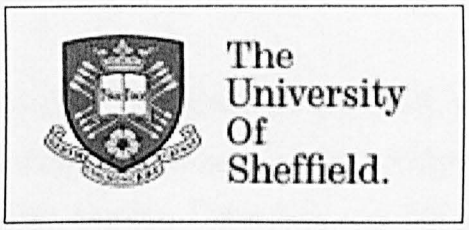


Department
Of
Information Studies

Barriers and Risks Associated with the Post-Implementation of ERP Systems in China: Cases of State-Owned Enterprises in the Electronic and Telecommunication Manufacturing Sector in Guangdong

(Volume 1)

Ph.D. Thesis

By

Guo Chao (Alex) Peng

A study submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Information Studies at the University of Sheffield

Sheffield, April 2009

Abstract

Since 1978, China has gradually reformed its economic system from the traditional planning economy to a more competitive market-oriented economy. After an effort of three decades, China has now become the world's fourth-largest economy behind the US, Japan and Germany. Nevertheless, the continuous national economic reform and entrance of foreign companies have significantly changed China's business *status quo*, and resulted in increasingly drastic market competition in the domestic market. Faced with this competitive environment and economic pressure, thousands of Chinese companies have implemented Enterprise Resource Planning (ERP) systems in order to improve operational efficiency and enhance core competencies.

Nevertheless, as identified from the literature review, successful implementation of the ERP system is not the end of the ERP journey. In order to maximize potential *Return on Investment* (ROI) of ERP, user companies must be ready for the long-term fight in the system post-implementation stage. However, when actually using, maintaining and enhancing the ERP system in the post-implementation stage, user companies may often encounter a wide range of barriers and risks that can prevent them from achieving long-term ERP and business success. Therefore this research project aimed at identifying, assessing and investigating potential ERP barriers and risks associated with the post-implementation of ERP systems in the context of Chinese companies.

However, as identified at the initial stage of this study, undertaking a national study of the whole of China would not be possible and feasible, due to the fact that the current economic situation and context in China are complicated and fluid. As a consequence, the research design of this study included a Political, Economic, Social and Technological (PEST) analysis, which was conducted at the initial stage of this project. The use of PEST enabled the researcher to narrow the scope of the study and identify an appropriate and feasible set of Chinese companies to base this study on, namely State-Owned Enterprises (SOEs) in the Electronic and Telecommunication Manufacturing Sector in the Guangdong province in China.

In order to answer the research questions and achieve theory building, testing and extension, this research adopted a QUAN and *qual* mixed-method research design, which consisted of a cross-sectional questionnaire survey at the first stage and a follow-

up multi-case study component at the second stage. The questionnaire design was based on a theoretical ontology of barriers and risks drawn from a systematic literature review process. The questionnaire was sent to the operational managers and the information technology (IT) managers of 118 SOEs in China. A total of 42 SOEs (2 * 42 SOEs = 84 respondents) completed and returned the questionnaire, which represented a response rate of 35.6%. After the data derived from the questionnaire was analysed, a follow-up case study was conducted to further explore, validate and strengthen the quantitative findings. 2 of the 42 respondent SOEs were identified to participate in the case study. A total of 25 semi-structured interviews were conducted with the CEOs, IT managers, departmental managers and users of the case companies.

The findings identified a comprehensive set of 31 barriers and 43 risks associated with ERP post-implementation in the context of Chinese SOEs studied. These ERP exploitation barriers and risks were found around cultural, organizational and technical aspects. The study also explored and identified a large number of correlations and relationships between these ERP barriers and risks. By analysing these correlations, it was identified that the complicated network of ERP barriers and risks identified in SOEs was centred around four critical organisation-oriented barriers, namely Power centralisation of top management, Short-term behaviour of top management, Lack of in-house IT experts, and Low-skilled and ill-trained system users. Consequently, this study concluded that potential failure of ERP cannot be conveniently attributed to system problems, but more importantly should be attributed to organisational barriers and problems, in particular human problems that are related to top managers, IT experts and system users in the context of Chinese SOEs.

Keywords:

Information Systems, Enterprise Resource Planning (ERP) systems, risks, ERP post-implementation, ERP exploitation, Chinese State-owned Enterprises (SOE).

Table of Contents

List of Figures

List of Tables

Abbreviations and Acronyms

BI	Business Intelligence
BOM	Bill of Materials
CCP	Chinese Communist Party
CEO	Chief Executive Officer
CRM	Customer Relationship Management
DSS	Decision Support System
EIS	Executive Information System
ERP	Enterprise Resource Planning
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GNP	Gross National Product
GSB	Guangdong Statistics Bureau
HAS	Human Activity System
ICS	Inventory Control System
ICT	Information and Telecommunication Technology
IS	Information System
IT	Information Technology
MIS	Management Information System
MPS	Master Production Schedule
MRP	Material Requirements Planning
MRP II	Manufacturing Resource Planning
NPC	National People's Congress
NRP	Net Requirement Plan
NSBC	National Statistics Bureau of China
PEST	Political, Economic, Social and Technological analysis
PLM	Product Lifecycle Management
RMB	Renmingbi (Chinese currency)
SASAC	State-owned Assets Supervision and Administration Commission of the state council
SCM	Supply Chain Management
SEZ	Special Economic Zone

SMEs	Small and Medium-size Enterprises
SPSS	Statistical Package for the Social Science
TPS	Transaction Processing System
WTO	World Trade Organisation

Acknowledgement

The journey of my three-year Ph.D. was full of challenges, hardships, excitements and pleasant memories. I am so glad that during these three years, I was continuously supported and motivated by many people, who were witnesses of my growth and success in this period of time:

- First of all, I would like to thank my parents, for their endless and selfless love.

- I wish to thank my aunt, my mother's sister, for her continuous encouragement and moral support to make me feel that I have never been alone, even though I am far away from my family in China.

- I would like to express my gratitude to my supervisor, Dr. Miguel Baptista Nunes, for his valuable advices, support, encouragement and friendship. The skills that I developed with Miguel's guidance are not just valuable for my Ph.D. but would also be crucial to my future academic career.

- I would need to thank Professor Sheila Corrall (my BSc Dissertation Supervisor) and Professor Peter Willett (my BSc Personal Tutor), for their continuous support and help ever since I did my BSc in Information Management in the Department of Information Studies.

- Thanks to my friends, especially Wendy Liu, Tommy Yu and Nora Agustero, for always being there with me to share my sadness and happiness.

- Finally, thank all academic staff, technicians and Ph.D. researchers in the department for providing a collaborative, harmonic and pleasant working environment.

Chapter One: Introduction

1.1 Background and problem statement

China's population (1.3 billion) accounts for one-fifth of the world's total (6.5 billion), and its geographical area (9.6 million square kilometres) comprises about 6.5 percent of the world's total land area. China therefore possesses a huge market which contains highly promising potential business opportunities. However, as a result of continuous political and economic disasters between 1958 and 1976 (Perkins, 1997:32), China was among the world's poorest countries in the 1970s (Yusuf et al., 2006:3). In order to restore the national economy, the Chinese Communist Party initiated the nationwide economic reform in 1978. As a result, during the last 30 years, China has gradually reformed its economic system from the traditional planning economy to the more competitive market-oriented one, and become increasingly open to foreign investors and competitors. After this effort of almost three decades, China has now become the world's third-largest economy behind the US and Japan, the world's third-largest trading nation (Yusuf et al., 2006:3), and the world's second-largest recipient of foreign direct investment (FDI) (Yusuf et al., 2006:3). The revived China, which is widely considered as a new economic superpower (The Independent, 2008), has attracted substantial attention from the western world. In the academic environment in particular, there is a global and increasing research interest in China (Peng and Nunes, 2008a).

Consequently, continuous national economic reform and participation of foreign companies have significantly changed China's business environment, and resulted in increasingly drastic market competition in the domestic market. Faced with this competitive environment and economic pressure, thousands of Chinese companies have implemented Enterprise Resource Planning (ERP) systems in order to improve operational efficiency and enhance core competencies.

An ERP system is defined in this thesis as a configurable information system package that consists of a set of software modules and can integrate information and information-based processes within and across functional areas (including finance, human resource, manufacturing, sales and purchase sectors etc) in an organization by using a single comprehensive database. ERP systems originally aim to help companies

achieve seamless data and business process integration in their back offices. Contemporary ERP systems even contain modules, such as Customer Relationship Management (CRM) and Supply Chain Management (SCM), to integrate the company's back office with its front office. Thus, the ERP research community (e.g. Davenport, 2000; Gupta et al, 2004; Oliver et al., 2005; Sia et al., 2002) has illustrated that, successfully implementing ERP systems can bring companies a wide range of tangible and intangible benefits in operational, managerial, strategic and organizational level.

These attractive potential benefits associated with the system and ever-increasing market competition resulted in very high demand for implementing ERP in Chinese companies. China's ERP market size has therefore been increased rapidly in recent years. Data provided by a prominent Chinese consultancy firm (CCID Consulting), quoted by Xue et al (2005), shows that the ERP market size in Mainland China was around US$70 million in 2000 and grew to US$289.96 million in 2004. CCID Consulting (cited by Zhang et al, 2005) reports that China's ERP sales will grow at an estimated rate of 23.5% and reach US$652.8 million in 2008.

Despite this apparent success in ERP adoption, there are a number of risks associated with the fact that these systems are "large and complex, expensive, take over a year or more to install, use new technology, and impact significantly on the organizational culture and existing business processes" (Willcocks and Sykes, 2000). In fact, the adoption of ERP is never an easy task and can always result in significant impact to all business divisions in operational, managerial and strategic level of the company. As a result, the use of ERP often represents a business dilemma to user companies. Specifically, Liu Chuanzhi, former chairman and president of Lenovo, famously stated that in China:

> "Not implementing ERP means inevitable failure, while implementation could possibly contribute to one's demise." (SAP, 2005)

Actually, a review of previous literature identifies that implementation of ERP is often fraught with risks, difficulties and problems (Loh and Koh, 2004). However, as more and more companies have successfully implemented ERP, practitioners and researchers start recognizing that, the 'go-live' point of the system is not the end of the ERP journey. Very often the system post-implementation stage is where the real challenges begin

(Willis and Willis-Brown, 2002). In order to maximize potential benefits that can be received from the installed system and ensure long-term ERP success, user companies must pay substantial attention to ERP post-implementation and be ready for the long-term fight (Willis and Willis-Brown, 2002; Yu, 2005).

Nevertheless, it is expected that a wide range of barriers embedded in the local business context and the system itself can often prevent user companies from successfully using, maintaining and enhancing their ERP systems (Peng and Nunes, 2008b). Moreover, these barriers can also lead to the occurrence of a wide range of risk events during ERP post-implementation (Peng and Nunes, 2008c). Overall, the existence of these barriers and the occurrence of undesirable risk events may turn initial ERP success into a failure and may lead to system and business collapses (Peng and Nunes, 2007a; 2008b; 2008c).

Many researchers recognize the importance of ERP post-implementation and even state it is the direction of the second wave ERP research (Yu, 2005). Nevertheless, despite the imperative need for research in this area, there is a scarcity of studies focusing on ERP post-implementation, in contrast with an over abundance of studies focusing on implementation aspects. In truth, no study in ERP post-implementation barrier and risk in general, or in China in particular, was identified in the literature reviewed during the period of this research project. This obviously presents to be a crucial research gap in the ERP field. This study aimed at contributing to this increasingly significant research gap by identifying and investigating the barriers and risks to successful exploitation of ERP systems in the context of Chinese firms.

This chapter provides an outline for the thesis. After introducing the background for this study, the remainder sections of this chapter provide a brief description and discussion on the research questions and objectives, research focus, research motivations and audiences, research methodology, and research constraints of this project. Finally, this chapter concludes by presenting an overview of the structure of this thesis.

1.2 Definitions of key terms

Several key terms were crucial to this research project, namely ERP implementation, ERP post-implementation, Risk and Barrier. It is important to define and distinguish

these key terms at this point in order to clearly formulate the research question in the next section.

1.2.1 ERP implementation and post-implementation

Deloitte Touche Tohmatsu, a prominent global consulting firm, identifies that the ERP transformation journey consists of two distinct phases (Deloitte, 1999).

The first phase, which is also referred to as the implementation phase, can be described as the effort necessary to reach the 'go live' point of the ERP system (Willis and Willis-Brown, 2002). This includes the typical implementation tasks (e.g. system vendor selection, system requirements identification and the execution of the implementation project, etc), and is finalised when the ERP goes lived.

After the company successfully passes the 'go live' milestone of their ERP, they reach the second phase of the ERP journey, namely the system post-implementation or exploitation phase (Willis and Willis-Brown, 2002). Please note that, in this thesis, the researcher will use the terms 'ERP exploitation' and 'ERP post-implementation' interchangeably. When engaging in ERP exploitation, user companies need to properly and continuously use, maintain and enhance the installed ERP, in order to maximise potential benefits and value return of the system and ensure long-term ERP success.

A review of literature indicates that, there is an over abundance of studies focusing on ERP implementation and project management aspects, whereas there has been surprisingly little research that systematically investigates issues associated with ERP post-implementation. Therefore, instead of targeting on ERP implementation, this research study focused on ERP post-implementation, which was considered as a research area in need of addressing.

1.2.2 Risk

A risk can be defined as "the occurrence of an event that has consequences for, or impacts on" a particular business process (Kleim and Ludin, 2000:3). This definition actually implies a fundamental characteristic of a risk: uncertainty. Specifically, there is a probability that the risk event may occur and an impact on the business processes

that may imply substantial losses. For the purpose of this research, the researcher slightly modified the above definition given by Kleim and Ludin, and defined a risk as:

> "The occurrence of any event that has consequences or impacts on the use, maintenance, review and enhancement of the implemented ERP systems."

Kleim and Ludin (2000:4-6) provide a thorough classification of risks in terms of probability of occurrence, frequency of occurrence, impact on the business processes, relative importance to other risks, and business exposure resulting from the occurrence of the risk. This research study contextualises these general principles of risk identification within the context of ERP use and exploitation.

1.2.3 Barrier

The concept of barrier is defined differently in the literature as shown in the two examples below:

> "In relation to accidents, a barrier is an obstacle, an obstruction, or a hindrance that may...prevent an action from being carried out or an event from taking place ..." (Hollnagel, 2000).

> "[From the business perspective,] barrier is an obstacle within the business context that prevents business objectives from being realized" (Polikoff et al., 2005).

These two definitions point out that a barrier is an obstacle that prevents an action or event from being carried out successfully. For the purpose of this research, a barrier to ERP exploitation is defined as follows:

> "Any obstacle or factor that is inherent to the Chinese context or the ERP system itself; and can prevent companies from efficiently using, maintaining, reviewing and improving the implemented ERP system."

Additionally, the researcher identified, through a review of literature, that the terms 'barrier' and 'risk' were often misused by authors. In particular, some non-scientists (e.g. The Alaska Department of Natural Resources, 2003:11) and less careful researchers (e.g. Söderlind and Kidby, 2005:16) may use these two terms interchangeably. Nevertheless, these two concepts are in reality substantially different. Specifically, a barrier, unlike a risk, has no uncertainty associated to it. That is, a

barrier is a factor that is inherent to a given context and thus has 100% probability of occurrence. Due to this characteristic, a barrier is fundamentally different from a risk. These two terms must therefore be clearly distinguished and should not be used interchangeably. Nevertheless, it is obvious that an existing barrier may lead to the occurrence of a set of potential risk events. As a consequence, an ERP barrier can be the cause of a number of ERP risks.

1.3 Research questions and objectives

The research aim of this study was to identify, assess and explore potential barriers and risks that Chinese companies may experience during ERP exploitation. It also aimed to identify and investigate the causes and consequences of the identified ERP barriers and risks by exploring potential correlations between them.

A central research question is the question which the research needs to answer, and is used to guide the entire research study (Creswell, 2003). In order to address the research aims presented above, a central research question was formulated at the beginning of this research project:

What ERP post-implementation barriers and risks will be encountered by Chinese companies?

However, it soon proved that undertake a national study of all companies in China would be virtually impossible and unrealistic, due to the fact that the current economic situation and context in the country are complicated and fluid. Specifically, there are important changes occurring in coastal regions, whereas other parts of the country are still very traditionally led by the central government. There are also significant variances in uptake of technology and IS and specifically of ERP in diverse industry sectors and diverse types of companies in China. Moreover, due to geographical and political reasons, it is extremely difficult to identify a valid sample to represent all Chinese companies (Manion, 1994). Therefore, a nationwide study in China is not only unrealistic and potentially unfeasible, but may result in findings that are neither significant nor meaningful (Peng and Nunes, 2007b).

Faced with the necessity of focusing the research and the need of identifying an appropriate set of companies to carry out the study, the researcher adopted a Political, Economic, Social and Technological (PEST) analysis to narrow the scope of the study, as well as to identify an appropriate type of company, an industry sector and a region in China to base the study on. The results of the PEST analysis are presented in chapter four of this thesis. This rigorous approach was also illustrated and discussed extensively at the European Conference on Research Methodology for Business and Management Studies (ECRM) in 2007 (Peng and Nunes, 2007b). As a result of the PEST analysis, the researcher refined the research context and identified a reasonable and feasible set of Chinese firms for carrying out the research, namely Stated-Owned Enterprises (SOEs) in the Electronic and Telecommunication Equipment Manufacturing sector in the Guangdong province in China. Subsequently, the original research question was also refined as follows:

What ERP post-implementation barriers and risks may be encountered by SOEs in the electronic and telecommunication manufacturing sector in the Guangdong province in China?

In order to generate more specific directions to guide the research project, the central research question was divided into a set of sub-questions:

- What are the barriers associated with ERP post-implementation in Chinese SOEs?
- What are the causes and consequences of these barriers, and how these barriers correlated?
- What are the risks associated with ERP post-implementation in Chinese SOEs?
- What are the causes and consequences of these risks, and how these risks correlated?
- What are the causal relationships between the identified ERP barriers and risks?

In response to the research questions and research aims, a set of specific research objectives was established:

- Identify ERP exploitation barriers faced by Chinese SOEs;
- Investigate the causes and impacts of these barriers;
- Explore causal relationships between the identified ERP barriers;
- Identify ERP exploitation risks faced by Chinese SOEs;

- Investigate the causes and impacts of these risks;
- Explore causal relationships between the identified ERP risks;
- Identify which ERP barriers and risks are the most critical to SOEs;
- Explore causal relationships between the ERP barriers and ERP risks identified;

1.4 Research focus

The focus of this research is limited to barriers and risks associated with ERP post-implementation. In other words, and as discussed above, this project did not cover general ERP implementation and project management aspects. Moreover, it is apparent that ERP post-implementation is concerned with three general aspects, namely ERP usage, maintenance and enhancement (Willis and Willis-Brown, 2002). As such, the barriers and risks investigated and explored in this study were those that would prevent user companies from successfully using, maintaining or enhancing the installed ERP system. In other words, general barriers and risks, which are irrelevant to ERP exploitation, will not be considered in this study. For instance, business barriers and risks shown as examples below were not covered in this project:

- General barriers to market expansion, business globalisation, product transportation, equality of staff opportunity, etc.

- General risks associated with property damage, business acquisition, owner's ability to continue the business, staff safety, employee compensation, etc.

1.5 Research motivations and audiences

As more and more companies engaged with the exploitation of ERP, they will be confronted with a wide range of barriers and risks when actually using and enhancing the installed ERP system. User companies however may often not fully understand and recognise the existence and impacts of these barriers and risks, due to the present scarcity of research studies and guidance in these issues. This study aimed at contributing to a research topic that is becoming increasingly attractive and important, namely ERP post-implementation within China's context. This project represented a first attempt in producing a comprehensive study in its research area. The process of literature search could not return any other such studies.

The following incentives motivated the researcher to initiate, conduct and complete this research project:

- To contribute to a research field (i.e. ERP post-implementation) that is becoming increasingly important but lacks sufficient and significant study;
- To provide foreign and Chinese IS researchers with a comprehensive study on ERP exploitation in the Chinese context, especially the context of Chinese SOEs;
- To help Chinese practitioners, specially those in SOEs, to gain better understanding on current and potential ERP problems, and thus help them to utilize the implemented ERP systems;
- To enable foreign and Chinese ERP vendors and consultants to better understand the ERP problems faced by user companies and thus provide better post-implementation guidance and support to their clients.

The results and findings of this study are important contributions for researchers, practitioners and system vendors and consultants, who are therefore potential audiences of this research study:

- *Chinese and Foreign ERP researchers.* Findings of this research project are of interest to Chinese as well as foreign researchers, who are interested in ERP exploitation issues in the context of Chinese companies in general and in Chinese SOEs in particular. The ERP barrier and risk ontology, which was developed as the main output of this project, can be used as a starting point for fellow IS researchers to carry out further studies in ERP exploitation. Researchers can reuse and extend this ontology through their studies, and test the suitability of this ontology within their interested research contexts.

- *Chinese practitioners and user companies.* Chinese practitioners and user companies should be interested in the findings of this project. Results and recommendations derived from this study may provide useful guidelines for helping practitioners to identify, prevent and manage possible barriers and risks in ERP post-implementation. As a consequence, it may help to increase the possibility of user companies to better utilise and optimise their ERP systems in the long-term.

- *Chinese and Foreign ERP vendors and system consultants.* This project highlighted a comprehensive list of barriers and risks that Chinese companies are currently facing when using ERP. System vendors and consultants targeting on the Chinese ERP market should be aware of these ERP issues, in order to tailor better after-sales services to provide local user companies with necessary help and support to address these problems.

1.6 Research methodology

The research design for this project is explained in details in chapter five. This section provides a brief explanation of research methodologies in order to explain the structure of this thesis.

At the initial stage of the research, the first temptation of the researcher was to undertake a national study of the whole of China. As discussed earlier, this soon proved to be virtually impossible, due to the fact that the current economic situation and context in China are complicated and fluid. As a consequence, the research design of this project included a PEST analysis aiming at narrowing the scope of the study, as well as to identify an appropriate industry sector, a type of company and a region in China to base the study on. As a result of the PEST analysis, the researcher selected SOEs in the electronic and telecommunication manufacturing sector in the Guangdong province in China, as ideal contexts for carrying out this research project.

After a feasible set of companies was selected, the next step of the project was to establish explicit IS lens, in order to frame the study and generate meaningful and significant findings. Consequently, a critical literature review, which focused on IS and business research studies, case studies and theoretical papers, was conducted by the researcher. As a result of this critical literature review, the researcher established 29 ERP barriers and 40 ERP risks that Chinese companies might encounter in ERP exploitation. A barrier and risk ontology was subsequently developed to highlight these ERP barriers and risks.

In order to examine and explore the barrier and risk items identified from the critical literature review in the context of selected SOEs, the project adopted a mixed-method research design. This research design consisted of a cross-sectional questionnaire

survey at the first stage, and a follow-up multi-case study component at the second stage. It is apparent that this research design follows a typical Q*uan* and *qual* approach (Creswell, 2003:213). That is, at the first phase a quantitative study (i.e. questionnaire survey) was conducted and took the predominant position of the entire study. A supplementary qualitative component (i.e. follow-up case study) was carried out at the second phase to further explore and validate the findings derived from the quantitative study, and therefore achieved triangulation and theory extension. It is obvious that, as the questionnaire survey held the principal role in this study, this research was driven by a deductive approach.

The questionnaire was designed based on the theoretical barrier and risk ontology, and aimed at examining this ontology in the selected context (i.e. SOEs in the electronic and telecommunication sector in Guangdong in China). Of these ERP barriers and risks, some were related with core business aspects, while the remainder focused on technical issues. This clearly indicated that two different questionnaires needed to be designed to obtain perspectives from both business managers and ICT experts. According to statistical data provided by the local statistical bureau, there are 118 SOEs operating in the electronic and telecommunication manufacturing sector in Guangdong. A complete list of these companies was obtained from the Guangdong Statistical Bureau. The questionnaires were then posted to the operation managers and the IT managers of these SOEs. A total of 42 SOEs (2 * 42 SOEs = 84 respondents) completed and returned the questionnaire, which represented a response rate of 35.6%.

In addition, in the final section of the questionnaire, respondents were asked whether they would like to participate in the second stage of the study. 2 of the 42 respondent SOEs were thus identified to participate in the follow-up case study. The purpose for conducting this complementary case study was to further explore and validate the quantitative findings derived from the survey. A total of 25 semi-structured interviews were carried out with the CEOs, IT managers, and departmental managers and system users in diverse departments (i.e. sales, financial, production, and purchasing department) of these two case companies.

By analysing, triangulating and synthesising the quantitative findings derived from the questionnaire and the qualitative anecdotal evidence obtained from the multi-case study, the researcher revised and extended the theoretical barrier and risk ontology established

from the critical literature review. Consequently, the researcher identified respectively a set of 31 ERP barriers and a set of 43 ERP risks that proved to be crucial to SOEs in ERP exploitation. In addition, the researcher also identified a comprehensive set of causal relationships between the identified barriers and risks.

1.7 Research constraints

The researcher experienced two major types of research constraints when conducting this study, namely general academic constraints and contextual constraints.

1.7.1 General academic constraints

General academic constraints refer to research limitations that are prevalent in PhD projects. In particular, these constraints relate to the facts that PhD students:

- Are new researchers, who have limited experience in doing research;
- Are required to work individually in an isolated environment;
- Are limited by resources and a period of time for completion.

1.7.2 Contextual constraints

Contextual, cultural and political differences between China and the West determine that research difficulties, that may not generally be experienced and reported in the West, can arise when doing participative research in China. Contextual constraints, in this thesis, refer to specific research limitations that are inherent in the Chinese research context. Three contextual constraints were experienced in this study:

- Sampling constraint

Identifying a representative and reasonable sample in China presented to be a real challenge to this study. This difficulty does not only follow from China's large size and number of potential respondents (Roy et al, 2001), but is also attributed to the fact that China is by no means a homogeneous country. As stated by Liu (2004) since China started the transition to a market economy in the early 1980s, "ordinary Chinese people experience increased material comfort, greater freedoms and more diverse lifestyles",

while the country itself is in the midst of socio-political transitions characterised by the co-existence of rival cultural, ideological, political and economic systems of Confucianism, Marxism and Capitalism. These may be found across provinces or even within the same province. Consequently, Manion (1994) states that "for most researchers, obtaining a nation-wide probability sample [representative...of] the Chinese population [as a whole] is both impossible and impractical".

Faced with this sampling constraint, the researcher adopted a PEST analysis to narrow the scope of the study, as well as to identify a type of Chinese company, an appropriate industry sector and a region on which to base the study. As presented earlier, through the PEST analysis, the researcher selected SOE in the electronic and telecommunication manufacturing sector in the Guangdong province in China, as target companies for conducting the research.

However, it should be stressed that the very effort of narrowing and focusing the research, means that generalisation of findings is now only possible for similar regions, company types and sectors as the ones studied. Nevertheless, this was deemed particularly appropriate due to the complexity that currently characterises Chinese economy. A study that focuses on producing generalisable statements about a specific regional context is more likely to result in meaningful and significant findings than one that focuses on China as a whole. In truth, findings derived from a regional sample cannot be applied to the entire country, but can often be used as the basis for social scientists to carry out further research on contemporary China (Manion, 1994).

- Language constraint

The questionnaire and interview instruments used in this research study were originally developed in English and then translated into Chinese, in order for data collection to be conducted with prospective respondents in the Chinese language. On the other hand, after the study, selected quotations and the conclusions were translated back into English in order for them to be reported in this thesis. Nevertheless, due to lack of financial resources, all translations were done by the PhD candidate individually, who after 8 years in the UK considers himself to be bilingual. As a consequence, some deviation may occur in both validity and reliability due to the accuracy of the Chinese and English language translation.

– Constraint in getting sufficient response

A further significant constraint embedded in the Chinese research environment relates to non-response to research studies (Peng and Nunes, 2008a). Specifically, due to a long history of bureaucratic intervention and control, Chinese people are often reluctant to offer their views on questions that may be sensitive (Roy et al, 2001). Although researchers will often provide assurances about confidentiality at the beginning of data collection, Chinese respondents may not believe their anonymity can be protected (Manion, 1994). They thus may often decline to participate in the study in order to avoid potential personal risks under the bureaucratic environment. This contextual constraint presented to be a substantial challenge to this research. In particular, one month after the original questionnaire a reminder was sent out. Two months after this reminder only three replies were returned and one of these replies was inadequately completed (i.e. most questions were left blank and a big 'DON'T KNOW' was written by hand over many of the remaining questions).

Faced with this contextual constraint, the old system of *guanxi* (literally, personal relationships) was used (as explained in detail in section 5.6.5.3 in chapter five) in the data collection processes of this study. The purposes for using personal *guanxi* here were to get access to and gain trust from the prospective respondents, and thus increase the response rate, as well as ensure that the data obtained was of better quality and more earnest. Nevertheless, the use of personal relationships to get access to companies in China may be associates with a set of ethical problems. That is, it could be argued that the respondents may be put under pressure to respond, by the very relationships network that was used to reach them, and that such pressure may influence responses. However, the choices that had to be made were between no responses or understand the business environment and play by its rules. This issue is discussed thoroughly in chapter five.

These contextual research constraints, along with a set of elaborated processes conducted in this study to address them, were presented for discussion at the ECRM conference in 2008 (Peng and Nunes, 2008a). The reflection on these issues proved to be an unexpected contribution derived from this study to the research field. Moreover, more discussions on these constraints and associated solutions are provided in

appropriate chapters of this thesis, e.g. Chapter four for PEST analysis and Chapter five for the issue of translation and using personal relationships, etc.

1.8 Thesis structure

The remainder of this thesis contains another ten chapters, as briefly introduced below:

- Chapter Two: Information Systems in Organisations
- Chapter Three: An Overview of ERP Systems
- Chapter Four: PEST Analysis of China
- Chapter Five: Research methodology
- Chapter Six: Initial Identification of ERP Exploitation Barriers and Risks
- Chapter Seven: Results and Findings of the Questionnaire Survey
- Chapter Eight: Results and Findings of the Follow-up Case Study
- Chapter Nine: Global Discussion of Findings
- Chapter Ten: Conclusions and Future Research

Chapter Two: Information Systems in Organisations

In order to generate sufficient background knowledge on information systems (IS) in general, a literature review was conducted at the initial stage of this study. Chapter two focuses on the results derived from this literature review. The chapter discusses extensively the concept of IS, as well as discussing the value for using IS in organisations. It subsequently highlights the integration issue existed in traditional isolated ISs, and points out the emergence of ERP as a fundamental solution towards traditional IS integration issues, and therefore leads readers to the discussion of the next chapter which focuses on ERP systems.

Chapter Three: An Overview of ERP Systems

In order to generate sufficient background knowledge on ERP systems, a literature review was carried out at the early stage of this project. This chapter reports the results derived from this literature review. It provides an extensive discussion on the concept, background of emergence, evolution history, functionality, benefits and issues associated with ERP systems.

Chapter Four: PEST Analysis of China

Because a national study of China as a whole was identified to be both infeasible and unrealistic, a PEST analysis was conducted in this project in order to refine the research context, as well as to identify a geographical region and a type of company to base this study on. This PEST analysis was essentially a desktop study which was based on the process of a systematic literature review. A large amount of English and Chinese literature (including journal articles, books, official statistical reports, market research reports, news and online articles) were reviewed, compared and synthesised and then used as raw materials to construct arguments and standpoints for the PEST analysis.

Chapter four presents and discusses the results of this PEST analysis. The chapter starts by reviewing the political and economic issues existed in China in the 1950s when the People's Republic of China was just established. It then draws a large amount of statistical data and evidence to demonstrate how the political and economic environments of China have been changed over time. The chapter also highlights the political, economic, social and technological issues existing in contemporary China and their impacts to IT and ERP adoption in the country. As concluded from the PEST analysis, the researcher selected SOEs in the electronic and telecommunication sector in the Guangdong province as the ideal context for carrying out the study.

This rigorous approach was actually presented for discussion in the 6th ECRM conference in Portugal (Peng and Nunes, 2007b).

Chapter Five: Research Methodology

Chapter five focuses on the research methodology and design adopted for this project. In particular, the reasons for adopting a mixed-method research design, which consisted of a cross-sectional survey and a follow-up case study, are discussed and justified. Data collection methods (i.e. questionnaire and semi-structured interview) and instruments employed by this research is also identified and discussed. A number of difficulties (e.g. getting sufficient and earnest responses) were experienced when carrying out the data collection in China. These difficulties and associated solutions to address them are presented and discussed in this chapter. Moreover, the methods and procedures used to

analyse the data collected from the questionnaire and the interviews are also described and discussed.

Chapter Six: Initial Identification of ERP Exploitation Barriers and Risks

After a feasible set of companies were selected to conduct this study, the next step of the project was to establish explicit IS lens in order to frame the study and generate meaningful and significant findings. As a consequence, an extensive systematic review, which focused on current business and information systems studies, case-studies and theoretical propositions, was conducted by the researcher.

As a result of the systematic review, the researcher established 29 ERP barriers and 40 ERP risks that Chinese firms might encounter in ERP exploitation. These 29 ERP barriers consisted of 7 Cultural Barriers, 9 Organisational Barriers, 4 External Barriers and 9 System Barriers. On the other hand, the 40 identified risks contained 9 Operational Risks, 8 Analytical Risks, 16 Organisation-Wide Risks and 7 Technical Risks. These established ERP barriers and risks were then used as the theoretical basis to construct the questionnaire conducted in this research.

Chapter six presents and discusses extensively these identified ERP barriers and risks. A barrier ontology and a risk ontology, which were respectively developed to highlight these ERP barriers and risks, are also presented in chapter six.

In addition, the risk ontology and the 40 established ERP risks were presented for discussion in the 2nd South East European Doctoral Student Conference in 2007 (Peng and Nunes, 2007a).

Chapter Seven: Results and Findings of the Questionnaire Survey

A cross-sectional questionnaire survey was carried out to test the theoretical barrier and risk ontology in the context of selected SOEs. This chapter reports and discusses the results and findings derived from this questionnaire survey. It firstly provides a descriptive analysis on the characteristics of SOEs that participated in the questionnaire survey. The main findings reported in this chapter were generated from two types of analyses, namely univariate analysis and bivariate analysis. Univariate analysis

includes the use of frequency tables, percentages and bar charts, and focuses on a single variable associated with one ERP barrier or risk. On the other hand, bivariate analysis, which includes the use of Spearman's rho and one-tailed test, aims at exploring the correlations between two variables, i.e. between two barriers, between two risks, and between a barrier and a risk. Finally, this chapter identifies a set of ERP barriers and risks to be further explored and validated in the follow-up case study.

In addition, these questionnaire findings resulted in the publication of two full referred papers, respectively in the International Association for Development of the Information Society (IADIS) Information Systems conference in Portugal (Peng and Nunes, 2008b), and the European and Mediterranean Conference on Information Systems (EMCIS) in Dubai (Peng and Nunes, 2008c).

Chapter Eight: Results and Findings of the Follow-up Case Study

The complementary case study aimed at further exploring a number of ERP barriers and risks extracted from the questionnaire findings, as well as validating a set of causal relationships between them.

The data collected from the interviews were analysed by using the approach of thematic analysis. As a result of the data analysis, eight individual concept maps were produced to highlight the main themes and concepts identified. Chapter eight presents the findings of the multi-case study by using these concept maps as the infrastructure and relevant quotes from the interviews as anecdotal evidence to support the argumentation.

In addition, when reporting the case study results, the chapter also compares them with the findings of the questionnaire and the literature reviewed wherever appropriate. It was considered that this approach would enable triangulation to take place and therefore result in more in-depth and comprehensive discussion. The theoretical barrier and risk ontology derived from the literature review was revised after the comparison and synthesis of the questionnaire and interview findings. The revised ERP barrier and risk ontology is also presented in this chapter. Moreover, by analysing and synthesising the quantitative and qualitative findings, this chapter also presents a comprehensive set of correlations between the ERP barriers and risks identified.

Chapter Nine: Global Discussion of Findings

Chapter nine provides a global and interpretive discussion and analysis on the identified ERP barriers and risks by drawing on the evidence derived from the questionnaire, case study and literature review.

Chapter ten: Conclusions and Future Research

In response to the research questions, chapter ten provides readers with the general conclusions reached by this research project, as well as highlighting the contributions of this study to the research field. This chapter also makes recommendations and possible directions for further research emerging from this study.

Chapter Two: Information Systems in Organisations

2.1 Introduction

ERPs are usually perceived in both academic and business as information systems (IS). Nowadays, ISs are widely used in different levels and functions within diverse types of organisations with any sizes (Laudon and Laudon, 2004:4). Organizations need to use ISs to achieve higher levels of operational efficiency, competitiveness and profitability. Managers need ISs to process, retrieve and store valuable information to support their daily activities and decision making. It is widely acknowledged that information systems have become crucial for modern companies to survive and prosper in the highly competitive market of the new century (Laudon and Laudon, 2006:5; Hicks, 1993:2).

This chapter presents and discusses the results derived from a literature review on IS in general, since in order to understand the specific phenomenon of ERP it is important to understand firstly more general aspects of IS. The chapter presents and discusses extensively the theories and concepts related to IS, as well as discussing various types of IS applications in organisations.

2.2 An Overview of Information Systems

2.2.1 Human activity system, IS and IT

> "All the problem situations being addressed, whether in the public or in the private sector, whether in small firms or giant corporations, had one characteristic in common [...that is,] they all featured human beings in social roles trying to take purposeful actions [...in order to] make a situation seen as problematical somehow better" (Checkland, 1990:24).

Checkland (1990:24) thus uses the phrase 'human activity system' (HAS) to describe systems that involve "a set of [human] activities connected together in such a way that the connected set makes a purposeful whole" to solve human problems. A substantial characteristic of an HAS is that it engages human beings. It is therefore apparent that a HAS is a social system in nature. The definition of HAS has thus evolved to reflect this

social nature. In particular, Beynon-Davies (2002:66) and Bocij et al (2003:410) define human activity systems as

> "Social systems that consist of people engaging in coordinated and collaborative activities [...] to achieve specific purposes".

Based on this definition, it is apparent that any organisations, including companies, government agencies, hospitals, universities, etc, which involve people to work collaboratively to achieve common goals, are actually human activity systems. Additionally, as clearly identified by Checkland (1990:24), a further characteristic of a HAS is that a HAS may often consist of a number of subsystems and itself may be part of a larger system. As exemplified by Checkland (1990:24), a district nursing service may contain a number of purposeful subsystems (e.g. from nurse recruitment to service delivery). In turn, the district nursing service may be part of the total health care provision for a defined geographical area.

People generate large amount of data in the daily operations within the human activity system. A set of logical processes are required to record and store data and transform raw data to useful information (Bocij et al, 2003:5) to support daily activities and decision making of human beings. Information systems are thus developed for this purpose (a detailed definition of information system is provided in section 2.2.2.4). In fact, "Information systems are forms of human activity systems" since "they involve people in...collecting, storing and disseminating [data and] information" (Beynon-Davies, 2002:66). On the other hand, as further pointed out by Beynon-Davies (2002:84), information systems aim to support the human activity system(s) which they concerned by providing useful information to improve the performance of human beings inside the human activity system(s).

Most information systems in modern organisations are computer-based information systems which utilise information technologies (IT) to achieve higher speed, accuracy and reliability for data processing (Avison and Fitzgerald, 2003:4; Bocij et al, 2003:44-45). IT refers to "hardware, software, networks, data resource management and many Internet-based technologies" (O'Brien, 2004:6). However, the distinction between the terms 'information system' and 'information technology' is still controversial. Turban et al (2002:22) states that "information technology, in its narrow definition, refers to the

technological side of an information system...or it may even be used in a board way to describe a collection of several information systems, users, and management [of these information systems]...[therefore] the term[s] information technology [and] information system [is interchangeable]". Bocij et al (2003:44) argues that "the terms 'information system' (IS) and 'information technology' (IT) are often used interchangeably [but] this is an error, because the scope of [these two] terms is different". Both Bocij et al (2003:44) and Beynon-Davies (2002:66) argue that, the stress in 'IT' is on the technologies used to support information systems, whereas the term 'IS' does not only refer to the technology but focuses on human activities, such as how the data could be entered to the system, how the information produced by the system can be used to improve human performance, and how the system is maintained and managed, etc. This thesis supports the arguments and adopts these views of Bocij et al and Beynon-Davies.

2.2.2 Information system

Information system is a specific type of system for processing data and information. It therefore inherits the characteristics of normal systems. Before we move to the definitions of data, information and information system, it is useful for us to review the theories of general systems and the concept of work systems existing in organisation.

2.2.2.1 System theory

Systems are surrounding in our every day life. "Our bodies are made up of various systems, such as a digestive system and a central nervous system. We live on a planet that is a part of the solar system. We engage with people in groups that form social, political and economic systems" (Beynon-Davies, 2002:45).

Definition of a system

From the definitions of authors in the field (e.g. Beynon-Davies, 2002:46; Hicks, 1993:27; Bocij et al, 2003:37; O' Brien, 2004:8, etc), a system could be defined as

> A set of interrelated and interacting components that work together within a boundary towards some collective goals.

It should be noted that, as pointed out by Bocij et al (2003:37), natural systems such as the solar system may not have an obvious goal, whereas systems which involve the participation of human beings will normally have multiple goals, such as the goals of a business system could be to create profit or improve product quality.

Functions of a system

The fundamental purpose of a system is to convert inputs into outputs through a defined transformation process.

Figure 2.1: Basic functions of a transformation process
(source: Bocij et al, 2003:37)

Systems thus have three basic functions (Bocij et al, 2003:37; O' Brien, 2004:9):

- *Input* refers to capture and assemble elements that will be entered to the system for processing (e.g. raw material, data and energy etc).
- Inputs are converted into outputs through the *transformation process* of the system (e.g. manufacturing processes, mathematical calculations, etc).
- *Output* involves transmitting elements that have been produced by a transformation process to the ultimate destination (e.g. product, information and service, etc, must be transferred to their human users).

Additionally, systems may also contain two further functions, namely feedback and control functions (O'Brien and Marakas, 2007:27; Bocij et al, 2003:37):

- *Feedback* is data about the system's performance in terms of the suitability of input, processes and output of the system (e.g. data about the speed and direction of an aircraft is feedback to the pilot).
- *Control* involves monitoring and evaluating feedback to determine whether a system is moving towards the achievement of its goal, and if not then make the necessary adjustments to a system's input and transformation process to ensure that it produces proper outputs (e.g. the aircraft's pilot makes adjustments after

evaluating the feedback from the instruments to ensure the plane is exactly where the pilot wants it to be).

From an IS perspective, information systems contain all of these five general system functions (O'Brien and Marakas, 2007:28), as further discussed in section 2.2.2.4.

Other system characteristics

Apart from the functions mentioned above, systems will also share the following characteristics:

- A system does not exist in vacuum. Instead, it exists and functions in an environment (O'Brien and Marakas, 2007:27). A system will interact with and be continuously influenced by its environment (Hicks, 1993:29).
- A system can be made up of a number of smaller systems. These smaller systems are known as subsystems. Systems composed of one or more subsystems are referred to as suprasystems. The objectives of the subsystems are to support the larger objective of their suprasystem (Bocij et al, 2003:39).
- Since a system can be made up of a set of subsystems while it can actually be a subsystem of a larger system, systems are hierarchical and are dependant on one another in some way. A change to one system might lead to or result from changes to one or more other systems (Bocij et al, 2003:39).
- Systems interact with each other by exchanging inputs and outputs (Hick, 1993:30; Bocij et al, 2003:39). A system's outputs can be used as the inputs of another system, such as the output of a manufacturing process can be the input of the following assembling process.

It is apparent that these general system characteristics also apply to ISs in general and ERP in particular. Specifically, ISs and ERPs are operated within the organisational context, which can significantly affect the adoption and use of these systems. An IS/ERP will often contain a number of subsystems/modules, and may also interact with other ISs used in the organisation by exchanging inputs and outputs. For instance, the output of a Transaction Processing System could be a daily sales statement, which can be used as the input of a Management Information System to generate monthly and quarterly sales reports.

2.2.2.2 Work Systems in organisation

An organisation is a work system that consists of numerous smaller work systems. Alter (2002:45) defines a work system as

> "A system in which human participants and/or machines perform [one or several] business process[es] using information, technology, and other resources to produce products and/or services for internal and external customers".

Typical commercial organisations have work systems for purchasing materials from suppliers, processing customer orders, producing and delivering end products/services to customers, managing financial and human resources, etc. An IS is a particular type of work system "whose business process is devoted to capturing, transmitting, sorting, retrieving, manipulating, and displaying information, thereby supporting other work systems [of the organisation]" (Alter, 2002:6). It is obvious that this general aspect of IS can also apply to ERP, which consists of a wide range of processes to transform data into meaningful information. Therefore, an ERP system is also a work system.

In addition, the example of Amazon.com provided by Alter (2002:42-43) proves that, with the support of e-commerce technologies, a customer can also be involved in an organisation's work system to perform a part of the system's business process. As discussed by O'Brien (2004:50-52), a customer can fill in electronic order forms from a company's website and submit them to the company's database through Internet. These activities are actually the first few processes of a company's order processing system. In addition, the people who use and receive benefits from the products and services produced by the work system may be external customers or internal customers (e.g. employees, managers etc) of the organisation (Alter, 2002:46).

2.2.2.3 Data, information and data transformation process

The value of an information system relies on its ability to transform data to useful information through a set of data transformation processes.

Data are raw facts which "have little or no value until they have been processed and transformed into information" (Bocij et al, 2003:4). The basic data, which can be processed by a modern information system, include:

- Predefined data items (include numerical or alphabetical items whose meaning and format are specified, such as credit card number, customer name etc);
- Text (a series of letters, numbers and other characters which do not have a predefined meaning and formats);
- Images (such as pictures, photos, graphs etc);
- Audio (data which is in the form of sounds, such as voice messages);
- Video (data which combines pictures and sounds displayed over time).

(Alter, 2002:135-137)

Information is data that have been transformed to some form of meaningful context for a specific purpose by using a defined process so that they are able to serve information needs of human beings and help to reduce uncertainty for decision making (Bocij et al, 2003:5-6).

The processes used to convert raw data to information were called data transformation process. Some examples of data transformation process include (Bocij et al, 2003:6; Hicks, 1993:36-37):

- Rearranging/sorting (this involves organising/grouping data together according to particular orders, such as sorting records of personnel file into alphabetical sequence by using employee names);
- Aggregating (this involves summarising data into totals or condensations that are more meaningful than the unsummarised data, such as a sales report will summarise the data of sales, material cost and profits for a given period);
- Performing calculation (this involves all standard arithmetic operations, such as addition, subtraction, multiplication and division);
- Selection (this involves choosing or discarding items of data based on a set of selection criteria).

It is obvious that the fundamental goal of ERP systems is also to convert raw data into meaningful information. The data transformation processes exemplified here actually form the basic functionality of ERPs.

2.2.2.4 Definition of information system

An information system, as defined by Bocij et al (2003:43), is:

> "A group of interrelated components that work collectively to carry out input, processing, output, storage and control actions in order to convert data into information products that can be used to support forecasting, planning, control, coordination, decision making and operational activities in an organisation."

This definition identifies five basic activities associated with ISs (O'Brien, 2004:14-15; O'Brien and Marakas, 2007:27-28):

- Inputting data resources (e.g. capture, type or record data to the system by using PC keyboard or scanning devices);
- Processing data into information (e.g. typical data processing activities include sorting, summarising, calculating, comparing and selecting, etc);
- Generating information products as outputs (common information products provided by information systems include messages, reports, forms and graphic images, etc);
- Storing data and information in the database for later use;
- And controlling system performance based on feedback. Specifically, an IS would produce feedback (e.g. error messages, dialog boxes, etc) about its inputs, processing, output and storage activities. This feedback will be returned to appropriate members of the organisation to help them evaluate whether the system is performing properly. If no, pertinent adjustments will be made to the system's input, as well as to the system and even the business processes, to ensure proper information products are produced to end-users.

In order to conduct these activities, information systems consist of and rely on five interrelated components/resources (Bocij et al, 2003:44; O'Brien, 2004:11-14):

- People resources – end-users who use the information system or the information products it produces; IS specialists who develop, operate, maintain, monitor and control the system.
- Hardware resources – machines, such as computer, monitor, disk drives, printers and scanners, etc; media, such as floppy disk, tapes and memory stick etc.
- Software resources – computer programs, such as spreadsheet program, word processing program, etc; procedures used by people, such as data entry procedures, error correction procedures, etc.
- Data resources – data that was generated in the daily operation of the organisation, e.g. product descriptions, customer records, employee file and inventory records etc.
- Network resources – telecommunication technologies and networks, such as internet, intranets and extranets which link different systems together and allow them to transfer data.

It should be noted that, many IS definitions (e.g. Hicks, 1993:2; O'Brien, 2004:7) specify information systems are computer-based systems. However, since the essential task of an information system is to covert data into information, any systems that can perform this task can be considered as an IS regardless it is in a manual or computerized form. This viewpoint is supported by Bocij et al (2003:43) who state that "information system does not necessarily involve the use of information technology. A simple example of a 'manual' information system is a set of [paper-based] accounting ledgers". Nevertheless since the importance and impacts of computer-based information systems to modern organisations are far more significant than manual information systems, the term 'information system' used in literature and in this thesis actually refers to computer-based information system.

More importantly, an ERP is often perceived as an IS in literature. It is however obvious that while an IS consists of five components as discussed above, an ERP system contains only two of these components, namely software program and data. In other words, the other three essential components of an IS, namely people, hardware and network, are not constituents of an ERP. It therefore becomes clear that, an ERP system itself does not represent the entire IS; rather, an ERP is only a part of an IS, and needs to work together with people, hardware and network to achieve its intended goals.

This actually explains that, even when the ERP system itself is well-designed, the adoption and use of ERP may still be possible to fail, due to the occurrence and existence of potential people, hardware and network problems in the user company.

It is obvious that, while hardware and network problems are 'hard' problems that may often be addressed explicitly, human problems that are always ill-defined 'soft' problems may often be difficult to deal with (Checkland, 1990:17-18). In fact, Alter (2002:281) states that the skills, knowledge, involvement and commitment of users and IT people can significantly affect the success and efficiency of ISs. Additionally, the adoption and use of ERP can create opportunities to change an organisation's culture, structure and processes, as well as to change the distributions of power, autonomy, rights and obligations of people inside the organisation (O'Brien, 2004:52-53; Laudon and Laudon, 2004:146; Alter, 2002:275). These kinds of changes may cause a set of ethical, moral and political problems in user companies (Laudon and Laudon, 2004:146-150). Overall, it can be expected that human and organisational problems may be more crucial than technical ones to potential ERP failure.

2.2.2.5 Characteristics of information systems

In contrast with manual information systems, computer-based information systems manifest the following characteristics:

- *Speedily.* "Computers can process millions of instructions each second, allowing them to complete a given task in a very short time" (Bocij et al, 2003:44).
- *Accurately.* "The result of a calculation carried out by a computer is likely to be completely accurate" (Bocij et al, 2003:45). Many computer-based information systems can automatically check and correct data errors made by human beings, such as spelling errors, data values that are obviously too high or too low, and data in the wrong format etc (Alter, 2002:199).
- *Storage.* The database of a computer-based information system can store huge amount of data and information in a highly structured and logical way (Beynon-Davies, 2002:135).
- *Easy to access.* Data and information stored in a computerized information system can be easily retrieved by suitable users. With the support of internet

technologies, users can access to pertinent data and information of the system from anywhere and at anytime.

- *Security.* Specific data and information of the system can only be accessed by restricted users. Modern information systems adopt various technologies (e.g. setting password and firewall) to increase the level of information security.

These general IS characteristics also present to be relevant to ERP systems, because ERPs are computerised IS applications that are required to operate in advanced PC platforms. As a consequence, ERP system would enable processing, accessing and storing data and information speedily, accurately, and securely.

2.3 Information Systems in Organisations

ISs are used widely in different functions and levels of organisations. This section describes the concept of an organisation and the levels of management and decisions making in organisations, and then discusses various types of IS applications using in organisations.

2.3.1 What is an organisation

Information systems, as subsystems of an organisation, inevitably interact with the organisation as a whole. Information systems significantly affect an organisation's culture, structure and processes and thereby influence the working behaviours and performance of people within the organisation (Hicks, 1993; O'Brien, 2004:52-53). On the other hand, since "organisations form the immediate context for information systems" (Beynon-Davies, 2002:219), issues embedded in the organisational context can influence the performance and efficiency of information systems. Therefore, as stated by Beynon-Davies (2002:219), an understanding on the concept of organisation is fundamental for any IS researchers.

The definitions of organisation vary somehow in previous literature. For instance, Katz and Kahn (1966) define organizations as "open systems exist in ever changing environments. Each change in the environment implies a demand for change within the organization". Some recent definitions, as cited by Beynon-Davies (2002:221-225), consider organisation as structures that are divided into parts or functional departments,

as systems that take resources from its environment and process them to products/services which will be given back to the environment, or as networks of human beings who work together and interact with each other.

Mullins (2002:96-97) states that different types of organisations (e.g. food/car manufacturer, hotel, school, hospital, bank etc) are set up for different purposes, but they share four common factors:

- *People.* Organisations involve interaction and coordination of human beings.
- *Objectives.* Organisations exist in order to achieve predefined objectives.
- *Structure.* Some form of structure (e.g. division of functions, authorities and responsibilities, etc) is needed by which human's interactions and efforts can be channelled and coordinated.
- *Management.* Some process of management is used to control and direct human activities and the performance of organisations.

Combining the definitions mentioned above, the viewpoints provided by Mullins and the discussion of system theory and work system in early sections, this thesis defines an organization as:

> An open system that can be significantly affected by its environment, as well as a work system that involves a number of human participants with hierarchical authorities and responsibilities to convert resources, that are received from external environment, to some kinds of products/services through a set of business processes under the control of its management team to achieve the predefined organisational goals.

2.3.2 Levels of management and decisions in organisation

As shown in Figure 2.2, a typical commercial organisation has three management levels which are distinguished on the dimensions of decision time scale, decision types, decision frequency and data needs (Beynon-Davies, 2002:91-92; Bocij et al, 2003:17):

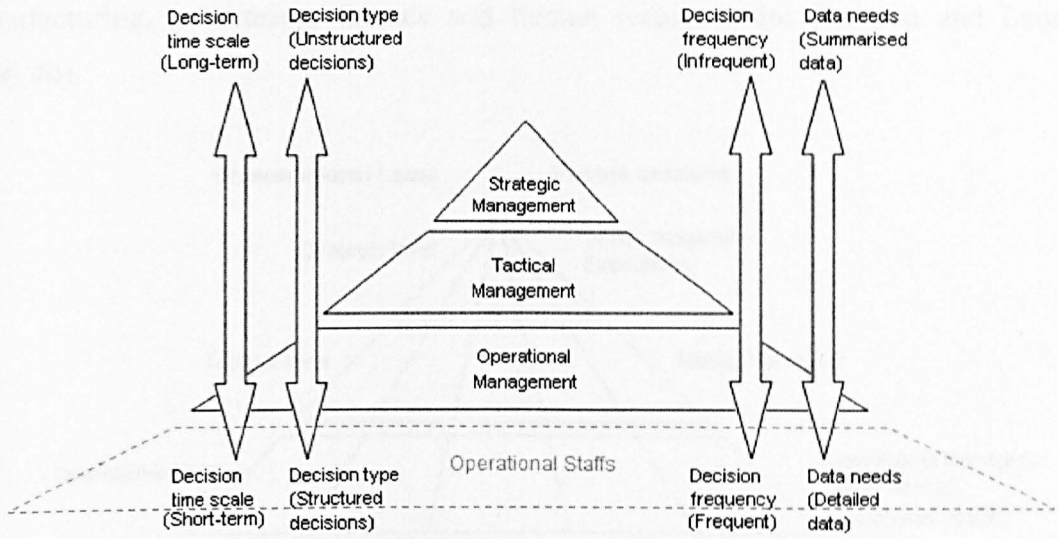


Figure 2.2: Levels of management

(modified from Figure 6.4 in Beynon-Davies, 2002:92)

- At the *operational level*, managers are concerned with short-term planning and control of the organisation's day-to-day activities. Operational managers need detailed data to make decisions on an hour-by-hour or day-to-day basis. Decisions in this level are highly structured (rules, constraints and procedures for making these decisions are known) and aim to direct the organisation to meet the medium-term goals.
- Middle managers at the *tactical level* deal with medium-term planning and controlling on budgets and resources, and monitoring the performance of the organisation. Decisions taken in this level tend to set medium-term goals to achieve the organisation's long-term strategy.
- Executives and senior managers at the *strategic level* are concerned with long-term planning and strategy making. Decisions made in this level are highly unstructured (rules, constraints and procedures for making these decisions are complicated or unknown) and have a long-term and significant impact to the organisation. Executives and senior managers require summarised data on internal performance and external environments to make such long-term decisions.

2.3.3 Traditional IS applications in organisation

An organisation can be vertically divided into operational, tactical and strategic level and then can be further divided horizontally into functional areas such as sales,

manufacturing, purchasing, finance and human resources etc (Laudon and Laudon, 2006:40).

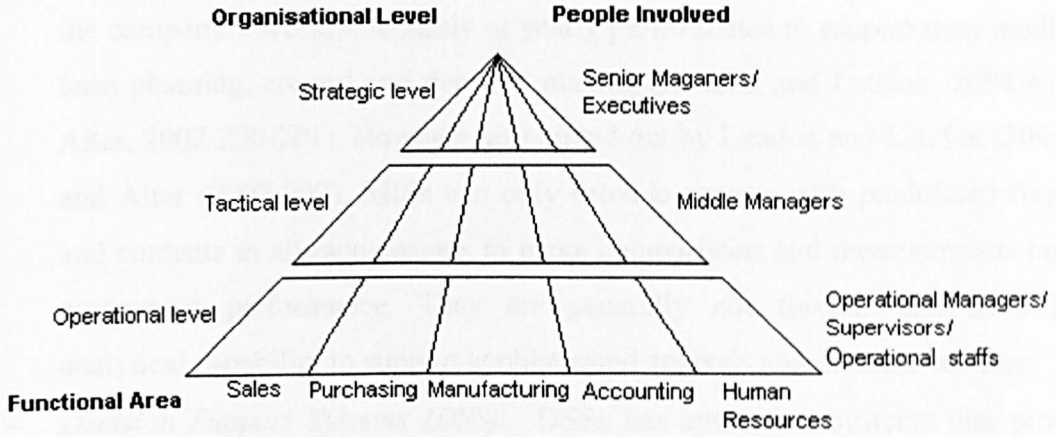


Figure 2.3: Division of organisational levels and functional areas
(modified from Figure 2.1 in Laudon and Laudon, 2006:41)

As discussed in section 2.3.2, managers in different organisational levels focus on different organisational objectives and make different types of decisions (i.e. structured, semi-structured or unstructured decisions). Hicks (1993:48) points out that the objectives, which managers aim to achieve, determine the types of decisions they must make, which in turn determine the various types of information that managers need to use. It is also obviously that managers and staff in different functional divisions are responsible for and control specific business processes of the division and hence have different information needs. Consequentially, various types of information systems are developed to support the information needs of managers and staff in different levels and functional divisions. Major types of information systems used in the three organisational levels include:

- *Transaction Processing Systems (TPS).* In its daily operation, an organisation performs so many transaction processing activities related with its customers (e.g. customer orders and payments), suppliers (e.g. purchase orders and payments) and employees (e.g. wages). A large amount of operational data can thus be generated during the organisation's daily operation, such as customer details, supplier details, sales order records, stock records and employee files etc. These data are essential to support the day-to-day operations of the company (Beynon-Davies, 2002:69). TPSs, which serve the organisation's operational level, are systems that perform, process and record daily routine transactions that are necessary to conduct business (Laudon and Laudon, 2004:41).

- *Management Information Systems (MIS).* MISs, which serve the tactical level of the organisation, extract, compress and summarize data from TPSs to provide middle managers with summary and exception reports which contain results of the company's weekly, monthly or yearly performance to support their medium-term planning, control and decision making (Laudon and Laudon, 2004:43-44; Alter, 2002:200-201). However, as pointed out by Laudon and Laudon (2004:45) and Alter (2002:202), MISs can only provide reports with predefined formats and contents to allow managers to make comparisons and measurements on the company's performance. They are generally not flexible and have little analytical capability to support sophisticated analysis and decision making.
- *Decision Support Systems (DSS).* DSSs are interactive systems that provide information, analytical models and data manipulation tools to help managers make decisions for semi-structured and unstructured situations where the procedures for arriving at a solution may not be fully defined in advance (Alter, 2002:205; Laudon and Laudon, 2004:45; Turban, 2004:550, Hicks, 1993:147). DSSs have more analytical power than the other systems, such as MISs and EISs. DSSs are often built with a variety of models to analyse data, or they can compress large amount of data from internal TPSs and MISs and information from external sources into highly logical forms in which they can be analysed by decision makers (Laudon and Laudon, 2004:45).
- *Executive Information Systems (EIS).* EISs, which serve the strategic level of the organisation, are highly interactive systems that allow executives and senior managers flexibly access to information for monitoring internal performance and external environment of the organisation (Alter, 2002:202). EISs are designed with easy-to-use interfaces which can be used by executives with little computer-related knowledge (O'Brien, 2004:25). EIS are not designed primarily to solve specific problems or provide specific reports (Laudon and Laudon, 2004:46). Instead, they draw and filter summarised and critical information from internal sources, such as MISs and DSSs, and external information sources (Laudon and Laudon, 2004:45-46) to "help executives find [and locate] the information they need whenever they need it and in whatever form is most useful, and therefore help executives make unstructured decisions" (Alter, 2002:202).

Some further examples of applications of TPSs, MISs, DSSs and EISs in different functional areas are shown in Figure 2.4.

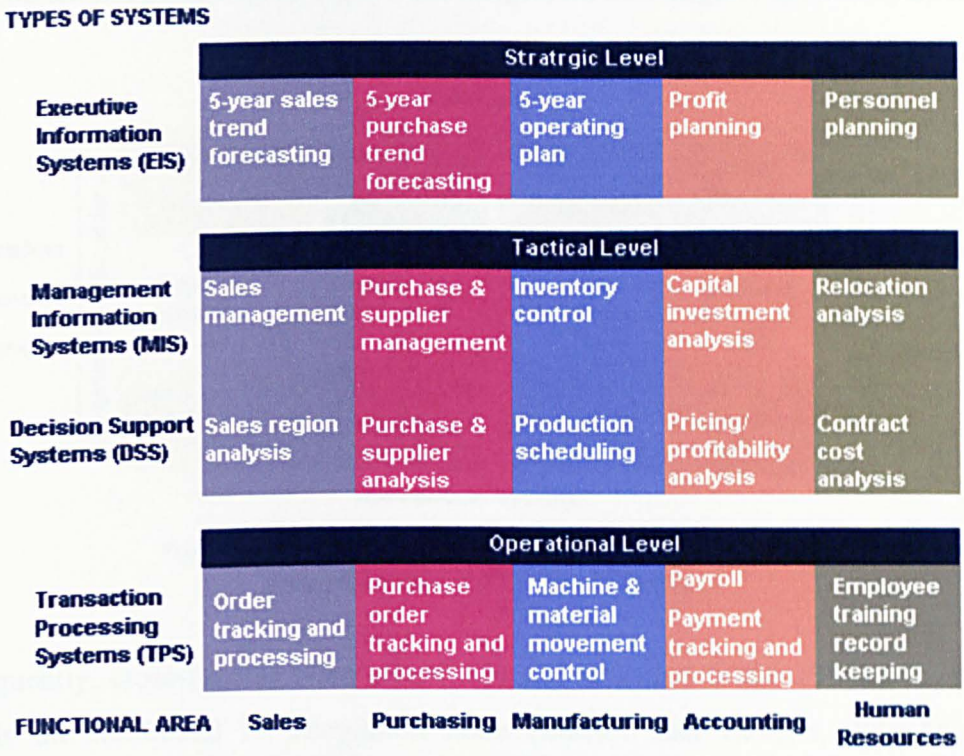


Figure 2.4: Applications of TPSs, MISs, DSSs and EISs in different functional areas (modified from Figure 2.2 in Laudon and Laudon, 2004:40)

2.3.4 Emerging view of integrated and enterprise systems

The various types of ISs presented above represent the traditional IS view that had been prevalent until the 1990s. These traditional ISs, which focus on a single business function or organisational level, is actually embedded with a significant issue, that is, the IS integration issue. Specifically, Alter (2002:31) explains that since ISs used for different business functions are usually developed by using different hardware, software and data resources, these systems are not able to communicate or share data and information with each other. McKenney and McFarlan (1982, quoted by Loonam and McDonagh, 2005:3), describe this phenomenon as "islands of automation" which means isolated information systems running separately from each other. Figure 2.5 illustrates this traditional view of isolated information systems.

Using such isolated systems, managers have to spend large amount of time to assemble data they need to generate a comprehensive picture on the organisation's operation, the organisation's efficiency and productivity will be significantly decreased (Laudon and Laudon, 2004:53). Kalakota and Robinson (2000:245) reinforce that the maintenance

cost of these isolated information systems could be very high, but companies receive little benefits from their use. Therefore Laudon and Laudon (2006:54) conclude that these isolated ISs present to be significant integration challenge to user companies.

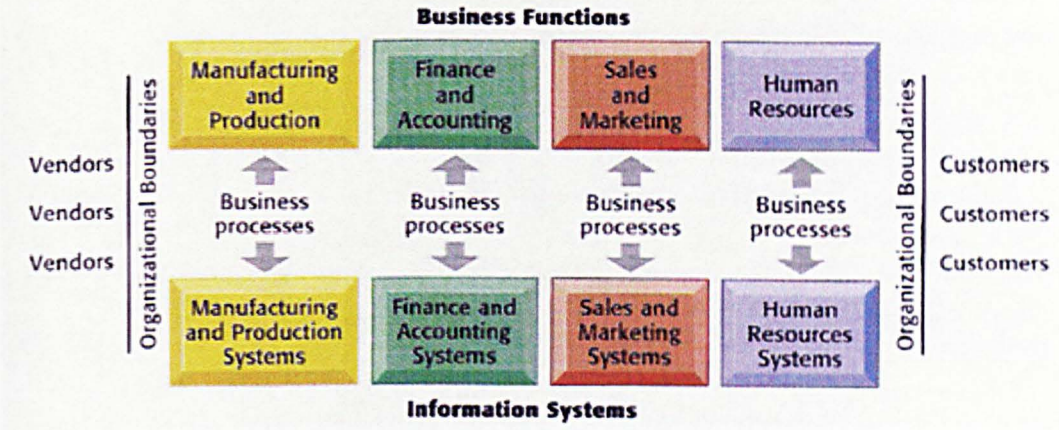


Figure 2.5: Traditional view of isolated information systems
(source: Laudon and Laudon, 2006:57)

Consequently, cross-functional enterprise systems emerged in the 1990s as a solution towards the traditional IS integration issue (Laudon and Laudon, 2006:56; Alter, 2002:31; Turban et al, 2004:343). Enterprise systems "cross the boundaries of traditional business functions in order to reengineer and improve vital business processes all across the enterprise" (O'Brien and Marakas, 2007:234). Instead of focusing on information requirements of business functions, such enterprise systems (as shown in Figure 2.6) focus on "supporting integrated clusters of business processes involved in the operations of a business" (O'Brien and Marakas, 2007:234).

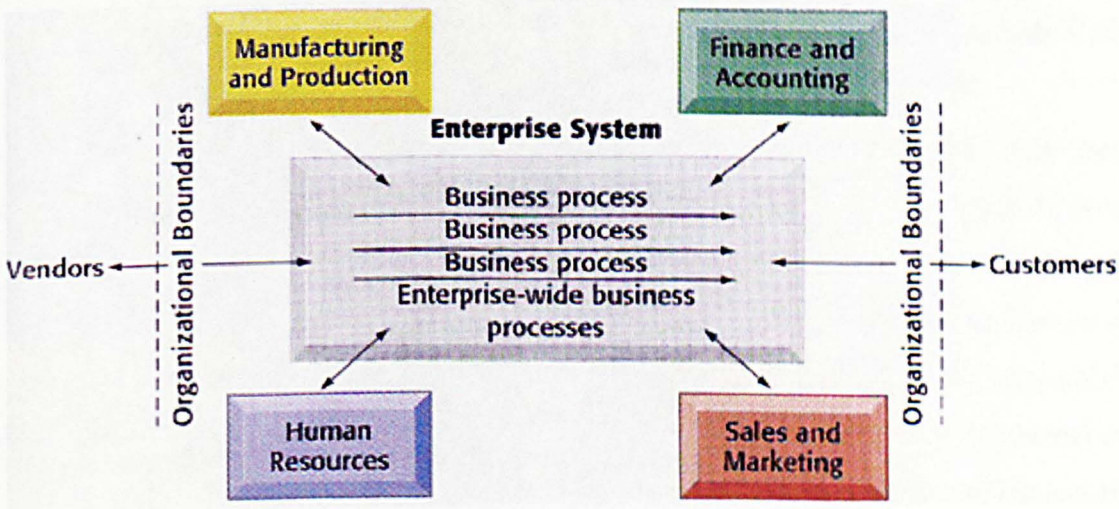


Figure 2.6: A model of enterprise systems
(source: Laudon and Laudon, 2006:57)

The major feature and benefit of enterprise systems is that, such cross-functional applications can help organisations integrate and coordinate their major business processes, and thus enhance efficiency and effectiveness of these business processes and improve data integration and sharing across the firm (O'Brien and Marakas, 2007:234; Laudon and Laudon, 2004:7). Three types of enterprise systems are currently prevalent in the industry, namely ERP systems, Customer Relationship Management (CRM) systems, and Supply Chain Management (SCM) systems:

- ERP systems consist of a set of independent software modules to collect "data from various key [internal] business processes in manufacturing and production, finance and accounting, sales and marketing, and human resources, etc, and store the data in a single and comprehensive data repository where they can be used by other parts of the business" (Laudon and Laudon, 2006:56). ERPs therefore allow internal "information that was previously fragmented in different systems [to] seamlessly flow throughout the [whole organisation]", and also facilitate the company to integrate its discrete internal business processes from different functions into enterprise-wide business processes which will "flow across organisational levels and functions" (Laudon and Laudon, 2006:56; O'Brien and Marakas, 2007:243).
- CRM systems are cross-functional enterprise systems that integrate and automate "many of the customer-serving processes in sales, marketing, and customer services that interact with a company's customers" (O'Brien and Marakas, 2007:238). CRM systems may often be integrated with ERPs in modern companies, and thus linking the firm's front office with its back office (Kalakota and Robinson, 2000; Jaiswal and Kaushik, 2005).
- SCM systems are cross-functional inter-enterprise systems that "help support and manage the links between some of a company's key business processes and those of its suppliers, customers, and business partners" (O'Brien and Marakas, 2007:248). The goal of SCM is to create a fast, efficient, and low-cost network between the firm and its business partners across the supply chain (O'Brien and Marakas, 2007:248; Laudon and Laudon, 2004:55). A SCM system can also be integrated with ERP to link together the company's front office and back office (Davenport, 2000).

More specific phenomena about ERPs are presented and discussed intensively in the next chapter. On the other hand, since CRMs and SCMs are not the main focuses of this study, they are not addressed extensively in this thesis.

2.4 Conclusions

This chapter presents and discusses the concept and theory of IS in general.

It is identified in this chapter that an IS consists of five fundamental components, namely people, hardware, software program, data and network. It is however obvious that, an ERP system contains only two of these components, namely software program and data. It therefore clearly emerged that, an ERP system should not be conveniently considered as an IS. Instead, an ERP should be considered as part of an IS, and needs to work together with other IS components (i.e. people, hardware and network) to achieve its intended goals. It can thus be concluded that, the success of ERP will not only rely on the design of the system itself, but more importantly also depends on the other IS resources namely people, hardware and network resources. It is apparent that problems associated with the ERP system itself or with the hardware and network resources are 'hard' issues that can often be explicitly identified and resolved. In contrast, problems related to human and organisational aspects are 'soft' problems that are always ill-defined, complicated and thus difficult to identify and manage. It is therefore expected that the most critical and dangerous barriers and risks that can lead to potential ERP failure may be related to human and organisational aspects rather than system ones. This expectation, derived from the results of the literature review presented in this chapter, was proved to be true in the context of Chinese SOEs, as further discussed in the finding sections of this thesis.

After obtaining a comprehensive understanding on IS in general, the next chapter takes a detailed look on more specific phenomena about ERPs.

Chapter Three: An Overview of ERP Systems

3.1 Introduction

After presented and discussed the general concept and theories of IS in the previous chapter, this chapter focuses intensively on the specific phenomena related to ERP systems. As briefly introduced in chapter two, ERP systems are cross-functional enterprise systems that aim at addressing an organisation's internal operations. Since its emergence, ERP systems have continuously evolved according to new market requirements and the development of new technologies. Contemporary ERPs do not merely improve an organisation's performance, by integrating its internal value chain, but may also provide companies with opportunities to build up stronger and closer business networks with their customers, suppliers and partners. Hence, it is widely recognised and acknowledged that ERP systems are now one of the essential tools for companies to survive and maintain competitive advantages under the global competitive environment in the new century. This chapter provides a comprehensive review of ERP systems by presenting and discussing the history, definition, functions, benefits and challenges related to ERP, as well as discussing the implementation and post-implementation stages of ERPs.

3.2 Introduction of ERP Systems

3.2.1 Emergence of ERP systems

In the 1970s, ISs, that were designed to support single functional areas of the firm, were prevalent in the industry (Loonam and McDonagh, 2005:3). In that period of time, different functional units of organisations often pursued their own objectives and had very clear boundaries between each other (Lambert and Peppard, 2003:430). Under this organisational context, ISs developed and used at that moment mainly aimed at supporting a single business function (Laudon and Laudon, 2006:57). However, because these ISs were developed by using different hardware, software and data resources, they were not able to communicate or share data and information with each other (Alter, 2002:31). These ISs resembled a set of separate instruments played by musicians in an orchestra. McKenney and McFarlan (1982, quoted by Loonam and

McDonagh, 2005:3) describe this phenomenon as "islands of automation", which means that information systems were isolated and running separately from each other. It is apparent that such isolated ISs would not bring sufficient strategic and competitive advantages to user companies. Specifically, managers had to spend a large amount of time to assemble data they needed from the isolated ISs, which led to significant reduction in efficiency and productivity (Laudon and Laudon, 2006:56). Maintenance cost of these isolated systems could be very high, but companies received little benefits from their use (Kalakota and Robinson, 2000:245). More importantly, as organisations gradually recognised the ineffectiveness of their traditional functional-based structure and cross-functional cooperation became increasingly important in the 1980s, organisations tended to break down the traditional boundaries between functional divisions and integrate business processes across traditional functions (Lambert and Peppard, 2003:430-442). It is apparent that the traditional isolated ISs could not support these organisational changes. Laudon and Laudon (2006:54) thus conclude that integration issues of ISs were the major challenge faced by many user companies in that period of time. Consequently, in the 1990s, ERP emerged as a fundamental solution towards resolving these integration issues, by using a single and enterprise-wide system to break down traditional boundaries between function units and replace the hitherto isolated ISs (Laudon and Laudon, 2006:56; Alter, 2002:31; Turban et al, 2004:343).

3.2.2 Evolution of ERP systems

The emergence of ERP systems is not occasional. In fact, the concept of ERP systems "has evolved over almost 50 years driven by the changing business requirements, new technologies and software vendors' development capabilities" (Møller, 2005). This section provides a detailed look at the evolution of ERP systems.

3.2.3.1 The past of ERP systems

The origin of ERP can be tracked back to the 1950s when inventory control systems (ICSs) and bill of material processors (BOMPs) were developed and used in Western companies (Møller, 2005; Shehab et al, 2004; Kapp et al, 2001:18). The early ICSs and BOMPs gradually turned into Material Requirements Planning (MRP) systems in the 1960s (Møller, 2005). MRP systems used bill of materials (BOM), inventory records and master production schedules (MPS) as inputs to calculate the net requirement plan

of materials as output, and therefore create production and purchase orders for lower-level components (Koh et al, 2000). The adoption of MRP systems helps companies improve their production processes by enhancing the efficiency of material scheduling and inventory control. During the 1970s and 1980s, Manufacturing Resource Planning (MRP II) systems emerged to extend MRP's traditional focus on production processes into other business functions related with manufacturing (Chen, 2001). MRP II integrates "primary functions (e.g. production) and other functions such as personnel, engineering and purchasing into the planning process to improve the efficiency of the manufacturing enterprise" (Chen, 2001). However, the main focus of MRP II is still on the manufacturing side of the company.

3.2.3.2 Generation and extensions of ERP systems

In the early 1990s, MRP II further evolved to ERP which does not just focus on the manufacturing side, but also on other aspects, especially sales, human resource and financial side, of the company. ERP systems were traditionally applied in capital-intensive industries such as manufacturing, construction, aerospace and defence (Shehab et al, 2004). During the 1990s, ERP systems continually evolved and were extended to integrate all functions (e.g. sales, production, distribution, human resources, finance and accounting function) of an organisation's 'back office' (Shehab et al, 2004). In the late 1990s, ERP systems have been expanded beyond the manufacturing sector and been introduced into other commercial (e.g. finance, insurance, retail and telecommunication) and non-commercial (e.g. government, health care, education) sectors (Shehab et al, 2004). However, ERP systems developed and used in the 1990s had a set of limitations:

- Limited functionality. Although ERP systems traditionally strived to automate and integrate all business processes and functions to allow data to seamlessly flow throughout the whole organization, many ERP adopters found that the actual implementation cases rendered a different story. Specifically, many organizations found that their ERP systems did not contain all necessary functions they expected and did not support any specific or unusual business processes they used to gain better competitive advantages, while customizing the system or changing the business processes is not always possible (Markus et al, 2000; Soh et al, 2000).

- Lack of decision support capability. Since ERP systems were originally designed to integrate the company's transaction processing systems, they were not designed to fulfil all the needs for business reporting, decision making and longer-term planning (Markus et al, 2000; Chou et al, 2005; Sammon and Adam, 2005).
- Inability to support a company's 'front office'. Traditional ERP systems mainly focused on integrating the company's 'back office', but they provide little functions to support the company's 'front office' which deals with people, suppliers and customers (Exact Software, 2005; Markus et al, 2000)
- Inability to link the company with its external supply chain. Traditional ERP systems were focused on the internal operation of companies, but they were not designed to address the external supply chain of the companies. In other words, they are incapable to link the company with its suppliers and customers in the supply chain (Davenport and Brooks, 2004; Møller, 2005).

Therefore, since 2000, ERP vendors have made a substantial effort in strengthening and developing their ERP packages. Consequently, contemporary ERP systems do not just contain broader and deeper functionalities, but also are able to integrate with other enterprise applications, such as supply chain management (SCM) and customer relationship management (CRM) – which address the company's front-office issues; and business intelligence (BI) – which provide the system with stronger forecasting and decision support functions. ERP vendors have also added web capabilities to their ERP packages to allow the systems to link directly with each other over the Internet (Davenport and Brooks, 2004). With such web-enabled ERP systems, companies can easily share information and knowledge, exchange transaction data (e.g. purchase/sales orders, production/delivery schedules and payments) and conduct collaborative processes/tasks with their partners, suppliers and even customers through the Internet (Jaiswal and Kaushik, 2005; Búrca et al, 2005). As a result, companies in the supply chain will be able to build up strong business networks with each other and even achieve inter-enterprise integration (Davenport, 2000; Kalakota and Robinson, 2000; Jaiswal and Kaushik, 2005).

3.2.3 Definition of ERP

Nowadays, researchers in the field draw slightly different definitions of ERP systems. For example, Kumar and Hillegersberg (2000) define ERP systems as "configurable information system packages that integrate information and information-based processes within and across functional areas in an organization". Gable (1998) defines ERP systems as comprehensive package software solutions that seek to integrate the complete range of business processes and functions in order to present a holistic view of the business from a single information and IT architecture. Shehab et al (2004) consider ERP systems as "business management system[s] that comprise integrated sets of comprehensive software, which can be used, when successfully implemented, to manage and integrate all the business functions within an organization". Møller (2005) defines an ERP system as "a standardized software package designed to integrate the internal value chain of an enterprise...[It] is based on an integrated database and consists of several modules aimed at specific business functions".

By analysing and comparing these four definitions, a comprehensive set of essential characteristics of ERP systems can be identified. In particular, ERP systems:

- can be reconfigured or customised;
- are standard information system packages that consist of a set of independent software modules;
- has a single IT architecture/data repository;
- can facilitate the integration of information-based processes within and across all functional areas of the organization.

By combining this comprehensive set of features of ERPs, this thesis defines an ERP system as:

> A configurable information system package that consists of a set of independent software modules, and can integrate information and information-based processes within and across functional areas, including finance, human resource, manufacturing, sales and purchasing areas, etc, in an organization by using a single comprehensive database.

The definition of ERP clearly shows that ERP systems are essentially software packages that facilitate data integration across the firm. As identified in the previous chapter, a company's IS does not only involves software and data, but also contains another three essential components, namely people, hardware, and network. The definition of ERP therefore supports the conclusion made in the previous chapter that ERP is not a company's IS but a part of the IS. ERPs need to work together with other IS components (i.e. people, hardware, and network) in order to achieve its intended goals.

3.2.4 Major modules of ERP systems

As emerged in the above definition, ERP systems consist of a set of interrelated modules that perform specific business processes and support different functional areas. The modules contained in actual ERP packages may often vary due to the differences on software capabilities of ERP vendors. With rapid technology development, companies are now also able to select, implement and integrate the most suitable modules from different ERP vendors to form their own ERP systems which best suit their needs. Nevertheless, four basic modules are typically involved in ERPs: sales and distribution, manufacturing and production, finance and accounting, and human resources. Contemporary ERP systems also act as platforms to integrate a number of new enterprise applications such as supply chain management (SCM), customer relationship management (CRM) and business intelligence (BI). This section discusses these ERP modules in detail.

Sales and Distribution

The sales and distribution module of ERP aims to handle processes such as order entry, order processing, product availability checking, sales forecasting, shipping scheduling, distribution management, etc (Shehab et al, 2004). In general cases, sales orders will be entered into ERP by sales clerks (Laudon and Laudon, 2006:380). However, if the ERP system also has an e-commerce application, customers can fill in their sales orders online, which will then be processed and stored in ERP (Alter, 2002:42-43; O'Brien, 2004:50-52).

Manufacturing and production

As mentioned earlier, MRP, which focuses mainly on production and manufacturing processes, is the former generation of ERP (Klaus et al, 2000). The core of manufacturing and production module of ERP is thus developed based on the MRP logic (Klaus et al, 2000). This module aims at generating production schedules, calculating net requirement plans of materials, releasing purchase orders, and automating capacity planning and inventory control (Shehab et al, 2004).

Finance and accounting

The finance and accounting module is usually the backbone of the ERP system (Marnewick and Labuschagne, 2005). It includes functions to handle the company's general ledger, accounts receivable, accounts payable, fixed assets, treasury management, cost control, profitability analysis and capital budgeting etc (Marnewick and Labuschagne, 2005; Yen et al, 2002; Shehab et al, 2004).

Human resources

The human resources module can automate the personnel management processes such as recruitment, workforce planning, training and development, business travel arrangement, vacation allotment and payroll (Yen et al, 2002; Marnewick and Labuschagne, 2005; Shehab et al, 2004). The payroll is usually integrated with the finance and accounting module and handles all the accounting issues and preparation of cheques related to employee salaries, wages and bonuses (Yen et al, 2002; Marnewick and Labuschagne, 2005).

Supply chain management

Supply chain management is the coordination of material/product flows, information flows, and financial flows between and among all participants in the supply chain, from suppliers to manufacturers to distributors to retailers and finally to consumers (Kalakota and Robinson, 2000; Marnewick and Labuschagne, 2005). It is usually seen as an independent IS, but is also possible to be integrated in most modern ERPs. The goal of SCM is to "allow everyone involved in the flow of goods to make decisions based on

the latest and best information from everyone else, both upstream and downstream. The company that manages its supply chain best gets its product from points of origin to points of consumption in the least amount of time at the lowest cost" (Davenport and Brooks, 2004). There are two groups of applications involved in a typical SCM system/module: supply chain planning (SCP) applications which integrate a set of planning functions, such as demand, distribution, transportation and manufacturing planning and scheduling; and supply chain execution (SCE) applications which help companies to automate the order planning, production, replenishment, distribution and delivery functions to ensure the right products are delivered to the right customer at the right time (Kalakota and Robinson, 2000:283-288).

Customer relationship management

Greenberg (2001, quoted by Loonam and McDonagh, 2005:), defines customer relationship management as "a comprehensive set of processes and technologies for managing the relationships with potential and current customers [...] across marketing, sales, and service regardless of the communication channel. The goal of CRM is to optimise customer [...] satisfaction by building the strongest possible relationships at an organisational level". CRM aims to collect, organise and maintain all customer-related information (including customer details, customer shopping history and behaviour, and any records of interactions between the company and its customers) in a structural way (O'Brien and Marakas, 2007:238). Companies can use such information to match customer needs with new product plans and offers, handle specific customer issues and provide suitable customer services.

Business intelligence

Traditional ERP systems are often criticised for having insufficient decision support and environmental scanning capabilities (Markus et al, 2000; Chou et al, 2005; Holsapple and Sena, 2005; Sammon and Adam, 2005). In order to address these weaknesses, many ERP vendors nowadays integrate BI applications in their ERP packages. BI applications are decision support tools that enable real-time and interactive access, analysis and manipulation of mission-critical corporate information (Marnewick and Labuschagne, 2005). The main purpose of BI is to accumulate the data and process it into useful information (Marnewick and Labuschagne, 2005). Data stored in the

integrated database of ERP system can be loaded into a data warehouse, and then linked to BI tools (such as OLAP, data mining, query and reporting) which can perform various data analysis and produce analytical reports (Chou et al, 2005).

3.2.5 Potential benefits for using ERP systems

The review of literature identified a wide range of potential benefits that ERP systems may bring to user companies in operational, managerial, strategic and organisational levels. This section provides a summary of the key benefits associated with the adoption of ERPs.

Operational benefits:

- *Improve, standardise and automate key business processes.* The adoption of ERP will not only automate all key business processes, but can also facilitate user companies to standardise and improve their current business processes (Oliver et al, 2005; Bergstrom and Stehn, 2005; Markus and Tanis, 2000).

- *Improve inventory management.* ERP systems enable better inventory control, higher inventory turnover and lower inventory cost (Bergstrom and Stehn, 2005; Gupta et al, 2004; Spathis and Constantinides, 2003).

- *Increase productivity and operational efficiency.* Operational data, such as customer orders, production capabilities, procurement plans and financial status, etc, can be shared among business functions in real time through ERP systems (Shang and Seddon, 2002). This can lead to significant increase in productivity and operational efficiency (Gupta et al, 2004; Bergstrom and Stehn, 2005; Shang and Seddon, 2002).

- *Reduce operational cost.* Automation of business processes and increase in operational efficiency can help user companies to reduce operational cost significantly (Oliver et al, 2005; Gupta et al, 2004; Spathis and Constantinides, 2003; Markus and Tanis, 2000).

- *Increase customer satisfaction.* ERP systems enable companies to become more flexible to respond to customer needs within the shortest time possible, and thus increase customer satisfaction (Oliver et al, 2005; Bergstrom and Stehn, 2005; Gupta et al, 2004; Shang and Seddon, 2002; Markus and Tanis, 2000).

Managerial benefits:

- *Improve forecasting, planning, controlling and decision making.* Substantial improvements in operational efficiency and data processing can in turn essentially increase management efficiency in terms of better forecasting, planning, controlling and decision making (Oliver et al, 2005; Bergstrom and Stehn, 2005; Spathis and Constantinides, 2003; Shang and Seddon, 2002; Markus and Tanis, 2000).

- *Improve resource management.* As managers can now access and retrieve needed data associated with any aspects of the firm more easily, they can arrange, control and allocate the firm's (e.g. human and finance) resources more efficiently (Shang and Seddon, 2002).

Strategic benefits:

- *Support business growth and goal achievement.* Substantial improvements in operational and management efficient can certainly render a positive impact on the business growth and goals achievement in the long-term (Bergstrom and Stehn, 2005; Shang and Seddon, 2002).

- *Increase global operation power.* Integrated cross-functional ERP systems present new opportunities for enhancing core competitive competencies, and thus increase global operation power of the firm (Bergstrom and Stehn, 2005; Shang and Seddon, 2002).

Organisational benefits:

- *Facilitate data and business process integration across the firm.* ERP systems use a single database to integrate all data and information collected from various

business processes across the firm, and thus enable these data and information to seamlessly flow throughout the whole organisation (Kumar and Hillegersberg, 2000; Gable, 1998; Shehab et al, 2004). Data integration also helps to break down traditional boundaries of business functions and facilitates cross-functional integration within user companies (Oliver et al, 2005; Spathis and Constantinides, 2003).

- *Increase organisational flexibility.* ERPs enable user companies to be more flexible in responding to customer needs and controlling inventory, human and capital resources (Oliver et al, 2005; Bergstrom and Stehn, 2005; Spathis and Constantinides, 2003).

- *Reduce the requirement of manpower.* Since most of the business functions get automated as a result of ERP adoption, manual output is greatly reduced. Consequently, requirements of manpower will be correspondingly reduced (Bergstrom and Stehn, 2005; Gupta et al, 2004).

- *Increase employee empowerment.* The greater availability of information enables greater empowerment of employees, since they can now use the accurate and comprehensive information contained in ERP to make decisions which used to be formally referred upwards or to other departments due to lack of information (Sia et al, 2002; Shang and Seddon, 2002).

- *Facilitate organisational learning.* ERP is not just an IT tool but is also embedded with advanced business management concepts. Using ERP and absorbing its embedded management knowledge present to be valuable learning opportunities across the organisation (Shang and Seddon, 2002).

Table 3.1 summarises all potential ERP benefits found in the literature review and discussed so far.

Category	Benefit	Authors mentioned
Operational benefits	Improve, standardize and automate key business processes	Oliver et al, 2005; Bergstrom and Stehn, 2005; Markus and Tanis, 2000
	Improve inventory management	Bergstrom and Stehn, 2005; Gupta et al, 2004; Spathis and Constantinides, 2003
	Increase productivity and operational efficiency	Gupta et al, 2004; Bergstrom and Stehn, 2005; Shang and Seddon, 2002
	Reduce operational cost	Oliver et al, 2005; Gupta et al, 2004; Spathis and Constantinides, 2003; Markus and Tanis, 2000
	Improve customer satisfaction	Oliver et al, 2005; Bergstrom and Stehn, 2005; Gupta et al, 2004; Shang and Seddon, 2002; Markus and Tanis, 2000
Managerial benefits	Improve planning, controlling and decision making	Oliver et al, 2005; Bergstrom and Stehn, 2005; Spathis and Constantinides, 2003; Shang and Seddon, 2002; Markus and Tanis, 2000
	Improve resource management	Shang and Seddon, 2002
Strategic benefits	Support business growth and goal achievement	Bergstrom and Stehn, 2005; Shang and Seddon, 2002
	Increase global operation power	Bergstrom and Stehn, 2005; Shang and Seddon, 2002
Organisational benefits	Facilitate data and business process integration	Oliver et al, 2005; Spathis and Constantinides, 2003
	Increase organisational flexibility	Oliver et al, 2005; Bergstrom and Stehn, 2005; Spathis and Constantinides, 2003
	Reduce labour requirement	Bergstrom and Stehn, 2005; Gupta et al, 2004
	Increase employee empowerment	Sia et al, 2002; Shang and Seddon, 2002
	Facilitate organisational learning	Shang and Seddon, 2002

Table 3.1: Summary of potential benefits for using ERP systems

User companies may often expect to receive the full range of benefits mentioned above once the ERP systems go live. However, this is actually unrealistic and unfeasible in real practices (Buonanno et al, 2005). In fact, the fully exploration of potential benefits of ERP is a long-term task that requires continuous contribution and effort of managers and employees across the whole company, as further discussed in section 3.3.

3.2.6 Potential issues for using ERP systems

This section describes and discusses some of the key issues that may occur when using ERP systems in organisations. These issues are further developed and discussed in chapter six.

Data accuracy

ERP systems require extremely high data accuracy to work effectively and efficiently (Koh et al., 2000; Zhou et al., 2005). The integrated nature of ERP determines that all data entered into the system will be stored in the central database and become available immediately to the whole company. As a consequence, if system user input incorrect data into the system, it will raise immediate impact and problems to the entire company and may disturb the operation of all functional divisions (Scapens and Jazayeri, 2003). System users thus need to use and operate the system carefully and earnestly in order to reduce the probability of occurrence of user mistakes (Gargeya and Brady, 2005). On the other hand, data stored in the system must be regularly purged to ensure highest level of accuracy possible (Loh and Koh, 2004). If outdated and duplicated data of the ERP system is not discarded properly, it may lead to low data accuracy, reduce speed of data search and increase data storage space and cost (Loh and Koh, 2004). Overall, the continuance of data accuracy depends on long-term efforts and carefulness of well-trained system users and IT maintenance staff.

Conflicts between greater management control and greater employee empowerment

ERP systems make user companies become more transparent by increasing their ability to gather more information in greater detail and in real time throughout the organisation (Sia et al, 2002). Consequently, managers can "remain in touch with the activities on the ground and are able to involve themselves in the decisions of the subordinates", and thus have greater control on their staff (Sia et al, 2002; Shang and Seddon, 2002).

On the other hand, with greater availability and accessibility of information, employees are now in a better position to make decisions which used to be formally referred upwards or to other departments due to lack of information (Sia et al, 2002; Shang and

Seddon, 2002). This actually serves as a means of greater employee empowerment (Sia et al, 2002).

However, as widely acknowledged, control and empowerment are actually opposite ends of the management power (Sia et al, 2002). Greater empowerment often means looser control, and vice versa. Therefore, finding a good balance between employee empowerment and efficient management control is frequently reported as a challenge faced by companies using ERPs (Sia et al, 2002; Elmes et al, 2005).

Technical integration vs. social integration

There is no doubt that ERP systems replace the traditional isolated information systems and help companies achieve data integration and break down functional boundaries. However, Allen (2005) states that, the technical data integration achieved by using ERP does not mean the social integration of people within diverse functions. In particular Allen (2005) argues that new value conflicts (e.g. conflicts over work priorities, over dependency on the commitments of others, and over evaluation fairness) may emerge with the use of ERP. If these value conflicts are not managed carefully, they may place "a strain on the close and trusting social relationships needed for cross-functional cooperation through ERP" (Allen, 2005). Therefore Allen concludes that these value conflicts must be solved in order to achieve social integration between different functional areas. Technical and social integrations are the prerequisite for achieving functional integration of the whole organization.

Cultural misfits

Cultural misfits are considered as one of the most important factors to affect the efficiency of ERP systems. For example, ERP systems require name to be entered in the Western format as first, middle, and last name. System users would find it difficult to understand which part of an Indian, Malay, or Chinese name should be considered a last name and a first name (Soh et al, 2000). The report formats (especially financial reports) of different countries might be different. Managers might get confused and not be able to find particular figures when reading reports provided by ERP systems of subsidiary operating in another country.

3.3 ERP implementation and post-implementation

Many companies expect to achieve the full range of benefits from their ERP systems once the systems go live (Buonanno et al, 2005). However, they soon became disappointed that, the actual performances of the systems do not meet their expectations (Buonanno et al, 2005). The survey conducted by Trunick (1999) reveals that 40 percent of implemented ERP systems perform to only some of their full effectiveness and 20 percent are scrapped as complete failure. Willis and Willis-Brown (2002) argue that the main reason for causing such disappointment and system inefficiency is due to the companies see the "go live" point as their final goal but fail to apply a long-term view to consider that the go-live of the new system is not the end of the ERP implementation journey but another beginning. From ERP implementation studies, Willis and Willis-Brown reveal that ERP implementation must go through two distinct phases in order to maximise the potential benefits of the ERP system (Figure 3.1).

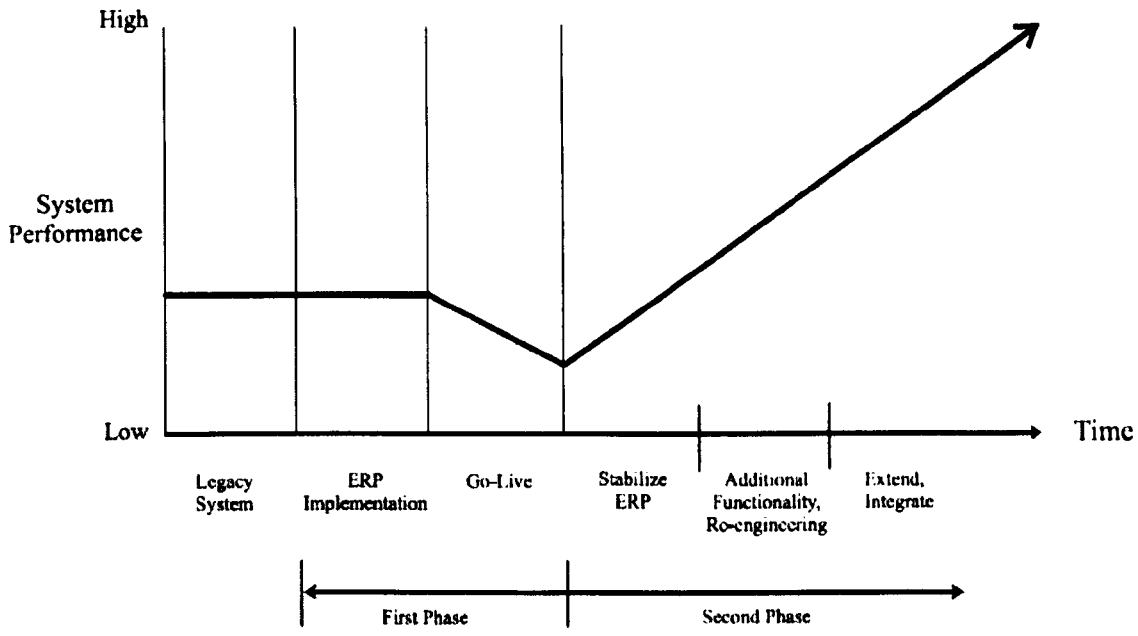


Figure 3.1: The two phases and performance trend for ERP implementation (source: Willis and Willis-Brown, 2002)

The first phase of ERP implementation can be described as focusing on the effort necessary to reach the 'go live' milestone. This includes the typical implementation stages (e.g. system vendor selection, system requirements identification and the execution of the whole implementation project) and the 'go live' stage. As shown in figure 3.1, the major hurdle to overcome in the 'go live' stage is a dip in performance of the ERP system. Almost every ERP project manager will be confronted with problems,

such as late orders, billing errors, and inaccurate inventory records, in the first few months after the system goes lived (Hammer, cited by Willis and Willis-Brown, 2002). If the company properly reengineers for the new processes and thoroughly masters the change culture, a significant performance dip can be avoided. Besides, companies should start recognising that the 'go live' stage is not the end of the journey but merely a beginning. They gradually turn to the second phase of ERP implementation.

The second phase is the post-implementation phase, in which the standard ERP system is continuously improved and extended to maximise the potential benefits and value return. The success of the post-implementation phase depends on three critical stages (Figure 3.1):

- The first stage aims to stabilise the installed system. An audit or evaluation of the new system should be conducted to identify major breakdowns, inconsistencies and deficiencies. All users must be trained and retrained to ensure they have sufficient skills and knowledge to operate the system. Process discrepancies and critical functionality shortages must be filled and corrected. The goal of this stage is to make sure that all functions of the new system are working correctly and properly and therefore build the foundation for further ERP extension.

- The second stage is to add functionality and to reengineer necessary processes. It is not surprised to find that the initial system requirement identification is not comprehensive enough when the new system is actually being used. More system functionalities and business processes might be needed in order to improve the operational performance and gain a better competitive advantage. External resources (e.g. consultants and academics) can be consulted to find out how the current system functionalities can be strengthened and what innovative business processes can be added. When companies are satisfied that their ERP systems can well support the operation of their back offices, they can go to stage three.

- The third stage is to extend the focus of ERP system from back-office operation to front-office operation and from internal integration to external integration. Companies can consider integrating their standard ERP systems with front-office applications, such as SCM and CRM. They can choose these new applications either from their existing system vendors or from third-party vendors whose

products can be easily integrated with the current ERP systems. They can also add e-business capabilities to the systems to enable them directly exchange data with other systems of business partners in the supply chain and achieve inter-enterprise integration. Mobile ERP is another possible extension which permits the user to take the ERP system to anywhere with him/her. One example is that, the sales representative in the field can use a mobile device to check the order and inventory information from the ERP system and even wirelessly send new customer orders to the system. Satellite-based global positioning system is another excellent extension which allows the ERP system to track company assets, such as trucks and materials which have moved beyond the plant. Delivery routes and schedules can be dynamically tracked and optimized.

Therefore, the 'go live' milestone of the system is not the end of the ERP journey. The system post-implementation stage is actually more crucial than the implementation one. User companies need to properly and continuously use, maintain and enhance the installed ERP in the post-implementation stage, in order to maximise potential benefits and value return of the system. This study thus focused on ERP post-implementation rather than on implementation. It aimed at investigating barriers and risks that could prevent user companies from achieving long-term ERP success in the Chinese context.

3.4 Conclusions

Successful implementation of ERPs will bring a set of substantial benefits to companies in operational, managerial, strategic and organisational dimensions. However, it is unrealistic and impossible for companies to receive this full range of potential benefits once the system goes live. In fact, in order to maximise value return of the system and ensure continuous ERP success, companies must be ready for the long-term fight of ERP post-implementation. It can be expected that a wide range of barriers and risks may affect the success of long-term ERP exploitation in user companies. As concluded in the previous chapter, these ERP barriers and risks will not be limited to technical dimensions (e.g. software, ICT infrastructure), but more importantly can also be found in various human and organisational aspects. Therefore, this study aimed at investigating and exploring potential ERP post-implementation barriers and risks across technical, human and organisational dimensions in the Chinese context.

Chapter Four: PEST Analysis of China

4.1 Introduction

As discussed in chapter one, at the beginning of this research project, the first temptation of the researcher was to undertake a national study of the whole of China. This however soon proved to be virtually impossible, due to the fact that China is by no means a homogeneous country. In particular, China has more than 2,000 cities. There are important changes occurring in coastal cities of China, whereas other parts of the country are still very traditionally led by the central government. Some regions in the country have achieved very high level of IT and IS utilisation, whereas other regions may not currently be ready for adopting IS in general and ERP in particular. There are also significant differences in organisational culture and information sharing in different types of organisations, namely between state-owned companies and newly created private organisations. Moreover, companies operating in different industrial sectors also have different characteristics and diverse needs for the use of IT. Therefore, it became clear that such a complex and wide study is not only unrealistic and potentially unfeasible, but may result in findings that are neither significant nor meaningful (Peng and Nunes, 2007b).

Faced with the necessity of focusing the research and the need of identifying an appropriate set of cases to carry out the project, the researcher adopted a Political, Economic, Social and Technological (PEST) analysis as a tool to narrow the scope of the study, as well as to identify an appropriate region, a business sector and a type of Chinese company where ERPs are routinely used. Additionally, as discussed in chapter two, the nature of IS determinates that the adoption and use of IS can be significantly affected by the business context and environment in which the system is being used. Therefore, the PEST analysis conducted also aimed at studying the Chinese context and its impact on the adoption and use of ERP in Chinese firms.

This chapter firstly provides an overview of the history of China and the concept of PEST analysis. Subsequently, this chapter presents and discusses the results derived from a PEST analysis of China. As concluded from this chapter, the researcher identified and selected State-Owned Enterprises (SOEs) in the electronic and telecommunication manufacturing sector in the Guangdong province as a suitable context to base this study on.

4.2 A brief historical overview of the People's Republic of China

The People's Republic of China, in short PRC or China (note: China is used in this thesis), was established in 1949 by the Chinese Communist Party (CCP) with Mao Zedong as the first president of the country. Under the leadership of Mao, China went through a stable period with continuous economic growth from 1949 to 1957. The country's Gross National Product (GNP) did grow with an annual rate of nearly 9 percent during China's first Five-Year Plan (a national economic plan from 1953 to 1957) (Perkins, 1997:30).

Nevertheless, China soon entered to a turbulent period which lasted for nearly twenty years, from 1958 to the death of Mao in 1976 (Perkins, 1997:32). In 1958, with the experience of continuous economic success in the past years, Mao initiated and led a new and ambitious economic plan, named the Great Leap Forward, which was initially scheduled to run from 1958 to 1969 (Peng, 1987; Li and Yang, 2005). The goals of Great Leap Forward were to significantly increase the production of steel by involving China's vast peasant population into steel production, and to rapidly transform mainland China from a primarily agrarian economy into a modern, industrialized communist society (Peng, 1987; Li and Yang, 2005). Unfortunately, significant mistakes were made during the Great Leap Forward. Instead of achieving its goals, the Great Leap Forward led to widespread economic and social dislocation and was eventually terminated in 1961 (Li and Yang, 2005; Peng, 1987). Mao took most of the blame for the failure of the Great Leap Forward (Li and Yang, 2005; Peng, 1987).

In order to restore his political base, crush his opposition and secure Maoism (Mao's thoughts) as the state's dominating ideology, Mao initiated and launched in 1966 the Cultural Revolution, which eventually run out his control (Perkins, 1997:32-34; Pu, 1996:48). During the Cultural Revolution, many CCP leaders were maligned, persecuted, forced to step down from the political arena, and were put under house arrest. The national education system including schools and universities were closed down and many economic activities were halted due to students and workers considering revolution through learning and following Maoism as the main priority of their activities. Intellectuals became suspected to be opposite to Maoism and thus were made targets of political persecution. The country's legal system was completely broken down and replaced by anarchy (Perkins, 1997:32-34; Pu, 1996:48). The turbulence of Cultural Revolution lasted for ten years and was finally ended with the death of Mao and the arrest of the "Gang of Four[1]" in 1976 (Perkins, 1997:32-34).

Both Great Leap Forward and Cultural Revolution have been criticised, inside and outside China, as two major mistakes made by Mao in his old age and caused political and economic disasters to the country for two decades (Perkins, 1997:32-34).

In 1978, the Third Plenary Session of the Eleventh Central Committee of the CCP summarised the lessons learned from the Cultural Revolution, and approved the motion of Deng Xiaoping (the *de facto* leader of the country at that moment) regarding China's economic reform and transforming the CCP from a revolutionary party to one with its emphasis on economic reconstruction (Zheng, 1999:11; Perkins, 1997:34). Since then, China has entered a path of economic recovery and development (Perkins, 1997:34). After nearly three decades of economic reform, China has now become an aspiring economic superpower in the world.

[1] "The Gang of Four was the name given to a leftist political faction composed of four Chinese Communist party officials. They came to prominence during the Cultural Revolution (1966-76) and were subsequently charged with a series of treasonous crimes. The members consisted of Jiang Qing, Mao's last wife and the leading figure of the group, and her close associates Zhang Chunqiao, Yao Wenyuan and Wang Hongwen". (source: Wikipedia website http://en.wikipedia.org/wiki/Gang_of_Four)

4.3 The concept and use of PEST analysis

PEST, as an analysis framework of macro-environmental factors, is also referred to as, STEP (Clulow, 2005), SEPT (Narayanan and Fahey, 1994:199-202), or STEEP (Voros, 2001). 'PEST' is an acronym for four types of factors existing in a firm's external macro-environment, namely (Ward and Rivani, 2005):

- *Political factors* (e.g. political/legal system of the country, government policies and regulations);
- *Economic factors* (e.g. economic situation of the country, any factors affecting the purchasing power of customers and the cost of capital of firms);
- *Social factors* (e.g. demographic, education and cultural aspects);
- and *Technological factors* (e.g. trends and development of technologies which affect production efficiency).

The usefulness of PEST lies in the assumption that the success of a particular organisation or management solution cannot be understood without having the information relevant to the specific business environment (Buchanan and Gibb, 1998). Business environment could be defined as all relevant physical and social factors outside an organization that are considered into decision-making process (Duncan, 1972). According to Ward and Rivani (2005), PEST analysis assumes that specific external and indirect circumstances that characterize the business environment are able to influence organisational capacity to produce value. Hence, PEST analysis provides a "satellite view" to assess the external environment (Ward and Rivani, 2005). This is particularly relevant when trying to narrow very large business environments in order to study organisational information systems (Peng and Nunes, 2007b).

PEST has been conventionally used in two different ways: first, to analyse the position of a particular organisation (e.g. Vrontis and Vignali, 2001) or industry sector (e.g. McManus et al., 2007:19-36) within a particular business environment; second, to analyse the viability of general management solutions in a business environment (e.g.

Economic and Social Commission for Western Asia, 2005). This chapter proposes to use PEST to analyse the study of a specific IS solution (i.e. ERP) in a particular business environment (i.e. China). That is, the purpose of the PEST analysis proposed in this chapter was to develop an in-depth understanding on the context (e.g. China) that was the original target of the study, and subsequently to identify a narrower context (e.g. a specific region and a type of company) where ERPs are routinely used and thus would allow this study to generate more in-depth and meaningful findings.

However, PEST is far from being a precise and clearly circumscribed analysis framework. There are an almost unlimited number of variables that may emerge from each dimension. Therefore there is the need to prioritise those variables that have highest impact on the industry, sector, or country being studied. For the purpose proposed in this chapter all these aspects of PEST were considered having an IS lens and aiming at conclusions that will enable the narrowing of the context.

Moreover, the PEST analysis presented in this chapter was essentially a desktop study which was based on the process of a systematic literature review. A large number of English and Chinese literature (including journal articles, books, official statistical reports, market research reports, news and online articles) were reviewed, compared and synthesised and then used as raw materials to construct arguments and standpoints for the PEST analysis.

4.4 PEST analysis of China

4.4.1 Political dimension

4.4.1.1 Political system of China

Under a dictatorship of the proletariat regime (Tung, 1974), the CCP is the dominating force in China's politics and has more than 69 million members nationwide. As shown in figure 4.1, the top leaders of the CCP (the General Secretary, Standing Committee of

the Politburo, and members of the Politburo) were elected by the Central Committee of the party (a body of approximately 200) which is in turn elected by the party's National Congress which consists of approximately 2,000 delegates and is held every five years (Shirk, 1994:17).

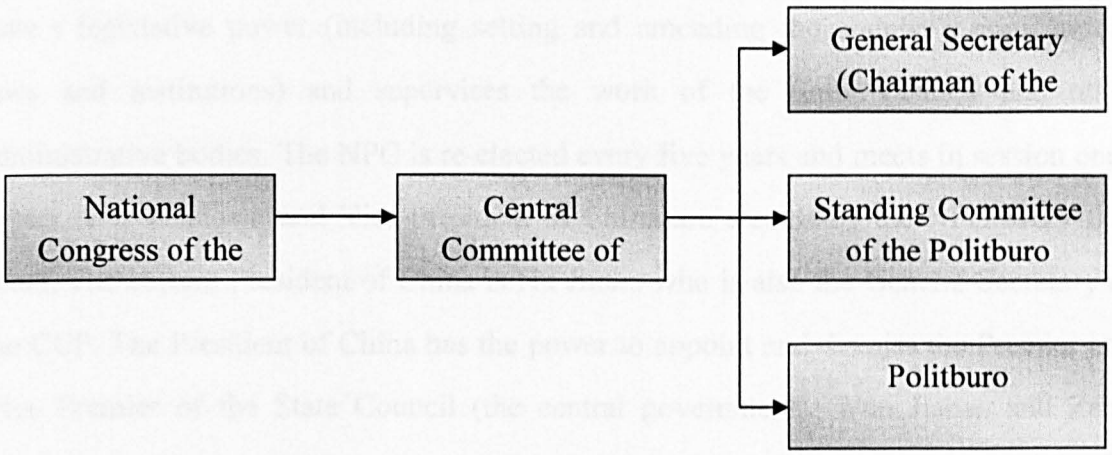


Figure 4.1: Structure of the leadership of the Chinese Communist Party

According to the Party Constitution of the CCP, when the National Congress is not in session, the Central Committee of the CCP carries out its decisions, directs the entire work of the Party and represents the CCP in its external relations; the Central Committee meets in Plenary Session at least once a year, when the Central Committee is not in session, the Politburo and its Standing Committee exercise the functions and powers of the Central Committee; the General Secretary of the CCP is responsible for convening the meetings of the Politburo and its Standing Committee. China's modern history proves that important policies and guidelines regarding the long-term development of the country must be discussed and approved in the Plenary Session of the Central Committee or the National Congress of the CCP before taking into action. For example, the Third Plenary Session of the Eleventh Central Committee of the CCP approved Deng Xiaoping's proposal regarding China's economic reform in 1978; the Fourteenth National Congress of the CCP decided to shift China's economic system from planning economy to market economy in 1992, etc.

While the CCP is the core of leadership in China and sets directions for the country, the National People's Congress (NPC) and the State Council (also known as the central government of China) are responsible for the governance of the country. The NPC

consists of approximately 3,000 delegates which come from the local people's congresses at different levels and have different statuses, e.g. members of CCP, members of other parties, entrepreneurs, workers, teachers and farmers, etc. As stated by the Constitution of PRC, NPC is the highest organ of state power and exercises the state's legislative power (including setting and amending the country's constitution, laws and institutions) and supervises the work of the State Council and other administrative bodies. The NPC is re-elected every five years and meets in session once a year. The President and Vice-President of China are elected by the NPC every five years. The current President of China is Hu Jintao who is also the General Secretary of the CCP. The President of China has the power to appoint and dismiss the Premier and Vice Premier of the State Council (the central government). Wen Jiabao and Zeng Qinghong are respectively the current Premier and Vice Premier of the State Council. According to the Constitution of PRC, the State Council is the highest executive organ of state power and responsible to the NPC. The State Council enforces the constitution and laws which were enacted by the NPC, and leads and directs the work of the country's ministries and local governments at different levels.

4.4.1.2 Legal system of China

The foundation of China's preliminary institutionalization and legalization was build by the Chinese People's Political Consultative Conference (CPPCC) who had stipulated a large number of laws and carried out the work of supervision from 1949 to 1954 (Pu, 1996:47-48). With the establishment of the NPC in 1954, the legislative and supervisory roles of the CPPCC were taken over by the NPC (Pu, 1996:48) who instituted the first version of Constitution of PRC in September 1954. NPC had made a lot of progress on both legislative and supervisory functions from 1954 to 1956 (Pu, 1996:48). However, from 1958 to 1976, especially in the turbulent period of the Cultural Revolution, the role of the NPC lost momentum: legislation was almost stopped and supervision hardly existed; no sessions of the NPC were convened for ten years; the role of laws and legal institutions were marginalized and replaced by personal dictatorship and anarchy (Pu, 1996:48; Potter, 1999:111).

From the lessons of the Cultural Revolution, the CCP learned that "in order to assure people's democracy [and social stability], the laws and institutions of socialism must be strengthened" (Pu, 1996:48). The Third Plenary Session of the Eleventh Central Committee of the CCP in 1978 therefore considered that a healthy and comprehensive legal system was the prerequisite for ensuring the success of the economic reform in the long term and stated that the nation must be ruled by law: "有法可依，有法必依，执法必严，违法必究" (literally, there must be laws for people to follow, the laws must be followed by people, the enforcement of laws must be strict, and law-breakers must be dealt with) (Zheng, 2004:190; Potter, 1999:111). Since then, the legislative and supervisory roles of the NPC have been resumed and strengthened (Pu, 1996:48). Legislation on business activities has been placed as a top priority due to economic necessity. Laws on contracts, property rights, and domestic and foreign business relations (e.g. the Economic Contract Law, the General Principles of Civil Law, the Company Law, the Securities Law and the Foreign Economic Contract Law etc), have been enacted and repetitively revised since 1978 (Potter, 1999:116-118). While the NPC enacted laws, the power of law enforcement is granted to the State Council, the Supreme People's Court and the Supreme People's Procuratorate, all of which are responsible to the NPC (Pu, 1996:47).

However, despite these efforts, China's current legal system still manifests certain drawbacks. It is evident that China has now set up various laws and regulations which cover most corners of the country after a twenty-year effort (Jiang, 2006; Ji, 2005). However, "有法不依，执法不严" (literally, the laws are not being followed, the enforcement of laws is not strict) have been the major issues existing in China's current legal system (Jiang, 2006). Jiang (2006) points out that laws and regulations of the country are too strict and also quite ambiguous and unspecific. According to Jiang (2006) and Ji (2005), when laws and regulations strictly cover too many corners of the social life, people try not to follow them. When laws and regulations are ambiguous and lack clear instructions for handling actual situations, law enforcement becomes extremely difficult and loose, and in turn increasing the possibility for people to break

the law (Jiang, 2006; Ji, 2005). Overall, China's legal system is still imperfect and thus must be continuously improved in order to satisfy the new requirements of a competitive market economy.

4.4.1.3 Economic reform policies

Soon after the CCP came to power in the country, it copied the development strategy and economic institutions from the Soviet Union, who was the only other large communist country that could serve as a model (Shirk, 1994:8; Perkins, 1997:30). Rapid development of the heavy industry, which is centred on steel and machinery, had been considered as the main development strategy of China since the 1950s (Shirk, 1994:8). In order to achieve this goal, China adopted the Soviet-style planning economic system (Shirk, 1994:9) which was characterised by the highly centralized economic control of the government. The planning economic system allowed the government to own the majority of resources of the country and enabled industrial labour, material inputs, finance, outputs and distribution to be centrally controlled by the government to guarantee that heavy industry had the first claim on resources (Shirk, 1994:9). Most Chinese enterprises in the planning economy were owned by the state and so called state-owned enterprises (SOEs), which basically acted as social-economic entities to fulfil production quotas assigned by the government rather than profit making units. The aim was to provide lifelong employment to citizens, and provide employees with social and welfare services through facilities owned by SOEs, such as schools, hospitals and houses (Sun et al, 2005; Zheng, 2004:129). However, it was inevitable that SOEs which were not driven by profit making objectives would have difficulties in competing in an openly competitive market environment. In other words, in order to protect SOEs and the government itself as the investor, strong competition in the domestic market had to be eliminated. Because domestic enterprises of the time were either owned or controlled by the government (Chen, 2005), the only potential source that could cause strong competition in the domestic market would be foreign competitors. As a result, participation of foreign products and investors in the national market was strictly limited during the planning economic era (Shirk, 1994:8). The government intended to

establish a self-reliant industry and built an airtight wall between the domestic economy and the world economy by direct controls on imports and foreign investments and other foreign trade policies (Shirk, 1994:8).

The Soviet-style planning economy enabled China to achieve continuous economic growth for a few decades. The country's GNP kept growing with an annual rate of nearly 9 percent from 1953 to 1957 and above 4 percent even in the turbulent period from 1958 to 1976 (Perkins, 1997:30-32). China's industrial growth was at an approximate rate of 10 percent per year from 1949 to 1980 (Shirk, 1994:10). However, despite the continuous economic growth, the planning economy actually caused crucial economic problems to China in the 1970s:

1) Poor investment decisions and weak project designs were frequently made by SOEs whose workers and management teams had few positive incentives on their jobs (Perkins, 1997:34) under the institutions of the planning economy. Since SOEs in the time were the mainstay for maintaining social stability and economic development, the losses and inefficiency of SOEs caused significant burdens to the country and the national economy.
2) After closing the country to international business for three decades, China's economy, technologies and business expertise were seriously lagging behind developed countries. The gaps between China and developed countries had rapidly increased during the ten-year Cultural Revolution (Research Lab of the Party History of the Central Committee of the CCP, 2001).
3) Total factor productivity of China declined between the early 1950s and 1979 at an average annual rate of 2.75 percent (Shirk, 1994:10) largely due to laggard technologies, outdated management concepts and the unmotivated work force of the country.
4) In order to resolve the problem of production inefficiency, the state had to pump more and more capital and labour from other sectors into industry to sustain its high growth (Shirk, 1994:10). This however would not be a long-term solution.

Thus in 1978, the Third Plenary Session of the Eleventh Central Committee of the CCP approved Deng Xiaoping's proposal to reform China's economic system by absorbing understanding of market economy from western countries (Research Lab of the Party History of the Central Committee of the CCP, 2001). The fundamental concept behind the economic reform was to reduce the government's highly centralised control on economic activities and allow economic activities to be influenced by market conditions in order to establish a stronger and more competitive economic system. However the revolutionary leaders of the CCP were initially unwilling to legitimate the market economy while negating the old planning economy (Zheng, 1999:17). At the Twelfth National Congress of the CCP in 1982, the leadership defined China's economic system as one in which "the planning economy is the main pillar and market economy a supplementary element" (Zheng, 2004:65). Five years later, at the Thirteenth National Congress of the CCP, the market economy acquired an equal status to that of the planning economy in party ideology, the leadership defined the country's economic system as one "combining planning and market economies" (Zheng, 2004:65). After Deng Xiaoping's southern tour in 1992 and seeing the benefits that market economy brought to southern costal cities, at the Fourteenth National Congress of the CCP in 1992, the leadership finally announced that the goal of China's economic reform is to completely shift the traditional planning economic system to a socialist market economy system (Liu, 1997:82; Zheng, 1999:18). The Third Plenary Session of the Fourteenth Central Committee of the CCP in 1993 subsequently outlined the development plan of the market economy system and divided the reform of China's economic system into two phases (Liu, 1997:85):

- From 1994 to 2000, a preliminary market economy would be established and Chinese people would be leading to a relatively comfortable life;
- From 2000 to 2020, the market economic system will be further improved and perfected, and China's per capita GNP is expected to reach the same level as that of a moderately developed country.

Accompanied with the economic reform, two significant national changes have been made in China:

1) Many SOEs have been gradually reformed to shareholding, limited liability or private companies which results in substantial improvements on company performance and employee incentives.
2) China has been opened up to the outside world which results rapid increase on the amount of international trading and foreign direct investment (FDI) received, and thus brings numerous new and advanced technologies and management concepts to the country.

The economic reform, as well as the SOE reform and China's opening up to the outside world, presented to be a substantial solution towards the economic problems faced by China in the planning economy era. Detailed policies regarding SOE reform and China's opening up to the outside world are discussed in the following two sections.

4.4.1.4 SOE reform policies

SOEs undertook many social and economic responsibilities in the planning economic era (Sun et al, 2005; Zheng, 2004:129) and thus were the mainstay for maintaining economic development and social stability. However, as discussed above under the institutions of the planning economic system, SOEs had extremely poor performance and experienced serious losses. In fact, there were at least three lethal reasons that determined the inefficiency and failure of SOEs in that period of time:

1) When the government was both the owner and supervisor of SOEs, executive and operational managers in these companies had no real power. As such, management decisions (e.g. the commissions of management teams, investment decisions and reward schemes etc) were highly interfered by the state or government agencies who frequently made their decisions based on political and social criteria rather than on business needs (Yusuf et al., 2006:22-4).

2) Since SOEs were not driven by profit-making objectives and would not be responsible for any profits or losses (Chen, 2005), management of SOEs would not put too much effort in minimising waste, reducing cost and improving performance.
3) SOEs had very soft budget constraints and could easily received loans from local banks without worrying the interests and even redemptions of loans (Yusuf et al., 2006:170). As a consequence, top managers would not receive too much pressure even when the company was experiencing significant losses.

In order to prevent SOEs from loss making and enable SOEs to compete in the new economic environment, reforming SOEs has been considered as the most essential part in the economic reform since 1980s. The SOE reform in the early stage (1980s to the early 1990s) was mainly focused on improving enterprise governance, increasing autonomy of SOEs and increasing the incentives of SOE managers and staff (Wen, 2004; Cheung, 2005; Zheng, 2004:130), but no substantial results were achieved (Zheng, 2004:130) because no real efforts were put to separate the enterprise ownership and enterprise management of SOEs. Since SOEs were still owned and run by the government, the overall situation was not much different from that of the pre-reform era (Yusuf et al., 2006).

Nevertheless, with the leadership's decision to completely shift the traditional planning economy to the market economy in 1992, the reform of SOEs entered a new stage. The move to build a modern enterprise system by corporatising SOEs was integrated into the development plan of the market economy system by the Third Plenary Session of the Fourteenth Central Committee of the CCP in 1993 (Zheng, 2004:131). The Company Law was subsequently enacted in 1994 in order to provide a modern legal framework for transforming SOEs from national enterprises to private companies (Zheng, 2004:131; Garnaut et al., 2005:46). According to the Company Law, after an SOE is transformed to a company, it will be run by its standard internal management organs (i.e. the broad of directors) and the government will no longer involve directly in enterprise management. In 1995, the central government approved the proposal of Zhu Rongji (China's former premier) and launched a new SOE reform policy called '抓大放小'

(literally, keep the big ones and let go the small ones) (Garnaut et al., 2005:3; Zheng, 2004:131; Cheung, 2005). The core of this policy was to maintain the state control on large-size SOEs and let go the smaller and low-profit or loss-making ones. As a result, between 1996 and 2001, close to 50,000 of small and medium-size SOEs were restructured and privatized through selling or leasing to the public or employees; declaring bankruptcy; merging with other companies; or other forms (Garnaut et al., 2005:3; Wen, 2004; Cheung, 2005). On the other hand, many of the large SOEs have been restructured through one of the following ways (Garnaut et al., 2005:46-50; Yusuf, 2006:156-157):

- *Internal restructuring.* The Company Law requires a company to have at least two shareholders, but it allows SOEs to register as limited liability companies with the state or a state-owned entity as the sole owner through a set of internal restructuring procedures (e.g. change the operating mechanism of the SOE, settle its creditors' rights and liabilities, and set up standard internal management organs etc). Although the state is still the owner of the SOE after such reform, the company will now be supervised and managed by its standard internal management organ (e.g. the board of directors) rather than by the state. This type of SOEs is also called as Wholly State-Owned Enterprises.
- *Ownership diversification.* Instead of maintaining the state as the sole owner of the firm, the ownership of SOEs may actually have been diversified by bringing in outside investors. Specifically, SOEs can be restructured to limited liability companies with at least two but not more than fifty shareholder/investors. While the biggest shareholder is the state or a state-owned entity, the other shareholders/investors can be private or foreign firms. SOEs can also be restructured to shareholding companies and listed in the stock market. While the state, directly or indirectly, holds the biggest part of the shares, the other shares can be purchased by the public through the stock market. SOEs that have gone through such ownership reform are also known as Majority State-Owned or Majority State-Controlled Enterprises. These SOEs are no longer merely invested by the state and will have many shareholders. Nevertheless, the biggest shareholder must be the

state or an SOE. The firm is supervised and managed by its board of directors and management team.

Overall, with the '抓大放小' policy, SOEs in any size (e.g. small, medium, large and very large-sized), have experienced some type of reform (Garnaut et al., 2005:5). Since thousands of small and loss-making SOEs were privatized, the number of SOE has been rapidly reduced in recent years (Garnaut et al., 2005:5). Large and medium-size SOEs have been transformed to wholly or majority state-owned companies, which have totally different but more efficient operating mechanism (Yusuf et al., 2006). Additionally, if crucial organisational problems of the SOE still remain unsolved after the reform, the firm may be restructured for a second time (Mo, 2005). Therefore, reform of Chinese SOEs is never a straightforward task.

After experiencing such transformation, reformed SOEs, on the one hand, inherit some features of traditional Chinese SOEs (e.g. a party system within the firm, management structure, organisational culture, work force, and work behaviour, etc), on the other hand, develop some new features (e.g. have a board of directors) by adopting western market economic and company principles. As a result, the organisational structure of reformed SOEs manifests as a combination of traditional Chinese SOE style and western style. Figure 4.2 shows the internal structure of a typical reformed SOE and the key external entities associated with it.

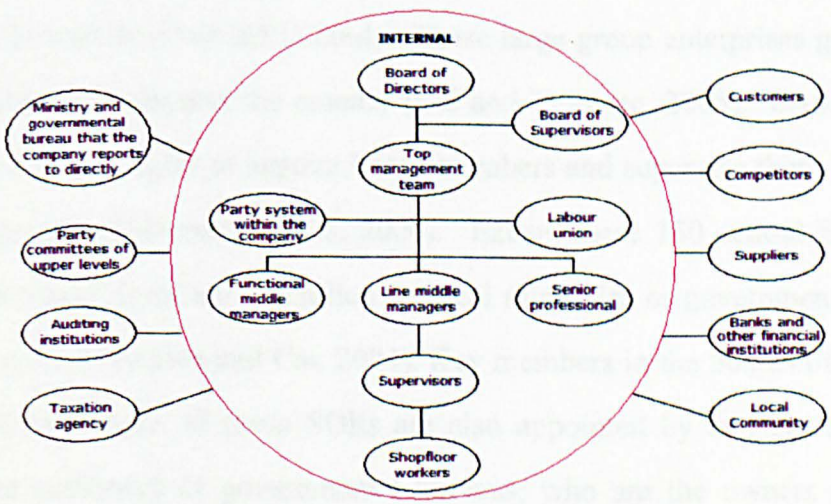


Figure 4.2: Internal and external relationship network of a typical reformed SOE.
(Source: modified from figure 9.1 in Chen, 2001:163)

As shown in the figure, most internal entities (e.g. the board of directors, board of supervisors and top management team) of reformed SOEs are similar to those of western companies, except the party system within the company which is inherited from traditional SOEs. In fact, all organisations (e.g. ministries, governmental bureaus and SOEs) that are owned or controlled by the state in China will be embedded with a party system. In SOEs, the party system exists as an independent function and will not affect the normal administrative functions of the firm (Liu, 2005). Since many staff, especially members of the management teams in SOEs are members of the CCP, the party system aims to regulate, manage and monitor the activities and behaviours of CCP members within SOEs and ensure the ideologies of CCP members in SOEs are consistent with the Central Committee of the CCP (Liu, 2005). The party systems within reformed SOEs are led by the Party General Secretary which will always be either the chairman of the board of directors or the general manager of the company. On the other hand, most external entities in the figure can be easily understood from their names. A notable point is that as the state retained itself as the owner or largest shareholder of modern SOEs, the government, which is now considered as an external entity, still has strong control on these firms. Specifically, the State-owned Assets Supervision and Administration Commission of the State Council (SASAC) was established in 2003 by the State Council as the top ministry for controlling state assets of SOEs (Garnaut et al., 2005:6). The SASAC is delegated as the owner of a group of China's largest state enterprises (currently 150 in number, SASAC website http://www.sasac.gov.cn/n2963340/n2971121/n4956567/4956583.html). These large group enterprises govern various industrial sectors throughout the country (Cai and Tylecote, 2005). SASAC, acting as the shareholder, has rights to appoint board members and supervise these large national enterprise groups (Tylecote and Cai, 2004). Except these 150 central SOEs, modern SOEs in provincial level are controlled by local ministries or governmental bureaus of different regions (Tylecote and Cai, 2004). Key members in the boards of directors and top management teams of these SOEs are also appointed by and are responsible to related local ministries or governmental bureaus, who are the owners or the largest shareholders of these firms. More details regarding the SOE reform are presented in section 4.4.2.3.

4.4.1.5 Open-door policies and WTO accession

As discussed above, in order to import advanced foreign technologies and management concepts to the country and accelerate the success of economic reform, China has gradually opened up the domestic market to foreign investors and competitors since 1979 (Sun et al., 2005). In 1979, four special economic zones (SEZs) were established in four southern coastal cities (Shenzhen, Zhuhai and Shantou in Guangdong province and Xiamen in Fujian province) under the SEZ policy to attract foreign direct investments (FDI) from external investors and companies (Shirk, 1994:34-35; Yusuf et al., 2006:1-2). SEZs were given unique freedoms to conduct various types of market economic experiments which eventually made SEZs the vanguards of the country's economic reform (Shirk, 1994:36). Concessionary investment terms and better business climate offered by SEZs attracted large amount of FDIs, especially from overseas Chinese companies that were located in Hong Kong and Taiwan and were an important source of business expertise (Shirk, 1994:35). With the success of the initial SEZ policy, the CCP applied similar open-door policies to other fourteen coastal cities in 1984, and to all cities of China's entire coastline in 1988 (Shirk, 1994:39). China's economic reform entered to a new stage in 1992, and many inland areas were finally opened for foreign investments (Shirk, 1994:41). The reasons for opening coastal areas first, as argued by Zhao Ziyang (General Secretary of the CCP in 1988), were that: "the economic and cultural differences between the coastal and inland areas made it impossible for all parts of the country to develop at the same speed; therefore the coastal areas should be allowed to move ahead by using their better labour, communications and infrastructure, and scientific and technological capacity to attract foreign business and expand exports" (Shirk, 1994:39-40).

The open-door policies successfully attracted large amount of FDIs to the country (Gao, 2005). However the Chinese government worried that these participations of foreign investors and competitors in the Chinese market since the 1980s, on the one hand, brought numerous advanced technologies and business expertise to the country (Cheung

and Lin, 2004), on the other hand, might cause insufferable competition to domestic industries (Shirk, 1994:68) in which domestic companies, especially pre-reformed SOEs, were still relatively small in size and lacked advanced technologies in production, management and new product development. In order to protect domestic industries from too drastic international competition, many industrial foreign-invested companies were restricted by regulations from participating in the domestic market and thus mainly engaged in the export business in the mid-1980s (Sun et al., 2005). The Chinese government also maintained a high import tariff to increase the selling prices of many imported products and utilised import quotas to limit the quantity of many types of foreign products, especially electronic and machinery products, to be imported to the country (Shirk, 1994:68; Sun et al., 2005). Nevertheless, in order to meet the requirements raised by the World Trade Organisation (WTO) as soon as possible, the Chinese government has gradually reduced the import restrictions since 1992 (Shirk, 1994:67-8).

The CCP leaders considered the accession to the WTO (formerly General Agreement on Tariffs and Trade) was the requisite for China to reconnect to the international economy and accelerate the progress of economic reform (Lardy, 2002:9-21; Anderson, 1997). China made application for joining the WTO in 1986, but due to various political reasons the progress of the negotiation for WTO accession was very slow (Shirk, 1994:70-71; Anderson, 1997). With the government's announcement for completely shifting China's economic system to market economy in 1992, the negotiation for WTO accession also entered to a new stage (Tuan and Ng, 2004). Since then, China, on the one hand, had been continuously negotiating with the leaguers of the WTO, on the other hand, had gradually adjusted the import restrictions to satisfy the trading requirements raised by WTO leaguers (Lardy, 2002:9-21). After 15 years of negotiation, China finally joined the WTO in 2001.

As a part of the agreement for joining the WTO, China has made substantial market access commitments to industrial foreign-invested companies who for the first time were given trading and distribution rights in the domestic market (Sun et al., 2005). In

addition to industrial sectors, China has agreed to relax foreign investment restrictions on many service sectors, including distribution services, telecommunications, insurance services and financial and banking services (Sun et al., 2005; Zeng, 2005). The Chinese government has also eliminated the import quotas by 2005, and gradually reduced the import tariff on industrial products from 24% to 9.4%, on vehicles from 100% to 25% and on vehicle parts to 10% (Lardy, 2006:76-80; Zeng, 2005; Sun et al., 2005).

4.4.1.6 Informatization policies

In order to survive and compete under the new business environment, Chinese companies must achieve substantial improvements on productivity and operational efficiency by utilising advanced ITs. However, effective use of IT in companies depend on various national factors, such as the development of IT industry, the building of national IT infrastructure and the environment for using IT in the country. In other words, in order to facilitate the use of IT in companies, the country must first achieve informatization to a basic level.

The Chinese government started developing the country's informatization in the mid-1980s (Liu, 1996). For example, in 1986, the High Tech Research and Development Program which launched by the Chinese government regarded IT as one of the preferential fields for development (Liu, 1996). However, no profound efforts had been put to develop the national information network and information infrastructure until the early 1990s.

The building of China's national information highway was started in 1993 when the government launched the Golden Bridge Project which aimed to form a national network across the whole country to link together all discrete and diverse networks nationwide and thus act as the backbone of China's national information infrastructure and the interface to international networks (Lovelock and Farhoomand, 1999). Accompanied with the Golden Bridge Project, another 13 golden projects were subsequently launched by the government to build various national networks and

electronic systems to satisfy a large set of government, economic, academic, social and enterprise requirements (Lovelock and Farhoomand, 1999). In the early 2000s, a new development strategy announced by the Sixteenth Central Committee of the CCP stated that China would utilise informatization to facilitate the development of the national industry. A mature national industry would in turn enable the country to achieve high level of informatization and modernization (China Economic Yearbook Editing Committee, 2004:111). The development of the IT industry has also been identified as the top priority in the country's 10th five-year national economic plan, which called for the government to invest US$151 billion over a period of five years (2001–2005) to further develop the national IT and telecommunication infrastructure (Quan et al., 2005).

With continuous support of the government, the development of informatization in China has been significantly accelerated in the last ten years, and consequently facilitates the adoption of IT/IS in Chinese companies.

4.4.1.7 Conclusion of political dimension

Economic, social and technological changes in a dictatorship of the proletariat regime, like China, are typically associated with political aims and policies. The understanding of the current situation in China and associated changes in political ideology enabled the researcher to better interpret and understand the remaining dimensions of PEST. Furthermore, this dimension enabled the identification of SOEs as the main driving force in Chinese economic politics.

4.4.2 Economic dimension

4.4.2.1 Prominent results since China's economic reform

One major factor to understand economic situation of a country is the Gross Domestic Product (GDP). It serves as "the value of a nation's annual total production of goods and services and serves as a major indicator of economic growth" (Wright et al.,

1996:26). According to Yusuf et al. (2006:3), in 1979, China's GDP was $177 billion of which more than half was generated by agriculture and the per capita GDP was only $183. China was among the world's poorest countries (Yusuf et al., 2006:3). During the last two decades, China has experienced remarkable economic growth at an average annual rate of over 9% (Keng, 2006; Zeng, 2005). By the end of 2005, China's GDP had risen to US$2.229 trillions of which 12.4% was generated by agriculture, 47.3% was generated by industry (41.8%) and construction (5.5%), and 40.3% was generated by service sectors, and the per capita GDP in 2005 rose to US$1740 (National Bureau of Statistics of China, 2006a). In 2007, China is ranked the third-largest economy in the world behind the US and Japan. Furthermore, due to a set of political developments reported in the previous section, the Chinese economy has become increasingly open. China's annual amount of imports and exports had risen from US$20.6 billion in 1978 to US$1422.1 billion by the end of 2005. Therefore, China has become the world's third-largest trading nation (Yusuf et al., 2006:3). As the world's second-largest recipient of foreign direct investment (FDI) (Yusuf et al., 2006:3), China's total accumulative FDI inflows had risen rapidly from US$1.8 billion in 1983 to US$620.7 billion[2] in 2005. By the end of 2003, about 226,373 companies were set up in China by foreign investors from more than 180 countries (National Bureau of Statistics of China, 2004). All these achievements so far have been unmatchable in the rest of the world (Zeng, 2005).

It is obvious that, China's economic reform and recovery will significantly facilitate the IT/IS adoptions in the country from at least three dimensions:

1) The government is able to generate sufficient capital to invest in the development of national informatization and IT industry which provides the fundamental for IT/IS adoption in organisations;

[2] The figure in 1983 was provided by Zeng (2005); the figure in 2005 was calculated based on the data provided by Zeng and the National Bureau of Statistics of China (2006).

2) More citizens and employees are able to use IT and the Internet and hence develop certain computer and IT literacy skills and are more positive for using information systems in their workplaces;
3) Domestic companies have experienced rapid growth in terms of revenue and company size, and hence have strong needs and sufficient capital for implementing IT/IS to strengthen their operations.

4.4.2.2 Inequality of economic development

Despite the rapid economic growth, China's economic development manifests significant inequality between different cities and regions, in terms of income, education, living standards, transportations, purchasing power and FDI received etc. The best way to show the economic inequality in China is to use the per capita GDP generated by different regions of the country (Figure 4.3).

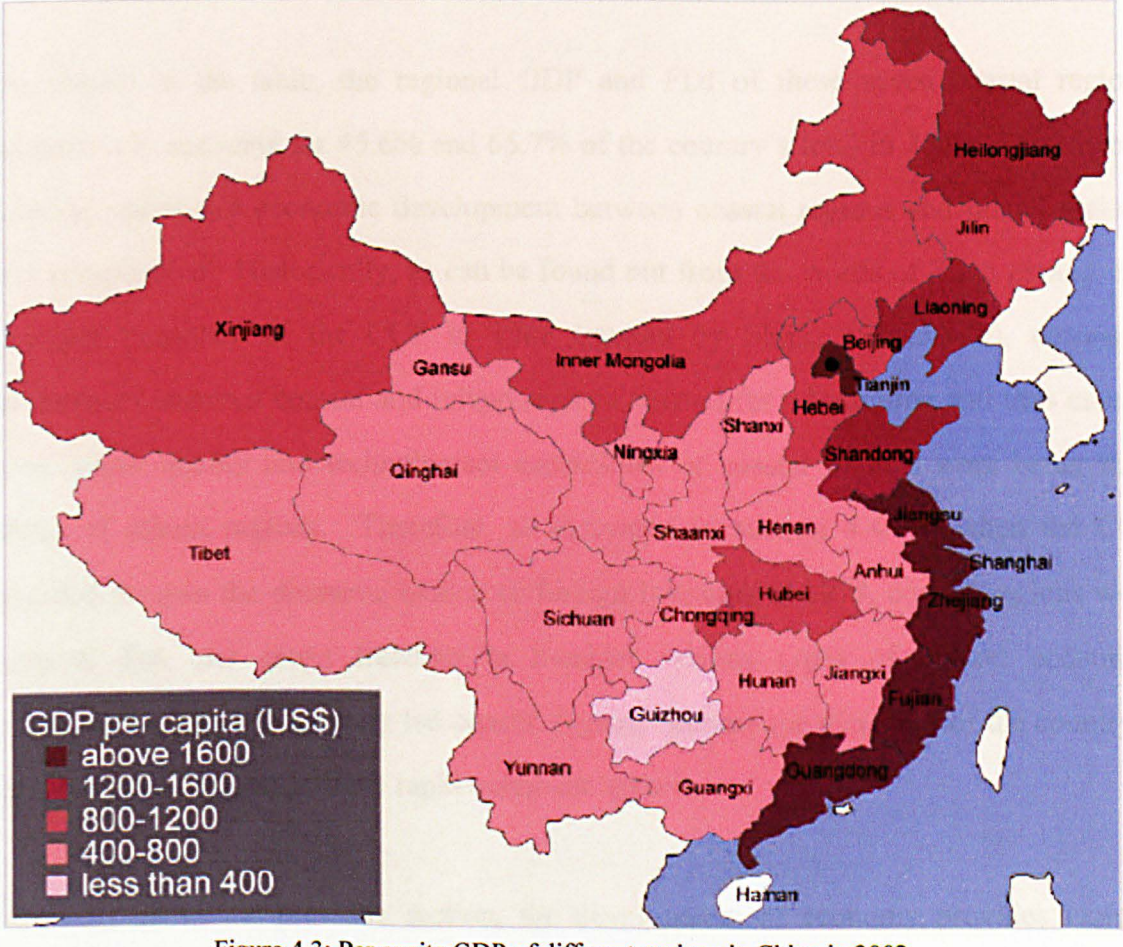


Figure 4.3: Per capita GDP of different regions in China in 2002
(Source: Klotz, 2004)

As shown in Figure 4.3, the seven regions (Guangdong, Fujian, Zhejiang, Shanghai, Jiangsu, Tianjin and Beijing) with the per capita GDP above US$ 1,600 in 2002 are all coastal regions and located in eastern China. In contrast, the per capita GDP of most inland regions is between US$ 400 to US$ 800. Table 4.1 shows more economic data of the seven coastal regions ranking by their regional GDP in 2003.

Region	Regional GDP (RMB 100 million)	Percentage of national GDP	Regional FDI (US$10,000)	Percentage of national FDI	Number of industrial SOEs (unit)
Guangdong	13625.9	11.7%	782,294	14.6%	2,103
Jiangsu	12460.8	10.7%	1,056,365	19.7%	1,242
Zhejiang	9395	8.1%	498,055	9.3%	861
Shanghai	6250.8	5.4%	546,849	10.2%	1,606
Fujian	5232.2	4.5%	259,903	4.9%	888
Beijing	3663.1	3.1%	219,126	4.1%	1,362
Tianjin	2447.7	2.1%	153,473	2.9%	1,625
Total		45.6%		65.7%	

Table 4.1: Economic data of the seven coastal regions in China in 2003.
(Source: summarized from table 3-11, 18-16 and 14-2 of China Statistical Yearbook, National Bureau of Statistics of China, 2004)

As shown in the table, the regional GDP and FDI of these seven coastal regions respectively accounts for 45.6% and 65.7% of the country's total in 2003. The reasons causing unbalance economic development between coastal regions and inland regions are complicated. Historically, as can be found out from the words of Zhao Ziyang, the General Secretary of the CCP in 1988 (quoted by Shirk, 1994:39-40), economic differences between coastal and inland regions existed for a long time and thus caused that labour quality and technological capabilities of coastal regions were better than those of inland regions. Therefore, as discussed in section 4.4.1.5, when the CCP decided to open the domestic market to foreign investors in 1979, coastal regions were opened first and given freedom to conduct various types of market economic experiments which eventually led coastal regions become the vanguard of the country's economic reform and achieve rapid economic growth.

As analysed in the previous section, the development of economy provides various positive impacts for IT adoptions. Thus it can be argued that the general level of IT

utilization in the coastal regions is much better than that of the inland regions. This argument is further demonstrated by the statistical data giving in section 4.4.4.1 which shows the number of netizens (users of the Internet) in the seven coastal regions accounted for 40.7% of the country's total in 2005 and more than 95% of the populations in many inland regions still cannot get access to the Internet. This evidence clearly shows that, coastal regions rather than inland regions will be more suitable to carry out this research. On the other hand, the number of netizens of Guangdong (a southern coastal province in China) is the highest among the seven coastal regions of the country. In fact, as shown in table 4.1, Guangdong also has the highest regional GDP and the second highest regional FDI among the seven coastal regions in 2003. In truth, Guangdong is the first region that has been opened up to foreign investors. As mentioned in section 4.4.1.5, three of the four Special Economic Zones (SEZs) established in 1979 are located in Guangdong province. Consequently, Guangdong presents itself as an ideal context for conducting this research study.

4.4.2.3 Companies operating in contemporary China

The economic and SOE reform, discussed in section 4.4.1, results in companies with diverse ownerships emerging and competing in the Chinese market. As shown in Figure 4.4, companies operating in contemporary China can be categorised as SOEs (including wholly state-owned companies and state-controlled companies) and non-SOEs (including private companies, collective-owned enterprises and foreign companies).

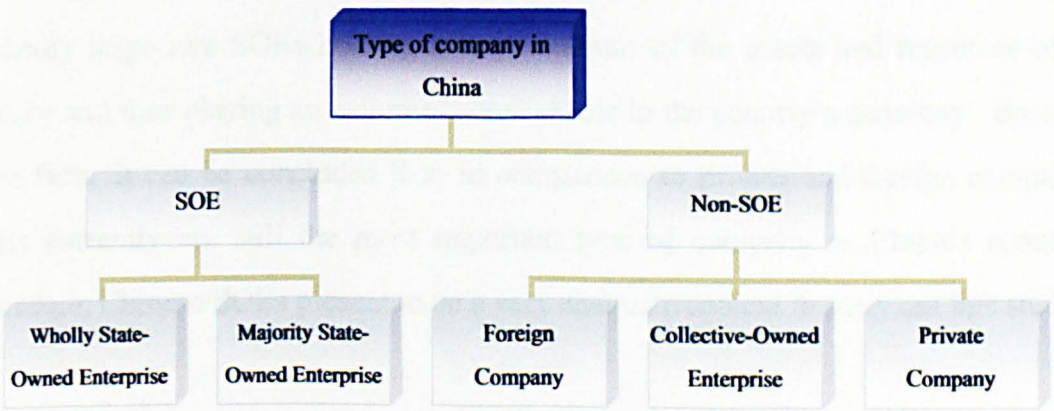


Figure 4.4: Companies with diverse ownerships in China

Year	SOE as % of all industrial enterprises	Non-SOE as % of all industrial enterprises	SOE assets as % of total industrial Assets	Average asset size of SOEs (RMB mn)	Average asset size of non-SOEs (RMB mn)	% of loss-making SOEs	% of loss-making non-SOEs
1999	37	63	68	134	36	41	22
2000	34	66	67	155	39	35	19
2001	28	72	65	184	39	36	19
2002	24	76	62	210	40	35	17
2003	19	81	57	260	46	36	15
2004	15	85	53	317	50	40	18
2005	10	90	48	428	52	--	--
2006	8	92	46	541	56	--	--

Table 4.2: Current status of SOEs and non-SOEs in the industrial sector.

(Source: data from 1999 to 2004 are obtained from table 1.1, Garnaut et al., 2005:8; data in 2005 and 2006 are obtained from the China Statistics Yearbook in recent years).

It should be noted that according to National Statistics Bureaus of China (NSBC), all Chinese SOEs are industrial companies, while 70% of them are in the manufacturing industry, 6% are in the mining industry and 24% are in the industry of production and supply of electric power, gas and water. As shown in table 4.2, in the industrial sector, the number of SOEs has reduced significantly since 1999 and they accounted for only 8% of all industrial enterprises in 2006. In contrast, the number of non-SOEs has been continuously increasing. However, despite this reduction in numbers, SOEs still held more than 46% of the total industrial assets in 2006. The average asset value held by SOEs has been dramatically increasing year by year. In 2006, the assets held by SOEs were in average valued at RMB 541 million which was almost 10 times higher than the average asset value of non-SOEs (RMB 56 million). These phenomena demonstrate that, with the 'zhuada fangxiao' policy (discussed in section 4.4.1.4), large amount of small and medium-size SOEs have been leased or sold and thus fallen in the group of non-SOEs, while the remainder SOEs that are still owned or controlled by the state are generally large-size SOEs holding a large amount of the assets and resources of the country and thus playing an extremely crucial role in the country's economy. Based on these facts, it can be concluded that, in comparison to private and foreign companies, SOEs currently are still the most important type of company to China's economy. Therefore, Chinese SOEs present to be a very adequate context to carry out this study.

However, as shown in the table, loss-making SOEs account for 40% of all SOEs in the industry. In contrast with non-SOEs of which 82% are profit making, operational efficiency of SOEs seems to be much poorer than non-SOEs. In truth, it is widely recognised that SOEs in China are 'big' enough (e.g. in company sizes and assets) but not 'strong' enough (e.g. has low international competitiveness; many are loss-making or just reaching the break even point). Hence, there are urgent needs for SOEs to further improve their operation and management modes in order to enhance their core competitive capability and improve operational efficiency by utilizing advanced information technologies (e.g. ERP). This also further supports that a study on ERP exploitation in the context of Chinese SOEs would be both meaningful and significant.

Additionally, as discussed earlier, contemporary SOEs are either wholly owned or majority owned by the state (Giles et al, 2006; Cai and Tylecote, 2005), as shown in Figure 4.4. As discussed in section 4.4.1.4, since the state is the owner or the largest shareholder of SOEs, it holds the ultimate controlling role in these companies (Qiang, 2003). Under this condition, wholly SOEs and majority SOEs currently have very similar context in terms of corporate governance, organisational culture, rules, structures and work behaviour, etc (Zhao, 2005; Cai and Tylecote, 2005; Tylecote and Cai, 2004; Zhang, 2004; Jiang, 2003; Qiang, 2003; Huang, 2002). Due to these contextual similarities, wholly SOEs and majority SOEs often share the same characteristics and problems in the development and use of technologies (Tylecote and Cai, 2004; Cai and Tylecote, 2005). Based on these facts, it was considered not necessary to study these two types of SOEs separately in this project, which focused on the use and exploitation of technology (i.e. ERP system) in the context of Chinese SOEs.

4.4.2.4 The manufacturing industry of China

As discussed in the political section of this PEST analysis, in order to enable the country to achieve high level of industrialisation and modernisation, the Chinese government has set the development of the manufacturing industry as a top priority in the political agenda since the 1980s.

As a consequence, China's manufacturing industry has achieved continuous and rapid development during the last few decades. The development of the national manufacturing industry has been further boosted since China jointed the WTO in 2001 (Yang and Li, 2005). In particular, the industrial output value of China's manufacturing industry has increased from RMB 8,443 billion in 2001 to RMB 27,457 billion in 2006, which represents an average annual growth rate of 65% (National Bureau of Statistics of China, 2007). With such a rapid development, China has now become the world's manufacturing centre. According to the statistics provided by the NSBC (2007), the annual export amount of China reached US$969.1 billion in 2006. Additionally, and more importantly, more than 39% of China's national GDP was generated by the manufacturing industry from 2000 to 2004 (NBSC, 2005). These statistical evidence prove that, the manufacturing sector is the pillar of China's national economy.

As classified by the NSBC, China's manufacturing industry consists of 31 sub-sectors. Among these, the top 8 manufacturing sectors contribute to more than 50% of the total industrial output of the country, as shown in table 4.3. The electronic and telecommunication equipment manufacturing sector in China proves to be particularly important, since its industrial output accounts for more than 10% of the total of the national industry.

Manufacturing sector	Industrial output (RMB 1 billion)	% of the total of the entire industry
Electronic and telecommunication equipment manufacturing sector	3,307.8	10.4
Ferrous metals smelting and manufacturing sector	2,540.4	8
Chemical manufacturing sector	2,044.9	6.5
Transport equipment manufacturing sector	2,038.2	6.4
Electrical machinery manufacturing sector	1,816.6	5.7
Textile manufacturing sector	1,531.6	4.8
Petrochemical manufacturing sector	1,514.9	4.8
Building material manufacturing sector	1,373.5	4.3
Total of the top 8 manufacturing sectors	*16,114.4*	*50.9*

Table 4.3: Industrial output of the top 8 manufacturing sectors in China in 2006

In truth, because electronic and telecommunication products (e.g. PCs, mainframe computers, cables, etc) are necessities for building the national and local IT infrastructure, this electronic and telecommunication sector is closely related with the IT industry (Wang and Li, 2004). As a consequence, companies in this sector are often pioneers for IT and IS adoption (Editing Department of Yearbook of the PRC, 2004). Moreover, according to a report provided by the Guanghua Management School of the University of Beijing (2006), many Chinese companies in this sector had passed the stage for implementing ERP, and engaged in the post-adoption phase for optimising of their ERP systems. Consequently, the electronic and telecommunication equipment manufacturing sector presents itself to be a suitable sector for a study of ERP post-adoption.

4.4.2.5 Conclusion of economic dimension

A number of important facts were identified from the analysis of the economic dimension. Firstly, the southern coastal province, Guangdong, presents itself to be the most prominent region in China. Specifically, Guangdong was the pioneer of China's economic reform, and also the first region that was open to foreign investments in the 1980s. It has the highest regional GDP and the second highest regional FDI among the 31 regions in the entire China. In addition, the number of netizens in Guangdong has also been the highest in the country. As a result, Guangdong presents itself as a region where the use of IS in organisations is mature enough to allow an exploration of post-implementation issues of ERP systems. Secondly, although the number of SOEs has been significantly reduced due to the national SOE reform, this type of company still holds more than 50% of the total industrial assets in China. In other words, SOEs currently play a crucial role in sustaining the continuous development of China's national economy. A study on China's SOEs is therefore important and meaningful. Thirdly, China's electronic and telecommunication manufacturing sector is a core segment of the country's industry. It was also identified that companies in this sector should have achieved high level of utilisation of IS in general and of ERP in particular.

Therefore, this manufacturing sector seems to offer a desirable context for a study of ERP post-implementation.

Overall, these realisations and facts led the researcher to select SOEs in the electronic and telecommunication manufacturing sector in the Guangdong province as suitable context for carrying out this project. Additionally, modern Chinese SOEs refer to enterprises that are either wholly owned or majority owned by the state. Because wholly and majority SOEs currently prove to have very similar context and characteristics for the use of technologies, they were not studied separately in this research.

4.4.3 Social dimension

4.4.3.1 Employment educational level

As discussed in section 4.2, China's education system was completely broken down during the period of Cultural Revolution from 1966 to 1976. Although the education system has been rebuilt during the last two decades, the impacts of Cultural Revolution can still be found in contemporary China. According to official data provided by the China Labour Statistical Yearbook, by the end of 2003, 7.1% of China's workforces were illiterate or semi-illiterate, more than 72% of China's workforces had graduated from only primary or secondary school, and 85.2% of departmental heads and 85.7% of professional and technical personnel in the country did not attain a university bachelor degree. Although individual capabilities of managers and employees cannot be simply measured by educational qualification, low education level is definitely an obstacle for Chinese managers and employees to accept, learn and use new technologies and scientific concepts which seem incomprehensible to them. Low-educated employees may often cause significant resistances when implementing and using ERP systems in companies (Wright and Donaldson, 2002; Sherer and Alter, 2004), since this type of employee will be less willing to change the traditional ways in which they do their jobs.

In order to increase the national education level, the Chinese government has required and facilitated the domestic education institutions, especially universities, to increase the recruitment number of new students since 1999. As a result, the number of annual university graduates was rapidly increased from around 1 million in 1999 to 3.38 million in 2005, and there will be another 4.13 million students graduated in 2006 (China education and research network, 2005). With retirement and layoff of current employees and the entering of new graduates, it can be anticipated that the total educational level of China's workforce will be fundamentally changed in the future.

However, although the national situation of the employment educational level can be described as above, the actual employment educational levels of different types of companies in China are varied and difficult to describe. No statistical data is found to illustrate the employment educational levels of various types of companies in China. Nevertheless, it is generally recognised that foreign-invested firms have higher education requirements on their employees than Chinese firms, and high-skilled and high-educated individuals are more interested in working in large-size firms rather than SMEs in China. SOEs, especially non-reformed SOEs might still have thousands of low-educated employees that have been working in the firm for more than three decades.

4.4.3.2 Chinese culture and its organisational impacts

Culture, as defined by Hofstede (1997:5), is the "collective programming of the mind which distinguishes the members of one group or category of people from another". Hofstede (1997:5, 10) points out that culture shapes a person's patterns of thinking, feeling and potential acting and has many types, e.g. national culture of a country and organisational culture of a company. Therefore, because organisational culture (which shapes employees' patterns of organisational thinking, feeling and acting) is embedded within national culture, differences on national cultures cause differences on organisational cultures and employees' organisational behaviours.

Hofstede's studies (1997; 2001) investigate the cultural differences of more than 50 countries in the world according to five dimensions: power distance, collectivism vs. individualism, femininity vs. masculinity, uncertainty avoidance, and long-term vs. short term orientation. Based on Hofstede's study, one conclusion can be drawn is that the Chinese culture is fundamentally different from that of western countries in terms of high power distance, low individualism and low uncertainty avoidance, etc. Many recent studies (Martinsons and Westwood, 1997; Martinsons and Hempel, 1998; Reimers, 2002; Liang and Xue, 2004; Zhang et al., 2005) thus demonstrate that the unique Chinese culture partially shapes the ways that Chinese people conduct organisational and business activities and influences the implementation and use of IS/ERP in Chinese companies.

Based on the analysis of Martinsons and Westwood (1997), the Hofstede's dimensions of power distance and uncertainty avoidance have an important impact in the use and exploitation of IT and ERPs.

The high power distances of the Chinese result in very centralized decision making and directive management systems in China's companies (Martinsons and Westwood, 1997; Martinsons and Hempel, 1998), in detail:

- most important decisions of Chinese companies are made by the top managers;
- the information flows in Chinese enterprises generally follow the direction of top-down directives and bottom-up reporting;
- subordinates tend to follow the directives of their superiors rather than to question the suitability of the superior's decisions.

Survey findings of Reimers (2002) show that centralized decision making renders many negative impacts for ERP implementation in China's companies in at least two ways: first, centralized decision making in the steering committee may lead to some delay in the decision making process thus causing schedule and possibly budget overruns of the ERP project; second, centralized decision making enables senior management to

unilaterally change some project parameters and thus increases the possibility for making mistakes. Pei (2005) finds in her case study that because Chinese employees generally accept work as assignment from their managers without knowing the reasons of doing so and have relatively low motivation of working as a member of a team, it is difficult for Chinese companies to form an effective project team to ensure the success of ERP implementation. In addition, the centralized decision making and top-down directive and bottom-up reporting approach in Chinese companies reduces the need and willingness to exchange information between managers and across departments of the company and thus become a significant constraint on IS/ERP implementation and use (Martinsons and Westwood, 1997; Martinsons and Hempel, 1998).

The cultural characteristic of low uncertainty avoidance results that Chinese people are more tolerant of uncertainty and unclear information, and tend to accept situations as they are rather than to predict and control the situations (Martinsons and Westwood, 1997). Thus, Chinese managers are less inclined to use systematic procedures and explicit information to tailor business plans and forecasts to predict the uncertain future (Martinsons and Westwood, 1997; Martinsons and Hempel, 1998). Also instead of conducting a rational analysis of data related to a specific problem, Chinese managers are inclined to make their decisions based on subjective experience, common sense and intuition (Martinsons and Westwood, 1997). Since a major purpose for using ERP is to collect comprehensive sets of data to support business planning and decision making, it can be argued that Chinese managers will not be willing to fully utilise such data and thus underutilise the full power of their ERP systems. Reimers (2002) reinforces that managers in traditional Chinese companies do not trust the data provided and the suggestions made by the ERP systems and they tend to modify the (production and purchasing) quantities recommended by the system based on their own experiences. Martinsons and Westwood (1997) conclude that the IT investments in Chinese companies typically aim to automate, control and monitor the company's basic operations rather than to improve business planning and decision making.

Furthermore, Martinsons and Westwood (1997) point out that westerners tend to use low context forms of communications which enable them to directly convey meaning of a message into explicit and elaborate codes (e.g. words and numbers) and therefore facilitate the use of MIS in western companies. In contrast, due to cultural specific traits, Chinese people tend to use high context and implicit forms of communications. "Chinese messages are comparatively terse in words but rich in meaning. Subtle cues are used to enrich the explicit content. Audible clues, such as tone, dynamics and any hesitation in response, together with facial expressions and body language must be perceived and interpreted in order to fully understand the words being communicated" (Martinsons and Westwood, 1997). Therefore, Martinsons and Westwood argue that high context forms of communications may make use of MIS in Chinese organisations both difficult and undesirable.

The Chinese culture also results in a special form of relationships among Chinese people which is called *Guanxi*. *Guanxi*, a Chinese term, is commonly defined as the special personal relationship/connection between two persons (e.g. friends, superiors and subordinates, businessmen and government officers, and business partners) with one needing something and the other one having the ability to give something (Su et al, 2003; Fan, 2002). *Guanxi* can be understood as the phenomenon that people develop extensive networks of interpersonal relationships to exchange favours and reciprocally share scarce resources and cope with uncertainties (Su et al, 2003). In China, *guanxi* is the most important personal social asset (Fan, 2002). Individuals spend most of their time on building their *guanxi* networks, especially with superiors, governmental officers or business partners, and utilise such personal assets in finding solutions for business problems and acquiring additional resources for their companies (Fan, 2002; Martinsons and Hempel, 1998; Lowe, 2003:12). As a result, *guanxi* networks of people within or between Chinese organisations are always complicated. However, the approach for utilizing *guanxi* to solve problems and acquire additional resources actually causes many personnel issues (e.g. corruption, unfair competition etc) in China's companies. From the perspectives of IS, *guanxi* networks can create significant barriers of communications and cause difficulties for information sharing and use of IS in Chinese

organisations. Chinese people consider information as a major personal asset which is rarely broadcasted or made accessible to a large audience (Martinsons and Hempel, 1998). Information exchanges and sharing within Chinese companies do depend on the nature of the relationship/*guanxi* between those communicating (Martinsons and Westwood, 1997). In other words, Chinese people may only be willing to exchange important information with those who they trust and have good *guanxi*, instead of sharing the information freely across the whole organisation. This phenomenon can actually cause difficulties and resistances for using IS/ERP in Chinese companies, when IS, especially ERP, aims to facilitate information to be shared smoothly and freely throughout the whole company.

4.4.3.3 Conclusion of social dimension

The analysis of social and cultural issues clearly indicates that these issues can significantly affect working behaviours of Chinese people and the use of IS in Chinese companies. The social and cultural factors identified in this section actually provided a basis for the researcher to identify potential cultural and organisational barriers that Chinese firms may encounter during ERP exploitation.

4.4.4 Technological dimension

Since the main subject studied in this research project is information technology, this section will specifically focus on the current development and use of information technologies in China rather than on other technologies.

4.4.4.1 Popularization of computers and the Internet in China

According to the official data provided by the China Internet Network Information Center, by October 1997, the number of netizens (users of the Internet) in China was only 0.62 million and there were only 0.3 million PCs can be used to access to the Internet. With the rapid development of informatization in China, the number of

netizens and the number of PCs that can access to the Internet had risen to 111 million and 49.5 million by the end of 2005 (China Internet Network Information Center, 2006). The total number of desktops in the country had also risen from 6.3 million in 1996 to 53 million in 2004 (Gong, 2002; Shanghai Electronics Manufacturing Profession Association, 2005). However, when taking China's total population into account, the levels of computer and Internet popularization in China are still very low. As shown in table 4.4, 24.7 persons in average occupied one PC in China in 2004, whereas in the developed countries, almost one or two persons would have a PC.

Country	Number of PCs (10,000 sets)	Persons per PC
USA	22300	1.32
UK	3589	1.68
Germany	4630	1.78
Japan	6920	1.84
China	5299	24.7

Table 4.4: Persons per PC in China and the developed countries in 2004
(Source: recalculated from data given by Shanghai Electrical Manufacturing Profession Association, 2005)

Based on the statistical report of the 17th China Internet development survey provided by the China Internet Network Information Center, the number of China's netizens had risen to 111 million in 2005 and China is now the second largest Internet-using country in the world behind the US. Among the 111 million netizens, 29.1 million netizens connected to the internet via leased lines (e.g. netizens who first connect to LAN via the Ethernet and then connect to the Internet via leased lines), 51 million via dial-up or ISDN, and 64.3 million via broadband (e.g. ADSL, Cable Modem etc). The number of netizens that connect to the Internet via broadband has been raised most rapidly from 6.6 million in 2002 to 64.3 million in 2005. Note that the total number of netizens by method of connection exceeds the 111 million total netizens because the report double counts netizens that reported accessing the Internet at the office and at home. However, the report also mentions that the number of China's netizens only accounted for 8.5% of the country's total population, and the usage of the Internet in China has manifested significant inequality by regions. According to the report, the numbers of netizens in many inland regions were less than 2% of the country's total (e.g. 0.1% in Tibet, 0.2% in Qinghai, 0.3% in Ningxia, 0.6% in Hainan), and more than 95% of the population in

many inland regions cannot access to the Internet. In contrast, the usage of the Internet in coastal regions is much better than that of the inland regions. Table 4.5 takes the seven coastal regions mentioned in section 4.4.2.2 as examples to show the usage of the Internet in coastal regions.

Region	Number of netizens in the region (10,000)	Regional number of netizens as % of the total in the country	Regional number of netizens as % of regional population
Guangdong	1486	13.4	17.9
Jiangsu	790	7.1	10.6
Zhejiang	707	6.4	15.0
Shanghai	463	4.2	26.6
Fujian	428	3.9	28.7
Beijing	397	3.6	11.3
Tianjin	229	2.1	22.4

Table 4.5: Popularization of the Internet in the seven coastal regions in 2005
(Source: extracted from table 4.2 in Statistical Report of China's Internet Development Status, China Internet Network Information Center, 2006)

As shown in the table, 40.7% of the country's netizens were located in the seven coastal regions and in average 19% of population in the seven coastal regions can access to the Internet. Guangdong, the southern coastal province that has been chosen for conducting this research project, has almost 1.5 million netizens and accounts for 13.4% of the country's total.

In addition, the information available on the Internet was greatly enriched in recent years. There was a total of 668,900 websites in the country in 2004, of which 60.7% were company websites, 13.6% were personal websites, 11.4% were commercial websites, 4.6% were educational websites, 4.6% were other public websites, and 3.6% were government websites (China Internet Network Information Center, 2005b). The netizens can retrieve large amount of information through the Internet, including news, journal articles, government policies, company information, product details, market analysis and research reports etc. Official statistics (China Internet Network Information Center, 2006) shows that, in 2005, the Internet services that netizens frequently use include: news browse (67.9%), search engines (65.7), email (64.7%), synchronous communication tools (41.9%), online forums (41.6%) and online shopping (24.5%).

4.4.4.2 Development of informatization in China

In fact, the rapid popularization of the Internet in China is mainly boosted by the rapid development of informatization in terms of information network and information infrastructure building in the country. As mentioned in section 4.4.1.6, the building of China's national information highway was started in 1993. After more than ten years of effort, China has now built up a modern information network which covers more than 2000 cities in the country and links to all major international networks in the world (China Economic Yearbook Editing Committee, 2004:111). It however should be pointed out that despite this network building, Chinese netizens often would not be able to access to international websites freely, due to Internet control by the Chinese government. Moreover, China currently has 9 network operators who form the backbone of China's networking infrastructure and have around 200 Internet service providers (ISPs) who can provide Internet services across different provinces (UNDP-APDIP, 2006). According to the survey of the China Internet Network Information Center (2006), the total international internet bandwidth provided by the 9 network operators in 2005 was 136,106 megabyte per second (Mbps) which was almost 49 times higher than the total international internet bandwidth of the country (2799 Mbps) in 2000. The international internet bandwidth provided by the three largest networks (China Public Computer Net, China Network Communication and China Scientific Net) respectively reached 70,622 Mbps, 38,941 Mbps and 15,120 Mbps in 2005 (China Internet Network Information Center, 2006). Wide geographical coverage and large network bandwidth enable Chinese netizens to be easier and quicker to access to the Internet and communicate with people all around the world and thus facilitate the rapid popularization of the Internet in China. However, it should be recognised that China's networking infrastructure development still lags far behind the developed countries. Data gathered by Chon (2002) shows that the international internet bandwidth of New York in USA, London in UK and Amsterdam in Netherlands has already reached 149,835 Mbps, 85,519 Mbps and 24,480 Mbps respectively by 2002.

4.4.4.3 Development of informatization in China's companies

In order to survive and compete under the drastic market competition, Chinese companies have invested heavily in IT in recent years. Around 70% of large and medium size domestic enterprises have established company websites by 2002 (Gong, 2002). In 2004, the number of company websites reached 446,156 and accounted for 60.7% of the total number of websites in the country. 32% and 24% of the company websites were created respectively by manufacturing companies and IT companies, and 11.3% of the company websites contained online trading functions (China Internet Network Information Center, 2005b). Many leading domestic companies have successfully conducted e-business activities, such as e-commerce, e-purchasing and e-collaboration, to increase sales and reduce transactional cost since 2001 (Gong, 2004). According to China Center for Information Industry Development (CCID) Consulting (quoted in China Economic Yearbook Editing Committee, 2004:114), China's business-to-consumer (B2C) and business-to-business (B2B) trading amount reached to RMB 5.2 billion and RMB 270.4 billion in 2003. The success of e-business application in many leading companies was based on the implementation of enterprise management systems (including ERP, SCM, CRM and PLM etc). As reported by Analysys International (2006), in the fourth quarter of 2005, China's enterprise management software market size reached RMB 1.6 billion, increasing 26.1% year on year and 13% quarter on quarter. Since China aims to utilise informatization to drive the development of industrialization (as mentioned in section 4.4.1.6), manufacturing companies as the main part of China's industrial sector have been the major investors of enterprise management systems. Nevertheless, other sectors such as construction, energy, transportation and other services sectors also invested heavily in these information systems. According to CCW Research (quoted by Zuo, 2005), IT investments of the manufacturing sector reached RMB 24.5 billion in 2004, of which 61% were on hardware and IT infrastructure building and 39% were for IS development and IT services outsourcing. Furthermore, 50% were invested by large-size manufacturing companies and 33.2% were invested by medium-size manufacturing companies. Another report provided by Wang (2006) shows that, IS investments of manufacturing

companies in recent years consisted of approximately 63% on ERP systems, 12% on SCM systems, 6% on CRM systems, 8% on PLM systems and 11% on other types of information systems. It is also reported that after successfully implementing ERP systems, many large manufacturing companies started to invest in SCM and CRM systems to improve their relationships with suppliers, customers and business partners. On the other hand, IT investments from small-size manufacturing companies were still relatively small since many small-size companies lacked sufficient investment capital and lacked consciousness for using IT to improve business performance (Zuo, 2005). Nevertheless, according to the national statistics bureau, the number of small-sized companies accounted for 88% of the total of companies in the industrial sector. Small-sized companies therefore represent a huge market for potential IT investments. In addition, many small-size companies in China are actually involved in the supply chains of large and medium-size companies in the industrial sector and act as distributors, component manufacturers and regional agencies of large and medium-size companies. Hence, while large and medium-size firms invest heavily in IT, they will also require and drive small-size firms in the same supply chain to utilize IT to improve internal performance in order to increase the operational efficiency of the whole supply chain.

4.4.4.4 Development of the Chinese ERP market

The core of informatization development in China's companies is to utilise enterprise management systems to improve their daily performance. An efficiently operating ERP system is the prerequisite for implementing their policies and the backbone to support other types of enterprise management systems (e.g. CRM and SCM). Due to this fact, China's ERP market size has been increasing rapidly in recent years. The ERP market size in Mainland China was around US$70 million in 2000 (CCID Consulting, quoted by Xue et al, 2005). CCID Consulting, cited by Zhang et al (2005), reports that China's ERP sales reached US$226.9 million in 2003 and will grow at an estimated rate of 23.5% and reach US$652.8 million in 2008. A later report of CCID Consulting, cited by Wang (2006), states that China's ERP sales reached US$289.96 million in 2004. When taking the global ERP market which reached US$23.65 billion in 2004 (ARM Research,

2005) into consideration, China's ERP sales accounted for 1.2% of the global ERP market. In fact, the ERP market in China has experienced more than 20 years evolution which consists of four periods as discussed below.

Introductory period (1980s)

MRP and MRP II, the former generations of ERP, were introduced to China's companies in the 1980s and used by a few large manufacturing SOEs. However, since China's economic reform had just started, the competition in the market was not strong and not many entrepreneurs and managers had the consciousness to use information systems to improve business performance (Zhou et al, 2005:1-2). On the other hand, since all MRP and MRP II systems were imported from foreign vendors, significant misfits occurred when the systems were implemented in Chinese firms (Zhou et al, 2005:1-2). Consequently, the MRP/MRP II usage and successful implementation rate in China were extremely low. Nevertheless, many Chinese firms started recognising the development and impacts of MRP and MRP II systems during this period (Zhou et al, 2005:1-2).

Developing period (1990 - 1996)

This second period saw the concept of ERP system being introduced to China's companies. With the implementation of economic reform and 'open door' policies, the competition of domestic market was significantly increased. Domestic companies started recognising that, their traditional management mode had to be replaced by a scientific and advanced one in order to adapt the environmental changes in the market economy (Zhou et al, 2005:2-3). Such change on people's notion provided the prerequisite and increased the probabilities for domestic companies to implement ERP in the future. However because the domestic ERP market in this period was dominated by foreign ERP vendors whose products were complicated and expensive and the IT infrastructure development of many Chinese firms was still poor, the major ERP adopters in this stage were foreign invested and joint-venture companies (Zhou et al,

2005:2-3). Nevertheless, the emergence and implementation of foreign ERP systems in China elicited the germination and development of domestic ERP vendors (Zhou et al, 2005:2-3).

Exploiting period (1997 - 2003)

After the product research and development in 1997, two major domestic financial software vendors, UFIDA (former UFSoft) and Kingdee successfully launched their ERP systems: UFERP and Kingdee K/3 ERP in 1998 and transformed from financial software vendors to enterprise management software vendors. In reality, many domestic ERP vendors have gradually emerged since 2000, e.g. LangChao Genersoft, Digital China, NewGrand, Bocsoft and hundreds of small ERP vendors. In 2000, the domestic ERP market was still dominated by foreign ERP vendors who totally held 81.6% of the market share (Li, 2004a). SAP was the biggest player in the domestic market and took 30% of the market share in 2000 (IDC, cited by ChinaByte, 2003). Nevertheless, the structure of China's ERP market has been gradually changing in 2001. As reported by CCID Consulting (quoted by Xue et al, 2005), in 2001, the top eight players hold 76% of the ERP market, with six Chinese domestic companies holding 51.7% and two foreign ERP leaders holding 24.3% market share. The market share of SAP reduced from 30% in 2000 to 16.9% in 2001, while three domestic ERP vendors, UFIDA, Kingdee and LangChao Genersoft, respectively took 16.2%, 13.2% and 10.3% market share in this year. In 2002, UFIDA, for its first time, beat SAP and became the biggest player in the domestic ERP market (CCID Consulting, quoted by BeijingBusinessToday, 2003). Domestic vendors further consolidated their market positions and dominated the national market by holding 79% of the market share in 2003 (CCW Research, 2004). Since then, the competition of the domestic ERP market has become increasingly drastic. Foreign ERP vendors, led by SAP and Oracle, were most welcomed by high-end enterprises due to the advanced technologies, comprehensive functions and high stability of their systems, whereas domestic ERP vendors, led by UFIDA and Kingdee, were largely accepted by low-end companies due to the low-cost and localized features of their products (Chen, 2005). In order to attract more customers and increase market

shares, domestic vendors, on the one hand, strived to improve the functionalities of their products while on the other hand, foreign vendors aimed to further localize their systems. As a result, both foreign and Chinese ERP vendors achieved significant development during this period of time.

Popularising period (2004 – present)

During the developing period discussed above, most large enterprises have implemented ERP systems and some of them have started investing on SCM and CRM systems to address the external supply chain. However, according to the China Internet Network Information Center (quoted by Zhou et al, 2005:5), China has more than 3.6 million SMEs which accounted for 95.9% of the total number of companies in the country, but 80% SMEs still had not implemented ERP systems by 2004. In order to popularise the use of ERP systems in China, SME is the major sector that must be addressed. Consequently, a set of ERP packages (e.g. SAP Business One, UFIDA's U860) emerged to address the SME ERP market. Moreover, in order to build up a strong sales network to cover all sectors and regions of the country, the major ERP vendors, especially UFIDA and SAP, formed long-term partnerships with thousands of local agencies and provide them with substantial trainings and supports to ensure local agencies can render professional and wide-range IT services (including system implementation consultation, staff training, system management and maintenance outsourcing) to customers (Li, 2004b; CCW Research, 2005a, 2005b). Hence, in the popularising period, driven by the major ERP vendors, the whole domestic ERP/IT industry has achieved significant development which benefits numerous current and future ERP users.

4.4.4.5 Conclusion of technological dimension

The analysis of IT development and usage in China clearly indicates that studies of IS post-implementation are now not only topical, but probably highly desirable. In particular, and due to the large investment in ERP systems (thousands of Chinese

companies have implemented these systems), it is clear that studies focusing on ERP post-implementation issues are now required to provide a vision of their utility, associated business advantages and risks.

4.4.5 Summary of PEST analysis

China's political system can be described in two parts: first, the CCP is the dominating party and the core of leadership in China by setting directions for the country; second, the country is governed by the State Council (also known as the central government of China) who is responsible to the National People's Congress.

China's economic status and national environment have been profoundly changed due to the economic reform accompanied with the SOE reform and opening up to the outside world since 1978. China has experienced a continuous economic growth with an annual rate of 9% during the last two decades as a result of this economic reform. The strong economic development enabled the government to generate sufficient capital to invest in the building of the national IT infrastructure and IT industry and thus provide the prerequisite for IT and IS adoptions in the country. However, China's economic development is extremely unbalanced. Statistical data shows that economic development in coastal regions is much faster than that of inland regions. Slow economic growth causes insufficient IT development and utilization in inland regions.

On the other hand, due to the economic and SOE reform, various types of companies, e.g. SOEs, private companies and foreign companies etc, have emerged and compete in the domestic market. However, two social issues are considered to affect the use and implementation of ERP systems in companies operating in China. The first one is China's low-educated labour force. It is considered that low-educated workforces may be less willing to change the traditional way in which they do their jobs and thus cause resistances for implementing ERP systems in China's companies. Secondly, the Chinese culture also seems to affect the use of ERP in Chinese companies. It is considered that organisational behaviours (such as centralised and experience-based decision making,

directive management mode, less inclined to set up business plans) can be barriers for successful ERP implementation and use in Chinese firms.

Nevertheless, despite all these obstacles, ERP system has become increasingly popular in Chinese business environment. In fact, more and more companies operating in China seem to recognise that ERP system is the most powerful tool to enable them to survive and compete under the increasingly drastic market conditions. As a result, most large Chinese companies, especially manufacturing companies, have implemented ERP systems and thus driven more and more SMEs in the same supply chain to use ERP to improve internal performance. After the introductory, developing and exploiting stage, China's ERP market has now reached a mature stage. All political, economic, social and technological issues discussed in the PEST analysis are summarised in Figure 4.5.

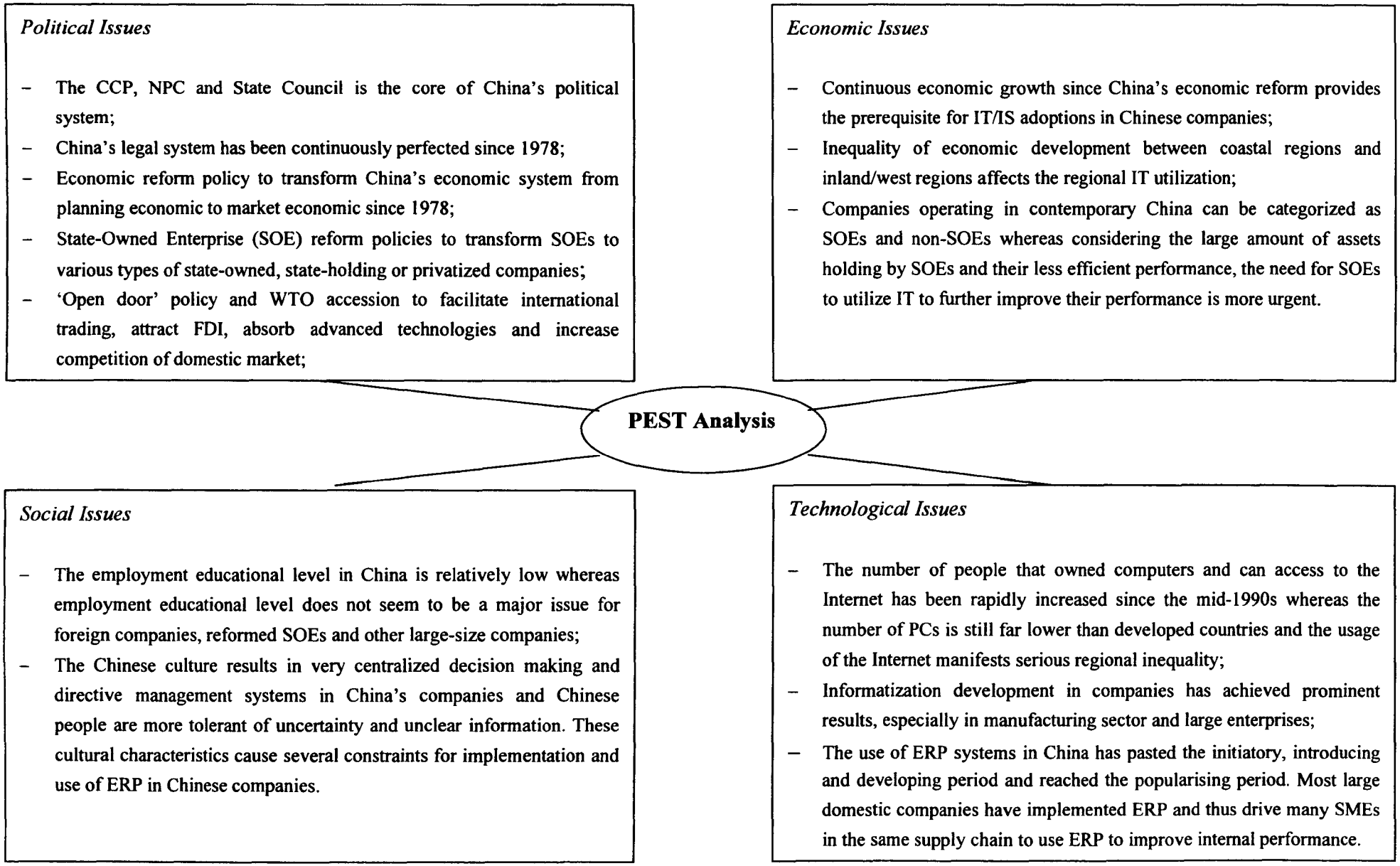
4.5 Conclusions

Through the PEST analysis, the researcher developed an in-depth understanding on China's current context in terms of political, economic, social and technological dimensions. The PEST analysis has led to a set of crucial conclusions.

Firstly, based on the PEST analysis, the researcher identified Guangdong (a southern province in China) as an ideal context for the study of ERP post-implementation. Guangdong is one of the pioneer regions of China's economic reform and one of the most important and fast-growing economic regions in the country. Consequently, the region has achieved very high levels of informatization development and IS adoption, therefore it presents itself as an ideal context where to study a phenomenon such as post-implementation of ERP. Conversely, other regions that are starting to implement ERP solutions would be ideal to study ERP implementation. Therefore, Guangdong was selected as the region for carrying out the study.

A second important conclusion of the PEST analysis was the realisation that SOEs hold more than 50% of the total industrial assets in China. Therefore, SOEs currently play a

Figure 4.5: Summary of PEST analysis



crucial role in sustaining the continuous development of China's national economy, in contrast with other types of companies (e.g. private companies and foreign firms) in the country. The contribution of these latter companies is expected to grow, but currently a study of ERP post-implementation in SOEs is expected to yield more important and significant findings. Therefore SOEs were selected to study in this project. Additionally, modern SOEs refer to enterprises that are either wholly owned or majority owned by the state. Because wholly and majority SOEs currently have very similar context and characteristics for the use of technologies, they were not studied separately in this research.

Finally, it was identified from the PEST analysis that, 70% SOEs in China are manufacturing companies, while the remainder 6% are in the mining industry and 24% are in the industry of production and supply of electric power, gas and water. This data clearly shows that, it would be more meaningful and desirable for this study to focus on the 70% manufacturing SOEs rather than all or the remainder 30% SOEs in China. In addition, it was identified that the electronic and telecommunication manufacturing sector is a core segment of the country's industry. Due to close link with the IT industry, companies in this sector have achieved very high level of IS and ERP utilisation. Therefore, this manufacturing sector is selected to carry out this ERP post-adoption study.

Consequently, the PEST analysis presented in this chapter allowed the researcher to narrow an initially over-ambitious study (i.e. ERP post-implementation in China) to a realistic and clearly limited context. One that is eminently feasible and will guarantee a better chance of success to the project (i.e. ERP post-implementation in SOEs, in the electronic and telecommunication manufacturing industry in Guangdong, in China).

After refining the research context and selecting a feasible set of Chinese companies to base this study on, the next chapter presents and discusses the research methodology adopted for this project to investigate and explore ERP exploitation barriers and risks in this selected context.

Chapter Five: Research Methodology

5.1 Introduction

In order to respond to the research questions defined in chapter one and achieve theory building, testing and extension, a mixed-methods research strategy was designed and used for this study. This mixed-methods approach consisted of two stages. At the first stage, a questionnaire survey was carried out to test the risk and barrier ontology that was established from the literature review (as presented in the next chapter). Subsequently, an exploratory case study component was conducted at the second stage to further explore, explain and triangulate the findings derived from the questionnaire survey.

This chapter presents and discusses the research philosophy, methodology and design adopted for this research project. In particular, the reasons for adopting a mixed-method research design are discussed and justified. Data collection methods (i.e. questionnaire and semi-structured interview) and instruments employed by this research is also justified and discussed. In addition, this chapter also describes and discusses how the data collection processes were conducted, as well as how the data collected from the questionnaire and the interviews were analysed.

5.2 Research philosophy

One of the initial considerations for this research was to determine which philosophical stance was to be adopted. Research philosophy concerns the ways, views and paradigms that we use to understand how knowledge is developed, which in turn will affect the way that we do research (Saunders et al., 2003:83). Researchers might call research philosophy in different ways, e.g. research paradigm (Saunders et al., 2003), philosophical assumptions (Crotty, 1998, quoted by Creswell, 2003:6), epistemology (Hirschheim, 1994), and knowledge claim (Creswell, 2003:6), etc. Regardless the actual term that is being used, here research philosophy refers to "our theory of knowledge, in particular how we acquire knowledge [...] two basic points which need to be looked at [are]: what [we think] is knowledge; [and] how do we obtain 'valid' knowledge" (Hirschheim, 1994).

Hirschheim (1994) states that information systems are essentially social systems rather than technical systems, and as a result information systems epistemology draws heavily from social sciences. Two research paradigms, which are prevalent in research in general and in social sciences research (Burrell and Morgan, 1985), are discussed below:

- **Positivism**. Positivism is the research philosophical stance which is generally adopted by the physical and natural scientists (Saunders et al., 2003:83) who assume that objects exist independently and the nature of an object is static and thus the reality about an object can be objectively and deductively tested and explained through repetitive experiments. In social sciences research, positivists prefer "working with an observable social reality and that the end product of such research can be law-like generalisations", and they assume that "the researcher is independent of and neither affects nor is affected by the subject of the research" (Remenyi et al. 1998, quoted by Saunders et al., 2003:83-84). As a result, researchers in this tradition tend to apply a value-free manner and highly structured methodology to collect quantifiable data (e.g. numbers and attitudes), which enables statistical analysis and generalisation (Saunders et al., 2003:83).
- **Interpretivism**. Interpretivism (also called sometimes interchangeably and wrongly as constructivism) is an epistemological stance which is opposite to positivism. Interpretivists argue that "the social world of business and management is [continuously evolving and is] far too complex to lend itself to theorising by definite 'laws' [... and that] rich insights into this complex world are lost if such complexity is reduced entirely to a series of law-like generalisations [...and therefore] it is necessary to explore the subjective meanings motivating people's actions in order to be able to understand [the very diverse realities in the social world]" (Saunders et al., 2003:84). As a result, instead of objectively observing the subject, interpretivists prefer interacting with the research participants to "seek to understand the subjective reality of those that they study in order to be able to make sense of and understand their motives, actions and intentions in a way that is meaningful for these research participants" (Saunders et al., 2003:84; Burrell and Morgan, 1985:28).

It is important to note that there are other approaches that can be used for specific research projects, such as critical realism and social constructivism, etc. However, these approaches were deemed to be unsuitable for this research.

The goal of critical realism is to critique "existing social systems [...and then] act to change [...current] social circumstances" (Orlikowski and Baroudi, 1991). However, this research set out to identify, explore and investigate ERP exploitation barriers and risks in Chinese SOEs, but it did not aim at changing the status quo of these companies.

On the other hand, the aim of social constructivism is to study and explore social facts, which "do not exist in the physical object world [...but] depend on human agreement that they exist and typically require human institutions for their existence" (Searle, 1995, quoted by Ruggie, 1998). In order to do so, studies that employ a social constructivist paradigm often need to adopt a more interactive approach in data collection, such as the Delphi method, which relies on a panel of independent experts to get involved in two or more rounds of data collection (Duncan, 2008; Wagner, 2004). However, for this particular research, it was considered infeasible for the researcher to go back to China to conduct multiple rounds of data collection from a specific panel of experts.

Therefore, these unsuitable approaches are not further considered and discussed here.

As concluded in chapter two, the success of ERP does not only depend on technical aspects, but is also attributed to human and organisational factors. It was thus deemed that in this particular research, in-depth human perceptions, insights and attitudes must be sought in order to study and understand ERP exploitation issues in the context of Chinese SOEs. It is obvious that positivism would be neither suitable nor desirable for an in-depth study of a very complex human activity system. It was therefore thought that interpretivism would be a more suitable approach for this research. Specifically, it was felt that the interpretivism approach would provide deeper insights into organisational strategies, processes and user needs that are concerned with ERP exploitation. This approach also proved to be relevant to many other studies that are investigating underlying causes for human issues, for example issues associated with managers, IT staff and system users. Such an approach would also consider factors such as socio-political, socio-technical, regional, cultural, organisational and interpersonal contexts, which are extremely important for a study of ERP exploitation in China. As a result of these considerations, the interpretive research perspective was adopted for this research.

5.3 Research strategy

A research strategy is a general plan that contains clear objectives derived from the research question and provides specific direction and methods for collecting data to answer this research question (Saunders et al., 2003; Creswell, 2003). This section describes the various research strategies available in the research field, and discusses why the mixed-methods strategy was adopted as the most suitable research strategy for this project.

5.3.1 Candidates of research strategies

According to Creswell (2003:13-15) and Saunders et al. (2003:91-95), research strategies that are widely employed by researchers can be divided into three categories, namely quantitative strategies, qualitative strategies and mixed-methods strategies. This section enumerates the candidates of research strategies that can be potentially applied for this interpretivist research.

5.3.1.1 Quantitative strategies

Quantitative strategies are generally based on the epistemological stance of positivism, and often adopt the deductive approach of which the main focus is to collect quantitative data to test a pre-defined theory or hypothesis (Saunders et al., 2003). Typical quantitative strategies include experiment and survey:

- Experiment is traditionally used in natural sciences but is increasingly adopted by social sciences researchers, particularly psychologists (Saunders et al., 2003). The basic idea of an experimental study is to examine the possible influences or cause-and-effect relationships between two factors under certain conditions (Leedy and Ormrod, 2001:229). Galliers (1992:150) reinforces the idea that experiments attempt to identify precise relationships between chosen variables via a designed laboratory environment, using quantitative analytical techniques, with an endeavour to deriving generalisable findings applicable to real-life situations.
- The survey strategy is a popular and common quantitative strategy in business and management research (Saunders et al., 2003:92). It aims at obtaining snap shots of practices, situations or views at a particular point in time via interviews or

questionnaires (Gallieres, 1992:150). In addition, a survey can be a cross-sectional or a longitudinal study with the intent of generalising from a sample to a targeted population (Babbie, 1990, cited by Cresswell, 2003:14). Saunders et al. (2003:92) further point out that the survey strategy allows the collection of a large amount of data from a sizable population and represents a highly economical way for doing research studies.

5.3.1.2 Qualitative strategies

Qualitative strategies are based on the philosophical stance of interpretivism, constructivism and critical realism. Qualitative strategies adopt an inductive approach and aim at collecting qualitative data to build up theories (Saunders et al., 2003). Typical strategies used in social sciences research include action research, inductive approaches (e.g. grounded theory and ethnography), and case study, etc:

- Researchers conducting an action research will need to form an alliance with the subject of the research (e.g. an organisation), and even become a member of it (Saunders et al., 2003). The allied organisation will often provide necessary access authority and resources to the researcher. Findings derived from the research will be used by the organisation to change the current problematic situation (Saunders et al., 2003:94). An action research thus has two folds: on the one hand, it contributes to the practical concerns of people engaged with an immediate problematic situation and aims at helping them to change the current situation; on the other hand, it enables the researcher to access to valuable sources of information and contribute to theoretical knowledge in the research field (Goduscheit et al., 2007; Gallieres, 1992:152). Please note that a study that adopts an action research approach may not necessarily be a qualitative study. For example, projects that aim at building prototypes of computer programs may often involve the use of questionnaires to collect user feedbacks.
- Traditional research designs are deductive in nature, and usually rely on a literature review leading to the formation of an hypothesis or theoretical framework. This hypothesis or theoretical framework may then be put to the test in the real world (Allan, 2003) or used to direct and organise the data collection and analysis of the research (Yin, 2003). In contrast, inductive approaches, such as grounded theory, investigate the actualities in the real world and analyse the data with no

preconceived hypothesis and theories (Glaser and Strauss, 1967, cited by Allan, 2003). In other words, in a grounded theory study, data collection starts without the formation of an initial theoretical framework (Saunders et al., 2003:389). Predictions, in terms of theories, themes and issues to be addressed by the study, will emerge from the process of data collection and analysis. The researcher then needs to continue the data collection and analysis process to confirm, or otherwise, these predictions (Saunders et al., 2003:93).

- Ethnographic research comes from the discipline of social and cultural anthropology, and is also firmly rooted in the inductive approach (Saunders et al., 2003:93). The purpose of an ethnography study is to "interpret the social world the research subjects inhabit in the way in which they interpret it" (Saunders et al., 2003:93). In particular, ethnographers are required to spend a significant amount of time in the field. They often immerse themselves in the life of people they study, and seek to study the phenomena in their social and cultural context, normally through the use of participant observation and interview (Myers, 1999). Ethnographic research is thus well suited to provide IS researchers with rich insights into the human, social, and organizational contexts of information systems (Myers, 1999). Moreover, both Saunders et al. (2003:93) and LeCompte and Schensul (1999, cited by Creswell, 2003:14) stress that "the research process [of an ethnography study] needs to be flexible and responsive to change since the researcher will constantly be developing new patterns of thought about what is being observed".
- Case study, as defined by Robson (2002:146), is "a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence". Yin (2003:2) reinforces that the case study approach allows the researcher to retain the holistic and meaningful characteristics of real-life events and phenomena. It is particularly useful in obtaining anecdotal evidence and in-depth human insights to explore the social context of interest (Saunders et al., 2003:93). When doing case study research, investigators may focus on a single case, which presents itself to be critical and can promote understanding of similar situations (Leedy and Ormrod, 2001:149; Yin, 2003). Alternatively, researchers may focus on multiple cases in order to enable comparisons, build theory, or propose theoretical replications (Leedy and Ormrod, 2001:149; Yin, 2003). Please note that a case study may not necessarily be a qualitative research. For instance, a case study may use questionnaire as the main data collection method.

5.3.1.3 Mixed-method strategies

Galliers (1994:150-152), Tashakkori and Teddlie (1998) and Creswell (2003:15-16) stress that research strategies based on either quantitative or qualitative approaches have their own strengths and limitations. In order to overcome the limitations of a single strategy researchers may often apply mixed strategies and methods in their study. A mixed-method strategy can be defined as a research design that uses qualitative and quantitative data collection techniques in either parallel or sequential phases to study the same concept(s) (Tashakkori and Teddlie, 1998:41). It is obvious that a mixed-method strategy stresses combining both quantitative and qualitative methods in a single study to achieve triangulation, and aims at supplementing the limitation of each single method (Creswell, 2003:15-16).

The term 'triangulation' is broadly defined by Denzin (quoted by Jick, 1979) as "the combination of methodologies in the study of the same phenomenon". In practices, the concept of triangulation can often be applied to two ways, namely method triangulation and data triangulation (Jick, 1979). Method triangulation refers to the phenomenon that different data collection methods are used to collect different sets of data to study the same concept/reality (Tashakkori and Teddlie, 1998:41). On the other hand, data triangulation refers to the phenomenon to use multiple techniques to analyse and interpret the same set of data from different dimensions (Jick, 1979). It is apparent that, when a study adopts a mixed-method design that consists of multiple data collection methods, method triangulation would be achieved.

According to Jick (1979) and Creswell (2003:15-16), the approach for using multi-methods to achieve method triangulation can provide researchers with a range of benefits:

- It allows researchers to be more confident on their results;
- It helps to neutralize or cancel the biases that may exist by using a single method;
- It stimulates the creation of new ways to combine different approaches, strategies and methods to answer a specific research question;
- It helps to uncover the unique or deviant dimension of a sophisticated phenomenon which might be overlooked by using a single method, and lead to a deeper explanation and understanding of the research problem.

In a mixed-method study researchers can combine the use of any research methods as far as these methods suit the needs of the research (Tashakkori and Teddlie, 1998). By observing previous studies, Creswell (2003:208-225) identifies six common ways that a mixed-method strategy may be formed (as briefly introduced in table 5.1).

Mixed-methods strategy	Characteristics
Sequential strategies:	
Sequential explanatory Strategy	This strategy contains two phases and is characterised by the collection and analysis of quantitative data followed by the collection and analysis of qualitative data. The priority is given to the quantitative data collection. The purpose of this strategy is to use qualitative results to further explore and explain the findings of a primarily quantitative study.
Sequential exploratory Strategy	This strategy is characterised by an initial phase of qualitative data collection and analysis which is followed by a phase of quantitative data collection and analysis. The priority is given to the qualitative aspect of the study.
Sequential transformative Strategy	This strategy contains two distinct data collection phases. However in this design, either method may be used first when collecting data from a targeted individual/case/organisation, and the priority can be given to either the quantitative or the qualitative phase, or even to both if sufficient resources are available.
Concurrent strategies:	
Concurrent triangulation Strategy	This strategy is selected as the model when a researcher uses two different methods in an attempt to confirm, cross-validate, or corroborate findings within a single study. The quantitative and qualitative data collection is happening simultaneously in one phase of the research and is considered as equally important.
Concurrent nested strategy	This strategy uses one data collection phase, during which both quantitative and qualitative data are collected simultaneously. However, one method (either quantitative or qualitative method) must take the predominant position while the other method should be embedded/nested within the predominant method to address a different question than the dominant method or seeks information from a different level.
Concurrent transformative strategy	This strategy may take on the design features of both concurrent triangulation and concurrent nested strategy. For instance, It may involve a triangulation of quantitative and qualitative method which may be embedded with a supplement method to further explore the issue. However all data are collected at the same time during one data collection phase.

Table 5.1: Six types of mixed-methods strategies

(source: Creswell, 2003).

5.3.2 Selection of research strategies

Six candidates of research strategies (i.e. experiment, survey, action research, grounded theory, case study and mixed-methods strategy) have been discussed above. This

section discusses the applicability of each of these research strategies in relation to the nature and research questions of this study, and aims at conclusions that will enable the researcher to select the most suitable research strategy for this project.

5.3.2.1 Justification of the mixed-method strategy

The applicability of each of the six potential research strategies to this research was carefully analysed and evaluated.

Firstly, the experimented strategy was considered. As argued by Galliers (1993:150), an experiment is an ideal strategy for the study of a small number of variables that are required to be investigated intensively. Nonetheless Galliers also points out that, in order to focus on a limited context, the designed laboratory situation for carrying out the experiment is often simplified. As a consequence, the experiment may not cover or consider all key factors that exist in the real context. These factors may have an impact on the variables and relationships being studied, and therefore the experiment may result in omitted findings. Because the implementation and use of ERP is closely related with and can be reduced significantly affected by the context, a study in ERP post-implementation will not be efficiently and successfully carried out without considering the full context. Due to this reason, the experiment strategy was considered to be unsuitable for this research. Moreover, an experiment can only allow the researcher to study a limited number of variables intensively (Galliers, 1993:150). Since a study of ERP exploitation will inevitably concern a large number of variables, these variables may not be fully investigated by using experiments. As a consequence, the experiment strategy was not used for this project.

Secondly, the applicability of the survey strategy was analysed. The survey strategy, which is based on the deductive approach, is also often considered to be suitable and desirable for testing theories (Saunders et al., 2003). As further stated by Saunders et al. (2003:92), the main strength for using a survey is that it enables researchers to study a large number of variables and make generalisable statements derived from a sizable population in a highly economical way. As concluded from the PEST analysis, the researcher selected a very specific set of Chinese companies (i.e. SOEs in the electronic and telecommunication manufacturing sector in Guangdong) to base this study on. The survey strategy thus presents itself to be suitable for generating generalisable findings to

this specific context of Chinese SOEs. Nevertheless, because ERP is used in a social and organizational context, the study of ERP post-implementation needs to take into account in-depth human insights in order to explore fully the social and organizational context in which ERP is used. In particular, in-depth human insights should be sought in order for the researcher to explore potential causes and consequences associated with identified ERP barriers and risks in the context of Chinese SOEs. However, as pointed out by Robson (2002) and Galliers (1993) a survey often will not allow researchers to explore intensively the human insights behind the variables being studied. In other words, the survey strategy may not fully satisfy the needs of this research project, in terms of in-depth understanding of the phenomenon being studied.

Thirdly, the suitability of the action research strategy was evaluated. As discussed by Saunders et al. (2003:93-94), researchers engaged with action research should ally with and even become a member of the organisation being studied. The researcher will then aim at changing the current problematic situation faced by the organisation through research. In the context of this research, the researcher did not form an alliance with any of the targeted companies and more importantly would not aim at changing the current situation of any particular company. The fundamental objectives of this research were to capture snap shots of the barriers and risks that Chinese companies may encounter when using ERP, and seek in-depth insights about why these barriers and risks exist and what impacts they may result in. Considering the nature and objectives of this research, the action research strategy proved to be a totally inappropriate approach for this research project.

Fourthly, the researcher considered the applicability of grounded theory and ethnography. The core of both of these inductive approaches is to start data collection without a predefined theoretical framework and then identify theories and themes through analysis of the collected data (Leedy and Ormrod, 2001:154). It is thus likely that these approaches may be best suited for a research where a theoretical framework is difficult to be constructed prior to data collection. However, for this project, the researcher would be able to establish a theoretical ERP barrier and risk ontology (as presented in chapter six) through the process of a critical literature review from other contexts, for instance USA and Europe. This certainly presents a different situation to that required to use these inductive approaches. More importantly, the next step of this project should be to collect data to test the suitability of this theoretical ontology. It is

obvious that when ground theory and ethnography are prominent inductive approaches for building theories, they are not suitable for theory testing. Consequently, neither grounded theory nor ethnography was adopted for this study.

Fifthly, the suitability of the case study strategy was considered. As stated by Saunders et al. (2003:93), a case study is particularly useful to obtain anecdotal evidence and in-depth human insights to explore issues within a given social context. Case study thus served to be a suitable strategy for this project to seek in-depth human insights in order to fully understand the identified ERP barriers and risks in the Chinese context. This research strategy however is often criticised for its incapability to achieve generalisation (Yin, 2003; Galliers, 1993; Leedy and Ormrod, 2001:149). In other words, researchers cannot be sure that results derived from either a single- or multiple-case study research are generalisable to other situations (Leedy and Ormrod, 2001:149). As the researcher selected a very specific set of Chinese companies to base this project on, it was considered essential and meaningful for this study to produce findings that were generalisable to this specific context. Consequently, the case study strategy cannot fully satisfy the needs of this research project.

Overall, the applicability of the five potential strategies based on either quantitative or qualitative approach was analysed and evaluated. None of these single-approach strategies however was considered as an ideal approach for this research project, although some of them partially fit the needs of this study. For instance, the survey strategy may enable the researcher to study a large number of variables and achieve generalisations, but it may not allow the researcher to explore the human insights behind these variables intensively. In contrast, the case study strategy may enable the researcher to investigate subjective human insights and attitudes thoroughly, but it is difficult for the researcher to make generalisable statements through either single- or multiple-case study. This situation actually reflects the traditional pitfall associated with a single-approach strategy. As argued by many researchers (e.g. Tashakkori and Teddlie, 1998; Creswell, 2003), by adopting a solely quantitative or qualitative research strategy, it may often be difficult for researchers to produce simultaneously generalisable and in-depth findings in the same piece of study.

Faced with the limitations of a single-approach strategy, the researcher decided to combine both quantitative and qualitative methods to form a mixed-method strategy for

this study. As stated by Tashakkori and Teddlie (1998) and Creswell (2003), the main purpose for using multiple methods in the same piece of study is to offset the limitations and biases that could exist by using a single method, as well as supplementing the data derived from each method. The mixed methods approach enables triangulation to take place and will often lead to more comprehensive, significant and meaningful findings (Saunders et al., 2003; Creswell, 2003). More importantly, when a mixed-method strategy composed of both a quantitative and a qualitative study was adopted for this project, the quantitative component (e.g. survey) was designed to allow generalisable statements on barriers and risks that Chinese SOEs may encounter in ERP post-implementation to be made, and the qualitative component (e.g. case study) aimed to enable the researcher to seek in-depth human insights to explore the causes and impacts of the identified ERP barriers and risks. In short, the use of a mixed-method strategy might help to produce generalisable as well as in-depth findings for this ERP post-implementation research.

5.3.2.2 Design of the mixed-method strategy for this project

Since the mixed-method approach was adopted, this section describes and discusses how the mixed-method strategy for this project was constructed and designed.

As discussed earlier, this project focuses on a limited context to study the exploitation of ERP. Therefore, findings that were generalisable to this specific context were considered to be not just essential but highly valuable and meaningful. A deductive quantitative study should thus be conducted. On the other hand, it was expected that some findings derived from the quantitative study might be different from original expectations because of different contexts between China and the West. This is certainly a very common issue to occur when doing quantitative research. Therefore, it was considered that a follow-up qualitative study should be carried out, in order to explore further any unexpected findings derived from the quantitative component. Consequently, it clearly emerged that there was a need for the researcher to adopt a research design, which consisted of a quantitative study and a follow-up qualitative component, for this research project. In fact, this emergent research design followed a typical QUAN and *qual* approach, which is one of the six mixed-method designs proposed by Creswell (2003:213) (as briefly introduced in table 7.1 in this chapter).

As presented by Creswell (2003) the QUAN and *qual* design consists of two phases (as shown in figure 5.1). At the first phase, a deductive and quantitative study is conducted and takes the predominant position of the entire research. A supplementary qualitative study is carried out at the second phase to further explore and explain the findings and unexpected results derived from the quantitative study and thus achieve triangulation.

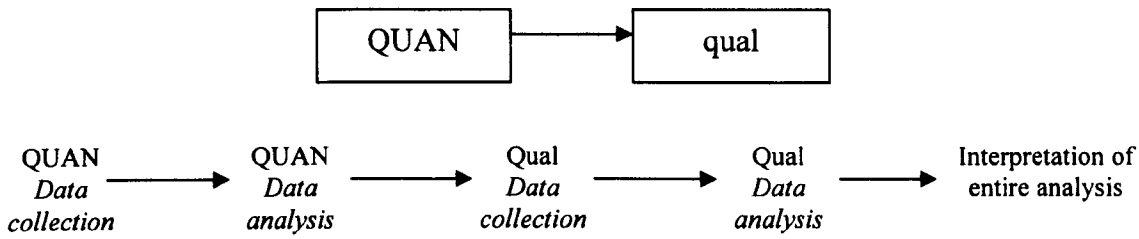


Figure 5.1: Sequential explanatory strategy
(*Source*: Creswell, 2003: 213)

As mentioned by Saunders et al. (2003:92), a survey allows researchers to collect a large amount of data from a sizeable population in a highly economical way to produce generalisable statements. Therefore, the survey presented itself as the most suitable quantitative strategy to be used at the first data collection phase of this study to identify generalisable aspects of ERP post-implementation barriers and risks within the selected context. Furthermore, this research project was aiming to capture a 'snap-shot' of the current issues for using ERP rather than to study how these issues change over time. The survey conducted in this project was thus a cross-sectional rather than a longitudinal study.

On the other hand, as argued by Saunders et al. (2003:93) the case study strategy is a particularly useful approach for gaining in-depth human insights and exploring existing theories. Case study was thus selected as the most suitable qualitative strategy to be adopted at the second data collection phase of this project to explore in-depth human insights to examine the causes and impacts behind the barriers and risks identified from the quantitative study. More importantly, the case study, as a supplementary qualitative component, could reinforce and further explore the findings derived from the survey, and thus could enable triangulation to take place and result in more comprehensive and meaningful outcomes. Additionally, because a single-case study might not yield sufficient qualitative evidence to triangulate with the quantitative findings, a multi-case study was conducted in this project. The companies involved in the case study were identified from the set of SOEs which also participated in the survey research.

Overall, the mixed-methods strategy adopted for this study was a sequential QUAN and *qual* design, which consisted of two phases. At the first phase, a cross-sectional survey research was conducted and took the predominant position in the study. A supplementary qualitative component (i.e. follow-up case study) was carried out at the second phase to further explore and validate the findings derived from the survey study, and therefore achieved triangulation and theory extension. It is obvious that, if the survey research held the principal role in this study, then this research was mainly driven by a deductive approach.

5.4 Critical literature review for initial barrier and risk identification

Before conducting the survey in the selected SOEs, there was a need for the researcher to establish explicit theoretical IS lens to frame the study and guide the data collection process, in order to generate meaningful and significant findings.

As a consequence, the researcher carried out an initial desktop study based on a critical literature review. As discussed in the introduction chapter, the process of this extensive literature review did not return any specific studies on ERP post-implementation barriers and risks. Nevertheless, the researcher identified and retrieved, through the critical analysis of the literature, a large amount of IS and general business research studies, case studies and theoretical papers in both English and Chinese. By analysing, systematically comparing and synthesising these articles and materials, the researcher identified and established a variety of barriers and risks which Chinese companies might encounter in ERP exploitation.

Specifically, as a result of the systematic review, the researcher established 29 ERP barriers and 40 ERP risks that might prevent Chinese companies from successfully using, maintaining and enhancing their ERP systems. A barrier ontology and a risk ontology were developed to represent these identified ERP barriers and risks. The established ERP barrier and risk ontologies were then used as the theoretical basis for constructing the survey of this project.

These ERP barriers, risks and ontology are presented and discussed in detail in the next chapter.

5.5 Candidates of data collection methods

As the sequential explanatory mixed-methods approach, consisting of a survey and a case study research, was adopted for this project, the next task of the researcher was to identify and select the specific data collection methods to be used respectively for the survey and the case study. A data collection method refers to the specific way that is used to collect data from the targeted research units (Saunders et al., 2003). The frequently-used data collection methods in social sciences research include questionnaire, interview, observation, and using documents and content analysis. This section describes and discusses these data collection methods in details.

5.5.1 Questionnaire

A questionnaire is a quantitative data collection method in which all respondents are asked to respond to the same set of questions in a predetermined order (deVaus, 2002). Questionnaires are frequently adopted in surveys, experiments and case study research, and can be used to collect opinions, attributes, beliefs and behaviours from the target stakeholders (Saunders et al., 2003:280). Closed-ended questions with fixed answers are often used in questionnaires, although open-ended questions may also be adopted where appropriate (Bryman, 2004:133-138). Each respondent is required to complete and return the questionnaire at their own convenience without the presence of the researcher (Bryman, 2004:132). A questionnaire can be posted to the respondents who return it by post after completion (postal questionnaire), alternatively, it can be delivered to and returned by the respondents electronically through using either email or the Internet (online questionnaire) (Saunders et al., 2003:282). Online questionnaires can also be distinguished as e-mail questionnaire which is sent to the respondents by emails, or web-based questionnaire which operates by inviting respondents to visit a website at which the questionnaire can be found and completed online (Bryman, 2004:480-481). In real world practice, researchers may combine the use of both postal and web-based questionnaire by embedding the URL of the web-based questionnaire in the postal questionnaire, and thus offering prospective respondents alternative ways to complete and return the questionnaire (Meckel et al., 2005).

The advantage for using questionnaire is that, when each respondent is asked to respond to the same set of questions, it provides an effective way for collecting standardised answers from the sample (Saunders et al., 2003:281). The questionnaire represents an efficient and economical way for researchers to collect data from a large sample in a wide geographical area at the same time (Bryman, 2004:133-134). Also since the respondents fill in the questionnaire without the presence of the researcher, the possibility of researcher bias can be removed (deVaus, 2002; Bryman, 2004:133). However these benefits may be accompanied with certain deficiencies. A notable one is that, any doubts that respondents may have when filling in the questionnaire may not be further clarified or explained by the researcher. In order to overcome this specific deficiency, Saunders et al. (2003:283) suggest that researchers should keep the questionnaire as short, clear and simple as possible, and increase the validity of the questionnaire by carrying out a pilot test to identify and tackle any uncertainties and ambiguities in the questionnaire prior using it to collect data.

A questionnaire can be used for either descriptive, explanatory or exploratory purposes (Robson, 2002:232). Many questionnaire surveys on social sciences issues (especially demographic issues) are descriptive in nature (Robson, 2002:232). When a questionnaire is carried out for descriptive purposes, it aims at generating an accurate profile to describe the general patterns and characteristics of the phenomena studied (Robson, 2002:59). Researchers must have extensive prior knowledge on the phenomena being investigated in order to identify appropriate aspects on which to collect data by using descriptive questionnaires (Saunders et al., 2003:97; Robson, 2002:59). It is possible for a questionnaire to go beyond the descriptive purpose to a more explanatory purpose. This means, to use the questionnaire to seek explanations of the phenomena studied and the patterns of results obtained as well as identifying and explaining relationships between aspects of the phenomenon (Robson, 2002:235). On the other hand, this data collection method may also be used for exploratory purposes to find out what is happening, seek new insights on little-understood situations, and generate ideas for further research (Robson, 2002:59). Robson (2002:234) however points out that questionnaires may not be the best method for carrying out exploratory work. Robson's concern is that, because questionnaires are mainly composed by closed-ended questions and it is an inefficient and ineffective procedure to ask a large set of open-ended questions in a questionnaire, this presents a difficulty to fully explore the complex social contexts. This viewpoint however proves to be over-simplified in

real world research. In reality, questionnaires are frequently adopted for exploratory studies (e.g. Tang, 2000) to probe and identify a set of characteristics for events and situations of which the researcher knows little about. The early findings derived from the exploratory questionnaire may then be verified, supplemented and further explored by using follow up qualitative and/or quantitative methods. In response to Robson's concern, it can be argued that although a questionnaire on its own may not be well suited to the needs of an exploratory study, it may be used in conjunction with other follow up research methods to achieve the exploratory goal effectively and efficiently.

5.5.2 Interview

An interview is a purposeful discussion, which is initiated by the interviewer in order to obtain research-relevant information from the interviewee for specific research purposes and objectives (Kahn and Cannell, 1957, quoted by Saunders et al., 2003:245; Cannell and Kahn, 1957, quoted by Robson, 1993:229). Interviews can enable the researcher to gather a great deal of useful information from the interviewee, including facts, beliefs, feelings, motives, behaviours and perceptions, etc (Leedy and Ormrod, 2001:159). As classified by the level of formality and structure, interviews can be categorised as structured interviews, semi-structured interviews and in-depth interviews (Saunders et al., 2003:246).

The structured interview is one of the two main ways for performing a survey research and involves the interviewer asking the interviewee a set of fixed and standardised questions in a predetermined order (Bryman, 2004:109-110). It enables the researcher to gather a set of generalisable and standardised responses. Due to its similarity with the questionnaire, structure interview is often referred to as interviewer-administered questionnaire (Saunders et al., 2003; Robson, 1993). The main difference between a questionnaire and a structured interview is that, when the questionnaire is administered by the respondent without the presence of the researcher, a structured interview is managed by the researcher/interviewer often over the telephone or by face-to-face (Saunders et al., 2003). As compared to questionnaires, structured interviews tend to have more open questions and offer a better opportunity for researchers to help respondents with questions that they found difficult to understand and answer (Bryman, 2004:134). Nonetheless, making appointments with respondents to phone or visit them in a convenient time may be a difficult task. Telephoning or travelling to the

respondents can also be costly and require more time and effort from the researcher. Saunders et al. (2003:284) therefore conclude that structured interviews may not be suitable for a research of which the selected sample is large and dispersed in a wide geographical area. Furthermore, structured interviews are suitable for quantitative studies (Bryman, 2004:109) of which the purposes are descriptive or explanatory, but it is incapable for exploring in-depth findings (Saunders et al., 2003:247-248). Therefore in exploratory qualitative studies, semi-structured and unstructured interviews are more likely to be used to explore in-depth human insights and seek new findings (Saunders et al., 2003:248).

In semi-structured interviews, a list of themes and questions to be covered and explored will be pre-defined prior to the collection of data (Saunders et al., 2003:246). When compared to structured interviews, semi-structured interviews are more flexible because the interviewer in this case may omit or add some questions and change the orders of questions depending on the flow of the conversation in order to fully explore the views of the interviewee (Saunders et al., 2003:246; Bryman, 2004:321). Because the interviewer is often free to probe beyond answers and can extend the predetermined questions flexibly (May, 1997:111), semi-structured interviews as compared to structured or unstructured interviews are more suitable to be used to seek further clarification and explanation for the specific themes and aspects derived from the preliminary stages of a research.

An unstructured interview is an informal conversation between the interviewer and the interviewee with no predetermined list of questions to work through (Robson, 2002:270). The interviewer talks with the interviewees freely about events, behaviour and beliefs in relation to the topic area. Nevertheless, the interviewer needs to have a clear idea about what aspects should be covered and explored (Saunders et al., 2003:247; May, 1997:112-113; Bryman, 2004:320-321). Unstructured interviews are particularly helpful to 'find out what is happening [and] to seek new insights' (Robson, 2002:59) for exploratory studies (Saunders et al., 2003:248). Because the unstructured interview is an entirely open conversation and does not require a predefined list of questions to work through, it may be best used at the beginning of the study in which little is known in order to explore and identify a set of preliminary findings for further investigation.

In general terms, when doing interviews the interviewer can conduct it either face-to-face or over the telephone. Telephone interviews may lead to a number of advantages in relation to access, speed and cost in contrast with face-to-face interviews (Saunders et al., 2003:269). However, conducting an interview and recording the interviewee's responses over the telephone is a difficult process, especially for semi-structured and unstructured interviews in which unpredictable questions and responses may come up. Moreover, in a telephone interview, the researcher will not be able to observe the non-verbal behaviours of interviewees (e.g. body languages). These non-verbal aspects sometimes can be crucial for the interviewer to understand the interviewee's speeches. In addition, without a face-to-face contact with the interviewer, the interviewees may put less trust in the interviewer and thus become less willing and even refuse to answer sensitive questions (Saunders et al., 2003).

5.5.3 Observation

If someone's research questions and objectives "are concerned with what people do, an obvious way in which to discover this is to watch them do it" (Saunders et al., 2003:221). Observation is a data collection method in which the researcher/observer watches what people do, records this in some way and then describe, analyse and interpret what has been observed (Robson, 1993:190). A major advantage of observation is that, instead of asking people about their views, feelings or attitudes, the observer just directly watches what people do and listens what people say (Robson, 2002:310). Observations thus can help researchers identify information that people may not be willing to reveal in interviews or questionnaires (Bryman, 2004:165-167). However observation is neither an easy nor a trouble-free method (Robson, 2002:311). There is a major issue concerning the extent to which an observer affects the situation under observation (Robson, 2002:311). Specifically, participants may perform differently if they are aware of the observation taking place (Leedy and Ormrod, 2001:158). The closeness of the researcher to the situation may also lead to significant observer bias (Saunders et al., 2003). Observations may "call for a heavy investment of time and effort and should not be used without careful consideration of their resource implications in the real world study" (Robson, 2002:310).

Observations can be performed in many different forms (Bryman, 2004:167). The two polar extreme types are participant observation and structured observation (Robson, 2002:309).

Participant observation is a qualitative method with flexible designs (Robson, 2002:310). It is closely related with the research strategy of ethnography (Bryman, 2004:292). In participant observations, the observer "attempts to participate fully in the lives and activities of subjects and thus becomes a member of their group, organisation or community" (Gill and Johnson, 1997, quoted by Saunders et al., 2003:222). Participant observations are normally unstructured, although the observer must have a clear idea about what aspects should be discovered (Saunders et al., 2003:222). By working with people and engaging in the social situation for an extended period of time, participant observers may be in a better position to interpret the observed activities and behaviours by using their own experiences (Robson, 2002:314; Saunders et al., 2003:230). However, this method may be seen as a totally unacceptable approach to positivists due to its high level of subjectivity (Robson, 2002:314).

In contrast, structured observation is a quantitative method with fixed designs and highly predetermined structures (Robson, 2002:310; Saunders et al., 2003:231). Structured observations normally use explicitly formulated schedules for the observation and recording of behaviour (Bryman, 2004:167). Structured observers adopt a more detached stance as compared to participant observers, and tend to be a 'pure observer' without trying to become an integrated part of the group or organisation (Saunders et al., 2003:231). Because its main function is to tell the researcher about how often things happen rather than why they happen, structured observation may form only a part of the data collection approach for a research (Saunders et al., 2003:231).

5.5.4 Using documents and content analysis

Instead of collecting primary data by using questionnaires, interviews or observations, researchers may use documents as secondary or supplementary sources in a multi-methods study for triangulation purposes (Robson, 2002:349-352). Documents of the kind referred to in research are materials that have not been produced specifically for the purpose of the research (Bryman, 2004:381) and thus will not be affected by the fact that the researcher is using it (Robson, 2002:349). Documents cover a wide range of

information sources, including company reports, government reports, minutes of meetings, letters, memos, diaries, newspapers, magazine articles, etc (Robson, 2002:351; Bryman, 2004:380). However, researchers may find it difficult to retrieve relevant documents for their research in real world practices. Specifically, it is often possible that the purposes of the retrieved documents may not suit the needs of the study, or the retrieved documents may not contain sufficient details or may contain inaccurate and unreliable information (Robson, 2002:350). In addition, the retrieved documents do not stand on their own, but need to be analysed and situated within a theoretical frame of reference in order that their contents are understood (May, 1997:171) and can be used to support the main findings of the research (Robson, 2002:352). Documents collected for the research can be analysed in many diverse ways, but the most common approach to documentary analysis is content analysis (Bryman, 2004:392; May, 1997:171). Strictly speaking, content analysis is a method of analysis rather than a method of data collection, but many researchers may consider it as a data collection method due to the fact that content analysis refers to a set of procedures used to extract and gather useful data from the retrieved documents (Bryman, 2004:181). Content analysis can be done by following either a quantitative or qualitative approach.

Quantitative content analysis is "an approach to the analysis of documents and text that seeks to quantify content in terms of predetermined categories and in a systematic and replicable manner" (Bryman, 2004:181). The researcher has to predetermine a theoretical frame that contains codes or categories (Robson, 2002:354). Relevant words or sentences of the documents collected will be sorted and situated under specific codes and categories of the predefined frame (May, 1997:171). After the coding process is completed, the data obtained can be analysed by using statistical methods and procedures (Robson, 2002:357). The focus of quantitative content analysis is to examine "the frequency with which certain words or particular phrases occur in the text as a means of identifying its characteristics" (May, 1997:171).

Qualitative content analysis is the most appropriate approach to the qualitative analysis of documents (Bryman, 2004:392). The qualitative content analysis "comprises a searching-out of underlying themes [and theories in the documents]...being analysed" (Bryman, 2004:393). Unlike quantitative content analysis, qualitative content analysis does not have predefined categorises for coding. Instead it follows the principles of qualitative data analysis, that is, to identify and generate codes and categories from the

data sources, and then code relevant text of the documents into the coding scheme for analysis (Bryman, 2004:393). The extracted themes and theories are usually illustrated with brief quotations from the related documents (Bryman, 2004:392).

5.6 Data collection for the survey research

After discussing the candidates of data collection methods, this section describes and discusses the selected methods and procedures used for collecting data in the survey research of this project.

5.6.1 Target companies of the survey

As concluded from the PEST analysis, the researcher identified and selected the SOEs operating in the electronic and telecommunication manufacturing sector in Guangdong in China as adequate companies for carrying out this research. As a consequence, each company that was invited to participate in the survey research should simultaneously satisfy three criteria: it must be a State-Owned Enterprise; it must operate in the electronic and telecommunication manufacturing sector; it must be located in the Guangdong province in China.

According to the statistics provided by the Guangdong Statistical Bureau (GSB), the number of SOEs that satisfy these three criteria is 118 at the time of conducting this survey. As a consequence, the survey research of this project was carried out across these 118 SOEs in Guangdong.

On the other hand, no data could be found to show how many of these 118 SOEs had ERP systems at present. However, as identified in the PEST analysis, most SOEs in the electronic and telecommunication manufacturing sector in Guangdong have achieved high level of informatization. It was therefore predicted that the majority of the selected SOEs should have adopted ERP systems for a few years. In truth, as presented in chapter seven, findings derived from the survey research confirmed this initial expectation was true, as 88% of the SOEs that participated in the study have implemented ERP. Nevertheless, even if a selected SOE had not yet adopted ERP, it was considered that managers of the company would still hold meaningful and valuable opinions regarding the barriers and risks that are preventing their company from using

such an advanced IS application. Due to this reason, companies that had not currently adopted ERP were not excluded from this research project.

5.6.2 Selection of data collection method

Questionnaire and structured interviews are common data collection methods used in a survey research (Robson, 2002; Saunders et al., 2003:92; Bryman, 2004). The structured interview was however rejected immediately in this survey, because it would be an infeasible and inefficient approach to contact and carry out structured interviews with managers of the 118 target SOEs that are dispersed in the 21 cities across the Guangdong province. As compared to structured interview, the questionnaire proves to be a more feasible and efficient approach to be used for this project. A questionnaire can be completed and returned by the respondents without the presence of the researcher and thus presents to be a highly efficient and economical way for collecting responses from prospective respondents. As a consequence, the researcher selected questionnaire rather than structured interview as the ideal data collection method to be used for the survey research of this study.

In addition postal questionnaire instead of email questionnaire was used in this case, because it was possible for the researcher to retrieve the address of each of the selected SOEs while it would not be a practical approach to attempt to gather personal email addresses from Chinese managers who are conventionally reluctant to disclose personal contact details (e.g. email) to external people. Nevertheless, a web-based version of the questionnaire was used in conjunction with the postal/paper-based questionnaire. The web-based questionnaire was administered through a web server. The URL to access to the web-based questionnaire was embedded in the postal questionnaire, and thus providing an alternative way for prospective respondents to complete and return the questionnaire. It was hoped that, as demonstrated by Meckel et al. (2005), the combination of the use of both postal and web-based questionnaire would help to increase the response rate.

5.6.3 Purposes for doing the questionnaire survey

The main purpose for doing the questionnaire survey was to examine the suitability of the theoretical ERP barrier and risk ontology (as presented in chapter six) in the context

of selected SOEs. Please note that the fundamental aim of the questionnaire survey conducted in this project was not to test hypotheses/theories. Instead, it aimed to use the theoretical ontology as the lens to explore and understand ERP barriers and risks, as well as their casual relationships, in the context of Chinese SOEs studied. Hence, this study followed interpretivism rather than positivism in a research approach.

In particular, the survey aimed to examine and explore whether and to which extent each identified ERP barrier existed in SOEs. Please note that, the established barrier ontology presented in chapter six contained 29 ERP barriers, namely 7 cultural barriers, 9 organisational barriers, 4 external barriers, and 9 system barriers. It was however considered that, the identified external barriers (e.g. government intervention and control) are relatively sensitive topics under the bureaucratic environment in China. As pointed out by Roy et al (2001), due to a long history of bureaucratic intervention and control, Chinese people are often reluctant to offer their views on questions that may be sensitive. Worse of all, when a survey contains sensitive questions, Chinese respondents may often tend to limit their co-operation and even refuse to participate in the survey (Roy et al, 2001). Due to these reasons, the researcher decided not to include the 4 external barriers in this questionnaire, in order to reduce potential risk of non-response. As a consequence, only 25 ERP barriers (i.e. 7 cultural barriers, 9 organisational barriers, and 9 system barriers) presented in the barrier ontology were covered in the questionnaire survey.

On the other hand, the questionnaire survey also aimed to identify which of the 40 identified risk events would be understood and accepted by respondents as risks for ERP exploitation, as well as, to assess the importance of these ERP risks in SOEs. In addition, as discussed in section 6.3.3 in chapter six, a risk event that has a high impact may not have a high probability of occurrence, and vice versa. For instance, system crash can certainly lead to significant impact to user companies, but the probability of occurrence of this risk is low. As a consequence, when assessing the importance of a risk, both its probability of occurrence and level of impact should be considered (Cadle and Yeates, 2001:231). Moreover, a risk event may occur not just once but repetitively within a given context. While the probability of occurrence tells us 'how likely' a risk event may occur, it provides no information about 'how often' this event may happen. As a consequence, the frequency of occurrence of a risk event may often be considered as a further dimension in risk assessment (Covello and Merkhofer, 2003). Based on

these considerations, the questionnaire survey aimed at exploring the importance of the identified ERP risks in Chinese SOEs from three dimensions, namely probability of occurrence, level of impact and frequency of occurrence.

Finally, by analysing the quantitative data collected from the questionnaire survey, the researcher aimed at identified a set of ERP barriers and risks that were the most crucial to SOEs, as well as exploring and investigating the correlations between the identified ERP exploitation barriers and risks.

In sum, it clearly emerged from above discussion that the purpose of this survey was exploratory in nature. By doing the cross-sectional questionnaire survey, the researcher aimed at achieving the following objectives:

- To explore whether, and to which extent, each of the 25 predefined ERP barriers exist in SOEs;
- To identify which of the 40 predefined risk events would be perceived by respondents as risks for ERP exploitation, as well as, to assess the importance of each identified risk according to its likelihood, impact and frequency of occurrence;
- To explore which ERP barriers and risks are the most crucial to SOEs;
- To explore the correlations between the barriers and risks identified.

5.6.4 Questionnaire instrument

In order to gather consistent and reliable data from prospective respondents, an effective and valid questionnaire instrument must be developed. This section presents and discusses how the questionnaire instrument used in this project was designed, developed and validated.

5.6.4.1 Design of the questionnaire instrument

"The validity and reliability of the data you collect and the response rate you achieve depend, to a large extent, on the design of your questions [and] the structure of your questionnaire. A valid question will enable accurate data to be collected, and one that is reliable will mean that these data are collected consistently" (Saunders et al., 2003:291).

This quotation clearly shows that, the design and development of the instrument is a crucial process to ensure the success of a questionnaire survey.

As pointed by Robson (2004:241), "the questions for the questionnaire...should be designed to help to achieve the goals of the research and, in particular, to answer the research questions". May (1997:88) reinforces that questions of questionnaires should be built on past work or theories related to the research topic. In this research project, the questionnaire design was based on a barrier and risk ontology, which was created through a process of critical literature review and was presented in chapter six.

From the ontology presented in chapter six, it became apparent that out of the 25 predefined barriers and 40 predefined risks, some were related with business aspects, while the rest focused on technical issues. This clearly indicated that two different questionnaires needed to be designed to obtain perspectives from both business managers and ICT experts. As a result, 10 barriers and 17 risks that were concerned with general business aspects were used to construct questionnaire A (appendix 2), which was required to be filled in by the operation manager of the company or one that had sufficient knowledge on the company's operation. The rest 15 barriers and 23 risks that were concerned with technical aspects of ERP were grouped into questionnaire B (appendix 3), which was expected to be completed by the IT manager of the firm or one that had extensive knowledge on information systems or ERP.

In order to achieve the objectives highlighted in section 5.6.3, the two designed questionnaires (appendix 2 & 3) contained the following sections:

- Section 1 was concerned with general information about the respondent company, e.g. whether the company is using ERP (if not, what are the reasons for not using; if yes, when did they implement it), and whether the company is using foreign or domestic ERP system, etc.

- Section 2 involved the barriers associated with ERP exploitation. Respondents were asked to which extent they agree or disagree with the listed barrier statements. Each item was scored using a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5). All barrier items were thus scaled, so that the greater the score, the greater the extent that a barrier exists in the

company. An open question was added at the end of this section to explore any barriers that were not included in the list but were experienced by respondents.

- Section 3 focused on the risks of ERP post-implementation. The researchers attempted to identify which of the 40 predefined risk events would be perceived by respondents as risks for ERP exploitation, as well as, to assess the importance of each identified risk according to its likelihood, impact and frequency of occurrence. In order to achieve these objectives, each of the 40 predefined risk events was examined in the questionnaire through four questions:
  1) Whether this event could be perceived as a risk to ERP exploitation (1 = yes, 2= no).
  2) What the probability of occurrence of this risk event could be (measured on a 3-point Likert scale, ranging from high [3] to low [1]).
  3) What level of impact this risk could result in (measured on a 3-point Likert scale, ranging from high [3] to low [1]).
  4) What the frequency of occurrence of this risk event could be (measured on a 5-point Likert scale, ranging from very often [5] to very rarely [1]).

  An open question was added at the end of this section in order to explore any risks that were not included in the list but were experienced by the respondents.

- At the end of the questionnaire, the respondents were asked what position they hold in the company. This piece of information is important to enable the researcher to check whether or not respondents of the questionnaire were appropriate stakeholders.

- Also at the end of the questionnaire, respondents were asked to indicate whether they want to receive a report of the findings, and whether they would like to participate in the second stage of the study. If so, respondents were asked to provide appropriate contact details.

In addition, appropriate codes were assigned to all answers of the questionnaire questions in order to facilitate data analysis at the later stage.

5.6.4.2 Instrument translation

The questionnaire used in the survey was originally developed in English and then translated into Chinese. The questionnaire could actually have been designed directly in Chinese, but since the literature review was undertaken in English as based mostly (90%) on English sources, the initial script was written in that language using its terminology. Furthermore, the study is based at an UK university and the entire research group uses English, so if the questionnaire was to be discussed and reviewed by both supervisor and colleagues, then the language would have to be English.

However, Carlson (2000) points out that it is always a difficult task to translate a questionnaire instrument from one language into another language due to cultural and linguistic differences. Carlson (2000) particularly raises the issue of 'emic' and 'etic' problems. These two terms are neologisms that emerged from an analogy with the terms 'phonemic' and 'phonetic' and were coined by the linguistic anthropologist Pike (1954). 'Emic' concepts refer to terms that are specifically defined under a particular culture. They may or may not hold any relevance in any other cultures. 'Etic' concepts are concepts that are held universally. Carlson (2000) argued that many Western 'emic' concepts may have little relevance to other cultures, and thus cause difficulty when translating them into other languages. This is particularly true when translating English instruments into Chinese, as many terms, concepts and expressions used in English may not make sense in the Chinese context. As exemplified in a research study of Pratt (1991), some 'emic' Western terms, such as 'self-concept' and 'individual differences', can often cause confusion in the Chinese context and thus are difficult to translate into appropriate Chinese phrasing. Carlson (2000) stresses that an inappropriately translated instrument may have low reliability and validity, and data obtained with instruments that are poorly translated are meaningless. This issue can be particularly serious in a questionnaire survey because any ambiguities and problems, which respondents may encounter when filling it in, cannot be further clarified and explained (Peng and Nunes, 2008a).

In addition, a review of literature on data collection methods suggested that a literal word-by-word translation can often result in awkward sentence structure and incomprehensive meaning in the target-language version. As a consequence, experienced translators always strive to adapt their translation to achieve conceptual

equivalence rather than literal equivalence when translating instruments (Carlson, 2000; Harkness and Schoua-Glusberg, 1998). The term 'conceptual equivalence' means that the meanings of the text in both versions of the instrument are conceptually the same despite the text not being literally translated. In order to ensure a conceptually equivalent instrument, careful attention must be paid to the translation process (Carlson, 2000). According to Carlson (2000) and Harkness and Schoua-Glusberg (1998), four approaches may be used in translating questionnaire instruments:

- *One-way translation.* This approach involves the use of a single translator to translate the instrument from the original version to the target version in one go.
- *Back-translation.* Back translation, also called as double- or two-way translation, involves at least two translators. The first translator translates the instrument from the original language to the target language. Then, the second translator, who has no contact with the first translator and has no knowledge about the original instrument, translates it from the target version back to the original language. The two instruments in the original language are then compared for accuracy and consistency.
- *Committee translation.* This approach requires two or more translators (the committee) to translate the instrument from the original version into the target version, working either independently or in collaboration. The committee will then either combine the translations to produce a consensus version or have an independent observer to select the most appropriate translated version for use.
- *Decentering translation.* The above approaches require that the instrument in the original language should be fully developed and validated before translation starts. In contrast, decentering translation assumes that the instrument developed in the original language is not considered finalised until the translation to the target language is completed. In other words, the instrument in the original language is just a first draft. As the translation process reveals problems in the original version, modifications can be made to the original version. Both versions of the instrument should be revised during the translation process until achieving conceptual equivalence.

One-way translation approach was rejected immediately for the project, because as argued by Carlson (2000), despite the fact that this method is the simplest and cheapest

approach to implement, it often results in low validity and reliability for the translated instrument.

Both back- and committee-translation approaches require the use of more than one translator. These two approaches thus prove to be infeasible for this project, which has insufficient resources to recruit multiple translators. Moreover, since the researcher of this project is fluent in both English and Chinese and has working experience in translation, it was unnecessary to employ alternative translators. As a consequence, neither back-translation nor committee-translation was adopted.

In contrast with the other three approaches, the decentering translation method presented itself to be a more feasible and suitable approach to be used for this study. Carlson (2000) points out that the development of both language versions simultaneously is considered as the optimal method in translating instruments. Harkness and Schoua-Glusberg (1998) reinforce that many translation problems related to the original version of the instrument only become apparent after the translation is started. It is therefore better to keep the original version 'open' and enable it to be reviewed and revised repetitively as translation is in progress (Harkness and Schoua-Glusberg, 1998). Previous translation experience of the PhD candidate of this survey also suggested that, by developing and revising both language versions simultaneously, it is easier for translators to ensure that, the text in both versions were conceptually equivalent and reflected the intended meanings of the questions, and therefore ensuring high validity of the instrument. Nevertheless, for many studies of which researchers are not fluent in both languages, it is impossible for them to develop the original and target versions simultaneously. Researchers of these studies thus often design the original version first and then recruit expert translators to handle translation, and adopt back or committee translation rather than decentering translation in the study. Due to these reasons, the decentering translation approach was adopted as the ideal method for translating the script of the survey reported in this paper. By drawing on the principle of the decentering approach, the researcher developed and translated the questionnaire script though a set of rigorous processes:

Step 1. Constructed the draft questionnaire in English based on the predefined theoretical ontology.

Step 2. Initially validated the English version by consulting with the project supervisor and other colleagues in the research group (especially regarding its content, format, layout and structure as well as the relevance of the English questions).

Step 3. Translated the English version into the Chinese version (there is a need to check a number of Chinese textbooks and articles to identify proper Chinese terms and phrasings to represent the original English text).

Step 4. Iteratively revised both language versions until it was assured that both versions were conceptually equivalent and reflected the intended meanings of questions.

After the translation process was completed, a pilot test was conducted to test the internal validity of the Chinese version of the questionnaire.

5.6.4.3 Pilot test of the questionnaire instrument

Internal validity in relation to questionnaire refers to the ability of the questionnaire to measure what it claims to measure (Saunders et al., 2007:366). Findings derived from a valid questionnaire should represent the reality of what the researcher is measuring (Saunders et al., 2007:366). In order to improve internal validity, questionnaires are often pilot tested prior to be used for collecting data (Robson, 2002). A pilot test of the questionnaire involves a group of stakeholders that are similar to the prospective respondents to fill in the questionnaire and provide feedback to the researcher, who may then revise and refine the questionnaire accordingly (Bryman, 2004). It thus helps to identify and tackle any possible uncertainties and ambiguities in the questionnaire in order to ensure that respondents will have no problems in understanding and answering the questions and thus will be more likely to provide valid and reliable responses (Saunders et al., 2007:366-377).

In order to improve internal validity of the instrument, a pilot test was performed in this project before the questionnaire survey was conducted. Because the Chinese version of the questionnaire was the one that was to be sent to the prospective respondents, this version rather than the English one was used and assessed in the pilot test. Each participant of the pilot test was required to complete the Chinese version of the

questionnaire, and then answer the following five questions which were developed based on the guidance provided by Bell (2005):

- Whether the layout, structure and instruction of the questionnaire were clear and appropriate;
- Which, if any, questions were unclear or ambiguous;
- Which, if any, questions the respondent felt uneasy to answer;
- How long the questionnaire took to complete;
- Any other comments.

The pilot test conducted in this study contained two stages.

The first stage of the pilot test involved eight Chinese postgraduate students and researchers in the author's department. After the pilot test, a few ambiguous phrases and sentences in the questionnaire were identified by the students. After asking for suggestions from these students and discussing them with other Chinese colleagues, a number of corrections to the questionnaire were made. These students also reported that questions were relatively difficult to understand and they had to spend around 20-25 minutes to complete the questionnaire. This however, as pointed out by the students, may be attributed to a lack of practical experience on specific barrier and risk items measured in the questionnaire.

After the first stage, the questionnaire was sent to the general manager and the IT manager of an SOE, which was operating in the special equipment manufacturing sector in Guangdong, for further testing. No further ambiguity or uncertainty about the questionnaire was identified by these managers. Both Chinese managers provided positive feedback regarding the layout, structure and questions of the questionnaire. They also found the level of difficulty of the questionnaire questions was acceptable and that they spent around 10 minutes on completing the questionnaire. The researcher finally reviewed the questionnaires completed by these two managers, and identified that their answers were of high quality. The researcher therefore concluded the pilot test and started conducting the questionnaire survey.

After the pilot test was finished and the final version of the questionnaire was obtained, a web-based questionnaire with the same layout, structure and content as the paper-

based version was developed and stored on a web server. The URL to access to the web-based questionnaire was embedded in the paper-based questionnaire, and thus providing an alternative way for prospective respondents to complete and return the questionnaire. As discussed in section 5.6.2, the combination of the use of both paper-based and web-based questionnaire can often help to increase the response rate.

5.6.5 Questionnaire administration

After the questionnaire instrument was developed and pilot tested, the questionnaire survey was carried out across the 118 target SOEs. This section describes and discusses how the questionnaire survey of this study was administered.

5.6.5.1 Retrieving an accurate contact list

The first task of the researcher was to obtain a contact list of the 118 SOEs. However, retrieving a contact list for these SOEs was not as straightforward as initially thought. This figure of 118 companies was found in the Guangdong Statistical Yearbook Online (http://www.gdstats.gov.cn/tjnj/ml_e.htm). This site only provides the actual number, not a list of companies and respective contacts.

Although a number of Chinese company directory databases were identified (e.g. China Yellowpages Online, China Telecom Yellow Pages, etc), none of them actually provided a complete contact list for the selected companies. This situation confirms the difficulties reported by Roy et al (2001), that information contained in business and telephone directories in China are often inaccurate and incomplete. After some despair and further investigation, the researcher concluded that the GSB is currently the only possible source of a complete and accurate list for the 118 SOEs. However, in the first attempt by telephone, staff in the GSB refused to provide such a list to the researcher. This should not have been a surprise, since as stated by Manion (1994), local authorities in China typically have few incentives to co-operate and are reluctant to allow access to official materials. Fortunately, an internal officer of the GSB was contacted by using family relationship (a very common stratagem in China). With the help of this internal contact, the researcher eventually retrieved the needed company list from GSB. From this anecdotal evidence, it is clear that personal relationships or "*guanxi*" are critical to the success of research in China. As discussed in the PEST analysis, *guanxi* is defined

as the special personal relationships/connections between two persons (e.g. friends, superiors and subordinates, business partners, etc), with one needing something and another having the ability to offer it (Su et al, 2003). People in China are connected by extensive *guanxi* networks, which are used to exchange favours and reciprocally share resources (Su et al, 2003). This has been a prevalent social custom in China in all areas of life; in family, as well as in dealing with political authorities, social institutions and business people (Steidlmeier, 1999). This phenomenon is widely acknowledged and personal *guanxi* is "seen as a prerequisite for most information and business exchanges" (Björkman and Kock, 1995).

5.6.5.2 Delivering the questionnaire

After a completed company list with accurate postal addresses was retrieved, the questionnaire was disseminated to the 118 SOEs by post. As explained in section 5.6.4.1, operation managers and IT managers were prospective respondents of the questionnaire. Therefore, the designed questionnaires were posted to these managers with a cover letter (appendix 1) as well as a pre-paid return envelope. The aim of the cover letter, as proposed by Hoinville and Jowell (1977), was to explain the purpose of the questionnaire survey, provide assurances about confidentiality, stress importance of the study and encourage recipients to reply. The URL of the web-based questionnaire was also embedded in the cover letter. The respondents could either complete the questionnaire and return it by using the pre-paid envelope or fill in the web-based version and submit it online.

In addition, it was recognised that the mail system in mainland China is relatively slow (Roy et al., 2001). In particular, it took at least 5 working days for the questionnaire to be posted from one city to another city in the Guangdong province. In other words, it would take at least 2 weeks for the questionnaire to be returned to the researcher even if the respondents completed and sent back the questionnaire immediately after receiving it. Considering this condition, a reminder was sent out one month after, meaning that 2 extra weeks were given to the respondents to complete the questionnaire. The reminder contained the original questionnaires as well as a follow-up letter which reminded the respondents that a response was expected.

5.6.5.3 Getting sufficient and earnest responses

Getting sufficient and earnest responses was the most significant challenge experienced in this survey research. One month after the original questionnaire a reminder was sent out. Two months after this reminder only three replies were returned and one of these replies was inadequately completed (i.e. most questions were left blank and a big 'DON'T KNOW' was written by hand over many of the remaining questions).

It is apparent that the researcher of this survey is not the only one who experienced this research difficulty in China. Apart from the argumentation made above from the literature review, concerning the use of social networks (*guanxi*) in research, the researcher sought advices through conversation with a Professor in the Management School in the Sun Yat-sen University in China. This professor revealed that there is a prevalent impression that Chinese managers would rarely fill in a questionnaire for someone who they did not know or did not have a relationship with. This may be attributed to a lack of understanding on the scholarly objectives of research, but also to a pragmatic unwillingness to be disrupted (Manion, 1994). Additionally, it was confirmed that it may stem from a lack of trust and the fear that any sensitive answers provided might be used as evidence to threaten their career in the future under the centrally controlled bureaucratic environment, as also put forward by Roy et al (2001). In fact, as discussed above and confirmed by authors such as Alon (2006:215), "the process of doing research in China is different from the process followed in the West, and reveals some of the intricacies of doing business there". In particular, practical experiences of many researchers (e.g. Gamble, 2003; Alon, 2006:215) show that, one may never successfully conduct a research in China by using routine data collection process without building and utilizing local personal *guanxi* networks.

Consequently and facing the failure of routine survey procedures, the researcher sought to use his own personal *guanxi* and relationships in order to get access to and gain trust from the prospective respondents, and thus increase the response rate, as well as ensure that the data obtained was of better quality and more earnest. Specifically, the researcher requested his family and friends in China to use their personal *guanxi* networks to seek internal contacts in as many selected SOEs as possible. When an internal contact of a particular SOE was found, he/she was asked to forward the questionnaire to appropriate managers in the company to fill it in. With such efforts, the

researcher successfully obtained valid and usable responses from a total of 42 out of 118 companies, which represents a relatively high response rate of 35.6%.

Practical experience gained from this survey research echoed that personal *guanxi* network was an essential tool to ensure success in collecting research data in China under the current circumstances in the country. Researchers who do not possess an extensive *guanxi* network in China will certainly be at a disadvantage and may experience substantial difficulty in data collection when doing research (questionnaire survey in particular) there.

The use of personal *guanxi* to get access to companies in China may be associates with a set of ethical problems, as well as advantages and disadvantages. The use of this type of social network may seem questionable and even abusive by Western standards. It could be argued that the sample obtained is neither random nor self-selected. Ultimately, it could be argued that the respondents may be put under pressure to respond, by the very *guanxi* network that was used to reach them, and that such pressure may influence responses. However, the choices that had to be made were between no responses or understand the business environment and play by its rules.

From the result of this survey study, it was apparent that this approach helped increase the response rate substantially and thus increase the external validity of the respondent sample. Since most respondents of the survey were contacted through personal *guanxi*, it was possible for the researcher to trace back to the respondents for any questions that were not answered properly. The respondents also seemed to fill in the questionnaire patiently and earnestly because all returned questionnaires were fully completed and the answers provided were of high quality. The major disadvantage of this approach was that, although the researcher attempted to use personal relationships to approach as many firms as possible, it was of course impossible to reach all of the 118 SOEs through the use of personal contacts. This was the reason why it was thought necessary and important to perform the routine data collection process first in order to ensure that each SOE had the opportunity and possibility to participate in the study. Also, due to its inherent deficiency, personal *guanxi* network should only be seen as a supplement tool to use for increasing the response rate rather than seeing it as the primary approach for collecting research data in China.

Due to its controversial nature, the issues presented and discussed in this section were actually also presented for discussion in the 7th European Conference on Research Methodology for Business and Management Studies (ECRM) in London (Peng and Nunes, 2008a).

5.7 Data analysis for the questionnaire survey

The questionnaires were sent to the operation managers and the IT managers of the 118 SOEs, from which 42 SOEs (2*42 = 84 respondents) completed and returned the questionnaire. The questionnaire data were then analysed by using the statistical software called SPSS (Statistical Package for the Social Science). Data analysis of the questionnaire comprised four components, namely descriptive analysis of respondents, univariate analysis of the barrier items, univariate analysis of the risk items, and bivariate analysis of correlations between barriers and risks. These components are discussed in the below sections.

In addition, factor analysis was also considered to be used in this study. However, the exploratory nature of this survey implied that each item measured in the questionnaire referred to an independent and specific aspect. Because these items/variables were independent from each other, it was impossible to group them into several common factors, which are the fundamental and prerequisite required to carry out factor analysis (Bryman and Cramer, 2005:326; Field, 2005:619-680). Due to this reason, factor analysis was not applicable in this study.

5.7.1 Descriptive and univariate analysis

Descriptive analysis of respondents aimed to provide a descriptive summary on respondents and their companies, e.g. number of respondents, job positions of respondents, number and percentage of respondent companies that used ERP, type of ERP vendor, etc.

Univariate analysis of the barrier items refers to the descriptive analysis of the 25 ERP barrier examined in the questionnaire. Frequency table was used to present to which degree respondents agreed or disagreed with each barrier item. Additionally, the mean was used to summarise the distribution of values for each barrier variable. The mean

consists of adding the value of the variable for each case and dividing the sum by the number of cases (de Vaus, 2002:220). It is often considered the most efficient method for summarising a distribution of values (Bryman and Cramer, 2005:101). Therefore, in order to provide a summary of responses regarding the 25 barrier statements, the means of the 25 barrier variables were calculated. The standard deviation was then used to reflect the degree to which the values of each barrier variable differed from the mean (Bryman and Cramer, 2005:105). Subsequently, the researcher prioritised the 25 barrier variables based on their means, as presented in chapter seven.

Univariate analysis of the risk items refers to the descriptive analysis of the ERP risk events examined in the questionnaire survey. For each risk event, four variables were generated, namely one nominal variable (i.e. whether this event could be perceived as an ERP risk) and three ordinal variables (i.e. its probability of occurrence, its level of impact, and its frequency of occurrence). As such, a total of 160 variables were generated for the 40 ERP risk events. Frequency table or mean was used to summarise the values for each of these variables. Moreover, the researcher also attempted to prioritise the identified ERP risks according to their importance. The importance of each ERP risk event was assessed by its risk score, which took into account its probability of occurrence, impact and frequency of occurrence. More specifically, the following formula was developed and used to calculate the risk score for each risk event:

$$\textit{Risk score of each ERP risk} = \Sigma\,[W^{*}(\textit{Probability} + \textit{Impact} + \textit{Frequency})]$$

Based on this formula, the calculation of the risk score for each identified risk event should go through the following 3 steps:

Step 1 *(Probability + Impact + Frequency)*: sum up the values given by each respondent for the three independent dimensions of this risk event, namely probability of occurrence (i.e. 3, 2 or 1), level of impact (i.e. 3, 2 or 1) and frequency of occurrence (i.e. 5 to 1).

Step 2 *W*(Probability + Impact + Frequency)*: 'W' refers to whether or not the respondent perceived the risk event as an ERP risk, with '1' stands for 'yes' and '0' means 'no'. In case that the respondent did not perceive the given risk event as an ERP risk, the formula will turn the value generated from step 1

into 0: W*(Probability + Impact + Frequency) = 0*(Probability + Impact + Frequency) = 0.

Step 1 and 2 thus generate the individual score that each respondent gave for a specific risk event.

Step 3 *Σ [W*(Probability + Impact + Frequency)]*: sum up the individual score that each of the 42 respondents of the survey gave for a particular risk event, and thus generate the total risk score received by this event.

Consequently, by using this formula, the researcher calculated the risk scores for all of the 40 identified risk events. Subsequently, the 40 ERP risk events were prioritised based on their risk scores, as presented in chapter seven.

5.7.2 Bivariate analysis

As discussed in section 5.6.3, this survey study aimed at also exploring the correlations between the identified ERP barriers and risks. In particular, it aimed at investigating:

- If the existence of a particular ERP barrier in the firm was related to the existence of other barriers;
- If the occurrence of particular risks was related to the occurrence of other risks;
- If the occurrence of particular ERP risks was related to the existence of particular ERP barriers.

In order to explore potential correlations between the identified ERP risks, a bivariate analysis was conducted. A bivariate analysis is a statistical technique that aims at identifying the correlation between two variables. Specifically, it aims to examine when scores of one variable change, whether scores of the other variable would change in the same or directly opposite way (Field, 2005:108-109). Measures of bivariate correlation indicate both the strength (i.e. 0 to 1) and the direction (i.e. positive or negative) of the relationship between a pair of variables (Bryman and Cramer, 2005:213).

Correlations can be measured by using different statistical techniques, e.g. Pearson's correlation, Spearman's rho and Kendall's tau. According to Field (2005:130-131) and Bryman and Cramer (2005:225), as compared to the other techniques, Spearman's rho (r_s) is a more common and appropriate approach to use to measure correlations of

ordinal variables. Because the barrier and risk variables of this study were ordinal data sets, Spearman's rho was adopted for this study.

In addition, correlations identified by using statistical techniques must be further tested for statistical significance (i.e. P value) in order to ensure that the correlation is not come up by sampling error and has external validity (Bryman and Cramer, 2005:225). Statistical significance of correlations can be examined by using either one-tailed or two-tailed test. Only a correlation that gains a P value of .05 or less from the test can be accepted as statistically significant (Field, 2005:31). As pointed by Field (2005:29), one-tailed test should be used if the correlation that we are examining is directional (e.g. the higher the education level, the higher the income level), while two-tailed test should be used if the correlation that is examining is non-directional (e.g. higher education level will affect income level, but we do not know whether the income level will increase or decrease). Because the correlations of the barriers and risks were directional (e.g. when a barrier is more likely to exist in the company, the probability of occurrence of a risk is higher), one-tailed test was selected to use in this study.

By following this approach, the researcher explored a comprehensive set of statistically significant relationships between the identified ERP barriers and risks, as presented and discussed in chapter seven.

5.7.3 Validity and reliability of the survey

Internal validity in relation to questionnaire surveys refers to the questionnaire's ability to measure what it claims to measure (Saunders et al., 2007:366). Specifically, answers derived from a valid question in the survey should represent the reality of what the researcher is investigating (Saunders et al., 2007:366). In order to ensure that all questions in the survey have high level of validity and enable that valuable and accurate responses are collected, the questionnaire instruments used in this study were developed, translated and pilot tested, as discussed intensively in section 5.6.4.

On the other hand, the Cronbach's alpha test was considered to test reliability or internal consistency of the responses. Reliability or internal consistency measures the consistency of responses across all the questions or a subset of the questions of the questionnaire (Saunders et al., 2003:310). It "is particularly important in connection

with *multi-item scales*. It raises the question of whether each scale is measuring a single idea and hence whether the items that make up the scale are internally consistent" (Bryman and Cramer, 2005:77). The Cronbach's alpha is the most frequently used statistical test to examine internal consistency (Field, 2005:667). If the alpha value is higher than 0.7, it can be concluded that the items that make up the scale have high level of internal consistency (Bryman and Cramer, 2005). However, the exploratory nature of this survey implied that each item in the questionnaire referred to an independent and specific factor. Because a large amount of factors were covered in this survey, each factor was measured by a single item rather than multiple items. The nature of Cronbach's alpha (Bryman and Cramer, 2005:77) determines that, when a survey does not involve the use of multiple items to measure any single concepts, it is impossible to perform the Cronbach's alpha test to examine the internal consistency of the responses. Due to this reason, the Cronbach's alpha was not applicable in this survey research. Also due to the same reason, factor analysis was not appropriate for this survey study, as discussed above. Nevertheless the researcher believed that the data collected from the survey had high reliability, because respondents of the survey seemed to fill in the questionnaire patiently and earnestly and all returned questionnaires were fully completed and the answers provided were of high quality.

5.8 Data collection for the case study research

After the questionnaire survey was concluded, an exploratory case study research was conducted at the second stage of the mixed-method design of this project in order to verify and further explore the findings derived from the survey research. This section presents and discusses the procedures and issues associated with data collection of the case study research of this project.

5.8.1 Selection of data collection method for the case study research

Multiple data collection methods may be used for a case study. However, considering that this case study component was a supplementary study to triangulate with the questionnaire findings, and also due to time and resource constraints of this project, the researcher decided to adopt a single data collection method rather than multiple methods for this qualitative study.

In a multi-methods case study, documents are commonly used as a supplementary source to corroborate the findings derived from other data collection methods (Yin, 2003:87; Robson, 2002:352). Because this case study was not a multi-methods study and more importantly it was perceived that Chinese managers would always be reluctant to give internal documents to external members, documentary information was not collected and used in this case.

On the other hand, according to Yin (2003), a case study research can always be flexibly designed in relation to the nature of the research question. All data collection methods (i.e. questionnaire, observation, and interview) discussed in section 5.5 may be used for a case study (Yin, 2003).

A questionnaire here however was rejected immediately, because the purpose for conducting a case study research was, at this stage, to explore qualitative human insights and to verify and supplement the primary questionnaire findings, rather than seeking further quantitative evidence.

The applicability of the observation method was then considered. As argued by Robson (2002:309-310) the purpose for doing observations is to seek understanding on human actions and behaviour by directly watching what people do and listening to what they say. However the purpose for doing a case study research here was not to understand human actions or behaviour, but to explore human perceptions and views on related ERP post-implementation issues. In addition it was perceived that, barriers and risks for ERP post-implementation may exist hidden in the business context, and thus may not be observed directly and easily. Due to these reasons, observation was considered as an unsuitable data collection method for this case study.

Subsequently, the suitability of structured interview and unstructured interview was analysed. Structured interviews are similar to questionnaires and can only be used to generate quantitative findings rather than in-depth and qualitative evidence, and thus could not suit the needs of this exploratory case study. Unstructured interviews are open conversations of which the direction may be changed unpredictably as the conversation flows. Due to this reason, unstructured interviews were inappropriate to be used to seek further clarification and explanation for a set of precise issues that were predefined after the analysis of the survey data.

In fact, as compared to all above data collection methods, semi-structured interview presents itself to be the most applicable and desirable approach for this case study. As discussed in section 5.5.2, semi-structured interviews are carried out based on a list of predefined questions and thus follow clear and specific directions. This feature would allow the researcher to focus on a set of issues identified from the survey during the interview. On the other hand, because interviewers can probe beyond answers and extend the predetermined questions flexibly in semi-structured interviews, it offers researchers the opportunity to gather in-depth insights from the interviewee to fully explore the phenomena studied. Based on these considerations, semi-structured interview was selected as the ideal data collection method for the case study.

In addition, all semi-structured interviews were conducted face-to-face rather than over the telephone. It was considered that, doing interviews face to face could lead to a number of advantages. In particular, it would enable the researcher to observe any non-verbal behaviours (e.g. facial expressions, body language) of the interviewees to fully explore and understand their views. This is one important aspect of communication in China. It would also help to increase the interviewee's trust in the researcher, and thus leading to more earnest and meaningful responses.

5.8.2 Purpose for doing follow-up interviews in the case study

The main purpose to conduct a set of follow-up interviews in the case study was to verify and further explore the findings derived from the questionnaire survey. Therefore, a list of ERP issues to be covered and explored in the semi-structured interviews was identified based on the questionnaire findings. The reasons for selecting these areas to be further explored are discussed and justified in chapter seven, and thus are not presented in detail here. Nevertheless, in general, the researcher identified and selected from the questionnaire findings the following areas to be verified and further explored in the interviews:

- All of the 25 identified ERP barriers;
- 24 shortlisted ERP risks (i.e. the top 15 risks, and another 9 risks that were found to have correlations with other ERP barriers and risks);

- As well as the 35 correlations identified (i.e. 17 correlations between barriers, 10 correlations between risks, and 8 correlations between barriers and risks).

As a consequence, the follow-up case study aimed at:

- Verifying the above ERP barriers and risks selected based on the questionnaire findings;
- Further exploring the causes and consequences of these barriers and risks;
- Further exploring the correlations identified between ERP barriers and risks;
- Exploring other possible ERP post-implementation barriers and risks that may be important to SOEs.

5.8.3 Identification of the case companies and interviewees

At the end of the questionnaire, respondents were asked whether or not they would like to participate in the case study stage to further discuss ERP-related barriers and risks in their companies. From these volunteer companies, two SOEs, which had completed the questionnaire, were identified to participate in the follow-up case study.

Additionally, it was considered that IT managers play a crucial role in ERP exploitation. Their perceptions and opinions on related ERP post-implementation issues were perceived to be highly valuable and meaningful to this study. IT managers of the case companies were hence selected to be interviewed. Moreover, CEOs or General Managers in Chinese SOEs hold very strong power in the firm. Their views and decisions can certainly affect the use and exploitation of ERP systems. CEOs of the case companies were thus also selected to be interviewed. In fact, for the two selected case companies, their IT managers and CEOs were also respondents to the questionnaire survey. Therefore, the purpose for interviewing them was also to seek further explanation on their answers provided in the survey. On the other hand, departmental managers and staff, who are key users of the ERP system, were also selected to be interviewed. In addition, as discussed in section 6.4.1, the researcher selected three business areas for studying operational and analytical risks of ERP, namely sales and marketing area, financial and accounting area, and purchasing and production area. Therefore, departmental managers and system users selected to be interviewed were all from one of these three business divisions.

Consequently, a set of semi-structured interviews was carried out with the CEOs, IT managers, and departmental managers and system users in diverse departments (i.e. sales, financial, production, and purchasing department) of the two case companies.

5.8.4 Design of interview instruments

An interview instrument is a list of themes and questions to be covered in the interview (Saunders et al., 2003:246). It helps the researcher to focus on the key issues and themes that are intended to be explored when doing interviews (Yates, 2004:163).

When designing the interview instrument, the first task of the researcher is to identify a possible range of themes to be covered (Yates, 2004:163). As mentioned above, a list of ERP issues to be covered and explored in the semi-structured interviews in the case study was identified and selected based on the questionnaire findings. As a consequence, these ERP areas and issues were used as the basis to construct the interview instruments (as specified in appendix 4).

On the other hand, in order to explore these identified areas efficiently, the designed instruments consisted of four types of questions, namely initiating questions, follow-up questions, trigger questions, and closed questions:

- Initiating questions are open questions that are related with the predefined categories and issues and are used to direct the conversation (Yates, 2004:165). This type of question is used to open up a topic and is designed to encourage the interviewee to provide an extensive and developmental answer to reveal and describe attitudes, facts or events (Yates, 2004:166; Saunders et al., 2003:262).
- The initiating questions were often followed by a set of follow-up questions, which aim at encouraging the interviewees to "expand on their initial responses and to develop points without changing topic or asking a new initiating question" (Yates, 2004:167).
- In addition, a set of trigger questions were also included in the instruments. Very often, interviewees may not be able to think of and give a proper and efficient response for a particular question. Trigger questions were used in this

situation in order to stimulate discussion and trigger interviewee's thinking (Anderson, 1990). Additionally, when conducting interviews, interviewees may sometimes unconsciously or consciously talk about something that may not be relevant to the topics being interested. In this situation, follow-up questions and trigger questions should be used to refocus the conversation and bring interviewees back to the topic.

- Closed questions are used to obtain specific information or to confirm a fact or opinion by restricting the interviewee to answer only yes or no (Saunders et al., 2003:263).

Consequently, four different interview scripts were developed in order to collect human insights respectively from the CEOs, IT managers, departmental managers and system users of the case companies. These four instruments had similar layout and structure, and each of these covered a specific set of ERP issues that were deemed to be relevant to the type of interviewee concerned. All ERP areas and issues listed above were covered in these four instruments. A brief description of these instruments is given below.

(a) Interview instrument for IT managers

The interview instrument for IT managers (appendix 8) focused on a number of organisational barriers, system barriers, organisation-wide risks and technical risks. A set of initiating question were designed to encourage the IT manager to talk freely about their perceptions on these barriers and risks. The initiating questions were followed by a set of follow-up and trigger questions in order to explore the manager's opinions on the causes and impacts of these factors/events. Closed questions were used where appropriate to check the researcher's understanding on the IT manager's responses.

(b) Interview instrument for CEOs

Diverse organisational barriers and organisation-wide risks were contained in the interview instrument for CEOs (appendix 6). Initiating questions were developed to explore CEO's perceptions on these barriers and risks from a senior management perspective. The instrument also contained a set of follow-up, trigger and closed

questions that were used to explore the causes and impacts of the barriers and risks concerned.

(c) Interview instrument for departmental managers

The interview instrument for departmental managers (appendix 7) covered a set of cultural barriers, organisational barriers, operational risks, and analytical risks. The researcher developed and used a variety of questions to explore the opinions of departmental managers on these ERP barriers and risks from the perspective of their own functional divisions.

(d) Interview instrument for system users

Interview instrument for system users (appendix 9) focused on a number of organisational barriers, system barriers, operational risks, analytical risks, organisation-wide risks, and system risks. The instrument consisted of a set of initiating, follow-up, trigger and closed questions that were used for the same purposes as those of the other three instruments.

Moreover, all interview instruments were originally developed in English and then translated to Chinese. The Chinese version of the interview instruments was one that being used in the interviews. Because any ambiguities that interviewees might have during the interview could be explained and clarified by the interviewer, the issue for translating interview instruments was not as significant as that of the questionnaire instruments. Due to this reason, the translation issue of interview instrument is not further discussed here, although the researcher would stress that careful attention was paid to translate the interview instruments and ensure each question of the instrument reflected its intended meaning.

5.8.5 Interview administration

The case study research was conducted in China in March 2008. The two case studies with the selected SOEs were carried out sequentially rather than simultaneously in order to avoid mixing up the data derived from different cases.

Before each case study started, the CEOs of both case companies wee contacted and been requested to arrange suitable staff (i.e. IT manager, departmental managers and users) to get involved in this case study. An introduction letter (appendix 5) was developed to explain briefly the purposes of the study, length of the interview, themes to be covered, how the collected data would be used, and confidentiality of the interview data. 20 copies of this letter were given to the CEO of each company, who was requested to pass this letter to selected interviewees before the interview day. It was perceived that this introduction letter would help to increase the interviewee's trust in the researcher, and thus may enable the interview to be carried out more smoothly.

Each interview was carried out at the workplace of the interviewee and lasted for 40 minutes to 1 hour. The interviews with the IT manager and the departmental managers of the case company were carried out first, and were followed by the interviews conducted with system users of the company in order to triangulate with the responses given by the managers. After all these interviews, the researcher was able to develop a sound knowledge on the company's current ERP usage status, and thus was ready to discuss related ERP issues with the CEO at a strategic level. Subsequently, the interview with the CEO of the firm was conducted. In addition, a maximum of three interviews were carried out per day in order to allow the researcher to have sufficient time to re-organise and make initial analysis on the data collected to identify new questions to be covered in the following interviews.

When opening the interview, the researcher firstly thanked the interviewee for taking part in the study, and then restated the purposes of the research and current progress, and more importantly reassured that confidentiality of responses and data collected would always be protected through the anonymisation of both interviewees and their firms.

The interview was conducted by following the established interview instruments and was recorded by using digital recorder with the permission of the interviewee. Additionally, it should be noted that, the flexible nature of semi-structured interview format adopted allowed that the researcher could modify the interview instruments to focus on particular areas of interest of the different managers interviewed and also to modify (and even exclude) questions that are found to be unproductive for the goals of the research in previous interviews. As a consequence, when the interview was in progress, the researcher may have omitted or added some questions and change the

orders of questions depending on the flow of the conversation in order to fully explore the views of the interviewee.

On the other hand, many experienced researchers (e.g. Robson, 2002; Saunders et al., 2003:260) suggest that a full record of the interview should be compiled as soon as possible after it has taken place. Otherwise, "the exact nature of explanations provided may be lost [...and therefore may] lead to an issue about the trustworthiness of [...the collected] data" (Saunders et al., 2003:260). Due to this reason, the researcher had spent 4-5 hours in average on transcribing each digital and verbal record derived from the interview into a written transcription, soon (usually within two days) after the interview had been taken place. The transcription of each interview was also emailed to the associated interviewee to read through. This activity would help the researcher to test his understanding on the responses provided by the interviewee and thus allowed removal of bias or incomplete interpretation. Moreover, it provided an opportunity for interviewees to add any further points (Saunders et al., 2003:260).

By following these procedures, the researcher conducted a total of 25 semi-structured interviews with the CEOs, IT managers, departmental managers and system users of the two case companies. In April 2008, the researcher completed the multi-case study and came back to the UK with all interview transcriptions that were ready for analysis.

5.9 Data analysis for the case study research

5.9.1 Analysis of interview data

The data collected from the 25 semi-structured interviews was analysed using a thematic analysis approach with a priori coding. Thematic analysis is "a method for identifying, analysing and reporting patterns (themes) within data" (Braun and Clarke, 2006). It is the process that involves the identification of themes through "careful reading and re-reading of the data" (Rice and Ezzy, 1999:258). This data-driven inductive approach however can also often be used together with a deductive priori coding, as proposed by Fereday and Muir-Cochrane (2006). As further explained by Fereday and Muir-Cochrane, this approach "complemented the research questions by allowing the tenets of social phenomenology to be integral to the process of deductive thematic analysis while allowing for themes to emerge direct from the data using

inductive coding". By following the principles given by Braun and Clarke (2006), the thematic analysis conducted in this study consisted of five stages:

Stage	Description of the process
1. Getting familiar with the data	Getting known the data through the process of transcription, reading and re-reading the data.
2. Coding the data	Developing the coding scheme by using priori codes and codes emerged from data, coding the textual data in a systematic fashion across the entire data set by using NVivo.
3. Connecting codes and identifying themes	Collating codes into potential themes, gathering all data relevant to each potential theme.
4. Reviewing themes and developing concept maps	Checking if the themes work in relation to the coded quotes and the entire data set, generating concept maps of the analysis.
5. Reporting findings	Final analysis of selected quotes, relating back of the analysis to the research question, questionnaire findings & literature, producing a chapter of findings.

Table 5.2: The five stages for doing thematic analysis
(modified from Braun and Clarke, 2006).

Stage 1: Getting familiar with the data

The process of transcription "while it may seen time-consuming, frustrating, and at times boring, can be an excellent way to start familiarizing yourself with the data" (Riessman, 1993). In particular, Braun and Clarke (2006) reinforce that "the time spent in transcription is not wasted, as it informs the early stages of analysis, and you will develop a far more thorough understanding of your data through having transcribed it". As a consequence, the researcher was able to develop a sound knowledge on the collected data through the process of transcription. Moreover, before conducting the actual data analysis, the researcher had read and re-read the full set of interview transcriptions in order to generate a more thorough and in-depth understanding about the data collected. Furthermore, any ideas for coding emerged at this stage were noted down in the memo.

Stage 2: Coding the data

After generating a thorough understanding on the data collected, the researcher began the second stage of the thematic analysis, which involved the generation of codes and then attaching the textual data into relevant codes (Braun and Clarke, 2006). A code is a label that refers to "the most basic segment, or element, of the raw data or information

that can be assessed in a meaningful way regarding the phenomenon" (Boyatzis, 1998:63). A "good code" is one that captures the qualitative richness of the phenomenon (Boyatzis, 1998:1).

Allan (2003) suggests that researchers should avoid coding by microanalysis of the data, word-by-word and line-by-line, which is not just time-consuming but may also lead to confusion at times. In order to avoid coding every single sentence in the original text, Attride-Stirling (2001) reinforces that the codes developed should be limited in scope and focus explicitly on the object of analysis (e.g. the established barrier and risk ontologies in this study). As a consequence, the identification of codes in this study focused particularly on texts related to ERP barriers and risks, as well as their causes and consequences, which were the main topics being studied in the interviews. The 25 barriers and 24 risks covered in the interview instruments immediately presented to be a set of priori codes to be used in this process. Additionally, the researcher also aimed at exploring extra codes that were related with new ERP barriers and risks, which had not been identified at the previous stages of this project but emerged from the interview data. The data were revisited many times looking and re-looking for emerging codes. Some identified codes might have been deleted, merged or split, as appropriate. Consequently, an initial coding scheme was established to highlight all codes identified (appendix 10). In addition, the codes in the coding scheme "should have quite explicit boundaries (definitions), so that they are not interchangeable or redundant" (Attride-Stirling, 2001), and therefore can allow constant comparison to take place. Due to these reasons, each code identified in the coding scheme was given an explicit definition, as shown in appendix 10.

Meanwhile, by working systematically through the entire data set, relevant pieces of the textual data were extracted and attached into the codes identified in the coding scheme. Each data extract might be uncoded, coded once, or coded many times, as relevant. In addition, NVivo, a data management program, was used to store all interview transcriptions, as well as to conduct the coding process.

Stage 3: Connecting codes and identifying themes

The third stage of the thematic analysis begins "when all data have been initially coded and collated, and you have a long list of the different codes that you have identified

across the data set" (Braun and Clarke, 2006). As specified by Braun and Clarke, this stage, "which re-focuses the analysis at the broader level of themes, rather than codes, involves sorting the different codes into potential themes, and collating all the relevant coded data extracts within the identified themes". A theme is a cluster of lined categories and codes that form a pattern or unit (Holloway, 1997:152).

By reading and re-reading the identified codes and the coded texts, two main themes were identified by the researcher, namely ERP barrier and ERP risk. In addition, the main theme of ERP barrier contained three sub-themes, namely cultural barrier, organisational barrier and system barrier. On the other hand, the main theme of ERP risk also involved four sub-themes, namely operational risk, analytical risk, organisation-wide risk and technical risk. It is obvious that, these sub-themes of ERP barrier and risk are actually priori themes that were identified in the theoretical barrier and risk ontology presented in chapter six. Subsequently, all identified codes and coded data extracts were sorted into relevant themes and sub-themes by using NVivo. Additionally, when a code is concerned with an ERP barrier/risk, it was linked with other codes that referred to as a cause or consequence of this barrier/risk, as exemplified in Figure 5.2.

The initial coding scheme was reorganised into the final coding scheme (appendix 11) to highlight the hierarchical structure between the main themes, sub-themes and codes, as well as, to highlight the cross-relationships between the identified codes. The entire data set was revisited in order to identify any new quotes or data extracts that could be added to the identified codes by using the final coding scheme.

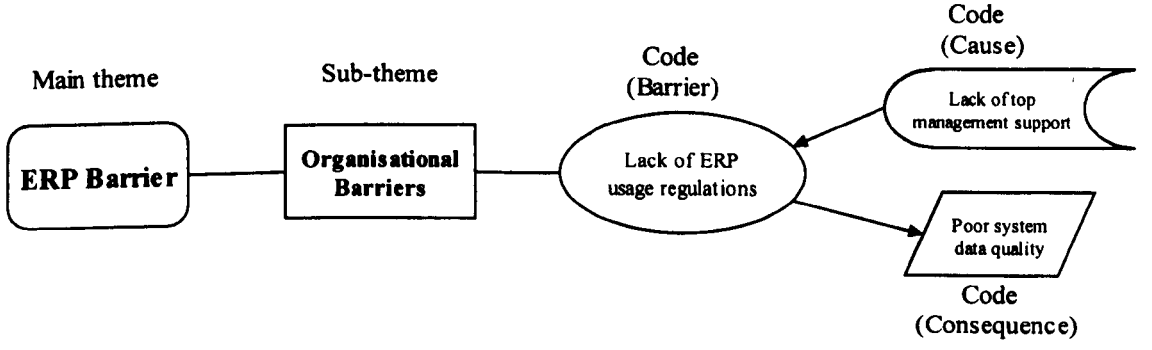


Figure 5.2: Linkage of main theme, sub-theme and codes

Stage 4: Reviewing themes and developing concept maps

Stage 3 ended "with a collection of candidate themes, and sub-themes, and all extracts of data that have been coded in relation to them" (Braun and Clarke, 2006). The fourth stage of the thematic analysis aimed at "checking if the identified themes work in relation to the coded data extracts and the entire data set" (Braun and Clarke, 2006). This stage contained three steps.

Firstly, the researcher reviewed all the codes and the coded texts for each main theme and sub-theme, and examined "whether they appear to form a coherent pattern" (Braun and Clarke, 2006). This process resulted in a number of changes to the codes and data extracts related with each identified theme.

Secondly, the researcher drew a set of concept maps to represent the identified themes. These maps were used, "as they are useful exploratory tools and an efficient method to share, discuss and represent qualitative data" (Nunes et al, 2004). Two concept maps were initially considered to develop for the two identified main themes, i.e. ERP barrier and ERP risk. It was however recognised that, each of these two main themes contained a large amount of codes, and thus could not be clearly represented in a single concept map. Therefore, instead of creating a holistic but over-complicated diagram, the researcher established seven concept maps, of which each covered one sub-theme of ERP barrier and risk (i.e. cultural barrier, organisational barrier, system barrier, operational risk, analytical risk, organisation-wide risk and technical risk), as presented in appendix 12. An example of these concept maps is given in Figure 5.3 to illustrate the complexity of the findings and the richness of the interview responses.

Finally, the researcher revisited the entire data set to examine the trustworthiness of the identified themes in relation to the data set, as well as to check whether the established concept maps 'accurately' reflected the meanings evident in the data set as a whole (Braun and Clarke, 2006). This process resulted in a number of revisions to the developed concept maps.

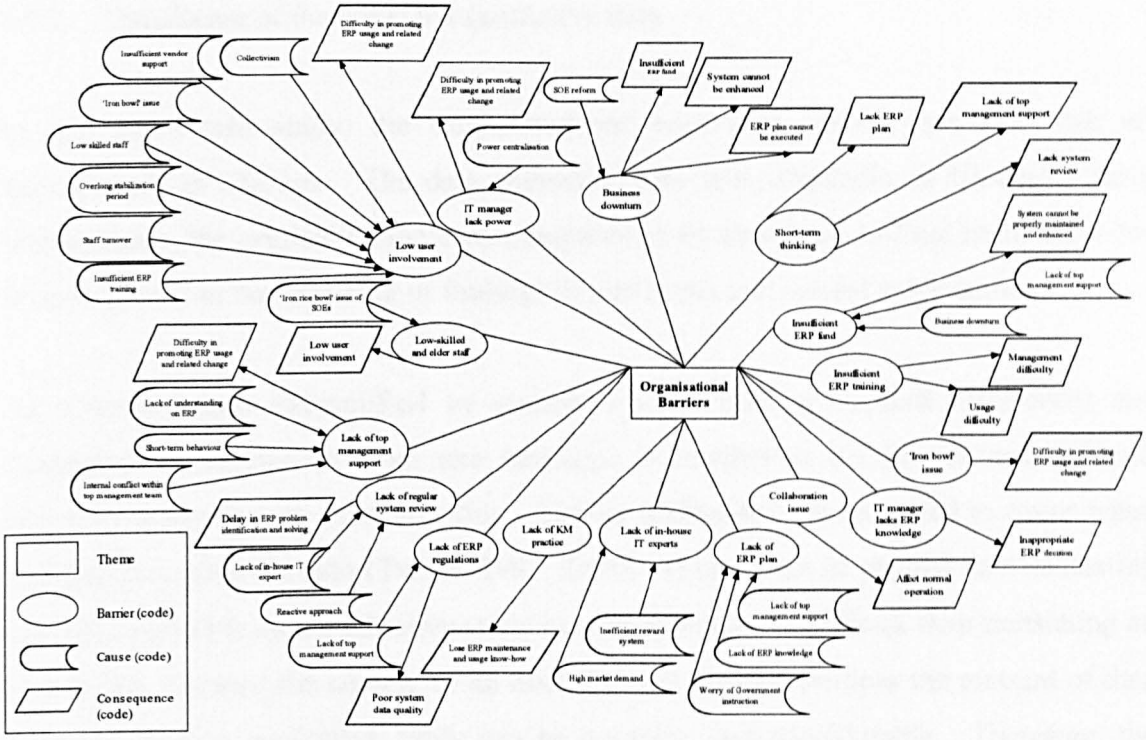


Figure 5.3: Concept map for the theme of organisational barrier

Stage 5: Reporting findings

The findings of the multi-case study were reported in chapter eight, by using the seven established concept maps as the infrastructure, and relevant quotes from the interviews as anecdotal evidence to support the argumentation. As highlighted by (Braun and Clarke, 2006), the process of reporting the findings was also the process of final analysis of selected quotes, relating back of the analysis to the research question, questionnaire findings and literature. This proved to be particularly valid for this study, as final decisions regarding which quotes to be used were only made in the process of reporting. Moreover, the researcher also linked the interview outcomes with findings of the questionnaire and the literature reviewed when reporting the results in chapter eight.

Overall, the interview data was analysed by using the rigorous approach of thematic analysis with a priori coding. Nevertheless, as all interviews were conducted in Chinese with managers in China, there was a need to translate the qualitative data collected from Chinese into English in order for it to be used in the reporting of findings in this thesis. This translation issue is addressed in the next section.

5.9.2 Translation of the collected qualitative data

In this multi-case study, the semi-structured interviews were conducted with all interviewees in Chinese. The data collected were thus originally in Chinese. As a consequence, the original Chinese data required to be translated to English in order for it to be quoted in the reporting of findings in this thesis and related publications.

As discussed and exemplified in section 5.6.4.2, due to cultural differences the translation of instrument from one language to another is a complex and difficult process which requires extra attention. Similar difficulties are expected to occur when translating qualitative data (Twinn, 1997, 2000). It can even be argued that translating the data derived from a qualitative study may be much more difficult than translating an instrument, because the content of an instrument is limited whereas the amount of data collected from a qualitative study can be complex and considerable. Therefore, the translation of qualitative data should be treated carefully and earnestly (Twinn, 1997; Temple and Young, 2004).

The first temptation of the researcher was to translate the full set of interview transcriptions from Chinese to English prior to data analysis. This however soon proved to be undesirable. In particular, Twinn (1997) argues that translating the full set of interview transcriptions can certainly be extremely time-consuming. More importantly, Twinn goes on to claim that the meaning underlying the original qualitative data may often be lost after such translation. In truth, by analysing the work presented by Twinn (1997) and Temple and Young (2004), the researcher identified a set of risk events that would often occur when translating interview transcriptions:

- The researcher may not be able to find appropriate and equivalent words and terms in the target language to represent the data in the original language. In particular, finding appropriate English words to capture the meaning of the Chinese data has been reported as a continuing problem in the qualitative studies conducted by Twinn (1997; 2000).
- As discussed in section 5.6.4.2, if the translation is done properly, conceptual equivalence rather than literal equivalence should be achieved. Different terms and words can be used in the translation as far as the meaning of the translated text is conceptually equivalent to the original one. This however may lead to a

significant risk that may affect the development of codes and categories in qualitative data analysis. As exemplified in the study of Twinn (1997), the three translators involved in the study came up with three different interpretations for the same piece of Chinese original data. These three interpretations had similar meanings but also involved the use of significantly different phrasings. Twinn (1997) argues that different codes and categories may be derived from these different interpretations.

- If subjective interpretations and explanations of the translator are added and used in the translation, the original meaning of the qualitative data collected from the interviewees may often be changed after the translation process.

The direct impact that may result from the occurrence of the above risk events is that, the original meaning of the data in the transcription may be relatively changed or lost after the translation, and therefore impacting the development of codes and themes from the data and also affecting the quality of data analysis (Twinn, 1997). As a consequence, in order to minimise the impact of these risks, the researcher decided not to translate the full set of transcriptions prior to data analysis. Instead, the researcher carried out the entire data analysis based on the original Chinese data. After the process of data analysis was completed, in other words, after all codes and themes were identified and all relevant pieces of the textual data were coded, the selected quotes were translated into English in order to be presented in the thesis. It was deemed that this approach could help to minimise errors and misrepresentations that might occur during the process of translation, and thus raise the quality of data analysis and enhance the trustworthiness of findings.

5.9.3 Validity and reliability of the case study

As argued by Lincoln and Guba (1985:290), the question of the trustworthiness of a piece of qualitative research must be addressed, in order to persuade audiences that the findings of an inquiry are meaningful and valuable. Lincoln and Guba suggest four key areas that should be considered when examining trustworthiness of a piece of qualitative research:

- Credibility (also referred to as Internal validity);
- Transferability (also referred to as External validity);

- Dependability (also referred to as Reliability);
- Confirmability (also referred to as Objectivity).

Among these areas, transferability refers to whether or not the findings can be generalised to other contexts. However, since the purpose for doing the follow-up case study in this project was not to produce generalisable findings, the issue of transferability was not particularly considered in this study. Consequently, the other three key areas, which can affect the trustworthiness of this case study, were considered and addressed:

- *Credibility* requires that researchers concern themselves with the accuracy of description in a piece of qualitative research, and ensure that the findings derived from the analysis are clearly relevant to the specifics of the field. The establishment of the credibility of findings "entails both ensuring that research is carried out according to the canons of good practices and submitting research findings to the members of the social world who were studied for confirmation that the investigator has correctly understood that social world" (Bryman, 2004:275). In order to ensure high credibility of findings, the data collected was rigorously and systematically analyzed by using the approach of thematic analysis as discussed in section 5.9.1. Moreover, the data collected were originally in Chinese, and thus were required to translate into English. In order to ensure the credibility of findings would not have been affected by inappropriate translation, the researcher carried out the entire data analysis based on the original Chinese data collected. After the process of data analysis was completed, the selected quotes were translated into English in order to be presented in the thesis. It was felt that this approach could help to minimise errors and misrepresentations that might occur during the process of translation, and thus enhance the credibility of findings.

- *Dependability* relates to both the research methods used and the analysis of the data. It "entails ensuring that complete records are kept of all phases of the research process, e.g. problem formulation, selection of research participants, fieldwork notes, interview transcripts, data analysis decisions, and so on, in an accessible manner" (Bryman, 2004:275). So that peers and audiences would act as auditors to establish how far proper procedures are being and have been followed (Bryman, 2004:275). It is evident that, complete records of all phases and processes of this case study

have been kept, as reported and discussed intensively in section 5.8 and 5.9. It should be stressed that these processes had been followed strictly and consistently during the case study, in order to ensure high reliability of the findings generated. In truth, by making use of the same set of interview transcripts in all of the 25 semi-structured interviews, it was deemed that a reasonably high degree of consistency and reliability should have been achieved.

- *Confirmability* is concerned with the issue that, during qualitative data collection and analysis, bias may creep in as a researcher consciously or unconsciously imposes his or her own interpretations on the data (Lincoln and Guba, 1985:292; Bryman, 2004:276). In order to reduce potential researcher bias in this study, written transcriptions of interviews had been sent to related respondents to read through, as discussed in section 5.8.5. A number of corrections to written transcriptions were made based on the feedbacks of respondents.

5.10 Research design of this project

So far, this chapter has discussed and explained the research methodology in terms of research strategies and data collection methods selected and used for this project. In conjunction with the literature review and the PEST analysis completed at the earlier stages of this study, the research design adopted for this project was presented as a rigorous approach to enable the researcher to achieve theory building, testing and extension, in answering the research questions. Figure 6.4 highlights all components/stages contained in this research design.

As shown in Figure 5.4, the research design of this project consists of seven components/stages.

Stage 1: Identifying research questions. The first stage of this research was to identify a clear and reasonable research question. A set of sub-questions, the research aims and objectives were also identified at this stage.

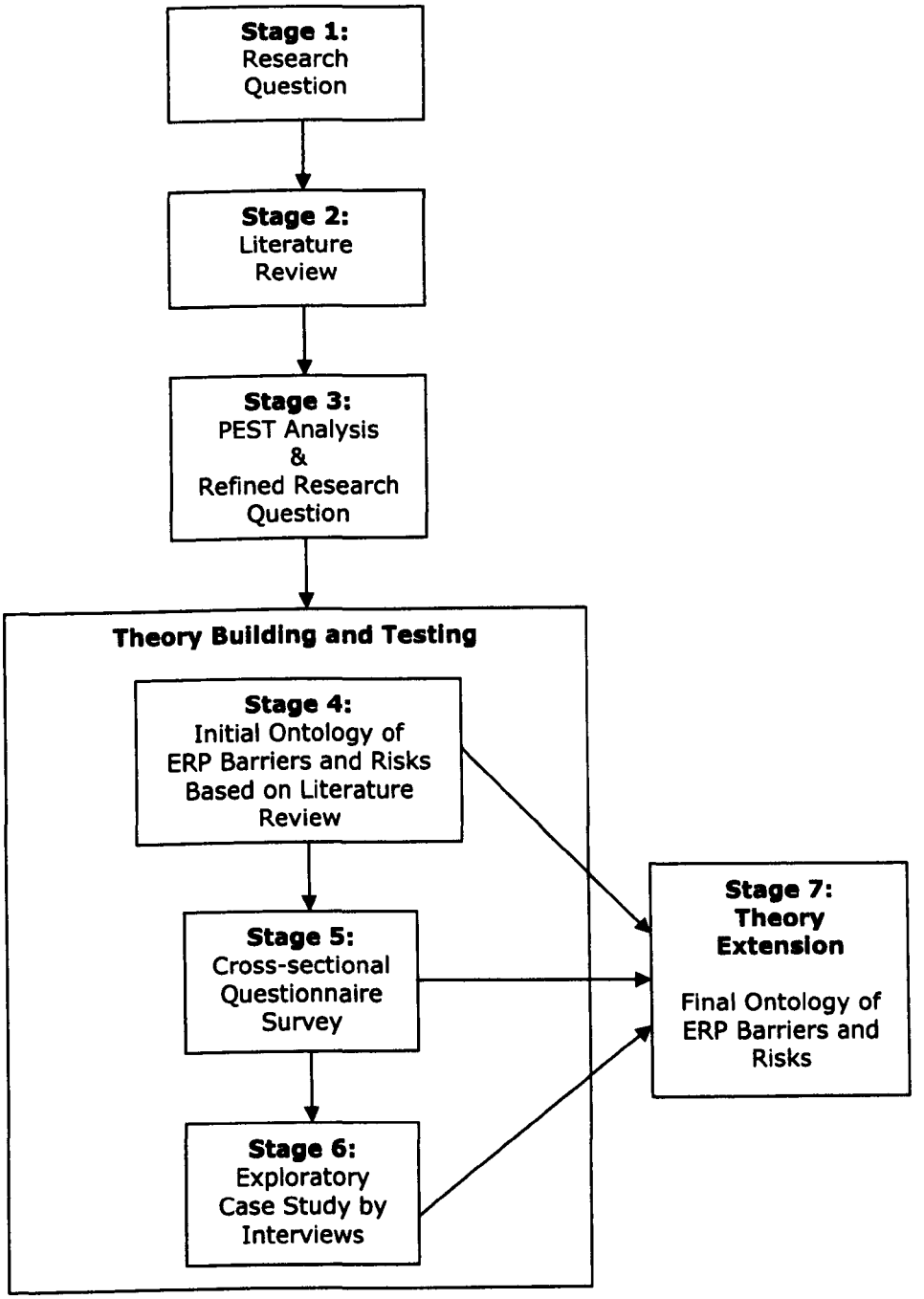


Figure 5.4: Research design of this research project

Stage 2: Literature review. The literature review aimed to generate sufficient background knowledge on the research subject by reviewing previous IS/ERP studies and clarifying the concept, development history, functionality, benefits and issues of information systems in general and ERP system in particular.

Stage 3: PEST analysis. In order to generate a profound understanding on the unique Chinese context, and refine and focus the research context by selecting a geographical region, an industrial sector and a type of company in China to base the study on, a PEST analysis was conducted at the third stage of this research. The researcher reviewed and

synthesised large amount of English and Chinese articles (including journal articles, books, official statistical reports, market research reports, news and online articles) and then used these literature as raw materials to construct arguments and standpoints for this analysis. The PEST analysis was considered an important analytical part where theory building of this project started. As concluded from the PEST analysis, SOEs in the electronic and telecommunication manufacturing industry in the Guangdong province in China were selected to study. Moreover, as the research context had been narrowed from all companies in China to a specific and feasible set of Chinese SOEs, the initial research question was refined to reflect this change of research context, as mentioned in chapter one.

Stage 4, 5 and 6 are the main stages for building and testing theories in the context of selected Chinese SOEs.

Stage 4: Building the initial ontology of ERP post-implementation barriers and risks. At the fifth stage, the researcher carried out a systematic review which focused on IS and business studies, theoretical papers and case studies. Through this systematic review, the researcher aimed at establishing an explicit IS lens to frame the study and guide the data collection process. As a result of the systematic review, a total of 29 ERP barriers and 40 ERP risks were identified. A barrier and risk ontology was then established to highlight the identified ERP barriers and risks. This barrier and risk ontology served as the theoretical basis for constructing the questionnaire survey at the next stage. Nevertheless, it was considered that the 4 external barriers contained in the ontology were sensitive topics under China's bureaucratic environment. Consequently, these 4 external barriers were not further studied in the survey. In other words, 25 out of 29 identified ERP barriers were involved in the questionnaire survey.

Stage 5: Cross-sectional questionnaire survey. The questionnaire survey, which was the first data collection phase, was the sixth stage of the entire project, and aimed to examine the suitability of the theoretical ontology in the context of selected Chinese SOEs. Specifically, the questionnaire survey aimed to:

- Explore whether, and to which extent, each of the 25 predefined ERP barriers exist in SOEs;

- Identify which of the 40 predefined risk events would be perceived by respondents as risks for ERP exploitation, as well as, to assess the importance of each identified risk according to its likelihood, impact and frequency of occurrence;
- Explore the most crucial ERP barriers and risks to SOEs;
- Explore the correlations between the barriers and risks identified.

Stage 6: Exploratory case study. After the data collected from the survey was analysed, a multi-case study composed by a set of semi-structured interviews was carried out to further explore and validate a set of findings derived from the questionnaire findings. In particular, the follow-up case study aimed at:

- Verifying a set of ERP barriers and risks identified and selected based on the questionnaire findings;
- Further exploring the causes and consequences of these barriers and risks;
- Further exploring correlations between the identified ERP barriers and risks;
- Exploring other possible ERP post-implementation barriers and risks that may be important to SOEs.

Stage 7: Theory extension. At the final stage of this research, the findings derived from the multi-case study were compared, triangulated and synthesised with the findings from the questionnaire survey and the literature reviewed, and therefore extended the theories built in previous stages of this project. In addition, the initial ERP barrier and risk ontology derived from the literature review was revised after the comparison and synthesis of the quantitative and qualitative findings.

5.11 Conclusion

In order to answer the research questions, a rigorous research design was adopted for this project. At the early stage of this study, a PEST analysis was conducted to focus the research context from the entire China to SOEs in the electronic and telecommunication manufacturing sector in Guangdong in China. Specific research strategies and data collection methods were selected in this chapter with the aim to collect a comprehensive set of data from the selected Chinese SOEs. After analysing and evaluating the applicability of various potential research strategies, the researcher selected the mixed-methods strategy to be used for this project. This mixed-method

strategy, which was based on a QUAN and *qual* design, consisted of two components, namely a quantitative survey at the first stage and an exploratory qualitative case study at the second stage. The quantitative survey aimed at the production of generalisable statements on barriers and risks that Chinese SOEs may encounter in ERP exploitation. The follow-up case study aimed at further clarifying and exploring the findings derived from the survey research. In addition, after further analysis, comparison and selection, questionnaire was used as the data collection method for the survey research, and semi-structured interview was adopted as the data collection method for the case study research. In conclusion, the use of a mixed-methods strategy in this project enabled triangulation to take place and was considered as an adequate and feasible approach to produce comprehensive, meaningful and significant findings and to answer the established research questions.

The next chapter presents and discusses the ERP barrier and risk ontology, which was used as IS lens to guide the data collection process. Subsequently, the findings derived from this study are presented and discussed in chapter seven, eight and nine. In particular, chapter seven focuses on findings derived from the questionnaire survey. Chapter eight reports the case study findings. An overall discussion of the most crucial outcomes derived from this study is given in chapter nine.

Chapter Six: Initial Identification of ERP Post-Adoption Barriers and risks

6.1 Introduction

In line with the overall deductive approach taken, before conducting the questionnaire survey in the selected Chinese SOEs, there was a need for the researcher to establish explicit IS lens to frame the study in order to generate meaningful and significant findings (as discussed in chapter five). Consequently, a critical literature review, which focused on IS and business research studies, case studies and theoretical papers, was conducted by the researcher. As a result of this critical literature review, the researcher established 29 ERP barriers and 40 ERP risks that Chinese companies might encounter in ERP exploitation. These 29 ERP barriers consisted of 7 Cultural Barriers, 9 Organisational Barriers, 4 External Barriers and 9 System Barriers. On the other hand, the 40 identified risks contained 9 Operational Risks, 8 Analytical Risks, 16 Organisation-Wide Risks and 7 Technical Risks.

These ERP barriers and risks are presented and discussed extensively in this chapter. Subsequently, a barrier ontology and a risk ontology were developed to highlight these identified ERP barriers and risks. These ontologies were then used as the theoretical basis for constructing the questionnaire survey of this project.

6.2 Barriers to ERP post-implementation

6.2.1 The concept of barrier

As discussed in chapter one, the concept of barrier is defined differently in the literature. For the purpose of this research, a barrier to ERP exploitation is defined as:

> "Any obstacle or factor that is inherent to the Chinese context or the ERP system itself; and can prevent companies from efficiently using, maintaining and improving the implemented system."

Due to the size and complexity of an ERP system, identification of barrier in ERP post-implementation may be a very complicated task. Nevertheless, it clearly emerged from

the PEST analysis that due to cultural characteristics, Chinese companies may often face diverse difficulties when using ERP systems, which are originally developed based on western culture and management philosophy. Therefore, when identifying barriers to ERP post-implementation in Chinese companies, the researcher firstly focused on potential cultural barriers that are associated with the unique Chinese culture. On the other hand, as pointed out by Polikoff et al. (2005), barriers to organisational activities may often exist within the internal and external business context. As a result, the researcher secondly looked at organisational barriers and external barriers, which are respectively inherent to the internal and external business context of Chinese firms. Finally, it was considered that, due to technical limitations and pitfalls related to the ERP system itself, a set of system barriers may also exist. Consequently, the researcher focused on four main areas for identification of ERP exploitation barriers, namely cultural barriers, organisational barriers, external barriers, and system barriers.

Through the process of a systematic review, the researcher identified and established a total of 29 ERP post-implementation barriers. Each of these barriers is presented and discussed extensively below.

6.2.2 Cultural barriers

As discussed in the PEST analysis, the unique Chinese culture shapes the ways that Chinese people conduct organisational and business activities, and thus influencing the implementation and use of IS/ERP in Chinese companies. 7 potential barriers, which are associated with the unique Chinese culture and may affect ERP post-implementation in Chinese companies, were identified and discussed below:

- High context and implicit form of communication;
- Unwilling to disclose problems, faults and failures due to preservation of 'face';
- Power centralisation and centralised decision-making due to high power distance;
- Chinese employees do not use their critical thinking skills;
- Less inclined to use systematic procedures and explicit information to tailor (e.g. sales and production) forecasts and plans;
- Trust personal common sense rather than system data to make decisions;
- Building inter-organisational relationships based on personal *guanxi*;

High context and implicit form of communication

As discussed in the PEST analysis, westerners tend to use low context forms of communications which enable them to directly convey meaning of a message into explicit and elaborate codes (e.g. words and numbers) and therefore facilitate the use of MIS in western companies (Martinsons and Westwood, 1997). In contrast, due to cultural specific traits, Chinese people tend to use high context and implicit forms of communications.

> "*Chinese messages are comparatively terse in words but rich in meaning. Subtle cues are used to enrich the explicit content. Audible clues, such as tone, dynamics and any hesitation in response, together with facial expressions and body language must be perceived and interpreted in order to fully understand the words being communicated*" (Martinsons and Westwood, 1997).

Therefore, Martinsons and Westwood (1997) argue that high context forms of communications make use of MIS in Chinese organisations both difficult and undesirable. More importantly, know-how and expertise developed in the ERP implementation and post-implementation stage may not be shared efficiently under high context forms of communications, and therefore can be lost if related specialists leave the company. As a result, IT staff that remained in the company may not have sufficient skills and expertise to enable continuous ERP improvement in the company in the long-term.

Unwilling to disclose problems, faults and failures due to preservation of 'face'

Mianzi (also called 'face' or personal image) defines a person's place in his social network and is the most important measure of social worth in the Chinese society (Graham and Lam, 2004:48).

> "*In Chinese business culture, a person's reputation and social standing rest on saving face [...] Sources of face can be wealth, intelligence, attractiveness, skills, position, and, of course, good guanxi [...] Face, like money, can be earned, lost, given, or taken away.* " (Graham and Lam, 2004:48-49)

Case studies provided by Shu (2001) show that, in order to maintain good reputation and social standing, Chinese people, as an individual, as a group or as an organisation,

tend to save face in any sense. As a result, Chinese people are traditionally less willing to disclose problems, faults and failures to the other people (e.g. colleagues, superiors and subordinates) or bodies (e.g. other departments, and business partners), which they considered will result in loss of face (Graham and Lam, 2004:48). They may hope that, if they do not disclose their faults or failures to the others, no one will recognise them.

Such cultural behaviour can hide potential system operation and maintenance problems which otherwise can be avoided or solved proactively in an early stage. Shu (2001) points out that lapses in operation and maintenance may often be revealed only when something goes seriously wrong in Chinese companies. In addition, in order to save face, system users may be less inclined to seek help when encountering system related problems/difficulties. This attitude may result in inefficient communication between users and IS staff, increase difficulty for IS staff to tailor suitable training scheme to help less-skilled users, and eventually lead to reduction of user satisfaction. In addition, if the company, as a whole, is unwilling to disclose internal problems to external bodies, it can reduce the chances for Chinese companies to receive suitable help and advice from system vendors and service consultants.

Power centralisation and centralised decision-making due to high power distance

As discussed in the PEST analysis, high power distance is one of the Chinese cultural features identified in Hofstede's study (1997). Power centralisation and centralised decision-making are direct results of high power distance, and have been identified as characteristics of Chinese firms for a long time (Martinsons and Westwood, 1997).

In most Chinese companies, the power within the company is centrally held by a few people. Power centralization enables leaders of Chinese companies to make centralised decisions. As pointed out by Martinsons and Westwood (1997), Martinsons and Hempel (1998) and Shu (2001:30), most important decisions of Chinese companies are made in private by a few people, normally the top managers. Martinsons and Westwood (1997) further state that, Chinese leaders may symbolically consult their subordinates but will rarely let them make a meaningful contribution to the decision-making process.

As stated by Reimers (2002), power centralisation and centralized decision-making enables senior management to unilaterally change some parameters of the ERP project and increases the possibility for making mistakes. Without collecting and considering alternative ideas from a wider group of people, it may be difficult for top managers to identify potential problems and risks related to their decisions. More importantly, top managers may not have as much know-how on the ERP system as the IS specialists in the company. Consequently, top managers may make inappropriate decisions regarding system maintenance and enhancement in the ERP post-implementation stage.

Chinese employees do not use their critical thinking skills

As a consequence of power centralisation, staff in Chinese companies traditionally tend to follow the directives of their superiors rather than to critically question the suitability of decisions made for them (Martinsons and Hempel, 1998). Most Chinese workers, including many with considerable expertise and experience, are comparatively content to receive explicit instructions from their bosses, and are uncomfortable with the delegation of discretionary decisions and reluctant to assume the risks associated with independently initiated actions (Martinsons and Hempel, 1998). Pei (2005) reinforces that, Chinese employees generally accept works as assignments from their managers without knowing or thinking the reasons of doing so. In other words, Chinese employees are generally less inclined to use their critical thinking skills.

In the ERP post-implementation stage, in-house IT staff and related specialists must continuously review and analyse the ERP system and utilise their expertise and experience to tailor the most suitable action plans for incremental ERP revision and enhancement in order to satisfy new requirements raised by the rapidly changing business context. Due to insufficient use of critical thinking skills, Chinese staff may not be able or willing to carry out these activities efficiently and continuously.

Less inclined to use systematic procedures and explicit information to tailor forecasts and plans

As discussed in the PEST analysis, low uncertainty avoidance is another feature of the Chinese culture as identified by Hofstede (1997), and results that Chinese people are more tolerant of uncertainty and unclear information, and tend to accept situations as

they are rather than to predict and control the situations (Martinsons and Westwood, 1997). Thus, Chinese managers are less inclined to use systematic procedures and explicit information to tailor business plans and forecasts to predict the uncertain future (Martinsons and Westwood, 1997; Martinsons and Hempel, 1998; Xue et al., 2005). Martinsons and Westwood (1997) further point out that the IT investments in Chinese companies typically aim to automate, control and monitor the company's basic operations rather than to improve business planning and decision making.

Since a major purpose for using ERP is to collect comprehensive sets of data to support business planning and decision making and thus increase operational and management efficiency, it can be argued that Chinese managers will not be able to fully utilise such data and thus underutilise the full power of their ERP systems.

Trust personal common sense/intuition rather than system data to make decisions

Instead of conducting a rational analysis of data related to a specific problem, Chinese managers are often inclined to make decisions based on subjective experience, common sense and intuition (Martinsons and Westwood, 1997; Zhang et al., 2005). Reimers (2002) points out that managers in Chinese companies do not trust neither data provided nor the suggestions made by their ERP systems, and tend to modify the (e.g. production and purchasing) quantities recommended by the system based on their own experiences. Lack of trust in the system can reduce utilisation of the ERP system and therefore reduce return of the ERP investment. In addition, making decisions based on subjective experience and common sense may lead to serious human mistakes, especially when the business context is complicated.

Building inter-organisational relationships based on personal guanxi

Trust is a critical factor in the development and maintenance of inter-organisational relationships on which knowledge sharing depends (Pardo et al., 2006). However, it is widely recognised that the level of trust between people in China depends mainly on their personal *guanxi* or relationship. As discussed in the PEST analysis, *guanxi* in China is the most important personal social asset (Fan, 2002). Individuals spend most of their time on building and maintaining their *guanxi* networks, especially with superiors, governmental officers or business partners, and utilise such personal assets in

finding solutions for business problems and acquiring additional resources for their companies (Fan, 2002; Martinsons and Hempel, 1998; Lowe, 2003:12).

As a consequence, the inter-organisational relationship between a Chinese company and a business partner may often be established based on personal *guanxi* networks of leaders from both sides. Nevertheless, because *guanxi* is a personal social asset that only belongs to a particular person rather than to the company, if the person working in either side of the partnership leaves the company, an inter-organisational relationship that is set up based on his/her personal *guanxi* network may also come to the end. Therefore, such type of inter-organisational relationship may be highly unstable.

In the ERP post-implementation stage, the company should set up long-term and stable relationships with its system vendor and service consultants, who can therefore develop a rich understanding on the company's IS development and usage history. Dealing with a new system vendor or service consultant, which the company has never been working with, can always cause unnecessary hazards, conflicts and collaboration difficulties. Therefore, if Chinese companies establish inter-organisational relationships with system vendors or consultants based on personal *guanxi* networks of company leaders, the firm may face significant potential problems in the ERP post-implementation stage.

6.2.3 Organisational barriers

Organisational barriers refer to obstacles within the internal context of companies. By analysing the organisational context of Chinese companies, as well as reviewing the organisational barriers existing in western companies, 9 potential organisational barriers to ERP post-implementation in Chinese companies are identified, as discussed below:

- Inefficient collaboration and communication between functional departments;
- Fear of loss of power and loss of job;
- Short-term behaviour of companies;
- Lack of explicit IS development plan and strategy;
- Lack of top management support;
- Insufficient ERP post-implementation funds and resources;
- Lack of in-house specialists;
- Low involvement of employees;

- Low-skilled and ill-trained staff.

Inefficient collaboration and communication between functional departments

Chinese employees often consider information as a major personal asset, which is rarely broadcasted or made accessible to a large audience or across the whole organisation (Martinsons and Hempel, 1998; Martinsons and Westwood, 1997). On the other hand, relationships, trust and loyalties between people in Chinese companies are mainly vertical in direction under the hierarchical organisational structure (Shu, 2001). Due to these two reasons, Chinese companies typically face problems of horizontal collaboration and communication between different departments (Shu, 2001).

Therefore, lack of collaboration and communication between functional departments is identified as a barrier to successful introduction of ISs in western companies (Beatty and Gordon, 1988; Fletcher and Wright, 1995), but it seems to be a particular barrier to ERP post-implementation in Chinese organisations. Due to inefficient collaboration and communication between different working groups and departments, Chinese companies may find it difficult to form an efficient cross-functional team to conduct system review and tailor action plans to further improve the ERP system. In addition, data and process integration driven by ERP systems requires staff and managers in different departments to develop superior co-operative relationships and work closely with each other (Scapens and Jazayeri, 2003). As discussed in the case study of Scapens and Jazayeri (2003), when system users in different departments are less inclined to generate efficient collaboration and communication with each other, it can result in significant reduction in operational efficiency when using ERP systems.

Fear of loss of power and loss of job

Information may often be considered as a key indicator of power within an organisation (Damodaran and Olphert, 2000). Beatty and Gordon (1988), as quoted by Fletcher and Wright (1995), thus state that users may be afraid of losing power when ISs are used to facilitate information sharing across the firm. It can be argued that this issue may be particularly relevant to Chinese companies, where most important information is traditionally kept by the leaders and the amount of information that employees can receive reflect the degree to which they are trusted by their superiors (Martinsons and Westwood, 1997). On the other hand, ISs, especially ERP, can automate dozens of

traditional manual processes and thus can often result in job substitution. Therefore, Martinsons and Westwood (1997) point out that wide-spread IT usage does not serve the general interests of either Chinese managers or workers, because managers in China may worry that an MIS will reduce their discretionary power while workers may fear that labour substitution by IT will leave them without a job. Therefore, fear of loss of power and loss of job are expected to be key barriers to system acceptance and usage in Chinese companies.

Short-term behaviour of companies

Top managers of modern western companies generally strive to pursue long-term objectives in order to enable their companies to achieve continuous success. In contrast, face with the highly dynamic and rapidly changing market Chinese managers are typically driven by short-term behaviour ('短期行为' in Chinese) and aim to achieve short-term results (Yuan and Ma, 2005). In its simplest form, short-term behaviour can be defined as the phenomenon that companies act to achieve short-term benefits while neglecting the associated impacts and problems that might occur in the long-term (Liu, 2004). Short-term behaviour has been frequently reported (e.g. Yuan and Ma, 2005; Zhang, 2004) as a crucial barrier to survival and development of various types of domestic companies (e.g. private companies and SOEs) in China.

From the IS perspective, it can be argued that due to short-term thinking, Chinese leaders may not provide sufficient support to ERP exploitation and may overlook ERP risks and problems that the company may encounter in the long term. In addition, as discussed in chapter three, many benefits, which ERP systems promise to bring to the company, may not be able to achieved or become apparent in the short-term. If Chinese managers focus only on short-term achievements, they may neglect potential opportunities to maximise the utilisation and return of the installed ERP.

Lack of explicit ERP development plan and strategy

Deficient strategic planning (e.g. business planning, IS development panning) which may not reflect the reality was identified as a barrier to the use of IT in western companies (Rucks and Ginter, 1982; Wright and Donaldson, 2002). In China, lack of explicit development plan and strategy may be a direct consequence of short-term behaviour and seems to exist in various types of Chinese companies. For instance, Xie

(2005) states that Chinese SOEs typically spend little efforts on tailoring clear and detailed planning and development strategies. Thus, lack of explicit development planning and strategy is one of the most crucial factors obstructing the continuous development of SOEs (Jiang, 2003). On the other hand, Liang (2001) and Wu and Tian (2000) argue that lack of strategic planning is also a common issue in Chinese private companies.

From an IS perspective, having a clear IS/ERP development plan and integrating the IS plan into business strategy will be crucial to ERP success in both system implementation and post-implementation stage. It can be argued that, without explicit development planning and strategies, Chinese companies may encounter many problems and risks in the ERP post-implementation stage, e.g. no clear direction for further ERP improvement, IS development plan may conflict with business strategy, ERP system fails to support long-term business goals, etc.

Lack of top management support

Top management support is a crucial factor to enable success in the use of IT in any companies. Lack of top management support was thus considered as a key barrier to continuous IS success in both western and Chinese companies (Wright and Donaldson, 2002; Sherer and Alter, 2004; Tsai et al., 2005). Lack of support from top managers in the ERP post-implementation stage can result in low motivation of system users and in-house specialists and lack of involvement in continuous system review and improvement.

Insufficient ERP post-implementation funds and resources

Implementing, maintaining, upgrading and revising the ERP systems require large amount of funds and resources from companies (Loh and Koh, 2004). Without sufficient funds and resources, companies will not be able to carry out system maintenance, upgrade and improvement properly in the ERP post-implementation stage. Therefore, insufficient ERP funds and resources could be a fundamental barrier to ERP post-implementation.

Lack of in-house specialists

Western companies are keen to invest in human resource which they consider as the most valuable asset of the company (Reid and Adams, 2001). Despite this fact, lack of in-house specialists (especially in-house IT specialists) has still been reported as a problem in western companies (Wright and Donaldson, 2002). The situation in China is worse. Zhang (2004) states that, in order to make good use of its talent, Chinese companies must continuously invest in their people by providing them with various training opportunities. However, contemporary Chinese companies typically make insufficient investment in their human resources (Zhang, 2004). As a result, Chinese employees may not be able to receive sufficient on-the-job training and thus may not be able to become real experts in their own area. On the other hand, due to insufficient investment in human resource and inefficient management and reward system, employee turnover in Chinese firms is generally very high (Shu, 2006; Ni, 2006; Zhang, 2004; Jiang, 2003).

From an IS perspective, success of ERP implementation and post-implementation relies on the collaboration and cooperation of various types of in-house specialists, e.g. project leaders, IT experts, and specialists in different functional divisions. It can therefore be argued that, due to lack of in-house experts, Chinese companies may not be able to maintain, monitor and improve the ERP system efficiently in the long-term.

Low involvement of employees

When employees are less willing to accept the changes caused by ERPs, they may have lower involvement in the implementation and use of the system. Low involvement of employees has been mentioned as a barrier to system implementation and usage in western companies (Namjae and Kiho, 2003; Wright and Donaldson, 2002). It is therefore to be expected that due to the existence of the set of cultural and organisational barriers identified above, involvement of Chinese employees in ERP post-implementation may also be low. Low involvement of employees can result in many problems to ERP exploitation, e.g. less willing to attend further user training, indifference in system problems, and low incentives to get involved towards system improvement, etc.

Low-skilled and ill-trained staff

Low-skilled staff, who also often have low educational levels, may be less inclined to use computerised information systems (e.g. ERP) and can be less willing to change the current way that they do their job. This group of people must be carefully guided and trained during the cycle of ERP implementation. Otherwise, they may not be able to use the ERP system properly and thus lead to significant data errors and data quality issues in the system post-implementation stage. Low-skilled and ill-trained staff represent a crucial barrier to the use of ERP systems in modern companies (Wright and Donaldson, 2002; Sherer and Alter, 2004). This barrier is also expected to exist in many Chinese companies, where staff often have relatively low educational level, as identified and discussed in the PEST analysis.

6.2.4 External barriers

External barriers refer to obstacles caused by the external environment of companies. By analysing the national environment in China and reviewing previous IS literature, 4 external barriers to ERP post-implementation are identified as follow:

- Government direct intervention;
- Problematic legal system and increase of business and economic crimes;
- Regional inequality;
- Lack of accurate and reliable market statistical data.

Government direct intervention

In order to accelerate the process of SOE reform local government may often instruct profit-making SOEs to merge with or acquire smaller or loss-making SOEs (Cheung, 2005). However, government officials sometimes may make such merger or acquisition instructions based on political needs without considering the actual situation of the company (Cheung, 2005). These mergers and acquisitions are therefore often fraught with risks and problems and can even lead to collapse of the firm (Cheung, 2005). It can be argued that internal organisational changes caused by inappropriate and unpredictable government intervention can cause problems to the use of ERP. In the case of business merger and acquisition, the merged company may face problems and difficulties in reconfiguring existing IS applications (e.g. ERP) to suit new business

processes and user needs. Nevertheless, due to the feature of low system flexibility of ERP, such reconfiguration may not be easy and sometimes may not be possible. In addition, staff of the company may neither be well-prepared for these changes nor be willing to engage with the new working environment. This may lead to significant user resistance to ERP adoption and use.

Problematic legal system and increase of business and economic crimes

Although numerous laws and regulations have been enacted during the last thirty years (Ji, 2005), China's current legal system is still fraught with problems. As discussed in chapter four, "有法不依，执法不严" (literally, the laws are not being followed, the enforcement of laws is not strict) has been the major issue existing in the current Chinese legal system (Jiang, 2006). Imperfect legal system and continuous economic development in China have resulted in rapid increase in the number of business and economic crimes (e.g. bribes, embezzlements and corruptions) in recent years (Potter, 1999). It can thus be argued that this situation may significantly increase the probability of occurrence of information security and leakage risks in Chinese companies when using computerised ISs.

Regional inequality

As discussed in the PEST analysis, different regions in China currently manifest significant inequality, especially in terms of economic development and use of IT. In fact, it clearly emerged from the PEST analysis that in contrast with inland regions, coastal regions in China generally contain a much better environment for ERP adoption and use. Nevertheless, it is common knowledge that Chinese companies with considerable size may often establish branches in different regions across the country in order to capture more sales opportunities in the national market. Due to regional inequality, it can be argued that ERP implementation in branches located in diverse regions may result in different outcomes. In particular, it can be expected that ERP implementation in coastal regions may lead to many successful stories. In contrast, ERP implementation in many inland regions may be fraught with challenges, as people in these regions may not currently be ready for using advanced computer technologies, such as ERP. Consequently, regional inequality may be an external barrier that may prevent Chinese firms from successfully implementing ERP in all their sites.

Lack of accurate and reliable market statistical data

One of the purposes for companies to implement ERP systems is to improve sales forecast and thus have better ability to respond to customer demand fluctuations in a timely manner (Doshi and Campbell, 2003). On the other hand, market statistical data, which could be gathered from external authorities (e.g. industrial associations, national and local statistical bureau, and market research consultancies, etc), is a crucial input for ERP systems to generate accurate sales forecasts.

Companies in western countries may often retrieve useful and reliable market statistical information from the government or market research companies. In contrast, market statistical data, which is available in the industry in contemporary China, typically lacks accuracy, reliability and currency due to various reasons, e.g. inappropriate statistical standards and strict government control on information accessibility (Lv, 2006). Inaccurate and unreliable market statistical data thus raises significant forecasting issues to both foreign and domestic companies operating in China. For instance, the Foreign Vice President of a joint venture company in China blames that the publicly available market information that she could obtain was at least 2 years out of date and thus it is difficult for her to ascertain the true market size in China (Haley, 2003).

It can therefore be argued that, due to inaccurate and unreliable market statistical data, Chinese companies may not be able to use their ERP systems to generate accurate sales forecasts, which can result in problems for production planning and difficulties to respond to high fluctuation of customer demand under the current market condition.

6.2.5 System barriers

System barriers refer to any obstacles and factors that can prevent the implemented ERP system from meeting its intended functions and performance requirements. By reviewing prior IS and ERP literature, 9 system barriers are identified as follows:

- Insufficient supports and services from system vendors;
- Inexperienced system consultants;
- System inflexibility;
- System incompatibility;

- High cost for add-ons and further system development;
- Deficient design of the system;
- Slow system response time;
- Misfits between system functions and company requirements;
- Poor data quality.

Insufficient supports and services from system vendors

Insufficient supports and services from system vendors is a common barrier to the use of ISs in western companies (Wright and Donaldson, 2002). In China, both domestic ERP vendors (e.g. UFIDA, Kingdee and LangChao Genersoft) and foreign ERP vendors (e.g. SAP and Oracle) are crucial players in the Chinese ERP market. However, researchers (e.g. Liang et al. , 2004; Liang and Xue, 2004) argue that, foreign ERP vendors are less familiar with the unique Chinese context and organisational requirements in Chinese companies, while consultant teams of domestic ERP vendors typically do not possess as much expertise and experiences as their foreign rivals. As a consequence, Chinese companies may not always be able to receive sufficient support and services from their ERP vendors. As a result of insufficient supports and services from system vendors, in-house staff may find it more difficult to maintain and revise the ERP system efficiently in the post-implementation stage.

Inexperienced system consultants

The development history of the modern management consulting industry can be traced back to the 1870s from the United States (Ma et al., 2003). With more than 100 years of development, the consulting industry in western countries has become highly mature, and can provide professional consulting support and advice for a wide range of business activities, e.g. strategy development, business review, staff training, and IS implementation and revision, etc (Ma et al., 2003). System consultants from consulting firms thus play a crucial role to facilitate ERP success in western companies. However, despite most of the world's leading management consulting firms have entered to the Chinese market since the 1990s, China's management consulting industry which has 20 years of development history is still in its infant stage (Ma et al., 2003; AMT ERP Research Group, 2001). It is argued that, foreign consultants who are from western countries will often have less experience to deal with the unique issues of Chinese

companies, while domestic consultants who are fostered by either foreign or Chinese consulting firms in recent years still lack sufficient expertise and experience to provide critical advice to client companies (Ma et al., 2003; AMT ERP Research Group, 2001). As a consequence, Chinese companies may often not be able to receive sufficient support from their system consultants, which thus increasing difficulties for in-house staff to maintain and revise the ERP system in the post-implementation stage.

System inflexibility

ERP systems are standard IS packages, which are traditionally complicated and difficult to customise and modify. Thus, system inflexibility has been identified in many studies (e.g. Ernst, 1989; Namjae and Kiho, 2003) as a barrier to successful introduction of ERP in companies. Due to system inflexibility, it is often difficult for user companies to revise and enhance their implemented ERP systems. As a result, when system requirements of companies have changed over time, the implemented ERP system that used to work efficiently may gradually become less effective.

System incompatibility

System incompatibility is a key barrier preventing data sharing and exchanging between ISs (Beatty and Gordon, 1988; Fletcher and Wright, 1995). In the use of ERP, system incompatibility can exist between the ERP system and the other IS applications (e. g. CRM, SCM, and CAD) in the company. This barrier may even exist between diverse modules of the ERP, if some functional units of ERP are provided by different system vendors. System incompatibility is a crucial barrier to data exchange and integration across the company. It can result in inefficient information flows between ERP modules or between ERP system and other IS applications, and therefore reduce both system efficiency and user satisfaction.

High cost for add-ons and further system development

In order to have better system functionality and achieve better system performance, it is important for companies to install add-ons and make further enhancements on their ERP systems in the post-implementation stage. Because ERP systems are large, complicated and inflexible software packages, the cost for add-ons and further development of the

ERP system can be very high. When companies have to spend a large amount of budget on system maintenance, they may not be willing or unable to provide sufficient funds for ERP add-ons and enhancement. High cost is a barrier that prevents companies from installing add-ons and making further improvements on their ISs (Fletcher and Wright, 1995; Wright and Donaldson, 2002).

Misfits between system functions and company requirements

ISs that cannot meet user requirements will certainly have low value to system users. Although satisfying user requirements is a crucial target that all ERP implementation projects aim to achieve, the implemented ERP may not be able to meet all user needs due to system limitations or human mistakes occurred in the system implementation phase. In addition, when user requirements of companies are continuously changed under the highly dynamic market environment, the installed ERP that used to work well may not be able to fulfil new user needs occurred in system post-implementation. Misfits between system functions and company requirements can definitely be a significant barrier to acceptance and use of ERP in companies (Sherer and Alter, 2004).

Deficient design of the system

The world's leading ERP vendors (Sage, 2005) stress that the design of an ERP system should be rational and flexible enough in order to enable the system to handle any situation that may come up in its daily use (e.g. allow users to search and add inventory items while they are in the middle of creating a manufacturing order). Deficient design of the system is identified as a barrier to the use of ISs in companies (Damodaran and Olphert, 2000; Sage, 2005). As a consequence of deficient system design, users may find it uncomfortable to input and retrieve data and information from the system, and thus reducing system acceptance and usage. Deficient design, although temporarily associated with the implementation of the system, may have several implications in its use later on.

Slow system response time

Slow system response time would be a barrier preventing users from using ISs in companies (Damodaran and Olphert, 2000). Damodaran and Olphert (2000) reveal in

their research that, users want their IS to have fast response times and would get frustrated if the system cannot respond as quickly as they expect.

Poor data quality

Poor data quality is a crucial barrier to successful introduction of ISs in companies (Wright and Donaldson, 2002; Sherer and Alter, 2004). As pointed out by Redman (1998), poor data quality is a common issue in ISs of many modern companies. Redman (1998) argue that companies often encounter a wide range of data quality problems (e.g. problems associated with data accuracy, relevancy, consistency, currency, completeness and presentation, etc). Poor data quality is an inevitable result of these problems (Redman, 1998). On the other hand, poor data quality can be caused by either technical pitfalls of ISs or human mistakes. From the technical side, inappropriate data flows within the system as well as system fragmentation are reported as the main causes for poor data quality (Loshin, 2001; Redman, 1998). From the human side, user errors due to negligence and insufficient training could result in significant data errors and data quality problems. Poor data quality can impact companies in many negative ways, e.g. low user satisfaction, increased operational costs, production and delivery failures, customer dissatisfaction, less effective decision making, and inappropriate strategy development (Redman, 1998). Poor data quality may even lead to a complete IS/ERP failure (Redman, 1998).

6.2.6 Summary of barrier discussion

The above sections present and discuss the 29 identified barriers that may prevent Chinese companies from succeeding in ERP post-implementation. Table 6.1 summarises these barriers and their potential consequences, and further indicates the barriers that are also identified in western companies and the barriers that are predicted to be particularly relevant to the Chinese context.

Table 6.1: Summary of potential barriers to ERP post-implementation

ID	Barriers preventing Chinese companies from succeeding in ERP post-implementation	Potential consequences	Support in Literature	Particularly relevant to Chinese firms
Cultural barriers (barriers caused by the Chinese culture)				
CB1	Power centralisation and centralised decision-making due to high power distance	– Top managers make decisions without considering alternative ideas and options, and thus increasing the possibility for top managers to make inappropriate decisions regarding system maintenance and improvement.	Martinsons and Hempel, 1998; Martinsons and Westwood, 1997; Reimers, 2002	√
CB2	Unwilling to disclose problems, faults and failures due to preservation of 'face'	– Hidden potential system operation and maintenance problems which otherwise could be avoided proactively or solved in an early stage; – Inefficient communication between users and IS staff; – Reduce the chances for Chinese companies to receive suitable help and advices from system vendors and service consultants.	Graham and Lam, 2004; Shu, 2001	√
CB3	High context and implicit form of communication	– Meaning of a message cannot be directly conveyed into codes and could be misrepresented when being stored in the system; – Valuable know-how and expertise cannot be shared efficiently and would be lost easily.	Martinsons and Westwood, 1997; Martinsons and Martinsons, 1996	√
CB4	Lack of critical thinking of employees	– In-house IT staff and related specialists have less abilities and expertise to enable successful and continuous ERP improvement.	Martinsons and Hempel, 1998; Pei, 2005	√
CB5	Less inclined to use systematic procedures and explicit information to tailor (e.g. sales and production) forecasts and plans	– Unwilling to utilise the data collected and stored in the ERP system to tailor business forecasts and plans, and thus underutilise the full power of ERP system.	Martinsons and Westwood, 1997; Martinsons and Hempel, 1998; Xue et al., 2005	√
CB6	Trust personal common sense rather than system data to make decisions	– Reduce utilisation of the ERP system and therefore reduce return of the ERP investment; – Increase probability for making human mistakes.	Martinsons and Westwood, 1997; Zhang et al., 2005; Reimers, 2002	√
CB7	Building inter-organisational relationships based on personal *guanxi*	– Unstable relationships with ERP system vendors and consultants; – Unstable relationships with suppliers and distributors. Frequently changing suppliers and distributors can increases difficulties in system data maintenance.	Fan, 2002; Lowe, 2003	√

Organisational barriers (barriers caused by internal factors of companies)				
OB1	Inefficient collaboration and communication between functional departments	– Difficult to form efficient cross-functional team to review and improve the ERP system; – Significant reduction in operational efficiency when using ERP systems.	Beatty and Gordon, 1988; Fletcher and Wright, 1995; Wright and Donaldson, 2002	
OB2	Fear of loss of power and loss of job	– Unwilling to share information with the others; – Resistance to system acceptance and usage from both mangers and workers.	Beatty and Gordon, 1988; Ernst, 1989; Damodaran and Olphert, 2000	
OB3	Short-term behaviour of companies	– Less inclined to provide long-term support to ERP post-implementation; – Overlook risks and problems and neglect potential opportunities when using the system in the long-term.	Liu, 2004; Zhang, 2004	√
OB4	Lack of explicit IS development plan and strategy	– Lead to many problems and risks in the ERP post-implementation stage, i. e. no clear direction for further ERP enhancement, IS development plan misfits with business strategy, ERP system cannot be used to support long-term business goals, etc.	Rucks and Ginter, 1982; Wright and Donaldson, 2002	
OB5	Lack of top management support	– Low motivation of system users and in-house specialists to involve in continuous system review and improvement.	Namjae and Kiho, 2003; Wright and Donaldson, 2002; Sherer and Alter, 2004	
OB6	Insufficient ERP post-implementation funds and resources	– System maintenance, upgrade and improvement can not be carried out properly.	Namjae and Kiho, 2003; Sherer and Alter, 2004	
OB7	Lack of in-house specialists	– No sufficient in-house specialists to enable continuous success in system maintenance, monitoring and enhancement in the post-implementation stage.	Namjae and Kiho, 2003; Wright and Donaldson, 2002; Sherer and Alter, 2004	
OB8	Low involvement of employees	– Less willing to attend further user training; – Indifference in system problems; – Low motivation to get involved in system improvement.	Namjae and Kiho, 2003; Wright and Donaldson, 2002; Sherer and Alter, 2004	
OB9	Low-skilled and ill-trained staff	– Not able to use the ERP system properly, and thus lead to operational problems or data errors; – Low system acceptance and usage.	Wright and Donaldson, 2002; Sherer and Alter, 2004	
External barriers (barriers caused by external factors)				
EB1	Government direct intervention	– Lead to undesirable organisational changes which may impact the use of ERP systems.	Cheung, 2005	√

EB2	Problematic legal system and increase of business and economic crimes	– Increase probability of occurrence of information security and leakage risks in Chinese companies when using ERP.	Ji, 2005; Jiang, 2006; Potter, 1999	√
EB3	Regional inequality	– Difficult to implement ERP in inland regions; – Staff in inland regions may not be ready to use new technologies such as ERP.	China Internet Network Information Center, 2006	√
EB4	Lack of accurate and reliable market statistical data	– Unable to generate accurate sales forecast, and thus results in issues for production planning; – Difficult to respond to changes in customer demand.	Doshi and Campbell, 2003; Haley, 2003	√
System barriers (barriers related to the ERP system)				
SB1	Insufficient supports and services from system vendors	– Increase difficulties for in-house staff to maintain and revise ERP in the post-implementation stage.	Wright and Donaldson, 2002; Namjae and Kiho, 2003	
SB2	Inexperienced system consultants	– Poor support from consultants, and thus increase difficulties for in-house staff to maintain and revise the ERP system.	Wright and Donaldson, 2002; Namjae and Kiho, 2003	
SB3	System inflexibility	– System revision and enhancement in the post-implementation stage would become very difficult.	Ernst, 1989; Namjae and Kiho, 2003	
SB4	System incompatibility	– Prevent data from being shared and exchanged smoothly across information systems; – Reduce system efficiency and user satisfaction.	Beatty and Gordon, 1988; Fletcher and Wright, 1995	
SB5	High cost for add-ons and further system development	– Companies might be unwilling or unable to provide sufficient funds for ERP upgrade and improvement.	Fletcher and Wright, 1995; Wright and Donaldson, 2002	
SB6	Deficient design of the system	– Users might find it uncomfortable to input and retrieve data and information from the system, and thus reduces system acceptance and usage.	Damodaran and Olphert, 2000	
SB7	Slow system response time	– Time-consuming, reduce system acceptance & usage.	Damodaran and Olphert, 2000	
SB8	Misfits between system functions and company requirements	– The system would not be able to satisfy the needs of users in their daily jobs, and thus reduce system acceptance and usage.	Sherer and Alter, 2004	
SB9	Poor data quality	– Users have less trust in the system, significantly reduce system acceptance and usage, and could lead to failure of the whole ERP system.	Wright and Donaldson, 2002; Sherer and Alter, 2004	

6.3 Risk and risk management

The second part of this chapter addresses potential ERP post-implementation risks in Chinese companies. Before identifying and discussing these potential risks in section 6.4, this section introduces the concept of risk, explains the differences between risk and barrier, and describes the theory of risk management and its application in this project.

6.3.1 The concept of risk

6.3.1.1 Definition and characteristics of risk

As presented in chapter one, a risk can be defined as the occurrence of an event that has consequences for, or impacts on a particular business process (Kleim and Ludin, 2000:3). The researcher slightly modified the definition given by Kleim and Ludin to make it more relevant for this ERP post-implementation study. For the purpose of this research, a risk is thus defined as:

> "The occurrence of any event that has consequences or impacts on the use, maintenance and enhancement of the implemented ERP systems."

In other words, any other business risks (e.g. property damage, business acquisition, owner's ability to continue the business, staff safety, employee compensation, etc.) that will not affect the exploitation of ERP systems were considered to be outside the study focus of this project and therefore were not covered in this research.

Moreover, despite the term 'risk' is often used to describe adverse events, a risk can actually lead to either negative or positive consequences (Hillson, 2001; Tchanakova, 2002), and raise either threats or opportunities to companies (Chapman and Ward, 1997: 8-9). As a consequence, Kleim and Ludin (2000:5) define risks that can hinder the completion of a critical activity as negative risks, and define risks that will facilitate the completion of a critical activity as positive risks. Although the PhD researcher recognise the importance of both negative and positive risks, this project focused only on negative risks and their relationships with barriers, which may be considered as major risk factors.

6.3.1.2 Risk and risk factor

A risk event must be caused by one or more factors (so called risk factors). For example, lack of top management support is a common risk factor identified in IS studies (e.g. Huang et al., 2004; Sherer and Alter, 2004), and can cause a set of risk events (e.g. in-house IT staff have low motivation to continuously review and revise the implemented ERP system, etc). In this example, lack of top management support is also a crucial barrier that prevents companies from efficiently using, maintaining and improving their ERP in the post-implementation phase. In other words, ERP barriers identified in this study can often be the cause of a set of ERP risks.

6.3.2 Differences between risk and barrier

As discussed in chapter one, the terms 'barrier' and 'risk' were often misused by authors. Nevertheless, these two concepts are in reality substantially different. Specifically, a barrier, unlike a risk, has no uncertainty associated to it. That is, a barrier is a factor that is inherent to a given context and thus has 100% probability of occurrence. Moreover, as discussed above, barriers are risk factors that can lead to the occurrence of potential risk events. These two terms must therefore be clearly distinguished and should not be used interchangeably. In truth, a clear understanding on the differences between risk and barrier is crucial to this study, because it can guide the researcher to separate ambiguous concepts into the category of either risk or barrier and avoid confusion.

6.3.3 Risk management and its application in this project

The essential purpose of risk management is to increase the chances of a business activity/process to be successfully carried out via systematic identification, assessment, and management of potential risks surrounding it. As discussed by Nunes and Annansingh (2002):

> *"While we can never predict the future with certainty, we can apply structured risk management techniques to peek over the horizon at the traps that might be looming, and take actions to minimise the likelihood or impact of these potential problems."*

Scholars propose a variety of frameworks to indicate the processes and phases to be involved in effective risk management, e.g.:

> *"identification, assessment, actions" (Cadle and Yeates, 2001:200)*
>
> *"define, focus, identify, structure, ownership, estimate, evaluate, plan and manage" (Chapman and Ward, 1997:48)*
>
> *"identification, analysis, control and reporting" (Kleim and Ludin, 2000:8)*

Despite these frameworks manifest certain variance and overlap, they point out three fundamental phases to be involved in the risk management cycle, namely risk identification, risk assessment, and risk control:

- *Risk identification* is concerned with conducting an in-depth analysis on the situation and context in order to identify and describe the possible risk events that might occur. All risk management frameworks involve the phase of risk identification (Chapman and Ward, 1997:55). As stated by Chapman and Ward (1997:55), "we would not be able to manage risk without identifying and knowing where and what risk events might arise". As a consequence, risk identification is the most important phase in the risk management cycle (Elkington and Smallman, 2002) and forms the basis for the remainder phases of risk management (Tchanakova, 2002).

- After risk identification, the next phase of risk management is to conduct a *risk assessment* on the risk events identified. It is widely acknowledged that both probability of occurrence and impact are essential dimensions to assess the importance of a risk (Cadle and Yeates, 2001:231). It is obvious that, a risk event that has a high impact may not have a high probability of occurrence, and vice versa. For instance, when confidential business data stored in the system is stolen by unauthorised people, this may lead to significant impact to user companies. However, the probability of occurrence of this risk event may be low. Hence, managers typically tend to focus on risk events that have both high probability of occurrence and high impact (Cadle and Yeates, 2001; Chapman and Ward, 1997:139-141). Moreover, a risk event may occur not just once but repetitively within a given context. As a consequence, the frequency of occurrence of a risk event may often be considered as a further dimension in risk

assessment (Covello and Merkhofer, 2003). While probability refers to 'how likely' a risk event may occur, frequency refers to 'how often' this event may happen. It is apparent that, a risk event that has a high probability of occurrence may not be necessarily to have a high frequency of occurrence. For instance, if a firm experiences significant financial losses in a given year, there may be a high probability for it to go bankrupt. It is however obvious that this risk event (i.e. go bankrupt) can occur only once in any firms.

- *Risk control* is concerned with tailoring action plans to manage the risk events that have been identified and assessed as significant. Two types of action plans could be established: avoidance action plans and mitigation action plans (Cadle and Yeates, 2001:233-234). Avoidance action plans indicate actions to be taken to entirely prevent the risks from occurring. In the cases that avoidance actions fail, mitigation actions should be taken in order to reduce the probability of occurrence and negative impact of the risks. It is important to note that both types of action include risks in themselves.

This study focuses on the aspects of risk identification and risk assessment:

- The next section of this chapter identifies a wide range of potential risk events that may occur in ERP post-implementation in Chinese companies. An initial attempt is also made to discuss and analyse the causes and impact of these risk events. A risk ontology was subsequently established and served as the basis for constructing the questionnaire survey.

- In the first data collection stage of this project, questionnaire survey was used to explore whether the risk events that are presented in this chapter would occur in selected Chinese SOEs, and collect a set of quantitative data to examine the importance of each identified risk according to its level of impact, probability of occurrence, and frequency of occurrence. In the second data collection stage, a multi-case study was conducted to seek qualitative evidence to further investigate the impact and causes of risk events that were identified as significant, and also to identify the correlations between these risk events.

6.4 Risks in ERP post-implementation

As discussed in chapter three, ERP systems in theory can provide a wide range of benefits to companies. However, due to various internal and external reasons, a set of risk events may occur when companies actually use the system in the post-implementation stage. These risk events may result in significant impact and negate the advantages that ERPs promise to bring to user companies.

The 29 potential ERP barriers identified and discussed in section 6.5 were actually starting point of risk identification in this section. It was expected that these barriers could be the causes of diverse potential ERP risk events in Chinese companies. By drawing on the results of the analysis of ERP barriers, and also by reviewing previous IS and business studies, the researcher identified a set of potential risks that may occur during ERP post-implementation and can affect the use of ERP systems in Chinese firms.

6.4.1 ERP areas of study for risk identification

Due to the size and complexity of an ERP system, identification of risk in ERP post-implementation is a very time-consuming and complicated task. In order to frame the study and generate meaningful and significant outcomes, the research project particularly looked at ERP post-implementation risks in the following four categories:

- *Operational Risk.* ERP systems are designed to address the majority of the transaction processing activities (e.g. order processing, invoice generating, etc) involved in the daily operation of a company. Operational staff are thus key users of ERP systems. Operational risks refer to risks that may occur as operational staff use ERP systems to perform daily business activities.

- *Analytical Risk.* Apart from operational functions, ERP systems also contain a number of analytical functions which can be used to analyse, model and evaluate data collected from daily operation of the company. Front-line managers will often use such analytical functions of ERP to generate plans and forecasts (e.g. production plan, sales forecast, etc) to predict and better manage the uncertain

future. Analytical risks refer to risks that may occur as managers use ERP systems to carry out analytical tasks.

- *Organisation-Wide Risk.* When using and maintaining ERP systems in the post-implementation stage, companies may encounter a set of risk events in relation to various internal (e.g. system users, in-house IT experts) and external factors (e.g. system vendor, system consultants). Such risks may have impact to the entire company and therefore are referred to as organisation-wide risks.

- *Technical Risk.* A set of system and technical factors may result in risk events that can hinder the implemented ERP system to meet its intended functions and performance requirements. These risk events are identified as technical risks.

Furthermore, it was considered that operational and analytical risks occur in different functional areas in a company and are therefore very different in nature. Their study needs to take into account diverse aspects and sometimes very disparate triggers. On the other hand, it emerges in the survey studies of Reimers (2001) and Tsai et al. (2005) that ERP systems are most frequently used in three business areas in Chinese firms, namely sales and marketing area, production and purchasing area, and financial and accounting area. Therefore, after identifying the operational and analytical risks in general, the researcher specifically selected and focused on these three business areas for identification of operational and analytical risks. Consequently, a total of 9 operational risks and 8 analytical risks were identified.

Additionally, the study also identified 16 organisation-wide risks and 7 technical risks. These organisation-wide risks and technical risks were further rearranged into different categories: the 16 organisation-wide risks were divided into five sub-categories, namely top management, IS/ERP planning, in-house specialists, system users, and system vendors and consultants; the 7 technical risks were rearranged into three subsets, namely system integration, system faults, and system maintenance and revision.

The following sections of this chapter present and discuss extensively these 40 identified ERP exploitation risks.

6.4.2 Operational risks

6.4.2.1 Generic risks

Operational staff are reluctant to use the ERP system

ERP systems are mainly designed to integrate and automate transaction processing activities of companies (Chou et al, 2005). Therefore, it is mainly operational staff in the shop floor, who use ERP extensively in their everyday work (Scapens and Jazayeri, 2003). If operational staff, as the main system users, are reluctant to use the implemented ERP, this may result in significant impact on the company (e.g. reduction of staff motivation and performance, reduction of system acceptance and usage).

This risk event may be caused by various factors, including psychological anxieties of staff (e.g. unwilling to change, unwilling to break down the traditional functional boundaries, and fear of loss of job), initial failures in system implementation (e.g. insufficient training), and system pitfalls (e.g. poor user interface, deficient design of the system, and poor data quality). These factors are frequently reported to exist in the use of ISs (e.g. Beatty and Gordon, 1988; Damodaran and Olphert, 2000; Sherer and Alter, 2004, etc). Therefore, it was expected that the probability of occurrence of this risk could be high, especially in the initial period that the system was just go live.

Operational staff input incorrect data into the system

ERP systems require extremely high data accuracy to work effectively and efficiently (Koh et al., 2000; Zhou et al., 2005). All preliminary data of ERP is inputted by operational staff, who use the system extensively in their everyday work. Data entered to ERP will be stored in the central database and become available immediately to the whole company. Scapens and Jazayeri (2003) state that "The integrated data flowed so quickly through the system that there was little opportunity to track down mistakes before they showed up on everybody's screens". As a consequence, if one operational staff inputs incorrect data into the system, it will raise immediate impact and problems to the entire company and may disturb the operation of all functional divisions.

This risk event may be caused by human negligence. Because of insufficient training, operational staff may not recognise how significant it is to have accurate data in the ERP system, and thus pay less attention when entering data. Staff may also purposefully input incorrect data into the system in order to gain, by fraud, illegitimate benefits and resources from the company. Because operational staff are required to handle large amount of transaction data each day, the probability and frequency for them to enter incorrect data into the system was expected to be high.

6.4.2.2 Sales and marketing risks

Sales staff are not able to obtain data and information they need from the system

A purpose for using ERP system is to enable sales personnel to retrieve relevant information of the company (e.g. product details, prices, order details and inventory records) whenever necessary to answer customer queries promptly (IBS, 2006). However, due to insufficient training, poor system interface, deficient system design or ill-defined requirement specification, sales staff may not be able to obtain relevant data and information from the system when they need it. If such a risk event occurs, sales staff will either not be able to answer customer requests or provide customers with incorrect information. It can thus lead to customer dissatisfaction and loss of competitive advantage.

Fail to maintain up-to-date and comprehensive customer information files

ERP systems can often help companies to maintain up-to-date and comprehensive customer information files. By analysing such customer files, modern companies can "ensure that relevant products and services are sold to the correct individual at the relevant point in their life" (Wright and Donaldson, 2002). As a consequence, failing to maintain up-to-date and comprehensive customer information files is a risk event that may lead to a set of undesirable outcomes, e.g. not be able to target on valuable customers, not be able to maintain customer loyalty and good customer relationship, and lose existing customers.

6.4.2.3 Production and purchasing risks

System contains inaccurate supplier records

Multi-national companies tend to build up long-term relationships with their suppliers and avoid frequent supplier changes. They can therefore reduce operational risks (e.g. inconsistent material quality, incoherent lead time, sudden increase in prices). On the other hand, they can avoid distortion of supplier and material records stored in the IS. However such a practice may not be adopted by many Chinese companies.

As discussed in section 6.2.2, inter-organisational relationships between Chinese companies and business partners (e.g. suppliers) may often be established based on personal *guanxi* networks of leaders from both sides and are therefore unstable. Due to unstable relationships, suppliers of Chinese companies may be frequently changed. As a consequence, it may be difficult for Chinese companies to maintain accurate and up-to-date records of suppliers and materials they supplied. Containing inaccurate supplier and material records was thus expected as a risk event that may result in significant problems, mistakes and delays in procurement and production in Chinese companies.

System contains inaccurate or incomplete bill of materials

ERP applications in material and production area typically follow the same logic as that of Material Requirements Planning (MRP) systems (Klaus et al, 2000). MRP is the former generation of ERP and now forms the core of most ERP applications (Klaus et al, 2000). It tends to use three types of inputs (i.e. bill of material, inventory records and master production schedule) to calculate the net requirement plan of materials as outputs (Koh et al, 2000). The term 'material' used in manufacturing companies refers to any components (e.g. raw materials, parts, accessories and casings) required to use in the production of a product (Zhou et al., 2005:52). A bill of materials, as one of the most important inputs of MRP, can be defined as:

> "a list of the component parts required to make up the total package for a product or service together with information regarding their level in the product or component structure and the quantities of each component required" (Slack et al, 2004:770).

The number of component parts required to make up a product can be varied from less than ten (e.g. a toy) to more than a thousand (e.g. an airplane). A bill of materials can therefore be the most complicated piece of information contained in the MRP/ERP system. In order to ensure that ERP systems work properly, the bill of materials must be accurate and complete. Otherwise, materials required in production may not arrive at the right time and in the right quantities (Zhou et al., 2005:53). This can lead to a set of serious outcomes, e.g. increase inventory and cost, reduce production efficiency, increase production lead time, and reduce customer satisfaction, etc (Zhou et al., 2005:53).

Therefore containing inaccurate or incomplete bill of materials was expected to be a crucial risk event faced by manufacturing companies. Producing a wide range of products with complicated structures and frequently launching new products can increase the probability and frequency of occurrence of this risk event. In addition, Zhou et al. (2005) state that different departments (engineering department and production department in particular) may modify the bill of materials, according to the actual design or production needs, without notifying the others. As a consequence, inconsistent and incomplete bill of materials may exist in the company.

System contains inaccurate inventory records

Inventory records are one of the most important inputs of MRP/ERP. Achieving over 95% accuracy in inventory record is a prerequisite to enable ERP systems to work properly (Zhou et al., 2005:75). 95% here means that the match rate between inventory records in ERP and the actual inventory level in the warehouse, must be at least 95 percent (Zhou et al., 2005:75). However due to human mistakes and/or frauds, inventory records stored in the ERP system may be inaccurate. Modern companies are also keen to store their stocks in third-party warehouses in order to reduce inventory cost, and this may potentially increase the difficulty for inventory management. As a result of inaccurate inventory record, sales staff may not be able to inform customers about crucial stock information and availability. Without knowing the exact content of warehouses, production staff may be unsure of production schedules and issuing of procurement orders. Finally, account staff may be misled in their calculations of the actual value of current inventories, procurement orders and production costs. In short, operation of the entire company may be disturbed.

6.4.2.4 Financial and accounting risks

Account staff are unwilling to release accounting responsibility/power to non-account staff and *Non-account staff are unwilling and incapable to take up accounting responsibilities*

ERP systems "integrate information and information-based processes within and across functional areas in an organization" (Kumar and Hillegersberg, 2000), and therefore break down the traditional boundaries between functional divisions. This diluting of divisional boundaries has impacts for the organisation as a whole, but is particularly noticeable in accounting divisions. With the adoption of ERP solutions, the accounting part of a company is no longer distinguished from the operational one and the traditional relationship between workers and accountants needs to be redefined (Caglio, 2003). Specifically, traditional accounting responsibilities and activities (e.g. budgeting, cost recording, etc) are gradually passed down to non-account personnel in diverse functional divisions (Scapens and Jazayeri, 2003). Both Scapens and Jazayeri (2003) and Caglio (2003) therefore point out that, efficient communication and co-operation between departments is essential to success under such a new working environment. In particular, accountants need to provide persistent help and professional guidance to non-account staff. In contrast, non-account staff should pass up-to-date financial information back to accountants.

It was however expected that account staff in some cases may not be willing to release accounting responsibility/power to non-account staff. On the other hand, non-account staff may be unwilling and incapable to take up accounting responsibilities. Both risk events may result in conflicts and arguments between functional divisions, which have a direct impact on operational efficiency and staff performance. These two risk events were expected to have a high probability of occurrence, especially in the early period that the ERP system was just implemented.

6.4.3 Analytical risks

6.4.3.1 Generic risks

Front-line managers refuse to use the ERP system

Ronald et al. (2000) state that, "in response to demands posed by the new global economy, managers on the front lines, where some say the real work is done", are assigned with a broader set of responsibilities and tasks (e.g. budgeting, planning, forecasting, quality management and benchmarking, etc). As a consequence, front-line managers should use ERP systems extensively in their jobs in order to make better planning and forecasting. However due to reluctance to change and insufficient training, front-line managers may refuse to use ERP in real practices. The situation in China may be worse, because Chinese managers are traditionally less inclined to use systematic procedures and explicit information to tailor plans and forecasts (Martinsons and Westwood, 1997). Additionally, Reimers (2002) reinforces that Chinese managers may not trust the data provided and the suggestions made by the ERP systems and tend to disregard the figures recommended by the system and replace these using their own experience. If front-line managers refuse to use ERP, they may not be able to use the system to improve planning and forecasting activities and thus underutilise the full potential of their ERP systems.

Managers cannot retrieve relevant and needed information from the system

It is generally accepted that, different managers often have different information needs according to their personal decision styles, contexts and actual situations (Lucas, 1975). Formats and contents of reports generated by ISs should therefore be flexibly changed and customised in accordance with the actual needs of managers (Sage, 2005). However not all ISs available in the current market can be flexible enough to satisfy this user requirement. In addition, structures and content of reports generated in a particular national context (e.g. USA) may not easily be used or even translated to other national contexts (e.g. China). Therefore, foreign ERP systems may not suit the needs of local companies due to cultural and political differences (Soh et al, 2000). As a consequence, managers engaged in certain situations may not be able to retrieve needed information

from the system. The occurrence of this risk event may lead to poor decision making of managers and reduce system acceptance and usage.

6.4.3.2 Sales and marketing risks

Fail to use the system to generate accurate sales forecast

Generating sales forecast has been traditionally considered as one of the biggest challenges faced by companies (Doshi and Campbell, 2003; IBS, 2006). As stated by Ranard (1972), the generation of accurate sales forecast requires various types of inputs, e.g. historical sales data, sales force estimates, and external market information, etc. A main purpose for using ERP is thus to enable companies to better capture and process these internal and external information to generate more accurate sales forecasts. Nevertheless, capturing accurate external market information to tailor sales forecasts may be currently a difficult task for Chinese firms. It is often considered that, market statistical data, which is available in the industry in contemporary China, typically lacks accuracy, reliability and currency (Lv, 2006). This issue is caused by various national reasons, e.g. inappropriate statistical standards and strict government control on information accessibility (Lv, 2006). Inaccurate and unreliable market statistical data thus raises significant forecasting issues to both foreign and domestic companies operating in China. Inaccurate sales forecast can result in significant impact in companies, e.g. e.g. unreasonable sales quotas may be assigned to staff, and production plans and financial budgets set up by ERP may be inappropriate or infeasible (Zhou et al., 2005).

Fail to predict the demands of new products

Despite the support of ERP systems, launching a new product onto the market is a difficult task that should be carefully managed. Due to lack of past sales data, rapid changes in customer trends and insufficient market information, it may often be difficult for sales personnel to predict the actual demands of new products. Failing to forecast the demands of new products is a risk event that may lead to two alternative outcomes: in one scenario, companies may over produce what they actually need and the over-produced good may never be sold in the market; conversely, the new product may be under-produced and therefore consumer demands may not be met. Both outcomes can

lead to financial loss and put the company at a disadvantage. Inaccurate demand forecast of new products may also disturb normal production of existing products, and distort production plans and financial budgets that are initially generated by the ERP system.

System fails to support sales personnel to provide special sales offers and promotions to existing customers

The integration of CRM and ERP can help companies to better manage and analyse the information of their existing customers. Companies, especially services companies, can therefore "increase customer retention, cross-sell, target sales and marketing activities [...and] ensure that relevant products and services are sold to the correct individual at the relevant point in their life" (Wright and Donaldson, 2002). However this may be a difficult task for many manufacturing companies in real practice. Specifically, products produced by manufacturing firms generally reached the end customers through local distributors and retailers (Wright and Donaldson, 2002). It may therefore be difficult for manufacturing companies to collect information directly from customers, while local distributors and retailers may be incapable or unwilling to capture and pass up-to-date sales information to original manufacturers. Without pertinent customer data, sales personnel may fail to provide suitable sales offers to existing customers at the right time.

6.4.3.3 Production and purchasing risks

System fails to generate appropriate master production schedule (MPS)

A master production schedule (MPS) "specifies the quantity of each finished product required in each planning period; it is a set of time-phased requirements for end items" (Chen, 2001). MPS is "the most important planning and control schedule in a business, and forms the main input to materials requirements planning" in ERP systems (Slack, 2005:489). Inappropriate MPS can result in finished product shortages and/or overages, which directly impact costs, customer delivery lead time and customer satisfaction. The appropriateness of MPS depends on the accuracy of sales forecast. Zhou et al. (2005:101) state that sales forecasts are original input to generate production schedule and planning. It was therefore considered that, failing to generate appropriate MPS may

be a risk event that has a high probability of occurrence in companies that are incapable to make accurate sales forecasts.

System fails to generate appropriate material net requirement plan (NRP)

Net requirement plan (NRP) of materials is the main output generated by the MRP component of ERP. Companies launch material production and procurement orders based on their NRPs. Inappropriate NRP can therefore result in material shortage or over-ordering or producing, which may directly lead to delay and/or cease of production. The generation of appropriate NRP depends on the appropriateness and accuracy of MPS, bill of materials and inventory records. It is however discussed above that, having inaccurate MPS, bill of materials and inventory records may be risk events faced by many modern companies. Furthermore, an additional factor that can lead to inappropriate NRP is that, ERP systems use fixed lead time to plan for material purchase and product manufacture, and cannot flexibly respond to changes on lead time. Koh et al. (2000) argue that, "this ignores real life uncertainties of supply unavailability and variability of queue, set-up and run times on the shopfloor". Therefore it was expected that, failing to generate appropriate NRP can be a risk event that may have a high probability of occurrence in companies.

6.4.3.4 Financial and Accounting risks

Fail to generate appropriate financial budgets

Financial budgets are crucial analytical outputs from the financial division of a company. Targets can be set for staff based on financial budgets in a period of time (e.g. annually, quarterly, and monthly). Top managers can therefore control and evaluate the performance of their staff (Ekholm and Wallin, 2000). The use of ERP systems, in theory, can help companies to generate better financial budgets. However, the appropriateness of financial budgets may be significantly affected by environmental changes in real practices. Rapid market growth, unpredictable changes in market conditions and inaccurate sales forecast may lead to significant variance between budgets and actual outcomes. As a result of inappropriate financial budgets, staff may be assigned with unreasonable targets, and important business areas (e.g. ERP upgrade and maintenance) may not be assigned with sufficient funds.

6.4.4 Organisation-wide risks

By drawing on the results of the analysis of barriers and the findings of previous IS/ERP studies, sixteen organisation-wide risks are identified and discussed in this section. These sixteen organisation-wide risks are further divided into five categories according to the specific organisational aspects, namely: top management, IS/ERP planning, in-house specialists, system users, and system vendors and consultants.

6.4.4.1 Top management risks

Top managers make important IT decisions without consulting IT experts/system users

Top managers are neither experts in IT/IS nor extensive users of the ERP system in their daily work. They therefore typically lack sufficient expertise and knowledge to make appropriate IT decisions on their own. Lientz and Larssen (2006:116) states that "decisions being made [by top managers] without the advice or involvement of the IT managers" is a risk that may occur in IT projects. It is expected that, this risk event may have a high probability and frequency of occurrence in Chinese companies, where top managers are inclined to make centralised decisions without consulting the opinions of their subordinates. The occurrence of this risk event may lead to inappropriate IT decisions being made and reduce motivation of staff and in-house experts.

Substantial personnel changes in the top management team

Top managers, who are involved in ERP implementation, should have a better knowledge regarding the IS background and needs of the company and therefore be more willing to provide continuous support to the system post-implementation. However due to company policies or personal reasons, top managers may leave the company after a period of time. A substantial personnel change in the top management team is considered as a crucial risk event that may occur in IS implementation (Lientz and Larssen, 2006:117). Because ERP post-implementation is a continuous and endless process, this risk event is predicted to have a high probability of occurrence in the system post-implementation phase. Substantial changes in the top management team may result in discontinuous top management support to ERP post-implementation and even changes in business and IS development direction.

Top managers do not provide sufficient support to ERP post-implementation

The attitude of top managers "will affect not only the flow of funds and information to the [IS] project, but also the subordinates view the project" (Gargeya and Brady, 2005). Top management support is therefore frequently reported (e.g. Loh and Koh, 2004; Gargeya and Brady, 2005) as one of the most crucial factors affecting the success of ERP implementation in companies. It can be argued that this factor is also crucial to the success of ERP post-implementation. Lack of continuous support from top managers can be a significant risk event that may lead to a set of negative consequences in ERP post-implementation, e.g. conflicts and arguments in ERP post-implementation cannot be solved, IS development plan is missing or inappropriate, etc. In addition, as discussed in section 6.2.3 top managers in Chinese companies are typically driven by short-term behaviour and are keen to achieve short-term results. It was thus expected that there may be a high probability for Chinese managers to fail to provide sufficient support to ERP post-implementation in the long-term.

6.4.4.2 IS/ERP planning risks

IS/ERP post-implementation development plan is ill-defined or misfit with business strategy

The implemented ERP system has to be continuously reviewed, revised and improved in the post-implementation stage. A clear IS/ERP development plan is the prerequisite to enable these activities to be carried out successfully. The establishment of an efficient IS plan depends on the commitment of top managers and endeavour of in-house experts. If the IS development plan of the company is ill-defined or presents a misfit with the business strategy (Lientz and Larssen, 2006:124-126), the company will not be able to retain a correct direction for further ERP development. As a consequence, the implemented ERP system may gradually become incapable to support business strategies and goals.

Direction for further ERP improvement and development is unclear

Having unclear direction for further ERP improvement is a risk event that can be directly caused by inefficient ERP development plan. Without a clear and correct

development direction, system investments being made in ERP post-implementation may be inappropriate, the implemented ERP system may not be further improved to support long-term business goals.

Budgets and funds assigned to ERP post-implementation are insufficient

Insufficient budgets and funds can prevent the ERP implementation from progress and full completion (Loh and Koh, 2004; Lientz and Larssen, 2006:225), and can also disturb system maintenance, upgrade and revision in the post-implementation phase. Budgets and funds assigned to ERP post-implementation in the company may be insufficient due to various reasons, e.g. lack of top management support, lack of appropriate IS development plan, and post-implementation cost is insufferably high, etc.

6.4.4.3 In-house specialists risks

Fail to form an efficient cross-functional team to continuously review and revise ERP

A cross-functional team, which should include members covering an adequate range of knowledge from both a technical perspective and the different operational perspectives of functional divisions in the company, is crucial to enable the success of ERP projects (Gargeya and Brady, 2005; Buckhout et al, 1999). It can be argued that, when an efficient cross-functional ERP team is missing, the organisation may neither properly revise ERP pitfalls resulted from the implementation cycle nor adapt the implemented ERP to emerging changes in the long run. However, forming these efficient cross-functional teams is not an easy task (Loh and Koh, 2004; Sumner, 2000) and can often be very controversial inside the organisation. Specifically the company may not have as many specialists as required to form an efficient ERP team. Alternatively, in-house specialists may do not have sufficient skills and expertise to enable continuous ERP success. Moreover, team members may perceive their participation as an unwelcome deviation from their operational duties and therefore lack the motivation to participate fully. Or conversely, team members may volunteer to be part of this type of cross-functional team for internal political or power grabbing reasons and then be equally motivated to provide a full contribution. Inefficient communication and collaboration between departments and lack of top management commitment can also significantly reduce efficiency of the ERP team.

Lose qualified IT/ERP experts

Recruiting and retaining qualified and high-skilled IT/ERP staff is crucial for system maintenance and revision in ERP post-implementation. However as discussed by Sumner (2000), due to high market demand of these professionals and inappropriate retention programme, it may be difficult for companies to retain high qualified ERP experts. Failing to retain qualified IT/ERP experts was thus expected as a risk event that could have high probability and frequency of occurrence in ERP post-implementation.

Loss ERP-related know-how and expertise accumulated over time

In-house experts are actually able to accumulate a large set of know-how and expertise through ERP implementation and post-implementation. These know-how and expertise however may not be shared effectively throughout the organisation, especially in Chinese companies. Chinese staff are less willing to share information with others and are more inclined to use high context and implicit form of communication which does not facilitate knowledge sharing (Martinsons and Westwood, 1997). As a consequence, valuable ERP know-how and expertise accumulated over time may be lost when in-house experts leave the company.

6.4.4.4 System users risks

Users (both staff and managers) do not receive sufficient and continuous training

Staff should be adequately trained during the cycle of ERP implementation in order to enable them to have sufficient skill and knowledge to maximise their use of the system at 'go-live' (Gargeya and Brady, 2005). However, the ERP system will be constantly upgraded and improved during the system post-implementation stage. In order to ensure that staff can use any newly installed functions effectively, they should be provided with continuous training. Furthermore, Loh and Koh (2004) stress that sufficient training should not only be provided to staff who will use the system daily, but also to managers who can then facilitate and better control the changes taking place within the company. However, it is common knowledge that staff and managers of

many companies may not receive sufficient and continuous ERP training, usually due to lack of funds, resources and expert trainers. The occurrence of this risk event may lead to significant resistance to the use of ERP system in the company, as well as misunderstanding and use of newly implemented features and facilities.

Users are uncomfortable to use the ERP system in their daily jobs

Insufficient training can result in difficulties for users to use the ERP system. Also due to slow system response time (Damodaran and Olphert, 2000) and deficient system design (Sage, 2005), ERP users may find it uncomfortable to input and retrieve data from the system. The occurrence of this risk event may lead to user frustration and dissatisfaction, more human mistakes, and low operational efficiency.

ERP-related problems are not reported promptly by system users

Pitfalls and problems of the ERP system may not always be reported promptly by system users in the post-implementation phase, probably due to low user involvement and user indifference (Namjae and Kiho, 2003; Wright and Donaldson, 2002). As a result, it may be difficult for IT staff to identify system and user-related problems and take appropriate actions in the early stage. This issue may be particularly serious in Chinese companies, where people as discussed in section 6.2.2 are typically unwilling to disclose faults and failures to the others in order to save face (Shu, 2001).

Data access right is authorised to inappropriate users

It is important for companies to draw a clear policy to specify what types of data access rights can be given to users according to their departments and job functions (Loh and Koh, 2004). It is also crucial to clearly specify who should be responsible for authorising access to the system (Loh and Koh, 2004). Otherwise, data access right of the ERP system may not be allocated to appropriate system users. As a consequence of this risk event, system data may be accessed and modified by inappropriate users, which can result in data loss, errors and information leakage. Alternatively, users may not be granted sufficient data access right and thus cannot obtain necessary amount of information to fulfil daily job tasks.

Confidential data is accessed by unauthorised people

Confidential data of the company should be stored in a secure place and carefully managed. If important and confidential information is accessed by unauthorised people, this may potentially lead to information leakage and business crisis (Yosha, 1995). The causes of this risk event may be poor data protection and access policy of the company and poor IT security (Wilding, 2003; Loh and Koh, 2004). Additionally, confidential information of the firm may also be disclosed to competitors and other unauthorised people by internal staff, who have low loyalty to the company (Wilding, 2003).

6.4.4.5 System vendors and consultants risks

Cannot receive sufficient technical support from system vendors

Appropriate technical support from system vendors is crucial for companies to successfully maintain and upgrade their ERP system in the post-implementation phase. However, due to various issues (e.g. inadequate vendor performance, vendor withdraws from the market for commercial reasons or failures, vendor is acquired by another company etc), user companies may not be able to receive sufficient and continuous technical support from their system vendors (Lientz and Larssen, 2006:165-179; McDowall, 1993). When the ERP system is provided by multiple vendors, it becomes more difficult for the company to manage the relationships with these vendors and receive sufficient support from them. As a consequence, technical pitfalls of the implemented ERP system may not be solved speedily and properly.

Cannot receive sufficient and proper consulting advice from system consultants

In order to fill internal knowledge gaps, companies may often need to recruit external system consultants, who are expected to have extensively knowledge and experience in specific ERP applications (Sumner, 2000; Sage, 2005). However the recruited system consultants may not always be willing to share their knowledge freely with internal staff. Furthermore, system consultants can be recruited from different places (e.g. system providers, professional consulting firms), and thus may manifest poor collaboration and communication with each other. As a consequence, companies may face a risk for receiving inappropriate advice from their system consultants. In contrast with western

companies, this risk event may have a higher probability of occurrence in companies operating in China, due to a lack of highly qualified and experienced ERP consultant in the country at present, as discussed in section 6.2.5. Also, Chinese people are traditionally less inclined to disclose problems and failures to external bodies. This barrier may block effective communication between internal staff and system consultant.

6.4.5 Technical risks

Seven technical risks associated with ERP post-implementation are identified in this section and are further divided into three categories, namely system integration, system faults, and system maintenance and revision.

6.4.5.1 System integration risks

Different modules of the ERP system are not seamlessly integrated

Modern companies can purchase suitable software modules from different system vendors to form their own version of ERP system, when no solution from a single ERP vendor can satisfy all their needs. This approach however may lead to an integration risk, that is, seamless integration may be difficult to be achieved between current ERP modules or between current and new ERP modules offered by different system vendors. Sage (2005), one of the world's leading ERP vendors, reinforces that even all modules of the ERP system is provided by the same vendor, it does not mean they can achieve solid integration. The occurrence of this risk event may lead to system fragmentation in the company, through the creation of technological islands which are very often totally isolated and non-communicant.

Current ERP system is not able to seamlessly integrate with other IS applications

ERP systems are frequently criticised for being difficult to integrate with legacy systems and to infirm from low compatibility (Beatty and Gordon, 1988; Fletcher and Wright, 1995). In fact, it is often difficult for ERPs to be seamlessly integrated with other IS applications (e.g. legacy system, system of the newly merged or acquired company). The occurrence of this risk event may lead to poor data and business process integration and the creation of the same insulated technological islands discussed above.

6.4.5.2 System failure risks

Invalid data is not automatically detected when getting into the system

A well-designed ERP system should contain the capability to detect invalid data, e.g. duplicate customers and vendors, incorrect item numbers, unreasonable amounts and dates, and unusually high quantities or unit prices, etc (Sage, 2005; Alter, 2002:199). If invalid data cannot be automatically detected and prevented from getting into the system due to deficient system design, significant data errors and various data quality problems may arise.

Hardware or software crashes

Hardware or software crash can happen at any time when using a computerised IS. It is therefore a risk event that can occur during ERP post-implementation. The occurrence of this risk event may inevitably result in system to be out-of-work for a period of time and thus disturb normal operation of the organisation (Sherer, 2004). System users and in-house IT experts should ensure appropriate system use, monitoring and maintenance in order to reduce the frequency of occurrence of this risk event (Sherer, 2004).

6.4.5.3 System maintenance and revision risks

System is not properly modified to meet new business requirements

User requirements of the company may be constantly changed under the highly dynamic market environment. The implemented ERP system should therefore be continuously reviewed and modified in the post-implementation phase in order to meet new user requirements. However, this task may not always be carried out properly in many companies due to low flexibility of the ERP system, high reconfiguration cost, lack of in-house experts and insufficient support from system vendors and consultants. If this risk event occurs, the system may gradually become less efficient to support user needs, which may impact business operational efficiency.

Technical bugs of the system cannot be speedily overcome

Technical errors, usually known as bugs, may exist in the ERP system due to poor system design or technical mistakes being made in the cycle of implementation and even post-implementation (Sherer, 2004). These technical bugs may not be able to be overcome easily and speedily due to various ERP barriers and risks discussed above, e.g. insufficient user feedback, low system flexibility for modification, insufficient fund, and insufficient support from system vendors. It can therefore impact system performance and business operational efficiency (Sherer, 2004).

Outdated and duplicated data is not properly discarded

Loh and Koh (2004) state that "arranging, purging and updating the data are fundamental to ensuring the highest level of accuracy possible". They further point out that companies should develop and retain good system maintenance discipline to ensure data in the ERP system can be purged regularly. It can be argued that if outdated and/or duplicated data of the ERP system is not discarded properly, it may lead to low data accuracy, reduce speed of data search and increase data storage space and cost.

6.4.6 Summary of risk discussion

The above sections present and discuss 40 potential risk events that may occur in ERP post-implementation. Table 6.2 summarises these identified risk events associated with their potential causes and consequences.

6.5 Initial ontology of ERP post-implementation barriers and risks

6.5.1 What is an ontology?

Conceptualization refers to the objects, concepts and other entities that are assumed to exist in a domain of interest and the relationships that these hold among them (Gruber, 1993). Whereas a conceptualization is an abstract and simplified view of the world that we wish to represent for some purposes, an ontology is an explicit specification of a conceptualization (Gruber, 1993). Therefore, an ontology can be seen as:

Table 6.2: Summary of potential risk events in ERP post-implementation

Categories	ID	Risk event	Causes/Risk factors	Potential impacts/consequences	Supported literature
Operational Risk (OR)	**OR**				
In General (OR1)	OR1.1	Operational staff are reluctant to use the ERP system	Reluctant to change; Fear of loss of job; Insufficient training; Deficient system design; Poor data quality.	Reduce staff motivation and performance; Reduce system acceptance and usage.	Chou et al., 2005; Scapens and Jazayeri, 2003
	OR1.2	Operational staff input incorrect data into the system	Insufficient training; Lack of experience; Human negligence; Human fraud, etc.	Poor data accuracy and quality; One user's mistake can raise immediate impact and problems to the entire company and disturb normal operation.	Scapens and Jazayeri, 2003; Fisher and Kingma, 2001; Vosburg and Kumar, 2001.
Sales and Marketing area (OR2)	OR2.1	Sales staff are not able to obtain data and information they need from the system	Insufficient training; Poor system interface; Irrational system design; Misfits between system functions and user requirements.	Not able to respond to customer requests (e.g. order-related issues, after-sales service) speedily;	Wright and Donaldson, 2002
	OR2.2	Customer files contained in ERP are out-of-date or incomplete	Inappropriate system usage due to sufficient user training; Deficient system design.	Fail to target on valuable customers; Fail to maintain customer loyalty and good customer relationship; Lose existing customers.	Vosburg and Kumar, 2001; Wright and Donaldson, 2002.
Production and Purchasing area (OR3)	OR3.1	System contains inaccurate supplier records	Large number of suppliers for wide range of material; Frequently changing suppliers due to unstable relationship; Human mistake.	Result in significant problems, mistakes and delays in procurement and production.	Zhou et al., 2005
	OR3.2	System contains inaccurate or incomplete bill of materials	Human mistake; Different and inconsistent BOM exist in the company.	Materials required in production cannot be arrived at the right time and in the right quantities; Lead to a set of serious outcomes, e.g. increase inventory cost, reduce production efficiency, etc.	Klaus et al., 2000; Koh et al., 2000; Zhou et al., 2005

	OR3.3	System contains inaccurate inventory records	Human mistake; Fraud/thief; Record of stocks stored in third-party warehouse is not up-to-date.	Disturb operation of the entire company (e.g. inappropriate procurement and production orders, and miscalculate the value of current inventory, etc).	Zhou et al., 2005; Umble et al., 2003; Chen et al., 2001
Financial and accounting area (OR4)	OR4.1	Account staff are unwilling to release accounting responsibility/power to non-account staff	ERP systems enable and require account information to be used and handled by non-account staff across the company; Inefficient communication and collaboration between departments.	Conflicts and arguments between functional departments; Poor operational efficiency and performance.	Kumar and Hillegersberg, 2000; Caglio, 2003; Scapens and Jazayeri, 2003
	OR4.2	Non-account staff are unwilling and incapable to take up accounting responsibilities			
Analytical Risk (AR)	**AR**				
In General (AR1)	AR1.1	Front-line managers refuse to use the ERP system	Reluctant to change; Insufficient training; Poor data quality; Less inclined to use systematic procedures and explicit information to tailor forecasts and plans; Trust personal common sense rather than system data to make decisions.	Low system acceptance and usage; Underutilise the full potential of ERP systems.	Scapens and Jazayeri, 2003; Ronald et al., 2000
	AR1.2	Managers cannot retrieve relevant and needed information from the system	Formats and contents of reports provided by the system are inappropriate and cannot be flexibly changed and customised; Misfits between system functions and user requirements.	Poor decision making; Reduce system acceptance and usage.	Lucas, 1975; Sage, 2005; Soh et al, 2000

Sales and Marketing area (AR2)	AR2.1	Fail to use the system to generate accurate sales forecast	Rapid market growth and changes in customer needs; Lack of accurate and reliable market statistical data;	Sales staff are not assigned with reasonable sales quotas; Inappropriate production plan and financial budget.	Doshi and Campbell, 2003; Ranard, 1972; Zhou et al., 2005
	AR2.2	Fail to predict the demands of new products	Lack of past sales data; Rapid changes in customer trends; Insufficient market information; Frequent launch of new products.	Lead to financial loss and put companies at a disadvantage; Disturb the production of existing products and distort production plans and financial budgets generated by the ERP system.	Wright and Donaldson, 2002
	AR2.3	System fails to support sales personnel to provide special sales offers and promotion to existing customers	Lack of up-to-date customer info file; Lack of fast and up-to-date sales information from local retailers.	Reduce competitive advantage; Reduce customer retention; Lose potential cross-selling and up-selling opportunities.	Wright and Donaldson, 2002
Production and Purchasing area (AR3)	AR3.1	System fails to generate appropriate master production schedule	Inaccurate sales forecast.	Result in finished product shortages and/or overages, which directly impact costs, customer delivery lead time and customer satisfaction.	Chen, 2001; Slack, 2005; Zhou et al. 2005
	AR3.2	ERP fails to generate appropriate material net requirement plan	Inappropriate master production schedule; Inaccurate BOM; Inaccurate inventory records.	Material or component shortage or over-ordering/producing; Production of end product is delayed or ceased.	Chen, 2001; Koh et al, 2000; Musselman et al., 2002.
Financial and accounting area (AR4)	AR4.1	Fail to generate appropriate financial budgets	Rapid market growth and changes in market conditions (e. g. customer needs, material prices); Inaccurate sales forecast.	Staff are assigned with unreasonable targets; Important business areas (e.g. ERP upgrade and maintenance) may not be assigned with sufficient funds.	Ekholm and Wallin, 2000

Organisation-Wide Risk (OWR)	**OWR**				
Top management (OWR1)	OWR1.1	Top managers make important IT decisions without consulting IT experts and system users	Power centralization and centralised decision making.	Inappropriate decision making; Reduce involvement and motivation of staff.	Lientz and Larssen, 2006
	OWR1.2	Substantial personnel changes in the top management team	Company policies; Personal reasons.	New managers do not provide sufficient support to ERP; Changes in business direction and goals.	Lientz and Larssen, 2006
	OWR1.3	Top managers do not provide sufficient support to ERP post-implementation	Short-term thinking; Lack of awareness.	Low employee involvement; Conflicts and arguments related to ERP cannot be solved smoothly; Insufficient ERP fund.	Gargeya and Brady, 2005; Sherer and Alter, 2004; Tsai et al., 2005; Zhang, 2004.
IS/ERP planning (OWR2)	OWR2.1	IS/ERP post-implementation development plan is missing, ill-defined or misfit with business strategy	Short-term behaviour; Lack of top management commitment; Lack of IT experts; Changes in business strategy and direction.	Unclear direction for further IS development; IS cannot support business strategies and goals.	Willis and Willis-Brown, 2002; Lientz and Larssen, 2006
	OWR2.2	Direction for further ERP improvement and development is unclear	Lack of efficient IS development plan.	ERP system cannot be further improved to support long-term business goals; Inappropriate system investment.	Lientz and Larssen, 2006
	OWR2.3	Budgets and funds assigned to ERP post-implementation are insufficient	Short-term behaviour; Lack of top management support; Lack of appropriate IS development plan; Post-implementation cost is too expensive.	System maintenance, upgrade and improvement cannot be carried out properly.	Loh and Koh, 2004; Lientz and Larssen, 2006

In-house specialists (OWR3)	OWR3.1	Fail to form an efficient cross-functional team to continuously review and revise the ERP system	Lack of in-house experts; In-house staff lack critical thinking skills; Inefficient communication and collaboration across departments; Lack of top management commitment; Team members are assigned with too many responsibilities.	System pitfalls cannot be properly overcome; Goals of post-implementation projects cannot be met; System may not be able to improve to satisfy new business requirements.	Gargeya and Brady, 2005; Buckhout et al, 1999; Loh and Koh, 2004; Sumner, 2000
	OWR3.2	Lose qualified IT/ERP experts	High market demand of skilled IT/ERP experts; Poor retention programme of the company.	Lack of in-house IT experts to lead ERP review and revision	Sumner, 2000; Burrows et al., 2005
	OWR3.3	Lose ERP-related know-how and expertise accumulated over time	High context and implicit form of communication; Staff are unwilling to share information freely; In-house specialists leave the company.	Loss of important intangible asset.	Scott and Vessey, 2000;
System users (OWR4)	OWR4.1	Users (both staff and managers) do not receive sufficient and continuous training	Poor training programmes for existing and new employees; Insufficient resources and funds allocated.	Do not have sufficient skills to use the system; Employees and managers are reluctant to change; User frustration and dissatisfaction.	Gargeya and Brady, 2005; Loh and Koh, 2004
	OWR4.2	Users are uncomfortable to use the ERP system in their daily jobs	Insufficient training; Slow system response time; Irrational and inflexible system design.	User frustration and dissatisfaction; More human mistakes; Time-wasting.	Damodaran and Olphert, 2000

	OWR4.3	ERP-related problems are not reported promptly by system users	Low involvement of staff; Unwilling to disclose problems, faults and failures due to preservation of 'face'.	Difficult for IT staff to identify system issues and areas for revision and enhancement.	Namjae and Kiho, 2003; Wright and Donaldson, 2002
	OWR4.4	Data access right is authorised to inappropriate users	The company lacks clear and suitable data access policies.	System data can not be accessed and modified by appropriate users, which may result in data loss, errors and information leakage.	Loh and Koh, 2004
	OWR4.5	Confidential data is accessed by unauthorised people	Poor data protection and access policy; Business crimes.	Information leakage; Financial loss; Business crisis.	Yosha, 1995; Wilding, 2003; Loh and Koh, 2004.
System vendors and consultants (OWR5)	OWR5.1	Cannot receive sufficient technical support from system vendors	Various vendor issues (e.g. inadequate vendor performance, withdrawal from the market, vendor is acquired by another company, etc).	Increase difficulties for companies to maintain and upgrade their systems; Technical pitfalls of the system may not be solved speedily and properly.	Lientz and Larssen, 2006
	OWR5.2	Cannot receive sufficient and proper consulting advice from system consultants	Inexperienced consultants; Staff of user companies are unwilling to disclose problems.	Increase difficulties for companies to revise and improve their systems.	Sumner, 2000
Technical Risk (TR)	**TR**				
System integration (TR1)	TR1.1	Current modules or current and new modules of the ERP system can not be perfectly integrated	Poor system design; ERP system consists of modules provided by different system vendors.	Poor data and business process integration; System fragmentation.	Currie, 2003; Brehm and Gómez, 2005

	TR1.2	Current ERP system is not able to seamlessly integrate with other information systems (e.g. legacy systems, systems of the newly merged companies)	Low system compatibility.	Poor data and business process integration; System and data fragmentation.	Fletcher and Wright, 1995
System faults (TR2)	TR2.1	Invalid data is not automatically detected when getting into the system	Poor detection capability of invalid data	Data errors (e.g. duplicated, outdated, incorrect and unreasonable data).	Sage, 2005; Alter, 2002
	TR2.2	Hardware or software crashes	Inappropriate system operation & maintenance; Poor system quality.	System has to be out of work for a period; Disturb normal operation.	Sherer, 2004
System maintenance and revision (TR3)	TR3.1	Technical bugs of the system cannot be speedily overcome	Insufficient user feedback; Low system flexibility; Insufficient budget; Insufficient support from system vendors and consultants.	Poor system performance; Reduce business operational efficiency; User dissatisfaction.	Sherer, 2004
	TR3.2	Outdated and duplicated data is not properly discarded	Invalid data cannot be detected; Inappropriate system maintenance discipline.	Reduce data accuracy and speed of data search; Increase data storage space and cost.	Loh and Koh, 2004
	TR3.3	System is not properly modified to meet new business requirements	Low system flexibility; High reconfiguration cost; Lack of in-house and external experts.	Poor system performance; Reduce business operational efficiency; User needs cannot be satisfied.	Cabrera et al., 2001; Willis and Willis-Brown, 2002

> "a diagrammatic model and a knowledge base that defines a common vocabulary for researchers who need to share information in a domain. It includes [...] interpretable definitions of basic concepts in the domain and relations among them." (Noy and McGuinness, 2001)

Ontology is a tool that has been commonly used in computer sciences and programming, and is increasingly adopted by social science researchers to highlight and share key concepts and ideas in their study (Peng and Nunes, 2007a). There are three reasons why an ontology is worth developing in research studies (Noy and McGuinness, 2001):

- An ontology allows researchers to highlight and share common and novel concepts in their subject domain more easily and efficiently.
- Other researchers can reuse the domain knowledge presented in the ontology and make further extension and development.
- Concepts and assumptions made in the ontology can be easily changed and extended in accordance with changes of the researcher's knowledge about the subject domain.

Despite the fact that procedures for developing an ontology in different subject domains may vary, two tasks lay at the core of ontology development: first, defining concepts to be covered in the ontology; second, organising these concepts into a taxonomic (subclass–superclass) hierarchy, in which upper level contains general concepts and lower level covers more specific concepts (Noy and McGuinness, 2001). By following these principles, a barrier ontology and a risk ontology were developed to highlight the identified ERP exploitation barriers and risks, as shown in the following sections.

6.5.2 Initial ontology of ERP post-implementation barrier

The barrier ontology shown in Figure 6.1 highlights the identified ERP exploitation barriers in this chapter. This barrier ontology consists of two hierarchical levels ranging from general barrier categories (e.g. organizational barrier) to specific barrier items (e.g. lack of top management support). The suitability of this barrier ontology in the context of selected Chinese SOEs was examined through a questionnaire survey at the next stage of this project, as discussed in chapter seven.

Moreover, it emerged from the discussion made in section 6.2 that, an ERP barrier may often be the cause or consequence of other barriers. The barrier ontology thus also highlights a number of potential causal relationships that may exist between the identified ERP barriers based on discussion made in section 6.2, and thus provides some initial ideas for the researcher to explore correlations between ERP barriers in the selected context at the next stage of this study.

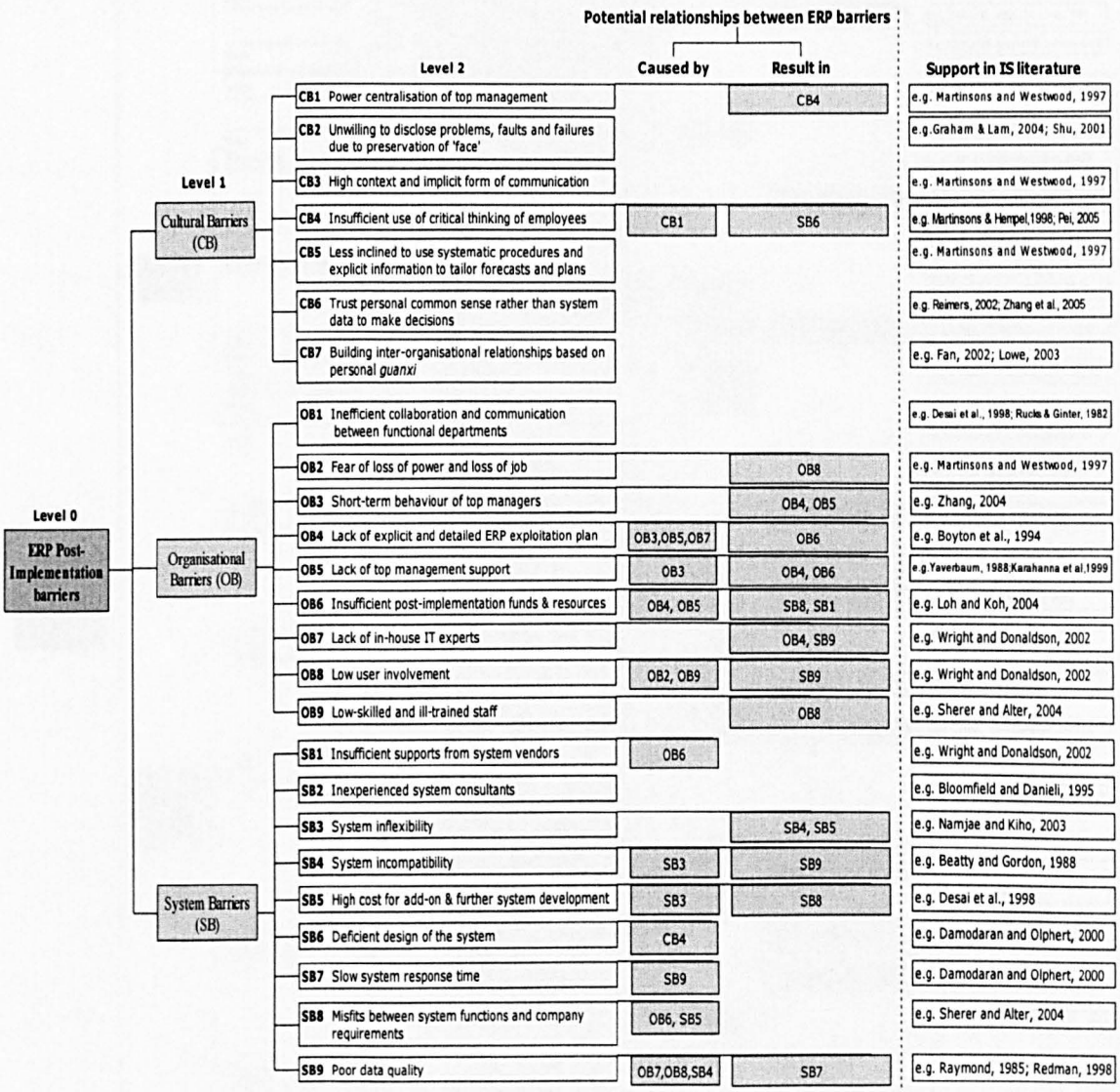


Figure 6.1: Ontology of ERP post-implementation barriers

6.5.3 Initial ontology of ERP post-implementation risk

The risk ontology shown in Figure 6.2 highlights the identified ERP risk events in this chapter. This risk ontology consists of three hierarchical levels ranging from general risk categories (e.g. operational risks) to specific risk items (e.g. operational staff are reluctant to use ERP). The suitability of this risk ontology within the context of

selected Chinese SOEs was examined through a questionnaire survey at the next stage of this project.

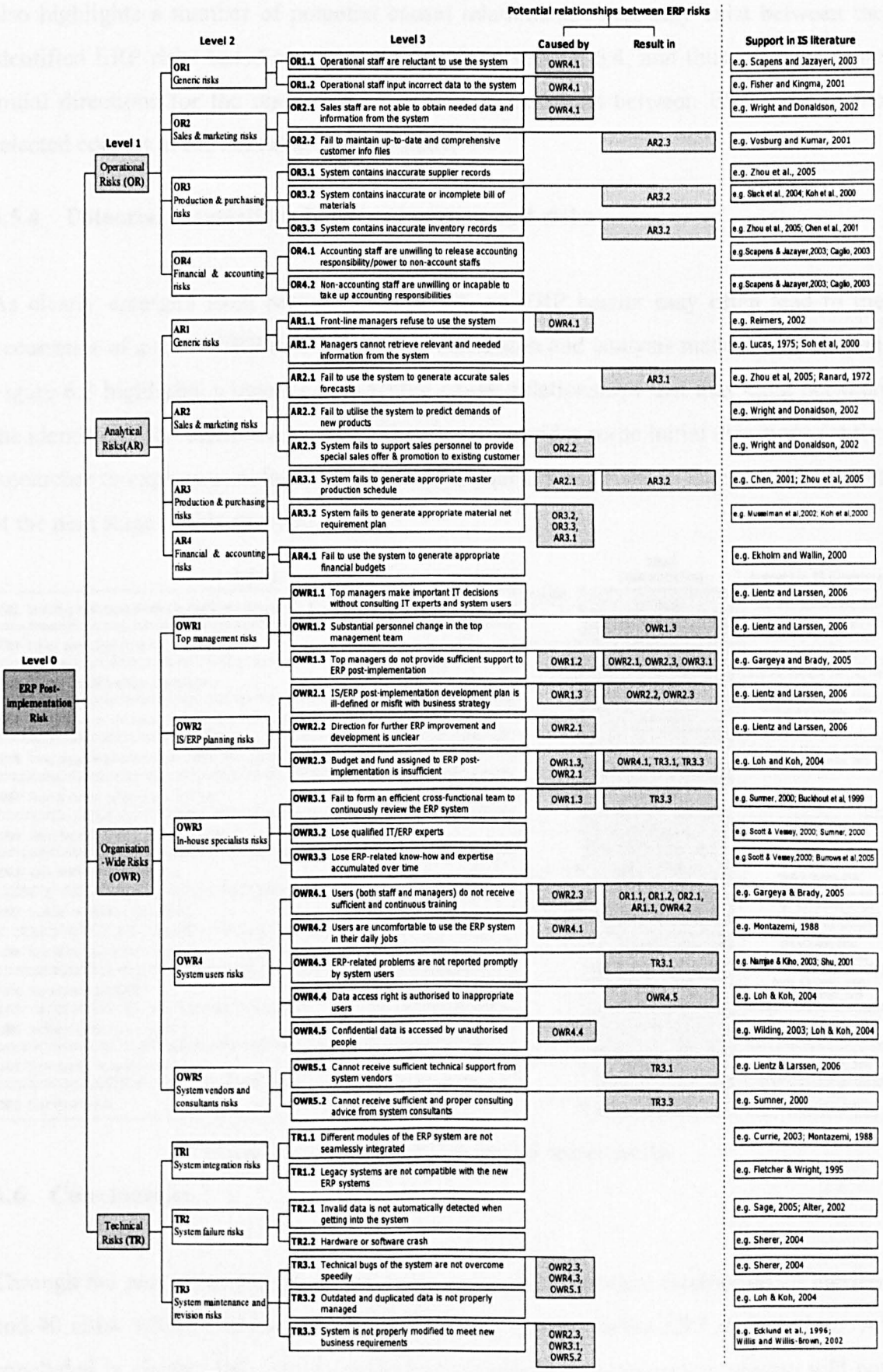


Figure 6.2: Ontology of ERP post-implementation risks

In addition, it emerged from the discussion made in section 6.4 that, the occurrence of an ERP risk may often be related to the occurrence of other risks. This ontology thus also highlights a number of potential causal relationships that may exist between the identified ERP risks based on discussion made in section 6.4, and thus provides some initial directions for the researcher to explore correlations between ERP risks in the selected context at the next stage of this study.

6.5.4 Potential correlations between barriers and risks

As clearly emerged from section 6.2 and 6.4, an ERP barrier may often lead to the occurrence of a set of ERP risks. Based on discussion and analysis made in this chapter, Figure 6.3 highlights a number of potential causal relationships that may exist between the identified ERP barriers and risks. This figure provides some initial directions for the researcher to explore correlations between ERP barriers and risks in the selected context at the next stage of this research.

BARRIER	cause	ID of RISK EVENT(S)	Support in IS literature
CB2 Unwilling to disclose problems, faults and failures due to preservation of 'face'	→	OWR4.3	Shu, 2001; Namjae & Kiho, 2003
CB3 Power centralisation of top managers	→	OWR1.1	Martinsons &d Westwood, 1997; Reimers, 2002.
CB4 Lack of critical thinking of employees	→	OWR3.1	Martinsons & Hempel, 1998; Pei, 2005; Gargeya & Brady, 2005
CB5 Less inclined to use systematic procedures and explicit information to tailor forecasts and plans	→	AR1.1	Martinsons & Westwood, 1997; Xue et al., 2005
CB6 Trust personal common sense rather than system data to make decisions	→	AR1.1	Martinsons & Westwood, 1997; Zhang et al., 2005; Reimers, 2002
OB2 Fear of loss of power and loss of job	→	OR1.1, AR1.1	Beatty & Gordon, 1988; Martinsons & Westwood, 1997
OB3 Short-term behaviour of top managers	→	OWR1.3, OWR2.1	Yuan & Ma, 2005; Gargeya & Brady, 2005
OB4 Lack of ERP exploitation plan	→	OWR2.2, OWR2.3	Wright & Donaldson, 2002; Lientz & Larssen, 2006
OB7 Lack of in-house IT specialists	→	OWR2.1, TR3.3	Wright & Donaldson, 2002; Lientz & Larssen, 2006
OB9 Low-skilled and ill-trained staff	→	OR1.1, AR1.1	Sherer & Alter, 2004; Wright & Donaldson, 2002
SB4 System incompatibility	→	TR1.2	Beatty and Gordon, 1988; Fletcher & Wright, 1995
SB6 Deficient design of the system	→	OWR4.2	Damodaran & Olphert, 2000; Sherer & Alter, 2004
SB7 Slow system response time	→	OWR4.2, OR1.1	Damodaran & Olphert, 2000;
SB9 Poor data quality	→	OR1.1, AR1.1	Redman, 1998; Sherer and Alter, 2004

Figure 6.3: Causal relationship between barrier and risk

6.6 Conclusions

Through the process of a critical literature review, the researcher established 29 barriers and 40 risks, which Chinese companies might encounter during ERP exploitation. As concluded in chapter two, problems associated with ERP post-implementation will not be limited to technical dimensions (e.g. software, ICT infrastructure), but more

importantly can also potentially be found in various human and organisational aspects. The ERP barriers and risks identified and discussed in this chapter echoed this original expectation. Specifically, the 29 identified ERP barriers consisted of 7 cultural barriers, 9 organisational barriers, 4 external barriers, and 9 system barriers. On the other hand, the 40 identified ERP risks contained 9 operational risks, 8 analytical risks, 16 organisation-wide risks and 7 technical risks.

Moreover, two ontologies were developed to highlight respectively the identified ERP barriers and risks. These established ERP barrier and risk ontologies are an explicit IS lens, which enabled the researcher to frame the study and generate data collection tools. In order to examine the suitability of the established theoretical ontology in the context of selected Chinese SOEs, a cross-sectional survey was designed and conducted in this project and discussed in the next chapter. Please note that because the 4 external barriers identified were concerned with relatively sensitive topics under the current Chinese context, they were not included in the questionnaire as discussed in chapter five (section 5.6.3).

Chapter Seven: Results and Findings of the Questionnaire Survey

7.1 Introduction

As discussed in chapter five, after the questionnaire survey was administrated and completed, all collected data were inputted into SPSS for analysis. The analysis of the quantitative data comprised four main parts in accordance with the structure of the questionnaire (appendix 2 & 3):

- The first part of the analysis was concerned with questions involved in the first section of the questionnaire. It aimed at generating a descriptive analysis about the characteristics of the respondents and SOEs that participated in the survey.

- The second part of the analysis involved both a univariate analysis and a bivariate analysis of the barrier items that were listed in the second section of the questionnaire, and aimed at identifying a set of ERP barriers that were crucial to SOEs as well as exploring the correlations between the identified barriers.

- The third part of the analysis contained a univariate analysis as well as a bivariate analysis of the risk items that were listed in the third section of the questionnaire. It aimed at identifying a set of risks that were significant to ERP post-implementation in SOEs and exploring the correlations between the identified risks.

- The final part of the analysis included a bivariate analysis which aimed at exploring the correlations between the identified ERP barriers and risks.

This chapter thus presents, describes and discusses the findings derived from each of these components of the data analysis.

7.2 Descriptive analysis of the respondent sample

Job titles of respondents in the company

As discussed in chapter five, two questionnaires were designed in this study in order to obtain perspectives from both business managers and ICT experts. Specifically, questionnaire A was expected to be filled in by the operation manager of the company or one that had sufficient knowledge on the company's operation. On the other hand, questionnaire B was expected to be completed by the IT manager of the firm or one that had extensive knowledge on ISs or ERP. The two designed questionnaires were then sent to 118 SOEs in Guangdong. As presented in chapter five, 42 SOEs (2*42 = 84 respondents) completed and returned the questionnaires, which represented a response rate of 35.6%.

As shown in figure 7.1, the vast majority of the respondents of questionnaire A held managerial positions in the company, i.e. operation manager, general manager or CEO, manager in the general management team and IT manager. On the other side, respondents of questionnaire B held IT or managerial positions in the firm. Respondents of this survey therefore proved to be suitable stakeholders to participate in the research.

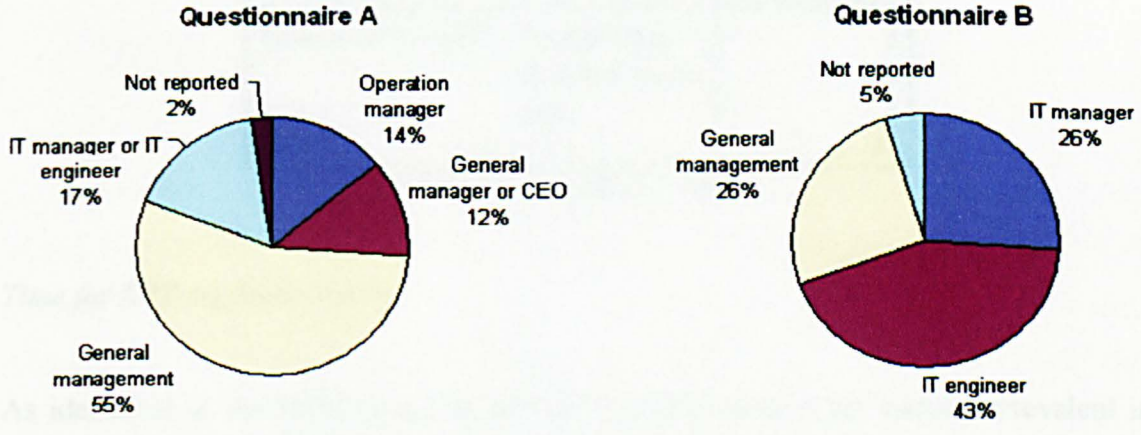


Figure 7.1: Job titles of respondents

Whether or not the respondent SOE has ERP

As identified in the PEST analysis, Chinese companies in the electronic and telecommunication manufacturing sector should have achieved high level of informatization development. It was therefore expected that the majority of SOEs

studied should have adopted ERPs. This original expectation proved to be true. As shown in Table 7.1, ERP has been implemented in 37 (88.1%) out of 42 respondent SOEs. It therefore seems that a study of ERP post-implementation in Chinese SOEs may not just be timely but actually highly adequate.

Whether the SOE has ERP	Frequency	Percent
Yes	37	88.1
No	5	11.9
Total	42	100.0

Table 7.1: Whether the SOE has ERP

Whether the respondent SOE is using foreign or domestic ERP

In addition, among the 37 SOEs that have ERP, 6 of them are using foreign ERP systems, 27 of them have adopted domestic ERP packages, and 4 of them combined the use of ERP components provided by both foreign and domestic vendors (Table 7.2). This result echoed the findings of the literature review (as discussed in the PEST analysis), which identified that local ERP vendors currently hold a stronger position and possessed a larger portion of the market share than their foreign rivals in the Chinese ERP market.

		SOE has ERP
Type of ERP vendor	Foreign vendor	6
	Domestic vendor	27
	Both	4
Total		37

Table 7.2: Type of ERP vendor

Time for ERP implementation

As identified in the PEST analysis, the use of ERP systems has become prevalent in China since 2000. ERP was thus expected to be used in Chinese SOEs for a number of years. This was confirmed in the findings. In particular, as shown in table 7.3, among the 37 respondent SOEs that have adopted ERP, the majority (83.8%) of them have been using ERP for 2 to 6 years.

How long has ERP been implemented	Frequency	Percent
Less than 2 years	2	5.4
2 to 4 years	25	67.6
5 to 6 years	6	16.2
7 to 9 years	2	5.4
10 years or more	2	5.4
Total	37	100.0

Table 7.3: How long has the ERP system been implemented

Reasons for not using ERP currently

Furthermore, the 10 respondents, from the 5 SOEs that had not adopted ERP, highlighted a number of reasons why ERP was not currently used (table 7.4). These reasons included: they do not have sufficient knowledge about ERP (40%); they do not have sufficient fund to implement ERP (40%); the ERP implementation project involves too many risks (30%); there is no need to adopt ERP since the firm has many legacy systems (20%); and they may implement ERP in the future but now it is not the right time (70%).

Reasons for not using ERP	Frequency (Total = 10)
Do not have sufficient knowledge about ERP	4
Do not have sufficient fund to implement ERP	4
The ERP implementation project involves too many risks	3
Have many legacy systems and no need to use ERP	2
May implement ERP in the future but now it is not the right time	7

Table 7.4: Reasons for not using ERP

In sum, the two questionnaires were completed and returned by respondents from 42 out of the 118 SOEs. 37 (88.1%) of the 42 respondent SOEs have implemented ERP systems. Among these, 31 (83.8%) have been using ERPs for 2 to 6 years. Although 5 respondent SOEs have not adopted ERP, 70% of the respondents from these SOEs stated that they would consider implementing ERP in the future. These results prove that a research study on ERP post-implementation may not just be significant but may also be highly desirable, in order to help SOEs to identify and tackle possible ERP exploitation issues.

7.3 Analysis of ERP barriers

This section presents and discusses the findings derived from the univariate and bivariate analysis of the barrier variables examined in the questionnaire. In addition, these findings were discussed and interpreted in relation to previous IS and ERP literature as relevant.

7.3.1 Univariate analysis of barrier items

As presented in chapter five, univariate analysis of the barrier items refers to the descriptive analysis of the ERP barriers examined. Frequency table is used to present to which degree respondents agreed or disagreed with these barrier items.

7.3.1.1 Cultural barriers

7 cultural barriers to successful ERP exploitation were identified from the critical literature review, as presented in chapter six. Table 7.5 summarises the questionnaire findings associated with these cultural barriers.

Cultural Barriers	N = 42	Strongly Disagree		Disagree		Neither		Agree		Strongly Agree	
		F	%	F	%	F	%	F	%	F	%
CB1	Power centralisation of top management	12	28.6	12	28.6	2	4.8	15	35.7	1	2.4
CB2	Unwilling to disclose problems, faults and failures	12	28.6	25	59.5	4	9.5	1	2.4	0	0
CB3	High context and implicit form of communication	15	35.7	19	45.2	6	14.3	2	4.8	0	0
CB4	Staff do not use critical thinking skills	18	42.9	14	33.3	6	14.3	3	7.1	1	2.4
CB5	Less inclined to use explicit procedures and info to tailor forecasts and plans	6	14.3	27	64.3	6	14.3	3	7.1	0	0
CB6	Trust personal common sense/intuition rather than system data to make decisions	8	19	22	52.4	4	9.5	8	19.1	0	0
CB7	Building inter-organisational relationships based on personal *guanxi*	26	61.9	7	16.7	7	16.7	2	4.8	0	0

F = Frequency

Table 7.5: Frequency table for cultural barriers

As shown in the table, only 'power centralisation of top managers' was perceived by a significant amount (38.1%) of the respondents as a barrier to ERP exploitation. This finding seemed to confirm that top managers in a considerable number of SOEs would often hold strong and centralised power in the firm. As argued by Reimers (2002), the

existence of this barrier may result in Chinese leaders to make centralised decisions on important IS issues without collecting and considering alternative ideas from a wider group of people. This could be particularly dangerous, since top managers may typically lack sufficient experience of operational situations and lack technical knowledge to make appropriate ERP post-adoption decisions on their own.

On the other hand, the remainder 6 cultural barriers examined were not considered by the majority of the respondents as problems that they encountered during ERP exploitation. More specifically, 72% ~ 88% of the respondents disagreed with the barrier statements given. In fact, it is reasonable to argue that the recent SOE reform (as discussed in the PEST analysis) and the adoption of ERP systems may actually help SOEs to improve some of these traditional cultural issues. For instance, it was expected that Chinese staff may be traditionally 'reluctant to disclose problems, faults and failures to their colleagues' in order to preserve personal images (Shu, 2001). However, the finding of the survey was different from this original expectation. It is possible that, after experiencing economic and SOE reform, modern SOEs may provide a more open climate to facilitate staff to talk about their problems and failures in order to gain advices and help from each other. More importantly, this internal change may actually be a consequence of the use of ERP systems. In particular, business processes of the firm will often become more integrated and transparent after using ERP (Scapens and Jazayeri, 2003; Allen, 2005). As a result, staff in SOEs may be more willing to report problems they encountered at an early stage rather than attempting to hide their mistakes, which can now be identified by the others easily and can also result in significant impacts on other's work.

Overall, the questionnaire findings showed that, among the cultural barriers studied, only 'power centralisation of top managers' was identified as an important ERP exploitation issue by a considerable number of the respondents.

7.3.1.2 Organisational barriers

A set of 9 organisational barriers were initially identified and presented in chapter six. Table 7.6 presents the questionnaire results associated with these ERP barriers.

Organisational Barriers N = 42		Strongly Disagree		Disagree		Neither		Agree		Strongly Agree	
		F	%	F	%	F	%	F	%	F	%
OB1	Inefficient collaboration & communication between functional departments	18	42.9	13	31	4	9.5	7	16.7	0	0
OB2	Fear of power and job loss	17	40.5	19	45.2	4	9.5	2	4.8	0	0
OB3	Short-term behaviour of companies	24	57.1	8	19.1	5	11.9	4	9.5	1	2.4
OB4	Lack of explicit business and IS development plan and strategy	11	26.2	14	33.3	11	26.2	6	14.3	0	0
OB5	Lack of top management support	23	54.8	13	31	3	7.1	3	7.1	0	0
OB6	Insufficient ERP exploitation funds and resources	10	23.8	15	35.7	11	26.2	6	14.3	0	0
OB7	Lack of in-house experts	10	23.8	14	33.3	5	11.9	13	31	0	0
OB8	Low involvement of employees	8	19.1	21	50	9	21.4	3	7.1	1	2.4
OB9	Low-skilled and ill-trained staff	11	26.2	22	52.4	4	9.5	5	11.9	0	0

F = Frequency

Table 7.6: Frequency table for organisational barriers

It clearly emerged from this table that, among the organisational barriers examined, only 'lack of in-house experts' was perceived to be important by a significant amount (31%) of the respondents. As discussed in chapter six, success of ERP implementation and post-implementation is dependent on the collaboration and cooperation of various types of in-house experts, e.g. project leaders, IT experts, and specialists in different functional divisions. The existence of this barrier may prevent Chinese SOEs from effectively maintaining, monitoring and improving their ERP systems in the long-term.

On the other hand, the other 8 organisational barriers were not perceived by the majority of the respondents to be important. As shown in the table, 60% ~ 85% of the respondents disagreed or strongly disagreed with the statements associated with these barriers. In truth, it can be argued that the adoption and use of ERPs may help SOEs to remove some of these organisational barriers. For instance, ERP systems can often help user companies to break down departmental boundaries, and thus encourage cross-functional integration and cooperation (Sia et al., 2002; Allen, 2005). This can potentially improve 'collaboration and communication between functional divisions'. Moreover, it may also be argued that some of these organisational barriers (e.g. fear of losing power and job) may be more likely to exist when the ERP system just goes live. However, as discussed above, the majority of the respondent SOEs have been using ERP for 2 ~ 6 years. These SOEs thus may get more used to the ERP environment and have less organisational problems towards ERP usage.

In sum, the findings showed that, among the 9 organisational barriers studied, only 'lack of in-house experts' was identified by a significant number of the respondents as an important ERP exploitation barrier.

7.3.1.3 System barriers

It was also expected that user companies may often be confronted with a number of system barriers in ERP post-implementation. Table 7.7 presents the findings associated with the 9 system barriers initially grounded from the critical review process.

System Barriers N = 42		Strongly Disagree		Disagree		Neither		Agree		Strongly Agree	
		F	%	F	%	F	%	F	%	F	%
SB1	Insufficient support & service from ERP vendors	3	7.1	14	33.3	9	21.4	14	33.3	2	4.8
SB2	Inexperienced and low-qualified system consultants	4	9.5	15	35.7	13	31	10	23.8	0	0
SB3	System inflexibility	2	4.8	18	42.9	8	19.1	14	33.3	0	0
SB4	System incompatibility	2	4.8	17	40.5	8	19.1	15	35.7	0	0
SB5	High cost for add-ons and further system development	6	14.3	19	45.2	7	16.7	10	23.8	0	0
SB6	Deficient design of the system	3	7.1	18	42.9	7	16.7	14	33.3	0	0
SB7	Slow system response time	1	2.4	17	40.5	13	31	11	26.2	0	0
SB8	Misfits between system functions and company requirements	2	4.8	27	64.3	10	23.8	2	4.8	1	2.4
SB9	Poor data quality	4	9.5	26	61.9	7	16.7	5	11.9	0	0

F = Frequency

Table 7.7: Frequency table for system barriers

Investigating this frequency table, it became apparent that about 70% of the respondents disagreed with the statements related to 'misfits between system functions and user requirements' and 'poor data quality'. These two system barriers thus did not seem to be current ERP issues faced by SOEs. Nevertheless, the remainder 7 system barriers examined were perceived by a significant amount (23.8% ~ 38%) of respondents to be important ERP exploitation issues. These barriers should therefore receive particular attention from SOE managers.

Overall, the questionnaire findings presented so far showed that, most system barriers were perceived by respondents to be important to SOEs, while only 1 cultural barrier and 1 organisational barrier were identified to be important ERP issues in these firms. In other words, respondents of the survey seemed to perceive system barriers to be more

critical than cultural and organisational ones. This issue is further analysed and discussed in section 7.3.3.

7.3.2 Bivariate analysis of barrier items

The study also aimed at investigating if the existence of a particular ERP barrier was related to the existence of other barriers. A set of potential relationships between the identified barriers were initially grounded from the critical literature review process, and were highlighted in the barrier ontology presented in section 6.5.2.

In order to examine these potential barrier correlations in the context of Chinese SOEs, a bivariate analysis was conducted. As justified in chapter five, Spearman's rho (r_s) and one-tailed test was used in this bivariate analysis. By following this approach, the researcher identified a set of statistically significant relationships between the identified ERP barriers, as presented below.

Short-term thinking and lack of top management support

As discussed in chapter six, when top managers in the firm value short-term results more than long-term achievement (Yuan and Ma, 2005), they may fail to provide continuous support to ERP exploitation. In other words, 'lack of top management support to ERP post-implementation' may be directly related with 'short-term behaviour' in the firm. Spearman's correlation was thus used to measure the relationship between these barrier variables. The output in table 7.8 shows that, these two variables are positively related with a Spearman correlation coefficient of $r = .584$, and this correlation is significant at $p < .001$. It can thus be concluded that, as top managers are more likely to have short-term behaviour, it is more likely for them to provide insufficient and discontinuous support to ERP exploitation.

			Lack of top management support	Short-term behaviour
Spearman's rho	Lack of top management support	Correlation Coefficient	1.000	.584(**)
		Sig. (1-tailed)	.	.000
		N	42	42

** Correlation is significant at the 0.01 level (1-tailed).

Table 7.8: Correlation between top management support and short-term behaviour

Lack of ERP plan, management behaviour and IT experts

It was considered that the absence of a clear ERP plan could be a result of insufficient top management support, short-term behaviour of top managers and/or lack of in-house experts. Spearman's correlation was thereby used to measure the relationship between these four barrier variables. The output in table 7.9 shows a number of correlations between these variables.

			Lack of ERP plan	Lack of top management support	Short-term behaviour	Lack of in-house experts
Spearman's rho	Lack of ERP plan	Correlation Coefficient	1.000	.517(**)	.446(**)	.507(**)
		Sig. (1-tailed)	.	.000	.002	.000
		N	42	42	42	42

** Correlation is significant at the 0.01 level (1-tailed).

Table 7.9: Correlation between lack of ERP plan, lack of top management support, short-term behaviour and lack of expert

Firstly the variables 'lack of ERP plan' and 'lack of top management support' are positively related with a Spearman correlation coefficient of r = .517, and this relationship is statistically significant ($p < .001$). It thus can be concluded that, as top management support is more likely to be insufficient, the firm is more likely to lack an explicit ERP plan. Moreover the output also shows that, the variables 'lack of ERP plan' and 'short-term behaviour' are positively related with a Spearman correlation coefficient of r = .446, and this relationship is significant at p = .002. It can be concluded that, as top managers of the company are more likely to have short-term behaviour, an explicit IS plan is more likely to be missing. Finally, the variables 'lack of ERP plan' and 'lack of in-house experts' are positively related with a Spearman correlation coefficient of r = .507, and this relationship is significant at $p < .001$. Strong statistical evidence thereby proves that, as the company are more likely to have insufficient in-house experts, an explicit IS plan is more likely to be missing in the firm.

Lack of ERP fund, top management support and ERP plan

It was expected in chapter six that 'insufficient ERP fund' may be a result of 'insufficient top management support' and 'absence of an effective ERP development plan'. In order to prove this initial expectation, Spearman's correlation was used.

The output in table 7.10 shows that, the variables 'lack of ERP fund' and 'lack of top management support' are positively related with a Spearman correlation coefficient of r = .505, and this relationship is significant at $p < .001$. It is thus concluded that, as top management to ERP is more likely to be insufficient, the firm is more likely to assign insufficient fund to ERP exploitation.

Additionally, the variables 'lack of ERP fund' and 'lack of ERP plan' are also positively related with a Spearman correlation coefficient of r = .696, and this relationship is significant at $p < .001$. It thus can be concluded that, as the firm is more likely to lack an explicit IS plan, the fund assigned to ERP is more likely to be insufficient.

			Lack of top management support	Lack of ERP plan
Spearman's rho	Lack of ERP fund	Correlation Coefficient	.505 (**)	.696(**)
		Sig. (1-tailed)	.000	.000
		N	42	42

** Correlation is significant at the 0.01 level (1-tailed).

Table 7.10: Correlation between lack of ERP plan, lack of top manager support and lack of ERP fund

User involvement, staff training and fear of job loss

In addition, statistical evidence was found in this study to prove that 'low user involvement' could be a result of 'low-skilled and ill-trained staff' and 'fear of losing power/job'. As shown in table 7.11, Spearman's correlation was used to measure the relationship between these variables.

			Low-skilled and ill-trained staff	Fear of loss of power/job
Spearman's rho	Low user involvement	Correlation Coefficient	.542(**)	.371(**)
		Sig. (1-tailed)	.000	.008
		N	42	42

** Correlation is significant at the 0.01 level (1-tailed).

Table 7.11: Correlation between low-quality staff and low user involvement

The output shows that, the variables 'low user involvement' and 'low-skilled and ill-trained staff' are positively related with a Spearman correlation coefficient of r = .542, and this relationship is significant at $p < .001$. It thus can be concluded that, as staff in the firm were more likely to be low-qualified and receive insufficient ERP training, user involvement in the firm was more likely to be low. The output also shows that, the

variables 'low user involvement' and 'fear of loss of power/job' are positively related with a Spearman correlation coefficient of r = .371. As p = .008 this relationship is statistically significant. It thereby can be concluded that, as staff in the firm are more likely to fear that the use of ERP can result in power or job losing, user involvement in using ERP is correspondingly low.

ERP fund and vendor support

It was expected that if user companies do not have sufficient ERP fund to pay for the maintenance fee, they may not be able to receive continuous support from their system vendors during ERP exploitation. As shown in table 7.12, Spearman's correlation was used to measure the relationship between the variables 'insufficient ERP fund' and 'insufficient vendor support'. The output shows that, these two variables are positively related with a Spearman correlation coefficient of r = .439, and this relationship is significant at $p < .001$. It can thus be concluded that, as ERP exploitation fund is more likely to be insufficient, support provided by system vendors in ERP exploitation is more likely to be insufficient.

			Insufficient vendor support	Insufficient ERP fund
Spearman's rho	Insufficient vendor support	Correlation Coefficient	1.000	.439(**)
		Sig. (1-tailed)	.	.002
		N	42	42

** Correlation is significant at the 0.01 level (1-tailed).

Table 7.12: Correlation between low-quality staff and low user involvement

ERP flexibility and compatibility

Because ERP systems were often inflexible (Ernst, 1989; Namjae and Kiho, 2003), it may often be difficult for user companies to modify their ERP systems and then integrate ERP seamlessly with other IS applications. In other words, low compatibility of ERP may be a result of low flexibility of the system. Bivariate analysis was thereby carried out to measure the correlation between the variables 'system flexibility' and 'system compatibility'. The output in table 7.13 shows that, these two variables are positively related with a Spearman correlation coefficient of r = .474, and this relationship is significant at p = .001. It can thus be concluded that, if system flexibility of the ERP system is low, compatibility of the system will be correspondingly low.

			System flexibility	System compatibility
Spearman's rho	System flexibility	Correlation Coefficient	1.000	.474(**)
		Sig. (1-tailed)	.	.001
		N	42	42

** Correlation is significant at the 0.01 level (1-tailed).

Table 7.13: Correlation between system flexibility and system compatibility

System inflexibility and high enhancement cost

As discussed in chapter six, low system flexibility of ERP may be an essential reason that leads to high system enhancement cost. Spearman's correlation was thus used to measure the correlation between the variables 'System inflexibility' and 'High enhancement cost'.

			System inflexibility	High cost for ERP enhancement
Spearman's rho	System inflexibility	Correlation Coefficient	1.000	.622(**)
		Sig. (1-tailed)	.	.000
		N	42	42

** Correlation is significant at the 0.01 level (1-tailed).

Table 7.14: Correlation between system flexibility and cost of ERP enhancement

The output in table 7.14 shows that, these two variables are positively related with a Spearman correlation coefficient of $r = .622$, and this relationship is significant at $p < .001$. It can thus be concluded that, if the ERP systems are more likely to be inflexible, costs for ERP add-ons and enhancements are more likely to be high.

System speed and data quality

It was expected that a large amount of redundant, outdated and irrelevant data stored in the system can significantly slow down system response time. In other words, slow system response time may be a result of poor data quality. Spearman's correlation was used to explore the relationship between the variables 'system response time' and 'data quality'. The output in table 7.15 shows that, these variables are positively related with a Spearman correlation coefficient of $r = .352$. As $p = .004$, this relationship is statistically significant. It can be concluded that, when data quality of the system is low, system response time of ERP is more likely to be slow.

			System response time	Data quality
Spearman's rho	System response time	Correlation Coefficient	1.000	.400(**)
		Sig. (1-tailed)	.	.004
		N	42	42

** Correlation is significant at the 0.01 level (1-tailed).

Table 7.15: Correlation between system response time and data quality

ERP fund, high enhancement cost and system misfit

It can be argued that, when cost for ERP enhancement is high, or when ERP fund is insufficient, the firm may not be able to continuously revise and enhance the installed ERP system, and thus resulting in misfits between ERP functions and user requirements. Spearman's correlation was used to measure the correlation between the variables 'system function misfit', 'cost for ERP enhancement' and 'ERP fund'.

The output in table 7.16 show that, the variables 'system function misfit' and 'cost for ERP enhancement' are positively related with a Spearman correlation coefficient of r = .312, and this relationship is statistically significant (p = .022). It thus can be concluded that, when ERP enhancement cost is high, misfit between ERP and user needs is more likely to exist. The output also shows that, the variables 'system function misfit' and 'ERP fund' are also positively related with a Spearman correlation coefficient of r = .352, and this relationship is significant at p = .011. It is thereby concluded that, as the company assigns less fund to ERP exploitation, misfit between system functions and user requirements is more likely to occur.

			System function misfit	Cost of ERP enhancement	ERP fund
Spearman's rho	System function misfit	Correlation Coefficient	1.000	.312(*)	.352(*)
		Sig. (1-tailed)	.	.022	.011
		N	42	42	42

* Correlation is significant at the 0.05 level (1-tailed).

Table 7.16: Correlation between system function misfit and cost of ERP enhancement and ERP funds

Data quality, system compatibility, user involvement and in-house experts

Poor data quality may be the result of low system compatibility, which can often lead to poor data and system integration (Loshin, 2001; Redman, 1998). Additionally, it was considered that, users with low involvement in using ERP may make human mistakes frequently. Lack of in-house experts may also result in difficulties in system and data

maintenance. Spearman's correlation was thereby used to measure the correlation between the variables 'Data quality', 'System compatibility', 'User involvement' and 'In-house experts'. The output in table 7.17 shows a number of correlations between these variables.

			Data quality	System compatibility	User involvement	In-house expert
Spearman's rho	Data quality	Correlation Coefficient	1.000	.282(*)	.384(**)	.396(**)
		Sig. (1-tailed)	.	.035	.006	.005
		N	42	42	42	42

* Correlation is significant at the 0.05 level (1-tailed). ** Correlation is significant at the 0.01 level (1-tailed).
Table 7.17: Correlation between data quality, system compatibility, user involvement and in-house expert

First, 'Data quality' and 'System compatibility' are positively related with a Spearman correlation coefficient of r = .282, and this relationship is statistically significant (p = .035). It thus can be concluded that, as system compatibility of ERP is low, data quality of the system is more likely to be low. Second, the variables 'Data quality' and 'User involvement' are also positively related with a Spearman correlation coefficient of r = .384, and this relationship is significant at p = .006. It thereby can be concluded that, as user involvement to ERP is low, data quality of the system can be correspondingly low. Finally, the output also shows that the variables 'Data quality' and 'in-house experts' are positively related with a correlation coefficient of r = .396, and this relationship is significant at p = .005. It is thereby concluded that, as the company is more likely to lack sufficient in-house expert, data quality of the system can be relatively low.

7.3.3 Discussion of findings and ranking of barriers

The results derived from the questionnaire survey for the barrier variables have been presented and discussed in above sections. This section provides an overall discussion on the questionnaire findings identified so far.

The mean was used in order to provide a summary of responses regarding the barrier statements. As justified in chapter five, the mean is often considered the most efficient method for summarising a distribution of values (Bryman and Cramer, 2005:101). Therefore, the means of the barrier variables were calculated by using SPSS, as

presented in table 7.18 below. The standard deviation was also shown in the table to reflect the degree to which the values of each barrier variable differed from the mean.

Category	Barrier	N=42	Mean	S.D.
Cultural Barrier (CB)	CB1	Power centralisation of top management	2.55	1.31
	CB2	Unwilling to disclose problems, faults and failures	1.86	.683
	CB3	High context and implicit form of communication	1.88	.832
	CB4	Lack of critical thinking of employees	1.93	1.045
	CB5	Less inclined to use explicit procedures and information to tailor forecasts and plans	2.14	.751
	CB6	Trust personal common sense/intuition rather than system data to make decisions	2.29	.995
	CB7	Building inter-organisational relationships based on personal *guanxi*	1.64	.932
Organisational Barrier (OB)	OB1	Inefficient collaboration and communication between functional departments	2.00	1.104
	OB2	Fear of power and job loss	1.79	.813
	OB3	Short-term behaviour of companies	1.81	1.131
	OB4	Lack of explicit and detailed IS development plan and strategy	2.29	1.019
	OB5	Lack of top management support	1.67	.902
	OB6	Insufficient ERP exploitation funds and resources	2.31	1
	OB7	Lack of in-house specialists	2.50	1.174
	OB8	Low involvement of employees	2.24	.932
	OB9	Low-skilled and ill-trained staff	2.07	.921
System Barrier (SB)	SB1	Insufficient support & service from ERP vendors	2.95	1.081
	SB2	Inexperienced and low-qualified system consultants	2.69	.950
	SB3	System inflexibility	2.81	.969
	SB4	System incompatibility	2.86	.977
	SB5	High cost for add-ons and further system development	2.50	1.018
	SB6	Irrational and inflexible design of the system	2.76	1.008
	SB7	Slow system response time	2.81	.862
	SB8	Misfits between system functions and company requirements	2.36	.759
	SB9	Poor data quality	2.31	.811

Table 7.18: Total scores of the 25 ERP barrier variables

In table 7.19, the researcher rearranged and prioritised the barrier items based on their means. It emerged from this table that, the top 9 ERP barriers listed seemed to be particularly critical for SOEs. As presented in above sections, a significant amount (38%-24%) of respondents perceived these 9 barriers as important issues to ERP exploitation in their companies. It should be noted that 7 of these top 9 ERP barriers relate to one category, namely the system category. Therefore, it was apparent from the analysis of the questionnaire that the respondents of the survey identified organisational and cultural barriers as less important in their companies.

Rank	Barrier	N = 42	Mean
1	SB1	Insufficient supports and services from system vendors	2.95
2	SB4	System incompatibility	2.86
3	SB7	Slow system response time	2.81
3	SB3	System inflexibility	2.81
5	SB6	Irrational and inflexible design of the system	2.76
6	SB2	Inexperienced and low-qualified system consultants	2.69
7	CB1	Power centralisation of top managers	2.55
8	OB7	Lack of in-house specialists	2.50
8	SB5	High cost for add-ons and further system development	2.50
10	SB8	Misfits between system functions and company requirements	2.36
11	OB6	Insufficient ERP post-implementation funds and resources	2.31
11	SB9	Poor data quality	2.31
13	CB6	Trust personal common sense/intuition rather than system data to make decisions	2.29
13	OB4	Lack of explicit and detailed IS development plan and strategy	2.29
15	OB8	Low involvement of employees	2.24
16	CB5	Less inclined to use systematic procedures and explicit information to tailor forecasts and plans	2.14
17	OB9	Low-skilled and ill-trained staff	2.07
18	OB1	Inefficient collaboration and communication between functional departments	2.00
19	CB4	Lack of critical thinking of employees	1.93
20	CB3	High context and implicit form of communication	1.88
21	CB2	Unwilling to disclose problems, faults and failures	1.86
22	OB3	Short-term behaviour of companies	1.81
23	OB2	Fear of loss of power and loss of job	1.79
24	OB5	Lack of top management support	1.67
25	CB7	Building inter-organisational relationships based on personal *guanxi*	1.64

CB = Cultural Barrier, OB = Organisational Barrier, SB = System Barrier

Table 7.19: Ranking of the 25 ERP barriers by total scores

A possible explanation to these findings is that, as a result of China's economic reform and corresponding very recent changes in SOE structures, management and culture, the organisational mechanism of modern SOEs has been gradually but surely transformed from the traditional Chinese centralised style to a more modern and flexible Western management style (Garnaut, et al, 2005). As a consequence, reformed SOEs, which had to adopt a modern management system, will have a more appropriate environment for ERP adoption than traditional Chinese firms (Reimers, 2002; Zhang et al., 2005). As a result of these organisational improvements, many cultural and organisational barriers, that were expected to exist in traditional Chinese firms, might have been substantially resolved in SOEs.

Nevertheless, Fletcher and Wright (1995) point out that in IS studies, despite other types of barriers (e.g. organisational barriers) are in fact more important than the systems ones, respondents may not often perceive this to be the case. It is possible that these types of

barriers may actually not be an issue in a particular context. Alternatively, these barriers may not be perceived as an issue by respondents, who may indeed underestimate these factors due to a lack of realisation about the existence and importance of these barriers (Fletcher and Wright, 1995). Additionally, it could also be argued that the Chinese managers involved in the survey might not be willing to disclose these issues to the researcher. Overall, it was possible that the cultural and organisational barriers studied in the survey might be, to a certain degree, understated by respondents due to a lack of understanding and awareness. In fact, the findings derived from the bivariate analysis in this study confirmed that organisational barriers were in reality as important as system barriers.

Specifically, through the bivariate analysis, the researcher identified a set of statistically significant relationships between the identified barriers (as presented in section 7.3.2). Figure 7.2 presents a summary of these correlations. A full description for each of these correlations is presented in Table 7.20.

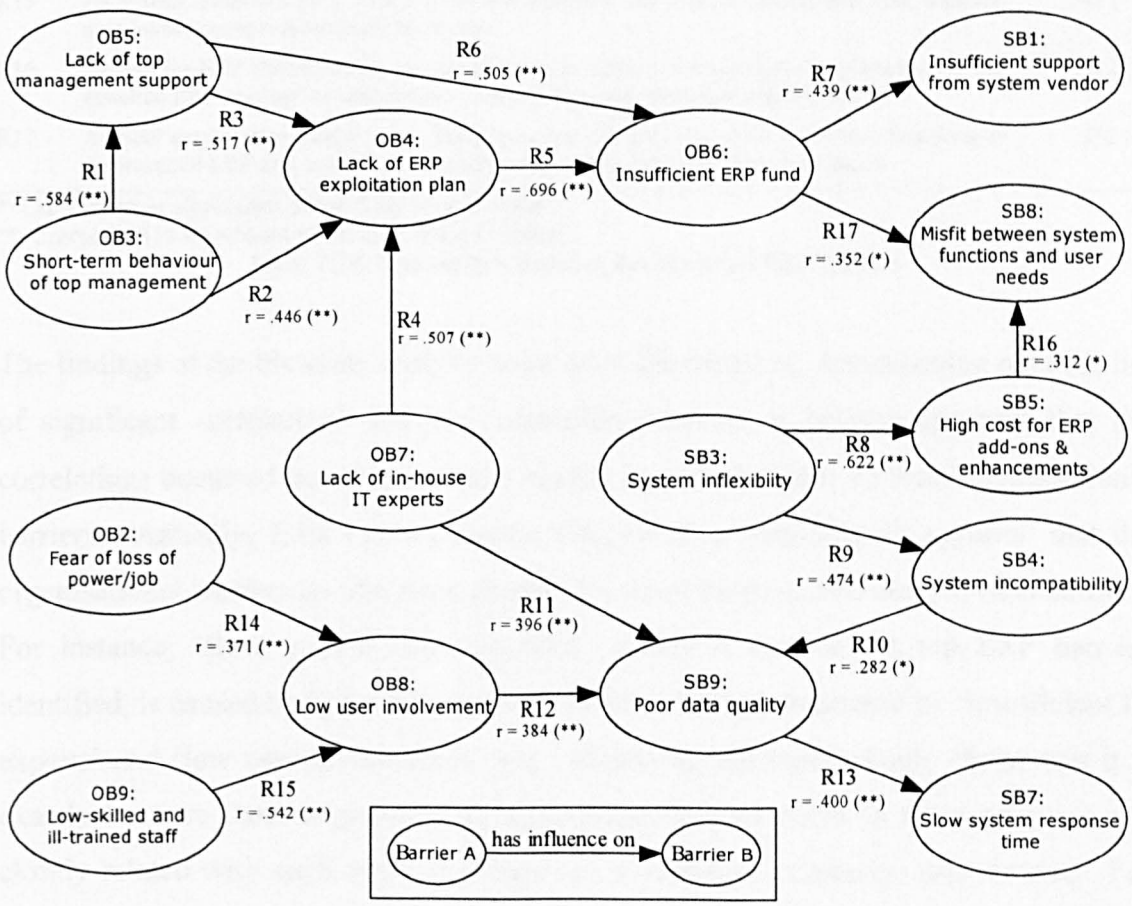


Figure 7.2: Correlations between the identified ERP barriers

	Correlation	Coefficient
R1	When top managers are more likely to focus on short-term results, it is more likely for them to provide insufficient and discontinuous support to ERP exploitation.	.584 (**)
R2	When top managers are more likely to focus on short-term results, it is more likely for the firm to lack a detailed plan to guide future ERP development and exploitation.	.446 (**)
R3	As top management support to ERP is more likely to be insufficient, the firm is more likely to lack an explicit ERP exploitation plan.	.517 (**)
R4	As the company are more likely to have insufficient in-house IT experts, a detailed and feasible ERP exploitation plan is more likely to be missing	.507 (**)
R5	As the firm is more likely to lack an ERP plan, ERP fund is more likely to be insufficient.	.696 (**)
R6	As top management support to ERP is more likely to be insufficient, the fund assigned to ERP exploitation is more likely to be insufficient.	.505 (**)
R7	As ERP exploitation fund is more likely to be insufficient, support provided by system vendors in ERP exploitation is more likely to be insufficient.	.439 (**)
R8	As ERP is more likely to be inflexible, cost for ERP add-ons will be correspondingly high.	.622 (**)
R9	As ERP is more likely to be inflexible and difficult to customise, the system is more likely to have low compatibility with other IS application.	.474 (**)
R10	When ERP is more likely to have low compatibility with other IS applications, data quality of the system is more likely to be affected.	.282 (*)
R11	As the firm is more likely to lack IT experts, data quality of ERP is more likely to be affected.	.396 (**)
R12	As user involvement to ERP is low, data quality of the system is more likely to be low.	.384 (**)
R13	As data quality of the system is poor, system response time of ERP is more likely to be slow.	.400 (**)
R14	As system users are more likely to fear that ERP can result in power or job losing, user involvement towards ERP is correspondingly low.	.371 (**)
R15	As system users are more likely to be low-qualified and receive insufficient ERP training, user involvement is more likely to be low.	.542 (**)
R16	As cost for ERP enhancements is more likely to be high, it is more likely that functions of the installed ERP may not be continuously enhanced to meet emergent user needs.	.312 (*)
R17	As ERP exploitation fund is more likely to be insufficient, it is more likely that functions of the installed ERP may not be continuously enhanced to meet emergent user needs.	.352 (*)

* Correlation is significant at the 0.05 level (1-tailed);
** Correlation is significant at the 0.01 level (1-tailed).

Table 7.20: Correlations between the identified ERP barriers

The findings of the bivariate analysis were quite illuminating. Investigating both the list of significant correlations and the correlation diagram, it became apparent that the correlations occurred not only between system barriers but also between organisational barriers. Actually, from the correlation diagram it is immediately apparent that the organisational barriers are the main triggers for other barriers, including system barriers. For instance, 'slow system response time', which is one of the top ERP barriers identified, is caused by 'poor data quality' which is in turn originated by 'insufficient IT experts' and 'low user involvement', etc. Moreover, the study clearly shows that it is exactly because these organisational and system barriers seem to be interwoven and closely related with each other, that they are so difficult to manage and remove. For example, in order to ensure sufficient ERP funds, SOEs may need to address a set of issues related to top managers, IT experts and internal IS policies. As a consequence, potential failure of ERP systems cannot be conveniently attributed to system aspects,

such as the software package and the ICT infrastructure. Other types of barriers (e.g. organisational barriers) should in reality be as important as the technical ones.

Overall, the findings in this section showed that most system barriers examined were perceived by respondents as crucial ERP barriers in their firms. Therefore, there was a need to further explore the causes and consequences of these crucial system barriers in the follow-up case study. On the other hand, the analysis of the data showed that respondents of the survey identified organisational and cultural barriers as less important in their companies. However, the bivariate analysis conducted in this study indicated that other types of barriers (e.g. organisational barriers) should in reality be as important as the system ones. It was thus evident that the cultural and organisational barriers studied in the questionnaire were underestimated by respondents, probably due to a lack of understanding and awareness, as further discussed in chapter eight and nine. Due to this reason, it was considered necessary to further investigate these cultural and organisational barriers in the exploratory case study. Consequently, the researcher selected all of the 25 ERP barriers to be further studied and explored in the follow-up case study, which also aimed at validating the 17 correlations identified between these ERP barriers.

7.4 Analysis of ERP risks

This section presents and discusses the findings derived from the univariate and bivariate analysis of the risk items examined in the questionnaire. It aims at identifying a set of ERP risks that was crucial to SOEs, as well as exploring potential correlations between these risks. Findings derived from the critical literature review in chapter six were used, as relevant, to compare with and interpret the questionnaire results.

7.4.1 Univariate analysis of risk items

As discussed in chapter five, univariate analysis of the risk items refers to the descriptive analysis of the ERP risk events examined. For each risk event, four variables were generated, including whether this event can be perceived as an ERP exploitation risk, its probability of occurrence, level of impact, and frequency of occurrence. As such, a total of 160 variables were generated for the 40 ERP risks

studied. Frequency table or mean is used in this section to summarise the values for each of these variables.

7.4.1.1 Operational risks

Through the critical literature review, the researcher established 9 operational risks around sales, production and accounting areas. The questionnaire results associated with these operational risks are presented in table 7.21.

In chapter six, it was identified that 'account staff in some cases may not be willing to release accounting responsibility/power to non-account staff'. On the other hand, 'non-account staff may be unwilling or incapable to take up accounting responsibilities'. However, the questionnaire findings showed that these two risk events were not particular issues to many SOEs. Specifically, more than 40% of the respondents did not perceive these two events to be ERP post-adoption risks in their firms. Moreover, more than 53% of the respondents considered the probability of occurrence of these two risk events to be low. Therefore, these two risk events seemed to be less crucial to SOEs.

On the other hand, 55% and 90% of the respondents respectively perceived that there was a low probability and frequency for their operational staff to 'be unwilling to use the ERP system' and 'input incorrect data into ERP'. However, the vast majority (i.e. more than 80%) of the respondents stated that the occurrence of these two risk events could lead to a high to medium impact. In other words, the findings showed that these two events are typical risk events that have low probability of occurrence but critical impact. The occurrence of these risk events is thus unacceptable.

Finally, the remainder operational risks examined (i.e. OR2.1, OR2.2, OR3.1, OR3.2 and OR3.3) were perceived by more than 90% of the respondents to be ERP risks in their firms. Moreover, the questionnaire results presented in table 7.21 showed that, these operational risks did not just have a relatively high probability of occurrence, but more importantly could also lead to a significant impact. They should therefore receive substantial attention from SOE managers.

Operational Risks (OR)	This is a risk event (%)	Probability			Impact			Frequency *	
		Low (%)	Med (%)	High (%)	Low (%)	Med (%)	High (%)	Mean	S.D.
Generic risks (OR1)									
OR1.1 Operational staff are unwilling to use the ERP system	35 (83.3)	22 (55)	18 (45)	0 (0)	8 (20)	23 (57.5)	9 (22.5)	2.03	0.92
OR1.2 Operational staff input incorrect data into the system	34 (81)	37 (90.2)	3 (7.3)	1 (2.4)	6 (14.6)	15 (36.6)	20 (48.8)	1.61	0.997
Sales & marketing risks (OR2)									
OR2.1 Sales staff are not able to obtain needed data and information from ERP	39 (92.9)	13 (31.7)	27 (65.9)	1 (2.4)	3 (7.3)	35 (85.4)	3 (7.3)	2.44	0.95
OR2.2 Customer info files contained in ERP are out-of-date or incomplete	38 (90.5)	7 (17.5)	31 (77.5)	2 (5)	3 (7.5)	28 (70)	9 (22.5)	2.35	0.70
Production & purchasing risks (OR3)									
OR3.1 ERP system contains inaccurate supplier records	38 (90.5)	11 (26.8)	27 (65.9)	3 (7.3)	5 (12.2)	30 (73.2)	6 (14.6)	2.41	0.921
OR3.2 ERP system contains inaccurate or incomplete bill of materials	38 (90.5)	10 (25)	27 (67.5)	3 (7.5)	5 (12.5)	19 (47.5)	16 (40)	2.15	0.77
OR3.3 ERP system contains inaccurate inventory records	39 (92.9)	8 (19.5)	28 (68.3)	5 (12.2)	4 (9.8)	22 (53.7)	15 (36.6)	2.49	0.978
Financial & accounting risks (OR4)									
OR4.1 Account staff are unwilling to release accounting power to non-account staff	29 (69)	20 (54.1)	17 (45.9)	0 (0)	8 (21.6)	28 (75.7)	1 (2.7)	2.11	0.658
OR4.2 Non-account staff are unwilling/incapable to take up accounting responsibilities	23 (54.8)	17 (53.1)	14 (43.8)	1 (3.1)	10 (31.3)	19 (59.4)	3 (9.4)	2.06	0.801

* From 1 (very rarely) to 5 (very often)

Table 7.21: Frequency table for operational risks

7.4.1.2 Analytical risks

Table 7.22 presents the questionnaire findings associated with a set of analytical risks, which were initially established and discussed in chapter six.

Among the 8 analytical risks examined, AR1.1 and AR 2.3 were found to have relatively low probability of occurrence and low level of impact. These two risk events thus seemed to be acceptable risks to Chinese SOEs.

On the other hand, it was expected that 'managers may not always be able to retrieve needed information from their ERPs', probably due to deficient system design (Sage, 2005) and cultural misfits (Soh et al, 2000). This original expectation was confirmed to be true by the majority of the respondents, who perceived the probability of occurrence of this risk event as medium (85%). Furthermore, because the occurrence of this risk event may often affect decision making of managers, it was perceived to have a medium impact by 87.5% of respondents. This risk event thus needs to be handled carefully by SOE managers.

More importantly, the remainder analytical risks (i.e. AR2.1, AR2.2, AR3.1, AR3.2 and AR4.1) were perceived by the majority of the respondents to have both relatively high probability and impact. Specifically, it was identified in chapter six that market statistical data, which is available in the industry in contemporary China, typically lacks accuracy, reliability and currency (Lv, 2006). Inaccurate and unreliable market statistics can raise many forecasting problems and risks (Ranard, 1972), e.g. 'inaccurate sales forecast' and 'difficulty in predicting new product demand'. 78% ~ 87% of the respondents confirmed that the likelihood for these risk events to occur was medium to high. The occurrence of these risk events could also lead to significant impact to SOEs, as confirmed by more than 87% of the respondents. In addition, inaccurate sales forecast may in turn increase the probability for ERPs to generate 'inappropriate master production plans', 'inadequate material requirement plans' and 'inappropriate financial budgets' (Zhou et al, 2005:101). A vast majority (more than 88%) of the respondents perceived these later risk events could lead to a critical impact in their firms. Overall, since these analytical risks are both critical and frequent, they need to be addressed with high priority.

Analytical Risks (AR)	This is a risk event (%)	Probability			Impact			Frequency *	
		Low (%)	Med (%)	High (%)	Low (%)	Med (%)	High (%)	Mean	S.D.
Generic risks (AR1)									
AR1.1 Front-line managers refuse to use the ERP system	33 (78.6)	27 (67.5)	12 (30)	1 (2.5)	12 (30)	22 (55)	6 (15)	1.75	0.809
AR1.2 Managers cannot retrieve relevant and needed information from the system	38 (90.5)	4 (10)	34 (85)	2 (5)	3 (7.5)	35 (87.5)	2 (5)	2.48	0.933
Sales & marketing risks (AR2)									
AR2.1 Sales forecast is inaccurate and inappropriate	39 (92.9)	9 (22)	29 (70.7)	3 (7.3)	4 (9.8)	26 (63.4)	11 (26.8)	2.29	0.716
AR2.2 Fail to predict actual demands of new products	37 (88.1)	5 (12.5)	33 (82.5)	2 (5)	5 (12.5)	26 (65)	9 (22.5)	2.38	0.705
AR2.3 Fail to provide special sales offers and promotion to existing customers	38 (90.5)	14 (34.1)	24 (58.5)	3 (7.3)	21 (51.2)	17 (41.4)	3 (7.3)	2.10	0.995
Production & purchasing risks (AR3)									
AR3.1 Master production schedule generated by the ERP system is inappropriate	36 (85.7)	11 (26.8)	27 (65.9)	3 (7.3)	3 (7.3)	24 (58.5)	14 (34.1)	2.34	0.938
AR3.2 System fails to generate appropriate material net requirement plan	37 (88.1)	8 (20)	30 (75)	2 (5)	1 (2.5)	26 (65)	13 (32.5)	2.33	0.888
Financial & accounting risks (AR4)									
AR4.1 Fail to use the system to generate appropriate financial budgets	38 (90.5)	7 (17.1)	30 (73.2)	4 (9.8)	5 (12.2)	27 (65.9)	9 (22)	2.32	0.82

* From 1 (very rarely) to 5 (very often)

Table 7.22: Frequency table for analytical risks

7.4.1.3 Organisation-wide risks

A critical review of the literature in the previous chapter identified a set of organisation-wide risks, which were related to diverse aspects of top managers, ERP planning, system users, in-house IT experts, and system vendors. Table 7.23 presents the questionnaire findings associated with these risk events.

As clearly shown in this table, all of the established organisation-wide risks were perceived by the majority (76% or more) of the respondents to be risk events to ERP post-implementation. However, perceptions of probability, frequency and impact of these risk events varied.

Specifically, more than 73.8% of the respondents perceived that there was a very low probability and frequency that 'data access right was assigned to inadequate users', and that 'confidential data of the system is accessed by unauthorised people'. However, because the occurrence of these risk events could often lead to information leakage and even direct financial loss (Yosha, 1995), they could result in critical impact as confirmed by more than 73% of the respondents. Therefore, these critical risks, even if they only occur very infrequently, may be considered as un-acceptable risks to take.

Furthermore, for another 6 organisation-wide risks examined (i.e. OWR1.1, OWR1.3, OWR2.3, OWR3.1, OWR4.2 and OWR4.3), more than half of the respondents perceived their probability of occurrence to be low. However, another 40% of the respondents stated that the likelihood for these events to occur was medium. More importantly, these organisation-wide risks were considered by more than 80% of the respondents to have a high to medium impact. Therefore, these ERP risks should receive substantial attention from managers in SOEs.

Finally, the remainder organisation-wide risks (i.e. OWR 1.2, OWR2.1, OWR2.2, OWR3.2, OWR3.3, OWR4.1, OWR, 5.1 and OWR5.2) were perceived by the majority (65% ~ 95%) of the respondents to have medium to high probability and impact. Because these risks seem to be both critical and frequent, they need to be addressed with a high priority in SOEs.

Organisation-Wide Risks (OWR)	This is a risk event (%)	Probability			Impact			Frequency *	
		Low (%)	Med (%)	High (%)	Low (%)	Med (%)	High (%)	Mean	S.D.
Top management risks (OWR1)									
OWR1.1 Top managers make centralised IT decisions	40 (95.2)	23 (56.1)	17 (41.5)	1 (2.4)	6 (14.6)	18 (43.9)	17 (41.5)	1.90	1.02
OWR1.2 Personnel changes in top management team	33 (78.6)	5 (13.5)	31 (83.8)	1 (2.4)	7 (18.9)	27 (73)	3 (8.1)	2.53	0.603
OWR1.3 Support from top managers to ERP post-implementation is insufficient	42 (100)	21 (50)	17 (40.5)	4 (9.5)	8 (19)	24 (57.1)	10 (23.8)	2.12	0.861
IS/ERP planning risks (OWR2)									
OWR2.1 IS/ERP development plan is ill-defined or misfit with business strategy	37 (88.1)	11 (27.5)	25 (62.5)	4 (10)	3 (7.5)	27 (67.5)	10 (25)	2.45	0.986
OWR2.2 Direction for ERP improvement and further development is unclear	36 (85.7)	10 (25)	26 (65)	4 (10)	2 (5)	33 (82.5)	5 (12.5)	2.65	0.864
OWR2.3 Insufficient funds are assigned to ERP	41 (97.6)	21 (50)	19 (45)	2 (5)	8 (19)	29 (69)	5 (11.9)	2.43	0.966
In-house IT expert risks (OWR3)									
OWR3.1 Fail to form an efficient cross-functional team to review and revise the system	36 (85.7)	19 (50)	14 (36.7)	5 (13.3)	3 (7.7)	32 (82.3)	4 (10)	2.59	0.966
OWR3.2 Lose qualified IT/ERP experts	36 (85.7)	10 (23.5)	29 (69)	3 (7.5)	7 (16.7)	26 (61.9)	9 (21.4)	2.57	0.831
OWR3.3 Lose ERP-related know-how accumulated	39 (92.9)	5 (11.9)	36 (85.7)	1 (2.4)	3 (7.1)	32 (76.2)	7 (16.7)	2.43	0.737
System users risks (OWR4)									
OWR4.1 Users do not receive sufficient training	37 (88.1)	9 (22)	32 (78)	0 (0)	7 (17.1)	34 (82.9)	0 (0)	2.59	0.865
OWR4.2 Users are uncomfortable to use the ERP system in their daily jobs	32 (76.2)	20 (52.6)	16 (42.1)	2 (5.3)	9 (23.7)	27 (71.1)	2 (5.3)	2.53	0.797
OWR4.3 ERP-related problems are not reported promptly by system users	37 (88.1)	22 (55)	16 (40)	2 (5)	5 (12.5)	31 (77.5)	4 (10)	2.50	0.784
OWR4.4 Data access right is given to inadequate users	37 (88.1)	32 (78)	8 (19.6)	1 (2.4)	11 (26.9)	14 (34.1)	16 (39)	1.76	0.969
OWR4.5 Confidential data of the system is accessed by unauthorised people	38 (90.5)	31 (73.8)	10 (23.8)	1 (2.4)	10 (23.8)	13 (31)	19 (45.2)	1.64	1.10
System vendors and consultants risks (OWR5)									
OWR5.1 Cannot receive enough technical support from system vendors	36 (85.7)	3 (7.3)	35 (85.4)	3 (7.3)	5 (12.2)	29 (70.7)	7 (17.1)	2.59	0.836
OWR5.2 Cannot receive sufficient/proper consulting advice from system consultants	35 (83.3)	6 (14.6)	31 (75.6)	4 (9.8)	5 (12.2)	32 (78)	4 (9.8)	2.46	0.809

* From 1 (very rarely) to 5 (very often)

Table 7.23: Frequency table for organisation-wide risks

7.4.1.4 Technical risks

Finally, a number of prevalent technical risks were also identified and included in the risk ontology, as presented in chapter six. The following table presents the questionnaire results related to these risks.

Technical Risks (TR)	This is a risk (%)	Probability			Impact			Frequency*	
		Low (%)	Med (%)	High (%)	Low (%)	Med (%)	High (%)	Mean	S.D
System integration risks (TR1)									
TR1.1 Seamless integration is not achieved between modules of the ERP system	38 (90.5)	4 (9.8)	36 (87.8)	1 (2.4)	3 (7.3)	33 (80.5)	5 (12.2)	2.41	0.774
TR1.2 ERP system is not able to seamlessly integrate with other information systems	37 (88.1)	4 (10)	33 (82.5)	3 (7.5)	2 (5)	35 (87.5)	3 (7.5)	2.48	0.847
System failure risks (TR2)									
TR2.1 Invalid data is not automatically detected when getting into the system	36 (85.7)	8 (20)	31 (77.5)	1 (2.4)	4 (10)	33 (82.5)	3 (7.5)	2.28	0.816
TR2.2 Hardware or software crashes	36 (85.7)	7 (17.5)	31 (77.5)	2 (5)	5 (12.5)	28 (70)	7 (17.5)	2.33	0.797
System maintenance and revision risks (TR3)									
TR3.1 Technical bugs of our ERP system is not speedily overcome	38 (90.5)	5 (12.2)	35 (85.4)	1 (2.4)	5 (12.2)	32 (78)	4 (9.8)	2.44	0.709
TR3.2 Outdated and duplicated data of our ERP system is not properly discarded	36 (85.7)	5 (12.2)	33 (80.5)	3 (7.3)	3 (7.3)	36 (87.8)	2 (4.9)	2.46	0.745
TR3.3 ERP is not properly modified to meet new business requirements	35 (83.3)	5 (12.2)	34 (82.9)	2 (4.9)	4 (9.8)	33 (80.5)	4 (9.8)	2.32	0.687

* From 1 (very rarely) to 5 (very often)

Table 7.24: Frequency table for technical risks

Investigating table 7.24, it became apparent that all of the predefined technical risks were perceived by the majority (83% or more) of the respondents to be risk events to ERP post-implementation. The respondents thus seemed to recognise the importance of these technical issues. Moreover, the majority (70% ~ 87.8%) of the respondents perceived all of the established technical risks to have both medium likelihood and impact in their firms. Therefore, there seems to be a need of a number of risk management mechanisms in place to help SOEs to both mitigate and resolve these potential technical issues.

7.4.2 Bivariate analysis of risk items

The study aimed at also investigating potential correlations between the identified ERP risks. Specifically, this study used bivariate analysis to explore if the probability of

occurrence of a particular risk was related to the increase of the probability of occurrence of other risks. A set of potential relationships between the identified risks were initially grounded from the critical literature review process, and were highlighted in the risk ontology presented in section 6.5.3.

In order to examine these potential risk correlations in the context of SOEs, Spearman's rho (r_s) and one-tailed test was used, as justified in section 5.7.2. By following this approach, the researcher identified a set of statistically significant correlations between the identified ERP risks, as presented below.

Inventory record, master production schedule and material requirements plan

As discussed in chapter six, inventory records and master production schedules are two main inputs used to calculate material requirements plans (Koh et al, 2000). Thus, it was expected that having 'inaccurate inventory record' or 'inadequate master production schedule' may increase the probability for having 'inappropriate material requirements plans'. Spearman's correlation was used to examine the relationships between these risk items.

			Prob. to have inappropriate material requirements plan	Prob. to have inaccurate inventory records	Prob. to have irrelevant master production schedule
Spearman's rho	Prob. to have inappropriate material requirements plan	Correlation Coefficient	1.000	. 439(**)	. 573(**)
		Sig. (1-tailed)	.	.002	.000
		N	40	41	40

** Correlation is significant at the 0.01 level (1-tailed).

Table 7.25: Correlations between material requirements plan and master production schedule and inventory records

The output in table 7.25 shows that the variables, that are concerned with the probability of having inaccurate inventory record and inappropriate material requirements plan, are positively related with a Spearman correlation coefficient of $r = .439$. This relationship is significant at $p = .002$. It can therefore be concluded that, as the probability of having inaccurate inventory record increases, the probability of having inappropriate material requirements plan increases.

The output also shows that the variables, associated with the probability of having inappropriate production schedule and inappropriate material requirements plan, are positively related with a Spearman correlation coefficient of $r = .573$. This relationship is significant at $p < .001$. It thus can be concluded that, as the probability of having inappropriate production schedule increases, the probability of having inappropriate material requirements plan correspondingly increases.

Changes in top management team and insufficient top management support

It was expected that substantial changes in the top management team may increase the probability for having insufficient top management support to ERP (Lientz and Larssen, 2006). Spearman's correlation was thereby used to examine the relationship between these two risk items. The output in table 7.26 shows that these risk variables are positively related with a Spearman correlation coefficient of $r = .276$. This relationship is relatively significant as $p = .049$. Some statistical evidence are thus found to prove that, as the probability of having personnel changes in the top management team increases, the probability of having insufficient top management support to ERP may correspondingly increase.

			Prob. to lack top manager support	Prob. to personnel change in top management team
Spearman's rho	Prob. to lack top manager support	Correlation Coefficient	1.000	.276(*)
		Sig. (1-tailed)	.	.049
		N	37	37

* Correlation is significant at the 0.05 level (1-tailed).

Table 7.26: Correlation between top management support and personnel change in top management term

Top management support and ERP plan

As discussed in chapter six, top managers play an important role in establishing, implementing and sustaining an efficient ERP exploitation plan. It was thus expected that, insufficient top management support may increase the probability of having inappropriate and ill-defined ERP plans. Spearman's correlation was used to examine the relationship between these two risk items. The output in table 7.27 shows that these risk variables are positively related with a Spearman correlation coefficient of $r = .402$. This relationship is significant at $p = .005$. It thus can be concluded that, as the

probability of having insufficient top management support increases, the probability of having inappropriate and ill-defined IS plan increases.

			Prob. to have inappropriate ERP plan	Prob. to lack top manager support
Spearman's rho	Prob. to have inappropriate ERP plan	Correlation Coefficient	1.000	.402(**)
		Sig. (1-tailed)		.005
		N	40	40

** Correlation is significant at the 0.01 level (1-tailed).

Table 7.27: Correlation between top management support and ERP development plan

ERP plan and ERP development direction

It was considered that, inappropriate and ill-defined ERP plan may increase the probability of having unclear ERP development direction. Spearman's correlation was thus used to examine the relationship between these risk items. The output in table 7.28 shows that the two risk variables examined are positively related with a Spearman correlation coefficient of $r = .795$. This relationship is significant at $p < .001$. Therefore, strong statistical evidence are found to prove that, as the probability of having inappropriate and ill-defined ERP plan increases, the probability of having unclear ERP development direction correspondingly increases.

			Prob. to have unclear ERP development direction	Prob. to have inappropriate ERP plan
Spearman's rho	Prob. to have unclear ERP development direction	Correlation Coefficient	1.000	.795(**)
		Sig. (1-tailed)	.	.000
		N	39	40

** Correlation is significant at the 0.01 level (1-tailed).

Table 7.28: Correlation between ERP development direction and ERP plan

ERP fund, top management support, ERP plan and budget

As discussed in chapter six, the occurrence of insufficient ERP fund may be the result of the occurrence of a set of other ERP risks, e.g. insufficient top management support, inappropriate and ill-defined ERP plan, and inappropriate financial budget. In order to verify this expectation, Spearman's correlation was used to examine the relationship between these risk items. The output in table 7.29 shows three correlations between insufficient ERP fund and the other three risk items measured.

		Prob. To have insufficient top management support	Prob. to have inappropriate ERP plan	Prob. to have inappropriate financial budget
Prob. To have insufficient ERP fund	Correlation Coefficient	.373(**)	.710(**)	.324(*)
	Sig. (1-tailed)	. 008	.000	.019
	N	42	40	42

** Correlation is significant at the 0.01 level (1-tailed).
* Correlation is significant at the 0.05 level (1-tailed).

Table 7.29: Correlation between insufficient ERP fund and other ERP risks

Firstly the risk variables, that are concerned with insufficient top management support and insufficient ERP fund, are positively related with a Spearman correlation coefficient of $r = .373$. This relationship is significant at $p = .008$. Strong statistical evidence are thus found to prove that, as the probability of having insufficient top management support is higher, the probability of having insufficient ERP fund will be higher.

Secondly the risk variables, that are concerned with inappropriate ERP plan and insufficient ERP fund, are positively related with a Spearman correlation coefficient of $r = .710$. This relationship is statistically significant, since $p < .001$. Strong statistical evidence are thus found to prove that, as the probability of having inappropriate and ill-defined ERP plan is higher, the probability of having insufficient ERP fund will be correspondingly higher.

Finally the risk variables, that are concerned with inappropriate financial budget and insufficient ERP fund, are positively related with a Spearman correlation coefficient of $r = .324$. This relationship is significant at $p = .019$. It can thus be concluded that, as the probability of having inappropriate financial budget increases, the probability of having insufficient ERP fund will correspondingly increase.

Data accessibility

Confidential data stored in ERP should be carefully handled and managed. However, as discussed before, when data access right is assigned to irrelevant users, it may increase the probability for unauthorised people to access to sensitive data stored in the system (Wilding, 2003). Spearman's correlation was thus used to examine the relationship between these two risk items.

			Prob. that data is accessed by unauthorised people	Prob. that data access right is given to irrelevant user
Spearman's rho	Prob. that data is accessed by unauthorised people	Correlation Coefficient	1.000	.464(**)
		Sig. (1-tailed)	.	.001
		N	42	41

** Correlation is significant at the 0.01 level (1-tailed).

Table 7.30: Correlation between information leakage and problematic data access right

The output in table 7.30 shows that the examined risk variables are positively related with a Spearman correlation coefficient of $r = .464$. This relationship is significant at $p = .001$. Strong statistical evidence are hence found to prove that, as the probability that data access right is assigned to irrelevant user increases, the probability of having unauthorised people to access to sensitive system data will increase.

ERP fund and ERP enhancement

The implemented ERP system has to be continuously reviewed and enhanced in the post-implementation phase (Willis and Willis-Brown, 2002), in order to meet emergent user needs. However, it was considered that having insufficient ERP fund may increase the probability that the implemented ERP may not be continuously and adequately enhanced. Spearman's correlation was thus used to examine the relationship between these risk items.

			Prob. that ERP cannot be modified to meet new requirement	Prob. to have insufficient ERP fund
Spearman's rho	Prob. that ERP cannot be modified to meet new requirement	Correlation Coefficient	1.000	.348(*)
		Sig. (1-tailed)	.	.013
		N	42	42

* Correlation is significant at the 0.05 level (1-tailed).

Table 7.31: Correlation between ERP enhancement and ERP fund

The output in table 7.31 shows that the two examined risk variables are positively related with a Spearman correlation coefficient of $r = .348$. This relationship is significant at $p = .013$. Statistical evidence are thus found to prove that, as the probability of having insufficient ERP fund increases, the probability that the implemented system cannot be continuously modified will increase.

7.4.3 Discussion of findings and ranking of risks

The questionnaire results associated with ERP post-implementation risks were presented above. This section provides an overall discussion of this part of questionnaire findings.

In general, the findings show that all of the 40 events, which were pre-defined in the theoretical risk ontology, were confirmed by the majority (e.g. 80% or more) of respondents as risk events to ERP exploitation. However, perceptions of impact, probability of occurrence, and frequency of occurrence varied somewhat.

The survey asked respondents to assess the importance of each risk from three independent aspects, namely probability of occurrence, impact, and frequency of occurrence. As discussed and exemplified in chapter five (section 5.6.3), a risk event that had a high probability of occurrence may not have a high impact or a high frequency of occurrence. It is thus necessary to take into account these three risk aspects, when evaluating the overall importance of each of the identified ERP risks. In order to do so, the following formula was developed and used to calculate the risk score for each ERP risk event:

$$\text{Risk score of each ERP risk event} = \Sigma\,[W^{*}(\text{Probability} + \text{Impact} + \text{Frequency})]$$

The interpretation and justification of this formula were given in detail in section 5.7.1. In brief, this formula enabled the researcher to calculate the risk score to show the importance of each identified risk event by taking into consideration its probability of occurrence, impact and frequency of occurrence. By using this formula, the researcher calculated the risk scores for all of the identified ERP risk events, as presented in Table 7.32.

Table 7.32: Risks scores of the 40 identified ERP risks

Level 1 category	Level 2 category	Level 3 Risk item	N = 42	Risk Score
Operational Risk (OR)	Generic risk (OR1)	OR1.1	Operational staff are unwilling to use the ERP system	196
		OR1.2	Operational staff input incorrect data into the system	182
	Sales and marketing risk (OR2)	OR2.1	Sales staff are not able to obtain data and information they need from the system	241
		OR2.2	Customer info files contained in the ERP system are out-of-date or incomplete	246
	Production and purchasing risk (OR3)	OR3.1	ERP system contains inaccurate supplier records	238
		OR3.2	ERP system contains inaccurate or incomplete bill of materials	243
		OR3.3	ERP system contains inaccurate inventory records	263
	Fin. & acc. risk (OR4)	OR4.1	Account staff are unwilling to release accounting responsibility and power to non-account staff	166
		OR4.2	Non-account staff are unwilling and incapable to take up accounting responsibilities	131
Analytical Risk (AR)	Generic risk (AR1)	AR1.1	Front-line managers refuse to use the ERP system	163
		AR1.2	Managers cannot retrieve relevant and needed information from the system	247
	Sales and marketing risk (AR2)	AR2.1	Sales forecast is inaccurate and inappropriate	250
		AR2.2	Fail to predict actual demands of new products	238
		AR2.3	Fail to provide special sales offers and promotion to existing customers	213
	Production and purchasing risk (AR3)	AR3.1	Master production schedule generated by the ERP system is inappropriate	237
		AR3.2	System fails to generate appropriate material net requirement plan	240
	Fin. & acc. risk (OR4)	AR4.1	Fail to use the system to generate appropriate financial budgets	247
Organisation-Wide Risk (OWR)	Top management risk (OWR1)	OWR1.1	Top managers make important IT decisions without consulting IT experts or system users	223
		OWR1.2	Substantial personnel changes in the top management team	209
		OWR1.3	Support from top managers to ERP post-implementation is insufficient	242
	IS/ERP planning risk (OWR2)	OWR2.1	IS/ERP development plan is missing, ill-defined or misfit with business strategy	240
		OWR2.2	Direction for ERP improvement and further development is unclear	238
		OWR2.3	Insufficient resources and funds are assigned to ERP training, maintenance and enhancement	242
	In-house IT experts risk (OWR3)	OWR3.1	Fail to form an efficient cross-functional team to continuously review and revise the ERP system	235
		OWR3.2	Lose qualified IT/ERP experts	233
		OWR3.3	Lose ERP-related know-how accumulated over time	252
	System users risk (OWR4)	OWR4.1	ERP users (both staffs and managers) do not receive sufficient and continuous training	233
		OWR4.2	Users are uncomfortable to use the ERP system in their daily jobs	209
		OWR4.3	ERP-related problems are not reported promptly by system users	235
		OWR4.4	Data access right to ERP is authorised to inappropriate users	192
		OWR4.5	Confidential data of the system is accessed by unauthorised people	197
	System vendors and consultant risk (OWR5)	OWR5.1	Cannot receive enough technical support from system vendors	238
		OWR5.2	Cannot receive sufficient and proper consulting advice from system consultants	228
Technical Risk (TR)	System integration risk (TR1)	TR1.1	Seamless integration is not achieved between modules of the ERP system	243
		TR1.2	ERP system is not able to seamlessly integrate with other information systems	244
	System failure risk (TR2)	TR2.1	Invalid data is not automatically detected when getting into the ERP system	223
		TR2.2	Hardware or software crashes	232
	System maintenance and revision risk (TR3)	TR3.1	Technical bugs of our ERP system is not speedily overcome	240
		TR3.2	Outdated and duplicated data of our ERP system is not properly discarded	233
		TR3.3	ERP is not properly modified to meet new business requirements	223

Subsequently, the researcher prioritised the 40 identified ERP risk events based on their risk scores, as presented in table 7.33. The top 15 risk events, of which the risk scores are above 240, are highlighted in this table.

Rank		Risk item	Risk Score
1	OR3.3	ERP system contains inaccurate inventory records	263
2	OWR3.3	Lose ERP-related know-how accumulated over time	252
3	AR2.1	Sales forecast is inaccurate and inappropriate	250
4	AR1.2	Managers cannot retrieve relevant and needed information from the system	247
4	AR4.1	Fail to use the system to generate appropriate financial budgets	247
6	OR2.2	Customer files contained in the ERP system are out-of-date or incomplete	246
7	TR1.2	ERP is not able to seamlessly integrate with other IS applications	244
8	TR1.1	Seamless integration is not achieved between modules of the ERP system	243
8	OR3.2	ERP system contains inaccurate or incomplete bill of materials	243
10	OWR1.3	Support from top managers to ERP post-implementation is insufficient	242
10	OWR2.3	Insufficient resources and funds are assigned to ERP exploitation	242
12	OR2.1	Sales staff are not able to obtain data and information they need from ERP	241
13	OWR2.1	ERP development plan is ill-defined or misfit with business strategy	240
13	AR3.2	System fails to generate appropriate material net requirement plan	240
13	TR3.1	Technical bugs of ERP system is not speedily overcome	240
16	AR2.2	Fail to predict actual demands of new products	238
16	OWR2.2	Direction for ERP improvement and further development is unclear	238
16	OR3.1	ERP system contains inaccurate supplier records	238
16	OWR5.1	Cannot receive enough technical support from system vendors	238
20	AR3.1	Master production schedule generated by the ERP system is inappropriate	237
21	OWR4.3	ERP-related problems are not reported promptly by system users	235
21	OWR3.1	Fail to form an efficient cross-functional team for ERP exploitation	235
23	OWR3.2	Lose qualified IT/ERP experts	233
23	OWR4.1	ERP users (both staff and managers) do not receive sufficient ERP training	233
23	TR3.2	Outdated and duplicated data of our ERP system is not properly discarded	233
26	TR2.2	Hardware or software crashes	232
27	OWR5.2	Cannot receive sufficient and proper support from system consultants	228
28	TR2.1	Invalid data is not automatically detected when getting into the ERP system	223
28	OWR1.1	Top managers make important IT decisions without consulting the others	223
28	TR3.3	ERP is not properly modified to meet new business requirements	223
31	AR2.3	Fail to provide special sales offers and promotion to existing customers	213
32	OWR1.2	Substantial personnel changes in the top management team	209
32	OWR4.2	Users are uncomfortable to use the ERP system in their daily jobs	209
34	OWR4.5	Confidential data of the system is accessed by unauthorised people	197
35	OR1.1	Operational staff are unwilling to use the ERP system	196
36	OWR4.4	Data access right to ERP is authorised to inappropriate users	192
37	OR1.2	Operational staff input incorrect data into the system	182
38	OR4.1	Account staff are unwilling to release accounting responsibility to other staff	166
39	AR1.1	Front-line managers refuse to use the ERP system	163
40	OR4.2	Non-account staff are unwilling and incapable to take up accounting duties	131

Table 7.33: Ranking of the 40 identified ERP risks based on risk scores

In table 7.34 below, the researcher further rearranges the top 15 risks according to their main categories.

Category	Top 15 ERP risk items		Risk score	Rank
Operational risks	OR2.1	Sales staff cannot obtain data & information they need from ERP	241	12
	OR2.2	Customer info files contained in ERP are out-of-date or incomplete	246	6
	OR3.2	ERP contains inaccurate or incomplete bill of materials	243	8
	OR3.3	ERP system contains inaccurate inventory records	263	1
Analytical risks	AR1.2	Managers cannot retrieve needed information from ERP	247	4
	AR2.1	Sales forecast generated by ERP is inaccurate and inappropriate	250	3
	AR3.2	System fails to generate appropriate material net requirement plan	240	13
	AR4.1	Fail to use ERP to generate appropriate financial budgets	247	4
Organisation - wide risks	OWR1.3	Support from top managers to ERP post-implementation is insufficient	242	10
	OWR2.1	ERP plan is ill-defined or misfit with business strategy	240	13
	OWR2.3	Insufficient resources and funds are assigned to ERP training, maintenance and enhancement	242	10
	OWR3.3	Lose ERP-related know-how accumulated over time	252	2
Technical risks	TR1.1	Seamless integration is not achieved between modules of ERP system	243	8
	TR1.2	ERP is not able to seamlessly integrate with other information systems	244	7
	TR3.1	Technical bugs of ERP system is not speedily overcome	240	13

Table 7.34: Top 15 ERP exploitation risks

As clearly emerged in table 7.34, these top ERP risks did not cluster around a specific subset of the main categories. This means that top risks seem to be found across the organisational processes and not conveniently localised around one category, namely not around the technical category. Therefore, this study seemed to confirm that failure of ERP systems may not just be conveniently related to the technical infrastructures and software packages. Actually, what this study confirms is that it is in operational, management and strategic thinking areas that the majority of critical and important risks may be identified.

In addition, a bivariate analysis was also conducted in this study to investigate the correlations between the identified ERP risks. A set of statistically significant relationships between the identified risks were thus identified, as presented and discussed above. Figure 7.3 presents a conceptual map to summarise and represent these correlations. A full description of each of these correlations is presented in table 7.35 below.

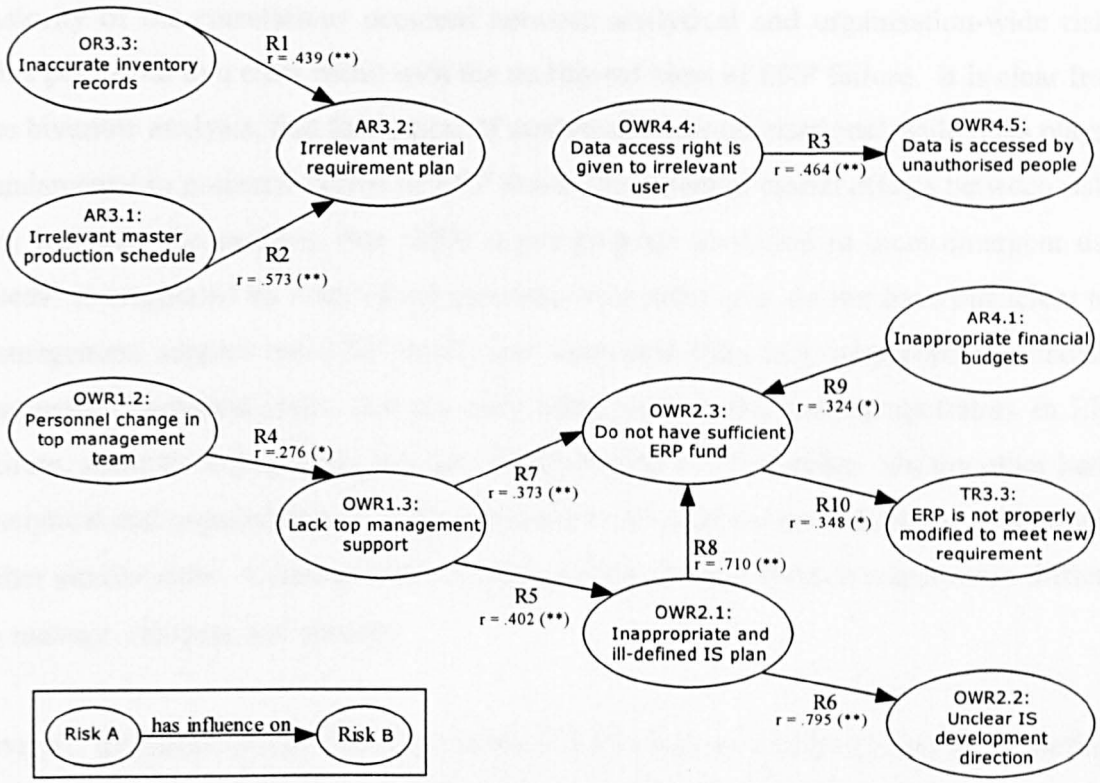


Figure 7.3: Correlations between the identified ERP risks

Correlation		Coefficient
R1	As the probability of having inaccurate inventory record increases, the probability of having inappropriate material requirements plan increases.	.439(**)
R2	As the probability of having inappropriate production schedule increases, the probability of having inappropriate material requirements plan correspondingly increases.	.573(**)
R3	As the probability that data access right is assigned to irrelevant user increases, the probability of having unauthorised people to access to sensitive system data will increase.	.464(**)
R4	As the probability of having personnel changes in the top management team increases, the probability of having insufficient top management support increases.	.276(*)
R5	As the probability of having insufficient top management support increases, the probability of having inappropriate and ill-defined IS plan increases.	.402(**)
R6	As the probability of having inappropriate and ill-defined IS plan increases, the probability of having unclear IS development direction correspondingly increases.	.795(**)
R7	As the probability of having insufficient top management support is higher, the probability of having insufficient ERP fund will be higher.	.373(**)
R8	As the probability of having inappropriate and ill-defined IS plan is higher, the probability of having insufficient ERP fund will be correspondingly higher.	.710(**)
R9	As the probability of having inappropriate financial budget increases, the probability of having insufficient ERP fund will correspondingly increase.	.324(*)
R10	As the probability of having insufficient ERP fund increases, the probability that the implemented system cannot be continuously modified will increase.	.348(*)

* Correlation is significant at the 0.05 level (1-tailed);** Correlation is significant at the 0.01 level (1-tailed).

Table 7.35: Correlations between the identified ERP risks

The findings of the bivariate analysis were again quite illuminating. Investigating both the list of significant correlations and the correlation map, it becomes apparent that the

majority of the correlations occurred between analytical and organisation-wide risks. This points out to a clear break with the traditional view of ERP failure. It is clear from the bivariate analysis, that the impact of analytical and organisational-wide risks plays a fundamental in potential failure of ERP due to the potential causal effects between risks. For instance, the problem that 'ERP is not properly modified to meet emergent user needs' is originated by a set of organisation-wide risks (e.g. do not have sufficient top management support and ERP funds) and analytical risks (e.g. inappropriate financial budgets). Technical risks, that are very often seen as the main perpetrators in ERP failure, seem to be important but not strictly related to other risks. On the other hand, analytical and organisation-wide risks seemed to be interwoven and closely related with other similar risks. Consequently, the occurrence of these risks is much more difficult to manage, mitigate and contain.

Overall, the questionnaire findings reported in this section confirmed that all predefined risk events were perceived by respondents as ERP exploitation risks in their firms. Among the list of risks, the top 15 risks were identified as the most crucial to SOEs. These top risks were thus selected to be further explored in the follow-up case study. In addition, 10 significant correlations were found between the identified ERP risks. It emerged from the correlation map presented in Figure 7.3 that, 6 ERP risks (i.e. AR3.1, OWR1.2, OWR2.2, OWR4.4, OWR4.5, and TR3.3) shown in the diagram were not included in the list of top ERP risks. In order to further explore the identified ERP risk correlations, these 6 ERP risks were also selected to be further investigated in the interviews. Consequently, 21 (i.e. 15 + 6) ERP risks were selected to be further validated and studied in the follow-up case study.

7.5 Bivariate analysis: correlations between barriers and risks

The final part of the analysis of the questionnaire data included a bivariate analysis, which aimed at exploring potential correlations between the barriers and risks identified. Specifically, this bivariate analysis attempted to explore if the existence of an ERP barrier could increase the probability of occurrence of certain ERP risks. Spearman's correlation and one-tailed test were used as the ideal approach to explore the relationships between these ordinal variables. A total of eight correlations between barriers and risks was thereby identified, as presented below.

7.5.1 Individual correlation between barriers and risks

Power centralisation and centralised IT decision

Due to the cultural barrier of power centralisation and centralised decision-making, Chinese managers may rarely involve their subordinates in the process of decision making, and may be less inclined to collect and consider alternative ideas from a wider group of people (Martinsons and Westwood, 1997; Reimers, 2002). It was therefore expected that, the existence of this cultural barrier might increase the probability of the risk that top managers make important IT decisions without consulting the opinions of IT experts or system users.

			Power centralisation and centralised decision-making	Prob. that top managers make centralised IT decision
Spearman's rho	Power centralisation	Correlation Coefficient	1.000	.445(**)
		Sig. (1-tailed)	.	.002
		N	41	41

** Correlation is significant at the 0.01 level (1-tailed).

Table 7.36: Correlation between power centralisation and centralised IT decision

The output in table 7.36 shows that the two examined variables are positively related with a Spearman correlation coefficient of $r = .445$. This relationship is significant at $p = .002$. Strong statistical evidence are thereby found to prove that, as the barrier of power centralisation is more likely to exit in the firm, the probability for top managers to make centralised IT decisions is higher.

Short-term behaviour and probability to have insufficient top management support

Chinese managers are often accused of focusing too much on achieving short-term business results when neglecting associated long-term effects and issues (e.g. Yuan and Ma, 2005; Zhang, 2004; Liu, 2004). It was thereby considered that, this organisational barrier might increase the probability that top managers did not provide sufficient and long-term support to ERP exploitation.

The output in table 7.37 shows that the two examined variables are positively related with a Spearman correlation coefficient of $r = .381$. This relationship is significant at $p = .006$. Strong statistical evidence are thus found to prove that, as the barrier of short-

term behaviour is more likely to exit in the firm, the probability of the risk that top managers fail to provide sufficient and continuous support to ERP is higher.

			Short-term behaviour	Prob. to have insufficient top management support
Spearman's rho	Short-term behaviour	Correlation Coefficient	1.000	.381(**)
		Sig. (1-tailed)	.	.006
		N	42	42

** Correlation is significant at the 0.01 level (1-tailed).

Table 7.37: Correlation between short-term behaviour and insufficient top management support

Lack of ERP plan, unclear ERP development direction and insufficient ERP fund

Lack of explicit IS or ERP plan is a barrier to the use of information systems. It was considered that, the existence of this barrier might increase the probability for the company to have 'unclear ERP development direction' and 'insufficient ERP fund'.

The output in table 7.38 shows that the variables 'lack of ERP plan' and 'probability to have unclear ERP development direction' are positively related with a Spearman correlation coefficient of r = .419. This relationship is significant at p = .004. The conclusion that can be drawn is that, as the firm is more likely to lack an explicit IS/ERP plan, the probability of the risk that the firm has unclear ERP enhancement direction is higher.

The output also shows that the variables 'lack of IS plan' and 'probability to have insufficient ERP fund' are positively related with a Spearman correlation coefficient of r = .327. This relationship is significant at p = .017. It can hence be concluded that, as the firm is more likely to lack a detailed IS and ERP plan, the probability of having insufficient ERP fund is higher.

			Lack of explicit ERP plan	Prob. to have unclear direction for ERP enhancement	Prob. To have insufficient ERP fund
Spearman's rho	Lack of explicit ERP plan	Correlation Coefficient	1.000	.419(**)	.327(*)
		Sig. (1-tailed)	.	.004	.017
		N	42	40	42

** Correlation is significant at the 0.01 level (1-tailed).* Correlation is significant at the 0.05 level (1-tailed).

Table 7.38: Correlation between ERP plan, ERP development direction and ERP fund

In-house expert and efficient ERP plan

Establishing an efficient ERP plan may often rely on the contribution of a large group of in-house experts. It was thus expected that lack of in-house experts, as an organisational barrier, might increase the probability that an efficient ERP plan is missing or ill-defined. The output in table 7.39 shows that the two examined variables are positively related with a Spearman correlation coefficient of r = .303, and this relationship is significant at p = .029. It thereby proved that, as the firm is more likely to lack in-house experts, the probability for the firm to have inefficient and ill-defined ERP plan is higher.

			Lack of in-house experts	Prob. that an efficient ERP plan is missing or ill-defined
Spearman's rho	Lack of in-house expert	Correlation Coefficient	1.000	.303(*)
		Sig. (1-tailed)	.	.029
		N	42	40

* Correlation is significant at the 0.05 level (1-tailed).

Table 7.39: Correlation between In-house expert and efficient ERP plan

Low-skilled staff and resistance to use ERP

Low-skilled and ill-trained staff is a barrier to introduction and use of ERP systems (Wright and Donaldson, 2002; Sherer and Alter, 2004). It was expected that, the existence of this organisational barrier might increase the probability for operational staff and managers to be reluctant to use ERP.

			Low-skilled and ill-trained staff	Prob. That operational staff are reluctant to use ERP	Prob. that front-line managers refuse to use ERP
Spearman's rho	Low-skilled and ill-trained staff	Correlation Coefficient	1.000	.320(*)	.310(*)
		Sig. (1-tailed)	.	.022	.026
		N	42	40	40

* Correlation is significant at the 0.05 level (1-tailed).

Table 7.40: Correlation between low-skilled staff and user resistance

The output in table 7.40 shows that, the variables 'low-skilled and ill-trained staff' and 'probability that operational staff are reluctant to use ERP' are positively related with a Spearman correlation coefficient of r = .320. This relationship is significant at p = .022. Thus, the conclusion to be drawn is that, as staff in the firm are more likely to be low-

skilled and ill-trained, the probability for operational staff to be reluctant to use ERP increases. The output also shows that the variables 'low-skilled and ill-trained staff' and 'probability that managers refuse to use ERP' are positively related with a Spearman correlation coefficient of $r = .310$. This relationship is significant at $p = .026$. It thereby seemed that, as staff in the firm are more likely to be low-skilled and ill-trained, the probability for managers to refuse to use ERP rises.

System response time and user acceptance of the system

System users often want the IS to have fast response time and will get irritated if the system cannot respond as quickly as they expected (Damodaran and Olphert, 2000). Slow system response time is thus a barrier to the use of ERP. It was expected that, the existence of this system barrier might increase the probability for staff to be reluctant to use the ERP system.

The output in table 7.41 shows that the two examined variables are positively related with a Spearman correlation coefficient of $r = .385$. This relationship is significant at $p = .007$. Strong statistical evidence are thereby found to prove that, as the ERP system is more likely to have slow response time, the probability for staff to be reluctant to use it increases.

			Slow system response time	Prob. that staff are reluctant to use ERP
Spearman's rho	Slow system response time	Correlation Coefficient	1.000	.385(**)
		Sig. (1-tailed)	.	.007
		N	42	40

** Correlation is significant at the 0.01 level (1-tailed).

Table 7.41: Correlation between system response time and user acceptance

7.5.2 Summary of correlations between barriers and risks

The above correlations between the ERP barriers and risks are summarised in the diagram below.

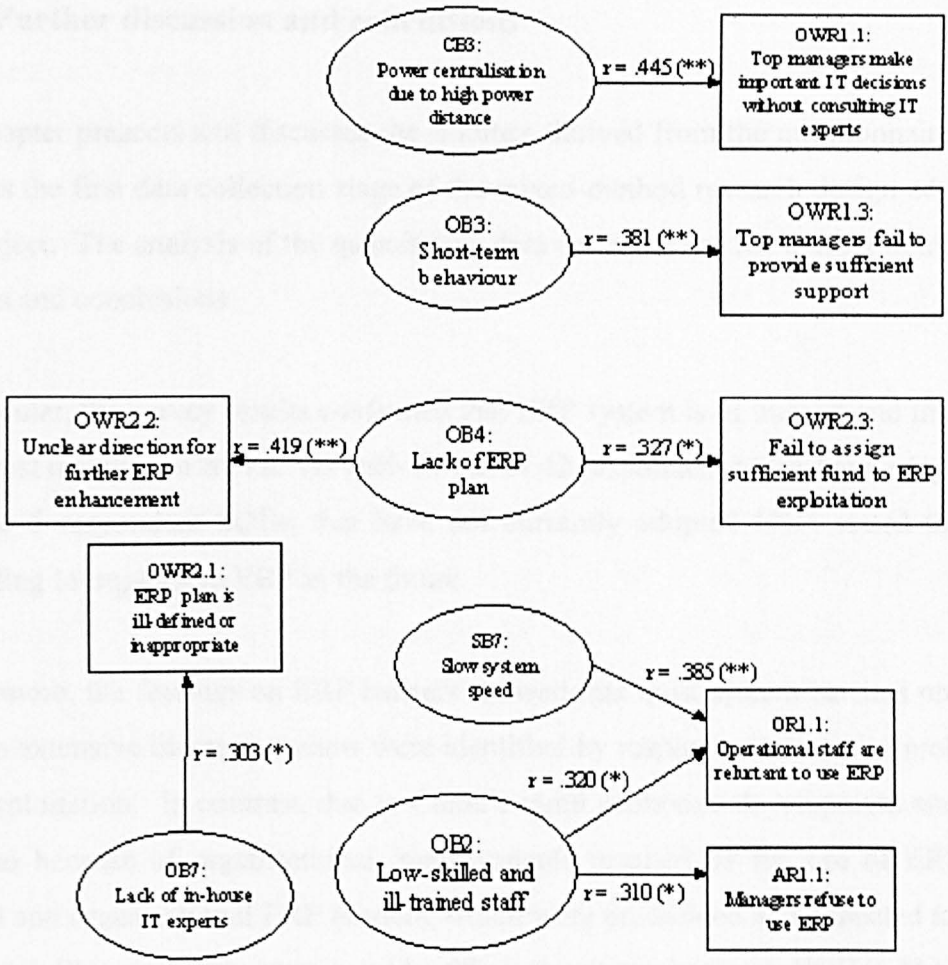


Figure 7.4: Correlations between identified ERP barriers and risks

It clearly emerged from this correlation diagram that, the majority of correlations occurred between organisational barriers and various types of risks, including operational risks, analytical risks and organisation-wide risks. Cultural and system barriers seemed to be important, but they did not prove to be the main triggers of ERP risks. As a consequently, it is evident from this diagram that organisational barriers are the most crucial type of ERP barrier that needed to be carefully handled in order to prevent the occurrence of potential ERP risks.

In addition, 3 risks (i.e. OR1.1, AR1.1, and OWR1.1) contained in the diagram have not been included in the 21 ERP risks that were selected to be further explored in the case study, as discussed in section 7.4.5. Consequently, in order to further explore the identified barrier-risk correlations in interview, these 3 ERP risks were added to the list, which resulting in a total of 24 ERP risk events to be selected for further investigation in the follow-up case study.

7.6 Further discussion and conclusions

This chapter presents and discusses the findings derived from the questionnaire survey, which is the first data collection stage of the mixed-method research design adopted for this project. The analysis of the quantitative data collected has led to a set of significant findings and conclusions.

In particular, the survey results confirmed that ERP system is of interest and importance to the vast majority of SOEs. As such 37 out of 42 respondent SOEs have adopted ERP. 3 of the 5 respondent SOEs, that have not currently adopted ERP, stated they were scheduling to implement ERP in the future.

Furthermore, the findings on ERP barriers showed that most system barriers predefined from an extensive literature review were identified by respondents as major problems to ERP exploitation. In contrast, due to China's rapid economic development and reform and also because of organisational improvements resulted by the use of ERP, many cultural and organisational ERP barriers, which were predefined and expected to exist in traditional Chinese firms, were not identified as critical issues in SOEs. However, it seems that these later barriers were understated by respondents, who may have minimized the existence and impact of these barriers. This understatement was confirmed by a bivariate analysis, from which it could be concluded that organisational barriers are often the triggers for complex networks of ERP barriers, including the system ones. In fact, the understatement of cultural and organisational barriers may be attributed to many potential reasons. It is possible that some of these factors may actually not be an issue in SOEs, or they may not be perceived by respondents as an issue in their firms due to a lack of understanding. It is also possible that Chinese managers participated in the survey may not be willing to disclose these internal problems to the researcher. These issues are further discussed in chapter nine.

On the other hand, the findings on ERP risks confirmed that all of the 40 predefined risk events were perceived by the majority of respondents as risks to ERP exploitation in their firms. Among the list of risks, the top 15 risks were identified as the most crucial to SOEs. These top 15 risks were distributed across organisational processes and operation. Therefore, the survey study seemed to confirm that potential failure of ERP systems cannot be conveniently attributed to technical aspects, such as the software

package and the ICT infrastructure. In fact, the findings of the study showed that it was in organisation processes and procedures that the more dangerous and difficult to manage risks can be found. This conclusion was further supported by a bivariate analysis, which confirmed that analytical and organisation-wide risks, rather than technical risks, seemed to be interwoven and closely related with other similar risks. Consequently, the occurrence of these risks is much more difficult to manage, mitigate and contain.

Moreover, by using the bivariate analysis to explore potential correlations between the ERP barriers and risks, it was identified that organisational barriers were often the triggers of various types of ERP risks. In contrast, cultural and system barriers seemed to be important, but they did not prove to be the main triggers of ERP risks. Consequently, it was concluded that organisational barriers are the most crucial type of ERP barrier that needed to be carefully handled in order to prevent the occurrence of potential ERP risks. This finding therefore further confirmed the importance of organisational barriers to potential ERP exploitation failure in the context of Chinese SOEs and the underestimation of this type of barrier in the questionnaire.

Additionally, as argued by Chung and Smith (2007), Ma (2003:29-35) and Wang (1993:937-938), Chinese in mainland China differ with overseas Chinese (e.g. in USA and Europe) in cultural, political and economic values. The gap between overseas and mainland Chinese was further widened after China's Cultural Revolution in the 1970s (Wang, 1993:937-938). As discussed above, the majority of ERP exploitation problems identified were related to cultural and organisational aspects of user companies. Therefore, after analysing the questionnaire results, a further question that occurred to the researcher was: *would contextual and value differences between overseas and mainland Chinese firms result in different ERP barriers and risks*? This question emerged as an area for future research work, as discussed further in the conclusion chapter of this thesis.

In addition, based on the findings derived from the questionnaire survey, the researcher selected a set of ERP areas to be further explored in the follow-up case study.

First of all, and as discussed above, among the 25 identified ERP barriers the system ones were perceived by respondents as important to SOEs, while the other barriers

especially the organisational ones were proved in the bivariate analysis to be underestimated by respondents. Therefore, the researcher selected to further explore and investigate all of these 25 ERP barriers in the case study.

On the other hand, among the list of ERP risks, the top 15 risks were identified to be particularly crucial to the SOEs studied. It was therefore considered significant to seek in-depth human insights to further investigate the causes and consequence of these top 15 risks. Moreover, a further set of 9 risks was found to have correlations with other ERP barriers and risks. These 9 risks were thus also considered necessary to be further investigated in order to verify the correlations that they concerned. As a consequence, a total of 24 (i.e. 15 + 9) ERP risks were selected to further explore and study by using interviews.

Finally, the bivariate analysis conducted in this study had identified a set of 35 correlations, namely 17 correlations between ERP barriers, 10 correlations between ERP risks, and 8 correlations between ERP barriers and risks. These correlations between the identified ERP barriers and risks were certainly the most crucial and interesting part of findings derived from this project. Consequently, these 35 identified correlations were selected for further verification and exploration in the follow-up case study.

Overall, the follow-up case study aimed at further exploring and validating all of the 25 identified barriers, 24 shortlisted ERP risks, as well as the 35 barrier and risk correlations identified. The findings and results of this follow-up case study are presented and discussed in the next chapter. The conclusions and key findings reached in this chapter are also further explored, discussed and validated in chapter eight and nine.