AN EMPIRICAL VALIDATION OF THE CRITICAL SUCCESS FACTORS FOR THE IMPLEMENTATION OF ERP SYSTEMS

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Abstract

The main objective of this paper is to identify the success factors that are critical to the implementation processes of ERP systems. Based on the literature support, a survey instrument was developed. This was then mailed to top 200 Australian companies that had already implemented an ERP system or were in the process of implementing one of them. To enable the IS executives to indicate their degree of agreement with each item, a 7-point Likert rating scale was used. Data from 53 respondents were analysed and interpreted by using various statistical techniques. This paper empirically investigates critical factors that contribute to the success of implementation of ERP processes. The intensity of the impact of the critical success factors such as planning, accurate information, top management support and consultants’ involvement is greater than that of the remaining factors.

Keywords: CSFs, Implementation, ERP

1. INTRODUCTION

Enterprise Resource Planning is an information system which attempts to integrate all departments and functions across a company onto a single computer system. It is a complex system and the decision to implement it can be problematic if certain issues are not properly considered. Clear understandings about the factors that contribute to the success of the acquisition and implementation processes enable an organisation to improve the success rate of their undertakings. This paper investigates the critical success factors that dominate the ERP acquisition and implementation process, and validates these critical success factors empirically.

ERP systems are the software tools that are used to manage enterprise data. They can be viewed also as information technology (IT)-based solutions that attempt to integrate core business processes, share common data and practices across the entire enterprise and produce and access information in a real-time environment. An ERP system is an integrated software package composed of a set of standard functional modules developed or integrated by the vendor, which
can be adapted to the specific needs of each customer. It attempts to integrate all departments and functions across a company onto a single computer system that can serve all those different departments’ particular needs (Genoulaz, 2005). An ERP system provides an enterprise database wherein all business transactions are entered, processed, monitored and reported. Data is uploaded into the system only once, at one single entry point, and then is disseminated instantaneously to wherever else in the system that it needs to go. The aim of ERP is to improve the co-operation and interaction between all the organisations’ departments such as the manufacturing, marketing and customer service departments. In this paper, an ERP system has been defined as a management information system that consists of a single comprehensive database, accomplishes real-time dissemination of data throughout the organisation, and makes available relevant information for decision-making to the appropriate level of management.

During the 1990s, ERP systems were the de-facto standard for the replacement of legacy systems in large companies (Parr and Shanks, 2000). The impact of ERP systems is so broad, touching many aspects of an organisation’s internal and external operations, that the successful implementation and use of these systems is critical to organisational performance and survival (Markus, Axline et al., 2000). Indeed, the failure of some ERP system implementations has led to organisational bankruptcy (Davenport, 1998; Markus and Tanis, 2000).

1.2 Benefits of ERP systems

ERP systems offer immense benefits to organisations. ERP systems offer companies three major benefits: (1) business process automation, (2) timely access to management information, and (3) improvement in the supply chain via the use of e-communication and e-commerce. Ahmed et al, (2003) suggested that the benefits that are gained by implementing the ERP systems are that they (1) provide an integrating working environment, (2) enable automation, (3) provide available information from field to management level, (4) allow integration in applications in any departments, (5) provide flexibility and facility to standardising processes, accommodating changes and globalisation, (6) achieve balanced people, process and technology changes across all areas, and (7) apply planning and program management practices throughout the program lifecycle of a project.

Lozinsky (1998) suggests that successful implementation results in operating costs being reduced (leading to an improved return on investment), and improved access to information makes possible more agile decision-making for better negotiating with customers and suppliers; with no need for rewriting reports, reliable figures will be available to analyse business performance. ERP systems are expected to reduce costs by improving efficiencies through computerisation, and enhance decision making by providing accurate and timely enterprise-wide information.

ERP is critical to competitiveness because this sophisticated information technology not only helps organisations perform above average, but may also help them survive in the long term. However, its capabilities and functionalities are not being implemented and utilised to the extent possible. One of the main barriers to the implementation of an ERP system is the resistance on the part of some employees.
1.3 ERP problems

ERP system projects are large, complex and costly and require large investment in capital, staff and management time. A long implementation process is needed to customise a company’s processes to match the system. Huge storage needs, networking requirements and training overheads are frequently mentioned as ERP problems (Shehab, Supramaniam and Spedding, 2004). Yen (2002) identified the following disadvantages of ERP: its high cost prevents small businesses from setting up an ERP system, the privacy concern within an ERP system, and the lack of trained people may affect ERPs efficiency. There are various shortcomings of ERP systems, such as functionality (project tracking and reporting deficiencies, cash-flow and planning deficiencies, report production limitations), technicality (integration between ERP system and non-ERP system, deficiencies in data interfaces, input and handling by an ERP system), usability (the learning curve is too steep, low user-friendliness for the occasional user, system input is not logical, report terminology can be difficult to understand, ability to cut and paste, online help capability and accounting rules are difficult to understand), cost and implementation (very costly, long implementation process to customise a company’s processes to match the system).

2.0 LITERATURE REVIEW

Rockart (1976) defines CSFs as those few key areas of activity in which favourable results are absolutely necessary for a particular manager to reach her or his goals. He proposed the CSF method to help CEOs specify their own information needs about issues that were critical to their organisations, so that information systems could be developed to meet those needs. Other researchers, who have similar conclusions to Rockart, include Zahedi (1987) and Soliman (2001). CSFs for any information systems project have been a topic for research in the IS research community for quite some time (Bacon 1993). CSFs for an organisation are the limited number of areas in which results, if they are satisfactory, will ensure the successful competitive performance of the company.

CSFs are the number of factors that may affect the ERP implementation process, and the probability of conversion success has been identified in the IT implementation, IT failures, and business process re-engineering literature. Among the more important factors are top management support and involvement, need for a project champion, user training, technological competence, project planning, change management and project management (Somers and Neslon, 2001). From the perspective of ERP implementation, additional issues which could be incorporated are business process re-engineering, business teams and others.

Within an ERP context, CSFs for ERP implementations are defined as “factors needed to ensure a successful ERP project” (Holland and Light 1999, p. 31). Research conducted earlier on CSFs for ERP implementations have developed different factor checklists for ERP implementations. CSFs analysis may be beneficial in identifying “the limited number of areas in which results, if they are satisfactory, will ensure successful competitive performance for the organisation”.

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(Somers and Nelson, 2003). The following table outlines the identification of CSFs for implementation from various authors.

<table>
<thead>
<tr>
<th>Authors</th>
<th>Research area and findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Somers and Nelson (2004)</td>
<td>Top management support, project champion, user training and education, management of expectations, vendor–customer partnerships, use of vendor’s development tools, careful selection of the appropriate package, project management, steering committee, use of consultants, minimal customisation, data analysis and conversion, business process re-engineering, defining the architecture, dedicated resources, project team competence, change management, clear goals and objectives, interdepartmental communication, interdepartmental co-operation, ongoing vendor support.</td>
</tr>
<tr>
<td>Umble, Haft and Umble (2003)</td>
<td>Clear understanding of strategic goals, commitment by top management, excellent project management, organisational change management, data accuracy, user education and training, focused performance measures.</td>
</tr>
<tr>
<td>Al-Mashari, Al-Mudimigh and Zairi (2003)</td>
<td>Management and leadership, visioning and planning, ERP package selection, communication, process management, training and education, project management.</td>
</tr>
<tr>
<td>Rosario (2000)</td>
<td>ERP teamwork and composition, business plan and vision, change management and culture, BPR and minimum customisation, effective communication, project management, project champion.</td>
</tr>
<tr>
<td>Wee (2000)</td>
<td>ERP teamwork and composition, top management support, business plan and vision, change management and culture, BPR and minimum customisation, effective communication, project management, software development.</td>
</tr>
<tr>
<td>Bingi, Sharma and Godla (1999)</td>
<td>ERP teamwork and composition, change management and culture, top management support, BPR and minimum customisation.</td>
</tr>
<tr>
<td>Buckhout, Frey and Nemec (1999)</td>
<td>ERP teamwork and composition, top management support, BPR and minimum customisation.</td>
</tr>
<tr>
<td>Holland and Light (1999)</td>
<td>Strategic: legacy systems, business vision, ERP strategy, top management support, project scheduling and planning. Tactical: Client consultation, software configuration, client acceptance, monitoring and feedback, communication, troubleshooting.</td>
</tr>
<tr>
<td>Stefanou (2000)</td>
<td>ERP teamwork and composition, project champion.</td>
</tr>
<tr>
<td>Sumner (1999)</td>
<td>ERP teamwork and composition, top management support, change management and culture, BPR and minimum customisation.</td>
</tr>
<tr>
<td>Authors</td>
<td>Research area and findings</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Falkowski et al. (1998)</td>
<td>ERP teamwork and composition, change management and culture, BPR and minimum customisation, effective communication, project management, monitoring and evaluation of performance, project champion.</td>
</tr>
<tr>
<td>Nah, Zuckweiler and Lau (2003)</td>
<td>Top management support, project champion, ERP teamwork and composition, project management and change management program and culture.</td>
</tr>
<tr>
<td>Zhang and Banerjee (2003)</td>
<td>Business process re-engineering and organisational culture are extremely important for ERP implementation.</td>
</tr>
<tr>
<td>Bingi, Sharma and Godla (1999)</td>
<td>Top management commitment, integrating, finding and retaining competent consultants, selecting a suitable ERP package, and user training.</td>
</tr>
<tr>
<td>Nah et al., (2001)</td>
<td>Top management support; business plan and vision; business process re-engineering with minimum customisation; project management; monitoring and evaluation of performance; effective communication; software development, testing and trouble-shooting; project champion; and appropriate business and IT legacy systems.</td>
</tr>
<tr>
<td>Kania (2002)</td>
<td>Project management, top management support, organisational culture, business plan and vision, business process re-engineering, project champion, employee attitudes and the use of outside consultants.</td>
</tr>
<tr>
<td>Parr and Shanks (2000a)</td>
<td>ERP project team and users of the system were identified as management support, best people full-time, empowered decision-makers, deliverable dates, champion, vanilla ERP, smaller scope, definition of scope and goal, balanced team, commitment change.</td>
</tr>
</tbody>
</table>

Table 1. Summary of Important Studies on CSFs of ERP Implementation.

Based on the literature review, a list of major CSFs implementation processes of ERP systems are identified and summarized in the following Figure. These CSFs are then validated empirically in the following sections.
Table 2. List of CSFs for the Implementation of ERP systems for current study.

### 3.0 RESEARCH METHODOLOGY

In this section, the above factors that are found to be critical for the implementation processes are validated using an empirical approach. To enable the IS executives to indicate their degree of agreement with each factor, a 7-point Likert rating scale was used. Data collected from 53 respondents out of 200 top Australian companies that have been sent with the mail surveys, were analysed and interpreted by using various statistical techniques. In order to empirically validate the CSFs, the following research question and hypotheses have been established:

<table>
<thead>
<tr>
<th>Research questions</th>
<th>Hypotheses 1–2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research question</td>
<td><strong>H1</strong>: The factors such as project management, business process reengineering, user training, change management, top management support, effective communication, team work, users’ involvement, consultants’ involvement and clear goals are important for the ERP implementation processes?</td>
</tr>
</tbody>
</table>

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Research questions

<table>
<thead>
<tr>
<th>Implementation process.</th>
</tr>
</thead>
</table>

Table 3. Research question and hypothesis

4.0 ANALYSIS OF IMPLEMENTATION CSFs

Analysis of the critical success factors is presented in this section. A successful organization requires high performance on important factors and do not waste resources on factors of low importance. Table 1.1 reflects the viewpoint of respondents on their degree of agreement with each factor on a 7-point Likert rating scale, and summarises the results of the survey in terms of the factors.

In order to investigate the overall results of the respondents, the various means for the perception of importance of the acquisition and implementation CSFs were analysed. Table shows the overall means for each factor obtained to explore the level of importance perceived by the respondents. The results reveal that the importance values ranged from important to very important for the success of acquisition and implementation. In the acquisition of ERP, CSFs were arranged in order of importance. Communication, planning and user involvements were perceived to be the three top critical success factors for the acquisition of ERP process. Top management, communication and teamwork were ranked as the top three CSFs for ERP implementation by the respondents.

There are some interesting similarities between the top three factors and three least important CSFs of ERP acquisition and ERP implementation. Both top management support and communication were ranked in the top three, while consultants’ involvement was among the bottom three in perception of importance between acquisition and implementation. This indicates that the importance of top management support in providing resources, commitment and champion is very important for both acquisition and implementation. Similarly, communication is important for both processes as well. The survey result demonstrates that most organizations believe that planning, top management support and communication in the first place are critical for successfully acquiring ERP systems. Furthermore, the results also show that top management support, communication and teamwork are critical for the success of ERP implementation process.

<table>
<thead>
<tr>
<th>Implementation CSFs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measure</td>
</tr>
<tr>
<td>Balanced team</td>
</tr>
<tr>
<td>Top management support</td>
</tr>
</tbody>
</table>

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Effective communication  |  6.07  |  .72  
Users’ involvement  |  5.97  |  .93  
Technological infrastructure  |  5.95  |  1.0  
Business process re-engineering  |  5.93  |  1.0  
User training and education  |  5.90  |  .96  
Project management  |  5.90  |  .90  
Clear goals and objectives  |  5.90  |  1.07  
Change management  |  5.88  |  1.06  
Consultants’ involvement  |  5.68  |  1.15  

Table 4. Mean and SD Importance of Acquisition and Implementation CSFs

4.1 Hypothesis Testing

In this section, the hypotheses for this study are tested and the results are discussed.

Hypothesis 1: CSFs for Implementation of ERP

The factors such as project management, business process re-engineering, users training, change management, top management support, effective communication, teamwork, users’ involvement, consultants’ involvement and clear goals are important for the ERP implementation process.

In Table 1.3 the hypothesis analysis of eleven factors that are critical for ERP implementation process is shown. The mean values range from 5.68 to 6.27, representing “important for success” to “very important for success” and the p-value for all factors is 0.000, which is much less than the significance level of 0.01. The data provides very strong support that all these factors are statistically significant. The finding of our research for this hypothesis confirms that respondents consider that project management, business process re-engineering, users training, change management, top management support, effective communication, teamwork, users’ involvement, consultants’ involvement and clear goals are important for ERP implementation process.

<table>
<thead>
<tr>
<th>Ho (Null Hypothesis)</th>
<th>Ha (Alternate Hypothesis)</th>
<th>Mean (x)</th>
<th>p-value</th>
<th>Conclusion</th>
</tr>
</thead>
</table>
| H2a μ Project management ≤ 5  
Project management is not critical to ERP implementation | μ Project management > 5  
Project management is critical to ERP implementation | 5.90  | .000  | Reject null hypothesis.  
Project management is critical for ERP implementation. |
| H2b μ Business process re-engineering ≤ 5  
Process re- | μ Business process re-engineering > 5  
Process re- | 5.93  | .000  | Reject null hypothesis.  
Business process re- |

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<table>
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<tr>
<th>Ho (Null Hypothesis)</th>
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<th>Mean (x)</th>
<th>p-value</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>H₀: Engineering is not critical to ERP implementation</td>
<td>H₁: Engineering is critical for ERP implementation</td>
<td>engineering is critical to ERP implementation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H₂c: ( \mu \text{ User training} \leq 5 ) User training is not critical to ERP implementation</td>
<td>H₂c: ( \mu \text{ User training} &gt; 5 ) User training is critical for ERP implementation</td>
<td>5.90</td>
<td>.000</td>
<td>Reject null hypothesis. User training is critical to ERP implementation.</td>
</tr>
<tr>
<td>H₂d: ( \mu \text{ Technological infrastructure} \leq 5 ) Technological infrastructure is not critical to ERP implementation</td>
<td>H₂d: ( \mu \text{ Technological infrastructure} &gt; 5 ) User training is critical for ERP implementation</td>
<td>5.95</td>
<td>.000</td>
<td>Reject null hypothesis. Technological infrastructure is critical to ERP implementation.</td>
</tr>
<tr>
<td>H₂e: ( \mu \text{ Change management} \leq 5 ) Change management is not critical to ERP implementation</td>
<td>H₂e: ( \mu \text{ Change management} &gt; 5 ) Change management is critical to ERP implementation</td>
<td>5.88</td>
<td>.000</td>
<td>Reject null hypothesis. Change management is critical to ERP implementation.</td>
</tr>
<tr>
<td>H₂f: ( \mu \text{ Top management support} \leq 5 ) Top management support is not critical to ERP implementation</td>
<td>H₂f: ( \mu \text{ Top management support} &gt; 5 ) Top management support is critical to ERP implementation</td>
<td>6.17</td>
<td>.000</td>
<td>Reject null hypothesis. Top management support is critical to ERP implementation.</td>
</tr>
<tr>
<td>H₂g: ( \mu \text{ Effective communication} \leq 5 ) Effective communication is not critical to ERP implementation</td>
<td>H₂g: ( \mu \text{ Effective communication} &gt; 5 ) Effective communication is critical to ERP implementation</td>
<td>6.07</td>
<td>.000</td>
<td>Reject null hypothesis. Effective communication is critical to ERP implementation.</td>
</tr>
<tr>
<td>H₂h: ( \mu \text{ Balanced team} \leq 5 ) Balanced team is not critical to ERP implementation</td>
<td>H₂h: ( \mu \text{ Balanced team} &gt; 5 ) Balanced team is critical to ERP implementation</td>
<td>6.27</td>
<td>.000</td>
<td>Reject null hypothesis. Balanced team is critical to ERP implementation.</td>
</tr>
<tr>
<td>H₂i: ( \mu \text{ Users' involvement} \leq 5 ) Users’ involvement is not critical to ERP implementation</td>
<td>H₂i: ( \mu \text{ Users' involvement} &gt; 5 ) Users’ involvement is critical to ERP implementation</td>
<td>5.97</td>
<td>.000</td>
<td>Reject null hypothesis. Users’ involvement is critical to ERP implementation.</td>
</tr>
<tr>
<td>H₂j: ( \mu \text{ Consultants’ involvement} \leq 5 ) Consultants’ involvement is not critical to ERP</td>
<td>H₂j: ( \mu \text{ Consultants’ involvement} &gt; 5 ) Consultants’ involvement is critical to ERP</td>
<td>5.68</td>
<td>.000</td>
<td>Reject null hypothesis. Consultants’ involvement is critical to ERP implementation.</td>
</tr>
</tbody>
</table>
### Table 5. Summary of Test of Hypothesis 1

<table>
<thead>
<tr>
<th>Ho (Null Hypothesis)</th>
<th>Ha (Alternate Hypothesis)</th>
<th>Mean (x)</th>
<th>p-value</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>implementation</td>
<td>implementation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H2k</td>
<td>μ Clear goals and objectives ≤ 5</td>
<td>5.90</td>
<td>.000</td>
<td>Reject null hypothesis. Clear goals and objectives are critical to ERP implementation.</td>
</tr>
<tr>
<td></td>
<td>Clear goals and objectives are not critical to ERP implementation</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

### 5.0 CONCLUSIONS

From the analysis of 53 respondents out of 200 top Australian companies that have been sent with the mail surveys, 10 critical success factors were found to influence the acquisition process and 11 factors have influence on the implementation process. The major findings from the analysis are that planning, accurate information, selection criteria, structured process, vendor relationship, top management support, communication, team work, user involvement and consultants’ involvement are critical for the acquisition of ERP systems. Project management, business process re-engineering, user training, change management, top management support, effective communication, teamwork composition, users’ involvement and consultants’ involvement and clear goals are found to be important for the ERP implementation process. Both acquisition and implementation processes share five common factors: top management support, effective communication, teamwork composition, users’ involvement and use of consultants.

### REFERENCES


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