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A Review

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Abstract

Recently e-business has become the focus of management interest both in academics and in business. Among the major components of e-business, ERP (Enterprise Resource Planning) is the backbone of other applications. Therefore more and more enterprises attempt to adopt this new application in order to improve their business competitiveness. Owing to the specific characteristics of ERP, its implementation is more difficult than that of traditional information systems. For this reason, how to implement ERP successfully becomes an important issue for both academics and practitioners. In this paper, a review on critical successful factors of ERP in important MIS publications will be presented. Additionally traditional IS implementation and ERP implementation will be compared and the findings will be served as the basis for further research.

Keywords: E-business, ERP, Critical Successful Factors, Literature Review

1. Introduction

Recently the focus of IT application has shift from computerization and automation to electronic transaction or the so-called E-business which is regarded as the most important improvement to commercial competition. Therefore, e-business has come into the limelight not only academically but also commercially. The key components of e-business include Customer Relationship Management (CRM), Supply Chain Management (SCM), Enterprise Resource Planning (ERP), E-Procurement, Knowledge Management (KM) and so on [7]. Among these components of e-business, ERP is the backbone of other applications [7][10]. Davenport [4] indicates that ERP integrate all the information flowing through a company- financial and accounting information, human resource information, supply chain management, customer information seamlessly. This integration can overcome the information island problem in traditional IT application and increase efficiency and effective. In addition, with the use of central database, it can promise to provide accurate and real time data in business operation. For traditional businesses, with the adoption of ERP, it can employ the best practice of ERP to reengineer their business process. In contrast, for new established

businesses, it can apply best practice into the templates for their system design. Markus and Tains [10] also indicate that both small and large companies benefit both technically and strategically from investments in ERP. Because of the advantages discussed above, more and more business administrators attempt to adopt ERP recently. In U.S more than 70 percent of Fortune 1000 companies have either begun implementing an ERP systems or plan to do so over the nest few years [7]. In Taiwan, ERP adoption is also becoming more and more popular in nowadays.

Although ERP is a powerful tool for business operations, yet we can find that many businesses have experienced failure in ERP implementation. And those who declared their success in ERP implementation remain suffer different problems after installation. Davenport [4] indicated that the biggest problems of ERP implementation are not technical challenges, but business problems. Although, ERP can deliver great rewards, managers can not afford to ignore the high risks it carry. ERP's implementation is usually more difficult than that of traditional IS, because of the specific characteristics of ERP.

Based on the discussions above, we can find that how to implement ERP successfully becomes a critical issues in the development of e-business. Although many reports had proposed critical successful factors about ERP implementation, we are still in need of a systematic view of this issue, because many papers usually focus on special cases and do not present a substantive theory. Therefore an overview of the critical successful factors of ERP implementation has become crucial for e-business implementation.

In order to provide the basic structure for further studies, this study surveys into numeral journal papers about this issue and analyzes these articles based on the Lucas's [8] perspective. First, the characteristics of ERP are summarized in order to illustrate why ERP implementation is different from other IS implications. Next, the theoretical background of this paper is illustrated and employed for later analysis. Third, the research method of this study will be illustrated. Fourth, analysis method and results will be presented. Finally, the conclusions and limitations of this study will be

discussed.

2. The Characteristics of ERP

Markus and Tanis [10] summarizes several characteristics of ERP, each of them with important implications for the organizations that adopt them. These characteristics include:

(1) Integration.
(2) Packages.
(3) Best Practices.
(4) Business process reengineering.
(5) Some assembly required.
(6) The way to integrate legacy system.
(7) Rapid change.

In contrast to traditional IT applications, ERP is costly and enterprise wide. Therefore, there are more challenges than department wide IT applications. Besides, business always choose package to be the solution for ERP. Therefore, the consequence of ERP implementation is reversed, and ERP customization becomes an important issue. These attributes are different from traditional in-house development IT applications.

3. Theoretical Background

3.1 The Key to Successful Information System Implementation

Lucas [8] proposes a systematic review about the critical successful factors of IS implication in the book: "Implementation the Key to Successful Information Systems". In this book, Lucas [8] defines information systems as "Information systems provide information to support decision making and control in the organization". Based on this definition, ERP is a kind of IS implementations in the organization. Therefore, based on Lucas's framework, this study will survey and analyze literatures which incorporate ERP critical successful factors.

In the discussions of critical successful factors of IS, we must identify the definitions of IS success first. Lucas [8] had mentioned four different success criteria:

(1) Time to complete the project/time estimated to complete;
(2) Actual cost to develop project/budgeted cost for the project;
(3) User satisfaction;
(4) The impact of the project on the computer operations of the firm.

In addition, five measures of IS success are often employed by IS research [8]:

(1) The use of the system;
(2) User satisfaction;
(3) Favorable attitudes;
(4) The degree to which a system accomplishes its original objectives;
(5) Payoff to the organization from a system.

Lucas [8] defines IS implementation as "an on-going process which includes the entire development of the system form the original suggestion through the feasibility study, systems analysis and design, programming, training, conversion, and installation of the system." In the context of ERP, this sequence is inversed [4]. Because choose among ERP packages is always the solution for ERP implementation. Therefore, the issues about vendor selection, outsourcing contract management, cooperation with outside consultant and so on have become more important than traditional IS implementation.

Different types of implementation research are proposed by Lucas [8] includes theories (insight), surveys of factors, and case study, etc. The relationship between these types of research is illustrated in figure 1.

Lucas [8] also synthesizes past studies into a conceptual framework in order to be the base for understanding IS implementation. Four constructs are included in this framework: Client actions, Technical characteristics, Attitudes toward systems, Decision Style, Personal and situational factors, and successful implementation. This conceptual framework is illustrated in Figure 2.
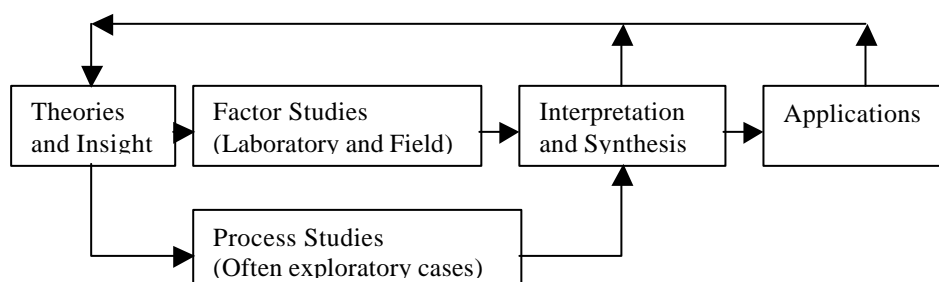

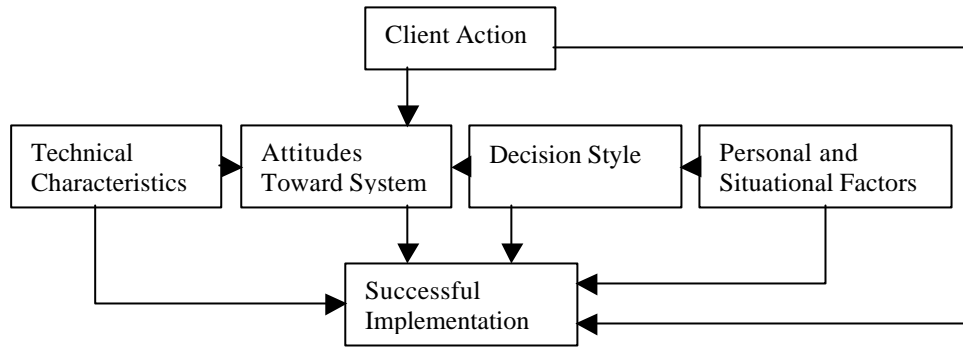**Figure 1. The Implementation Research Process [8]**

Figure 2. A Conceptual Framework about IS Successful Implementation Factors [8]

3.2 Justification of Research Approach

Although Lucas's framework focused on general IS implementations, it can also be applied to a specific IS implementation, especially in the context of ERP implementation. Based on the Lucas definitions about information system and IS success implementation, this study infers that Lucas's framework is still suitable for ERP implementation in general. On the other hand because of the specific characteristics of ERP, there must be some differences between traditional IS implementation and ERP implementation. Therefore, this study attempts to modify this framework based on literatures about ERP implementation successful factors. This study will propose a modified framework that is tailored for ERP implementation.

4. Research Methodology

This study is based on a study of journal articles. Conference proceeding papers, master's theses, doctoral dissertations, textbooks, and unpublished working papers are excluded in this study. This is because only journal articles that we can browse completely from various powerful digital database. In addition, we believe that ERP is new IT implication and most of the newest research results will be published in journals. Journal articles are first hand information and suitable for this study. Three main digital databases are employed in this study, including ABI/INFORM, SDOS and EBSCO Online. Full text papers have been collected from on line PDF files and hard copies from the library.

Selected nine articles in this study are all related to the critical successful factors of ERP implementation. These papers are from Production and Inventory Management Journal, Communications of the ACM, Information Systems Management, IEEE Software, International Journal of Production Economics, European Journal of Information System, Industrial Management, Harvard Business Review. (Table 1.)

Table 1. Summary of Selected Research Papers

Period	Author(s)	Title	Published Journal
2002	Scott and Vessey	Managing Risks in Enterprise Systems Implementations	Communications of the ACM
2002	Motwani et al.	Successful Implementation of ERP Projects: Evidence form Two Case Studies	International Journal of Production Economics
2002	Akkermans and Helden	Vicious and Virtuous Cycles in ERP Implementation: A Case Study of Interrelations Between Critical Successful Factors.	European Journal of Information Systems
2002	Umble and Umble	Avoiding ERP Implementation Failure	Industrial Management
2001	Weston	ERP Implementation and Project Management	Production and Inventory Management Journal
2000	Willcocks	The Role of the CIO and IT Functions in ERP	Communications of the ACM
1999	Bingi et al.	Critical Issues Affecting an ERP Implementation	Information Systems Management
1999	Holland and Light	A Critical Success Factors Model for ERP Implementation	IEEE Software
1998	Davenport	Putting the Enterprise Into the Enterprise Systems	Harvard Business Review

5. Analysis Method

The analysis framework of this study is based on Lucas's [8] framework that is shown in Fig. 1. Five constructs of this framework are: (1) Client Actions, (2) Technical Characteristics, (3) Attitudes toward Systems, (4) Decision Style, and (5) Personal Situational Factors.

5.1 Client Actions

Two variables in the client actions class are extremely important in this dimension: management support and user involvement and influence [8].

5.2 Technical Characteristics

Technical variables can be divided into two main categories, which are absolutely mandatory for success and can greatly enhance the appeal and usefulness of a system. Variables in the first category include accuracy of input and output, reliability of an online system, the completion of processing on schedule for a batch system etc. Variables in the second categories such as the design of interface can be used to encourage use and satisfaction with the system [8].

5.3 Attitudes Towards Systems

Lucas [8] indicates that the attitude toward a specific stimulus like the input and output equality of a computer system is a good predictor of the use of a voluntary system or satisfaction with a mandatory systems. Besides, Davis et al. [5] also indicates that user attitude has positive effect on user intention to use computer technology. And user intention is the predictor of user behavior. Therefore, user attitudes will play an important role in IS successful implementation.

5.4 Decision Style

Decision style is the characteristics people have to deal with a decision problem, and this set of variables will affect IS implementation and the use of computer-based information system. Variables included in this category are personal cognitive style and complexity, etc [8].

5.5 Personal Situational Factors

The difference of personal variables such as age, education, length of time in the company, etc, can greatly influence the success of implementation [8]. Davis et al. [5] also indicates that when discussing about user acceptance of IS, external variables in Technology Acceptance Model (TAM) play an important role in IT acceptance. Individual difference is one of the categories of external variables and these characteristics will affect the success of IT implementation. Agarwal and Prasad [1] also propose similarly. They insist that individual differences are important factors in IT acceptance.

To summary the discussions above, we find that if we want to understand how to implement an information system successfully, we need an overall consideration. Factors of different levels are included in Lucas's framework: Managerial Level, Technical Level, and Personal Level.

6. Analysis Results

A total of nine articles were included in this analysis. This study analyzed the identified articles by year of publication, research method employed, case selected, critical successful factors proposed by selected articles, and key dimensions of ERP implementation.

6.1 Year of Publication

From Table 2 we can find that, the starting year of ERP CSF (Critical Successful Factors) related research publication appeared in 1998. In that year, Davenport's research "Putting the Enterprise into the Enterprise System" that was published in Harvard Business Review. This paper became one of the pioneers of ERP research. Besides, in the mid 2002, there are four papers about ERP CSF published in journals. From this trend, we find that ERP attracts more and more researchers recently

Table2. Year of Publication

Year	1998	1999	2000	2001	2002	Total
Count	1	2	1	1	4	9

6.2 Research Methods Employed by the Selected Papers

As regards to the research methods employed by the selected papers, we divide the selected articles into three categories based on Implementation Research Process [8] perspective: case study, factor studies, and theories/insight. Case study is the method that has often been used in ERP CSF studies (Table 3). The reasons for this phenomenon include:

(1) ERP has just been proposed in recent years, so we still have to collect more samples into our data bank.
(2) With sparsely data, we don't have enough information to do quantitative study.
(3) For some business, ERP is a kind of strategic information system, therefore few enterprises want to release the corporate confidential information.

In addition to case studies, many author's simply presented their insight or experience. From table 3, we find that none of research conducts the empirical study. Therefore it is recommended that further studies be try to collect data from business.

6.3 Cases Selected

From the above discussions, we can find that case study is the most popular research method so far. The cases conducted in the past are arranged in Table 4.

6.4 Critical Successful Factors of ERP Implementation

The selected articles have proposed sixty-eight critical successful factors (Table 5). Of course, these variables are overlapping and we will analyze them in the next section.

Table 3. Research Methods Employed by the Selected Papers

Research Method	Case Study	Survey Study	Theories/Insight	Total
Papers	Davenport [4]; Holland and Light [6]; Akkermans and van Helden [2]; Motwani et al. [11]; Scott and Vessey [12]	N/A	Bingi et al. [3]; Willcocks [15]; Weston [14]; Umble and Umble [13]	
Count	5	0	4	9

Table 4. Cases Selected

Papers	Cases Selected
Davenport [4]	Elf Atochem Inc.
Holland and Light [6]	Threads Inc. and Statco Inc.
Akkermans and van Helden [2]	Two anonymous cases (medium-sized manufacturing firm in the aviation industry)
Motwani et al. [11]	Two anonymous cases (Pharmaceuticals industry and Footwear industry)
Scott and Vessey [12]	Dow Corning Inc. and FoxMeyer

Table 5. Critical Successful Factors of ERP Implementation

Authors	Critical Successful Factors
Davenport [4]	(1) Careful deliberation (2) Top management directly involved in planning and implementing
Holland and Light [6]	(1) Strategic Factors (Legacy systems, Business vision, ERP strategy, Top management support, Project schedule and plans) (2) Tactical Factors (Client consultation, Personnel, BPC and software configuration, Client acceptance, Monitoring and feedback, Communication, Trouble Shooting)
Bingi et al. [3]	(1) Top management commitment (2) Reengineering (3) Integration (4) ERP consultants (5) Implementation time (6) Implementation costs (7) ERP vendors (8) Selecting the right employees (9) Training employees (10) Employee Morale
Willcocks [15]	(1) Senior-level sponsorship, championship, support and participation (2) Business themes, new business model and reengineering rives technology choice (3) Multifunctional teams, time box philosophy, regular business benefits (4) CIO as strategic business partner (5) Nine core IT capabilities retained/being developed in-house (6) In-house and insourcing of technical expertise preferred (7) Supplier partnering (strong relationships and part of team) (8) ERP perceived as business investment in R&D and business innovation rather than primarily as a cost-efficiency issue.
Weston [14]	(1) Top management and cross-functional support (2) Project proposal (3) Clear deliverables (4) Clear assessment of business risk (5) Strong project manager and sound project plan (6) Awareness of the dangers of scope creep (7) Change management process (8) Training
Umble and Umble [13]	(1) Strong leadership provided by an executive management planning committee (2) The implementation is viewed as an ongoing process (3) Implementation teams are composed o the company's best workers representing all functions (4) Mid-level management is totally involved in the implementation (5) Excellent project management techniques are used (6) The old systems are eliminated (7) Proper measurements are implemented and closely monitored (8) An aggressive but achievable implementation schedule is established (9) Successful change management techniques are applied (10) Extensive education and training is provided.
Akkermans and van Helden [2]	(1) Top management support (2) Project team competence (3) Interdepartmental co-operation (4) Clear goals and objectives (5) Project management (6) Interdepartmental communication (7) Management of expectations (8) Project champion (9) Vendor support (10) Careful package selection.
Motwani et al. [11]	(1) Incremental, bureaucratic, strategy led cautious implementation process (2) Cultural readiness (3) Inter-organizational linkages (with the vendor) (4) Careful change management
Scott and Vessey [12]	(1) Organizational culture (2) Project management (3) Excellent business vision (4) Strong leadership (5) Stand the company in good stead

6.5 Dimensions of ERP Critical Successful Factors

In Table 5, we have arranged these factors into fourteen main critical factors based on the frequency that are proposed by the selected articles (Table 6). Base on the results in Table 6, we find that the top five factors are: Project Management, Top/Middle Management Support, Business Vision, Personnel/Employee/Acceptance, and Vendor Selection.

In order to understand the similarities and differences between ERP and traditional IS applications, fourteen categories from Lucas's [8] framework (Figure 2) are compared in Table 7 in which Client Actions is highly correlated between these two contexts. Yet in Lucas's framework, Decision Style and Personal Situational Factors are not emphasized in the domain of ERP. Other factors that are emphasized in the context of ERP are not equally emphasized by Lucas's framework. We can find that these specific factors are caused by the specific characteristics of ERP, therefore they may not be the key successful factors of traditional IS implementation.

Table 6. Main Critical Successful Factors

Categories	Frequency
Top/Middle Management Support	8
Project Management	14
Business Visions	6
BPC/BPR	3
Change Management	3
Careful Deliberation	2
Consultants	3
Personnel/Employee/Acceptance	4
Vendors Selection	4
Training	3
Project Team	3
Culture	2
Legacy System	2
Others	11

Table 7. Comparison of CSF Between Traditional IS Implementation and ERP Implementation

Dimensions of Lucas's Framework	Dimensions of Author's Arrangement
Client Actions	Top/Middle Management Support Project Team
Technical Characteristics	Legacy Systems
Attitudes Toward Systems	Personnel/Employee/Acceptance
Decision Style	N/A
Personal Situational Factors	N/A
N/A	Project Management
N/A	Business Vision
N/A	BPC/BPR
N/A	Change Management
N/A	Careful Deliberation
N/A	Consultants
N/A	Vendor
N/A	Training
N/A	Culture

7. Conclusions

Since the critical successful factors of ERP implementation are focused in this survey. Based on our analysis, we conclude the following points:

(1) Critical successful factors in traditional IS implementation and ERP implementation are not exactly the same.

(2) Three of the five dimensions proposed by Lucas [8] are often used to explain the success of ERP implementation.

(3) In the selected papers, case study is the most commonly utilized method to understand critical

successful factors of ERP implementation.

(4) Although critical factors have been arranged into fourteen categories, but we are still lack of a well-defined theory to understand their relationships.

(5) Based on the results of this study, we suggest that future study should do survey research that focus on a cross-sectional field study.

8. Limitations

The main limitation of this study is that only three digital databases are used to collect related studies, some omissions may occur. In addition, theses, dissertations, textbooks, and conference proceedings papers are not included in this study. It is possible that other related studies are included in the above materials. However, we have included all major MIS publications in our study.

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