Critical factors for successful ERP implementation: Exploratory findings from four case studies

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Abstract

As more and more organizations move from functional to process-based IT infrastructure, ERP systems are becoming one of today’s most widespread IT solutions. However, not all firms have been successful in their ERP implementations. Using a case study methodology grounded in business process change theory, this research tries to understand the factors that lead to the success or failure of ERP projects. The results from our comparative case study of 4 firms that implemented an ERP system suggest that a cautious, evolutionary, bureaucratic implementation process backed with careful change management, network relationships, and cultural readiness have a positive impact on several ERP implementations. Understanding such effects will enable managers to be more proactive and better prepared for ERP implementation. Managerial implications of the findings and future research directions are discussed.

Keywords: Case studies; Critical factors; ERP; Implementation

1. Introduction

The myriad challenges faced today by global businesses are expected to grow in intensity and complexity as we go further into this century. Expanded global competition has become the norm rather than the exception, with an unprecedented number and variety of products available to satisfy consumer needs and desires. In particular, many firms have implemented company-wide systems called Enterprise Resource Planning (ERP) systems, which are designed to integrate and optimize various business processes such as order entry and production planning across the entire firm [1]. According to Davenport [2], the business world’s embrace of enterprise systems may in fact be the most important development in the corporate use of information technology in the 1990s.

When used appropriately, ERP software integrates information used by the accounting, manufacturing, distribution, and human resources departments into a
seamless computing system. A successful ERP can be the backbone of business intelligence for an organization, giving management a unified view of its processes [3]. Unfortunately, ERPs have a reputation for costing a lot of money and providing meager results, because the people who are expected to use the application do not know what it is or how it works. When ERP software fails, it is usually because the company did not dedicate enough time or money to training and managing culture-change issues. “Faulty technology is often blamed, but eight out of nine times, ERP problems are performance related,” says Pat Begley, senior vice president of educational services at SAP, an ERP software company in Newtown Square, Pennsylvania [4].

Given the large financial commitment that an ERP project requires and the potential benefits it can offer if successfully implemented, it is important to understand what is needed to ensure a successful ERP implementation. There are two major objectives of this study. First, using a methodology grounded in business process change theory, this research reports on a comparative case study of 4 U.S. firms that implemented an ERP system. According to Tarafdar and Roy [5], there has been no research that analyzes and generalizes the characteristics and problems of the ERP implementation experience, on the basis of a systematic empirical study. Second, based on the lessons learnt from the literature and case studies, we then propose a framework be considered for successful implementation of ERP. This framework illustrates the critical factors/issues that need to be addressed at all three phases of the implementation process: pre-implementation or setting-up phase, implementation, and post-implementation or evaluation phase.

The reasons for selecting the business process change framework for providing a systematic comparative analysis are as follows: First, since ERP implementation has come to involve changing the business processes of companies that implement such software [6], we felt that business process change (BPC) theory may prove useful in explaining the outcomes of our case studies. BPC is defined as an organizational initiative to design business processes to achieve significant (breakthrough) improvement in performance (e.g. quality, responsiveness, cost, flexibility, satisfaction, shareholder value, and other critical process measures) through changes in the relationships between management, information technology, organizational structure, and people [7]. These initiatives may differ in scope from process improvement to radical new process designs depending on the degree of change undertaken in each organizational subsystem and their interactions. Second, the seven constructs and 24 variables covered by Kettinger et al. [7] in their framework incorporate all the critical success factors suggested in the ERP literature (Al-Mashari et al. 2003, [8–11]).

2. Classification of ERP literature

In order to better understand this burgeoning field, the ERP literature is classified into the following two categories: conceptual/theory building and empirical/theory testing.

2.1. Conceptual/theory building

In reviewing the conceptual research on ERP, three distinct research streams emerged. The first provides comprehensive overview of ERP systems (Appleton 1997, Bowman 1997, [12–16]) and focuses on the fundamental corporate capabilities driving ERP as a strategic concept [17–23]. These articles cover such aspects as research agendas; motivations and expectations; and proposals on how to analyze the value of ERP systems [24].

A second stream focuses on the details associated with implementing ERP systems and their relative success and cost. Specifically, the articles in this stream include topics such as the implementation procedures [25–28], critical success factors [29,8–10,30,11], pitfalls and complexities in ERP implementation [31–33], and successful strategies for effective ERP implementation [34,35,1,36–41].

The third stream focuses on the theoretical research models that have been developed. The theoretical research models covers aspects such as usage of modeling tools applied in ERP contexts, new business modeling approaches, and comparison between processes. The major studies done under this stream include:

- Al-Mudimigh et al. [26] propose an integrative framework for ERP implementation based on an extensive review of literature and the essential
elements that contribute to success in the context of ERP implementation.

- Arinze and Anandarajan [42] show how object-oriented mapping methods can be used to rapidly configure ERP systems.
- Hedman [43] presents a competing value approach enterprise systems framework to discuss enterprise systems from an organizational effectiveness perspective.
- Park et al. [44] present an object class extraction methodology of production planning and control system as a part of ERP environment.
- Sock et al. [45] suggest a technological evolution approach to ERP adoption.
- Stensrud and Myrtert [46] propose the use of data envelopment analysis variable return to scale to measure the productivity of software projects.
- Stewart and Rosemann [47] discuss the design of a problem-based learning approach that seeks to embed industrial knowledge in the ERP-related curriculum of universities.
- Stirna [48] analyzes the acquisition of enterprise modeling tools.

2.2. Empirical/theory testing

This section deals with the assessment and specific ERP implementations. Most of the research under this stream done through field studies, questionnaire surveys or case studies illustrates the extent of ERP implementation and the effects of various factors on ERP implementation. Specifically, these studies cover different perspectives in particular situations such as: ERP impacts, applied theories to specific ERP issues, organizational change management, business process reengineering, people roles, and decision-making [24]. The major empirical studies on theory testing include:

- Akkermans and van Helden [49] analyze and explain project performance in one ERP implementation in the aviation industry.
- Akkermans et al. [50] present results from a Delphi study on the future impact of ERP on supply chain management.
- Al-Mashari and Al-Mudimigh [51] describes a case study of a failed implementation of ERP to reengineer the business processes of a major manufacturer.
- Ash and Burn [52] demonstrate the integration of ERP and non-ERP systems using web-based technologies.
- Bernroider and Koch [53] detail the ERP selection process in midsized and large organizations.
- Everdingen et al. [54] discuss the ERP adoption by European midsize companies.
- Huang and Palvia [55] identify a range of issues concerning ERP implementation by making a comparison of advanced and developing countries.
- Koch and Buhl [56] discuss and study the concept of ERP-supported teamwork in Danish manufacturing.
- Mirchandani and Motwani [57] examine the end-user perception of ERP systems at an international automobile supplier.
- Motwani et al. [58] uses a case study methodology to compare a successful ERP implementation with an unsuccessful one.
- Olhager and Sellin [59] present a survey of ERP implementation in Swedish manufacturing firms.
- Robey et al. [60] report on a comparative case study of 13 industrial firms that implemented an ERP system. They compare firms on their dialectic learning process.
- Sheu et al. [61] investigate the relationships between national differences and multi-national ERP implementation.
- Tarafdar and Roy [5] analyze the adoption of ERP systems in Indian organizations.
- Tatsiopoulos et al. [62] propose a structured risk management approach for the successful implementation of ERP systems. The application of the proposed methodology is demonstrated with a case study company from the oil industry.
- Trimmer et al. [63] indicate support for the continuing use of critical success factors to help focus on the benefits of ERPs in rural health care.
- Schniederjans and Kim [64] discuss survey results on implementing ERPs with total quality management and business process reengineering.
- Sheng et al. [65] examine the relationship between organizational culture and employees’ self-efficacy for a sample of 352 subjects.
- Voordijk et al. [66] discuss the factors that lead to the success or failure of ERP in large construction firms.
It is clear from the review of the literature that much work has been done in the area of ERP implementation. However, what is lacking in the extant literature is a systematic, theory-linked study of characteristics of successful and unsuccessful ERP implementation.

3. Methodology

A case study approach was employed to identify the factors that facilitate and inhibit the success of ERP implementation. The criterion used to select the case study companies was that each of the case studies should use ERP software from the same vendor. Data was collected primarily through interviews, observations, and archival sources. Interviews were conducted with executives who were familiar with the ERP implementation progress. Archival documentation was the third major source of data used in the research. Feasibility studies, reports, memos, minutes of meetings, proposals, newspaper articles, and books that were available were reviewed and the contents analyzed. These documents were collected and analyzed to identify and/or validate data.

During the data collection, special attention was given to ascertaining whether evidence from different sources converged on a similar set of facts. Guidelines in the existing literature on the enhancement of retrospective data accuracy were followed in the process of data collection. When all the evidence had been reviewed, and after an initial case study narrative was documented, the factual portion of the case study was reviewed by the major informants in the company. Such a review was not only a minimal procedure for validating the data collection process, but also a courtesy to those who had cooperated with the research.

4. Case analysis

4.1. Background of case study companies and identification of business need

In this section, a brief background of the four companies and the need for implementing ERP is provided.

4.1.1. Company A (pharmaceutical)

Company A is one of the nation’s largest manufacturers of over-the-counter (non-prescription) pharmaceutical and nutritional products for the store brand market. The company’s products include over-the-counter pharmaceuticals such as analgesics, coughs and cold remedies, antacids, laxatives, feminine hygiene, smoking cessation products, vitamins, nutritional supplements and nutritional drinks. Over the years, Company A has seen substantial growth with net sales now exceeding $900 million. To serve its customers better, the company recently decided to upgrade its inventory management process that ran on an AS/400 system. An ERP solution seemed to be the logical answer, providing the ability to integrate accounting, inventory, production planning and materials management.

4.1.2. Company B (footwear)

Company B is a leading designer, manufacturer, and marketer of a broad line of casual shoes, work footwear, and constructed slippers and moccasins. The company employs approximately 6600 production, office and sales employees. Products are distributed domestically to over 65,000 department stores, footwear chains, catalogs, specialty retailers, and mass merchant accounts. The products are also distributed worldwide in 134 markets through licensees and distributors. The company sold over 38 million pairs of its footwear in 1999. Prior to the implementation of ERP, the sales, marketing and operations functions of the company ran on an AS/400 system. The system required an extremely long time to complete a task, from shipping an order to entering a production schedule for the factory. To obtain even the most basic information, a 6–8 h process was necessary. Also, the inventory reports would only show current on hand inventory unadjusted for orders already in the system. Promises were made to customers without knowing if the gross available inventory was earmarked for another customer. The drawbacks of the legacy AS/400 system were the driving forces behind the implementation of the ERP system.

4.1.3. Company C (energy)

Company C is a global energy company with revenues exceeding 50 billion dollars. The company is
engaged in exploration, production, refining, marketing, and distribution of energy products and technologies. Prior to the implementation of ERP, the sales, marketing and operations functions of the company ran on about 30 different legacy systems. The mix of aging legacy systems that led to high cost support and lack of data visibility was the driving forces behind the implementation of the ERP system.

4.1.4. Company D (automobile)

Case company D is primarily a supplier of wiring harnesses for the automotive industry. It was formed in 1986 as a result of a joint venture between 2 Japanese companies. The company has 28 facilities in the United States, Mexico and Canada. The company is broken down into three divisions: wireless, components, and electronics. Case company D began operations with an information system that was owned by one of the parent companies in Japan. This system was designed to work well in a decentralized manufacturing environment. As company D rapidly grew, it developed a centralized supply chain. Since the original system was written and supported by the parent company it was difficult for the case company to tailor the existing system to support its own unique business needs. Another weakness with the system included the fact that the general ledger system was not year 2000 compliant. The more important fact was that the parent company had abandoned development of the system and it would not be made year 2000 compliant. The programming language used for the legacy system was not mainstream, and therefore, it was difficult to find and retain experts to support the system. These were the two primary factors that lead the senior management to determine in 1996 that changes were in order.

4.2. Constructs: definition and analysis

This section briefly describes each construct of the research model [67] and then provides summative findings of our case studies for each variable under the construct. Whenever appropriate, respondents’ statements are quoted to illustrate the construct. Consistent with the research objectives, specific questions were asked concerning each construct. The research findings are summarized in Table 1.

4.2.1. Construct 1: strategic initiatives

Process change typically begins with strategic initiatives (often included in the corporate strategic plan) from the senior management team [68]. These could be a reaction to a need (e.g., company’s inability to provide adequate customer service) or a proactive push to leverage potential opportunities [69]. Evidence also exists that strategic change, and arguably process change, is often incremental, informal, emergent, and is based on learning through small gains [70] versus being revolutionary and radical. This construct consists of four variables discussed below.

4.2.1.1. Stimuli. Both companies A and B were strategically reactive to the environment and the needs of their customers. Company A realized that it needed a new inventory system to keep track of its more than 30,000 stock keeping units. Company B realized a need to reduce production lead times and to provide real time order information to customers. In contrast, Companies C and D realized the problems with their legacy systems and therefore, were more proactive in their desire for ERP systems.

4.2.1.2. Formulation scope. Company A formulated and maintained a strategy of revolutionary change from the start. They envisioned a sweeping “all-at-once” approach of replacing the legacy system with the ERP system. Company B on the other hand started out by implementing the ERP system in only their Marketing and Finance functions on advise from the ERP vendor. They envisioned an incremental, phased approach of introducing the system into the company. Company C’s scope emulated A while D’s scope was more in keeping with B.

4.2.1.3. Decision making. This construct indicates an important difference in the top management styles of the two companies. Company A’s managerial style may be described as autocratic with the top management mandating initiative without taking into consideration the majority sentiment of the company. As one interviewee candidly remarked:

“We (Company A) tried to prepare ourselves for the implementation in every means possible. Thousands of hours of training classes were completed and selected individuals were polled for their opinion of
### Table 1
Comparative analysis

<table>
<thead>
<tr>
<th>Construct</th>
<th>Company A</th>
<th>Company B</th>
<th>Company C</th>
<th>Company D</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Strategic Initiatives</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stimuli</td>
<td>Reactive</td>
<td>Reactive</td>
<td>Proactive</td>
<td>Proactive</td>
</tr>
<tr>
<td>Formulation scope</td>
<td>Revolutionary</td>
<td>Incremental</td>
<td>Revolutionary</td>
<td>Incremental</td>
</tr>
<tr>
<td>Decision making</td>
<td>Autocratic</td>
<td>Bureaucratic</td>
<td>Semi bureaucratic</td>
<td>Bureaucratic</td>
</tr>
<tr>
<td>Strategy led</td>
<td>Not strategy led</td>
<td>From onset (tied in with BPC and ERP efforts)</td>
<td>From onset</td>
<td>From onset (tied in with BPC and ERP efforts)</td>
</tr>
<tr>
<td><strong>Learning capacity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adaptation</td>
<td>Response to technology change, however,</td>
<td>Learning by doing and consultants’ prior</td>
<td>Learnt more from others</td>
<td>Learning by doing and consultants’ prior</td>
</tr>
<tr>
<td></td>
<td>underestimated the complexity</td>
<td>knowledge</td>
<td>knowledge</td>
<td>knowledge</td>
</tr>
<tr>
<td>Improved efficiency</td>
<td>Learning by doing</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Declarative knowledge</td>
<td>Did not develop knowledge base</td>
<td>Developed knowledge base</td>
<td>Developed partial knowledge base</td>
<td>Developed knowledge base</td>
</tr>
<tr>
<td>External information use</td>
<td>Boundary spanners (consultants) and customers</td>
<td>Technology gatekeepers (employees), boundary</td>
<td>Less of employees and customers, more of</td>
<td>Employees, consultants and voice of customers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>spanners, customers</td>
<td>consultants</td>
<td></td>
</tr>
<tr>
<td>Learning type</td>
<td>Deutero type of learning</td>
<td>Deutero type of learning</td>
<td>Deutero type of learning</td>
<td>Deutero type of learning</td>
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<tr>
<td>Cultural readiness</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Change agents and leadership</td>
<td>Senior management and CEO</td>
<td>Senior management and middle</td>
<td>More Senior management and less</td>
<td>Senior management and middle</td>
</tr>
<tr>
<td>(initiative for ERP)</td>
<td></td>
<td>management teams</td>
<td>middle management.</td>
<td>management teams.</td>
</tr>
<tr>
<td>Risk aversion</td>
<td>Aggressive</td>
<td>Cautious</td>
<td>Semi aggressive</td>
<td>Semi cautious</td>
</tr>
<tr>
<td>Open communications</td>
<td>Low</td>
<td>High</td>
<td>Medium</td>
<td>Medium to high</td>
</tr>
<tr>
<td>Cross-training</td>
<td>Very minimal</td>
<td>Some</td>
<td>Some</td>
<td>Some</td>
</tr>
<tr>
<td>IT leveragibility and knowledge-sharing</td>
<td>Enabling</td>
<td>Enabling</td>
<td>Enabling</td>
<td>Enabling</td>
</tr>
<tr>
<td>IT role</td>
<td>Medium</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Use of communication technology</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Network relationships</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interorganizational linkages</td>
<td>Low (focused on IT staff)</td>
<td>High (with vendor)</td>
<td>Medium (with vendor)</td>
<td>High (with vendor)</td>
</tr>
<tr>
<td>Cross-functional cooperation</td>
<td>Medium</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Change management</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pattern of change</td>
<td>Semiformal process</td>
<td>Formal phased process</td>
<td>Formal phased process</td>
<td>Formal phased process</td>
</tr>
<tr>
<td>Management readiness to change</td>
<td>Committed</td>
<td>Committed</td>
<td>Committed</td>
<td>Committed</td>
</tr>
<tr>
<td>Scope of change</td>
<td>Radical</td>
<td>Improvement</td>
<td>Semi radical</td>
<td>Improvement</td>
</tr>
<tr>
<td>Management of change</td>
<td>Inadequate (ignored employees)</td>
<td>Adequate</td>
<td>Semi adequate (involved employees partially)</td>
<td>Adequate</td>
</tr>
<tr>
<td>Process management</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process measurement</td>
<td>Little (process mapping and diagnostic</td>
<td>Use of process metrics</td>
<td>Use of process metrics</td>
<td>Use of process metrics</td>
</tr>
<tr>
<td></td>
<td>techniques)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tools and techniques</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Team based</td>
<td>No</td>
<td>Yes</td>
<td>Semi</td>
<td>Yes</td>
</tr>
</tbody>
</table>
readiness for the “go-live” date. However, upper management ultimately made the decision to throw the “ON” switch before the employees believed in or understood the software. The result was extremely costly, not only in dollars, but also in lost customers and customer service. Many employees wondered why the switch was ever made from the legacy AS/400 system to the ERP. Employees were disturbed and frightened by the new and complicated ERP system.”

On the other hand, a team-approach was followed at Companies B, C, and D that eventually received a bureaucratic consensus to proceed at a corporate-level.

4.2.1.4. Strategy led. Company A’s approach to implementing the ERP in retrospect seems to be hurried and not strategically thought out. The company tried to introduce a complex new system “all-at-once” within a time frame of only 6 months of preparation (January 1998 through July 1998). They did not take into account that disruptions to the information systems in their peak production season of September through December could prove fatal. Company B, as was the case with C and D, on the other hand devised a strategic plan tied in with its ERP and BPC efforts that focused on incremental improvements.

For example, the project leader in Company D was tasked with developing the master plan and implementation deadline. The first step was to determine which modules of Business Process Change System (BPCS) to implement. BPCS is like many ERP systems in that it has a modular design. The project team determined that the finance function (Configurable Enterprise Financials including sub-modules for accounts payable, accounts receivable, general ledger and fixed assets) would be the first to be converted to the new system, giving users time to get used to the new system. Converting the operations function to the ERP system would follow (Supply Chain Management including sub-modules for configurable order management and out-bound logistics management, Manufacturing Data Management, Shop Floor Control, Master Production Scheduling, Manufacturing Resource Management, Distribution Resource Planning, Purchasing, Inventory Control, and various other implied support modules).

The modules were selected in conjunction with the determination of which facilities would be imple-
learning from other organizations that had achieved best practices in the industry. Though company A was aware of the ERP mishaps of other companies they assumed they would be easily able to adapt to the new technology with the help of ERP consultants, some training and a “live” system in place. But they seriously underestimated the complexity of the new technology.

4.2.2.2. Improved efficiency. Company A as well as B and D had a tendency to improve learning efficiency through “learning by doing.” After the initial shock of being “thrown into” the new system, Company A’s employees gradually became more comfortable with the system. By February of 1999, they were starting to master the transactions needed to complete normal business operations, and production and shipment levels returned to normal levels. Company B’s employees were ready in time for Phase two of the implementation process. This involved “bringing live” additional features the ERP system had to offer that had not been fully recognized in Phase one. In contrast, Company C learnt from others, primarily from consultants.

4.2.2.3. Declarative knowledge. Company A’s approach of bringing the ERP system live “all-at-once” did not allow for the building of a collective knowledge base (of experiences) for the company. On the other hand, the other three companies phased implementation of the ERP system into the Marketing and Finance areas in Phase one allowed for the Operations area to learn from their experiences in Phase two of the implementation.

4.2.2.4. External information use. All four companies made use of external information to enhance their learning capacity. While Company A used consultants who acted as “boundary spanners,” they also listened to the “voice of the customer.” Company B made use of technology gatekeepers who were company employees aware of the advantages and pitfalls of new technology. They too widely used consultants (boundary spanners) and surveyed customers to assess gaps in customer service.

4.2.2.5. Learning type. All four companies adopted a deutero type of learning, and were willing to adopt a strategy for learning based on past failures. Deutero learning can be defined as higher-level learning that occurs when members reflect on past learning experiences to discover new strategies for learning. For example, an employee of Company A commented: “In retrospect, the implementation should have been pushed back to January of 1999. In turn, customer service during the busy season would not have been as adversely affected. It also would have given more time for the employees to gain knowledge and become comfortable with the new applications. Upper management even admitted they were in error when they decided to “go live” in September and apologized to the employees.”

4.2.3. Construct 3: cultural readiness
Organizational culture facilitates (or inhibits) the integration of individual learning with organizational learning by influencing the organization’s ability to learn, share information, and make decisions [75]. According to [71], leadership (top management) support or change agents (e.g., BPCS team) may be considered important prerequisites for business process change. Open communication and information sharing can promote a common culture and innovative behavior in the organization. So also can cross-functional training and personnel movement within the organization [71]. This construct comprises of the following four variables.

4.2.3.1. Change agents and leadership. Company A’s initiative for the ERP system came directly from the senior management and the chief executive officer. On the other hand, Company B’s initiative, similar to C and D, for the ERP system came from both senior management and middle management teams. Three crucial teams were assembled to ensure successful implementation—a strategic thinking team, a business analysts group, and an operations group.

4.2.3.2. Risk aversion. With respect to risk aversion, Company A was clearly more aggressive than Company B as was C in relation to D in deciding to implement the ERP system in a short time frame and also “all-at-once.” Company B cautiously chose to follow a phased implementation of a chosen few features of the ERP system.
4.2.3.3. Open communications. Company B encouraged participation of its employees in the process of ERP implementation much more than Company A did. In fact, A scored the lowest in all four companies.

4.2.3.4. Cross-training. None of the four companies attached much importance to cross-training and personnel movement within the organization. In fact the re-distribution of job responsibilities caused by the ERP system greatly confused Company A’s employees.

4.2.4. Construct 4: information technology leveragability and knowledge-sharing capability

The role of IT in the business process change project could be either dominant or as an enabler. Evidence suggests that IT led projects often fail to capture the business and human dimensions of processes, and are likely to fail ([76,77]). A case is often made for the socio-technical design approach that suggests a mutual, bi-directional relationship between IT and the organization (Mumford, 1994). Such an approach recommends synergy between the business, human and IT dimensions of an organization and could be promoted through cross-functional teams. The following two variables represent this construct.

4.2.4.1. IT role. All companies used their information technology departments as facilitators of the process of ERP implementation. Company B took steps to ensure that users and all functional areas were considered in the systems development process.

For example, at Company A, interface to existing systems was created at two levels. The IT department played a very active role at both these levels. The first being interfaces of the systems at non-BPCS facilities into the financial elements of the BPCS general ledger system. This was accomplished via a mechanism that is supplied with the BPCS for performing this type of integration. It is referred to as Batch Transaction Processing (BTP). The second level was the interfacing of the new data collection system deServ into the BPCS inventory and shop floor control modules. Since a vendor, deServ, was selected because of the pre-existing relationship with BPCS this interface was purchased as a component of the data collection system. The individual shop floor and inventory control transactions were defined and configured during this phase. In addition to these on-going interfaces, there was a need to convert data from existing financial applications over to BPCS. Examples of these files were: item master, bills of material, customer master, vendor master, and many others. In all there were about thirty files that required conversion. There was no existing tool to accomplish this so the case company hired a consultant familiar with the BPCS file structures to write the programs necessary to convert this data.

Company C also used their IT department as facilitators of the process of ERP implementation. They took steps to ensure that users and all functional areas were considered in the systems development process. A business analyst group was formed to provide additional feedback to the ERP experts. This group was involved with piloting. They were given access to the ERP virtual screens. They would spend time entering orders and tracking them as they downloaded to the warehouse. Financial reports and transactions were also included in the “dry run”. This process began as soon as the ERP crew set up the system and continued through until 2 months before the “go live date” date. When the business analysts were comfortable with the system, trainers were brought on board from each division’s different functional areas. Team leaders were assigned to each area of the business and were responsible for coordinating training sessions. Hundreds of hours were spent on “training the trainers”. The trainers were responsible for teaching the other members of their division. Again many hours were spent bringing all employees of the company up to speed with the ERP.

4.2.4.2. Use of communication technology. Communications technology such as e-mail enabled effective communication and team work. Companies B, C, and D used teams effectively during the implementation, and thus leveraged communication technology better in the process.

4.2.5. Construct 5: network relationships

Research indicates that under most circumstances cooperative, interpersonal and group behavior results in superior performance [78]. In terms of inter-organizational processes, research indicates the benefits of partnering with external suppliers [79]. Organizations that can manage these aspects of competition and cooperation continuously can benefit from employee incentives and controls, as well as
instill change more effectively [71]. Two variables account for this construct.

4.2.5.1. Interorganizational linkages. Company B (similar to C and D) worked very closely with the ERP vendor during the implementation process, even allowing vendor consultants remote access to their system. When any problems were discovered, managers would meet to discuss the same and contact vendor consultants for fixes. One manager described this:

“The project managers would convene to discuss each problem. If they felt it was an issue they could remedy immediately, they would again call upon the vendor consultants. Vendor consultants could remotely access our ERP system to make the changes requested.”

On the other hand, Company A chose to rely on its own IT staff and hired external consultants to work in-house to correct problems. For example, at company A, the project team and NCS initially worked with the various software and hardware vendors to develop the project budget. The initial project budget would include the cost of the AS/400 system, the BPCS software, dcServ software, a full education curriculum, consulting services, and multitude of incidental expenses. The initial implementation was $1.9 million. They tentatively defined the phase II costs that would be incurred when expanding the system to the other facilities. The phase II budget was $4.93 million to expand BPCS to all facilities in North America.

4.2.5.2. Cross-functional cooperation. Company B’s phased implementation plan mandated close cooperation between the functional areas that first implemented the ERP system with those that implemented the system later. Company A’s “all-at-once” implementation led to lower cross-functional cooperation. C and D were similar to B.

4.2.6. Construct 6: change management practice

Change management involves effectively balancing forces in favor of a change over forces of resistance [80]. Organizations, groups, or individuals resist changes that they perceive threaten them [71]. It has been suggested that corporate transformation require a general dissatisfaction with the status quo by employees who have to change (i.e. a readiness to change), a vision of the future, and a well-managed change process. Revolutionary and evolutionary change theorists propose contrasting tactics for accomplishing change [81] that vary depending on the type of employee involvement, communication about the change, and leadership nature.

Thus, the pattern of change (formal versus informal), management’s readiness to change (i.e. being committed to it, participative in the process, or resistant to it), scope of change (continuous improvement versus radical change), management of change (alleviation of dissatisfaction, top management’s vision for change, well managed process of change, and use of evolutionary versus revolutionary change tactics) are the key constructs in practicing change management [67].

4.2.6.1. Pattern of change. Company A showed little or no formality in the process of change whereas the other three followed a structured methodology recommended by the ERP vendor.

4.2.6.2. Management readiness for change. The management of all four companies was committed and ready for the change process. However while Company A’s management underestimated the complexity of the process, On the other hand, the management of the other three case study companies had taken into consideration that glitches would occur in the process and were not alarmed when they did occur.

4.2.6.3. Scope of change. The radical scope of the ERP project at Company A created expectations for immediate improved performance. When this did not happen, frustration and disappointment crept into the company. Company B, however was not prepared to make any radical changes to the organization (as did C and D) and quickly found out that the best way to succeed was through incremental change. Credibility established with these small successes eventually paved the way for larger-scale changes.

4.2.6.4. Management of change. Clearly, Company A inadequately managed the change process. They did not take into account employee readiness or satisfaction with the new system. Top management was unable to convey to the employees their vision for change. Most employees did not understand the need
for change from the legacy system. The process of change too was not well managed with the aid of a formal methodology. The revolutionary change scared the employees and left them confused. The other three companies followed just the opposite approach and management was able to take all employees in their fold. Employees were willing to allocate a large amount of their time to the project. They were aided by training sessions that were available both day and night. The open communication encouraged by management gave users a sense of ownership of the system.

4.2.7. Construct 7: process management practice

Process management is defined as a set of concepts and practices aimed at better stewardship of business processes [2]. It combines methodological approaches with human resource management to improve the outcome of business process change [71]. Successful process management uses process measurement (use of process metrics, process information capture, improvement feedback loop, and process audit), tools and techniques (e.g. quality control tools, data flow diagrams, CASE tools, and simulation) and documentation (e.g. process flow chart analysis, fishbone and root cause analysis). This construct comprises of the following three variables.

4.2.7.1. Process measurement. Company A used some process mapping and diagnosis techniques to study the “as-is” process as well as measurements of process performance. The others used formal techniques and process metrics successfully for process measurement. Business analyst teams would regularly measure changed processes and articulate their value to management and functional groups.

4.2.7.2. Tools and techniques. All four companies for process analysis and design successfully used techniques and methods such as CASE tools and simulation.

4.2.7.3. Team basis. Company A did not choose to use a team-approach for implementing or for designing new processes. This however was fundamental to the other three companies that used three core teams: a strategic thinking team, a business analysts group, and an operations group.

5. Lessons learnt from ERP implementation

According to Davenport [82], “A well-planned and well-executed ERP implementation, in conjunction with a good change management program, can create a dramatic turnaround for the company.” The successful implementation of ERP at our case study companies clearly support the point. There are several lessons that can be learnt from the findings of the comparative case analysis. These lessons are also consistent with the findings of prior research studies

(1) Ross [83] noted that there are six reasons for a company to implement ERP. The chief reason is a need for a common IT platform. In our study, a common IT platform was one of the primary reasons for implementing ERP, according to the experts interviewed.

(2) The implementation time at all four case studies was between 12 months and 4 years. The project length supports the findings of Bancroft et al. [84] who estimated that an implementation might vary between 6 months and several years.

(3) The literature states that it is unusual for a case company to implement all modules (for example, SAP R/3 has eleven core modules and each of these in-turn have sub-modules). Of the four companies documented in this study, only one had opted for full functionality.

(4) There are two standard approaches to connecting each module to existing systems: either implement module-by-module or alternatively implement all modules and then connect them to the existing system(s) [3]. The literature clearly suggest that a company which selects the full functionality of the ERP are committing themselves to a radically more complex task and are likely to use the implement all modules strategy. The findings of our case study are consistent with the literature as far as module implementation strategy is concerned.

(5) As far as the nature of the change is concerned, it is widely believed that BPR is a necessary feature of ERP implementation. In our case studies, the experts interviewed emphasized this point and saw the adoption of ERP as an opportunity for comprehensive BPR. In all four
cases, some BPR did occur, it occurs more in situations where legacy systems were involved.

(6) According to Esteves and Pastor [24], the implementation phase of the ERP cycle deals with the customization or parameterization and adaptation of ERP package acquired to meet the needs of the organization. Usually this task is performed with the help of consultants who provide implementation methodologies, know-how, and training. Experts interviewed in three of our four case studies totally agreed with the above viewpoint and also stated that the largest training investments was made in the implementation phase.

(7) The composition of the project team is crucial and must convey the strong will to ensure the representatives of the various company functions [85]. In all four instances, the project team did represent the main processes of the company.

(8) The literature states that project management, process and systems integrity, and change management are essential threads to ensure successful ERP implementation. The experts interviewed strongly agreed with the above statement and also stated that a lack of attention to the above threads could actually inhibit the project.

(9) According to Lee [22], top management needs to publicly and explicitly identify the project as a top priority. In all four cases, this was true. However, the three case study companies that implemented a cautious, evolutionary, and bureaucratic implementation strategy were more successful as the top management was able to develop a shared vision of the organization and was also able to communicate the new system and structures more effectively to their employees.

(10) A clear business plan and vision to steer the direction of the project is needed throughout the ERP life cycle [86]. Of the four companies documented in this study, three of them had a clear business model of how the organization should operate behind the implementation effort.

(11) Project champion is critical to drive consensus and to oversee the entire life cycle of implementation.

Fig. 1. Theoretical framework for ERP Implementation Management (adapted from Kettinger and Grover’s model of BPC Management, 1995).
In all four cases, a high level executive sponsor was selected to be the project leader. According to Holland and Light, organizations implementing ERP should work well with vendors and consultants on software development, testing, and troubleshooting. In three of the four cases, the project teams worked very closely with vendors to obtain interorganizational linkages.

The progress of the project should be monitored actively through set milestones and targets. According to the experts interviewed, process metrics and project management based criteria was used to measure against completion dates, costs, and quality.

Based on the lessons learnt from the literature and case studies, we propose the following framework (See Fig. 2) be considered for successful implementation of ERP. This framework illustrates the critical factors/issues that need to be addressed at all three phases: pre-implementation or setting-up phase, implementation, and post-implementation or evaluation phase. All the factors/issues proposed in Fig. 2 relate to the seven constructs illustrated in Fig. 1 and are consistent with the frameworks proposed by Al-Mashari et al. (2003) and [28].

6. Conclusion

This research attempted to answer the following two questions. First, “What factors facilitate and inhibit the success of ERP projects?” Through a case study comparison of four ERP implementations, it was determined that a cautious, evolutionary, bureaucratic implementation process backed with careful change management, network relationships, and cultural readiness can lead to successful ERP implementations. On the other hand, a revolutionary project scope that is mandated autocratically by top management without organizational readiness and proper change management is likely to lead to a troubled ERP implementation, as was in the case of Company A.

Second, “What critical factors/issues need to be considered during each stage of the implementation?” Fig. 2 clearly depicts the critical factors/issues that need to be addressed at all three phases: pre-implementation or setting-up phase, implementation, and post-implementation or evaluation phase. These critical factors/issues are consistent with the seven constructs proposed in Fig. 1.

The two frameworks presented in this study clearly indicate that a clear vision and top management commitment are fundamental for successful ERP implementation. Also, the evaluation and proper monitoring of ERP system’s implementation (post-ERP implementation stage) can make an organization more adaptable to the change programs and therefore, help them derive maximum benefits from investing in ERP.

The results of this study should assist both practitioners and academicians. The frameworks presented in the study, along with the lessons learnt, should provide practitioners (especially non-technical managers) with insights on how to better understand and prepare for ERP implementation. Specifically, the factors that help and hinder ERP success, the critical factors that need to be focused on in each phase of implementation and the wide arrays of benefits (both tangible and intangible) that can be achieved from ERP implementation are some areas that practitioners can benefit from our findings. Also, the frameworks...
recommended in this study should assist academicians who undertake studies that focus on rigorous theory building and testing. For example, the results of our case studies will be beneficial for identifying comparable cases. We strongly believe that future case study research would serve to reinforce and validate the findings of this study. In the area of theory building, the critical constructs identified can be used by academicians as the basis of undertaking rigorous empirical studies that test ERP success in relationship to these factors.

ERP systems offer many potential areas for research in both theory building and theory testing. Five specific areas, which we feel are important, and need to be addressed in the future. First, although several theory testing articles dealing with case studies exist in the literature, very few discuss ERP systems other than SAP. It would be beneficial to generalize the findings to other ERP systems. Second, more effort should be put in the definition and subsequent validation of critical success factors since majority of these studies focus on only one case company. It would also important to relate critical success factors with implementation methodologies [24]. Thirdly, we recommend that more comprehensive empirical studies be conducted to study the direct and indirect relationships among the critical factors and the actual benefits of ERP implementation. Fourth, there is a need for empirical studies to examine the approaches adopted for the evaluation, selection and project management of ERP systems and ERP success. Lastly, we feel research needs to be conducted to better understand the different roles played by various stakeholders (steering committees, consultants, vendors, among other) in ERP implementation projects.

References


