Critical Failure Factors in ERP Implementation

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Abstract

This study firstly examines the current literature concerning ERP implementation problems during implementation phases and causes of ERP implementation failure. A multiple case study research methodology was adopted to understand "why" and "how" these ERP systems could not be implemented successfully. Different stakeholders (including top management, project manager, project team members and ERP consultants) from these case studies were interviewed, and ERP implementation documents were reviewed for triangulation. An ERP life cycle framework was applied to study the ERP implementation process and the associated problems in each phase of ERP implementation. Fourteen critical failure factors were identified and analyzed, and three common critical failure factors (poor consultant effectiveness, project management effectiveness and poo555îr quality of business process re-engineering) were examined and discussed. Future research on ERP implementation and critical failure factors is discussed. It is hoped that this research will help to bridge the current literature gap and provide practical advice for both academics and practitioners.

Keywords: Critical Failure Factors, ERP Implementation, ERP Life Cycle.

1. Introduction

An ERP system is an integrated software solution, typically offered by a vendor as a package that supports the seamless integration of all the information flowing through a company, such as financial, accounting, human resources, supply chain, and customer information (Davenport, 1998). ERP implementation is a lengthy and complex process, and there have been many cases of unsuccessful implementations (Parr and Shanks, 2000), which have had major impacts on business performance. As ERP plays a very important role in business, ERP implementation and its critical issues, success factors and implementation problems have been investigated in the past (Parr and Shanks, 2000; Majed et al., 2003; Soh et al., 2000; Sumner, 2000).

Prior research has shown that conflict with consultants is one of the main managerial problems during the implementation period of ERP system (Themistocleous et al., 2001). Consultants can bring to the organisation specialised skills, experience, and know-how that the organisation needs when it is both time-consuming and expensive for it to build internally (Gable, 2003). They can also offer a firm-wide view, encourage unity between members, and

they are usually neutral (Davenport, 1998). ERP implementation is by no means a purely technical system implementation, and will include Business Process Reengineering (BPR). Consultants can perform the role of change facilitator and are involved in very important knowledge transfer. Consulting firms use techniques such as guided learning, formal training and knowledge creation activities to direct clients to the necessary knowledge required for a successful implementation. This guidance saves the client considerable time and effort in knowledge search costs (Gable, 2003).

It has been found that the mismatch between ERP and organization can have significant impacts on organizational adoption, and this could be the main reason causing the ERP implementation failure (Umble et al., 2003). The need for greater customization of ERP software will increase in this case, and the risks associated with the ERP implementation will be much higher (Soh et al., 2000). According to Soh et al. (2000), there could be different levels of mismatch, namely business function, data and output. Careful selection and evaluation of ERP systems is required in order to reduce the potential risk of software mismatch.

Different ERP implementation phases are associated with specific ERP implementation problems (Markus et al., 2000). The ERP implementation literature has provided a solid theoretical background to ERP research. However, our review of literature suggests that there seems to be insufficient research investigating the failure factors of ERP implementation from planning to post ERP implementation. Further in-depth research here seems justified in order to provide useful information for practitioners and a research framework for understanding critical factors and how those factors influence ERP implementation. This study aims at achieving the following objectives: examining the process of ERP implementation based on an "ERP System Life Cycle" (Markus et al., 2000); and identifying the factors contributing towards ERP implementation failure.

This paper is organized into three sections. Firstly, a review of current literature on ERP implementation is presented, and gaps are identified in the literature investigating failure factors in ERP implementation. Secondly, a detailed examination of ERP implementation problems based on case studies is presented. Thirdly, critical failure factors are discussed and examined. This leads to research contributions and future research directions.

2. Background and Literature Review

There have been many reports of unsuccessful ERP implementations within business, including accounts of the inability of Hershey to ship candy at Halloween, Nike losing shoe orders, and Foxmeyer's failure to process orders (Cotteleer, 2003). Majed (2000) reported that 70% of ERP implementations did not achieve their estimated benefits. In other studies, the percentage of ERP implementations that can be classified as "failures" ranges from 40% to 60% or higher (Langenwalter, 2000), and failures of ERP system implementation projects have been known to lead to problems as serious as organizational bankruptcy (Bulkelery, 1996; Davenport, 1998; Markus et al., 2000).

Practitioners tend to discuss the impact of the failure of ERP implementation in a relative sense, referring to the shutting down of the system, being able to use only part of the ERP

system, suffering business loss, dropping market price, losing both market share and competitive advantage due to implementation failure, and so on (Deutsch, 1998; Diederich, 1998; Nelson and Ramstad, 1999). However, there have been various definitions of failure of ERP implementation. Failure has been defined as an implementation that does not achieve a sufficient Return On Investment (ROI) identified in the project approval phase. Using this definition, it has been found that failure rates are in the range of 60 – 90% (Ptak, 2000).

As ERP implementation failure rates are so high and the consequent impacts are so detrimental to business, there is a compelling reason for opening the "black box" to investigate the factors causing failure. In order to examine the causes of failure in the ERP implementation process, an "ERP System Life Cycle" (Markus et al., 2000) perspective was adopted, that can help to look at what goes on (e.g., problems experienced and attempts at problem resolution) at each phase of the experience cycle (Markus et al., 2000). Previous research has focused on IS implementation for the definition of IS failure (Lyytinen, 1988). However, the majority of studies have failed to take into account the richness of the ERP failure phenomenon. In this study, we have conducted empirical investigations into ERP failure from the perspectives of management, the project team, and the consultants involved in ERP implementation. We define critical failure factors (CFFs) as the key aspects (areas) where "things must go wrong" in order for the ERP implementation process to achieve a high level of failure.

3. Research Methodology

A case study method has been adopted for determining the specific CFFs, "how" they influence the effectiveness of ERP implementation, and for concluding "why" the factors led to failure and "how" they influenced ERP implementation failure. The case study, as a research strategy "attempts to examine a contemporary phenomenon in its real-life context, especially when the boundaries between phenomenon and context are not clearly evident (Yin, 2003)." Thus, the case study method can help to acquire rich data for exploring how CFFs in different ERP implementation phases affect ERP implementation failure.

Based on a case study methodology (Yin, 2003), a research protocol was established drawing on a literature framework. The protocol was critically evaluated and reviewed by industrial practitioners to ensure that the protocol design is appropriate for answering the research question. All interview results were taped, transcribed and reviewed by a research assistant. The resulting interview transcription was reviewed by the interviewees to confirm the internal reliability of the research study. During the case interviews, each of the interviewees was asked to suggest a set of critical failure factors. Data were collected during 2003-04 from semi-structured interviews. Top management, project managers and project team members (such as the IT manager, logistics manager, production and logistics supervisor, senior logistics manager and external ERP consultant) were interviewed. Data triangulation was conducted to increase the reliability of the study. All the written documentation regarding the organization's ERP implementation process was accessed and examined. These include meeting minutes, email communications, proposals, ERP project related presentation materials, implementation documents, intranet and knowledge management systems (systems that store, manage and disseminate ERP related knowledge). As the respective interviewees evaluated the systems based on different perspectives, judgment was provided and this was reviewed and confirmed by the chief informant (e.g., project manager) of the company. By

conducting data triangulation and building a chain of evidence in research database, the factors acquired from the different interviewees were verified and evaluated. After all the data were input into the textual table for multiple case studies comparison, specific patterns could be identified and findings could be summarized (Yin, 2003).

4. Research Framework

Many organizations appear to underestimate the issues and problems often encountered throughout the ERP life cycle (Markus et al., 2000). Understanding life cycle management issues will also help to direct the ERP research agenda (Chang et al., 2000). A number of phase models in the literature suggest that a specific focus is required within the various stages of ERP implementation. For example, Markus et al. (2000) developed a four-phase process model of ERP implementation consisting of a project phase, shakedown phase, and an onward and upward phase. Also, Parr and Shanks (2000) in examining the actual implementation process, presented a project-phase model. This provides a useful template for organizations planning ERP implementation. Several researchers have developed process models of ERP implementation. In this section we review three of those models. A company must focus on, evaluate and define relevant company processes in precise detail in order to implement an ERP system. Implementing the ERP system involves a process that begins with planning for the system. After planning is completed, a project team embarks on and then moves through a number of distinct 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 et al., 2000; Parr and Shanks, 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 research involving 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 can be seen as a planning phase involving the setting-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 the analysis of current business processes, installation of the ERP technology, mapping of business processes on to the ERP functions, and training the project team. The “to be” phase entails high-level design, and then detailed design which is subject to user acceptance, followed by interactive prototyping accompanied by constant communication with users.

Ross (1998) has developed a five-phase model based on 15 case studies of ERP implementation. The phases of this model are; design, implementation, stabilization, continuous improvement and transformation. The design phase is a planning phase in which critical guidelines and decision making for 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. Ross’ (1998) stabilization phase occurs after cut-over, and is a period of time for fixing problems and improvement of organizational performance. This is followed by a continuous period of steady improvement when functionality is added. Finally, transformation occurs when organizational boundaries and systems are maximally flexible.

Markus et al., (2000) developed a four-phase model of ERP implementation: chartering, project, shake-down and an onwards and upwards phase. 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 four of Bancroft et al.'s (1998) phases (as is, to be, construction and testing and actual implementation). The main activities of Ross' (1998) project phase are 'software configuration, system integration, testing, data conversion, training and roll-out' (Markus et al., 2000). Markus et al. (2000) onward and upwards phase is essentially a synthesis of Ross' (1998) continuous improvement and stabilization phases. There are several points of interests with these three models. Firstly, Markus et al. (2000) and Ross (1998) include 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 sub-phases (as is, to be, construction and testing, and actual implementation). Thirdly, two of the models (Ross, 1998; Markus et al., 2000) include a post-project phase (which are referred to as either continuous improvement, transformation, or onward and upwards) in the model of the whole ERP implementation enterprise. None of them relate critical success factors or critical failure factors to the phases of implementation.

Markus et al.'s (2000) model could be adopted with an enhancement to measure failure and identify failure factors, as their model is flexible in including detailed elaborated activities and problems associated in each phase (starting from planning to post-implementation). It could be useful to ask the participants to conclude their critical failure factors after reviewing the whole implementation process and the associated problems in each phase of ERP life cycle. Details of different phases in the research framework will be briefly illustrated as follows: 1. Chartering Phase: decisions defining the business case and solution constraints; 2. Project Phase: getting the system and end users up and running; 3. Shakedown Phase: stabilizing, eliminating "bugs", getting to normal operations; 4. Onward and upward Phase: maintaining systems, supporting users, getting results, upgrading and systems extensions.

5. The Case Studies

The four cases were selected based on the following criteria: firstly, they had completed the ERP implementation process: the details of implementation problems associated with each phase of the ERP life cycle will be discussed in the Appendix section (available upon request from the first author); secondly, they encountered failures and the ERP systems were unable to support their business operations after the ERP "go-live" date; thirdly, the project team, top management and consultants were willing to share the problems they encountered during the ERP implementation process and identify what they considered were their critical failure factors for our research. As ERP implementation failure experience is not a pleasant experience, in order to protect the participating companies, their information was treated with strict confidentiality. Thus, the project team, top management and consultants were confident in sharing their problems during the case studies. ERP related documents could be disclosed for research purposes. An overview of each case is presented in this section, followed by a detailed comparison of four cases. Subsequently, a summary of ERP implementation critical failure factors is presented.

	Alpha	**Beta**	**Gamma**	**Delta**
Business Profile	Multi-national electronic component manufacturing company (listed in Fortune 500), headquartered in Europe with production plants located in China and Taiwan	Furniture manufacturing company (listed in the Hong Kong Stock Exchange market), headquartered in Hong Kong with a production plant located in China	Electronic component manufacturing company headquartered in Hong Kong with a production plant located in China	Multimedia speaker manufacturing company headquartered in Hong Kong with a production plant located in China
Sales Turnover (US dollars)	Around 400 million	Around 140 million	Around 10 million	Around 10 million
Budget reserved for ERP implementation	1.3 million	1 million	0.2 million	0.18 million
Planned Implementation Period	6 months	6 months	12 months	4 to 6 months
Actual Implementation Period	12 months	18 months	18 months	18 months

6. Analysis of Critical Failure Factors

Critical failure factors were assessed based on the information suggested by participants and triangulated from the documents describing the ERP implementation (ERP project plan, meeting minutes, email communications and so on). The determination of critical failure factors is based on (1) an understanding of the ERP implementation process from the information given by participants (2) each participant's critical failure factors (validated using secondary source evidence, e.g., implementation related documents, email communications and meeting minutes) and (3) a relative comparison of the most important critical failure factors with the approval from the chief informant (such as the project manager). The fourteen critical failure factors were identified as follows:

Critical Failure Factors for ERP Implementation	**Alpha**	**Beta**	**Gamma**	**Delta**
1. ERP system misfit		√	√	√
2. High turnover rate of project team members		√		
3. Over-reliance on heavy customization			√	√
4. Poor consultant effectiveness	√	√	√	√
5. Poor IT infrastructure	√			
6. Poor knowledge transfer		√		√
7. Poor project management effectiveness	√	√	√	√
8. Poor quality of Business Process Re-engineering (BPR)	√	√	√	√
9. Poor quality of testing	√		√	√
10. Poor top management support	√	√	√	
11. Too tight project schedule	√	√		√
12. Unclear concept of the nature and use of ERP system from the users' perspective	√		√	√
13. Unrealistic expectations from top management concerning the ERP System	√			
14. Users' resistance to change		√	√	

Based on the research study, there are three common factors that can be summarized as poor consultant effectiveness, poor project management effectiveness and poor quality of BPR, and a detailed discussion is shown as follows.

6.1 Poor consultant effectiveness

Alpha's consultants were considered by their project team members to be inexperienced with ERP systems and unable to provide a professional level of advice on EPR project planning. Consultants communicated ineffectively during the project phase due to language barriers, and they copied the ERP configuration directly from the India branch office and only suggested workarounds without applying professional skills to conduct BPR to bridge the gap between ERP systems and business processes. A detailed test plan and guidelines were not suggested to the project team. For Beta, the consultants delivered poor quality of training (very brief and like a pre-sales demonstration), conducted BPR to a poor quality and delivered poor quality management reports due to insufficient industrial experience. For Gamma, consultants spent only two days on training the project team and configuring the

ERP systems. They did not provide any consulting service on BPR, project management, or ERP implementation. The project team commented that the service was insufficient and unprofessional. For Delta, the consultants were inexperienced in using the ERP system, they followed their formal implementation methodology during only the first two months, BPR was poorly conducted as they were not satisfied with the consulting fee received from the project. Also, the user requirement analysis document produced was too wordy (all business process flow charts for clarifying how to conduct BPR were absent) and the training material (prepared by the consultants) was found to be too brief and unhelpful.

6.2 Poor quality of BPR

For Alpha and Beta, the project team members disclosed that they had an unclear vision of why or how to conduct BPR, and their consultants provided unprofessional advice for conducting BPR. They commented that the consultants provided lots of workarounds to resolve problems associated with business process mismatch. Project team members found it difficult to collaborate and contribute to BPR, and the poor quality of BPR led to incorrect system configuration problems. Business processes were not successfully reengineered to fit with the ERP systems, and the project teams were unready for the adaptation of new business processes and they did not have the mind-set for implementing or using the ERP system. Moreover, during the BPR process, consultants did not conduct mapping analysis to map the software functionalities with business requirements, and this led to a mismatch between ERP and business processes. Users and the business process were not ready for ERP implementation, and thus, the ERP system could not provide support for business. For Gamma, as their ERP vendor adopted a customization strategy and provided a two-day consulting service (all BPR expertise, ERP implementation process and testing advice were absent), it took more than eighteen months for vendors to complete the customization programming (mapping the ERP functions with the business processes). For Delta, the project team mentioned that mapping analysis was conducted in a rush. The high level business process flow diagram was missing, and thus, project team members and users were unsure of how to reengineer the business process to fit with the ERP system. The wordy BPR documents which were free from diagrams were insufficient for the project team to understand how to reengineer the business process for a better adaptation to the new business process and ERP system usage.

6.3 Poor project management effectiveness

Due to limited ERP knowledge, capability and poor project management skills, none of the companies' project managers could exercise effective project management of ERP implementation. They agreed that a failure to plan, lead, manage and monitor the project was a core factor that resulted in their implementation failure, because the ERP system was complex, and project teams were required to collaborate with top management, different departments, users and consultants during implementation process. The ERP project was considered by the project mangers to be challenging and demanding, as it involved managing systems, people (project team, users and external consultant) as well as re-designing business processes. For Beta, Gamma and Delta, the over-tight and unrealistic project time schedule and insufficient human resource exhausted the project team members and users in coping with the ERP implementation. Activities of the different phases could not be conducted thoroughly (e.g., systems configuration and testing were conducted in a rush). Users could not understand the new system or adapt to the new business process within the over-tight schedule. None of the project managers in these studies were able to exercise effective project management control, especially in managing consultants, and reporting implementation problems to top management whenever necessary. It is important for the

project manager to effectively manage the consultants, for example, in evaluating their communication and training performance, when conducting BPR, and when testing system performance. Indeed, in this study, most of the companies' project team members lacked ERP experience (including top management, the project manager, middle level management and operational staff). However the external consultants were not able to provide professional advice and so led a failed implementation. Top management and project managers need to ensure sufficient knowledge and expertise for ERP implementation before the start of ERP implementation.

Due to word limitation, please contact the authors by email for further information concerning the detailed case description for other critical failure factors.

6.4 ERP Software misfit

Due to poor ERP selection and evaluation process, ERP software was found to be ill-fitting with the business requirements. For example, the ERP was inefficiently managing a high volume of product master files, and unable to design complicated bills of materials and production planning formulation). Our research results indicate the ERP system was utilized in a very limited way due to the problem of misfit. Project teams relied on heavy customization (for example, changing the system program, or writing many management reports, or conducting data transfer as workarounds) to solve problems.

6.5 High turnover rate of project team members

As project team members suffered from high work stress and tremendous workload when coping with the implementation, some members resigned from their jobs. This contributed to the insufficient ERP knowledge and skill transfer among project team members during the ERP implementation life cycle. In the end, users and project team members had insufficient ERP knowledge for performing their daily tasks when using the ERP system.

6.6 Over-reliance on heavy customization

Due to software mismatch, heavy customization was required in the areas of program customization and report customization. Customization could cause project delays, overspent budget and an unreliable system (due to poor quality of customization, unresolved system bugs and insufficient testing). Customizing the ERP to fit with business processes might lead to sacrificing "best practices" embedded in the ERP system.

6.7 Poor IT Infrastructure

Due to top management's insufficient financial resource provided for the implementation budget, a low performance IT infrastructure hardware was proposed by the consultants and project manager so as to reduce the costs of ERP implementation. The poor IT infrastructure contributed to the slow processing capability of the ERP system.

6.8 Poor knowledge transfer

Consultants were found to be inexperienced in the use of the ERP system (as they tried to practice during training sessions), and they could not deliver professional ERP training to the users. Their training material and user documentation were found to be too brief and unhelpful by the users. Project team members mentioned that the knowledge transfer process was ineffective, and the project team members and project manager could not acquire sufficient knowledge or skills to use, maintain and support the ERP system.

6.9 Unclear Concept of the Nature and Use of the ERP system from the Users' Perspective

Due to the poor quality of training provided by the consultants and insufficient education delivered by the top management and project team, users were not given a clear idea of the nature and use of the ERP system. They did not understand the rationale for implementing the ERP system or the process of implementation. Thus, they were not prepared for the implementation, and had high resistance to change, which led to political problems, poor quality of BPR and a resistance to using the system.

6.10 Unrealistic expectations from top management concerning the ERP systems

Top management assumed that ERP implementation could provide great solutions without considering the complexity of the ERP system, the possible implementation process complications and the associated risks. This gave the whole project team and users unrealistic expectations. This misconception also led to superficial project planning and an underestimation of budget and resource allocation, and resulted in a failure of ERP implementation from a project management perspective.

6.11 Too tight project schedule

Top management and the project manager would like to reduce the budget of the ERP project, and thus they set too tight a project schedule. Implementation activities were conducted in a rush (e.g., project planning, BPR, training, testing and so on) in order to meet the project deadline. The project team and users were overloaded and thus they might have had higher resistance to change. Some users were absent from training as they were too exhausted. It resulted in poor knowledge transfer.

6.12 Users' resistance to change

Due to a limited knowledge of formalized business processes and ERP systems, as well as work overload during the implementation process, users were resistant to change. This contributed to user resistance to participating in BPR, a lack of use of the ERP system, and poor quality of data entered into the system.

6.13 Poor top management support

Top management is expected to provide support in the areas of committing to the ERP project, sufficient financial and human resource, and the resolution of political problems if necessary. Limited financial support contributed to a rushed ERP implementation process, project team members were overloaded and thus high staff turnover rate, ineffective knowledge transfer, and political problems occurred. Insufficient commitment could lead to political problems which hindered the implementation process (causing poor BPR, widespread user resistance to change and low user satisfaction).

6.14 Poor quality of testing

Due to the over-tight project schedule and insufficient knowledge in testing ERP systems, it was conducted in a rush and was of low quality. It was agreed by the project team that the ERP testing result was an indicator for revealing the readiness of the ERP system to "go live" (from the perspectives of examining IT infrastructure capacity, correct configuration of ERP system, people (including users and project team) were equipped with sufficient knowledge and skills, and data was of good quality). They mentioned that they should not expect that all problems could be resolved after the systems goes live, as problems had become more complicated than they had predicted. They pointed out that workload of project team members and users had increased tremendously in order to fix the problems and cope with daily operations.

7. Discussion

This study of the ERP implementation process and the examination of failure factors helps to reveal that ERP consultant effectiveness plays an important role in determining the failure of ERP implementation. ERP consultants are third parties hired to fill in gaps in expertise and transfer knowledge. They have to provide expertise concerning project planning, ERP systems and BPR during ERP implementation (Brown and Vessey, 2003). According to these four case studies, the consultants were not effective in performing the task of filling the knowledge gaps (for example, communicating with project team members and users for acquiring business requirements, conducting BPR and delivering professional training). As a result, the project team members were unable to acquire enough knowledge to implement and use the ERP system. Therefore, it is important to ensure that the quality of consultants is up to a professional standard. Apart from systems knowledge, consultants should be able to demonstrate a mastery of professional communication skills, good language capability, industrial knowledge, and business analytical skills. Otherwise, they could not perform as change agents. The project manager should evaluate the consultants' capabilities prior to ERP implementation. Project teams need to select, evaluate, manage, collaborate and monitor the level of consultant effectiveness. If not satisfactory, it is important to take prompt action to remedy the problem, as ERP problems can rapidly develop complications.

In addition, project managers should exercise close control and monitoring of ERP project management, to ensure that the knowledge transfer process is effective, the consultants' service level is up to a professional standard, and BPR is conducted in a professional and effective manner. Prior to the ERP selection process, it is important to conduct a detailed and comprehensive evaluation on the potential candidates of ERP systems and consulting firms. All the business requirements from each functional area (for example, accounting, production, sales and purchasing departments) should be clarified and documented prior to the ERP system selection process. All these could help to minimize the risk of ERP mismatch. Sufficient top management support, whether in commitment to the project, or support in the areas of finance and human resource, should be provided during the whole ERP life cycle. Top management, the project team, and users should receive effective education concerning "what" ERP is and "how" to implement ERP systems, the processes involved in conducting BPR, the potential associated risks and the importance of collaboration with the third parties – external consultants.

In order to minimize users' resistance to change, effective change management should be introduced during the ERP life cycle, for example, how ERP systems could improve business process efficiency, and thus, the staff member could focus on the value-added tasks. During the chartering phase of ERP implementation, the project manager should formulate a detailed and feasible project plan (including detailed tasks which will be conducted by the consultants and milestones to be achieved) with the assistance of consultants. The project schedule should be feasible and if necessarily, additional human resources should be assigned to reduce project team members' increase in workload (caused by the ERP implementation). The project plan should be supported by both the top management and project team members. IT infrastructure should be designed and it should meet business capacity needs. Prior to the "go-live" date, sufficient testing should be conducted to ensure the organization (such as business processes, users' ERP knowledge, data quality and ERP systems) are ready prior to the "go-live" date. This may help to minimize the risk of ERP implementation failure. Finally, top management and the project team should not adopt a mindset that customization

will solve all the business problems and then be over-reliant on ERP customization for solving ERP misfit problems. As ERP systems might include best practices and it is a package system, a certain degree of BPR might be required to map the business requirements with ERP system functionalities (Davenport, 1998).

Based on the research result, it is possible to identify the interrelationships between critical failure factors; for example, poor consultant effectiveness will contribute to poor knowledge transfer, as consultants are there to transfer ERP related knowledge to the project team members. If consultants cannot perform professionally due to poor ERP system knowledge, insufficient commitment to the project or poor preparation of user manual and training material, knowledge transfer may be adversely affected. Users might have difficulty utilizing the ERP system properly. This may lead to poor data quality problems, and then customer dissatisfaction and complaints may occur. Secondly, poor consultant effectiveness and poor project management effectiveness can lead to a low quality of BPR, and the business processes may match poorly with the ERP systems, resulting in implementation failure. Based on the case study results, all of the companies studied were suffering from unstable ERP systems which where incapable of providing support for business operations, and required an extended implementation period to fix all the associated problems.

8. Implication for future research

The application of a case study method is useful for acquiring rich data to explain "what" the critical failure factors are and "how" they contribute to implementation failure. The consultants, top management, project team members and project managers involved in this study, were willing to divulge problems associated with the phases of the ERP life cycle and make conclusions about what they considered the most critical failure factors. They agreed that it was easier for them to be conclusive about the critical failure factors after reviewing all of the problems in the ERP life cycle. This study makes a contribution in identifying fourteen critical failure factors and specifying the three most common failure factors involved in ERP implementation.

In order to reduce the ERP implementation failure rate, it is useful to establish a robust framework of critical failure factors analysis. The interrelationship between the factors should receive more attention in future research. Prior research has indicated that critical success factors can affect each other in a reinforcing manner (Akkermans and Van Helden, 2002). It would be beneficial in future research on critical failure factors to consider how certain factors affect each other in a reinforcing manner. We have discovered that poor ERP consultant effectiveness and poor project management effectiveness could be the causes of low quality BPR, which in turn contributes to users' resistance to change. In future research studies, it is suggested that researchers investigate the kinds of professional advice and knowledge that can be provided by ERP consultants in specific phases of the ERP system life cycle.

Multiple case studies with various industries (e.g., service, trading and manufacturing) and various organizational sizes (e.g., small, medium and large) can be conducted to identify the reasons for implementation failure. Specific industries or organizational sizes might have different organizational characteristics and business requirements for ERP systems, and this may have an influence upon critical failure factors. All of these possible factors could help to

create a robust research framework and model which may be useful for understanding the critical failure factors for ERP implementation.

9. Conclusion

This study makes use of a case study research method and follows the ERP life cycle framework to identify ERP implementation associated problems. More importantly, it examines and discusses fourteen critical failure factors contributing to failed implementation. The results of this research result suggest that the role performed by consultants is important for filling the knowledge gap within the different phases of ERP implementation. Project managers should exercise effective control and monitoring of the ERP project and ERP consultant effectiveness. BPR should also receive attention for all ERP implementation projects, as this factor is important for matching business processes to ERP system functions. It is hoped that more studies will be conducted in future in order to further examine the black box of ERP implementation failure and enable both practitioners and academic researchers to discover the best ways to reduce the failure rate of ERP implementation. Case study participants have agreed that the overall picture of critical failure factors would be more complete after clarifying cause-and-effect issues based on the ERP life cycle framework. It is also hoped that this study will serve as a guideline for researchers wishing to investigate failure factors or problems associated with ERP implementation.

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