies are essential for adapting and deploying ERP systems in organisations to achieve the desirable outcomes (Kim *et al.*, 2005). By comparing one successful and one failed ERP implementations, Motwani *et al.* (2000) found that a project that is supported by top management without appropriate organisational readiness and adequate change management strategies in place is more likely to fail. By contrast, a cautious, evolutionary and bureaucratic implementation that is supported by careful change management, network relationships, and cultural readiness can lead to successful ERP implementation.

³ Note: Other critical success factors were found in the reviewed articles, such as: system testing, building a business case, and empowered decision makers. However, for this study, if the critical success factor was cited less than 10 times in the reviewed articles; it was excluded.

The implementation of an ERP system is more than just changing the software or hardware systems; it will enable the organisation to achieve a higher level of performance through a restructured business process (Ehie and Madsen, 2005). Bingi *et al.* (1999) stated that implementing an ERP system involves the re-engineering of existing business processes to the best business processes standard. Consequently, the implementation of an ERP system will change the way an organisation conducts its business, and may require the re-engineering of essential business processes and/or the development of new business processes to support the organisation's goals (Umble *et al.*, 2003). Therefore, the changes that will take place can lead to resistance, uncertainty and horror among users of the new system (Glover *et al.* 1999), and employees' turnover and employees' resistance may place additional risks on ERP implementation (Grabski and Leech, 2007). Hence, the success in implementing an ERP system depends on balancing the major conflicts between the organisation and its technology, and effectively managing its employees in the change process (Ash and Burn, 2003). As such, Hawking *et al.* (2004) claimed that ERP system implementations are people-focused projects that depend on the change to achieve success. Thus, strong ability and flexibility to change as well as the acceptance of new technologies will help in the implementation process. This can be achieved if top management spread out its vision to change, enlist employees' adherence and readiness to the new system, and ensure they are familiar and satisfied with the changes that will occur (Motwani *et al.*, 2005).

4.3 Project Management

An effective project management is essential for a successful ERP implementation (Umble *et al.*, 2003; Nah and Delgado, 2006). However, Umble & Umble (2002) have found that managers are often surprised by the scope, size, and complexity of an ERP implementation and they sometimes fail to initiate the necessary level of detailed project management planning and control. Kim *et al.* (2005) listed 47 impediments to a successful ERP system implementation, and many arose from project management issues. Therefore, the role of the project manager becomes singularly important in ERP implementation success. Given this information, it is expected that senior management will not only endorse the changes but they will also provide the necessary support and resources for the project manager to ensure the success of the implementation (Botta-Genoulaz *et al.*, 2005; Taube and Gargeya, 2005).

Implementing an ERP system requires an appropriate project management structure and methodology (Bingi *et al.*, 1999). However, the author posited that the main reason for an ERP implementation failure stems from a lack of understanding of the project and an inability to provide guidance and adequate leadership to project team members. Maber *et al.*, (2001) documented the importance of a project that is well-planned and is managed very efficiently. Hence, proper project management and an adequate implementation methodology must be used to ensure all important project steps are clearly defined and included in the project plan (Scott and Vessey, 2002) for the system to be implemented successfully. Moreover, effective project management should contain a clear definition of the project objectives, the development of a work and resource plans, and a cautious tracking of the project's progress (Davis and Wilder, 1998; Laughlin, 1999). Also, a detailed project plan that is linked to the project goals should be defined and established in the early stages (Holland *et al.*, 1999). This is because a clear project plan and a clear definition of the project objectives will help organisations to avoid the "scope-creep", which can blemish the project budget (Laughlin, 1999). However, the scope of the ERP system must be clearly defined, controlled, and limited (Umble *et al.*, 2003; Al-Mashari *et al.*, 2003; Bajwa *et al.*, 2004) because scope modification will result in additional time and costs (Sumner, 1999). In addition, obligations and responsibilities for an ERP system implementation should be allocated and wisely assigned (Rosario, 2000), to accomplish the required tasks. Bender *et al.* (2000) argued that the use of a detailed project plan, that is used to set project deadlines and key milestones, is an essential element of project success. Deadlines, timelines and the effort needed to accomplish specific tasks should be realistically estimated and clearly stated (Rosario, 2000; Wee, 2000; Al-Mashari *et al.*, 2003). For instance, Bender *et al.* (2000) found a strong relationship between a team's ability to achieve project deadlines and the success of the ERP implementation project.

4.4 Business Process Re-engineering and System's Customisation

Shehab *et al.*, (2004) stated that there are two different strategic approaches to implementing an ERP system. In the first approach, organisations have to re-engineer the business processes in order to fit the functionality of the ERP system package. This may entail changes in the essential business processes in which organisations are conducting their daily tasks, and may result in changing employees' responsibilities (e.g. Holland and Light, 1999; Bingi *et al.*, 1999; Hong and Kim, 2002; Yusuf *et al.*, 2004). The second approach is the customisation of the ERP system package to fit the existing business processes. However, customisation of the ERP software

package should be avoided, or at least minimised as much as possible, in order to achieve the full benefits of the ERP system (Shanks *et al.* 2000; Light, 2001; Bajwa *et al.* 2004). This is because customisation will increase the project time, ruin schedules, introduce new bugs into the system, and make the upgrade to the vendor's new released software harder (Shehab *et al.* 2004). As a result, the term of vanilla ERP was introduced. Vanilla ERP means that organisations should be committed to the idea of implementing the "vanilla" version of an ERP. This is the basic version with no or minimal customisation (Siriginidi, 2000a, b; Somers and Nelson, 2001, 2004; Nah *et al.*, 2001, Palaniswamy and Frank, 2002, Mabert *et al.*, 2003, Shanks and Parr, 2000).

4.5 Training

A large number of researchers have stressed the need to include training as a critical aspect of an implementation. While some researchers have generally mentioned the need for training, most researchers have mentioned the need for user training (e.g. Bingi *et al.*, 1999; Kumar *et al.*, 2002; Robey *et al.*, 2002; Trimmer *et al.*, 2002; Mandal and Gunasekaran, 2003). It has been suggested that the training should encompass the development of IT skills (Stratman and Roth, 2002; Voordijk *et al.*, 2003; Tarafdar and Roy, 2003) and that it should be hands-on (Aladwani, 2001).

Appropriate education and training should be provided to users of the new system to ensure they understand how the system works and how it can help them to perform their daily tasks (Bajwa *et al.*, 2004). Moreover, the provision of printed and on-line user manuals, tutorials, workshops, and help desks should be used to support the users and to ensure appropriate understanding of the ERP system functionality. The end-users and training facilities have received the least amount of attention (Gargeya and Brady, 2005) because the resources for training and support can be expensive. However, the failure to provide significant resources for these purposes has seen short-term gains, but end-user ignorance and discontinuance have led to long-term failure.

4.6 ERP Team Composition

It has been repeatedly mentioned throughout the literature that there is a critical need to put in place a solid, core implementation team that is comprised of the organisation's best and brightest individuals. Additionally, ERP implementation team should consist of representatives from all functional units of the organisation, from technical experts to senior executives, because the effort and collaboration of technical and business experts and the system's end-users are essential to the success of ERP implementation (e.g. Siriginidi, 2000b; Shanks and Parr, 2000; Nah *et al.*, 2001; Kalling, 2003; Mandal and Gunasekaran, 2003; Somers and Nelson, 2004; Nah and Delgado, 2006).

Bingi *et al.* (1999) claimed that a key reason for project failure in an ERP implementation is the inability of an organisation to provide accurate resources for the project. Hence, Bingi emphasised that the right internal resources should be selected for the project team. Consequently, the implementation of an ERP system requires the selection of the best employees to be part of the team in order to maximise the chances of a successful implementation (Bingi *et al.*, 1999; and Siau and Messersmith, 2003). Moreover, Bingi *et al.* (1999) stated that the project team members should be familiar with the internal business processes and with industry best practices. Accordingly, the project team should possess sound business and technical skills for a successful ERP implementation (Sumner, 1999; Shanks *et al.* 2000; Somers and Nelson, 2001; Al-Mashari *et al.*, 2003).

Furthermore, choosing the right implementation team is critical because it will be responsible for creating the preliminary and full-detailed project plan, project schedules, assigning the required responsibilities to accomplish a set of tasks, and determining the deadlines (Umble *et al.* 2003). As such, the team members should consider the ERP project as their top and only priority and their other workloads should be manageable (Wee, 2000). They should work full-time on the project (Shanks *et al.* 2000; Wee, 2000) and the top management should motivate and reward the team (Wee, 2000). Additionally, trust and authority should be granted to the team through critical decision-making capability (Davis and Wilder, 1998; Shanks *et al.* 2000)

4.7 Visioning and Planning

The literature has frequently mentioned clear vision, project objectives and project mission as critical factors for successful ERP implementation projects. Therefore, project requirements, objectives, setting a clear vision, and a comprehensive project plan should be developed to fit within organisation goals to ensure the success of an ERP implementation.

Project benefits and goals should be clearly identified, well understood, and tracked (Holland *et al.*, 1999). Goals should also be measurable (Al-Mashari *et al.*, 2003). On the other hand, the development of detailed requirements at project inception is essential to ensure successful ERP

implementation (Verville and Halingten, 2002). Otherwise, a misunderstanding of project requirements can lead to project risk or failure (Keil *et al.*, 1998). Hence, a project plan is critical in specifying the benefits, goals, resources, risks, costs, and timelines of the project (Wee, 2000). For this reason, Mabert *et al.* (2001) found that successful ERP implementers allocated significant time before implementing the system in order to develop a playbook or project plan on how an implementation should be carried out. The project plan provides guidance throughout the implementation process and allows the project team to keep focused on the project goals and objectives. Thus, project requirements provide a clear view to what needs to be done during the project, and the project plan provides detailed steps on what needs to be accomplished in the project (Grabski and Leech, 2007).

In addition, ERP projects should encompass a clear vision and a business plan in order to direct the implementation process (Al-Mashari *et al.*, 2003; Nah and Delgado, 2006). Moreover, the implementation of ERP projects requires the creation of a clear and compelling vision of how an organisation should function in order to achieve the desired outcomes (Umble *et al.*, 2003). Thereafter, the project plan can be built to support and improve this vision, because the investment in ERP systems should closely parallel the strategic direction of an organisation, and be aligned with its vision and future direction (Nah and Delgado, 2006).

4.8 Consultant Selection and Relationship

ERP consultants can play many different and essential roles in ERP system implementations. Consultants can help staff the project team, help to back-fill positions, be charged with responsibility for project management, audit the project, serve as the prime contractor, and be the one source for everything from software to hardware and personnel for the ERP. Thus, many researchers have supported the need to include an ERP consultant as part of the implementation team (e.g. Bingi *et al.*, 1999; Al-Mudimigh *et al.*, 2000; Willcocks and Stykes, 2000; Motwani *et al.*, 2002; Trimmer *et al.*, 2002; Skok and Legge, 2002; Bajwa *et al.*, 2004). However, as part of this relationship, it is imperative to arrange for knowledge transfer from the consultant to the implemented organisation (Al-Mashari *et al.*, 2003) so as to decrease the dependency on the vendor/consultant (Skok and Legge, 2002).

4.9 Communication Plan

Project communication is considered as an essential CSF for ERP implementations. While some researchers argued the need for communication among various functions/levels (Mandal and Gunasekaran, 2003), other specifically argued the necessity of communication between business and IT personnel (Grant, 2003). Sumner (1999) debated that the communication plan should not just exist between senior management and project team members. The whole organisation should be aware of the project scope, its objectives and activities as an effective communication plan will have a direct impact on the success of the change management program (Mendel, 1999). Communication should take place during regular update meetings, the distribution of project newsletters or the placement of wall charts in conspicuous locations (Sumner, 1999). Further, Mendel (1999) stated that strong communication throughout the various stages of the implementation process is essential in allowing employees to understand what is going on in the project, why change is necessary, and how it will benefit the organisation. In addition, an effective communication plan will lead to the development of trust and the exchange of information needed for process changes and the acceptance of the new technology (Amoako-Gyampah, 2004)

Organisation's stakeholders must be informed of the project goals and the expected benefits of the ERP project as well as its capabilities and the limitations of the ERP system (Holland *et al.*, 1999; Al-Mashari *et al.*, 2003; Nah and Delgado, 2006). For instance, Al-Mashari and Al-Mudimigh (2003) argued that the importance of an effective communication plan relies on the fact that it could build the ability of the entire organisation in business process reengineering, and gain all stakeholders' support and commitment. Al-Mashari and Al-Mudimigh provided a number of different communication methods to keep all stakeholders informed of new developments and answering questions about the project implementation by way of newsletters, focus groups, e-mail and Web-based archives.

4.10 ERP System Selection

A number of researchers has stressed the need for careful consideration and attention in selecting a specific ERP system (e.g. Kraemmergaard and Rose, 2002; Al-Mashari *et al.*, 2003; Yusuf *et al.*, 2004; Somers and Nelson, 2001; 2004). The ERP selection process is a critical process (Hedman and Borell, 2004) and a select team should be appointed to carry it out (Bernroider and Koch, 2001). According to Davenport (1998), organisations often fail to consider whether the chosen system will fit their overall business processes and enable them to avoid, or at least minimise, software customisation. Thus, a detailed requirements specification for ERP

software selection will increase the probability that the ERP system will meet the organisation's requirements and support the newly redesigned operational processes (Grabski and Leech, 2007). Therefore, it is important that the selected ERP package fits within the organisational needs and supports the organisation's business processes (Somers and Nelson, 2001, Verville *et al.* 2005, Berchet and Habchi, 2005; Beheshti, 2006). The various selection criteria for ERP systems are well-documented in the literature (e.g. Siriginidi, 2000; Chen, 2000). Siriginidi (2000) addressed several factors to be considered when selecting an ERP system, including: the stability and history of the ERP vendor, last 12-month track record of ERP sales, implementation support from the vendor, and improvement in ERP software packages.

4.11 ERP Systems Integration

Organisations must fully integrate the ERP systems into their daily operations in order to achieve the full benefits of the system. Hence, the integration of data from the organisation's wider system is essential in ensuring the successful implementation of an ERP system (e.g. Bingi *et al.*, 1999; Somers and Nelson, 2001). However, Bingi *et al.* (1999) posited that, with tight integration, organisations must also be aware of the potential risks of the errors that might occur in the process.

4.12 Post-implementation Evaluation

ERP implementation projects are not complete without the allowance for some kind of post-evaluation (e.g. Holland and Light, 1999; Nah *et al.*, 2001; Al-Mashari *et al.*, 2003; Tarafdar and Roy, 2003). However, the post assessment will be difficult to complete unless there had been established metrics (Ross and Vitale, 2000) or focused performance measures (Umble *et al.*, 2003).

5. CONCLUSION AND FUTURE RESEARCH

Based on a review of the ERP literature, 12 critical success factors for ERP implementation have been identified. Top management commitment and support as well as change management are the most widely cited factors of ERP implementation success. To successfully implement an ERP system; appropriate project management structure and methodology should be in place. Another very critical factor is business process re-engineering and system's customisation. Moreover, user training should be available and highly supported. Since ERP systems cover a wide range of functional areas, it is also important to have a cross-functional implementation team. Other critical factors include visioning and planning, consultant selection and relationship, effective communication plan, ERP system selection, ERP systems integration, and post-implementation evaluation measures.

This study suggests potentially valuable future research in the next stages of the overarching research, including:

- We are interested in categorising the identified CSFs into the respective phases in the ERP life cycle model proposed by Markus and Tanis (2000)
- A case study was planned to be conducted at a leading Australian university to identify the applicability of the success factors, identified in the ERP literature, in the higher education context.
- Survey questionnaires will be sent to universities in Australia to evaluate the degree of the success factors identified in the ERP literature.
- Finally, CSFs studies have been criticised because it is felt that the approach relied on the opinions of managers only and it was, therefore, biased (Davis, 1980). Munro and Wheeler (1980) responded to this suggested weakness in the CSF approach by identifying a method that would incorporate the ideas of senior middle managers in determining information requirements. Similarly, Boynton and Zmud (1984) suggested that a cross-section of management be interviewed, so that all levels would be incorporated. Even when these weaknesses are addressed, the CSF approach, nevertheless, can still be biased and requires that an interviewer possess advanced skills (Munro, 1983) and that there be careful application of the technique (Boynton and Zmud, 1984). Hence, one of our future studies will investigate how the perceived relative importance, of these factors, may differ across different implementation stakeholders (i.e. different employment cohorts) such as top executives, end-users, project team members, technical users, and consultants.

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