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A model of ERP project implementation

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Problems with the implementation of ERP systems are well documented. Although companies spend millions on ERP packages and the implementation process, there is extensive evidence that they experience considerable problems, particularly during the actual implementation project. This paper presents a project phase model (PPM) of ERP implementation projects that is a synthesis of existing ERP implementation process models and focuses on the implementation project. Two case studies of ERP implementation within the same organization, one unsuccessful and a later successful one, are reported and analysed in order to determine which critical success factors (CSFs) are necessary within each phase of the PPM. The CSFs are drawn from an earlier stage of this research and from recent literature. The PPM is used as a 'lens' for understanding ERP implementation projects, by highlighting the differences between the two cases. We then offer an explanation for these differences, focusing particularly on the successful case. Firstly, the organizational learning that occurred during the unsuccessful project and the associated early appointment of an experienced 'champion' with clearly defined responsibilities were critical to the successful project. Secondly, organizations implementing ERP systems should partition large projects into several smaller, simpler projects identified here as 'vanilla' implementations. The PPM, together with associated CSFs, provides guidance for practitioners when planning ERP implementation projects and also provides researchers with a foundation for further empirical research.

Introduction

During the 1990s, enterprise resource planning (ERP) systems became the *de facto* standard for replacement of legacy systems in large and, in particular multinational companies (Holland *et al.*, 1999a, b). Implementation of an ERP system is an extensive, lengthy and costly process, typically measured in millions of dollars. The investment is both in the software itself and in related services such as consulting, training and system integration (Parr *et al.*, 1999).

Although companies spend millions on both the packages and the implementation process, there is extensive evidence (Fine, 1995; Ambrosio, 1997; Piszczalski, 1997; Tebbe, 1997; Gartner Group, 1998; Horwitt, 1998; Martin, 1998; Stedman, 1998a, b; Parr *et al.*, 1999) that most companies experience considerable problems, particularly during the actual implementation project. While it is not unusual for information technology (IT) projects to have problems, ERP project problems are abnormal. Martin (1998) reported that over 90% of ERP implementations were either late or over budget, some implementations have ended in failure and resulted in legal action (James, 1997; Shanks *et al.*, 2000) and the popular literature (Infoweek, Computerworld, etc.) contains numerous stories which describe ERP implementations in colourful terms such as 'endurance' tests, 'fiascos', 'living to tell about it' and 'war stories' (see, for example, Tebbe, 1997; Horwitt, 1998).

In response to these problems, there has been a developing body of academic literature (Bancroft, 1996, Bancroft *et al.*, 1998; Holland *et al.*, 1996b; Markus and Tanis, 1999; Parr *et al.*, 1999; Parr and Shanks, 2000; Ross, 1999) which addresses the difficulties of ERP implementation by proposing critical success factors (CSFs) and process models of the implementation. Both are aimed at better planning and, hence, more successful ERP implementation. Bancroft (1996), Ross (1998) and Markus and Tanis (1999) have all proposed models of ERP implementation in order to gain a deeper understanding of the process and, hence, provide guidelines for successful implementation.

In this paper, we first review the process models so far proposed and conclude that there is justification for creating a project phase model (PPM) of ERP implementation which is centred on the individual, discrete phases of the implementation project itself rather than one which treats the project as just another phase in the

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whole implementation enterprise. The CSFs, which were identified in an earlier stage of this research, are used to augment this model (see Table 1). We then report on two case studies in which the PPM model was empirically tested by relating the CSFs to the PPM implementation phases. The cases were selected because the first was, in project terms (defined below), unsuccessful, while the second was considered a model of successful implementation. Because the companies are closely related, the lessons learned in the first, unsuccessful case were available to the participants in the second one, so the later one exemplified an evolutionary stage of ERP implementation. Case study data are analysed in order to highlight and explain the differences between the two cases. The PPM proved to be a useful lens for understanding ERP implementation projects. Augmenting the PPM with CSFs for each phase within the PPM extends previous research that has simply enumerated CSFs for the entire implementation process. Finally, the case findings lead to a best practice ERP implementation process model.

The PPM, together with associated CSFs, provides guidance for practitioners when planning ERP implementation projects and also provides researchers a foundation for further empirical research. The important implications of the research are, firstly, that the organizational learning that occurred during the unsuccessful project and the associated early appointment of an experienced 'champion' with clearly defined responsibilities were critical to the successful project. Secondly, organizations implementing ERP systems should partition large projects into several smaller, simpler projects which are identified here as 'vanilla' implementations. Finally, the PPM highlights those CSFs that are necessary for successful ERP implementation and which will be used when planning ERP implementation projects.

ERP implementation process models

Several researchers have developed process models of ERP implementation. In this section we review three of those models. The implementation of an ERP system implies that a company must focus on, evaluate and define relevant company processes in precise detail. Implementing the ERP system is itself a process that begins with planning for the system. After planning is complete, a project team embarks on and then moves through a number of discrete project phases. After the system is up and running, there may be a post-implementation review and later a stabilization phase. As several authors (Markus and Tanis, 1999; Shanks *et al.*, 2000) have stated, the implementation process of an ERP system is best conceptualized as a business project rather than the installation of a new software technology.

Bancroft *et al.*, (1998) presented a view of the implementation process which was derived from discussions with 20 practitioners and from studies of three multinational corporation implementation projects. The Bancroft *et al.* (1998) model has five phases: focus, as is, to be, construction and testing and actual implementation. The focus phase is essentially a planning phase in which the key activities are the set-up of the steering committee, selection and structuring of the project team, development of the project's guiding principles and creation of a project plan. The as is phase involves analysis of current business processes, installation of the ERP, mapping of the business processes on to the ERP functions and training of the project team. The to be phase entails high-level design and then detailed design subject to user acceptance, followed by interactive prototyping accompanied by constant communication with users. The key activities of the construction and testing phase are the development of a comprehensive configuration, the population of the test instance with real data, building and testing interfaces, writing and testing reports and, finally, system and user testing. The final phase, actual implementation, covers building networks, installing desktops and managing user training and support. In summary, the model of implementation extends from the beginning (focus) of the project proper to the cut-over to the live system.

Ross (1998) developed a five-phase model based on 15 case studies of ERP implementation. The phases are design, implementation, stabilization, continuous improvement and transformation. The design phase is essentially a planning phase in which critical guidelines and decision making for the implementation are determined. Ross' (1998) implementation covers several of Bancroft *et al.*'s (1998) phases: as is, to be, construction and testing and actual implementation. For Ross (1998), stabilization occurs after cut-over and is a period of time in which system problems are fixed and organizational performance consequently improves. This is followed by a continuous period of steady improvement in which functionality is added. Finally, firms expect to reach the stage of transformation in which organizational boundaries and systems are maximally flexible.

Markus and Tanis (1999) developed a four-phase model of ERP implementation: chartering, project, shake-down and onwards and upwards. The chartering phase begins before Bancroft *et al.*'s (1998) focus and Ross' (1998) design phases. It includes the development of the business case for the ERP, package selection, identification of the project manager and budget and schedule approval. The description of their project

phase is similar to Ross' (1998) project phase and it covers all of Bancroft *et al.*'s (1998) as is, to be, construction and testing and actual implementation phases. The main activities of this phase are 'software configuration, system integration, testing, data conversion, training and roll-out' (Markus and Tanis, 1999, p. 20). Markus and Tanis' (1999) onward and upwards phase is essentially a synthesis of Ross' (1998) continuous improvement and stabilization phases.

Several points need to be made about these three models. Firstly, Markus and Tanis (1999) and Ross (1998) included a planning phase which occurs prior to the actual implementation project. Secondly, these two models collapse the actual implementation project into one discrete unit. In contrast, Bancroft *et al.* (1998) categorized the stages of the actual project into four project subphases (as is, to be, construction and testing and actual implementation). Thirdly, two of the models (Ross (1998) and Markus and Tanis (1999)) include a post-project phase (variously called continuous improvement, transformation and onward and upwards) in the model of the whole ERP implementation enterprise. Finally, none of them relates CSFs to the phases of implementation.

The model on which this research is based, the PPM, synthesizes previous models in that it recognizes the importance of the planning and post-implementation stages. However, the focus of the model is on the implementation project and the factors which influence a successful outcome at each of the phases of the implementation. There are three justifications for this focus.

(1) Many problems documented in the literature relate to the actual implementation project (Fine, 1995; Ambrosio, 1997; Piszczalski, 1997; Tebbe, 1997; Gartner Group, 1998; Horwitt, 1998; Martin, 1998; Stedman, 1998a, b; Parr, *et al.*, 1999). A strength of the PPM is that it identifies the discrete subphases of the project while also recognizing the importance of the planning and post-implementation phases. Although organizations are primarily interested in business success (Markus and Tanis, 1999), understanding how to also achieve project success is critical in ERP implementation due to the high costs involved.

(2) The PPM model relates success factors to the phases of the ERP implementation process. This builds on earlier work which identified those factors which experts in ERP implementation believe lead to successful implementation. It also augments the model in that it links factors leading to success with implementation stages.

(3) The PPM is concerned with the concept of project 'success'. Project success simply means bringing the project in on time and on budget. This concept of success was recognized by Markus and Tanis (1999) and is the concept used by the implementation experts discussed below. This differs from the Ross (1998) and Markus and Tanis (1999) models which are aimed at 'success' in terms of a contribution to company performance. It is recognized that the notion of 'success' changes over the life of the implementation enterprise (Shanks *et al.*, 2000). The purpose of a process model of implementation is to provide guidance for 'successful' project implementation. A process model which extends over the life of the implementation enterprise, extending beyond the project and into refinement and organizational transformation and which incorporates the project as only one of several phases, is aimed towards a concept of success that involves the contribution of the ERP to the performance of the implementing company.

The PPM of ERP implementation

The PPM consists of two concepts: implementation phases and critical success factors. Each of these is discussed below.

The PPM phases

The PPM (see Figure 1) has three major phases: planning, project and enhancement. The planning phase includes the selection of an ERP, assembly of a steering committee, determination of high-level project scope and broad implementation approach, selection of a project team manager and resource determination. The project phase extends from the identification of ERP modules through to installation and cut-over. The enhancement phase may extend over several years and includes the stages of system repair, extension and transformation, that is it encapsulates Ross' (1998) continuous improvement and stabilization phases and Markus and Tanis' (1999) onwards and upwards phases.

In addition, because the focus of the model is on the implementation project itself, the project phase is divided into five subphases: set-up, re-engineering, design, configuration and testing and installation. In the set-up phase, the project team(s) are selected and structured with an appropriate mix of technical and business expertise, the team(s) integration and reporting processes are established and guiding principles are developed and/or reaffirmed. The re-engineering phase involves analysis of current business processes, often to

determine the level of business process engineering (BPR) required, installation of the ERP, mapping of the business processes on to the ERP functions and training of the project team(s). The design subphase entails high-level design and then detailed design subject to user acceptance. This is followed by interactive prototyping and is accompanied by constant communication with users. The major activities of the configuration and testing subphase are the development of a comprehensive configuration, population of the test instance with real data, building and testing interfaces, writing and testing reports and, finally, system and user testing. Finally, the installation subphase includes building networks, installing desktops and managing user training and support. These last four subphases are comparable to those described above for the Bancroft *et al.* (1998) model. Figure 1 provides a graphical representation of the PPM.

The PPM CSFs

The PPM builds on previous models of the ERP implementation process by augmenting them with CSFs. These CSF were identified in an earlier stage of this research (Parr *et al.*, 1999). The purpose of identifying CSFs is to provide guidance to practitioners in planning and monitoring an ERP implementation. CSFs are defined as 'those few critical areas where things must go right for the business to flourish' (Rockhart, 1979). They have been applied to many aspects of information systems (IS) including project management, manufacturing systems implementation, re-engineering, and, more recently, ERP systems implementation (Holland *et al.*, 1999b; Parr et al. 1999).

Williams and Ramaprasad (1996) noted that, although CSFs are widely used by academic researchers and practitioners, it is important to discriminate between different levels of criticality. They distinguished four types of criticality: '. . . factors linked to success by a known causal mechanism; factors necessary and sufficient for success; factors necessary for success; and factors associated with success' (Williams and Ramaprasad, 1996, p. 250).

These factors are in descending order of power. For example, a causal link between a factor and an outcome is empirically and logically stronger than a mere association between a factor and an outcome. Similarly, a necessary and sufficient link is stronger than a link that is only necessary. In this paper, the CSFs were generated from a previous study (Parr *et al.*, 1999). In the taxonomy, provided by Williams and Ramaprasad (1996) the level of criticality is the third one: they defined those factors which, while not sufficient to ensure a successful outcome, are necessary to achieve success. Both the concepts of causality and necessary and sufficient conditions are concepts so rigorous that they were regarded by the authors as unachievable in the analysis of complex social, organizational and technical interactions such as an ERP implementation. Association is too weak a notion. The concept of necessity, while not optimal, does however provide guidelines for practitioners on those factors that must be present if successful implementation is to be achieved.

The CSFs for ERP implementation were identified using a review of the literature on systems implementation followed by an extensive set of interviews regarding ERP implementation. The interviewees had been involved in a total of 42 ERP implementation projects in Australia and the USA (Parr *et al.*, 1999). The CSFs identified in the earlier study are shown in Table 1.

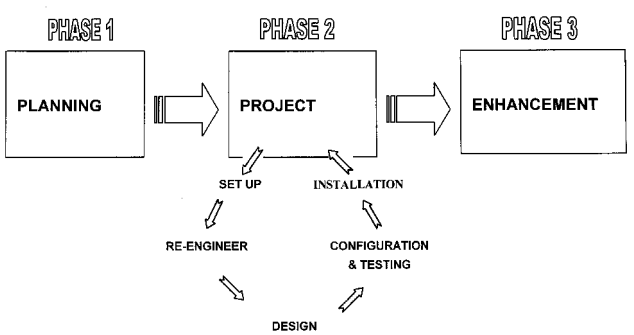

Figure 1 The PPM model of ERP implementation.

Combining the PPM with the CSFs

The CSFs elicited from the first stage of the research may be combined with the PPM in order to examine the relationship between the CSFs and the PPM. Several questions about the relationship are investigated. First, which CSFs are necessary in which phase? Second, when comparing a successful case and an unsuccessful case, what are the differences in the relationship between the phases of the PPM and CSF's. Thirdly, how are these differences explained?

Research method

The case study research method was used in this study in order to investigate the relationship between phases in the PPM and necessary CSFs in a real world context. Case studies are useful for studying a contemporary phenomenon in a real world context and creating and refining theory (Eisenhardt, 1989; Yin, 1989). Two case studies are reported in order to allow a cross-case comparison. The first case ('Oilco')

Table 1 CSFs for ERP Implementation

Factors	Description
Management support	Top management advocacy, provision adequate resources and commitment to project
Release of business experts with relevant knowledge onto the project on a full-time basis	Release full-time on to the project of relevant business experts
Empowered decision makers	The members of the project team/s must be empowered to make quick decisions.
Deliverable dates	At planning stage, set realistic milestones and end date
Champion	Advocate for system who is unswerving in promoting the benefits of the new system
Vanilla ERP	Minimal customization and uncomplicated option selection
Smaller scope	Fewer modules and less functionality implemented, smaller user group and fewer/single site/s
Definition of scope and goals	The steering committee determines the scope and objectives of the project in advance and then adheres to it
Balanced team	Right mix of business analysts, technical experts and users from within the implementation company and consultants from external companies
Commitment to change	Perseverance and determination in face of inevitable problems with implementation

concerns the implementation of an ERP into the Australian and New Zealand subsidiaries of a multinational oil company. The second ('Exploreco') is an Australian implementation of an ERP into the exploration arm of the same company some years later. Both cases were perceived within each company to have been 'successful' in that they have brought considerable benefits to the companies. However, they differed in terms of the project concept of success defined above. The Oilco implementation went substantially over budget and over time. Eventually, it cost $A70 million, and extended over a 7 year period. Exploreco, on the other hand, came in under budget and within 2 weeks of its time allocation. This case in particular was thought by all participants to have been a model of successful project implementation that had incorporated the knowledge gained from the parent company's earlier implementation.

Data collection

Data were collected in 1999 from semi-structured interviews, general company documentation and implementation-specific documentation such as project plans and post-implementation reports (Darke *et al.*, 1998). The PPM provided a framework from which the interview protocol was developed. Interviews were conducted with at least five stakeholders in each of the companies. These were selected in order to cover a range of possible viewpoints and, between the two companies, they included system managers, project managers, project team members, business analysts, consultants and system users (expert and non-expert).

The case studies

An overview of each case is presented in this section, followed by a detailed comparison of the two cases. Subsequently, a tabular summary of the importance of each CSF in the PPM phases is presented.

The two ERP implementations

The first case study involved Oilco, a refiner and marketer of a broad range of petroleum products in Australia and 11 countries in the Pacific. As one of Australia's major industrial companies, Oilco directly employs over 2000 people and owns assets valued at approximately A$2 billion. Oilco is the Australian subsidiary of one of the world's largest multinational oil companies. It has a nationwide network of 1800 locations, is one of the four major oil companies in Australia and enjoys a substantial market share. In the late 1980s the global oil industry underwent significant restructuring and increasing competition. As a consequence, Oilco wished to implement a new IS in order to achieve fully integrated process automation and improved levels of customer service and facilitate planned business restructuring. In order to meet these business requirements in 1989 the company selected a mainframe-based ERP solution. With 1600 users in Australia, New Zealand and the Pacific Islands, this ERP system is now one of the largest and most complex mainframe implementations in the world. It processes 25 000–35 000 transactions per hour and handles over 1000 orders per day across the country. The implementation of the system involved major change to the company's business processes so that they matched the ERP's processing methods. While recognizing that some existing business process

changes were necessary, Oilco aimed to maximize the integration benefits of the ERP and simultaneously streamline the company's existing processes. The implementation also involved the development of an oil industry specific module. The ERP (referred to here as ERP 1) has now been implemented for over 4 years and the business benefits are substantial. They include better sales forecasting, fully automated ordering and delivery processes, real-time financial data, improved data quality and streamlined business processes. Although eventually significant benefits have been achieved, the project itself went significantly over budget and over time.

The second case study involved Exploreco, an oil and gas exploration and production company in the southwest of Australia. Exploreco is a major affiliate of Oilco. The company is involved in offshore gas and oil exploration and production. In 1997 Oilco acquired another oil exploration company which had an operational resource system and it became the Exploreco operational system. However, there was substantial dissatisfaction with this system within Exploreco and it was not Year 2000 compliant. Thus, in 1998 the company had to decide either to rework and upgrade the existing system or replace it. They chose a new system and conducted a feasibility analysis of several ERP systems. They decided for budgetary reasons and, because it suited their exploration business, to implement an ERP system (referred to here as ERP 2). Although Oilco had ERP 1, the company already had experience with ERP 2 systems in Canada, Nigeria and Singapore. The budget and project scope was considerably more modest that the Oilco implementation, so they planned to implement the system within 12 months, from January 1998 to November 1998. Documentation on the existing system indicated that understanding of the requirements was already advanced, but they took the opportunity to refine and re-engineer the system, particularly given the level of dissatisfaction with the old system. Moreover, they needed to align the new system (ERP 2) with Oilco's existing ERP (ERP 1). The implementation project was driven by Oilco's head office, which performed costings, set the scope, made recommendations and provided leadership on the steering committee. System goals were set via performance indicators. For example, the indicators included the number of cheque runs in a given period, a measured reduction in off-system payments and a reduction in suppliers from 6000 to 600. Given the lessons learned in the Oilco implementation, the steering committee insisted that the best people be released full-time for the life of the project and that a 'project champion' (that was the official title) was placed on the steering committee. The project was completed on time and on budget and was described by the highly experienced project manager as the 'easiest implementation' he had 'ever been involved in' (interview, December 1999). It has now been in operation for 15 months and the business benefits are significant. These include (1) a measured reduction in manual processes, manual transactions and the number of suppliers, which has led to improved procurement and inventory systems, (2) streamlined, real-time accounting systems, (3) a re-engineering of processes which involved a devolution of responsibility back into the hands of the operators and (4) improved time accounting (to 15 min intervals). This last benefit has been particularly important since this company has many joint ventures.

Case study data

Table 2 provides a detailed description and comparison of the two cases. It is clear that there is significant variation in the CSFs for each implementation in each phase of the PPM. Only those CSFs that were believed by most participants to be important to very important are identified in Table 2. They are shown in descending order of importance.

Tabular summaries of the importance of each CSF in the PPM phases is then presented in Tables 3 and 4. Table 3 represents the Oilco case study findings and Table 4 the Exploreco findings. The tables show the PPM, its phases and the CSFs. Each cell represents a particular CSF in a particular phase. The number of ticks in each cell represents the strength of the participants' consensus that that particular CSF was necessary in that phase. Four ticks indicate that the particular CSF was considered to be of major importance in that phase of the PPM. Three ticks indicate that the CSFs were considered very important. Two ticks indicate that the CSFs were considered important. One tick indicates that the CSFs were considered to be of minor importance and no ticks indicate that the CSFs were considered to be unimportant. We have not included 'smaller scope' as a CSF in Table 3 as one implementation was clearly large in scope and the other smaller in scope. We draw on this difference later in the case study analysis.

Discussion and analysis

The two cases were selected for two prime reasons. Firstly, while both cases were perceived to have brought considerable business benefits to the organizations, the Oilco implementation was considered a failure in a project sense and the Exploreco implementation was considered successful in a project sense. Secondly, the Exploreco implementation represented

Table 2 Case study findings using the PPM

Phase	Oilco	Exploreco
1. Planning: Clarification of the system rationale, selection of an ERP, determination of high-level project scope and broad implementation approach and resource determination	Prior to the Asia-Pacific implementation, in 1988 the international parent of Oilco began a pilot ERP project in Europe. Oilco conducted a 6 month evaluation of the ERP. The evaluation included a technical evaluation and a high-level evaluation by user personnel of the ERP modules in order to determine their fit with the business requirements for the financial and operational systems. The evaluation, while generally positive, highlighted some risks in adoption of the ERP. However, senior management insisted on a global commitment to the ERP. The level of management involvement focused the organization at senior levels, both locally and in the parent corporation. This led to the commitment and resources required to implement a common integrated systems. It was recommended that the ERP be used both for pricing and sales and to support system integration and reduce costs by minimizing the number of application technical platforms that were being supported. In 1990, it was decided to implement the ERP in multiple stages. Stage 1 was implementation of financials and purchasing for Australia and New Zealand and sales and pricing for Australia. Stage 2 covered logistics and plant maintenance for Australia. Stage 3 extended this functionality to the Pacific Islands. Stage 4 was intended as a roll-out of the Australian design to New Zealand but incorporated some local changes CSFs Management support Champion Commitment to change Vanilla ERP	In 1997, Exploreco was dissatisfied with its existing system which had been inherited as a result of a takeover. The system was deficient particularly in the accounting and inventory areas, had poor levels of user acceptance and was not year 2000 compliant. The parent company (Oilco) considered an upgrade of the existing system or an ERP. The company had global experience of both ERP 1 and ERP 2 systems and decided on the ERP 2 system. Oilco did the costings and project scope. The single-site, 12 month project was not expected to be problematic because there was company experience of the ERP, requirements were known because of the existing system and the users' dissatisfaction with the existing system meant they were keen to obtain a superior system CSFs Management support Champion Commitment to change Vanilla ERP Best people full-time Deliverable dates Definition of scope and goals

Table 2 continued

Phase	Oilco	Exploreco
2a. Set-up: Steering committee/team selection, resourcing, back-fill staff, project structures and reporting mechanisms	The ERP implementation project was set up under the leadership of a venture manager who came from the UK. The venture manager reported directly to the chief executive officer (CEO) in Australia. The team consisted of business and IT personnel from both Australia and New Zealand and consisted of 90 full-time people plus another 20 who developed documentation, plus the local user experts (LUEs). Project managers for each application area were responsible for a number of application teams. These managers reported to the venture manager. A steering committee had overall responsibility for the whole project. Separate teams were used to develop each application and they consisted of business experts and IT staff, approximately 50% of each CSFs Management support Balanced team Definition of scope and goals	A project champion was appointed. He was also a member of the leadership council (board). His task was to create acceptance within the organization and head off problems, select a project manager, then select the project team (eight members plus consultants) and communicate with the Leadership Council. Measurable goals were set via key performance indicators. It was decided to walk-through all milestones. The end date was 'set in concrete'. The best staff from accounting were released full-time. The team represented a mix of IT and business expertise. It was determined to do minimal customization of the ERP CSFs Management support Champion Balanced team Vanilla ERP Deliverable dates Definition of scope and goals
2b. Re-engineering: Analysis of current business processes, installation of the ERP, mapping of the business processes on to the ERP functions, identification of data and system interfaces and training of the project team	The decision had been taken to have minimal customization of the software. However, it was found that an oil industry-specific module needed to be commissioned. Moreover, although some business processes did not fit well with the software, those processes were not re-engineered as they would have meant job restructuring and it was considered that line operators would be resistant CSFs Balanced team Definition of scope and goals	Although the decision had been taken to have minimal customization, it was agreed that this was an opportunity to improve business processes. The data quality was 'awful', and there was a proliferation of manual systems. There needed to be changes so that all transactions were electronic. This required communication with and persuasion of users to accept change. Such change was more acceptable when proposed by an expert colleague CSFs Empowered decision makers Management support Balanced team Definition of scope and goals

Table 2 continued

Phase	Oilco	Exploreco
2c. Design: High-level design followed by detailed design and interactive prototyping This was accompanied by constant communication with users	This phase accompanied a company restructure, which meant that project personnel changed. In addition, there was a scarcity of expertise available at that time on this ERP. User commitment waned. The company had determined to have a policy of minimal customization, but encountered a push from those who wanted 'a gold-plated solution' (a wish list). Thus, management energy was spent on conflict resolution CSFs Best people full-time Vanilla ERP Management support Commitment to change	Decisions taken in the planning phase by management resulted in very little 'push-back' from users in this stage. The decision to do minimal customization meant that there were no significant changes to the software apart from customizing it to a mainframe interface. The adherence to 'rock-solid' project milestones acted as a curb on the impulse to generate numerous reports of doubtful use CSFs Vanilla ERP Management support Deliverable dates
2d. Configuration and testing: Development of a comprehensive configuration, the population of the test instance with real data, building and testing interfaces, writing and testing reports and, finally, system and user testing	This phase was also concurrent with extensive company restructuring. As a result personnel changed and the required people were not always released on to the project. This underlined the need for the best human resources. A huge amount of ABAP (advanced business application programming) programming was done in order to generate reports. The decision to adhere to minimal customization precluded an easier, more user-friendly option CSFs Best people full-time Vanilla ERP	During this phase it was decided that the user interface was unacceptable and that there should be a Lotus Notes interface to the ERP and to the users. It was also decided that the system should support EFT (electronic funds transfer) to the bank. Finally, it was decided that the system should interface with an offshore company's maintenance system. These late changes meant that the system end date was (marginally) later than expected. These changes required management to authorize and support them. The business experts on the project team were valuable in gaining user acceptance and the changes further highlighted the effects of not adhering to the principle of minimal customization. CSFs Management support Balanced team Vanilla ERP

Table 2 continued

Phase	Oilco	Exploreco
Installation Building networks, installing desktops and managing user training and support	Since this had been a long (7 years) and complex implementation and because there had been extensive restructuring during the time of the implementation, over the life of the project there had been surges of enthusiasm, followed by indifference and a low project profile. Training of users was an immense task: in the early stage 1525 people were trained in 3 months. This involved 1600 training sessions at 12 locations by professional trainers. In the second stage a different approach to training was taken: LUEs conducted training. These were often drawn from the business members of the project teams CSFs Management support Commitment to change Balanced team Best people full-time	Given the level of planning, the 'go live date was a non-event' (project manager). Management support was needed to engender enthusiasm. The technical membership of the project team managed the actual installation, while the user experts from the project team were responsible for user training and support CSFs Management support Balanced team Commitment to change
3. Enhancement: System repair, extension and transformation	It is at best unclear whether transformation has occurred (see discussion below)	Since the system went live in 1998, there have been no significant repairs or changes.

Table 3 Oilco – the PPM of ERP implementation incorporating CSFs

Factor	Phase						
	Planning	Project					Enhancement
		Set up	Re-engineering	Design	Configuration and testing	Installation	
Management support	•••	•••	•	•	•	•••	
Champion	•••	•		•		•	
Balanced team		•••	••	••		••	
Commitment to change	•••	•		•		••	
Vanilla ERP	•••			••	••		
Empowered decision makers		•		•			
Best people full-time		•	•	••	••	••	
Deliverable dates		•				•	
Definition of scope and goals	•	••	••	•		•	

Table 4 Exploreco – the PPM of ERP implementation incorporating CSFs

Factor	Phase						
	Planning	Project					Enhancement
		Set up	Re-engineering	Design	Configuration and testing	Installation	
Management support	••••	••	•••	•••	•••	•••	••
Champion	•••	••	•	•	•	•	•
Balanced team		••	•••	••	••	••	•
Commitment to change	•••	•	•	••	•	•	•
Vanilla ERP	•••	••	••		••		
Empowered decision makers	•	•	•••	••	•	•	
Best people full time	•••	•	•	•	•	•	•
Deliverable dates	•••	••	•	•	•	•	•
Definition of scope and goals	•••	••	••	•	•	•	••

an evolution of ERP implementation: Oilco is now a 'dinosaur' of the ERP implementation process and the implementation at Exploreco represented a unique opportunity for pinpointing the next evolutionary stage using the PPM framework.

In discussing the two cases it is important to note that they differ in three important aspects. Firstly, the scope of the Oilco case is much larger than the Exploreco case. Secondly, the Oilco case involved an earlier version of the ERP system that was more limited in functionality than the Exploreco system and required additional programming in order to generate required reports. Thirdly, although Oilco and Exploreco are companies in different geographical locations, the implementation project at Exploreco was driven from Oilco's head office and the project 'champion' had access to extensive experience from the Oilco implementation. Our discussion highlights the similarities and differences in CSFs within each phase of the PPM between the two cases. We then offer some explanations for these differences, noting particularly the features of the successful case. Finally, we consider the implications of the PPM for research and practice.

Case findings – similarities

A number of important similarities between the two cases are evident.

The planning phase was clearly considered the most critical by both companies

Both companies understood that ERP implementation is a major project, requiring substantial resources, commitment and change management. The CSFs identified by both companies during the planning phase were management support, a champion for the project, commitment to the change and a vanilla ERP approach.

The installation phase was very similar in both cases

In both cases management support, a balanced team, commitment to the change and having the best people

full-time were considered crucial in the installation phase of the PPM.

There was no significant enhancement phase in either company

This phase was defined as including system repair, continuous improvement and organizational transformation. The Exploreco ERP has now been in place for 15 months and there has been no post-implementation review. All interviewees were delighted with the system: 'Never seen this done so well' (project champion) and 'Cut-over was a non-event' (project manager). Perhaps this explains why there has been no significant repair of the system (although they have made minor adjustments to the accounting and purchasing systems), nor has the business been transformed subsequent to a continuous period of steady improvement. The Oilco ERP has been in operation for 3 years. In that time and during the 7 year implementation, there was extensive company restructuring. Although it was claimed by one person that there has been continuous improvement in system operation and performance, 'no quantitative post-implementation audit has been done' (interview with management information systems manager) of the Oilco ERP. Given the complexities of the restructuring and the lack of a post-implementation audit, it is at best unclear whether transformation has occurred.

Case findings – differences

A number of important differences between the two cases are evident.

The importance of CSFs over all phases of the PPM in the Exploreco case

For Oilco, only one CSF – management support – was considered necessary in all phases of the PPM. Exploreco considered seven CSFs to be necessary in all phases. These were management support, a champion, commitment to change, vanilla ERP, empowered decision makers, the best people full-time, deliverable dates and the definition of scope and goals. For Oilco most of the CSFs related to the planning phase. For Exploreco, the CSFs were more evenly distributed across all phases.

The CSFs within Exploreco were generally considered more important than with Oilco

There were significant differences in the CSFs within phases between the two cases. For example, Exploreco interviewees thought nine CSFs were important/crucial in the re-engineering phase, whereas Oilco interviewees nominated, somewhat unenthusiastically, four CSFs as important in this phase.

Strategic differences in the planning phase

Although the companies shared some common ground in the planning phase, they also exhibited a strategic difference. Exploreco, who had had the benefit of learning from the parent company's earlier implementation, added two more CSFs to the planning phase: a 'rock-solid' decision to release the best business user experts on to the project full-time and the setting and deliverance of project milestones and a final end date. Oilco had come to recognize the value of the business user experts, particularly for training and user support and they adopted an implementation methodology with clear processes and targets.

The scope of the two cases differed in several key dimensions: physical scope, level of BPR, technical scope, module implementation strategy and resource allocation. The CSF 'definition of scope and goals' was considered very important in the planning phase at Exploreco but not at Oilco.

Facilitating the achievement of CSFs

Even when both companies identified what appeared to be the same CSF, they differed in that Exploreco devised a process and structures in order to facilitate its achievement. The starkest example of this concerns their recognition that a project champion was crucial. In Exploreco the champion was actually known by that title, was allocated to the project for the life of the project, had defined responsibilities and, most importantly, was a member of the board (called the leadership council) of the company. This level of seniority plus the daily hands-on approach proved invaluable. In contrast, in Oilco this person was not officially recognized and the person in the role changed over time. Initially, the drive for the system came from a USA managing director who promoted the ERP as a global strategy. Subsequently, the venture manager (brought in from the UK) became the *de facto* champion and then later there was an in-house senior ERP 'convert'. There was neither a defined role nor processes or structures via which his influence could be conveyed.

Focus in the set up phase for Exploreco

In Exploreco, there was formal recognition of the 'champion' role throughout the set up phase. Although in both cases a balanced team and clear definition of scope and goals was recognized as important in set up, in Exploreco the strong focus on implementing a vanilla ERP and setting clear deliverable dates was evident.

Importance of the re-engineering and configuration phases

There was a marked difference in the re-engineering and configuration and testing phases for the two cases. Exploreco recognized and ensured that all the CSFs

were present. This indicates that they placed equal weight on each stage of the project. For Oilco, little emphasis was placed on these phases. In addition, decisions made by Exploreco at the planning phase influenced other phases of the project. For example, during re-engineering and design, management at Exploreco were actively involved at the 'coalface' in, for example, promoting the benefits of process changes to employees who would be directly affected by them and participating in project group and departmental walk throughs at milestones. In Oilco during these phases management activity can be seen as more remote – 'storming' around the country and making presentations. This remoteness was evident very early in the planning phase. The evaluation team, who were principally locals, recommended against the ERP. They were overruled.

Consistency and persistence of CSFs throughout all phases

There was also a difference simply in the patterns of individual CSFs, which was underscored by the PPM. As shown, commitment waxed and waned at Oilco. This is hardly surprising given the length of the project. At Exploreco, there was a steady, persistent commitment to the project. They did have advantages: it was a smaller, self-contained project and they were replacing an unpopular system. They were able to obtain persistent commitment because they carefully scoped the project at the planning stage and because they set an immoveable end date.

This variation in pattern can also be seen with other CSFs. Both companies adopted a policy of minimal customization and deliverable dates. However, Oilco was forced to commission an oil industry specific module and they generated endless reports often because it was possible rather than desirable (MIS manager). These changes were accompanied by extensive company restructuring and it is unclear which of these caused them to go years over their projected end date. Exploreco adhered to the principles of minimal customisation and deliverable dates until their project was well advanced in the configuration and testing phase when it became clear that the interfaces were unacceptable to the users. They then bought in Lotus Notes and wrote the necessary interfaces. This meant they ran 2 weeks over their 'rock-solid end date'.

Explanations for the similarities and differences

Two explanations for the similarities and differences between the successful and unsuccessful cases are offered. These concern organizational learning and the scope and complexity of each project.

The organizational learning that took place at Oilco during the unsuccessful project led to a clear articulation of the project plan for ERP implementation at Exploreco. The project was driven from Oilco's head office and led to Exploreco's decision at the early planning phase to adhere to a rock-solid deadline, insist on minimal customization and appoint a senior member of the board on the steering committee as a champion, one of whose tasks was to provide the authority to release the best business experts on to the team. In addition, they learned from prior experience that system training and *de facto* 'selling' had to be done by the in-house experts who were committed to the new ERP and not by the consultants or by senior managers. Previous experience of the Exploreco project team in ERP systems implementation allowed them to identify readily both the CSFs required and the right process for ensuring the manifestation of each CSF. The processual details included what phase it should be present in, at what level and in what form.

The scope and complexity of the Oilco implementation was clearly greater than the Exploreco implementation. We have argued elsewhere (Parr *et al.*, 2000) that there are three archetypal categories of ERP implementations. These are 'comprehensive', 'middle level' and 'vanilla'. Essentially, these categories are a grading in project scope from the most extensive to simplest and are based on a set of ERP implementation characteristics. These include physical scope (multisite, multinational boundaries versus single site for example), technical scope (involves decisions either to modify or accept the ERP as is), module implementation strategy (essentially a modular or 'big-bang' approach), the level and type of re-engineering involved and resource scope. In this categorization scheme, Oilco was a comprehensive and Exploreco was a vanilla implementation. Comprehensive implementations are inherently large and complex and IT projects with these characteristics are high risk with a significant probability of failure (Willcocks and Sykes, 2000). In contrast, Exploreco was a vanilla implementation with manageable scope. The Oilco implementation was also more complex and involved an earlier version of the ERP software and, consequently, involved development of a specific module and extensive programming for reports.

Implications of the PPM for practice and research

(1) Large-scale ERP implementation projects are high risk and difficult to implement on time and within budget. Organizations considering ERP systems implementation should partition the large project into several simpler and smaller implementation projects. Further case studies of ERP implementations should investigate this proposition.

(2) In both cases there was no marked 'enhancement' phase. This is in contrast to the findings of Ross (1998) and Markus and Tanis (1999), where significant post-implementation phases were identified. Further case studies of ERP systems implementation are required in order to investigate the nature of activities within the enhancement phase of the PPM.
(3) The appointment of an experienced ERP implementer early in the project as a 'champion' who is empowered to make decisions about the project is important to the success of the project. This kind of role is highly relevant in the smaller scale vanilla category of ERP implementation projects. Further studies of ERP implementation projects are needed to understand the nature of the champion role better and the importance of previous experience to project success.
(4) The PPM model together with associated CSFs from the Exploreco case provides practitioners with a useful example of a successful 'vanilla' ERP implementation and may be considered a best-practice ERP implementation process model. Three amendments need to be made to the CSFs in Table 4 from the case study analysis. The 'smaller scope' CSF should be added to the set of CSFs, with particular emphasis in the planning phase. The 'vanilla ERP' CSF should include the assumption that the ERP selected is a recent version of software with suitable functionality. The 'champion' and 'best people full-time' CSFs should emphasize the value of experience with ERP implementations. Further case studies of ERP systems implementation are required in order to validate and extend the particular CSFs that are important in each PPM phase.

Conclusions and future research

This paper has reported on the development of a PPM of ERP systems implementation which focuses on the implementation project itself and links it to CSFs. That model was used in two case studies of ERP implementation: one successful and the other unsuccessful. Evidence from the case studies suggests that the PPM has a dual function. For researchers, it is a useful model of ERP system implementation and provides a foundation for further empirical research. For practitioners, it provides a template which suggests important CSFs to consider during particular project phases. The case study findings emphasize that practitioners need to pay even more attention to the planning phase and to the manifestation of CSFs across the phases of the implementation project. They also provide a model of a successful project implementation. However, only two case studies are reported here. Care was taken internally to improve the validity by using multiple sources of data and multiple viewpoints and the cases were selected in order to demonstrate a transition from failure to success. Nonetheless, further cases are required to strengthen the findings.

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