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Are all Critical Success Factors in ERP Implementation Created Equal?

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ABSTRACT

This study identifies ten potential critical success factors (CSFs) in Enterprise Resource Planning (ERP) Systems implementation from ERP and IS literature and examines the application of these factors in eight projects. ERP systems promise to provide an off-the-shelf solution to an organization's information needs. Implementation of ERP projects has proven difficult, complex, costly and time consuming. ERP projects require most organizations to change existing business process and to adopt one of several standardized processes provided by the ERP system. Findings show choosing the right project manager, training and a champion were significant to project success. Establishment of a project headed by a project manager, the use of consultants and the use of a steering committee did not differentiate successful and unsuccessful projects. Integration of ERP planning/business planning, reporting level of the project manager, involvement of general manager and the role of management in reducing user resistance were not supported.

Keywords

ERP systems implementation, critical success factors, DeLone-McLean success model

INTRODUCTION

ERP systems are off-the-shelf software solutions that promise to meet the information needs of organizations for replacement of legacy information systems. These legacy systems are frequently aging and difficult to maintain. Despite the promise of ERP systems, these systems are very complex and have proven difficult and costly to implement. The business press cites numerous examples of failed and abandoned implementation projects. The challenges of completing successful implementations have not deterred business spending on ERP implementation. In the late 1990s global businesses were spending \$10 billion a year on ERP software and another \$10 billion a year on consultants to implement the software (Davenport, 1998). By 2001, an AMR study expected firms to spend \$47 billion on ERP implementation (Cotteleer, 2002). The magnitude of these expenditures makes the knowledge of factors likely to improve the chances of successful implementation of vital important to executives implementing these systems and academics studying ERP.

RESEARCH PROBLEM

This study examines the use of management based critical success factors suggested by the ERP and IT literature in ERP implementation. Are these critical success factors used in implementation projects and are they related to project success?

LITERATURE

ERP and IS literature were reviewed using the lens of the five functions of management theory. Possible critical success factors were identified in the areas of planning, organizing, staffing, leading and controlling. Prior literature on critical success factor was reviewed including a summary of ten academic and practitioner articles (Nah, Lau, & Kuang, 2001), case studies of a dozen ERP implementations (Brown & Vessey, 2003) and an additional study of four cases (Sumner, 1999).

Planning

The integration of business planning and IS planning is one of the top problems reported by executives and IS managers (Reich & Benbasat, 1996). An A.T. Kearney study demonstrates that firms that integrate business plans with IS plans outperform other firms (Das, Zahra, & Warkentin, 1991). Most executives do not understand the connection between modern business and technology and "leave technology compartmentalized within the I/T department with disastrous effects (Severance & Passino, 2002)." This literature suggests that the higher the level of integration of ERP planning with business planning the more likely the ERP implementation will be successful.

H1. The level of integration of ERP planning and business planning is positively related to implementation project success.

Organizing

Firms must deploy organizational resources to attain strategic goals (Daft, 2000). Organizing encompasses such issues as organizational structure, delegation of authority, and staff versus line functions.

A long held view is that a user must head a project, such as an ERP implementation project, and that it must be a full time job (Wight, 1974). Another view is that systems knowledge is the least important skill of a project manager (Flosi, 1980). The project manager needs the authority to make difficult decisions so the reporting level and rank of the project manager are important factors in project success. Cisco Systems overcame organizational inertia only when its ERP project was “led by the CIO and the vice president of manufacturing, who reported directly to the board of directors (McAfee, 2003).

H2. Organizing the ERP implementation project under the direction of a project manager, whose sole responsibilities are the project, is positively related to implementation project success.

H3. An organizational structure in which the project manager reports to the business unit’s senior manager is positively related to implementation project success.

Staffing

The firm’s ability to perform any task, including an ERP implementation project, is dependent on the firm’s ability to recruit, select, place, appraise and develop appropriate employees. Current literature emphasizes the business skills of the project manager. “Project leaders must be veterans who have already ‘earned their stripes’ leading projects (Brown & Vessey, 2003).” The motivation of the project leader to succeed may also be a factor in project success. Incentives may take the form of formal or informal rewards. Intrinsic satisfaction may suffice as an informal reward (Maciariello & Kirby, 1994).

H4. Staffing the ERP project manager position with an individual with extensive experience is positively related to implementation project success.

Lassila and Brancheau (1999) found that a positive initial experience for users of a new software package was important. Further, they found that a tendency to cut training and associated costs could result in “negative user attitudes and low-integration equilibrium.” They further found that “enhanced training on both the packaged systems features and related work processes” could be an important factor in overcoming the problem (Lassila & Brancheau, 1999). A Gartner Group study indicates that 25 percent of the ERP budget should be dedicated to training users (Coetzer, 2000). However, a study by Benchmarking Partners found that training averaged 8 percent of total project cost, but varied from 1 percent to 30 percent (Wheatly, 2000).

H5The quantity and quality of training are positively related to implementation project success.

Consultants have played a key role in staffing many implementations. One practitioner states “the success of the project depends strongly on the capabilities of the consultants...” (Welti, 1999). However, another study found no significant relationship between the use of consultants and MRP success (Sneller, 1986). The perceived importance of consultants is demonstrated by the expenditures of \$10 billion a year in the late 1990s, equal to the spending on ERP software (Davenport, 1998). Management faces a dilemma between reducing the use of costly consultants and the lack of internal skills and knowledge to implement ERP (Haines & Goodhue, 2000).

H6. Use of an ERP consultant for guidance in the implementation project is positively related to implementation project success.

Leading

Leadership can be defined as “the ability to influence people toward the attainment of goals (Daft, 2000). “Few nostrums have been prescribed so religiously and ignored as regularly as executive support in the development and implementation of management information systems (MIS) (Jarvenpaa & Ives, 1991).” ERP implementation projects are as much about organizational change as IT. “Major changes are more and more necessary to survive and compete effectively in this new environment. More change always demands more leadership (Kotter, 1990).” A case study of 12 manufacturers found a common characteristic of ERP projects that finished on time and on/under budget was the involvement of senior executives who also established clear priorities (Mabert, Soni, & Venkataramanan, 2003).

H7. CEO involvement in the planning and implementation of ERP systems is positively related to implementation project success.

IT literature describes the idea of a champion as critical for new systems. Champions are described as “more than ordinary leaders; they are more like transformation leaders who inspire others to transcend self-interest for a higher collective purpose (Burns, 1978). IT champions bring about organizational change. They vigorously promote their vision of IT and overcome hurdles in the authorization and implementation phases. “Successful champions can break down bureaucratic barriers and drive change through the organization while the firm’s competitors deliberate of the feasibility of an idea (Beath, 1991).”

H8. The existence of a champion is positively related to implementation project success.

ERP implementations involve change in almost every area of business processes. Software vendors include several options for configuring ERP systems based on best practices, but it is unlikely that these options will fit existing practices of all users. Implementation projects inevitably cause major changes in the adopting organization resulting in “resistance, confusion,

redundancies and errors (Somers, Ragowsky, Nelson, & Stern, 2001).” Half of the ERP implementation failures occur because companies “significantly underestimate the efforts involved in change management (Appleton, 1997). Change management planning must be an integral part of project planning. It must be “rigorously planned and generously resourced (Brown & Vessey, 2003).”

H9. Management’s effectiveness in reducing user resistance to change is positively related to implementation success.

Controlling

Control is the systematic process of regulating organizational activities to make them consistent with the expectations established in plans, targets, and standards of performance (Daft, 2000). Management steering committees for information systems projects have been a common method of control. These committees can be viewed as a method to get top management involved, ensure IS/BP planning fit, improve communications and change user attitudes toward IS (Gupta & Raghunathan, 1989). A study of twelve manufacturing firms found that steering committees with executive leadership were one of the characteristics of companies that stayed on time and on/under budget with their implementation projects (Mabert et al., 2003).

H10. The use of a steering committee that a.) Is headed by the CEO, and b.) Meets at least every four weeks is positively related to implementation project success.

Success Measurement

Markus and Tanis (2000) observe “a lack of consensus and clarity about the meaning of ‘success’ where information systems are concerned.” DeLone and McLean (1992) reviewed 180 articles published between 1981 and 1987 and developed an IS success model based on six dimensions—systems quality, information quality, use, user satisfaction, individual impact and organizational impact. The DeLone-McLean model has been referenced in 285 papers through mid-2002. Seddon and Kiew and Rai et al. empirically tested and validated the model (DeLone & McLean, 2003). The DeLone-McLean model, and on-time and on/under budget performance of the projects are used in this study.

METHODS

A multiple case study approach is used in this research supplemented by a small number of questionnaires. An open-ended list of sixty-eight questions was used in structured interviews. In some cases multiple in-person interviews were conducted, in other cases the questions were answered by e-mail with follow up by e-mail or phone. Archival data were used where available. The validity of the information collected was assured by giving the persons interviewed a copy of the draft of their case write-up and asking them to indicate any errors, omissions or misstatements.

Cases

Eight sites were selected with project beginning dates ranging from 1999 to 2001. Company size ranges from \$11 million to \$12.5 billion. Six different software packages were used in these 8 cases, including SAP, Baan, Oracle and a best of breed approach. The companies operated in a variety of industries including aerospace, transportation, oil and gas supplies and building products.

Case 1

Pacific Clay Products, Inc. (“PCP”) is a privately owned manufacturing company founded in 1886. The company consisted of two manufacturing divisions during the implementation. Each division had its own manufacturing facilities and management staff, but shared certain business functions, including accounting, data processing, human resources, clay mining and research. Together, the businesses employed about 300 people with combined annual sales of about \$30 million. The project was begun in mid-1990 when the controller convinced management to purchase and install an ERP system to replace its aging and hard to maintain legacy systems.

Case 2

Smith International, Inc. “manufactures and markets premium products and services to the oil and gas exploration and production and petrochemical industries and other industrial markets. ” The firm’s revenues for 2002 totaled \$3.2 billion with 53 per cent coming for outside the U. S. Net income exceeded \$53 million in 2002. Smith employs over 11,000 workers (Smith International Inc., 2002).

Smith Bits and Smith Services, divisions of Smith International, began their implementation project in 1993. The software vendor for their legacy systems had discontinued support of the manufacturing system. Heavy customization made upgrading to this vendor’s current package too expensive. Management wanted a standard software package that would operate on an open platform. Smith selected Oracle as the software vendor and Arthur Andersen & Co as consultants. The company considered the project successful, but painful. Firm performance was initially impacted negatively by ERP, but improved rapidly

Case 3

M-I Drilling Fluids is a global energy services company. Before the ERP project the company was using home grown information systems on an outsourced IBM platform. The legacy systems were islands of automation. The information provided by these systems was accounting oriented, not operations oriented. Even inventory data was of limited use because of incomplete, inaccurate and late data for receipts and shipments. The ERP project, begun in 1995, was the company's effort to get up to date and improve the scalability of IT costs. The impetus to do it now was the foreseeable Y2K problems in the legacy systems. The ERP project combined Oracle financials and Datalogix's GEMMS for purchasing, manufacturing, inventory, cost accounting and sales order entry. Computer Science Corporation was selected as consultants on the projects.

Case 4

Pacific Aerospace & Electronics is a mid-sized aerospace and electronics manufacturer based in Washington. The Pacific Coast Technologies ("PCT") division legacy systems were a mix of manual systems and single function personal computer based accounting programs without any integration. The project was conducted very informally. The production and IT manager at PCT was project manager for the ERP implementation project begun in 1995. The software for the project was MCS by Enterprise Systems, Inc. A sister division of PCT was already using this software. PCT employees visited this sister division which had used the software since 1988 and developed confidence in the system. The project was so informal that no specific time budgets or cost budgets were used. Management's expectations were met.

Case 5

The Aerospace and Design division of Litton Industries utilized a best of breed approach in its ERP implementation begun in 1996. The division had approximately 3500 employees and revenues of \$600 million. Currently available ERP systems did not meet the division's needs. A best of breed approach was used with WDS (now Manugistics) for manufacturing and procurement, Oracle for financial processes, TIP QA for quality assurance, PeopleSoft for human resource management, and Matrix One for product data management. Management's goals for the project included reduced operating costs, becoming more competitive in their industry, improving business processes, creating tools for productivity improvements and using ERP as a driver for process re-engineering and organizational change.

The project was completed six months late and \$2 million over budget, however, both of these measures had been provided as contingency allowances in the original budget. Management was not happy about the investment in ERP, but did not believe it had any other viable alternatives.

Case 6

Halliburton Company, a major international energy services company embarked on an ERP implementation. The project was the largest SAP implementation at the time of its completion. The project would create a single system that would eliminate 75 legacy systems (HSE Web Depot, 2004). Alan Horden, a Halliburton vice president, stated, "We had endless legacy systems that didn't 'talk' to each other, so none of the business units knew what other business units were doing, even though they often dealt with the same customers. We wanted a common platform so that our managers could access information to help them make smarter business decisions (Accenture, 2004)." Management believed it could manage the business better with one global consolidated system. The HALCO 21 project was launched in January 1997. Almost all SAP modules were used in the implementation and a single production instance was used. At completion in 2000, 95% of the Energy Services Group and 30% of the Engineering and Construction Service Group were on SAP.

Case 7

Kenworth Mexicana, S.A. de C.V. ("Kenmex") is the Mexican subsidiary of PACCAR, Inc. PACCAR's revenue for the year 2002 was nearly \$6.8 billion, down from \$8.6 in 1999. A weak US economy contributed to the decline. Although the parent company abandoned its ERP project due to the weak economy, its Mexican subsidiary, Kenmex, implemented a Baan system and the English subsidiary implemented an Oracle ERP system. Kenmex employs 1500 workers and in addition to serving the Mexico market exported 1100 trucks to the US in 2002 (PACCAR, 2002). The project began in 1998 in two phases. Phase one included the distribution modules and most of the financial process modules. Phase two consisted of manufacturing modules and the remaining financial modules.

Case 8

Northrup/Grumman Corp. acquired Litton Industries, Inc. in 2001. The Navigation Systems Division was made up of several of the operations acquired from Litton. The division employed 2300 people and had sales of \$600 million. The Litton operations combined to form Navigation Systems had various legacy systems. The ERP system was adopted to provide for effective interchange of information and standardization of financial and operating reports. The same best-of-breed approach described in Case 5 was used in this implementation.

DISCUSSION OF RESULTS

The results of the case studies are discussed in the areas of planning, organizing, staffing, leading and controlling.

Planning

The first hypothesis states that a higher level of integration of business planning and IS planning leads to implementation project success. The cases do not support H1. Six of the eight cases are classified as reactive planning, with the ERP systems function reacting to the business plan but with no input to the business planning process. Two cases are described as linked planning where business planning is interfaced with ERP systems planning with system resources matched against business needs. None of the cases demonstrated integrated planning where the business plan and ERP systems plan occur simultaneously and interactively.

Organizing

H2 states that organizing the project under the direction of a project manager whose sole responsibilities are project implementation is positively related to project success. The case studies support this hypothesis. The Smith Divisions, M-I Drilling, Halliburton and Kenmex had full time project managers and were successful. Litton and Northrup Grumman project managers devoted about 75% of their time to the project and experienced problems with on time and on budget performance. Pacific Clay project manager had significant non-project responsibilities leading to time and cost overruns and failure to improve organizational performance.

H3 proposed that an organizational structure in which the Project Manager reports directly to the business unit's senior manager is positively related to project success. H3 is not supported by the cases. In most cases, the project manager reported to a steering committee or member of the top management team, but not the CEO, president or general manager. Differences in reporting level did not impact project success.

Staffing

H4 posits that staffing the project manager with an individual with extensive ERP implementation experience and project management experience is positively related to implementation project success. This hypothesis is confirmed.

H5 states the quantity and quality of training is positively related to implementation project success. Most of the case study companies indicated a high importance given to training for both successful and unsuccessful cases.

H6 states that use of an ERP consultant for guidance in the system implementation process is positively related to success. The case study information does not support the relationship between use of consultants and project success. Both successful and unsuccessful companies used consultants during implementation.

Leading

H7 states that CEO involvement in the planning and implementation of ERP systems is positively related to implementation project success. CEO involvement is often interpreted as an indicator of the importance of the project to the organization. Case studies indicate that in most cases the CEO "involvement" is limited to project approval and occasional review of projects and budgets. Involvement was the same for successful and unsuccessful projects. The hypothesis is not supported.

H8 states the existence of a champion is positively related to implementation project success. A champion can often generate support for the project and overcome resistance to change. The case studies confirmed the importance of a champion to project success. The Smith Divisions, M-I Drilling, Litton, Halliburton and Kenmex reported that champions played a significant role. Pacific Clay lacked a champion and struggled with its implementation. H8 is supported.

H9 states that management's effectiveness in reducing user resistance is positively related to project success. Case study results did not support this hypothesis. Management of both successful and unsuccessful implementation reported similar levels of awareness of user resistance and acted to reduce resistance by extensive communication of the importance of the project.

Controlling

H10 states that the use of a steering committee that is headed by the CEO and meets at least every four weeks is positively related to implementation project success. Case studies indicate that the CEO did not generally head the steering committee. Often another member of the top management team headed the committees. No relationship was found between CEO heading the committee and project success.

CONCLUSIONS

The findings of this research are summarized in three categories. The first group summarizes implementation management techniques used at successful firms, but used less or not at all at unsuccessful firms. These findings include the experience of the project manager, quality of training and the role of the champion. The second group includes practices considered in the

literature to be essential to success, but which did not differentiate between successful projects and unsuccessful projects. The final group includes management practices supported in the literature that are not supported in the case studies.

Group 1

Project Manager. Choosing the right project manager can be critical to project success. Managers of successful projects had more ERP experience than managers of unsuccessful projects. Monetary or non-monetary rewards were not found useful to motivate project managers

Training. Training was regarded as important by both successful and unsuccessful projects. Importance on training was shared by all projects, but successful projects rated training quality higher and spent more on training.

Champion. The use of a champion in a significant role is important to project success. Projects reporting a significant role of a champion were more successful than those without champions.

Group 2

Establishment of a Project Headed by a Project Manager. Both successful and unsuccessful projects were established as projects and headed by a project manager.

Consultants. Both successful and unsuccessful projects used consultants and the impact of the consultants on the project was favorable. Consultant use had no impact on on-time and on/under budget performance.

Steering Committee. Both successful and unsuccessful projects used a steering committee to review the project. CEO's were more likely to head steering committees of successful companies, but even among successful project only half were headed by CEOs.

Group 3

Integration of Business Planning and IT Planning. The study did not support the idea that higher levels of integration would lead to project success. The case studies did indicate that after the project was completed a generally higher level of business planning and IT planning integration developed.

Reporting Level of Project Manager. The reporting level of the project manager was not a factor in project success or on-time/on budget project completion. The literature indicating the reporting relationship is an important signal of the projects importance is not supported.

Involvement of the General Manager. Successful and unsuccessful firms reported the same level of general manager / president involvement and that level amounted to occasional review of the implementation progress with department heads. While top management support may be vital to a project, involvement is clearly not required.

Role of Management in Reducing User Resistance. No differences were found between successful and unsuccessful implementation projects in the effectiveness of management in reducing user resistance. This finding is counter to the literature that top management support is necessary to reduce user resistance.

PRACTICAL IMPLICATIONS OF THE CONCLUSIONS

This study began by examining the literature that exists on the implementation of Enterprise Resource Planning systems. Much of this literature contains recommendations that are untested and unstructured. Specific recommendations were hypothesized and tested.

Planning. The hypothesis that higher levels of integration of business planning and IT planning are related to success was not supported. The results show that when IS and business executives share a common vision of IT and the contribution of IT to the organization's mission, projects are likely to be completed on-time and on/under budget. Where IS executives understand current business objectives, projects are likely to finish on/under budget.

Organizing. The use of a full time project manager was supported. But nearly all projects used a full time project manager, indicating this practice does not assure success. Organizing the projects using a project manager with prior ERP experience will help assure completing the project on-time and on/under budget.

Training. Firms should place importance on training as a part of the project. Successful firms reported higher quality of training and spent more on training.

Consultants. Both successful and unsuccessful firms used consultants. Use of consultants does not guarantee success, although firms using consultants indicated a favorable impact on project success. The practice of using consultants is supported.

Champion. Organizations implementing ERP should identify and encourage champions. The existence of champions is related to project success, and to on-time and on/under budget project completion.

Steering Committees. The use of steering committees to control the ERP implementation project is a practice of firms with successful and unsuccessful projects. Steering committees should be encouraged. Although using a steering committee does not assure success, it is related to on-time project completion.

A study completed in 1986 on MRP implementation practices found "a lack of good old fashioned management in the implementation approach used for projects that were unsuccessful (Sneller, 1986)." This study found that while firms implementing ERP are generally using recommended management practices; these practices work for some not for others.

A new question to be examined is why the conventional wisdom expressed by academics and practitioners works for some implementation projects but not for others?

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