Lingnan University

Digital Commons @ Lingnan University

Theses & Dissertations

Department of Computing and Decision Sciences

2005

ERP implementation planning : a critical success factors (CSFs) approach

Jia Hui KONG

Follow this and additional works at: https://commons.ln.edu.hk/cds_etd

 Part of the Management Information Systems Commons

Recommended Citation

Kong, J. H. (2005). ERP implementation planning: A critical success factors (CSFs) approach (Master's thesis, Lingnan University, Hong Kong). Retrieved from http://dx.doi.org/10.14793/cds_etd.4

This Thesis is brought to you for free and open access by the Department of Computing and Decision Sciences at Digital Commons @ Lingnan University. It has been accepted for inclusion in Theses & Dissertations by an authorized administrator of Digital Commons @ Lingnan University.

Terms of Use

The copyright of this thesis is owned by its author. Any reproduction, adaptation, distribution or dissemination of this thesis without express authorization is strictly prohibited.

All rights reserved.

ERP Implementation Planning:

A Critical Success Factors (CSFs) Approach

KONG Jia Hui

MPHIL

LINGNAN UNIVERSITY

2005

ABSTRACT

Enterprise Resource Planning (ERP) is an integrated set of software modules which are linked to a common database to handle basic corporate functions such as planning, manufacturing, sales, marketing, accounting, distribution, human resource and inventory. When ERP is implemented successfully, it can reduce operating costs, increase productivity, and improve customer services. However, ERP fails to deliver the promised benefits in many companies due to the poor implementation planning. A successful ERP implementation requires a careful thinking, good planning from a strategic perspective.

It is difficult to measure the success of an extremely complex information system such as ERP as it involves almost every aspect of business operations. Different people from different perspectives will have different views about the success of ERP implementation. Therefore, we adopted Critical Success Factors (CSFs) approach. We identified the critical success factors for the success implementation of ERP based on literature review. A model is developed with assumption that there is Relative Importance (RI) among these critical success factors. The data collected in Chinese Mainland manufacturing companies were analyzed on Structural Equation Modeling by LISREL.

Six critical success factors were identified by the survey as the relative important critical success factors. They are (1) Business Process Reengineering management, (2) change readiness, (3) software competence and IT skills, (4) departmental communication, (5) top management support, and (6) hardware and equipments. Understanding the importance of these factors will help managers to make a good planning for ERP implementation. It is suggested to set high priority to these critical success factors, which can help managers to have a better control of the activities in the process of ERP implementation. Hopefully, it will increase the chance to implement ERP successfully.

I declare that this thesis 《ERP IMPLEMENTAITON PLANNING: A CRITICAL SUCCESS FACTORS (CSFS) APPROACH》 is the product of my own research and has not been published in any other publications.

Signature of student

Date

CERTIFICATE OF APPROVAL OF THESIS

ERP Implementation Planning: A Critical Success Factors (CSFs) Approach

LIST OF TABLES

Table 1 Constructs for ERP Competence (Stratman and Roth 2002)..... 11
Table 2 Constructs for Strategic Information Systems Planning (Gottschalk 2003)..... 13
Table 3 Constructs for Culture (Hofstede, 2004)..... 15
Table 4 Construct and Measurements..... 31
Table 5 Type of Ownership of Company Distribution..... 37
Table 6 Respondents Role Distribution..... 38
Table 7 Software Vendor Distribution..... 38
Table 8 Reliability Test (Revised Model)..... 45
Table 9 Correlation between CSFs and ERP Implementation..... 46
Table 10 Relative Importance among CSFs..... 46
Table 11 Correlation Matrix of CSFs and ERP Implementation (Revised Model)..... 47

LIST OF FIGURES

Figure 1 CSFs for EIS Success Model (Poon and Wagner 2001).....8
Figure 2 Taxonomy for ERP critical factors (Al-Mashari 2003).....8
Figure 3 ERP competence measurement scale development methodology (Stratman and Roth 2002) 10
Figure 4 Overall MIS Strategic Planning Process-1 (King 1978).....20
Figure 5 Overall MIS Strategic Planning Process-2 (King 1978).....20
Figure 6 Organizational Characteristics and IS Planning Model (King 1994).....21
Figure 7 Planning Characteristics for Planning System Success Model (Papke-Shields 2002).....21
Figure 8 Conceptual Model.....24
Figure 9 Critical Success Factors for ERP Implementation Extent Model.....25
Figure 10 A Paradigm for assessment of measurement properties (Koufteros 1999).....39
Figure 11 Measurement Model (Before Refinement).....41
Figure 12 Measurement Model (After Refinement).....42
Figure 13 Path Analysis Model.....43
Figure 14 CSFs with different RI for ERP Planning.....47

LIST OF ABBREVIATIONS

IT	Information Technology
ERP	Enterprise Resource Planning
IS	Information Systems
MRP	Materials Requirements Planning
MRPII	Management Resource Planning
BPR	Business Progress Reengineering
CSFs	Critical Success Factors
RI	Relative Importance
TMS	Top Management Support
TE	Training and Education
PM	Project Management
DC	Department Communication
CR	Change Readiness
BPRM	Business Process Reengineering Management
CA	Cultural Adaptability
CITS	Competence and IT Skills
HE	Hardware and Equipments

ACKNOWLEDGEMENT

This thesis is a fruit work with assistance from many people. I appreciate so much to my supervisor, Professor Daning Sun's guidance, patience and help. I learnt how do a research, how to think and how to keep pursuing "better" and study life-long. I appreciate so much for his willingness to spend so much time on changing my way of thinking, to be logic. "Thank you" is not enough to express my grateful heart. I appreciate so much to Professor Ming-te Lu, who is my supervisor before his retirement one year before. He guided me into this area and provided valuable suggestions to my thesis. He never ceased his care and encouragement on me after his retirement. Learning from them is my fortune of whole life. I want to present my best regards to Mrs Sun and Mrs Lu, who cared my study and growth, gave me warm feeling when I was far from home. I am also grateful to all the Professors and colleagues in Department of Computing and Decision Sciences and Business School in Lingnan University.

I appreciate so much to Professor Daning Guo, and Mr Pingjun Dong. Thanks to their supports, I finished data collection successfully. I can never forget the long-time help, care and trust from my friends, thanks especially to Archer Li, Bennet Yu, Bruce Shao, Carmen Tsui, Daniel Mu, Feng Tang, George Ho, Haiqing Xu, Hoyin Cheung, Hua Chang, Ivan Lau, Jacky Lam, Jing Zhang, Kurt Xu, Lei Xuan, Lala Pan, Maggie Du, Mingzhi Liu, Peilin Fu, Ula Guo, and Zuobin Ye.

All my growth is with my parents. I hereby present my improvements and thesis to their deep understanding and endless love.

TABLE OF CONTENTS

ABSTRACT ..... **i**
LIST OF TABLES ..... **iv**
LIST OF FIGURES ..... **v**
ACKNOWLEDGEMENT ..... **vii**
CHAPTER 1 INTRODUCTION **1**
1.1 Background **1**
1.2 Research Objective **3**
1.3 Organization of the Thesis **3**
CHAPTER 2 LITERATURE REVIEW **4**
2.1 Introduction **4**
2.2 Research in ERP Implementation **4**
2.2.1 ERP Success **5**
2.2.2 ERP Research Models **6**
2.2.3 Constructs for ERP **9**
2.3 Decision Making **16**
2.3.1 Rules in Effective Decision Making **16**
2.3.2 Information System Planning **18**
2.3.3 IS Strategic Planning **19**
2.4 CSFs for IS Planning **22**
CHAPTER 3 RESEARCH FRAMEWORK **24**
3.1 Introduction **24**
3.2 Research Model **24**
3.3 Variable Definitions and Measurements **25**
3.3.1 Dependent Variable **25**
3.3.2 Independent Variables **26**
3.4 Construct and Measurements **30**
3.5 Hypotheses Development **33**
3.5.1 Hypothesis H_1 ..... **33**
3.5.2 Hypothesis H_2 ..... **34**
CHAPTER 4 RESEARCH METHODOLOGY **35**
4.1 Introduction **35**
4.2 Research Methods **35**
4.3 Survey and Questionnaire **35**
4.4 Structural Equation Modeling (SEM) **36**
CHAPTER 5 DATA COLLECTON AND ANALYSIS **37**
5.1 Introduction **37**
5.2 Data Collection **37**
5.3 Demographic Data **37**
5.3.1 Types of the Ownership of Companies **37**
5.3.2 Roles of the Respondents **37**
5.3.3 Software Vendors **38**
5.4 Measurement Refinement **38**

5.5 LISREL Path Analysis **43**
5.6 Model Fit and Unidimensionality **44**
5.7 Validity and Reliability **44**
5.7.1 Content Validity **44**
5.7.2 Convergent Validity and Item Reliability **44**
5.7.3 Discriminant Validity **45**
5.7.4 Reliability **45**
5.8 Hypotheses Testing **46**
5.9 Relative Importance of the CSFs **46**
CHAPTER 6 CONCLUSION **51**
6.1 Introduction **51**
6.2 Contribution of the Study **51**
6.3 Conclusion **51**
6.4 Limitations and Further Research **52**
BIBLIOGRAPHY **53**
Appendix: Questionnaire **59**

CHAPTER 1 INTRODUCTION

1.1 Background

ERP is an integrated set of software modules linked to a common database, handling basic corporate functions. It attempts to integrate all departments and functions across a company into a single computer system that serves different departments' particular needs such as planning, manufacturing, accounting, distribution, sales, human resource, inventory management, service and maintenance, transportation and e-business. ERP can be viewed as a software solution that addresses the enterprise needs taking the process view of the organization, to meet the organizational goals tightly integrating all functions of an enterprise.

Enterprise Resources Planning (ERP) can be dated back to 1970's. It starts from Materials Requirements Planning (MRP) as a new computer-based approach for organizations to planning and scheduling of material requirements and inventory, featuring the time-phased order point. Following MRP, during 1980's to 1990's, when labor and machine (resources) planning were incorporated into MRP, it became known as Management Resource Planning (MRPII). MRP II included distribution management, project management, finance, human resource and engineering. At the beginning of 1990's, MRPII evolved to Enterprise Resources Planning (ERP) with new features of enterprise-wide inter-functional coordination and integrating. With the evolution of ERP, software vendors added more modules functions to core modules of ERP, including advanced planning and scheduling (APS) and e-business solutions such as customer relationship management (CRM) and supply chain management (SCM). ERP realized the seamless integration of all information flows (Umble 2003), including financial and accounting information, human resource information, supply chain information and customer information.

When ERP is successfully implemented, it promises significant business breakthrough doing away with inconsistent data, incomparable formats, and uncooperative applications. It (Robey, Ross, and Boudreau 2002) reduces operating costs, increases productivity and improves customer services and inventory control. ERP is "integrated instead of fragmented". Umble (2003) stated that ERP allows organizations to have a more convergent view of real-time information by integrating processes across functional departments; and it also provides organizations an enterprise database where "all business transactions are entered, recorded, processed, monitored and reported." In addition, it increases departmental corporation and coordination.

Because of those potential benefits, most of the manufacturing companies invested time and money for ERP implementation to replace the legacy systems, with the expectation of high efficiency, competitive power and more profits. However, business world had witnessed many failure stories in past years. The ERP failures include that companies are unable to (1) accomplish process reengineering, (2) meet user needs, (3) achieve functional requirements, (4) finish project by deadline, (5) spend within budget, and (6) receive expected return on investment (ROI). ERP can yield high return on investment when successfully implemented, nevertheless, like a two-edged sword, the ERP failure is devastating to companies. The amount of the money invested on ERP project, such as software, consultant, and staff training, is large and sometimes can even draw a company into bankruptcy. Furthermore, when the project is failed, the business found itself in a dilemma. They could not integrate their business with the ERP software, but they could neither go back because once the system is implemented; it is hard to undo the changes brought to the company.

Most companies started the ERP project in such a rush without second thought. However, the ERP project is not as easy as people imagine to control. Scholars (Umble 2003, Jenster 1987, Lederer 1998, Segars 1999, Bingi 1999) sought the causes of ERP failures. They claimed that the failures of ERP are due to the poor implementation planning. Umble (2003) stated that the main reasons are (1) poor planning and/or poor management, (2) change in business goals during the project, and (3) lack of business management support. Kensner (1988) claimed that the "true winners" are those organizations that are "far-sighted enough to manage the introduction of new MIS products and services as part of their long-term strategic planning process." Barker and Frolick (2003) claimed that if the company wants to yield the benefits of the ERP, "it must first develop a plan for success". The quality of the strategic planning has direct impacts on the implementation result. How the strategy is developed will affect the outcome of the implementation. The smooth and successful information systems implementation needs careful thinking, precise planning and negotiations with departments and divisions from a strategic viewpoint.

With regard to planning for information systems, Jenster (1987) stated that the information systems planning processes include identification, selection and monitoring of information related to the strategic performance. Segards and Grover (1998) stated that the planning for information systems requires substantial resources of both managerial time and budget. Although widely discussed, the process of information systems planning is more difficult and complex than description.

1.2 Research Objective

ERP implementation is one of the most challenges faced by senior managers. Due to its pervasive nature, the implementation result is highly related to business future. However, to survive in the complex implementation process and the evolution of information technology and the restructure for enterprise is definitely not easy. The decisions are difficult to make. Many managers complain that it is overwhelmed with so many details and they tend to lose sight of the initial goals.

Considering the complexity of ERP and its importance to the companies, we recognize the need of ERP implementation planning and aim at finding a systematic planning solution to direct implementation towards success. We expect to understand the process and characteristics for ERP systems implementation deeply, which could help to make an effective planning strategy for this issue. Therefore, the research objective is to identify the most important critical success factors, which will affect the result of the ERP implementation. After that, the identified factors should be set with high priority in ERP planning and implementation process. In this research, we first identified certain critical success factors for ERP implementation based on literature review. Secondly, we applied the relative importance decision rule to theoretical model: Critical Success Factors (CSFs) for ERP implementation. Thirdly, we developed multiple-item construct to measure the performance of critical success factors and the ERP implementation based on prior studies. Forth, a survey is conducted in manufacturing companies in Chinese Mainland from April to June 2005. Fifth, the relationships of each CSF to the ERP implementation result are calculated by Structural Equation Modeling on LISREL. Finally, we conducted a detailed analysis and drawn the conclusion. The implications were given and the further research is suggested.

1.3 Organization of the Thesis

There are seven chapters in this thesis. The thesis is organized as followed. Chapter 1 introduces the research background and the research objective. Chapter 2 reviews the literature related to ERP implementation and decision sciences area. Chapter 3 introduces the research framework, the developed research model, conceptual and operational definitions of the variables and hypotheses development. Chapter 4 is the research methodology part. Chapter 5 is the data collection and analysis part. In chapter 6, the conclusion, suggestions for further study and the contributions of this study were introduced.

CHAPTER 2 LITERATURE REVIEW

2.1 Introduction

As ERP implementation is information systems usage in organizations to help integrating all the functions to enhance the organizations performance, ERP planning is not only a software installation problem, but also, a decision-oriented managerial issue. We need to explore and understand principles in areas of decision sciences and organizational sciences to understand ERP implementation. Therefore, in this chapter, we reviewed relevant scholarly articles, books and other sources (dissertations and conference proceedings) as well as business newsletters related to the topic of ERP implementation, ERP research models, constructs and measurements, decision rules in decision making and methodologies for planning for Management Information Systems (MIS).

2.2 Research in ERP Implementation

To understand ERP, it is suggested to remember “integration”, which is ERP's true ambition. Umble (2003) mentioned that the ultimate goal of ERP implementation is to improve business performance, rather than the software installation. The ERP implementation is viewed as a part of the company to help realize efficient and effective business performance. The implementation should be directed by business requirements and objective.

ERP is a project; nonetheless, it has some special features comparing with other projects. Licker (1997) listed six special features of ERP including (1) high cost, (2) delayed benefits, (3) intangible products at all stages of development, (4) rapidly changing technology, (5) high risk of obsolescence, and (6) rapid turnover of systems professionals. Robey, Ross and Boudreau (2002) stated that organizations often adjust slowly to ERP and ERP investments are risky. Besson and Rowe (2001) claimed that the risks associated with information systems project are always related to (1) the project’s size (number of people and sub-teams requiring coordination), (2) the technical difficulties involved, (3) the ease with which it can be integrated into a firm’s existing management system, (4) the diversity of the various functions involved (its scope), and (5) the diversity of the competencies that its implementation requires.

In addition, ERP is not just a technology installation; rather, it encompasses wider behavioral factors. It is not entirely the same in different countries and areas. Differences stemmed from the different history background, social context, cultural recognition, and unbalance of technologies. In order to deal with change effectively, Esteves and Pastor (1999) recommended that company establish a “change vision” in the given technical, social, and

organizational context.

2.2.1 ERP Success

There are two groups on ERP implementation study. One group prefer to discuss ERP implementation from failure perspective, they suggest that the chance of ERP implementation failure is high and lessons from failure cases can offer great inspiration for that of “not to do”. The other stream support success research argued that success implementations are easier to get access to than the failed ones considering the human psychological nature. Because people are unwilling to mention the failure for recalling the painful experience of past, even if the failure cases are much more than the success ones, it is actually harder to get access to the failed implementation than the success ones, and even more difficult to get deep understanding of this issue. Therefore, this stream claimed that it would be much wiser to study from the success perspective rather than the failure perspective.

No doubt, the success result is the terminal for ERP implementation. “ERP Success” is a heated topic. Markus and Tanis (2000) defined ERP success as “the best outcomes the organization could possibly achieve with enterprise systems, given its business situation, measured against a portfolio of project, early operational, and longer term business results metrics”. However, ERP implementation is a complex exercise and must incorporate consideration of the intangible process differences and details. Markus and Tains (2000) admitted that success depends on who defines it, in other words, definition of success ERP implementation depends on the points of view of the involved stakeholders such as customers, employees, and vendors. For example, in ERP implementation process, managers view success as earning benefit from system, the software vendors view success as running data smoothly to realize module functions, project leaders view success as completing project on time and within budget, while those who adopt information systems and use them tend to emphasize having a smooth transition to stable operations with the new system, achieving intended business improvements like inventory reductions, and gaining improved decision support capabilities.

Robey (2003) measured success of ERP from the changes angle since the transition to ERP is often combined with a business process reengineering effort which intends to produce radical organizational change. Change is the main phenomenon associated with ERP system (Esteves and Pastor 1999). From this angle, there is a stream (Al-Mashari, Abdullah and Al-Mudimigh, 2003) defines ERP implementation success as the ability to manage adequately a complex context involves organizational changes across various key areas

related to strategy, technology, culture, management systems, human resources. The success of ERP is to transfer from existing systems to new systems, which achieve the organizational objectives.

There are other rules to measure a success, one is to measure the return of invest (ROI). If the return is more than the investment part, it could say “not fail” at least. Other measures are from the terms of technology, economics, financial or strategic business terms, smooth running of business operations, ERP-adopting inner organization’s managers and employees, out organization’s customers, suppliers, and investors.

2.2.2 ERP Research Models

There are two widely used models in the research of ERP implementation. One is called life cycle model and the other is Critical Success Factors (CSFs) Model.

2.2.2.1 ERP Life Cycle Model

ERP implementation follows a mechanism named as “life cycle”. ERP’s realization, benefits and feedbacks could not be realized in a short period. ERP transition is not a project that someday will end, but rather, a way of life. The ERP life-cycle model is structured in phases. Phases are the different stages of an ERP system life-cycle within an organization. Esteves and Pastor (1999) stated that the phases of the ERP life-cycle are consisted of stages that an ERP system goes through its whole life in organizations. There are different stages in the life cycle; Umble (2003) claimed there are 11 steps for implementation the ERP systems. They are: (1) review the pre-implementation process to data, (2) install and test any new hardware, (3) install the software and perform the computer room pilot, (4) attend system training, (5) train on the conference room pilot, (6) establish security and necessary permissions, (7) ensure that all data brings are sufficiently robust and the data are sufficiently accurate, (8) document policies and procedures, (9) bring the entire organization on-line, either in a total cutover or in a phased approach, (10) celebrate, and (11) improve continually. A common acceptable stage division is: (1) design stage, (2) implementation stage, (3) put-into-use stage, (4) maintenance stage, and (5) not-in-use stage. When one life cycle is ended, another one begins just like the life cycle in eco-system.

Holland and Light (2001) stated that life cycle model could help managers to understand implementation process and provide guidance on how to realize the strategic potential of the ERP systems. The value of the ERP life-cycle theory is concluded as it could provide a map for understanding the evolution of ERP systems in organizations. It gives details about tasks have been finished and tasks need to be done in next step, which could offer insights for managers to make implementation decision.

2.2.2.2 Critical Success Factors (CSFs) for ERP Model

Much of the Information Systems literature is congruent with Critical Success Factors (CSFs) approach. Years studies about decision-making, planning and information systems (IS) discussed and referred to CSFs approach. It is a typical approach for managers to identify the most strategic relevant information on the important business needs. CSFs approach is a method that supports the activities, by which an enterprise reexamines its goals and how to achieve them, and redesign the business process.

Rockart (1979) considered Critical Success Factors (CSFs) as an approach to help managers to define their information needs and link these needs with general business needs. He defined the critical success factors as 'the limited number of areas in which results, if they are satisfactory, will ensure competitive performance for the organization". The CSFs can also be viewed as business activities that are measurable and are easily understood to assure the project success. Jenster (1987) stated that a benefit of CSFs approach is that it identifies "strategically relevant" information. He said that critical success factors are events, conditions, circumstances or activities that relate to the basic internal or external conditions for the firm's strategy, or competencies or resources that it must be attained.

Pinto and Slevin (1987) developed a Project Implementation Success model (PIS) with an equation as following,

$$S = F(X_1, X_2, ...X_n),$$

where S is project success and Xi is Critical Success Factor (CSF) i. The CSFs are multi-dimensional concepts. To ensure the project success, the first task is to find each Xi. It is the early study related to the critical success factors for information systems implementation.

In the study by Somers and Nelson (2001), they suggested that CSFs can be viewed as "situated exemplars" that help to surpass the boundaries of process improvement; in addition, they pointed out that the effect will be much richer if viewed within the context of each stage in the implementation process.

To sum up, critical success factors can be viewed as a small number of easily identifiable operational goals shaped by the industry, the manager, and the broader environment. On one side, it helps to focus on the goal to be accomplished rather than all that needed to finish the job. If these small goals can be attained, the success of the firm or organization is ensured. On the side, failure to ensure some of the CSFs will generally leads to failure result. The strength of the CSFs approach is: (1) it produces a smaller data set to analyze rather than enterprise analysis; (2) it addresses the critical information needed in the planning process

by relating information resources and enhances the understanding of MIS by management. (3) it provides a natural link between tactical and strategic planning.

In the literature, many researchers studied ERP and information systems through CSFs approach. Poon and Wagner (2001) adopted CSFs approach and developed a model (Figure 1) to study Hong Kong organization's information systems. They proved that the presence of ten CSFs would result in the success of the information system while absence of some CSFs would lead to project failure. This study addressed the importance of the CSFs as the necessary and sufficient conditions for system success.

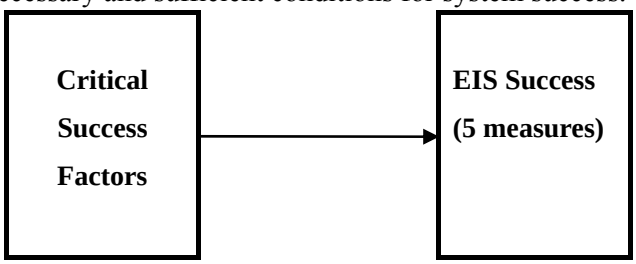


Figure 1 CSFs for EIS Success Model (Poon and Wagner 2001)

Years of study on CSFs enlarged its intentional and extensional meanings and their relationships with ERP performance. For example, Al-Mashari (2003) created the taxonomy for CSFs and linked those factors with ERP success and ERP benefits. The taxonomy is shown in Figure 2.

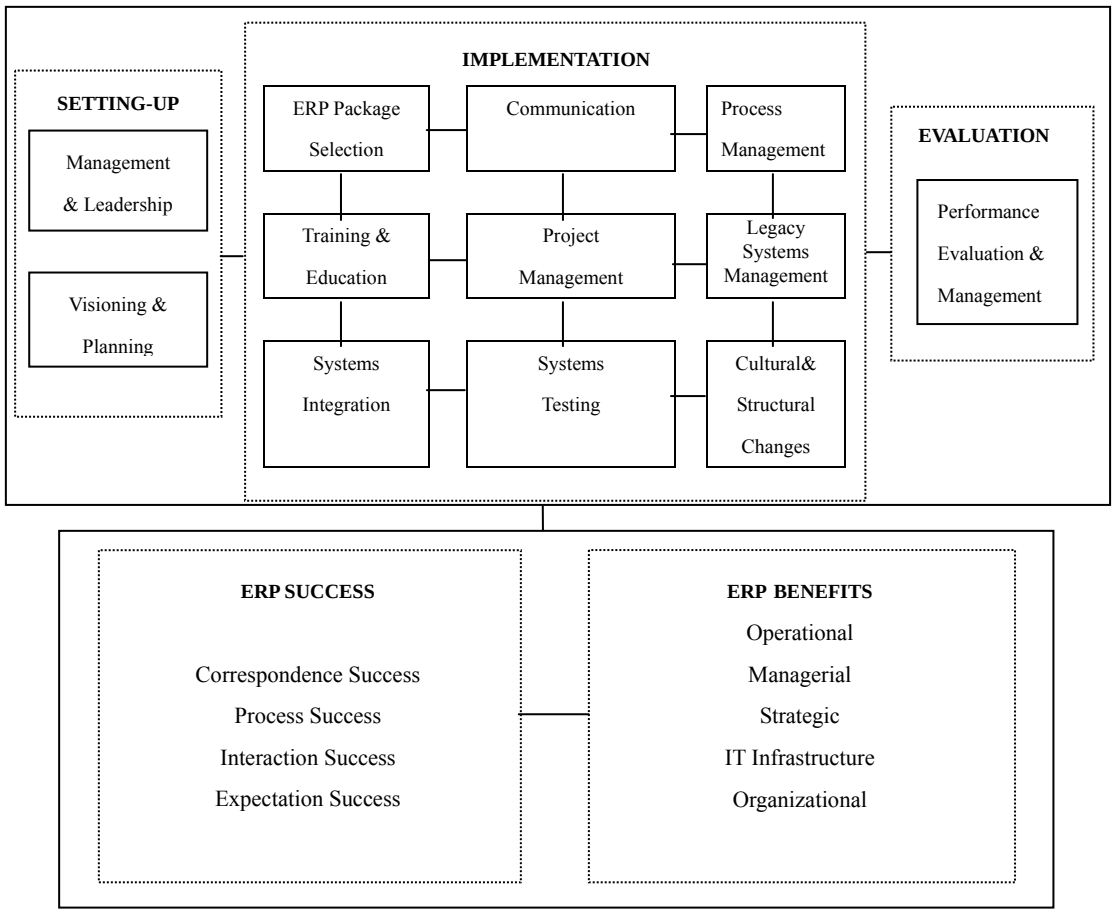


Figure 2 Taxonomy for ERP critical factors (Al-Mashari 2003).

Scholars (Rockart 1982, Gottschalk 1999, Nah 2001) extended the methodology of CSFs to identify a small number of critical success factors such as: top management support of the ERP project, an effective project team staffed full time with top business and information technology people, and organization-wide commitment. Poon and Wagner (2001) pointed that they are meta-CSFs, "if managed correctly, result in all others to go right". Without the presences of these meta-CSFs, it would result ERP implementation in failure without doubt.

CSFs approach is a good multiple-dimensional conceptualization approach. Segares and Grover (1999) emphasized that the conceptualization is an important step to better understanding the nature of planning profiles and the rationale for the adoption by Chief Information Officers (CIOs) in strategic planning. They claimed that the development of multi-dimensional conceptualizations can (1) capture multiple aspects of strategic information systems planning success that may be subsumed within general measures, (2) provide insight into the nature of interrelationships among success dimensions, and (3) provide a more accurate diagnostic tool to assess SISP activities within organizations. To identify operational dimensions could help identify effective approaches to strategic planning. Peffers (2003) pointed out that many senior managers emphasized the strategy of the portfolio is well supported by CSFs because they are "intended performance consequences of systems and behaviors within the firm that are related most strongly to the achievement of desired firm objectives" and they also "focus IS planning on the most important business needs".

Although a very useful approach, CSFs approach has its shortages. Robey, Ross, And Boudreau (2003) claimed that it could not offer the explanations why the results happened in this way, the studies of ERP's critical success factors offer few insights beyond conventional wisdom because they lack the power to explain why the business outcomes occurred. What's more, there are always correlations between the critical success factors because they are highly related with all the activities in the organizations and all the activities happened in organizations could not be separated very clearly. Besides, when conducting interviews, there is often confusion among interviewees between individual and organizational CSFs. The methods to resolve this problem is give clear definitions before conducting interviews, which will decrease the possibility of misunderstanding between people.

2.2.3 Constructs for ERP

In the studies of ERP, multi-item measurement scales and constructs are developed to measure the competence of systems. Stratman and Roth (2002) stressed that "the complexity inherent in many business processes can not be adequately measured with a single item because of the organization's inherent complexity". The multi-item scales can reduce

measurement error and provide a more robust measure of complex variables by combining several individual items. They defined eight ERP competence constructs following the methodology from Churchill (1979) as illustrated in Figure 3.

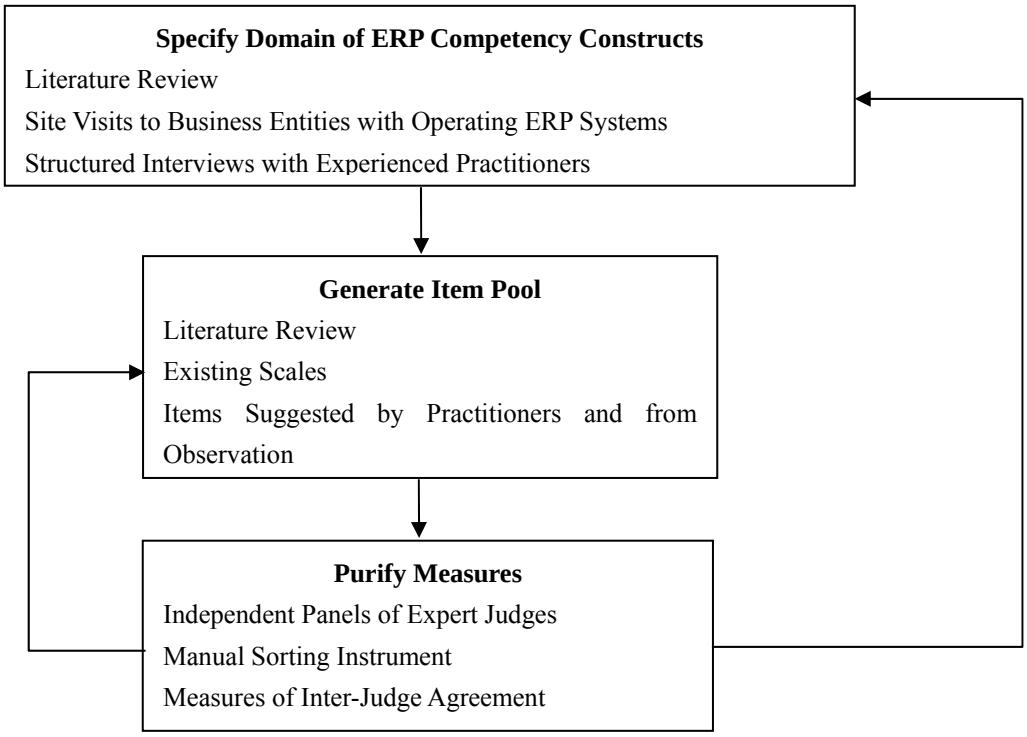


Figure 3 ERP competence measurement scale development methodology (Stratman and Roth 2002)

Stratman and Roth developed the constructs for ERP competence as shown in Table 1. Similarly, Gottschalk (2003) developed another construct for strategic planning information systems (Table 2). Hofstede (2004) built five dimensions for culture (Table 3). These constructs provide a measurement instrument for capturing the data on ERP study.

Table 1 Constructs for ERP Competence (Stratman and Roth 2002)

Strategic IT Planning
We constantly review our IT capabilities against strategic goals
IT plans are redesigned as required to meet evolving conditions
Strategic IT planning is a continuous process
Written guidelines exist to structure strategic IT planning in our organization
Top management is not involved in strategic IT planning
Strategic IT planning includes inputs from all functional areas
Executive Commitment
Functional managers willingly assign resources to the ERP project as they are needed
The need for long-term ERP support resources is recognized by management
Executive management is enthusiastic about the possibilities of ERP
Executives have invested the time needed to understand how ERP will benefit the enterprise
Executives mandate that ERP requirements have priority over unique functional concerns
Top management has clearly defined the ERP Entity's business goals
All levels of management support the overall goals of the ERP Entity
Project Management
The tasks to be performed during the ERP project are clearly defined
The responsibilities of project team members are clearly defined
There is a formal management process to track external contractor activities
Problems found during reviews of external project members are not tracked to closure
Measurements are used to determine the status of project tasks
Project tasks are reviewed on a periodic basis
The ERP project leader is able to track project management
Project tasks are reviewed on an event-driven basis
IT Skills
The internal IT staff have the ability to conduct routine ERP system
There is a high degree of technical expertise in the IT organization
The database administrator is an expert in the ERP database management system
Internal IT team members understand custom ERP software programs
The IT staff are able to efficiently implement ERP system upgrades
The IT staff have the technical ability to conduct a formal validation of all systems changes
The IT staff have the technical ability to conduct a formal validation of all system changes
The IT staff are able to analyze the technical impact of proposed system changes
The IT staff actively builds relationships with business managers
Business Process Skills
There is a high level of business process knowledge within the ERP entity
Employees understand how their actions impact the operations of other functional areas
Employees understand how their daily business activities support the goals of the ERP Entity
Managers are not clear on how ERP-focused business processes support the goals of the ERP Entity
The operational processes of the ERP Entityare formally documented
Our ERP entity's business process documentation reflects actual operational activities
Functional managers are able to document cross-functional business process flows
Business process design is driven by customer requirements
Managers are skilled at analyzing business processes for customer benefits

Table 1 Constructs for ERP Competence (Stratman and Roth 2002) (Continued)

Learning
Benchmarking is used to identify cutting-edge ERP techniques
We keep track of ERP developments related to our industry
Cross-functional groups meet regularly to discuss new uses for the ERP system
Internal groups meet regularly to share new methods of using the ERP system
ERP improvement suggestions are regularly collected from multiple employees levels
Business experiments are conducted to evaluate potential improvement is unsuccessful
External ERP experts are invited to suggest better ways to use the ERP system
ERP Training
Specific user training needs were identified early in the implementation
A formal training program has been developed to meet the requirements of ERP system users
Training materials have been customized for each specified job
We seldom update training materials to reflect system changes
Training materials target the entire business task, not just the ERP screens and reports
Employees are tracked to ensure that they have received the appropriate ERP system training
All users have been trained in basic ERP system skills
ERP system training review sessions are scheduled
Training materials target the entire business task, not just the ERP screens and reports
Employees are tracked to ensure that they have received the appropriate ERP system training
All users have been trained in basic ERP system skills
ERP system training review sessions are scheduled
Improved Business Performance
Company business processes have been rationalized through the use of the ERP system
Business flexibility has been diminished through the use of the ERP system
The ERP system allows for better control of business operating expenses
New market opportunities have been identified through the use of the ERP
The ERP system has improved customer satisfaction
ERP Entity facilities have been rationalized due to information provided by the ERP system
The ERP system allows users to generate supply-chain schedules addressing customer needs
The efficiency of the ERP Entity's supplier network has been improved
The efficiency of the procurement function has been improved
The efficiency of the distribution function has been improved
Business benefits have been realized from the reengineered ERP process
Internal integration across functions
Internal integration across lines of business
Overall organizational agility
External integration with suppliers
External integration with customers

Table 1 Constructs for ERP Competence (Stratman and Roth 2002) (Continued)

Change Readiness
Employees understand how they fit into the new ERP entity
Employees have input into how their jobs will change with new ERP business processes
Management actively works to alleviate employee concerns about ERP
An ERP support group is available to answer concerns about ERP job changes
The roles of all employees under the ERP system have been clearly communicated
The change readiness of employees impacted by the ERP system is regularly assessed
Employees are not prepared for a series of ERP-related changes as the system evolves (reverse coded)
ERP-focused changes to the employee reward system have been communicated

Table 2 Constructs for Strategic Information Systems Planning (Gottschalk 2003)

Implement Extent
IT strategy has been implemented as planned
IT strategy implementation has been completed on time (Williams, 1992)
IT strategy implementation has been completed within budget
IT strategy implementation has been completed as expected
IT strategy implementation has achieved the desired results
Deviations from the IT strategy have occurred during implementation
You are satisfied with the IT strategy implementation
Resources needed for the implementation
Financial resources needed for implementation
Technical abilities needed for implementation
Human resources needed for implementation
Project team time needed for implementation
External consultants needed for implementation (new)
A ‘project champion’ needed for the implementation (new)
User involvement during implementation
Degree of systems-related training received by information systems users
Users’ understanding of systems’ functional and technical features
Users’ participation in systems projects
Users’ involvement in the operation of information systems
Participation in the ongoing development of information systems
Users’ support for the implementation (new)
Analyses of the organization
Information needs of organizational sub-units
How the organization actually operates
A ‘blueprint’ which structures organizational processes
Changing organizational procedures
New ideas to reengineer business processes through IT
Dispersion of data and applications throughout the firm
Organization of the IT function (new)

Table 2 Constructs for Strategic Information Systems Planning (Gottschalk 2003) (Continued)

Solutions to potential resistance during the implementation
Solutions to resistance caused by job security
Solutions to resistance caused by change in position
Solutions to potential resistance caused by new skills requirements
Solutions to potential resistance caused by skepticism of results
Solutions to potential resistance caused by a unit's interests
Solutions to potential resistance caused by our customers
Information technology to be implemented
Hardware to be implemented
Communications technology to be implemented
Databases to be implemented
Applications software to be implemented
Operating systems to be implemented
A data architecture for the organization
Projects in accordance with the expectations of management
Projects in accordance with the expectations of management
Organizational goals for the projects
Benefits of the projects to the organization
Projects that contribute to new business opportunities
Competitive advantage from IT
Strategic applications of IT
Responsibility for the implementation
Responsibility for the implementation on time
Responsibility for the implementation within budget
Responsibility for the implementation with intended benefits
Responsibility for the stepwise implementation of large projects
Responsibility for the implementation of high priority projects
Responsibility for short-term benefits from initial projects
Personnel rewards from successful implementation
Management support for the implementation
Management expectations of the implementation
Management participation in the implementation
Management monitoring of the implementation
Management knowledge about the implementation
Management time needed for the implementation
Management enthusiasm for the implementation
Clear presentation of implementation issues
Evaluation of progress clearly
Change management clearly
A list of projects clearly
A schedule for the implementation clearly
Alignment of IT strategy with business strategy clearly

Table 3 Constructs for Culture (Hofstede, 2004)

Power Distance Index (PDI)	**Power Distance Index (PDI)** focuses on the degree of equality, or inequality, between people in the country's society. A High Power Distance ranking indicates that inequalities of power and wealth have been allowed to grow within the society. These societies are more likely to follow a caste system that does not allow significant upward mobility of its citizens. A Low Power Distance ranking indicates the society de-emphasizes the differences between citizen's power and wealth. In these societies equality and opportunity for everyone is stressed.
Individualism (IDV)	**Individualism (IDV)** focuses on the degree the society reinforces individual or collective achievement and interpersonal relationships. A High Individualism ranking indicates that individuality and individual rights are paramount within the society. Individuals in these societies may tend to form a larger number of looser relationships. A Low Individualism ranking typifies societies of a more collectivist nature with close ties between individuals. These cultures reinforce extended families and collectives where everyone takes responsibility for fellow members of their group.
Masculinity (MAS)	**Masculinity (MAS)** focuses on the degree the society reinforces, or does not reinforce, the traditional masculine work role model of male achievement, control, and power. A High Masculinity ranking indicates the country experiences a high degree of gender differentiation. In these cultures, males dominate a significant portion of the society and power structure, with females being controlled by male domination. A Low Masculinity ranking indicates the country has a low level of differentiation and discrimination between genders. In these cultures, females are treated equally to males in all aspects of the society.
Uncertainty Avoidance Index (UAI)	**Uncertainty Avoidance Index (UAI)** focuses on the level of tolerance for uncertainty and ambiguity within the society - i.e. unstructured situations. A High Uncertainty Avoidance ranking indicates the country has a low tolerance for uncertainty and ambiguity. This creates a rule-oriented society that institutes laws, rules, regulations, and controls in order to reduce the amount of uncertainty. A Low Uncertainty Avoidance ranking indicates the country has less concern about ambiguity and uncertainty and has more tolerance for a variety of opinions. This is reflected in a society that is less rule-oriented, more readily accepts change, and takes more and greater risks.
Long-Term Orientation (LTO)	**Long-Term Orientation (LTO)** focuses on the degree the society embraces, or does not embrace, long-term devotion to traditional, forward thinking values. High Long-Term Orientation ranking indicates the country prescribes to the values of long-term commitments and respect for tradition. This is thought to support a strong work ethic where long-term rewards are expected as a result of today's hard work. However, business may take longer to develop in this society, particularly for an "outsider". A Low Long-Term Orientation ranking indicates the country does not reinforce the concept of long-term, traditional orientation. In this culture, change can occur more rapidly as long-term traditions and commitments do not become impediments to change.

2.3 Decision Making

Konsynski (1992) mentioned that decision is a judgment and conclusion reached after consideration. The decision process is defined as:

> *Recognize choice, understand the situation, analyze options, assess implications of choice, select an action, and implement it.*

And,

> *In the term of decision process, we combine ideas of action for decision and decisions for action; that is, there is continuity between the preparatory of the actions decided upon during the decision process. Collectively, these actions constitute the behavior of the firm. Thus, one might characterize an organization on the basis of its portfolio of decision process.*

Konsynski categorized seven steps in the decision making process: (1) scanning—search that may directed or undirected, (2) interpretation and assessment — judge the results of historical analysis, threat assessment studies, (3) design—to determine possible options and alternatives and to develop criteria for choices, (4) choice—according to some process of argumentation, select the actions to be taken, (5) ratification—the attainments of the consensus or authority in acceptance of the choice, (6) implementation—the determination of the means and mechanisms for and consequences of implementation of the means and mechanisms for and consequences of implementing selected actions, and execution of the actions via a separate decision process that provides a control and coordination function), and (7) feedback—the evaluation of consequences of decisions and the determination of the quality of the process.

2.3.1 Rules in Effective Decision Making

A decision rule is a function that maps the current state to the business decision or choice, or the expressed preferences of each of a group of agents to a group decision. There are several rules for effective decision making from years of experience and lessons in running business. We concluded three rules from literature (Jenster 1987, Drucker 2001, Soofi , Retzer and Yasai-Ardekani 2002, Peffers 2003) that are frequently mentioned and used by managers.

First, the decision makers need to know what the ultimate objective is. As Aristotle said “archer is more likely to hit the target if he is aware of what he is aiming at”. All the

activities must line with the business objectives. It is a matter of directions but not a matter of methods. It is important to know the objective of the organization when analyzing the organization. The analysis of the organization includes analyzing the information needs of organizational sub-units, how should the organization actually operate, the 'blueprint' which structures organizational process, dispersion of data and applications through the organization and so on. Jenster (1987) and Peffers (2003) claimed that "rich information about relationships between systems attributes, performance, and goals is essential for planers and developers to understand what must be done to gain and retain competitive strengthening. It needs to describe information systems attributes in terms of features and their purposes, and the organization." An excellent understanding of organizational objectives, the role of information systems in the organization, and the relationships among systems in the organization is essential for successful planning.

Second, the decision makers need to know what really matters. Drucker (2001) revealed the reality of the effective decision as following:

> *Effective executives do not make a great many decisions. They concentrate on what is important. They try to make the few important decisions on the highest level of conceptual understanding. They try to find the constants in a situation, to think through what is strategic and generic rather than to 'solve problems.' They are, therefore, not overly impressed by speed in decision making; rather, they consider virtuosity in manipulating a great many variables a symptom of sloppy thinking. They want to know what the decision is all about and what the underlying realities are which it has to satisfy. They want impact rather than technique.*

Konsynski (1992) suggested the decision making process in real world:

> *When events occur, communication actions are performed, and decisions are made. These decisions translate into actions (some of which may be communication actions and others actions in the more traditional sense).In the aggregate and over the course of time, the actions that are taken determine the fate of the firm.*

Third, decision makers should set the priority based on the importance and/or urgency of the business needs. In the areas of decision making and strategic planning, assigning relative importance weighs high in the fields of multi-criteria strategic planning and decision analysis. There is relative importance between the different factors' relationship with the result. Relative importance (RI) is defined by Soofi, Retzer and Yasai-Ardekani (2002) as "quantities that compare the contribution of individual explanatory variables to a response

variable". The relative importance measures are parameters be defined as more basic parameters such as correlation coefficients. They defined the Analysis of Importance (ANIMP) framework that reflects two describable properties for the relative importance measures: additive separability and order independence. They used this relative importance measures in an actual management decision situation. Soofi, Retzer and Yasai-Ardekani (2002) criticized that it is inappropriate to use the frequency to measure the relative importance. They pointed out that the statistical significance only maps the analyst's strength of confidence in making inference about an unknown parameter based on a statistics. They admitted that there is no uniquely best importance measure for any problem. The relative importance is interpretable only in the context of the measure used.

2.3.2 Information System Planning

Information system planning is one of the most complex and important analytical and decision-oriented managerial problems for senior managers. Kensner (1988) stressed the importance of strategic planning to the success of information system implementation. A good strategic planning makes contribution for the overall direction and control of the enterprise. The benefits (Kensner 1988, Lederer 1998, Segars 1999) of strategic planning for informaiotn systems include: (1) it provides a long-term perspective on organization activities and objectives (Kensner 1988), (2) it directs human and financial resources in adherence to the plan so as to ensure its realization (Kensner 1988), (3) it reduces uncertainty (Lederer 1998), (4) it establishes dialogue and lines of communication among various departments in order to coordinate the efforts of organizational members (Lederer 1998), (5) it searches for business opportunities within the competitive domain (Segars 1999), and (6) it identifies opportunities to utilize information technology (IT) for competitive advantages (Segars 1999).

Mclean and Soden (1976) stated that the strategic planning involves three activities: (1) identify potential project, (2) evaluate and rank project priority, and (3) translate projects into time-phased profiles of tasks, resources requirements and action steps. For evaluate and rank project priority, he indicated that:

The collected idea for new projects must be sorted out so that the highest priority applications or services can be undertaken in the near term.

and,

The major challenge is to obtain a summary evaluation of these project characteristics without entering into a detailed project feasibility study, since the primary objective is to decide which projects should initially be allocated feasibility study resources.

Jenster (1987) identified nine steps for information systems planning for developing, monitoring and integrating critical information into effective strategic management decision support, they are: (1) provide structure for the design process, (2) determine general elements which will influence success, (3) develop a strategic plan or revise/modify the current plan, (4) identify a selected number of critical success factors (CSFs), (5) determine who is going to be responsible for what, (6) select the strategic performance indicators (SPIs), (7) develop and enact appropriate reporting procedures, (8) initiate use of procedures by managerial personnel, (9) establish evaluation procedure. More simply, Peffers (2003) suggested information systems planning process involves four principle tasks: (1) generating ideas, (2) evaluation, (3) feasibility and sourcing study, and (4) making the decision. The steps are helpful to create a strategic context for the organization.

2.3.3 IS Strategic Planning

Head (1982) stated that the strategic planning for information systems has to do with the overall conduct of large-scale operations. It concentrates on the immediate problems of maneuvering military units in the field to achieve specific objectives. To Head, “planning” refers to “a process for exercising favorable influence over future events”. It is active rather than passive. It helps forecast “which is concerned with estimating the future rather than influencing it through actions and decisions”. He suggested that the strategic planning for information systems seeks to assure organizations take full advantage of the requirement and software technology to satisfy the requirement proposed in the planning period.

Kesner (1988) stated that strategic planning process provides a long-term perspective on organization activities and objectives. The planning for information systems can directs human and finical activities in adherence to the plan so as to ensure its realization. He stated

that "the purpose of strategic planning is to define a mission, to position the institution for success against all competitors, and to ensure that all players understand the plan and perform accordingly". King (1978) developed model for performing information systems strategic planning. He suggested that MIS strategic planning process involves the identification and assessment of an "organizational strategy set", including organization's mission, objectives, strategies, and other strategic attributes. The organizational strategy set should transfer to the MIS strategy (Figure 4, 5).

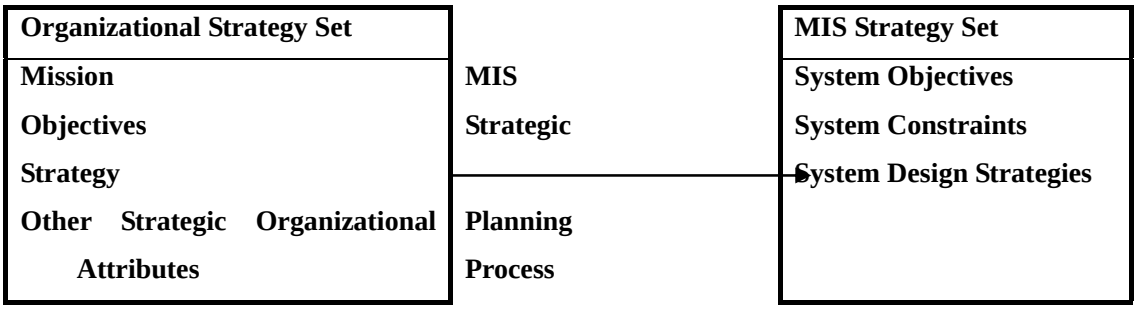


Figure 4 Overall MIS Strategic Planning Process-1 (King 1978)

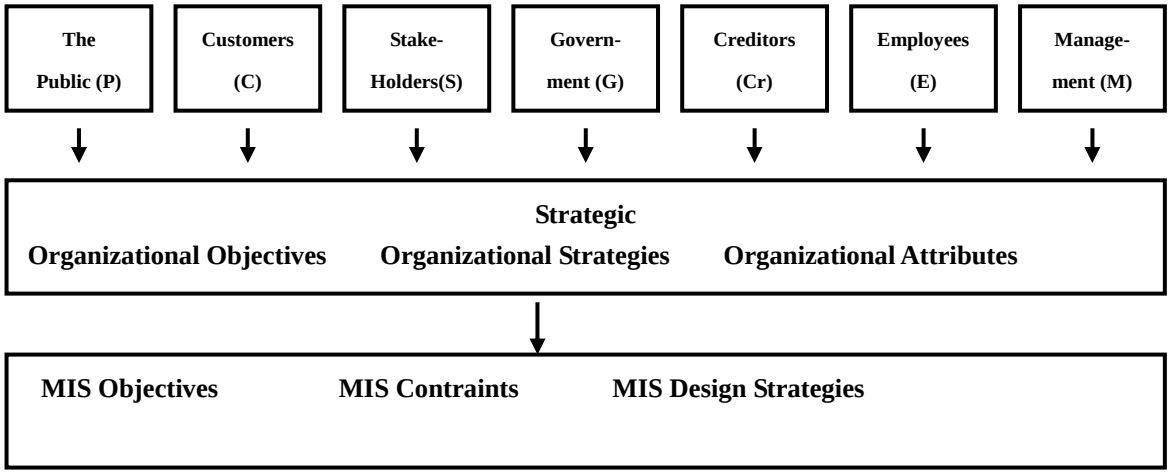


Figure 5 Overall MIS Strategic Planning Process-2 (King 1978)

King and Premkumar (1994) studied the organization characteristics for information systems strategic planning. A model links two major dimensions of information systems planning-"the quality of the planning process and planning effectiveness-with a set of eight organizational factors derived from contingency research in information systems planning" is developed as illustrated in Figure 6.

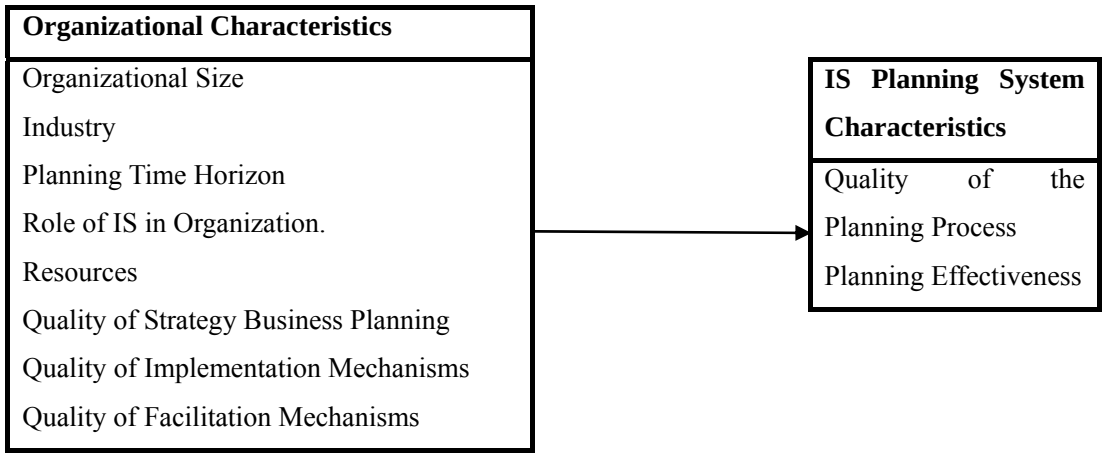


Figure 6 Organizational Characteristics and IS Planning Model (King 1994).

Papke-Shields (2002) developed a planning system success model to illustrate the relationships between the strategic manufacturing planning characteristics and planning systems success (Figure 7). The result of planning is organizational performance.

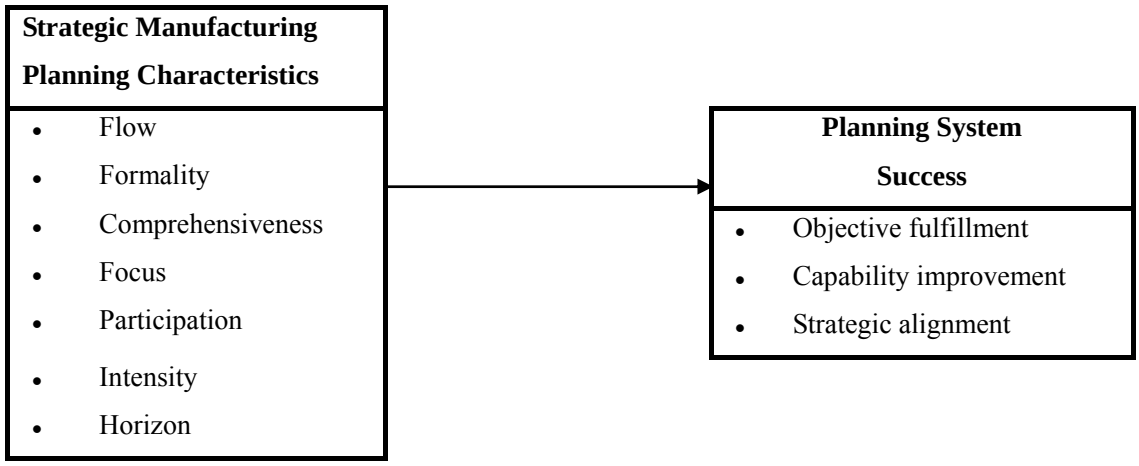


Figure 7 Planning Characteristics for Planning System Success Model (Papke-Shields 2002)

Segars and Grover (1999) made six dimensions for measurement of planning, they are: (1) planning comprehensiveness, (2) planning formalization, (3) planning focus, (4) planning flow, (5) planning participation, and (6) planning consistency.

There are many benefits of strategic planning for information systems. Head (1982) stated that the planning contributes to enhance communications between the top managers and the directiors and subordinate managers as well as professionals. It also helps to establish constraints because an information systems plan can provide a constraining mechanism on

the allocation of resources among systems projects. In addition, it helps to control the resources. Head suggested that “the plan permits goals and objectives to be tied with budget allocations to provide better assurance that dollars are channeled to those activities that are most relevant to the achievement of strategic goals. Besides, it also helps to manage the technological changes.

2.4 CSFs for IS Planning

Jenster (1987) studied Critical Success Factors in planning. He stated that the successful strategy development and implementation rely on the quality of the available information. The benefits of this approach are: (1), it is good at identification, selection and monitoring of information related to strategic performance of the companies, and (2) it helps managers to shape the way in which other members of the organization define their tasks, interpret the firm’s strategy and what is important and what is not. Jenster (1987) gave design procedures for a strategic process and information system for integrating planning and control. The approach is based on the idea that executive must focus on factors that are most vital to the organization’s success and then manage by creating a context within which others are able to align their efforts accordingly.

Jenster (1987) identified nine steps for this CSFs approach for IS planning: (1) provide structure for the design process, (2) determine general elements which will influence success, (3) develop a strategic plan or review/modify the current plan, (4) identify a selected number of critical success factors (CSFs), (5) determine who is going to be responsible for what, (6) select the strategic performance indictors (SPIs), (7) develop and enact appropriate reporting procedures, (8) initiate use of procedure by managerial personal, and (9) establish evaluation procedure. This idea provides a strategic context for the managers. He stated that this method can help to make a good strategy for company and ensure that the appropriate actions are taken.

Teo and Ang (1999) stressed the importance of aligning the IS planning with the business plans by CSFs approach. They reported that top management commitment to the strategic use of IT, IS management knowledge about business, and top management confidence in the

IS department are the top three CSFs to help aligning the IS plan with business plans. Head (1982) shred lights on improving the systems planning. He suggested three issues: (1) preparation for well thought out systems goals, objectives, and strategies, (2) critical evaluation by the top management, and (3) a tracking mechanism to assure that plans are being carried out and milestones met. Head also suggested that a good planner should have a strategic planning, which means, the planner focuses on a global or macro-view.

Shank, Boynton and Zmud (2001) studied further on CSFs analysis as a methodology for IS planning. They suggested the benefits of this approach by a case study in a company named Financial Institutions Assurance Corporation (FIAC) as following:

> *It provided a clear focus to structure the vital issues which were considered in MIS planning. ... It provided a natural link between the tactical and strategic planning. Use of the method provided assurance that critical information needs were explicitly addressed in the planning process by relating information resources to those areas of an FIAC's activity which must go well in order for the corporation to succeed. The CSFs methodology developed a core of information technology proponents throughout the organization and enhanced the understanding of MIS by management. Finally, this organization-wide CSFs study now provides an excellent vehicle for the new MIS director to align his strategic plans with those of FIAC's top management.*

CHAPTER 3 RESEARCH FRAMEWORK

3.1 Introduction

This chapter introduces the framework of our research. Based on the background theories in ERP implementation and the principles for effective decision making and strategic planning, the research model is developed. We are going to find answers to the research questions of how to make a good planning for the ERP implementation. This model combines the critical success factors approach for ERP implementation and the rules of effective decision making. The main idea is to set the priority among the CSFs when making the planning for ERP implementation. The hypotheses in this model are constructed and the constructs and measurements are developed in this chapter.

3.2 Research Model

We embedded the decision rule of controlling the relative importance into the Critical Success Factors for ERP implementation model (CSFFPI). The critical success factors are viewed as controllable and measurable events happened in the ERP implementation process. The achievements of the critical success factors will directly affect the result of ERP implementation. Among these factors, some factors are more important than others in the ERP implementation. We name this priority as relative importance (RI). The conceptual model is illustrated in Figure 8.

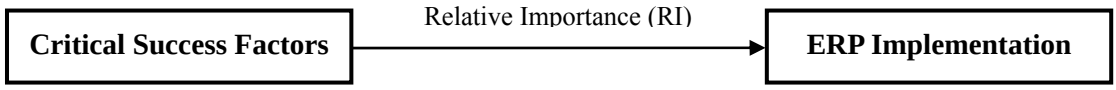


Figure 8 Conceptual Model

The critical success factors in the left side of the model are identified from literature. We searched and listed the factors mentioned in prior studies. The descriptive language differs slightly by different scholars. We traced the content of each factor and categorized them by the real meaning. After comparison and combination, eight factors were identified. They are: (1) top management support (TMS), (2) training and education (TE), (3) project management (PM), (4) departmental communications (DC), (5) change readiness (CR), (6) business process reengineering management (BPRM), (7) cultural adaptability (CA), (8)

software competence and IT skills (CITS), and (9) hardware and equipments (HE). With the identified CSFs, the research model is specified in Figure 9.

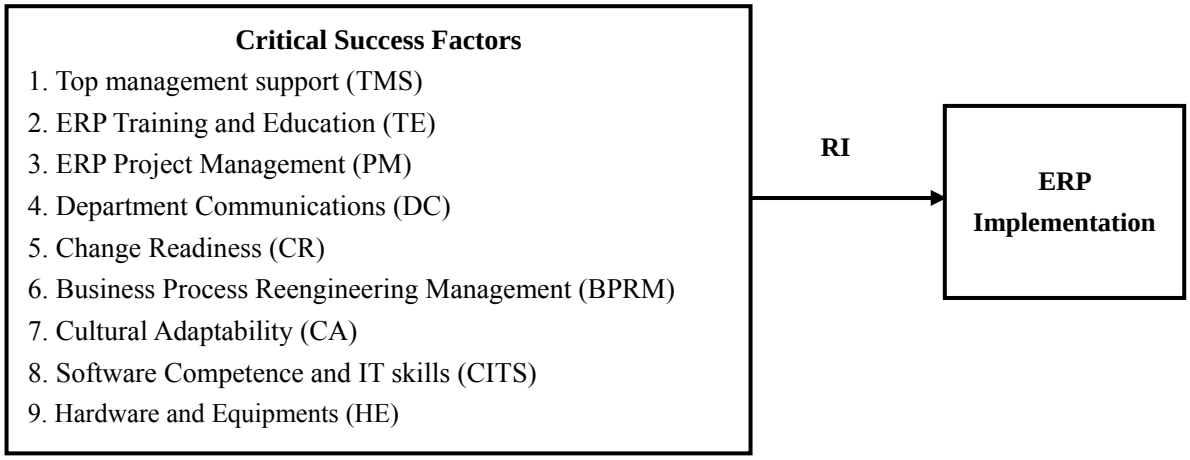


Figure 9 Critical Success Factors for ERP Implementation Extent Model

3.3 Variable Definitions and Measurements

Considering the complexity of all the critical success factors together with the multi-criteria for ERP implementation, all the variables in our study are measured by multi-items scale. Stratman and Roth (2002) suggested that "the complexity inherent in many business processes can not be adequately measured with a single item because of the organization's inherent complexity". Multi-item scales reduce measurement error and provide a more robust measure of complex variables by combing several individual items. The construct is developed based on the construct developed by Strataman (2002). All the items for each CSFs can be viewed as the controllable "meta" critical success factor to assure the ERP's successful implementation. These items could also provide criterion to evaluate the activities in the ERP implementation. The definitions and measurements of the variables are given.

3.3.1 Dependent Variable

The dependent variable "ERP implementation" is defined as all the results brought by the implementation of ERP project. Premkumar and King (1987) stated that "implementation extent" may be much closer to the reality and the nature of an information systems implementation. The "implementation extent" refers to the condition of the accomplishment of the project. Scholars (Boynton 1994, Gottschalk 1999, Stratman and Roth 2002) provided the measurements for implementation extent: (1) the period of the software implementation: whether it meets the project deadline, (2) user satisfaction and long term benefits, (3) the

realization of business reengineering goals, and (4) the realization of improved enterprise operating capabilities and functional performance. In sum, the success result of ERP implementation should be evaluated from different perspectives.

3.3.2 Independent Variables

1. Top Management Support (TMS)

Top management support refers to (Bingi and Sharma and Godla 1999, Poon and Wagner 2001, Nah 2001, Stratman 2002, Umble 2003) the executive sponsors (1) invest sufficient time, effort and resources to the project; (2) have a realistic understanding of the capabilities and limitation of the systems; (3) legitimize new goal and objectives and ask questions before the project implemented; (4) establish and approve new organizational structures, roles, policies and responsibilities; (5) monitor project process constantly; and (6) in times of conflict, managers should mediate between parties. The importance of the top management support is agreed by all researchers. The IT literature has clearly documented that for IT projects to succeed top management support is critical. Bingi, Sharma and Godla (1999) emphasized the top managers' understanding of the systems and IT is highly related to the quality of the top management support factors. The success of a project completely hinges on the strong, sustained commitment of top management. It is the first condition of any success ERP project. No support from the top managers, everything is hard to do. Umble (2003) suggested that the ERP should have an executive management planning committee that is committed to "enterprise integration, understanding ERP, fully supports the costs, demands payback, and champions the project."

2. Training and Education (TE)

ERP training and education is the process to introduce the knowledge of ERP program during the ERP implementation. The trainees include the managers as well as the employees. This factor reflects "knowledge transfer" in the IT adoption in business. Training and education is a very important critical success factor because ERP requires a critical mass of knowledge to enable people to solve problems within the framework of the system. Employees are expected to be able to efficiently use the new system. The benefits of ERP systems will not be realized unless the end users are using the new systems properly. Umble (2003) suggested that reserving 10-15% of the total ERP implementation budget for training

increase 80% chance of implementation success. However, ERP training is not easy because the system is complex and difficult. The “knowledge transfer” will be hard if the workers lack of information literacy. Bingi, Sharma and Godla (1999) suggested companies provide opportunities to enhance the skills of the employees by providing training opportunities on a “continuous basis” to meet the changing needs. Umble (2003) stated that good user training should start early, preferably well before the implementation begins. He also suggested training should maintain an ongoing contract with all systems users and monitor the problems and requirements of the new system, in other words, the post-implementation training. Robey, Ross and Boudreau (2002) found that firms had two kind knowledge barriers of two types: “those associated with the configuration of the ERP package and those associated with the assimilation of new work processes.” They gave two way-outs for overcome these two barriers: one of the two is user training, which could help overcome assimilation knowledge barriers.

3. Project Management (PM)

As mentioned before, ERP is a project with its special features. To ensure its success, the mangers should have a good ERP project management. The ERP project management refers to the process of a clear definition of objective, development of both a work plan and a resource plan, and careful tracking of project progress. In addition the project should establish aggressive, but achievable, schedules that maintain a sense of urgency (Umble 2003). The project management is a key process to realize the ERP project and push it to all the departments in companies.

4. Department Communication (DC)

The factor of department communication means the employees from different departments have a good reactive information transformation related to the problems or functions in the ERP implementation or usage. Al-Mashari (2002) claimed that the communication should detail several areas including the rationale for the implementation, the business process management change, demonstration of applicable software modules, and briefing of change management strategies and tactics and establishment of contact points. Communication should cover people, objectives and tasks of the projects.

The importance of communication across different business functions and departments is well known in information systems literature. Jenster (1987) said it is vital that all members in the organization have a firm understanding of procures and it is necessary to involve the right people as early as possible. The communication involved from the employees, users, software vendors and project managers. The good communication can reduce the resistance and conflict in the implementation. In the study of human factor in decision making for business, it is well known that people tend to active positively when they know clearly their role from company-wide view. If people know how their work is related to the others, they will work much easier and actively. In addition, according to Papke-Shields, Malhotra and Grover (2002), planning for systems will benefit from communication and coordination among a wide range of individuals with the relevant information. The good planning always needs more information, and a very important resource of more information come from the communication of employees in all the departments.

5. Change Readiness (CR)

Change readiness refers to the preparation for organization change occurred in the ERP implementation period. Esteves (1999) defined the preparation for changes as all the stakeholders and the team readiness for the changes associated with information systems implementation. A good preparation for organization changes will reduce the risk of conflicts and mass in the ongoing implementation. Umble (2003) stated that the existing organizational structure and process should not be compatible with ERP software. ERP brought changes to the organization's structure, business process and strategy. The success realization of the ERP benefits requires the change readiness from all over the organizations.

6. Business Progress Reengineering Management (BPRM)

Business Process Reengineering Management (BPRM) is defined as the activity by which an enterprise reexamines its goals and how it achieves them, followed by a disciplined approach of business process redesign. It is a disciplined approach of business process redesign. Bingi, Sharma and Godla (1999) stated that "implementing ERP systems involves reengineering the existing business processes to the best business process standard". Studies show that even a best application package can meet only 70 percent of the organizational

needs. The business should change its process to adapt to the ERP package. Therefore, the factor of BPRM is very important to the ERP implementation success.

7. Cultural Adaptability (CA)

Culture is defined by Hofstede (2004) as "the collective programming of the human mind that distinguishes the members of one human group from those of another. Culture is a system of collectively held values," Cultural adaptability is the ability to change so as to be suitable for a different and new cultural context. Globalization is the trend of today's business, the multi-national companies are faced with the problems in the international cooperation and competition. The cultural gap is a very important factor when making a strategic planning in different organizational context. When ERP is implemented into different areas and regions, it deals with different people in different cultural systems. Cultural adaptability is an absolute necessity when working across cultures. If the system is not adaptable by people with different cultural background, it means the implementation may meet more conflicts, and as a result, are more likely to fail. Therefore, cultural adaptability is included in the CSFs list in our study.

8. Software Competence and IT Skills (CITS)

Software competence and IT skills are related with the computer-based applications among the organizations. It is related to the IT engineers' performance and their professional qualifications and understanding on the ERP project and the requirements from the organizations. The software competence and IT skills also include the selection of the system's functionality, after-sale services and systems maintenance.

9. Hardware and Equipments (HE)

The hardware and equipments refers to all the resources to offer a good operating system in the organization. It includes the computer settings, the communication-tools and so on. (Poon and Wagner, 2001) The inadequacy of resources has been identified as a significant problem in IS planning. In their following study, they suggested that one of the common reasons cited for the failure in implementation are resource shortages and the significant investment in new systems to replace operational and effective existing systems.

3.4 Construct and Measurements

Considering the complexity of all the critical success factors as well as the multi-criteria for ERP implementation extent, all the variables in our study are measured by multi-items scale. Kling (1998) stated that multiple measurements can assess different facets of the construct to enhance the validity. Our construct (Table 4) is developed based on literature review and the constructs developed by Stratman and Roth (Table 1), Gottschalk (Table 2), and Hofstede (Table 3). There are slightly modifications on this construct based on the comments from interviewees in Chinese Mainland. The added items are specified with mark "#" in Table 4.

Table 4 Construct and Measurements

1.ERP Implementation Evaluation (ERP)
1.1. Overall, ERP implementation is successful.
1.2. Overall, ERP software vendors were responsive to business need.
1.3. ERP implementation has realized the expectation for its benefits to Business. #
1.4. Company productivity is improved after using ERP.
1.5. Business operational efficiency has been improved after using ERP. *
1.6. Business processes have been rationalized through use of ERP. *
1.7. ERP allows for better control of business operating expenses. *
1.8. New market opportunities have been identified through use of ERP. *
1.9. The financial visibility has been improved after implementing ERP. *
1.10. The business process dependent on ERP after implementation. *
1.11. ERP is integrated in the whole business process. *
1.12. ERP has improved customer satisfaction. *
1.13. ERP system is easy to operate and user friendly. # *
1.14. ERP allows users to generate supply-chain schedules addressing customer needs. *
1.15. Business benefits have been realized from reengineered ERP processes. *
2. Top Management Support (TMS)
2.1. Top managers willingly assign and invest resources to ERP project as they are needed.
2.2. Top managers mandate ERP requirements' priority over unique functional concerns. #
2.3. Top managers are enthusiastic about possibilities of ERP.
2.4. Top managers invested time needed to understand how ERP will benefit the enterprise. *
2.5. Top managers personally solve the departmental conflicts in the implementation. *
2.6. Top managers are prepared to take the risk and responsibilities of ERP. # *
2.7. Top managers understand the objectives of ERP. *
2.8. Top managers have good knowledge of ERP. *
3. Training and Education (TE)
3.1. Specific user training needs were identified early in the implementation. *
3.2. A formal training program has been developed to meet requirements of ERP. *
3.3. Training materials have been customized for each specific job. *
3.4. All users related to ERP have been trained in basic ERP system skills. *
3.5. We seldom update training materials to reflect systems changes. *
3.6. Training materials target the entire business task, not just the ERP screen and reports. *
3.7. The time for ERP training is enough for most of the employees. # *

Items that are modified based on the comments from interviewees in Chinese Mainland.

***** Items that are dropped by CFA analysis.

Table 4 Construct and Measurements (Continued)

4. Project Management (PM)
4.1. The tasks to be preformed during ERP project are clearly defined. *
4.2. The responsibilities of the project team members are clearly defined. *
4.3. There is decision committee to make decision for the unexpected factors in the implementation. # *
4.4. There is clear document for the ERP project. # *
4.5. There is schedule for the ERP project and deadline. *
4.6. The team members learn other consultants' knowledge and experience. *
4.7. Measurements are used to determine the status of project tasks. *
4.8. Project tasks are reviewed on a periodic basis. *
4.9. ERP project leader is experienced in project management. *
5. Departmental Communications (DC)
5.1. Cross-functional groups meet regularly to discuss new uses for ERP.
5.2. Internal groups meet regularly to share new methods of using ERP.
5.3. ERP improvement suggestions are regularly collected from multiple employees levels.*
5.4. IT staff communicates with functional use groups in the ERP. *
5.5. There is a communication team to solve the departmental conflicts during the implementation. # *
5.6. Employees understand how their actions impact operations of other functional areas. *
6. Change Readiness (CR)
6.1. Employees have input into how their jobs will change with new ERP business processes.
6.2. Employees understand how they fit into the new ERP. *
6.3. Management actively works to alleviate employees concerns about ERP.
6.4. An ERP support group is available to answer concerns about ERP job changes. *
6.5. The change readiness of employees impacted by the ERP system is regularly assessed. *
6.6. ERP-focused changes to the employee reward system have been communicated. (move to BPRM) *
7. Business Process Reengineering Management (BPRM)
7.1. Managers are clear on how business processes support the goals of ERP.
7.2. We keep track of ERP developments related to our industry.
7.3. ERP process documentation reflects actual operational activities.
7.4. Business experiments are conducted to evaluate potential improvements to use ERP. *

Items that are modified based on the comments from interviewees in Chinese Mainland.

***** Items that are dropped by CFA analysis.

Table 4 Construct and Measurements *(Continued)*

8. Cultural Adaptability (CA)
8.1. Business has specific organizational culture. *
8.2. Employees are willingly to accept new things. *
8.3. Cultural factor has been considered when implementing ERP. *
8.4. The employees can adaptable to the new ERP systems. *
8.5. The personal characteristic is important in the organization. *
8.6. The manager is powerful in the organization. *
9. Software Competence and IT skills (CITS)
9.1. The database administrator is an expert in the ERP database management system.
9.2. Internal IT team members understand custom ERP software programs.
9.3. IT staffs are able to efficiently implement ERP system upgrades and maintaining.
9.4. IT staff actively builds relationships with business managers. *
9.5. IT staff offer ideas on how IT can be used to achieve business goals. *
10. Hardware and Equipments (HE)
10.1. Communications technology to be implemented.
10.2. Hardware to be implemented.
10.3. Other supporting software implemented.
10.4. Operating system to be implemented.

Items that are modified based on the comments from interviewees in Chinese Mainland.

***** Items that are dropped by CFA analysis.

3.5 Hypotheses Development

3.5.1 Hypothesis H_1

Based on literature review, we expect the positive relationships between CSF_i (i=1, 2 … 9) and ERP implementation, that is, higher the CSFs' achievement, higher the chance of ERP success. There are nine CSFs in the research model. Let r_i be the correlation between CSF_i (i=1,2,…, 9) and ERP. The positive relationship between CSF_i and ERP means $r_i>0$. The hypotheses H_{1i} (i=1,2,…, 9) are:

$$H_{1i0}: r_i \leq 0$$

$$H_{1ia}: r_i>0$$

It tests whether there is positive relationship between the achievements of the CSF_i (i=1,2,…, 9) and the achievements of ERP implementation.

3.5.2 Hypothesis H_2

Considering the claim that different CSFs play different roles in the ERP implementation, we claim that there are some factors more important than the others. The relative importance (RI_i) (i=1, 2…, 9) refers to the contribution of the CSF_i to ERP implementation. Different RIs mean that at least one RI is not equal to the others RIs. The hypothesis H_2 is:

H_o: $RI_1 = RI_2 = ... = RI_9$

H_a: *at least one* RI_i *is not equal to others.*

CHAPTER 4 RESEARCH METHODOLOGY

4.1 Introduction

In chapter 3, we developed research model and hypotheses. A cross-sectional survey is carried out to test the research model and hypotheses. The data collected will be analyzed by Structural Equation Modeling (SEM).

4.2 Research Methods

Survey and case study are widely used methods to collect data. Case study is beneficial especially for the exploratory study in the early stage. Survey is appropriate when research and theory are beyond the early stage. Premkumar (1994) suggested that "survey methodologies are useful for studying a large number of variables using a large sample size and rigorous statistical analysis, it provide greater external validity and easier generalization of results." This thesis is to collect the data of ERP implementation in Chinese Mainland.

4.3 Survey and Questionnaire

The questionnaire design is based on our research model discussed in chapter 3. The questionnaire consists of three parts (Appendix). Parts one and two gather the respondents' evaluation on the ERP implementation and the nine critical success factors. Part three seeks the demographic data. A seven-point Likert scale was used.

Yin (1994) stated that the understanding of information systems implementations cannot be achieved without considering the organizational context where it occurs. Therefore, we conducted interviews in four companies in Shanghai. Two of them are famous software vendor companies and the other two are manufacturing factories. The respondents are software developers, service consultants, and senior managers. Years' working experiences assured their ideas full of professional quality. The interviews were finished in two weeks. All of them were asked to review the questionnaire and give their comments. The sequences of the items, the content of the items and the descriptive languages were slightly modified based on their comments.

After that, we conducted a pilot test in an MBA class. The qualified testers must meet two requirements: (1) they did work or are working in companies adopted ERP project, and (2) the systems is still in use. We selected ten MBA students to complete the questionnaires. They were asked to answer the questionnaire and see whether the questions are readable and understandable. If any of the question or term is confusing, they should make their suggestions. We made some changes at our discretion.

4.4 Structural Equation Modeling (SEM)

Structural Equation Modeling (SEM) is a powerful multivariate data analysis tool. It (Kelloway 1998) estimates a complete model incorporating both measurement and structural considerations. It deals with how the measures reflect the intended constructs.

Confirmatory factor analysis is a widely used application of SEM to test the construct. It is (Mueller 1996) one of the most prevalent SEM techniques in the evaluation in the social and behavioral sciences. CFA provides a framework or addressing the problems associated with traditional ways of assessing a measure's validity and reliability. Therefore, the CFA approach to multivariate data analysis does not let a particular data set dictate, identify, or discover underlying dimensions, rather, it requires the researcher to theorize an underlying structure and assess the observed data fit the hypothesized model.

In path analysis, the path coefficients are interpreted similarly as the standardized beta coefficients in a regression analysis. The significance of the path coefficient is determined by t statistics. (Gefen, Straub and Boudreau, 2000).

CHAPTER 5 DATA COLLECTON AND ANALYSIS

5.1 Introduction

Based on the research methodology in chapter 4, we collected the survey data from the manufacturing companies in Chinese Mainland. The data were analyzed by CFA and path analysis. The results suggested a revised model. The implications of the data will also be discussed in this chapter.

5.2 Data Collection

The survey was conducted in Chinese Mainland from April to June 2005. Most of the manufacturing companies are located in Shanghai and others are in Guangzhou, Shenzhen, and Tianjing. The companies manufactured electronic products, autos, and others. About 400 questionnaires were sent out in two months. Around 80% of the questionnaires were sent out by letters and services of mail express (SME). 20% of the questionnaires were sent out by emails. 283 questionnaires were received. The response rate is 70.75%. Among them, 271 questionnaires are valid. It covers around 150 different companies and no more than four questionnaires were received from the same company.

5.3 Demographic Data

5.3.1 Types of the Ownership of Companies

The types of the ownership of the companies adopted ERP system include the foreign invested companies, joint venture companies, state-owned companies, private companies. Some of them did not specify the types of their organizations. The distribution of the company's ownership types are listed as below (Table 5).

Table 5 Type of Ownership of Company Distribution

Type	**Foreign Invested**	**Joint Venture**	**State-owned**	**Private**	**Not Specified**	**Total**
No.	46	63	48	22	92	271
Percentage	16.97%	23.24%	17.71 %	8.11%	33.95%	100%

5.3.2 Roles of the Respondents

The respondents in this survey include the executive sponsor, the project leader, the functional or technical specialist, the people who are partially involved and the ERP users. All the respondents actually are the ERP users. However, they could be the executive sponsor, or ERP project leader, or functional or technical specialist and people that partially involved (people who attend in only a part of the ERP project implementation). The respondents may choose more than one items in the questionnaires. There are overlaps in the

answers from the respondents. The distribution of the respondents is listed in Table 6.

Table 6 Respondents Role Distribution

Role of the respondents	**Executive Manager**	**Project Leader**	**Part Of Project Team**	**Functional or Technical Specialist**	**Partially Involved**	**ERP User**
No.	14	42	98	62	80	271
Percentage	3.67%	11.02%	25.72%	16.27%	21.00%	22.31%

5.3.3 Software Vendors

There are five major software vendors including UFsoft, Kindee, SAP, Peoplesoft, Oracle and some small vendors including self-developed software companies and European software vendors. The UFsoft and Kindee are domestic software companies in China and the SAP, Oracle and Peoplesoft are representatives of western software vendors. The distribution of the software vendors are listed in Table 7.

Table 7 Software Vendor Distribution

Software Vendors	**Domestic Software Vendors**		**Western Software Vendor**			**Others**	**Total**
No.	57		125			89	271
Percentage	21.03%		46.13%			32.84%	100%
	UFSoft	**Kindee**	**SAP**	**PeopleSoft**	**Oracle**	**Others**	**Total**
No.	42	15	86	2	37	89	271
Percentage	15.50%	5.54%	31.73%	0.74%	13.65%	32.84%	100%

5.4 Measurement Model Refinement

It is important to obtain an adequate measurement model before we test substantive theory. Koufteros (1999) developed a step-by-step approach for the assessment of unidimensionality and the evaluation of other measurement properties. Please refer to Fig. 2 of Koufteros (1999) or Figure 10 we cited below. It provides a paradigm for assessment of measurement properties. First, it tests the convergent validity and item reliability to find out “how a particular item behaves within the block of items intended to measure a single construct”. The items that do not load significantly on a scale and/or have low item reliabilities should be dropped. If a trimmed model is emerges, the model fit and unidimensionality should be examined. After that, the discriminant validity and the composite reliability should be tested. Reliability test is left to the last.

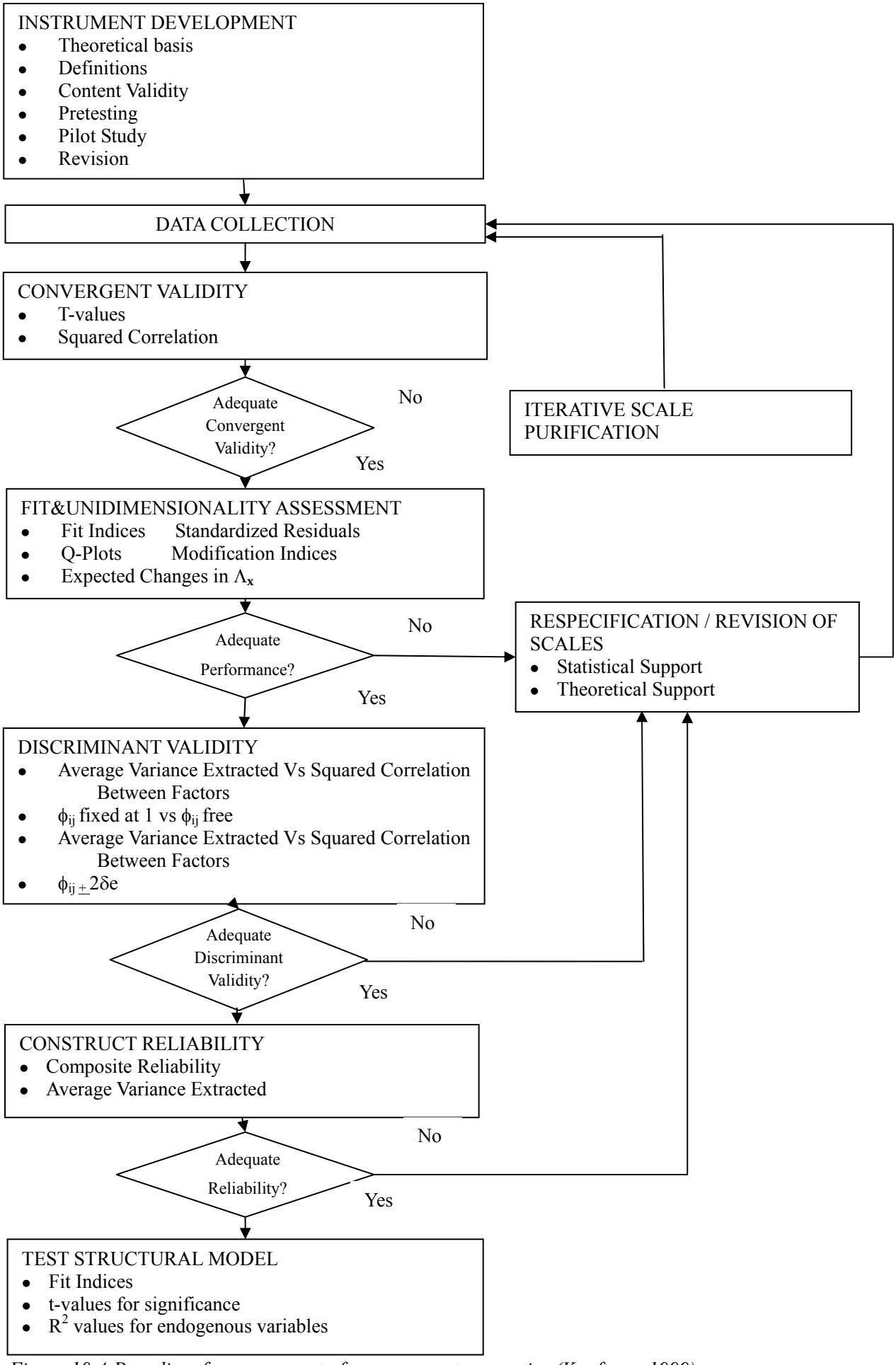


Figure 10 A Paradigm for assessment of measurement properties (Koufteros 1999)

We mainly follow the process provided by Koufteros (1999) to refine our model. The initial hypothesized model of our study is displayed in Figure 11, which includes ten latent variables (constructs) and their corresponding items (70 in total). The items are in the square box and the latent variables are in the ovals which are connected by arcs. These arcs mean the correlations between various latent variables. We use the confirmatory factor analysis (CFA) to exam the convergent validity, item reliability, the model fit, unidimensionality, and the discriminant validity of our model. Figure 12 is a model used for testing the discriminant validity of the model. No arcs between these latent variables mean the correlations between these latent variables are set to zero. After we completed the whole process, twenty one items and six latent variables were left. The final model is displayed in Figure 12.

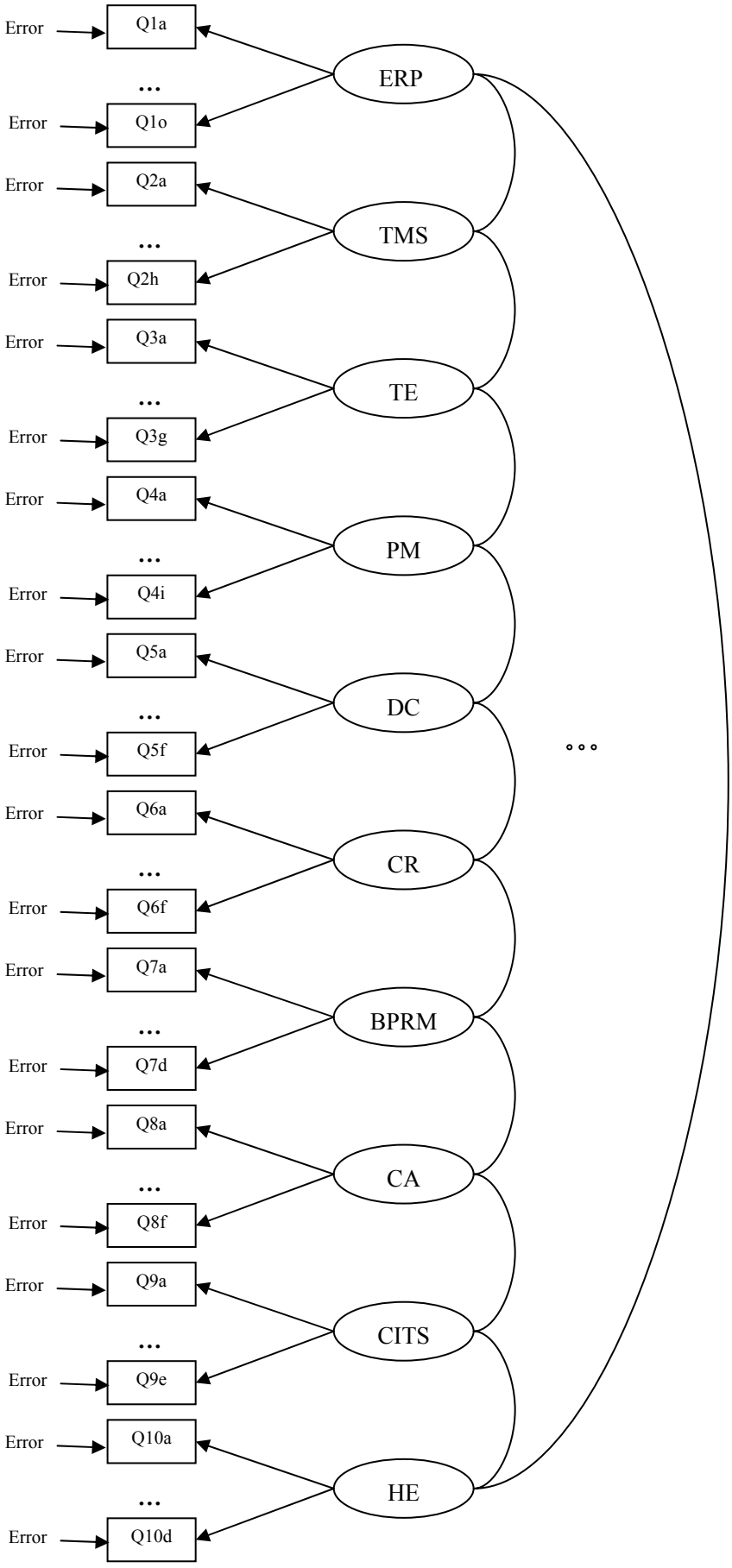
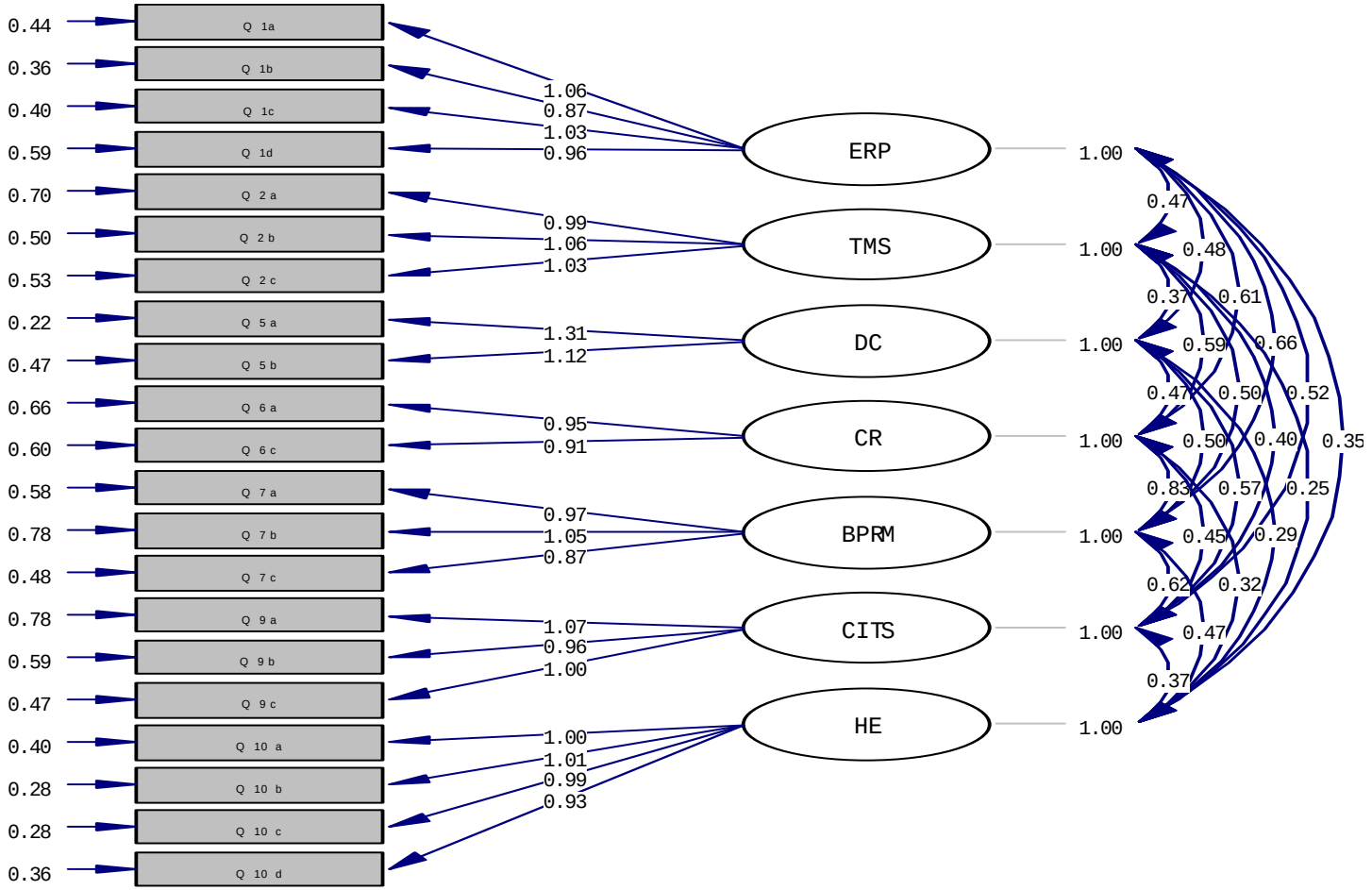


Figure 11 Measurement Model (Before Refinement)



Chi-Square=279.72, df=168, P-value=0.00000, RMSEA=0.050

Figure 12 Measurement Model (After Refinement)

5.5 Path Analysis

Once an acceptable measurement model is available, the structural model evaluation may begin. Path analysis is a useful analytical tool for testing particular predictors on the criterion variables and their regression weights in the multiple regression analysis (regression for explanation). Kling (1998) stated that the path analysis can test the presumed causal effects. The information used to estimate paths is the correlation of variables. We will use t-values to evaluate the model fit. A t-value is the ratio of an estimated parameter to its standard error.

The result of our path analysis model based on our data in Figure 13 is in Figure 14.

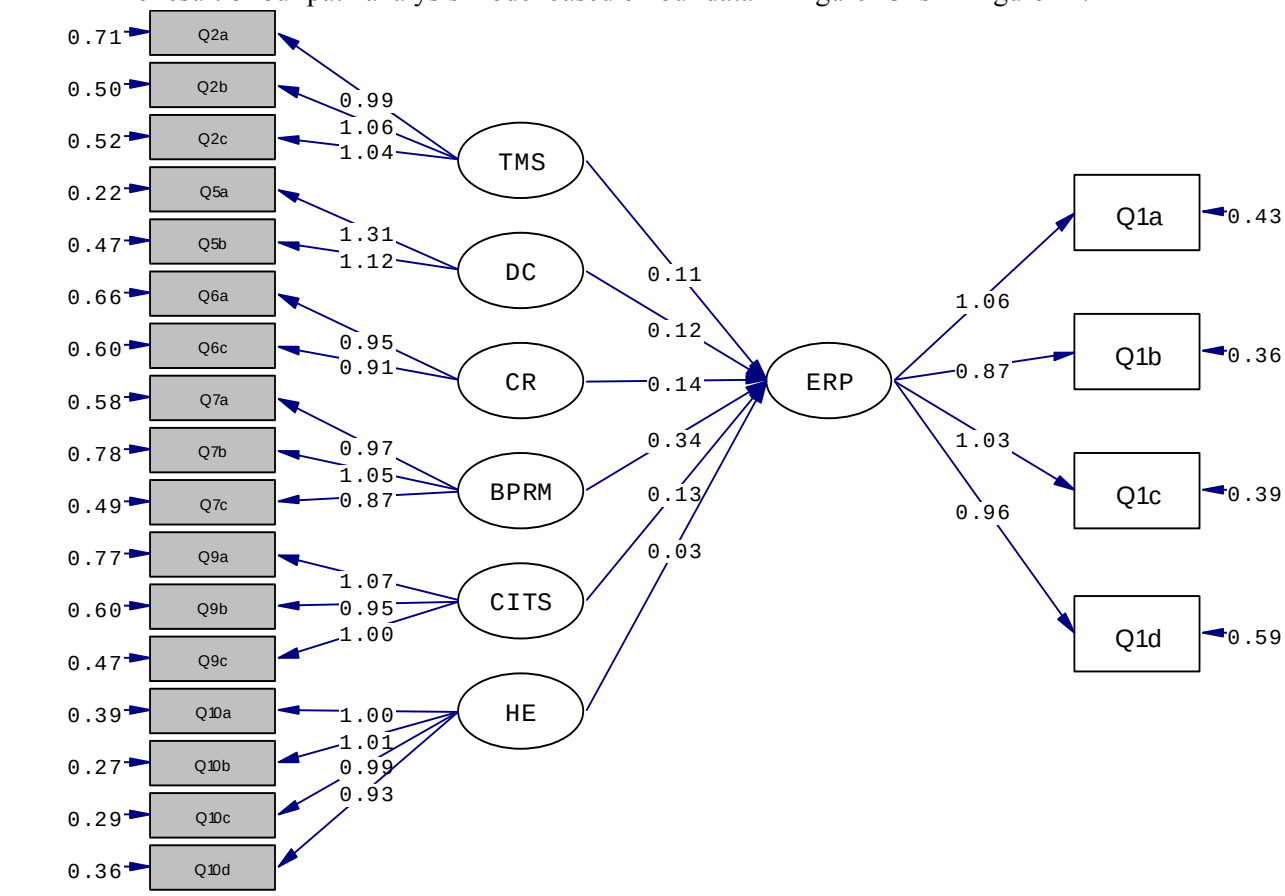


Figure 13 Final Path Analysis Model

Model Fit: χ^2=280.68(p=0.0), df=168, χ^2/df=1.67, NNFI=0.96, CFI=0.96.

And the equation of CSF for ERP implementation is:

ERP= 0.11* TMS + 0.12*DC + 0.14*CR + 0.34*BPRM + 0.13*CITS + 0.031*HE

The coefficient before the CSFs could be viewed as the relative importance (RI).

5.6 Model Fit and Unidimensionality

The overall fit of the model is tested by using the maximum likelihood χ^2 statistic provided by LISREL. χ^2 is a function of internal and external consistency. However, χ^2 statistics

(Koufteros 1998) is a test of model's ability to reproduce the sample variance / covariance matrix, its significance levels are sensitive to sample size and departures from multivariate normality. Therefore, caution is needed when using the indices to test the model as some of them are affected by sample size and the ratio of indicators per factor (p/r). Ding et al (1995) concluded that χ^2 per degree of freedom and NNFI are independent of sample size where CFI was affected by sample size to a small degree. It is suggested to use the ratio of χ^2 to degrees of freedom, the normed fit index (NFI), the non-normed fit index (NNFI) and the comparative fit index (CFI). Researchers recommended that the use of ration of χ^2 to degree of freedom less than 2 as indication of a good model fit, model exhibiting CFI and NNFI indices greater than 0.90 have adequate fit. In our trimmed model, the fit indices are: χ^2=279.72 (p=0.0), df=168, χ^2/df=1.665, NNFI=0.96, CFI=0.96, the ration of χ^2 to degree of freedom is less than 2 and the NNFI and CFI both are 0.96, indicating one expects any model that adequately explain the variances and covariance in the observed data to reflect a 96% improvement over the null model. The measurement model is assumed as an adequate model.

5.7 Validity and Reliability

After the measurement model test and the path analysis, we test the validity and reliability of the final model.

5.7.1 Content Validity

Content validity refers to (Nunnally 1978) the extent to which the items on a test adequately reflect the domain of the content for which they were written. The content should be achieved by reviewing the relevant literature as well as the content of other similar tests (Nunally 1978). In our study, we developed the construct based on the literature review in Chapters 2 and 3. In addition, we revised the constructs through the interviews in companies in Chinese Mainland as mentioned in Chapter 3. In this way, the content validity of this research is assured.

5.7.2 Convergent Validity and Item Reliability

Convergent validity is determined by hypothesizing and examining the overlap between two or more tests that presumably measure the same construct. The validity of the observed variables could be estimated by the standard factor loadings of observed variables (items) on latent variables (factors). The criteria are the t-values and the squared correlations (R^2). The larger the factor loadings or coefficients, as compared with their standard errors and expressed by the corresponding t-values, the stronger is the evidence that the measured variables or factors represent the underlying constructs (Bollen 1989). Koufteros (1998)

stated that if the t-values are greater than 2.567, it means that it is significant at the 0.01 level. In our study, all the t-values of the factor loadings are greater than 2.567. Thus the convergent validity of the final model is assured. As for the item reliability test, the proportion of variance (R^2) in the observed variables that is accounted for by the latent variables influencing them can be used to estimate reliability of a particular observed variable (item). Bollen (1989) suggested that R^2 values above 0.50 provide evidence of acceptable reliability. All the R^2 values in our final model are greater than 0.50, which indicate the item reliability satisfied.

5.7.3 Discriminant Validity

Discriminant validity refers to the degree to which measures of different constructs are distinct or unique from each other (Hair 1995). The discriminant validity can be tested by three means (Koufteros 1998). First, the differences between the χ^2 values for the fixed/constrained and free solutions indicate whether a unidimensional model would be sufficient to account for the intercorrelations among the observed variables in each pair. To test the discriminant validity is to compare a model in which latent variables correlate freely, with one in which they are perfectly correlated; the larger the discrepancy between the χ^2 and the GFI/CFI values, the stronger the support for evidence of discriminant significant (Byrne 1998). Second, the AVE with the squared correlation between constructs. Third, confidence interval, which is constructed by the correlation between two constructs plus or minus the standard error. In our study, the difference of χ^2 value between the free model and the model is 45 from LISREL or the p-value is 0.0 indicating a statistical significant difference between these two models. It indicates a good discriminant validity.

5.7.4 Reliability

Reliability refers to how consistent the instrument measures are. Cronbach's alpha is a coefficient of reliability. It measures how well a set of items/variables measures a single uni-dimensional latent construct. In our study, the Crobach's alphas for all multiple item scales are from 0.732 to 0.920 as listed in Table 8. It indicates a good reliability of this study.

Table 8 Reliability Test (Revised Model)

Construct	Cronbach's Alpha	N of Items
ERP Implementation Evaluation (ERP)	0.894	4
Top Management Support (TMS)	0.844	3
Department Communication (DC)	0.891	2
Change Readiness (CR)	0.732	2
Business Process Reengineering Magt. (BPRM)	0.817	3
Competence and IT Skills (CITS)	0.832	3
Hardware and Equipments (HE)	0.920	2

Composite reliability means that a set of latent construct indicators are consistent in their measurements (Koufteros, 1998). They are all measuring the same latent construct.

5.8 Hypotheses Testing

1. Hypothesis H_1

For easy reference, we cite H_1 again below:

H_{1i0}: $r_i \leq 0$

H_{1ia}: $r_i > 0$

Where r_i is the correlation between CSF_i (i=1,2,…,9) and ERP. Table 9 provides the multiple correlations of each variable in the hypothesized model. The correlation coefficients in the first column reflect the correlation between each CSF and ERP implantation. All r_i are significant at p-value less than 0.005. Besides, $r_i > 0$ (i=1,2,…,9).

Table 9 Correlation between CSFs and ERP Implementation.

	TMS	DC	CR	BPRM	CITS	HE
ERP	0.68	0.60	0.66	0.75	0.61	0.34

Therefore, H_{1io} is rejected. It means, each of the CSF_i (i=1, 2 … 9) has a positive relationship with the ERP implementation.

2. Hypothesis H_2

For easy reference, we cit H_1 again below:

H_o: $RI_i = RI_2 = ... = RI_9$

H_a: *at least one* RI_i *is not equal to others.*

Where RI_i is the relative importance of the CSFs (i=1, 2,…9). The path loadings in the path analysis represent CSFs' relative importance, therefore, the value are different from each other. Therefore, H_2 is rejected. Table 10 listed the correlation matrix of the independent variable.

Table 10 Relative Importance among CSFs

	BPRM	**CR**	**CITS**	**DC**	**TMS**	**HE**
RI	0.34	0.14	0.13	0.12	0.11	0.03

5.9 Relative Importance of the CSFs

Based on the path analysis in prior chapter, we get the correlation matrix of CSFs and ERP implementation. The correlation relationships among the six most important CSFs and ERP are listed in Table 11.

Table 11 Correlation Matrix of CSFs and ERP Implementation (Revised Model)

	ERP	TMS	DC	CR	BPRM	CITS	HE
ERP	1.00						
TMS	0.47	1.00					
DC	0.48	0.37	1.00				
CR	0.61	0.59	0.46	1.00			
BPRM	0.66	0.50	0.50	0.83	1.00		
CITS	0.52	0.40	0.57	0.44	0.62	1.00	
HE	0.34	0.25	0.29	0.32	0.47	0.37	1.00

There are six CSFs with different RI to the success of ERP implementation. From the largest to the smallest, they are: (1) business process reengineering management, (2) change readiness, (3) software competence and IT skills, (4) departmental communication, (5) top management support, and (6) hardware and equipment.Through data analysis via structural equation model, we purified a map for the ERP implementation and these six CSFs were listed with relative importance for the success result as illustrated in Figure 15. These factors are more important than the other three factors for the success ERP implementation. As mentioned and discussed before, knowing and control the priority among these CSFs will help managers have a better overview and control for the decision situation for ERP implementation. We are about to discuss these critical success factors.

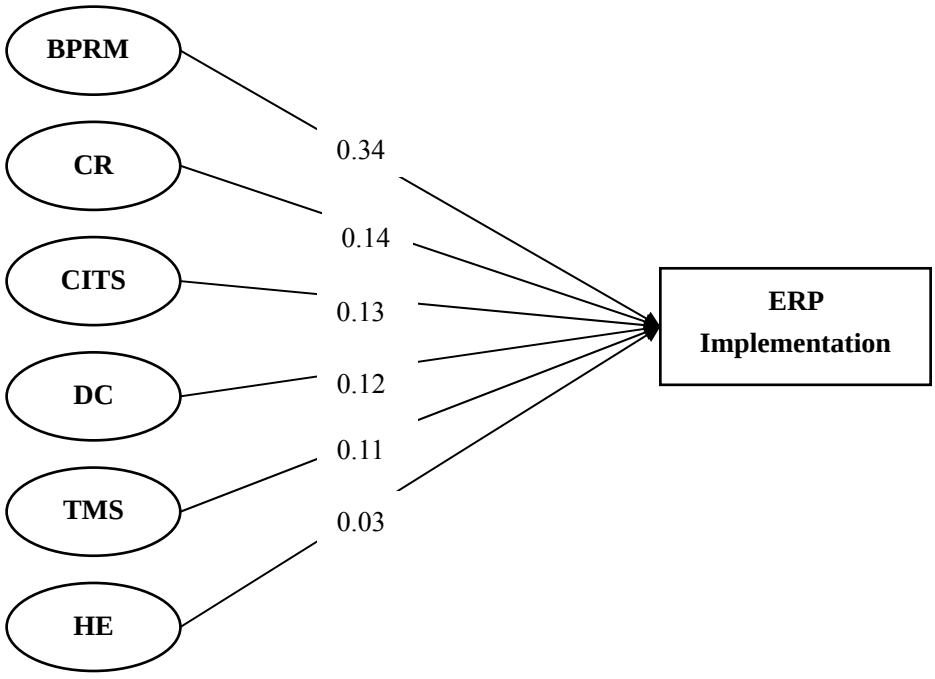


Figure 14 CSFs with different RI for ERP Planning

The attention is given to the top two CSFs, business process reengineering management (BPRM) and change readiness (CR). Both of them are related to “change”. The correlation coefficient between them is 0.83, the highest one. Business Progress Reengineering management (BPRM) is defined as the activity by which an enterprise reexamines its goals and how it achieves them, followed by a disciplined approach of business process redesign. The BPR involves radical organizational changes involving organizational structure, people and business activities and other settings in organizations. Because of the huge changes in ERP implementation, the risks of ERP fail are high. There are conflicts in the BPR process because of potential position movement or political power transfer. Suggestions for achieving a successful Business Process Reengineering Management are given from the revised model, they are: (1) Managers are clear on how business processes support the goals of ERP, (2) Managers keep track of ERP developments related to the industry, and (3) ERP process documentation reflects actual operational activities. Change readiness (CR) refers to the preparation for organization change occurred in the ERP implementation period. A good change readiness means: (1) employees have input into how their jobs will change with new ERP business processes，and (2) management actively works to alleviate employees concerns about ERP. In all, we can get inspiration “change” that happened in the BPRM and ERP implementation should be highly noticed before take the project into action.

Following, the relative importance of the other four CSFs, software competence and IT skills, departmental communication, top management support, and hardware and equipment are 0.13, 0.12, 0.11 and 0.03, respectively.

The criteria for assure a good software competence and IT skills can be drawn from the revised model, they are: (1) The database administrator is an expert in the ERP database management system., (2) Internal IT team members understand custom ERP software programs, (3) IT staffs are able to efficiently implement ERP system upgrades and maintaining, (4) IT staff actively builds relationships with business managers, and (5) IT staff offer ideas on how IT can be used to achieve business goals. Although the software competence and IT skills are very important, we should not deny a fact that in today’s ERP market, the ERP software developed in a relatively mature stage, the information technology develops more fast than the accordingly management skills to use it in business. When implemented the same software in different companies, the result may totally different. It is not because of the software itself, but because of the different organizational management. The difference mainly stem from the different the levels of top management support, or, the quality of BPR management and the competence of project management and other activities related to human management.

The good departmental communication is also very important with a very close RI value comparing with software competence and IT skills. The successful of ERP implementation means the systems integrated well in all the departments. Therefore, the department communication and cooperation are important. Good departmental communication can be obtained in these ways: (1) Cross-functional groups meet regularly to discuss new uses for ERP, (2) Internal groups meet regularly to share new methods of using ERP, and (3) ERP improvement suggestions are regularly collected from multiple employee levels.

As for the top management support, surprisingly, it does not have highest RI as we expected, which is not consistent with the literature. This result arouses our curiosity. Checking measurement, the top management support in the tested model measures whether: (1) top managers willingly assign and invest resources to ERP project as they are needed, (2) top managers mandate ERP requirements' priority over unique functional concerns, and (3) top managers are enthusiastic about possibilities of ERP. We believe this result does not mean that top management support is not important, rather, it means that the top management support is not enough in most of the companies because most of the respondents are required to evaluate the situation in their companies. We can recognize that the respondents expect more support from the top management from this result.

We can find data support from the correlation matrix in Table 11. The correlation coefficient between TMS and BPRM is 0.50, and that of between TMS and CR is 0.59. The highly correlated relationship between them means that the success of BPRM and CR both need the support from the TMS. The involvements of top managers can ensure the smooth undertaking of activities in ERP implementation.

Although with a relative low value of RI, the importance of top manager support should not be overlooked. The relative low RI on TMS only suggests that more effort and improvement should be made on TMS. A consultant in our interview said that "the ERP starts from the top manager's decision." As he suggested, "if the top manager does not want ERP, no one in the company will think for it and no one owns the power to realize it." No top management support, there will not be enough resources for the money and time consumed complex project. Any successful ERP project requires strong leadership, commitment, and participation by top management. The top managers play an important role to make decision when unpredicted issues is confronted, to release the conflicts in the turn-over in organizations, and to keep the ERP project in line of the original business needs. A project manager also mentioned that the conflicts and emergencies happened in the organizations need the on-time management to settle down the conflicts. The rank could not hide its

importance. A resourceful top management support is a good beginning for the ERP implementation. It provided the possibility of all the other activities undertaking. In all, the top management support is very important for success ERP implementation and more effort are needed in real business world.

As for the last one, hardware and equipment, the ERP implementation is realized on the computers and communication equipments in the companies, it is hard to imagine the success running of ERP systems without good hardware facilities. The data transfer, data backup, and the data sharing, all need the good hardware support. A good hardware and equipment environment means: (1) communications technology to be implemented is good, (2) hardware to be implemented is good, (3) other supporting software implemented is good, and (4) operating system to be implemented is good.

In the end, we should announce that the relative importance values among the six CSFs are slightly significantly different from each other after further calculation. However, it is not contradicted with our originally aim and objective. It is acceptable that all CSFs' realization assure the success result. We wanted to test the relative importance to understand the complex issues better to make a good planning. The relative importance could be very helpful when making planning strategy.

CHAPTER 6 CONCLUSION

6.1 Introduction

“How can a manger make a good planning for ERP implementation?” Based on the analysis in prior chapters, we draw a conclusion on this question. The contribution, limitation and future research are discussed in this chapter.

6.2 Contribution of the Study

There are mainly two contributions of this study. First, this study combines the decision rule into the model of Critical Success Factors for ERP implementation. It could give more implications and inspirations for managers to make a good decision in ERP implementation in organizations.

Second, (Apply to another cultural environment – external validity????) it helps to test the availability???? of theory in another cultural and contextual background and extends the application for ERP implementation. The manufacturing market increased in a surprising speed. China becomes a big ERP market in global economy. However, the information literacy in Chinese Mainland is different from that in other countries. For example, the history of IT is not long when comparing with the western countries. The real situation in PRC may different from the western countries, and the planning strategies for ERP may also different. This study explores the real situation in Chinese Mainland and the conclusion is applicable and practical to Chinese Mainland market. The research in Chinese Mainland is valuable for both the companies adopting ERP and the software vendors in wiliness to enlarge the market.

6.3 Conclusion

To conclude, for the effective planning of the ERP implementation, (1) business process reengineering management, (2) change readiness, (3) software competence and IT skills, (4) departmental communication, (5) top management support, and (6) hardware and equipment should be allotted high priority. The managers is highly recommended to consider the “change” that will happened in the ERP implementation when designing the planning. The top management support is very important and it needs more effort in Chinese Mainland companies. The top managers should realize their important and vital roles played in the implementation. Besides, in case that there are not enough resources such as time and money in the process of ERP implementation, it is suggested to consider the whole situation and the relative importance. More consideration and resources should be allotted to the activities with higher RI to reach an optimistic result.

6.4 Limitations and Further Research

There are limitations in this research and more efforts are needed for further research. First, the data collected from Chinese Mainland have regional limitations. It may not be applicable to other countries. Considering the similar information literacy background and other similar context in other cities and areas in Chinese Mainland, we believe the result could be applicable to other areas in Chinese Mainland. ????? Nevertheless, for the other countries in Asian, such as Singapore, Hong Kong and Taiwan, as the IT development history and employee's information literacy background differ, the generalization of this study needs more tests to get a cautious conclusion.

Second, some of the factors could not be tested and explored in this study. For example, it is hard for both the researchers and interviewees to give definition and understanding for the "culture" in organization. The measurements for the cultural factor in IT area and the suggestions for it are still rare. The importance of cultural difference is noticed and recognized. How to avoid the disadvantage and the gap of cultural difference deserved more exploration. Unfortunately, all the items in the hypothesized model for the cultural factor were eliminated in the model revision. The valuable suggestions could not be concluded from this research.

Third, there is problem in respondents' distribution. When collecting the information of the ERP implementation, we selected different people in a company to answer the questionnaire to avoid the subjective problem and get a more objective evaluation. However, other problem stemmed. The respondents may come from totally different levels and hold opposite views towards the ERP and CSFs' performance and achievement. For example, people come from managerial level may view the ERP very successful and the employees may think it is not easy to use, and the performance is very bad. Similarly, the CSFs achievement may also vary from different respondents. We recommend finding a trade-off for this problem in the future research.

BIBLIOGRAPHY

Akkermans, H. and Helden, K. V. (2002). Vicious and virtuous cycles in ERP implementation: A case study of interrelations between critical success factors, *European Journal of Information Systems, 11(1)*. 35-46.

Allen, D. K. T. and Havenhand, M. (2002). ERP Critical Success Factors: an exploration of the contextual factors in public sector institutions, *Proceedings of the 35th Hawaii International Conference on System Sciences,* IEEE.

Al-Mashari, M., Al-Mudimigh, A. and Zairi, M. (2003). Enterprise resource planning: A taxonomy of critical factors. *European Journal of Operational Research.* 146. 352-364.

Arsham, H. (1994). Leadership Decision Making: *http://home.ubalt.edu/ntsbarsh/index.html.*

Barker, T and Frolick, M. N. (2003). ERP implementation Failure: a case study. Information Systems Management. *Information Systems Management.* 20(4). 43-49.

Barker, T. and Frolick, M. N. (2003). ERP implmenetation failure: a case study. *Information Systems Management.* 20(4), 43-49.

Besson, P., and Rowe, F. (2001). ERP projecct dynamics and enacted dialogue: perceived understanding, perceived leeway, and the nature of task-related conflicts. *Database For Advances in Infomraiton Systems. 32(4).* 47-66.

Bingi, P., Sharma, M. and Godla, J. (1999). Critical Issues Affecting an ERP Implementation, *Information Systems Management,* 16(3), 7-15.

Black, K. Business Statistics for contemporary decision making, 4th edition, Leyh Publishing, LLC: USA.

Bollen, K. A., 1989. Structural Equations with Latent Variables. Wiley, New York, NY.

Boynton, A.Z. et al. and Jacobs, G. (1994). The influence of IT management practice on IT use in large organizations. *MIS Quarterly.* 18(3), 299-318.

Byrd, T. A. and Turner, D. E. (2001). An exploratory analysis of the value of the skills of IT personnel: Their Relationship to IS infrastructure and Competitive Advantage. *Decision Sciences,* 32(1). 21-54.

Byrne, B. M. (1998). Structural Equation Modeling with LISREL, PRELIS, and SIMPLIS: Basic concepts, applications, and programming. Lawrence Erlbaum Associates, Publishers: London.

Churchill, G. A. (1979) A paradigm for developing better measures of marketing constructs. *Journal of Marketing Research.* 16(3). 64-73.

Ding, L., Velicer, W. F., and Harlow, L. L. (1995). Effects of estimation methods, number of indicators per factor, and measurement error. *Journal of Marketing Research,* 25, 186-192.

Drucker, P. F. (2001). The effective decisions, *Harvard Business Review on Decision Making.,* Harvard Business School Press: United States, 1-20.

Duplaga, E. A. And Astani, M. (2003). Implementing ERP in manufacturing. *Information Systems Management.* 20(3). 68-75.

Esteves, J. M. and Pastor, J. A. (1999) An ERP life-cycle-based research agenda. *First International workshop in Enterprise Management and Resource Planning: Methods, Tools and Architectures.*

Gefen, D., Straub, D., and Boudreau, M. (2000). Structural Equation Modeling and Regression: Guidelines of Research Practice. Communications of the Association for Information Systems. 4(7). 1-78.

Gottschalk P. (1999). Strategic information systems planning: the IT strategy implementation matrix. *European Journal of Information Systems.* 8.107-118

Hair, J. F., Jr., Anderson, R. E., Tatham, R. L., and Black W. C. (1995). Multivariate Data Analysis with Readings. 5th Edition. Englewood Cliffs. NJ: Prentice Hall.

Harris, R. J. (1975). A Primer of Multivariate Statistics. *Academic Press*, New York.

Head, R. V. and Emery, J. C. (1982) Strategic planning for Information Systems. Revised Edition. Wellesley, Mass: Q.E.D. Information Sciences.

Hofstede, G. J. (2004) Cultures and Organizations: Software for the Mind. McGraw-Hill.

Holland, C. P., and Light B. (1999) A Critical Success Factors Model for ERP Implementation. *IEEE Software.* 30-36.

Holland, C. P., and Light, B. (2001) Stage Maturity Model for Enterprise Resource Planning Systems Use. *The Database for Advances in Information Systems,* 32(2). 34-45.

Imprint New York: Wiley, c1977

Janson, M. A. and Subramanian, A. (1996). Packaged Software: Selection and Implementation Policies. *INFOR,* 34(2), 133-151

Jenster, P. V. (1987). Using Critical Factors in Planning. *Long Range Planning,* 20(4). 102-109.

Jones, M. C. and Leon P. R. (2004) Organizational knowledge sharing in ERP implementation: lessons from industry. *Journal of Organizational and End User Computing,* 16(1). 21-24.

Kachigan, S. K. (1986). Statistical Analysis: An interdisciplinary introduction to univariate& Multivariate Methods, Radius Press: New York.

Kathuria, R., Anandarajan, M. and Igbaria, M. (1999). Linking IT Applications with Manufacturing Strategy: An Intelligent Decision Support System Approach, Decision Sciences, 30(4). 959-991.

Kelloway, E. K. Using Lisrel for structural equation modeling: A researcher's guide. Sage Publiscations, Inc: Thousand Oaks, CA.

Kenser, R. M. (1999) IT planning and procedurement-the underlying architectural process. Information Strategy, Fall, 7-14.

Kesner, R. M. (1988). Information Systems: A strategic approach to planning and implementation. Amaerican Library Association Chicago and London.

King, W. R. (1978). Strategic Planning for Management Information Systesms, *MIS Quarterly,* 2(1). 27-37.

King, W. R. (1994). Organizational characteristics and information systems planning: An empirical study. *Information Systems Research,* 5(2), 75-109.

Kline, R. B. (1998). Principles and practice of Structural Equation Modeling. The Guilford Press: New York.

Konsynski, B. R. and E. A. Stohr. (1992). Decision Process: An organizational View. …. [Book: Information Systems and Decision Processes]

Kruskal, W. (1987). Relative importance by averaging over ordering, *The American Statistician,* 41(1). 6-10.

Kruskal, W. and Major, R. (1989). Concepts of relative importance in recent scientific literature. *The American Statistician,* 43(1). 2-6.

Lau, R.S.M., Zhao, X and Lai, R. (2002). Survey of MRPII implementation and benefits in Mainland China and Hong Kong. *Production and Inventory Management Journal.* 43(3/4). 65-71.

Leder, A. L. and Sethi, V. (1992) Root causes of Strategic Information Systems Planning Implementation Problems. *Journal of Management Information Systems.* 9(1). 25-45.

Lederer, A. L. and Sethi, V. (1996) Key Prescriptions for Strategic Information Systems Planning. *Journal of Management Information Systems.* 13(1). 35-62.

Lederer, A.L. and Sethi, V. (1988). The Implementation of Strategic Information Systems Planning Methodologies, *MIS Quarterly*, Sep. 445-461.

Licker, P. S. (1997). Management information systems: A strategic leadership approach. The

Dryden Press, Harcourt Brace College Publishers: Orlando, FL.

Markus, M.L.and Tanis,C.(2000), The enterprise system experience: from adoption to success'', in Zmud, R.W. (Ed.), Framing the Domains of IT Management: Projecting the Future Through the Past, Pinnaflex Educational Sources, Inc., Cincinnatti, OH.

Marsch, H. W., and Hocevar, D. (1985). Application of confirmatory factor analysis of the study of self-concept: first and higher order factor models and their invariance across groups. *Psychological Bulletin.* 97(3), 562-582.

Mclean, E.R. and V. S. John. (1977). Strategic planning for MIS. New York: Wiley.

Mirani, R. and Lederer, A. L. (1998). An instrument for assessing the organizational benefits of IS projects. *Decision Sciences.* 29(4). 803-838.

Mueller, R. O. (1996). Basics Principles of Structural Equation Modeling: An introduction to LISREL and EQS. NY: Springer. Schumaker, RE

Nah, F. F., Lau, J. L. and Kuang, J. (2001). Critical factors for successful implementation of enterprise systems. *Business Process Management Journal,* 7(3). 285-296.

Newman, W. H. and E. K. Warren and AR. Mcgill. (1987). 6th ediction. The process of management: strategy, action, results. Prentice-Hall International Editions: NJ.

Nunnally, J. M. (1978). Psychometric theory (2^{nd} ed.). New York: McGraw-Hill.

Papke-Shields, K. E., Malhotra, M. K. and Grover, V. (2002). Strategic Manufacturing Planning Systems and Their Linkage to Planning System Success. *Decision Sciences,* 33(1).

Pedhazur. E. J. (1991). Measurement, Design, and Analysis. Pedhazur, EJ & Schmelkin, LP (1991). Measurement, design, and analysis: An integrated approach. Hillsdale, NJ: Lawrence Erlbaum Associates. SPSS, Inc.

Peffers, K., Gengler, C.E. and Tuunanen, T. (2003). Extending Critical Success Factors Methodology to Facilitate Broadly Participative Information Systems Planning, *Journal of Management Information Systems,* 20(1). 51-85.

Pinto, J. K., and Slevin, D. P. (1987) Balancing strategy and tactics in project implementation. Sloan. *Management review.* 33-41.

Poon, P. and Wagner, C. (2001). Critical success factors revisited: success and failure cases of information systems for senior executives. *Decision Sciences Systems*. 30. 393-418.

Premkumar, G., and King, W. R. (1987). Organizational characteristics and information systems planning: An empirical study. *Information System Research,* 5(2).75-109.

Premkumar, G., and King, W. R. (1994). The evaluation of strategic information system

planning*, Information & Management,* 26(6). 327-340

Rashid, M. A., Hossain, L. and Partick, J. D. (2002). The evolution of ERP systems: a historial perspective. Idea Group Publishing.

Robey, D., Ross, J. W. and Boudreau, M-C. (2002). Learning to implement enterprise systems: An exploratory study of the dialectics of change, *Journal of Management Information Systems.* 19(1). 17-45.

Rockart, J. F. (1979) "Chief executives define their own information needs". Harvard Business Review, March - April, 81-92.

Rockart, J.F. (1982).The changing role of the information systems executive: A critical success factors perspective. *Sloan Management Review,* 24(1), 3-13.

Roeby, D., Ross, J. W. and Boudreau, M.C. (2002). Learning to implement enterprise systems: an exploratory study of the dialectics of change. *Journal of Management Information Systems.* 19(1). 17-46.

Saunders, M., Lewis, P. and Thornhill, A. (2000). Research Methods for Business Students. 2nd Edition. Pearson Education Limited: England.

Segars, A. H. and Grover, V. (1998). Strategic Information Systems Planning Success: An Investigation of the Construct and Its Measurement. *MIS Quarterly.* June. 139-163.

Segars, A. H. and Grover, V. (1999). Profiles of strategic information systems planning. *Information System Research,* 10(3). 199-232.

Shank, M. E., Boynton, A. C. and Zmud, R. W. (2001). Critical Success Factor Analysis as a Methodology for MIS planning. *MIS Quarterly.* June. 121-129.

Somers, T. M. and Nelson, K. (2001). The Impact of Critical Success Factors across the Stages of Enterprise Resource Planning Implementation, *Proceedings of the 34th Hawaii International Conference on Systems Sciences.*

Soofi, E. S., Retzer, J. J. and Yasai-Ardekani, M. (2000). A Framework for Measuring the Importance of Variables with Applications to Management Research and Decision Models, *Decision Sciences,* 31(3). 595-625.

Sousa. J. E. and Collado, J.P. (2000). Towards the unification of critical success factors for ERP implementation, *10th Annual Business Information Technology(BIT) 2000 Conference,* Manchester.

Steiger, J. H. (1990). Structural model evaluation and modification: An interval estimation approach. *Multivariate Behavioral Research,* 25, 173-180.

Stratman, K. J. and Roth, A. V. (2002). Enterprise Resource Planning (ERP) Competence

Constructs: Two-Stage Multi-Item Scale Development and Validation, *Decision Sciences, 33(4).* 601-628.

Teo, T.S.H. and Ang, J. S.K. (1999). Critical success factors in the alignment of IS plans with business plans. International Journal of Information Management. 19, 173-185.

Umble. E. J., Haft, R. R. and Umble, M. M. (2003). Enterprise resource planning: Implementation procedures and critical success factors. *European Journal of Operational Research,* 241-257.

Ward, J. and Griffiths, P. (1996) Strategic planning for information systems, 2nd Edition. Imprint Chichester, West Sussex, England ; New York : Wiley.

Wysocki, R. K. and Young, J. (1989) Information Systems: Management principles in actions. John Wiley & Sons, Inc: Canada.

Yin, R. K. (1994). Case Study Research: Design and Methods. (2nd ed.) Thousand Oaks, CA: Sage.

Zhang, L., Lee, M.K.O. and Banerjee, P. (2002). Critical Success Factors of Enterprise Resource Planning Systems Implementation Success in China. *Proceedings of the 36th Hawaii International Conference on System Sciences.*

Zhu, K. and Weyant, J. P. (2003) Strategic Decisions of New Technology Adoption under Asymmetric Information: A Game-Theoretic Model, *Decision Sciences,* 34(4). 643-675.

Appendix: Questionnaire

香港岭南大学电脑与决策支持学系

Department of Computing and Decision Sciences

Lingnan University, Hong Kong

ERP 实施情况调查

ERP Implementation Survey

敬启者:

您好,

这是一份学术研究问卷，主题为“ERP 实施计划的研究：关键成功因素法”，目的在于研究探讨 ERP 的实施中的关键成功因素与实施结果的关联，据此为 ERP 的成功实施制定计划。敬请贵公司提供协助，转交相关负责人或 IT 部门主管人员回答。

您的帮助和答案对本研究之成败影响关键，请依据实际情况回答。本研究所有资料仅供学术研究之用，决不会对外泄漏，敬请安心做答。如果您希望得到整体研究分析结果，您可以在答完全部问题之后，填写回执信息，我们将寄给您。对于此次调查的任何问题，您可以联系孔嘉慧小姐，电话: (852)2616-8106 或者电邮: jkong@ln.edu.hk。

对于您的热心协助，谨献上最诚挚的谢意。

身体健康，宏图大展!

20 April 2005

Dear Sir/Madam,

We are conducting a research on ERP implementation planning using a Critical Success Factors (CSFs) approach. Our objective is to gain a better understanding of the factors that will affect ERP implementation, and find the relative importance of these factors.

Please answer with the best of your knowledge. Results will be analyzed on an aggregate basis only. If you wish to know the summary of findings, please write your name and address on the return receipt. We will send it to you. If you have any questions about this survey, please contact Ms. Kong Jiahui, at (852)2616-8106 or by email:jkong@ln.edu.hk

Thank you in anticipation for your help.

Yours faithfully,

Professor Sun Daning
Head of Computing and Decision Sciences Department
EMBA Programme Associate Director
Lingnan University
Tuen Mun, Hong Kong

Ms. Kong Jiahui
Computing and Decision Sciences Department
Lingnan University
Tuen Men, Hong Kong

I ERP 实施评价
I ERP Implementation Evaluation

请圈出您认为符合情况的相应同意程度的数字：
Please use following scale to answer following questions:

1.ERP 实施评价 **ERP Implementation Evaluation**	强烈不同意	不同意	有些不同意	中立	有些同意	同意	非常同意
总体来说，ERP 的实施是成功的。 *Overall, ERP implementation is successful.*	1	2	3	4	5	6	7
总体来说，ERP 实现了部门的需求。 *Overall, ERP software vendors were responsive to business need.*	1	2	3	4	5	6	7
ERP 的实施达到公司的预期期望。 *ERP implementation has realized the expectation for its benefits to Business.*	1	2	3	4	5	6	7
使用 ERP 之后，公司生产率提高。 *Company productivity is improved after using ERP.*	1	2	3	4	5	6	7
使用 ERP 之后，公司运营效率提高。 *Business operational efficiency has been improved after using ERP.*	1	2	3	4	5	6	7
公司的流程通过 ERP 而更加合理化。 *Business processes have been rationalized through use of ERP.*	1	2	3	4	5	6	7
ERP 使企业的运作成本得到更好的控制。 *ERP allows for better control of business operating expenses.*	1	2	3	4	5	6	7
实施 ERP 之后，市场机会得到提高。 *New market opportunities have been identified through use of ERP.*	1	2	3	4	5	6	7
实施 ERP 之后，财务可视化提高。 *The financial visibility has been improved after implementing ERP.*	1	2	3	4	5	6	7
ERP 实施以后，整个业务依赖于 ERP 系统。 *The business process dependent on ERP after implementation.*	1	2	3	4	5	6	7
ERP 系统融合在整个业务流程中。 *ERP is intergrated in the whole business process.*	1	2	3	4	5	6	7
ERP 提高了顾客的满意程度。 *ERP has improved customer satisfactions.*	1	2	3	4	5	6	7
ERP 的使用方便，人性化。 *ERP system is esay to operate and user friendly.*	1	2	3	4	5	6	7
ERP 会产生满足客户需求的供应链计划表。 *ERP allows users to generate supply-chain schedules addressing customer needs.*	1	2	3	4	5	6	7
企业的利益通过 ERP 流程重组得到实现。 *Business benefits have been realized from reengineered ERP processes.*	1	2	3	4	5	6	7

II 各关键因素达到水平评价
II Critical Success Factors Achievement Evaluation

请圈出您认为符合情况的相应同意程度的数字：
Please use following scale to answer following questions:

2.最高管理层支持 **Top Management Support**	强烈不同意	不同意	有些不同意	中立	有些同意	同意	非常同意
最高层管理者主动地为 ERP 项目提供及投资所需的资源。 *Top managers willingly assign and invest resources to ERP project as they are needed.*	1	2	3	4	5	6	7
最高层管理者对于 ERP 的需求给予高于其他事务的优先权。 *Top managers mandate ERP requirements' priority over unique functional concerns.*	1	2	3	4	5	6	7
最高层管理者对 ERP 有很高的热情。 *Top managers are enthusiastic about possibilities of ERP.*	1	2	3	4	5	6	7
最高层管理者花时间来了解 ERP 如何为公司带来益处。 *Top managers invested time needed to understand how ERP will benefit the enterprise.*	1	2	3	4	5	6	7
最高管理着出面来解决实施过程中的部门间的冲突问题。 *Top managers personally solve the departmental conflicts in the implementation.*	1	2	3	4	5	6	7
最高层管理者愿意承担 ERP 所将可能带来的风险和责任。 *Top managers are prepared to take the risk and responsibilities of ERP.*	1	2	3	4	5	6	7
最高层管理者非常了解实施 ERP 所要实现的目标。 *Top managers understand the objectives of ERP.*	1	2	3	4	5	6	7
最高层管理者非常了解 ERP。 *Top managers have good knowledge of ERP.*	1	2	3	4	5	6	7

3.ERP 培训和学习 **Training and Education**	强烈不同意	不同意	有些不同意	中立	有些同意	同意	非常同意
用户的培训需求在 ERP 实施早期就已规定。 *Specific user training needs were identified early in the implementation.*	1	2	3	4	5	6	7
我们建立了 ERP 用户所需正式的培训项目。 *A formal training program has been developed to meet requirements of ERP.*	1	2	3	4	5	6	7
ERP 培训的内容根据不同的工作而制定。 *Training materials have been customized for each specific job.*	1	2	3	4	5	6	7
所有与 ERP 相关的内部员工都进行了 ERP 技能的基础培训。 *All users related to ERP have been trained in basic ERP system skills.*	1	2	3	4	5	6	7
我们经常根据系统需求的变化来更新 ERP 培训资料和内容。 *We seldom update training materials to reflect systems changes.*	1	2	3	4	5	6	7
培训关注整个企业项目，而不仅仅是 ERP 操作平台。 *Training materials target the entire business task, not just the ERP screen and reports.*	1	2	3	4	5	6	7
对于大部分员工来说，ERP 培训的时间是足够的。 *The time for ERP training is enough for most of the employees.*	1	2	3	4	5	6	7

4.ERP 项目管理 **Project Management**	强烈不同意	不同意	有些不同意	中立	有些同意	同意	非常同意
ERP 项目的所需执行的工作有明确的定义。 *The tasks to be preformed during ERP project are clearly defined*	1	2	3	4	5	6	7
各个项目组的成员的责任有清晰的定义。 *The responsibilities of the project team members are clearly defined.*	1	2	3	4	5	6	7
在项目管理小组中有决策委员会能够为实施过程中未曾预料的问题做出方向性决策。*There is decision committee to make decision and direction for the unexpected factors in the implementation.*	1	2	3	4	5	6	7
各个项目有明确的文件可供参考。 *There is clear document for the ERP project.*	1	2	3	4	5	6	7
各个项目有明确的日程安排以及完成日期。 *There is schedule for the ERP project and deadline*.	1	2	3	4	5	6	7
项目组成员借用参考咨询公司的知识和经验。 *The teammember learn other consultants knowledge and experience.*	1	2	3	4	5	6	7
项目工作的执行情况可以被衡量。 *Measurements are used to determine the status of project tasks.*	1	2	3	4	5	6	7
项目工作定时被检查。 *Project tasks are reviewed on a periodic basis.*	1	2	3	4	5	6	7
ERP 项目领导人对于项目管理经验丰富。 *ERP project leader is experienced in project management.*	1	2	3	4	5	6	7

5.部门内部沟通 **Department Communications**	强烈不同意	不同意	有些不同意	中立	有些同意	同意	非常同意
各 ERP 的相关部门经常一起议讨论 ERP 的新功能。 *Cross-functional groups meet regularly to discuss new uses for ERP.*	1	2	3	4	5	6	7
内部组织定期进行会议分享使用 ERP 的新的方法。 *Internal groups meet regularly to share new methods of using ERP.*	1	2	3	4	5	6	7
ERP 实施过程中, 常常从不同的使用者那里征集改良建议。 *ERP improvement suggestions are regularly collected from multiple employees levels.*	1	2	3	4	5	6	7
IT 职员和部门的使用团队进行较好的交流。 *IT staff communicate with functional use groups in the ERP .*	1	2	3	4	5	6	7
有一个协调小组为实施过程中部门间的冲突问题做工做和沟通。 *There is a communication team to solve the departmental conflicts during the implementation.*	1	2	3	4	5	6	7
职员了解他们的行为与其他功能部门的关系和影响。 *Employees understand how their actions impact operations of other functional areas.*	1	2	3	4	5	6	7

6.为变革作的准备 **Change Readiness**	强烈不同意	不同意	有些不同意	中立	有些同意	同意	非常同意
职员知道他们的工作将会发生什么样的改变。 *Employees have input into how their jobs will change with new ERP business processes*	1	2	3	4	5	6	7
职员了解他们应该如何适应新的 ERP 系统。 *Employees understand how they fit into the new ERP.*	1	2	3	4	5	6	7
管理者主动使职员对 ERP 产生积极的看法和思想准备。 *Management actively works to alleviate employees concerns about ERP.*	1	2	3	4	5	6	7
有 ERP 支持小组来回答对于企业内部关于 ERP 所带来改变的问题。 *An ERP support group is available to answer concerns about ERP job changes.*	1	2	3	4	5	6	7
职员可以预测 ERP 将会引起的改变。 *The change readiness of employees impacted by the ERP system is regularly assessed.*	1	2	3	4	5	6	7
ERP 引起的企业内部的变化变化得到了很好的沟通互动。 *ERP-focused changes to the employee reward system have been communicated.*	1	2	3	4	5	6	7

7.企业流程重组管理 **Business Process Reengineering Management**	强烈不同意	不同意	有些不同意	中立	有些同意	同意	非常同意
管理者明白企业流程如何支持 ERP 的整体目标。 *Managers are clear on how business processes support the goals of ERP.*	1	2	3	4	5	6	7
我们对于 ERP 的发展进行长期跟踪调查。 *We keep track of ERP developments related to our industry.*	1	2	3	4	5	6	7
ERP 的流程文档可以反映实际的运营活动。 *ERP process documentation reflects actual operational activities.*	1	2	3	4	5	6	7
企业内 IT 部门经常进行试验来衡量使用 ERP 的潜在改进。 *Business experiments are conducted to evaluate potential improvements to use ERP.*	1	2	3	4	5	6	7

8.企业文化适应 **Cultural Adaptability**	强烈不同意	不同意	有些不同意	中立	有些同意	同意	非常同意
企业有鲜明独特的企业文化。 *Business has specific organizational culture.*	1	2	3	4	5	6	7
员工愿接受新鲜事物。 *Employees are willingly to accept new things.*	1	2	3	4	5	6	7
实施 ERP 时考虑企业文化背景。 Cultural factor has been considered when implementing ERP.	1	2	3	4	5	6	7
员工短时间内可以适应新的 ERP 系统。 *The employees can adaptable to the new ERP systems.*	1	2	3	4	5	6	7
企业内部较注重个人个性。 *The personal characteristic is important in the organization.*	1	2	3	4	5	6	7
企业内部较注重领导权威。 *The manager is powerful in the organization.*	1	2	3	4	5	6	7

9.软件和 IT 技能 **Software Competence and IT skills**	强烈不同意	不同意	有些不同意	中立	有些同意	同意	非常同意
数据库管理员是 ERP 数据库管理的专家。 *The database administrator is an expert in the ERP database management system.*	1	2	3	4	5	6	7
内部 IT 部门成员了解 ERP。 *Internal IT team members understand custom ERP software programs.*	1	2	3	4	5	6	7
IT 职员能够有效的进行 ERP 的升级和维护。 *IT staffs are able to efficiently implement ERP system upgrades and maintaining.*	1	2	3	4	5	6	7
IT 职员和企业管理者有较好的互动关系。 *IT staff actively builds relationships with business managers.*	1	2	3	4	5	6	7
IT 职员提供 IT 如何实现企业目标的意见和建议。 *IT staff offer ideas on how IT can be used to achieve business goals.*	1	2	3	4	5	6	7

10.硬件设置 **Hardware and Equipments**	强烈不同意	不同意	有些不同意	中立	有些同意	同意	非常同意
通讯设备配置情况很好。 *Communications technology to be implemented is good.*	1	2	3	4	5	6	7
硬件配置情况很好。 *Hardware to be implemented is good.*	1	2	3	4	5	6	7
其他支持软件配置情况很好。 *Other supporting software implemented is good.*	1	2	3	4	5	6	7
运作系统的配置情况很好。 *Operating system to be implemented is good.*	1	2	3	4	5	6	7

感谢您的耐心。请信任我们并完成最后一页。

Thank you for your patience. Please trust us and finish the last one page.

III 基本信息
III Basic Information

请填写以下基本信息:

Please fulfill the basic questions:

公司名称（保密）： _____

公司地址: _____

联系电话: _____

公司员工人数: _____

企业性质: _____

请圈出您的答案:

Please cycle the answer:

1 请问您如何描述您在整个 ERP 实施过程中的角色？

How would you describe your involvement in your institution's ERP implementation?

A. 我是 ERP 项目总负责人。 *I was the executive manager for the project.*
B. 我是 ERP 项目组长。 *I was the project leader.*
C. 我是 ERP 项目成员。 *I was part of the management team.*
D. 我是 ERP 技术人员。 *I served as a functional or technical specialist.*
E. 我只参与了一部分。 *I was partially involved.*
F. 我和 ERP 项目不相关。 *I was not directly involved.*
G. 我是 ERP 的使用者。 *I was ERP users.*

2 请问贵公司购买那一家公司的 ERP 系统?

Which ERP vendors did you adopt?

A.用友 *UFSoft* B.金碟 *Kingdee* C. SAP D. PeopleSoft E. Oracle F.其他 (请注明)_____

3 请问贵公司在哪些部门实施 ERP 系统？

Which department did this ERP applied?

A. 全部部门 *The whole company*
B. 人力资源部门 *Human Resource Department*
C. 财务部门 *Finance Department*
D. 市场营销部门 *Marketing Department*
E. 进销存部门 *Inventory Department*
E. 生产部门 *Manufacturing Department*
F. 其他 (请注明) *Others (Please specify)*_____

4 请问贵公司何时购买的 ERP 软件？

When did you purchase the software?

A. 1999 年 B. 2000 年 C. 2001 年 D. 2002 年 E. 2003 年

5 请问 ERP 系统从购买到正式运行的时间有多久？

How long it takes from purchasing ERP to system going alive?

A. 不到 1 年 *Less than one year*
B. 1 年。 *1 year*
C. 2 年。 *2 years*
D. 多于两年。 *More than 2 years*

您已完成本次调查。对您的支持，我们再次表示最诚挚的谢意！若您需要我们的调研结果，请填写附于本业背面的回执。谢谢！

You have finished this survey. Thank you very much for your support. If you need out result, please fulfill the return receipt on next page. Thank you very much!

IV 回执
IV Return Receipt

请在此粘贴回执上写上您的邮编，公司地址，收信人姓名。我们将如约寄出整体分析结果。 谢谢。

Please write the post cold, address and name clearly on this self-adhesive label. We will do what as we promised. Thank you again.