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Management based critical success factors in the implementation of Enterprise Resource Planning systems

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ABSTRACT

This study examines critical success factors for implementing Enterprise Resource Planning systems using the framework of classical management theory. The study is motivated by conflicting results in earlier studies examining critical success factors in Enterprise Resource Planning implementation, many of which are anecdotal in nature. Ten critical success factors in ERP systems implementation proposed in past literature are selected. The relationship between each of these factors and project success is examined. Project success is defined as organizational impact and on time and on/under budget project completion. Eight implementation projects were qualitatively analyzed using the case study method to examine the proposed relationships. The findings suggest that choosing the right full time project manager, training of personnel, and the presence of a champion relate to project success. The use of consultants, the role of management in reducing user resistance and the use of a steering committee to control the project do not appear to differentiate successful and unsuccessful projects. Integration of ERP planning with business planning, reporting level of the project manager, and active participation of the CEO beyond project approvals, resource allocation and occasional project review, are not found to be critical factors of success. Considering the financial cost and risk associated with these projects, a better understanding of critical success factors will enable practitioners and academics to improve the chance of success in the implementation projects. All organizations implementing ERP, especially small and mid-sized enterprises with limited resources, will benefit from this knowledge.

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1. Introduction

This paper examines critical success factors (CSFs) in Enterprise Resource Planning (ERP) systems implementation. Much of the prior work on CSFs relies upon surveys of project managers, IT executives or consultants giving prescriptive recommendation without systematically examining whether the practices were actually used in projects or if those projects were successful. This paper contributes to the growing literature on critical success factors in ERP implementations by determining whether the practices recommended in the literature are actually used in ERP implementation projects and whether these practices are related to project success. Ten critical success factors suggested in the IT and ERP literature were selected and tested using eight case study companies to determine: (1) whether the practices recommended in the literature were followed in their implementation projects; and (2) whether the projects were successful in terms of organizational impact and were completed on time and on budget.

ERP systems promise to provide an integrated, packaged software solution to the information needs of organizations for replacement of legacy information systems. These legacy systems are usually aging piecemeal solutions created by IS departments or older off-the-shelf packages that have become difficult to maintain and no longer meet the business needs of the organization. Despite the promise of ERP systems, these software solutions have proven "expensive and difficult to implement, often imposing their own logic on a company's strategy and exiting culture" (Pozzebon, 2000, p. 1015). Numerous examples of failed and abandoned implementation projects are cited in past literature, such as Fox–Meyer Drug, Mobile Europe, Dell and Applied Materials (Davenport, 1998). Wah (2000) cites failures at Whirlpool, Hershey, Waste Management, Inc. and W.L. Gore & Associates. Further, the University of Massachusetts-Amherst (Bray, 2004) and Indiana University (Songini, 2004), have also experienced lost revenue, wasted time, cost overruns and delays in ERP implementation projects. The Chaos Chronicles indicate that only 34% of IT projects undertaken by Fortune 500 companies are successfully completed (Nelson, 2005). ERP is no exception. Muscatello and Parente (2006) cite ERP failure rates to be as high as 50%. Although these findings differ in percentage, the message is clear that IT projects, including ERP, are very risky. Brown and Vessey (2003) observe, "Although failures to deliver projects on time and within budgets were an old IT story, enterprise systems held even higher risks — they could be a 'bet-our-company' type of failure" (p. 65). Nike's ERP implementation is included in a listing of "infamous failures in IT project management" because of a major inventory problem which resulted in a profit drop of $100 million in the 3rd quarter of 2000 (Nelson, 2007).

Although many large organizations have completed their initial ERP implementations, demand for enterprise systems from small and mid-sized organizations is increasing (Gable and Stewart, 1999). With limited resources, experience and staffing skills (Nelson, 2007), these organizations may face problems implementing ERP. As ERP vendors add functionality to their software, large organizations that did not participate in the first wave of implementations are now purchasing the systems.

Global businesses seek to improve or maintain their competitiveness in the increasingly challenging global market place. Information systems are often used as a tool to improve customer service, shorten cycle times and reduce cost. Hitt et al. (2002) demonstrate that firms which invest in ERP show "higher performance across a wide variety of financial metrics." Wagner and Newell (2006) describe ERP as providing a powerful business system infrastructure for organizations providing "a depth of information by function and also a breadth of information horizontally across the value chain" (p. 42).

The challenges of completing successful ERP implementations have not deterred business spending. ERP spending grew from $20 billion annually in the late 1990s (Davenport, 1998) to $47 billion in 2001 (Cotteleer, 2002). Large sums continue to be spent on ERP implementation projects. Hunter and Lippert (2007) forecast the ERP market to reach $US 1 trillion by 2010. A Forrester survey found that ERP and enterprise applications remained "the top IT spending priority for 2005" (Hamerman and Wang, 2006). A summer 2005 survey of members of the Society for Information Management showed that ERP is among the top application and technology developments of its members (Luftman et al., 2006). By industry, ERP ranked second in manufacturing and education. The importance of ERP systems to an organization's competitiveness and the magnitude of ERP expenditures in relation to firm resources imply that executives who implement these systems and academics studying ERP need to know which factors are likely to improve the chances of successful implementation. This study seeks to examine those critical factors leading to ERP success.

A measure of success of IS projects that has been widely used is the Information Systems Success (ISS) theory. This theory is based on a six dimensional model consisting of systems quality and information

quality leading to use and user satisfaction resulting in individual impact and ultimately organizational impact (DeLone and McLean, 1992, 2002). The present study will apply the IS Success model to ERP implementation, together with on time and on budget project completion as the success definition. A successful project must satisfy the six dimensions of the ISS theory and be completed on time and on/under budget. Much prior work on critical success factors was done using surveys of project managers, IT executives and consultants that give prescriptive recommendations without systematically examining whether the practices were actually used on the project, if the project resulted in success, and how success was defined.

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

The multiple case study method (Yin, 2003) was used. A scripted, open-ended questionnaire was developed to promote consistency in the collection of qualitative observations across the different firms. Findings confirm that choosing the right full time project manager, the quality and quantity of training of personnel using the system, and the existence and effectiveness of a champion are critical to project success. The use of consultants, the role of management in reducing user resistance, and the use of a steering committee did not differentiate between successful and unsuccessful projects. The integration level of ERP planning and business planning, the reporting level of project manager, and the involvement of CEO beyond project approvals, resource allocation and occasional project review are not supported as success factors by the cases in this study.

A better understanding of the factors affecting the success of ERP implementation projects will benefit practitioners who implement these systems and academics who study them. Small and mid-sized enterprise, many of whom are currently beginning or planning ERP implementations, will benefit from this knowledge.

2. Literature review

This research is based on the premise that the classical management model can be used to evaluate ERP implementation projects. Fayol (1949) introduced the five functions of management which he defined as planning, organizing, coordinating, commanding and controlling. Subsequent management literature has modified Fayol's original functions. Koontz et al. (1980) describe a systems based approach to management. Their Operational Management model identifies planning, organizing, staffing, leading and controlling as the five management functions. Inputs to the Koontz model include human, capital, management and technology. A managerial transformation process, consisting of the five management functions, converts these inputs to such outputs as products, services, profits, satisfaction and goal integration. A communications system links the various elements of the model to each other and to outside stakeholders and the environment.

Drucker (1973) states that, above all, management "is responsible for producing the results" (p.17). Results in the case of ERP implementation projects can be defined as improving organizational efficiency and effectiveness through technology. Drucker continues stating that management must "lead the worker toward productivity and achievement" and "organize work for productivity" (Drucker, 1973, p. 17).

Current management authors (Daft, 2000; Jones and George, 2007; Williams, 2007) have simplified the management functions to four: planning, organizing, leading and controlling. The Koontz et al. (1980) model is useful to this study as it retains the function of staffing which is important to ERP implementation projects. Sneller (1986) used the Koontz model to examine CSFs in MRP implementation projects, finding that unsuccessful implementation projects were not employing good management practices. Where useful, the hypotheses developed by Sneller for testing MRP systems implementation are retained. In areas where the expanded functionality and scope of ERP systems requires or where new issues are raised in the literature, new propositions are substituted.

The use of theory outside the domain of IT in IT research is not unusual. The technology acceptance model (TAM) is based on the theory of reasoned action (Fishbein and Ajzen, 1975), a behavioral theory. Grabski and Leech (2007) use the economic theory of complementarity in their work on ERP critical success factors. Gottschalk and Solli-Saither (2005) use management theories to develop critical success factors in IT outsourcing relationships. Boersma and Kingma (2005) examine ERP using a cultural perspective.

ERP systems differ qualitatively from prior large scale IT implementations in three ways (Milford and Stewart, 2000): 1) ERP will impact the whole organization, 2) employees may be learning new business processes in addition to new software, and 3) ERP is often a business led initiative, rather than IT led. For these reasons the general management model may be a better framework to examine CSFs than a piecemeal approach used in much of the earlier research. Possible management-based critical success factors are identified using the lens of the functions of management theory (Fayol, 1949; Koontz et al., 1980; Daft, 2000). The literature review section begins with an overview of prior work on critical success factors. Beyond Sneller (1986), no other prior study has attempted to classify CSF into the five functions of management theory. Table 1 classifies CSFs found in earlier research into the areas of planning, organizing, staffing, leading and controlling. The literature review then examines additional ERP and IS literature using the lens of these five management functions to develop ten proposed critical success factors.

2.1. Critical success factors

Drucker (1973) states, "One has to control by controlling a few developments which can have significant impact on performance and results" (p. 499). Drucker asks, "What is the minimum information I need to know to have control?" The notion of critical success factors is rooted in management literature. Later, IS adopts the idea of CSFs. Bullen and Rockart (1981) define critical success factors (CSFs) in IS as "the few key areas of activity in which favorable results are absolutely necessary for a particular manager to reach his goals" (p. 383). Successful managers must focus their scarcest resource, their time, "on those things that make a difference between success and failure."

Nicolaou (2004b) reports that ERP implementation success often results from a number of factors, such as user participation and involvement in systems development, assessment of business needs, processes during the analysis phase of the project and the level of data integration designed into the system. ERP changes these processes from designing a custom system to accommodate the existing business processes of a firm to selecting a packaged application system that best meets the firm's needs. CSFs for ERP systems can be expected to differ from other IS projects because of these changed conditions.

Table 1 summarizes prior research in critical success factors organized by the five functions of management. Sneller (1986) examined CSFs based on classical management theory in MRP projects using a survey of 150 material managers using user satisfaction and perceived improvement in performance metrics as a composite success variable. Sneller (1986) failed to find a relationship between success and (1) user participation in planning, (2) reporting level of project manager, (3) experience levels of project manager, (4) use of a consultant, and (5) use of formal tracking system during implementation. But ERP systems are different from MRP systems because they encompass virtually all business processes throughout the entire enterprise.

Pinto and Slevin (1987) studied project management CSFs using evening MBA students. Subjects were allowed to use their own definitions of project success and develop prescriptive CSFs as if they were project managers. Sumner (1999) based her findings on four case studies of Fortune 500 top computer executives. Bingi et al. (1999) identified CSFs from a literature review. No empirical testing was conducted. Laughlin (1999) based his recommendations on his work as a consultant with IBM Global Services. Holland and Light (1999) propose a framework grouping CSFs into strategic and tactical factors based on eight case studies and a review of the literature. Nah et al. (2001) reviewed ten articles written by academics and practitioners discussing "What are the key critical factors for ERP implementation success?" Nah et al. did not distinguish whether empirical research, case studies or other methods determined the factors given. Brown and Vessey (2003) identify five success factors for ERP projects from the study of a dozen projects and an examination of prior research.

Significant findings in the planning area include the existence of a formal plan with well defined tasks, ERP supporting the business plan, clear project goals, and a motivating business justification. Findings in the area of organizing include a full time project manager who reports to a high level in the organization and a time budget with a manageable workload.

Findings classified as staffing and leading comprise the majority of success factors. In the staffing area significant findings include the training of management and users, skills of the project leader, selecting the right consultants and user teams, and incentives for successful project completion. In the area of leading, important findings include the support of top management, ERP as a top priority, culture of shared values,

Table 1
Critical success factors in the literature

Management function	Critical success factor	Author
Planning	Detailed formal plan with well defined tasks	(Sneller, 1986; Nah et al., 2001; Pinto and Slevin, 1987; Holland and Light, 1999)
	ERP tied to business plan	Nah et al. (2001)
	Clear project goals	(Pinto and Slevin, 1987; Holland and Light, 1999)
	Motivating business justification	Laughlin (1999)
Organizing	Full time project manager	Sneller (1986)
	Reporting level of project manager	Sneller (1986)
	Time budget, manageable workload	(Sneller, 1986; Nah et al., 2001)
Staffing	Training of management and users	(Sneller, 1986; Bingi et al., 1999; Sumner, 1999; Pinto and Slevin, 1987)
	Testing following training	Sneller (1986)
	Analysts with knowledge of both business and technology	Sumner (1999)
	Project leaders are veterans, team members decision makers	Brown and Vessey (2003)
	Technical skills of project team	Pinto and Slevin (1987)
	Selection and management of consultants and staff	(Bingi et al., 1999; Pinto and Slevin, 1987)
	Third parties (consultants) fill gaps in expertise and transfer knowledge	(Laughlin, 1999; Brown and Vessey, 2003)
	Teamwork and team composition	(Laughlin, 1999; Holland and Light, 1999; Nah et al., 2001)
	Incentives for success	Nah et al. (2001)
	Problem solving cooperation with vendors	Nah et al. (2001)
Leading	Top management support	(Sneller, 1986; Pinto and Slevin, 1987; Sumner, 1999; Bingi et al., 1999; Laughlin, 1999; Holland and Light, 1999)
	Top management is engaged, not just involved	(Brown and Vessey, 2003)
	Culture of shared values	Nah et al. (2001)
	ERP as top priority	Nah et al. (2001)
	Top management support with bonuses tied to success	Nah et al. (2001)
	Management communication, education and expectations	Nah et al. (2001)
	Project champion	Nah et al. (2001)
	Communications between team and rest of organization	(Pinto and Slevin, 1987; Holland and Light, 1999)
	User (client) buy in to project	(Pinto and Slevin, 1987; Holland and Light, 1999)
	Establishment of trouble-shooting mechanism	(Pinto and Slevin, 1987, Holland and Light, 1999)
	Change management hand-in-hand with project management	(Laughlin, 1999; Brown and Vessey, 2003)
	Satisficing mindset prevails	Brown and Vessey (2003)
Controlling	Control originating with top management	Sneller (1986)
	Steering committee that met at least monthly	Sneller (1986)
	Monitoring and feedback against initial plan	(Pinto and Slevin, 1987; Holland and Light, 1999)
Other	Redesign of business processes	(Sumner, 1999; Holland and Light, 1999)
	Minimum customization and willingness to adapt business processes	Nah et al. (2001)
	Choosing the right systems functionality; links to legacy systems	Nah et al. (2001)

project champion, communications between team, management and rest of firm, change management and a satisficing mindset.

Controlling the project should originate with top management, usually using a steering committee. Progress against the plan should be monitored in terms of time, budget and organizational impact of the project.

The present study differs from prior studies by selecting ten critical success factors suggested in the IT and ERP literature and using eight case study companies to determine: (1) whether the practices recommended in the literature were followed in their implementation projects; and (2) whether the projects were successful in terms of the IS Success Model and were completed on time and on budget. The following

section summarizes the literature on success measurement, then follows with a review of the planning, organizing, staffing, leading and controlling literature and develops the propositions shown in Fig. 1.

2.2. 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, 2003) 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 made a great impact. It is widely accepted, having been referenced in 285 papers through mid-2002. Google Scholar indicates 1330 citations as of October 2007. DeLone and McLean (2003) cite research by Seddon and Kiew (1994) and Rai et al. (2002), which empirically tested and validated their model. DeLone and McLean (2003) state that their success model has "become a standard for the specification and justification of the measurement of the dependent variable in information systems research."

Seddon (1997) respecifies and extends the DeLone–McLean model and argues that IS use "must precede impacts and benefits, but does not cause them" (Rai et al., 2002). Perceived usefulness and user satisfaction are both important constructs of the Seddon model. The DeLone–McLean model is developed from their review of literature in a period before ERP emerged. Does this model fit ERP implementations where use is not voluntary? Does this model fit enterprise wide scope of implementation projects which are unique to ERP implementations?

Gable et al. (2003) address the issue of use in an ERP success model which eliminates both use and user satisfaction from the DeLone–McLean IS Success model. Satisfaction is treated as a measure of success rather than a dimension of success. Ifinedo and Nahar (2006) propose an ERP success model which also eliminated use and user satisfaction from the DeLone–McLean model, but adds vendor/consultant quality and workgroup impact.

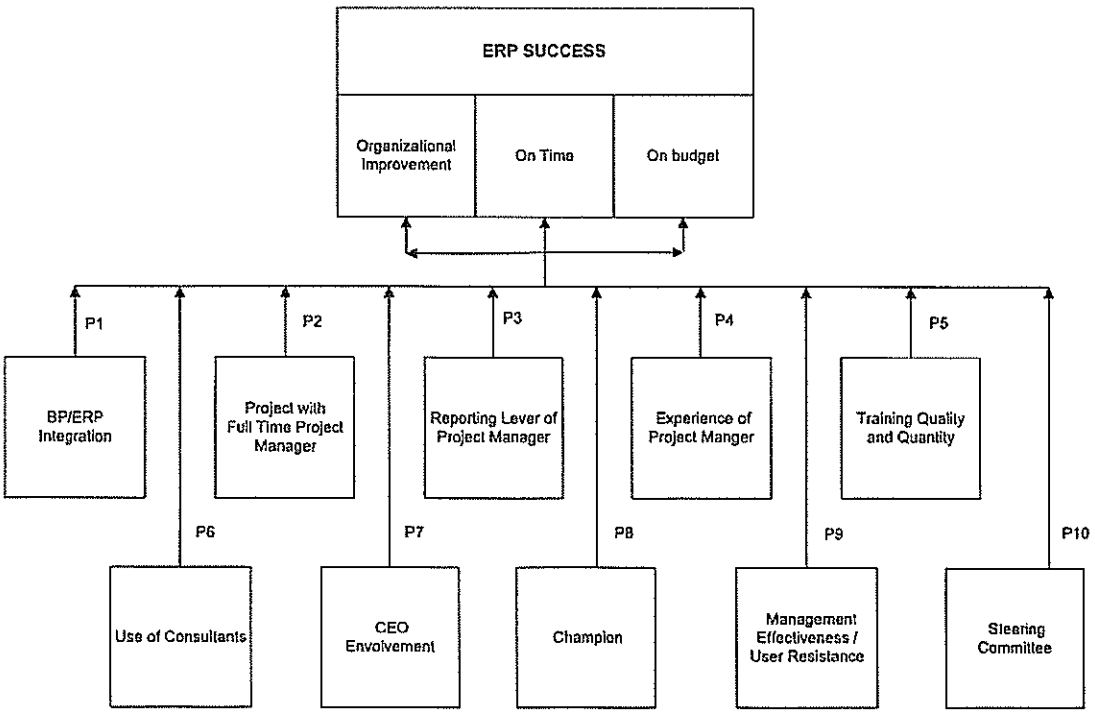

Fig. 1. Research model.

An Ernst and Young survey of CIOs and CEOs indicates a preference that IS performance be measured on the operational level according to the following criteria (Beshnahan, 1996):

- Are systems projects delivered on time?
- Are systems projects delivered on budget? and
- Are users satisfied with the delivered systems?

Brown and Vessey (2003) define ERP systems project success as "an up-and-running system with agreed-upon requirements delivered within schedule and budget" (p. 66).

Organizational impact, as developed in the DeLone–McLean model, and on time and on/under budget performance of the projects are used as success criteria in this study. All three factors must be in place for this study to consider an implementation project successful.

2.3. Planning

Planning is a management function that precedes all other management functions. Planning identifies organizational goals and how the organization will attain these goals (Koontz et al., 1980). The integration of business planning and IS planning is one of the top problems reported by executives and IS managers (e.g., Reich and Benbasat, 1996; Luftman, Papp & Brier, 1999; Brancheau and Wetherbe, 1987). King (1978) posits the importance of information systems planning integration with business planning as a one way flow from business planning to information systems planning. King and Zmud (1981) expanded the integration concept to two way integration. Kearns and Lederer (2001) found alignment of IT to the business plan influenced the ability of the firm to use IT as a competitive weapon, but not the reverse. An A.T. Kearney study demonstrates that firms that integrate business plans with IS plans outperform their competitors (Das et al., 1991). Keen (1993, p. 17) finds that "a far more interdependent alignment between business planning and IT planning is called for." Economic benefits can be gained by IT deployment where some business leader can fit the IT pieces together better than others. Oh and Pinsonneault (2007) find that when the fit between business strategy and IT strategy is high, organizational performance is higher than when the fit is low. Whalen (2007, p. 40) states that "strategic business and technology planning must become integrated and 'real time' as opposed to annual or serial events in order to maintain competitiveness."

Peppard (2001) describes that "in the majority of organizations there is a 'gap' between the information systems (IS) organization and the rest of the business. 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 and Passino, 2002). Peppard and Ward (1999, p. 29) describe building, maintaining and delivering IT systems as an "organizational wide activity requiring a strong business/IT partnership." Keen (1993, p. 22) states further "that information technology has moved from being an important but separate element of business management to being at the core of everyday business and social life." Bowen et al. (2007, p. 195) posit that, "effective IT governance enables business and IT executives to integrate business and IT decisions, implement IT solutions and monitor IT effectiveness." The 2005 survey of IT executives identified "IT and business alignment" as the top management concern. The survey defined IT/business alignment as "applying IT in an appropriate and timely way, in harmony and collaboration with business needs, goals, and strategies (Luftman et al., 2006, p. 83)." The 2006 survey indicates the IT/business alignment remains the top concern (Stevens Institute of Technology, 2007).

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. The integration signals the importance of the project to the whole organization. Levels of integration are classified as (Teo and King, 1997):

1. no business process (BP) planning or IT planning,
2. stand alone planning — either a business plan or IT plan but not both,
3. reactive planning, where IT reacts to the business plan but has not input the plan,
4. linked planning where systems resources are matched against business planning needs,
5. integrated planning where BP is indistinguishable from IT planning.

This examination of literature leads to the following proposition:

P1. *The level of integration of ERP planning and business planning is positively related to implementation project success.*

2.4. 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 major project, such as an ERP implementation project, and that it must be a full time job (Wight, 1974). A study of CIOs and CFOs identified a full time project manager as a best-practice (Frantz et al., 2002). Another view is that systems knowledge is the least important skill of a project manager (Flosi, 1980). The business skills of the project manager may be more important than the systems skills (Brown and Vessey, 2003). 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. Without decision-making authority, groups with vested interests in the affected business process will either proceed very slowly or resist the project entirely. A project manager with higher organizational position may be able to influence the personnel in the affected user groups and be more effective in the implementation process. 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)." However, Law and Ngai (2007) failed to support that the CEO-IT distance is negatively associated with ERP success. Therefore, it is proposed:

P2. *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.*

P3. *An organizational structure in which the project manager reports to the business unit's senior manager is positively related to implementation project success.*

2.5. 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 and Vessey, 2003). Somers and Nelson (2001) in a survey of IT executives found project team competence ranked second in importance but relied on prior literature concerning the project manager. This research examines the relationship between experience of the project manager and project success.

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 and Kirby, 1994). Therefore the following is proposed:

P4a. *Staffing the ERP project manager position with an individual with extensive experience is positively related to implementation project success.*

P4b. *Formal or informal rewards to the project team are positively related to implementation project success.*

In a pre-ERP systems field study of 100 IS user–managers, Nelson and Cheney (1987) found a positive relationship between training and computer-related ability and between computer-related ability and acceptance of IS products and technologies. 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 found that "enhanced training on both the packaged systems features and related work processes" could be an important factor in overcoming the problem (Lassila and Brancheau, 1999). Umble et al. (2003) cite education/training as the most widely recognized critical success factor. A change management consultant observes that while shortening planned training may be the "fastest and least expensive way" it may be "counter productive in the long run" (Wah, 2000). Bradford and Florin (2003) surveyed SAP users and found

a relationship between training and perceived organizational performance and user satisfaction. Bradley and Lee (2007) found a positive relationship between user satisfaction with ERP training and user satisfaction with the installed ERP system at a university. A Gartner Group study indicates that 25% of the ERP budget should be dedicated to training users (Coetzer, 2000). Yet, a study by Benchmarking Partners found that training averaged 8% of total project cost, but varied from 1% to 30% (Wheatly, 2000). Somers and Nelson (2001) found user training ranked 14 in list of CSFs developed from a survey of senior IS executives involved in both on going and completed implementations. This literature leads to the following proposition:

P5. *The 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 and Goodhue, 2000). Therefore, the following is proposed:

P6. *Use of an ERP consultant for guidance in the implementation project is positively related to implementation project success.*

2.6. 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 and Ives, 1991, p. 205). 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 et al., 2003). Laughlin (1999) posits top management support as the first order of business for ERP. But, what degree of involvement is appropriate? Jarvenpaa and Ives (1991) found that "executive involvement (a psychological state) is more strongly associated with the firm's progressive use of IT than executive participation (actual behaviors) in IT activities" (p. 205). Others posit that active involvement and participation are required. In a survey of SAP users, Bradford and Florin (2003) found top management support related to perceived organizational performance and user satisfaction. Brown and Vessey (2003, p. 65) state as a success factor that "top management is engaged in the project, not just involved." Executives demonstrate engagement "1) by being active members of the project oversight board, and 2) by being committed sponsors and champions." Umble et al. (2003) state "successful implementations require strong leadership, commitment and participation by top management." Liang et al. (2007) found that management participation positively affects the degree of ERP usage. However, Law and Ngai (2007) could not support the hypothesis that perceived senior management support is positively related to ERP success when measured by user satisfaction. Jarvenpaa and Ives (1991) found that CEO perceptions of IT were generally positive, but participation in IT activities was infrequent.

In the current study "participation" is defined as a level of involvement above executive support which is defined as approval, allocation of resources and occasional project review. This study seeks to re-examine and extend previous findings as to whether CEO support is adequate or if active participation is required for successful implementations. Therefore, it is proposed:

P7. *CEO participation in the planning and implementation of ERP systems is positively related to implementation project success.*

The idea of a champion permeates IS literature as critical for new systems. Champions are described in leadership literature 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. Champions must "understand the technology as well as the business and organizational context" (Somers and Nelson, 2001, p. 2). 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). The champion is usually from the business side of the firm, not IT and spends 20%–60% of his/her time "communicating the vision, maintaining motivation in the project team and the business, fighting political battles, and remaining influential with the stakeholders, including senior management" (Willcocks and Sykes, 2000). A factor in the failure to realize "hoped-for significant organizational changes" in an ERP implementation at a large utility company was identified as the lack of a powerful change champion even though the project had significant top management support (Legare, 2002). Sumner (2000) identifies lack of a champion as a risk factor in ERP implementation. Bowen et al. (2007) found both statistical and qualitative support to the proposition that higher levels of involvement of project champions are associated with IT project implementation success. Therefore, it is proposed:

P8. *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 et al., 2001). Half of the ERP implementation failures occur because companies "significantly underestimate the efforts involved in change management" (Appleton, 1997, p. 52). Change management planning must be an integral part of project planning. It must be "rigorously planned and generously resourced" (Brown and Vessey, 2003, p. 67). Lapoint and Rivard (2005) reveal that 43 articles published in the last 25 years in 20 IT and IT-related journals treated user resistance as a key implementation issue. Furumo and Melcher (2006) found management's failure to address problems with resistant team members contributed to the failed ERP project of a mid-sized university. For this study, the following is proposed:

P9. *Management's effectiveness in reducing user resistance to change is positively related to implementation success.*

2.7. 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 are a common method of control. These committees can be viewed as a method to get top management involved, ensure IS/Business Planning fit, improve communications and change user attitudes toward IS (Gupta and 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). Bowen et al. (2007) state that, "the IT steering committee should be the primary governing body for ongoing IT operations and initiatives of the organization, including IT investment projects" (p. 194). Therefore, it is proposed:

P10. *The use of a steering committee that a.) is headed by the CEO, and b.) meets al least every four weeks is positively related to implementation project success.*

3. Research methods

A multiple case study approach is used in this research (Yin, 2003). The multiple cases are appropriate where the research goal is theory building or theory testing (Benbasat et al., 1987). An open-ended list of sixty-eight questions was used in structured interviews with 20 people in 8 firms. 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. In the in-person interviews the questionnaire was provided to the subject in advance to complete. The answers were reviewed and elaborated upon during the interview. In the case of the Mexican site an English speaking manager gathered data from other managers and employees to prepare a consolidated response. Where multiple employees were interviewed from one firm, very few responses differed among the employees. Where any differences were observed, they are noted in the case.

Archival data in the form of presentations and reports were made available in some cases to confirm and support the information revealed in the scripted interview process. Case 1 was developed by action research, where the researcher participated in the project as the controller and project manager. In this case, other employees involved in the project reviewed the case notes to assure validity and lack of bias.

The first seven questions deal with demographic information on the company. The next 24 questions deal with project details, goals and results. The success was measured by questions about on time and on budget project completion. Questions 17 through 27 operationalize the IS Success Model by assessing information quality (Q 20, Q21 and 22), systems performance (Q20), including reliability (Q20), response rates (Q20), data accuracy (Q20) , and ease of use (Q20), user satisfaction and individual impact (Q23) and changes in such organizational performance metrics as inventory turnover (Q17), on time deliveries (Q18), and lead times (Q19). The balance of the questions relate to the individual propositions.

Success for this study is a combined variable of on time and on budget project completion and organizational impact of ERP. The dimensions of the IS Success Model lead to organizational impact which is determined using the input from interviewees. Organizational impact is summarized in Table 4. To be considered successful, the project must be completed on time and on/under budget and must demonstrate a favorable impact on the organization.

3.1. Introduction to cases

Eight sites were selected for the case studies. Criteria for site selection was manufacturing companies which had completed implementation projects or significant phases of their implementation project at least two years prior to the study. Nicolaou (2004a) found that post ERP implementation performance effects on return on investment occurred two years after project completion. Nicolaou (2004b) cites a Benchmarking Partners report that indicate "synergies of people, process, and technology" reach their peak 9 to 24 months after implementation following periods of productivity decline and skills development. Hunton et al. (2003) found that financial performance differed little between ERP adopting firms and non adopters until two years after adoption of ERP. The difference arose from a decline in non adopter performance, rather than an increase in adopter performance. Shang and Seddon (2002) found ERP operational, managerial, strategic, IT infrastructure and organizational benefits were realized 2–3 years after implementation.

Within the criteria of manufacturing companies that completed ERP projects two years ago or longer, a convenient selection of sites was established through former business colleagues of the researcher, contacts developed from the Central Washington University College of Business Advisory Board and the researcher's colleagues at Claremont Graduate University. Although consents were obtained at each case site, pseudonyms will be used to protect the identity of the participating firms.

Table 2 summarizes the case study site characteristics. Project start date, ERP software used, revenue, project cost and source of case data are indicated in the table. Characteristics of the eight sites are shown in Table 1. The first implementation project began in 1990 and the last in 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 "best-of-breed" approaches. The companies operated in a variety of industries including aerospace, transportation, oil and gas products and services, energy services and building products. All cases but one were publicly traded companies or their subsidiaries at the time of the project.

The research was conducted as a scripted interview with 68 open-ended questions. Where possible the researcher conducted multiple in-person interviews with key employees involved in the implementation project. In other cases the scripted interview questions were completed by e-mail or telephone, with follow-up also by e-mail or telephone. In one case the author was the ERP implementation project manager. In that case, the method is action research. Following the interviews the discussion notes for each case were written up by the researcher. The information collected was validated by giving the interviewee a copy of the draft of their case write-up and asking them to indicate any errors, omissions or misstatements.

3.1.1. Case 1

3.1.1.1. The company. Clay Products, Inc. is a privately-owned manufacturing company founded in 1886. The company consisted of two manufacturing divisions during the ERP implementation. Each division

Table 2
Summary of case study site characteristics

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8
Company name	Clay Products, Inc.	Drilling International Divisions	MudCo	PAE	DefenseCo	Global Energy	TruckCo Mexicana, S.A. de C.V. (TruckMex)	Nav Sys.
Project start date	1990	1993	1995	1995	1996	1997	1998	2001
Software vendor	Qad, Inc.	Oracle	Oracle/ Datalogix	ESI	Best-of-breed for industry[a]	SAP	Baan	Best-of-breed for industry[a]
Revenue	$30 million	<$500 million	$1 billion	$11 million	$600 million	$12.6 billion	$500 million	$600 million
Project cost	$100,000	Not available	$7 million (US only)	Not available	$15.7 million	$325 million	Not available	Not available
Data source	Action research and archival data	Interviews	Interviews and archival data	Interviews	E-mail responses to scripted questions	Interviews with phone and e-mail follow-up	E-mail and phone	E-mail and phone

[a] WDS (now Manugistics) for manufacturing and procurement, Oracle for financials, TIP QA for quality assurance, PeopleSoft for HR/Payroll, Matrix One for product data management.

operated its own manufacturing facilities and maintained its own 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.

3.1.1.2. The project. The project began 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. Additional goals stated in the capital expenditure request included: increasing information quality, reducing clerical effort (i.e., cost), support of the organization at any level of operations, replacing paper reports with a terminal on the desk of employees needing to use, input or maintain information.

MFG/PRO by QAD, Inc. was selected as the software package, primarily based on pricing considerations and the prior selection of this package by a sister division owned by the common parent company. No system users participated in the selection. Neither management nor future users were aware that business processes would need significant re-engineering to accommodate the new system.

3.1.1.3. The propositions. The top management team viewed the implementation project as an accounting department project to update its legacy systems, rather than a project impacting the whole organization. ERP was included in the business plan, but not integrated with the plan. Little thought was given to impacts or capabilities of the software package outside the accounting area. Manufacturing management at both plants resisted changing any business processes to adopt the ERP system.

The controller of Clay Products was the project leader. The first attempt to implement ERP was unsuccessful and failed. The controller/project leader was attempting to implement the system while dealing with the controllership responsibilities resulting in lack of success at both efforts. In addition, the controller was new to the organization and did not fully understand how the organizational structure impacted corporate reporting requirements. A new controller, with the help of Arthur Andersen consultants, successfully implemented the financial, order processing, inventory, billing, procurement, budget and payroll modules. Both controllers had significant project management experience. Neither controller had prior ERP implementation experience. The manufacturing modules, although purchased and included in the original implementation plan, were never implemented because of resistance from manufacturing management.

In the first implementation attempt, no consultants were used and the project failed. In the second attempt consultants were used to augment internal staff. Since ERP software was quite new at this time, the consultants were used more for their project management skills and to provide additional manpower, rather than for their ERP knowledge. The ability to focus exclusively on the project and the target date was the largest contribution of the consultants.

CEO involvement was limited to approving the project, supporting the capital expenditure, and occasional review of the project progress. A champion did not emerge during the implementation. Both

controller/project managers were new to the company and had not yet developed the confidence and trust of the other employees to be described as champions. Management did little to reduce user resistance. The brick division president and manufacturing manager walked out of the first significant training meeting after about 15 minutes, signaling to the other employees that they did not consider it to be important. A year after the project was complete, the VP Sales, who later became president of the pipe division, was still complaining about "sales doing accounting's work" by inputting sales orders on-line.

A steering committee was formed under the guidance of the consultants but never met. Project review was done in connection with quarterly operational review sessions with the parent company and informally at weekly staff meeting, usually if someone was complaining about the changes required by the system.

3.1.1.4. Results. The project is classified as unsuccessful since the organizational impact was limited to replacing the legacy accounting/order entry systems, the project did not improve operational performance; and the project exceeded both time and cost budgets. Only part of the software purchased was installed. The VP of Manufacturing resisted implementation of the system. An ERP consultant observes that the systems are sometimes resisted because it "shines an unwelcome spotlight on performance issues" (Wah, 2000, p. 23). The project is an example of the findings of Sousa and Goodhue (2003, p. 494), "Even though the potential of such systems is great, users frequently take advantage of only the most basic capabilities of the system." User satisfaction was low outside the accounting area.

3.1.2. Case 2

3.1.2.1. The company. Drilling 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 grew from approximately $3.2 billion in 2002, with 53% coming for outside the U. S., to $7 billion in 2006. Net income exceeded $53 million in 2002 and exceeded $500 million in 2006. The company employs over 17, 000 workers in 2006.

3.1.2.2. The project. Drilling Bits and Drilling Services, divisions of Drilling International Inc., began their implementation project in 1993. Their legacy systems software vendor discontinued support of their manufacturing system forcing the firm to explore other alternatives. 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. Drilling selected Oracle as the software vendor and Arthur Andersen & Co as consultants.

3.1.2.3. The propositions. The ERP project planning was not integrated with business planning. IT initiated the project to meet IT goals. Arthur Andersen & Co. served as the full time project manager reporting to the steering committee. The firm had significant project management experience, but no one had any experience with Oracle, since this was only the second implementation of Oracle's ERP system.

Employee training was described as generally weak and given too late. The training budget was described as "minimal." CEO involvement was limited to approving and supporting the project, but had no direct involvement. No one on the implementation team could identify a champion for the project. User resistance was considered extreme. Manufacturing was especially skeptical. IT sophistication was low at all the divisions involved in the project. Resistance was very visible to management, who gave constant support to the project.

3.1.2.4. Results. The company considered the project successful, but painful. The project ran over the budget due to post implementation consulting. Firm performance was initially impacted negatively by ERP, but improved rapidly. The initial poor performance can be attributed to under specified hardware and the lack of a data conversion effort in the implementation project. Much of the firm's data was entered on an as needed basis after implementation went live.

3.1.3. Case 3

3.1.3.1. The company. MudCo 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.

3.1.3.2. The project. The ERP project, begun in 1995, was the company's effort to get up-to-date, improve the scalability of IT costs, which had fluctuated greatly with economic cycles of the company in the past, and address the foreseeable Y2K problems in the legacy systems. The ERP project used a best-of-breed approach that combined Oracle financials and Datalogix GEMMS for purchasing, manufacturing, inventory, cost accounting, and sales order entry. Computer Science Corporation was selected as consultants on the project.

3.1.3.3. The propositions. ERP and IT planning supported the business plan. The business plan called for cost controls in IT, scalability of IT costs, more transparency of data throughout the organization and improved financial and operating information. CSC was selected as full time project manager, assisted by two company co-managers. The consultants/project manager reported to the IT manager who also chaired the steering committee. The IT manager reported to the CFO. The CSC project manager had excellent project management skills, a good working knowledge of the software, but limited knowledge of the process manufacturing and distribution software. The company co-managers provided that knowledge to the implementation team. Training was limited to keystrokes and data entry. The CEO did not play an active role in the project but fully supported it. The CFO and VP of Supply Chain Management were directly involved in the project and served on the steering committee. The two company co-managers were recognized as the project champions. Management initiated an active program of employee communication to reduce user resistance.

3.1.3.4. Results. The project was considered successful by the company since it met the objectives to provide better operational information and performance, and the project was completed on time and on budget.

3.1.4. Case 4

3.1.4.1. The company. PAE is a mid-sized aerospace and electronics manufacturer based in the Pacific Northwest. The legacy systems of PCT, a division of PAE, were a mix of manual systems and single function personal computer based accounting programs without any integration.

3.1.4.2. The project. The ERP 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. Nonetheless, the project manager stated that top management's expectations were met.

3.1.4.3. The propositions. The manufacturing manager also filled the role of IT manager and ERP project manager in this small firm. The project manager reported directly to the CEO. The project manager had substantial project management experience and ERP implementation experience. The project manager conducted both business process and software training. No consultants were used on the project. The CEOs role was limited to approval of the project and only became directly involved when business process options required his decision. No champion was involved in the project. Top down management support reduced user resistance which centered on engineering documentation issues and the sales group's visibility of production operations. The implementation team functioned as a steering committee.

3.1.4.4. Results. The project was classed as unsuccessful in the analysis of results as the lack of a plan makes it impossible to classify its completion as on time or on budget. The CEO did not respond to a request to verify that the project was completed within his expectations.

3.1.5. Case 5

3.1.5.1. The company. The Aerospace and Design division of DefenseCo Industries used a best-of-breed approach in its ERP implementation begun in 1996. The division had approximately 3500 employees and

revenues of $600 million at that time. ERP systems then available 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.

3.1.5.2. The propositions. This project was initiated by the business planning process but was strongly supported by IT. The integration level can be described as reactive planning, with IT reacting to the business plan. The IT director served as program manager devoting 75% of his time to the project and reported to a division Vice President. The project manager had good knowledge of the business, but limited ERP knowledge. Both business process training and software training was provided by team members and super users who were trained by the software vendors. Consultants were used for up front planning, requirements planning, pilot room preparation and testing. The role of the CEO was to communicate the need for change with special newsletters about the project, articles in division newsletter and hosting program review sessions with the project leaders. A champion played a role in the project. The champion was a senior internal consultant with the company who had several years' aerospace experience and significant ERP implementation experience. Management used a communications program, education and progress reviews to reduce user resistance. A steering committee headed by the IT director/project manager met monthly to review progress and resolve outstanding implementation issues.

3.1.5.3. Results. The project was completed six months late and $2 million over budget. However, both of these project 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. Since the project did not finish on time or on budget it is classified as unsuccessful.

3.1.6. Case 6

3.1.6.1. The company. Global Energy Company, the international energy services company, embarked on an ERP implementation.

3.1.6.2. The project. 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. A Global Energy vice president stated that the company had endless legacy systems that didn't 'talk' to each other. None of the business units knew what other business units were doing, even though they often dealt with the same customers. The company wanted a common platform so that managers could access information to help them make smarter business decisions. Management believed it could manage the business better with one global consolidated system. Y2K problems were also a concern with legacy systems. The project was launched in January 1997. Almost all SAP modules were used in the implementation and a single production instance was used.

3.1.6.3. The propositions. Business planning and ERP planning can best be described as reactive planning where IT reacts to the business plan. Integration improved substantially after the project was completed. The full time project manager was the former VP and CIO who gave up his position to head the SAP project. The project manager reported to a steering committee which included several members of the top management team and reported their progress to the Board of Directors quarterly. A change management team was developed and handled training. Both business process and software training was provided. Accenture was used as consultants throughout the project. The CEO's involvement included hiring the CIO to prepare the company for the project, approving the project and putting in brief appearances to signal his support. Several steering committee members served as champions during the project. The steering committee had responsibility for the project. The committee included members at the VP level for operating and overhead areas.

3.1.6.4. Results. At completion in 2000, 95% of the company's Energy Services Group and 30% of the Engineering and Construction Service Group were on SAP. The project was completed on time and on budget. Management was satisfied that the project improved organizational performance.

3.1.7. Case 7

3.1.7.1. The company. TruckCo Mexicana, S.A. de C.V. ("TruckMex") is the Mexican subsidiary of a leading US truck manufacturer. The consolidated revenue of the parent company at the time the project was being considered (2002) was nearly $6.8 billion, down from $8.6 billion 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, TruckMex, implemented a Baan system and its European subsidiary implemented an Oracle ERP system.

Case 7 employs 1500 workers and in addition to serving the Mexico market it exported 1100 trucks to the US in 2002. In a post-NAFTA economy, TruckMex customers became more educated, sophisticated, and selective. The company needed to improve business processes to support new model introductions, increased options, lower costs, and improved quality. TruckMex believed all of their competitors in Mexico were well ahead of it in the implementation of state-of-the-art information systems.

3.1.7.2. The project. TruckMex selected Baan IV c2 Multicurrency as its software package after proposals from several vendors. The project began in March 1998 in two phases. Phase "A" included the distribution modules and most of the financial process modules. Phase "B" consisted of manufacturing modules and the remaining financial modules. The project manager's main concerns were whether the implementation team would be able to meet its time commitments and whether management would remain committed to the project.

3.1.7.3. The propositions. TruckMex aligns its business and IT planning by having an IT representative on its strategic planning team. Key strategic objectives are identified for each IT project. A full time project manager was selected from the TruckMex management team and reported to the steering committee. This individual had wide experience in the business and in project management. ERP knowledge was gained from working with the consultants. Training was structured to meet the needs of the users. Both business process training and Baan software training were provided. Simulations were used to test user skills. The company used both business consultants and technical consultants. Management felt the consultants contributed to the projects success. The general manager (CEO of the division) was deeply involved in the project. "He knew each task of the Gantt chart: he understood every phase, component of the project." He held weekly meetings to review progress, address delays, review outstanding implementation issues and review the budget. A champion emerged during the project, and helped the implementation team clarify business requirements and facilitate resources. He was described as a constant source of support and advice to the project team. Management reduced user resistance by internal communications and meeting to reinforce the need for the system and the benefits to the company. A steering committee was used to control the project composed of the top management team at the company.

3.1.7.4. Results. The TruckMex project was a success in term of organizational impact and on time and on budget completion. Inventory turnover was expected to increase from 16 times to 25 times as a result of the project. Actual post project inventory turnover improved to 32 times. Shipping logistics was reduced from 2 days to 1 day.

3.1.8. Case 8

3.1.8.1. The company. A major defense contractor acquired DefenseCo (Case 5) in 2001 creating the Navigation Systems (Nav Sys) Division which was made up of several of the operations acquired from DefenseCo. The division employed 2300 people and had sales of $600 million at the time of the project. The operations composing the new Nav Sys division used various legacy systems. The ERP system was adopted to provide effective interchange of information and standardization of financial and operating reports.

3.1.8.2. The project. The same best-of-breed approach described in Case 5 was used in this implementation. Even with the best-of-breed approach to meet the business process needs of the divisions, new software had to be written to accommodate the commercial business unit.

3.1.8.3. The propositions. Separate groups conducted ERP planning and business planning. Although a good working relationship existed between the groups, IT planning reacted to business planning, but did not provide significant input. The project was led by a manager with 20 years experience with the company and background as a Senior Manager of Finance. The manager devoted approximately 75% of his time to the project. Both business process and software training were provided. Consultants from Oracle and Manugistics were used for data mapping and process evaluation and made a significant contribution to the project's success. The CEO's main involvement was to establish the business case for the project. Strong support for the project by senior management minimized any resistance to the project. A steering committed resolved design issues that the implementation team could not handle.

3.1.8.4. Results. Organizational results cited by the project manager included (1) better tools to control inventory, (2) more reliable systems performance and response rates, (3) ease of use for division employees, and (4) superior reports to the legacy system. The first three phases of the project were completed significantly under time and cost estimates. Phase 4 encountered some problems resulting in minor cost overruns and delays. The project is classified for this study as successful since the first three phases of the project which were complete at the time of the study were favorably impacting the organization and were completed on time and on budget.

3.2. Case summary

The results of the case studies for each proposition and an indication of the success based on organizational improvement, on time and on budget performance are summarized in Table 3. A project is considered successful if it satisfies the criteria of organizational improvement and on time and on budget completion. Cases 3, 6, 7 and 8 meet the success criteria. Cases 1, 2, 4, and 5 are classified as not successful.

Table 3
Summary of case study findings

	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6	Case 7	Case 8
	Clay Prod.	Drilling Int'l.	MudCo	PAE	DefenseCo	Global Energy	TruckMex	Nav Sys Division
Successful	No	No	Yes	No	No	Yes	Yes	Yes
P1. Integration of BP and IT planning	None	Low	Low	High	Low	Low	High	Low
P2. Full Time PM	No	Yes	Yes	No	No (75%)	Yes	Yes	No (75%)
P3. Reporting level of PM	GM	TMT	CFO	CEO	IT Director	Steering Committee	Steering Committee	VP-Business Management and ERP project office
P4. Experience of PM	PM—yes ERP—no	PM—yes ERP—no	PM—yes ERP—yes	PM—yes ERP—yes	PM—yes ERP—no	PM—yes ERP—yes	PM—yes ERP—no	PM—yes ERP—yes
P5. Training	Software only	Software Only	Software only	BP and Software	BP and Software	BP and Software	BP and Software	BP and Software
P6. Use of Consultants	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
P7. CEO Involvement	Minimal	Minimal	Minimal	Low	Yes	Minimal	Yes	Minimal
P8. Champion	No	No	Yes	No	Yes	Yes	Yes	Yes
P9. Management's effectiveness in reducing resistance	Low	Good	Good	Good	Good	Good	Good	Good
P10. Steering Committee	Yes, in form only	Yes	Yes	No	Yes	Yes	Yes	Yes
Organizational impact	Very little	Yes	Yes	Yes	Yes	Yes	Yes	Yes
On time	No	Yes	Yes	No formal plan	No	Yes	Yes	Yes
On/under budget	No	No	Yes	No formal budget	No	Yes	Yes	Yes

BP = business planning; PM = project manager.

Table 4 summarized the organizational impact of the ERP implementations on each case study company using the framework developed by Shang and Seddon (2002). This framework is composed of five benefit dimensions: operational, managerial, strategic, IT infrastructure and organizational. The information on this table is used to develop the conclusion shown in Table 4 on organizational impact.

Table 4
Summary of organizational impact at case study companies

Case	Operational benefits	Managerial benefits	Strategic benefits	IT infrastructure benefits	Organizational benefits
Case 1: Clay Products Co	No benefits in value chain	Maintained company ability to continue to provide financial and operating information to management and parent company	None – strategic necessity, not source of any strategic advantage	Replaced aging legacy software and hardware which it could not support with state-of-the-art systems.	Minimal
Case 2: Drilling International	Initially a negative impact on operations, but improved	Improved cost visibility Inventory accuracy	ERP system facilitated integration of numerous acquisitions into the company's systems	Enabled IT to be more responsive, decentralized IT staff, reduced costs, replaced had to maintain legacy software	ERP gave a temporary competitive advantage by providing better cost visibility and inventory accuracy Improve ability to absorb growth
Case 3: MudCo	Created enterprise wide visibility of inventory status which improved customer service, billing accuracy and improved cash flow	Supported company's global management efforts Brought company up-to-date on decision making information	Support future global growth	Solved Y2K problem, replaced outdated, hard to maintain piecemeal solutions	Reduced investment in inventory, scaleable IT costs, support future global growth. Provide much needed operational information.
Case 4: PAE	Formed business process background of a new business recently relocated. Managed large volumes of engineering data.	Enhanced visibility of financial and operating performance.	Facilitated division growth for a $180,000 to several million dollars	Established the division's first IT infrastructure replacing manual and PC solutions	Enabled firm growth
Case 5: DefenseCo	Improved visibility of operating and financial information.	Transparency of financial and operating information for decision making. Provided management control over highly independent divisions	None noted. Keeping up with competition, not creating any competitive advantage.	Common systems across three operating divisions. Replaced several non integrated mainframe systems.	Kept the company competitive in industry with information systems. Managerial control over highly independent divisions
Case 6: Global Energy	Common systems allow divisions to "talk to" each other.	Provides information for improved decision making.	Present one face to customer. Know what other operation were dealing with same customer	Replacement of 75 legacy systems facilitated support and reduced cost	
Case 7: TruckMex	Added capability to handle more complex products, new product introduction, more options, lower costs and higher quality	Provides better information for improved decision making.	Enhanced company competitiveness in the post-NAFTA market place	Gave the company state-of-the-art systems hardware and software	
Case 8: Nav Sys	Improved visibility of inventory requirements and excess inventory	Enabled effective interchange of information among divisions and with corporate parent	None specifically cited.	Systems performance more reliable with better reporting capabilities	Improved availability of critical business data for decision making and reporting

4. Discussion of results

The results of the case studies are discussed in this section in terms of the five areas of management: planning, organizing, staffing, leading and controlling.

4.1. Planning

P1. The first proposition states that a higher level of integration of business planning and IS planning leads to implementation project success. The cases do not support P1. 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 and 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.

Several of the firms studied indicated that following the completion of the ERP project the integration of business planning and information systems planning increased. Personnel of one firm indicated that the higher awareness of the contributions of IT to organizational success increased IS participation in the business strategy process.

4.2. Organizing

P2. 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 proposition. Mud Drilling, Global Energy and TruckMex had full time project managers and were successful in term of organizational impact and in completing the projects on time and on budget. The DefenseCo project manager devoted about 75% of his time to the project and experienced problems with on time and on budget performance. DefenseCo exceeded its original budget in time and cost, although within a contingency factor the company had provided. Nav Sys Division was on time and on budget on phases 1 and 2 with a 75% project manager, but experienced delays in phase 3. Pacific Clay's project managers had significant non-project responsibilities as Chief Financial Officer leading to project time and cost overruns and failure to improve organizational performance. The Drilling Companies had budget overruns with a full time project manager who was a consultant. However, because this was only the second Oracle ERP implementation, the problems can be partly attributed to the lack of experience of the project manager/consultant and the Oracle support staff.

P3. An organizational structure in which the Project Manager reports directly to the business unit's senior manager is positively related to project success. P3 is not supported by the cases. In most cases, the project manager reported to a steering committee or to a member of the top management team, but not the CEO, president or general manager. Differences in reporting level did not impact project success favorably or unfavorably.

4.3. Staffing

P4a 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. Prior ERP experience was found to be related to project success. P4b proposed that formal or informal rewards to the project team were related to project success. Only two companies among the cases distributed any tangible rewards, MudCo and Global Energy. MudCo bonuses were a surprise to the employees after project completion, so could not have provided any motivation. Global Energy has incentive bonus plans for all of its employees, whether implementation team members or not. The proposition is not supported.

P5 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 projects. The successful companies described both the quality and quantity of training as superior to unsuccessful companies. Only one successful company, Mud Drilling, experienced start up problems because of training difficulties. Employees were expected to write their own reports from the Oracle system but training proved inadequate in this area only. P5 is supported.

P6 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. P6 is not supported. Use of consultants may be necessary, but is not sufficient to insure project success.

4.4. Leading

P7 states CEO participation in the planning and implementation of ERP systems is positively related to implementation project success. The level of involvement examined is active participation rather than passive support. CEO involvement is often interpreted as an indicator of the importance of the project to the organization. The case studies indicate that in most firms the CEO "involvement" is limited to project approval, allocation of resources and occasional review of projects and budgets. While executive support was present in all of the cases, the degree of involvement was limited support in all but one of the cases. The proposition is not supported.

P8 posits that 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 Drilling Divisions, MudCo, Global Energy and TruckMex reported that champions played a significant role. Pacific Clay lacked a champion and struggled with its implementation. DefenseCo is the only case that cited a champion but exceeded time and cost budgets. P8 is supported.

P9. Management's effectiveness in reducing user resistance is positively related to project success. The case study results did not support this proposition. Management of both successful and unsuccessful implementations was aware of user resistance and took actions to reduce resistance by extensive communication of the importance of the project. P9 is not supported.

4.5. Controlling

P10. 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. Most steering committees met monthly unless significant implementation problems required more frequent meetings to resolve. No relationship was found between meeting frequency and project success. P10 is not supported.

5. Conclusions and recommendations for future research

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 proposed and tested. The findings of this research are summarized in three categories:

1. Implementation management techniques used at successful firms, but used less or not at all at unsuccessful firms.
2. Practices considered in the literature to be essential to success, but which did not differentiate between successful projects and unsuccessful projects. These factors may be necessary for project success but do not appear sufficient to guarantee success.
3. Management practices supported in the literature that are not supported in the case studies.

5.1. Observed success factors

5.1.1. Project manager

Choosing the right full time project manager can be central to project success. Managers of successful projects had more project management, business and ERP experience than managers of unsuccessful

projects. Monetary or non-monetary rewards were not found useful to motivate project managers. A personal sense of accomplishment and recognition of performance seems to be adequate incentives.

5.1.2. 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.

5.1.3. 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 or where the champion did not play a significant role.

5.2. Factors that did not differentiate between success and failure

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

5.2.1. Consultants

Both successful and unsuccessful projects used consultants. Management of these firms expressed that the impact of the consultants on the project was favorable. However, consultant use did not differentiate between firms that experienced on time and on/under budget performance or organizational improvement and firms that did not. In early implementation projects, such as cases 1 and 2, lack of the consultants' experience with ERP may explain this apparent lack of impact on project success. In case 5, external consultant use was very limited, although the project manager could be described as an internal consultant.

5.2.2. Role of management in reducing user resistance

Both successful and unsuccessful implementation projects perceived management as effective in reducing user resistance.

5.2.3. Steering committee

Both successful and unsuccessful projects used a steering committee to review and control the project. While this practice is supported in the literature and appears to be used broadly, use of a steering committee does not assure project success.

5.3. Literature recommendations not supported by cases

5.3.1. Integration of business planning and IT planning

The study did not support the proposition that higher levels of integration would lead to project success. Several case studies did indicate that after the ERP project was completed a generally higher level of business planning and IT planning integration developed. Management realized the potential or actual contribution of IT to organizational success.

5.3.2. Reporting level of project manager

The reporting level of the project manager was not a factor in project success. The literature indicating the reporting relationship is an important signal of the project's importance is not supported. Reporting level varied in these case studies among CEO, CFO, steering committees, VP of Projects, and IT director. No relationship was observed between reporting level and project success.

5.3.3. Participation of the CEO or general manager

Successful and unsuccessful firms reported the same level of general manager / president involvement. That level amounted to project approval, allocation of resources and occasional review of the implementation progress with department heads. In only one case did the involvement of the CEO rise to the level of participation. This study results do not challenge the concept that top management support is

vital to a project, but CEO participation is clearly not required. Other members of the top management team or even second tier managers can provide the support.

5.4. Recommendations for future research

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 current study finds that firms implementing ERP are generally using recommended management practices. These practices work for some projects and do not work for others. Some possible explanations are now discussed.

Karimi et al. (2007) examine ERP implementations from the organizational innovation and technology assimilation perspectives. They suggest that implementation outcomes are associated with business process outcomes and by ERP delivery systems, both of which are considered in this study. Karimi et al. add a third factor affecting ERP implementations they call ERP radicalness, which examines how far ERP business processes depart from existing processes. This study does not examine the radicalness factor, although at least in some of the cases the level of systems sophistication was very primitive before ERP and these cases would have a high degree of radicalness. High radicalness or degree of change in business processes was the situation at MudCo, for example, which was a successful implementation. The ERP radicalness factor does not appear to explain the findings.

Ifinedo and Nahar (2006) found contextual factors influenced assessments of project success. Industry climate and national economic climate "positively and significantly impact ERP systems success assessment." The cases in the current study encompass ten years and a wide variety of economic and industry climates, so they do little to support this theory.

A third possible explanation can be found in the work of Grabski and Leech (2007) who explore complementary controls and ERP success. They apply the work of Milgrom and Roberts (1995) on the economic theory of complementarity to ERP success, concluding that the project management, change management, alignment of the business and new information system, internal audit activities, and consultant and planning activities are complementary factors. That is, "the impact of one factor on the success of the ERP implementation depends on or is moderated by the levels of the other factors (p. 35)." Maciariello and Kirby (1994) refer to this relationship as the mutually supportive management systems model.

These are promising attempts to explain why the conventional wisdom, as expressed by both academics and practitioners, works for some implementation projects, but not for others. Future research should: (1) explore if and how potential CSFs must be combined to work together and mutually reinforce each other to produce a successful implementation project, and (2) determine which organizational factors influence the effectiveness of CSFs.

Appendix A. Questions for case study interviews

This list of questions is a guide for face-to-face, e-mail or telephone interviews of participants in the case studies.

Firm's background

1. What industry is the firm active?
2. What are the firm's main business functions/businesses?
3. How many employees does the firm have?
4. What is the sales/revenue of the firm?
5. Does the company build to order or for inventory?
6. What is your area of responsibility?
7. How many employees in your area?

ERP project

1. Describe the state of the firm's MIS before the ERP implementation, i.e., legacy systems.
2. When did the firm begin implementation of ERP?

3. Which modules of the ERP software were implemented?
4. Was the system implemented by a big bang approach, or incremental approach?
5. When was the project completed?
6. What were your biggest concerns about the project?
7. How were those concerns addressed?
8. How did management plan to measure success before the project actually started? After completion?
9. Was the project successful?
10. How did the ERP project affect inventory turnover?
11. How did the ERP project affect on time deliveries?
12. How did the ERP project affect delivery lead times?
13. How did the ERP project affect systems performance in terms of reliability? Response rates? Accuracy of data? Ease of use?
14. How did the overall quality of reports from the ERP system compare with those prepared by the older system?
15. How did the accuracy and timeliness of the ERP system produced reports compare with those from the older system?
16. Compare user satisfaction of the ERP system with the older system.
17. How did organizational performance change since implementing ERP?
18. Was the ERP system a major factor in this change?
19. What other factors influenced the change in performance?
20. Does management consider the ERP implementation worth the investment?
21. Was the project completed on time? Explain.
22. Was the project completed on budget? Explain.
23. Describe the company's goals when it embarked on the implementation project?
24. Were these goals satisfied by the project?

Planning

1. Describe the relationship between business planning and information systems in your organization.
2. Do business executives and IS executives share the same vision of the role of IT in the firm's mission?
3. Do IS executives understand current business objectives?
4. Do business executives understand current IT objectives?
5. How was the software selected?

Organizing

1. Was a project to implement ERP formally established with a project manager?
2. How much of the project manager's time was devoted to the ERP implementation project?
3. Did the project manager (PM) have adequate authority to complete the project?
4. What was the level of importance given to the ERP implementation project compared with other business goals?
5. What was the management level to which the PM reported?
6. Was a matrix structure used for the project?

Staffing

1. How much time did project team members devote to the project?
2. How much support was given to the project by senior management?
3. Discuss the experience of the project manager. ERP experience? Project management experience? Knowledge of your business?
4. How was the PM motivated to achieve success for the project?
5. Discuss how training was conducted for the project.
6. Was both business process and software training provided?
7. Was the timing of the training appropriate?

8. Was testing used to reinforce training?
9. Was a consultant used on the project?
10. Describe the role of the consultant.
11. Did the consultant make a significant contribution to the project?

Leading

1. Describe the involvement of the General Manager/President.
2. Did a champion play a significant role in the project? Describe the champion and how he/she contributed to the project.
3. Describe the level of user resistance to the ERP project.
4. Was management aware of the resistance?
5. How did management deal with user resistance?
6. How well did management convey the need for the system?

Controlling

1. How often did top management review the project?
2. Was a steering committee used?
3. How did it function?
4. How were project costs monitored during the project?
5. Did the project lead to competitive advantage over other firms in you industry? Or enable you to keep up with competition?
6. Did the firm have previous experience with a major IT project? How did this experience affect the current project?
7. Were all modules of the project implemented at once (big bang) or were individual modules implemented separately over time?
8. What vendor package was used?
9. What is your function in the company?

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